NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA) HEADQUARTERS

OFFICE OF STEM ENGAGEMENT

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WASHINGTON, DC 20546-0001

ENGAGEMENT OPPORTUNITIES IN NASA STEM FY2024 (EONS-2024)

NOTICE OF FUNDING OPPORTUNITY (NOFO)

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EXECUTIVE SUMMARY

This National Aeronautics and Space Administration (NASA) Notice of Funding Opportunity (NOFO), entitled *Engagement Opportunities in NASA STEM (EONS) – 2024*, solicits proposals for competitive funding opportunities in support of NASA's Office of STEM Engagement (OSTEM). EONS 2024 is an omnibus announcement that includes a wide range of NASA science, technology, engineering, and mathematics (STEM) engagement opportunities for basic and applied science and technology research and education. Specific opportunities will be issued periodically throughout the year as appendices to this Notice of Funding Opportunity (NOFO) with individual requirements and milestones.

NASA's journeys have propelled technological breakthroughs, pushed the frontiers of scientific research, and expanded our understanding of the universe. These accomplishments, and those to come, share a common genesis: education in STEM. The Agency's OSTEM delivers tools for young Americans and educators to learn and succeed.

NASA seeks to:

- create unique opportunities for students and the public to contribute to NASA's work in exploration and discovery;
- build a diverse future STEM workforce by engaging students in authentic learning experiences with NASA people, content, and facilities; and
- strengthen public understanding by enabling powerful connections to NASA's mission and work.

To achieve these goals, OSTEM strives to increase K-12 involvement in Agency projects, enhance higher education, support underrepresented/underserved communities, strengthen online education, and boost NASA's contribution to informal education. The intended outcome is a generation prepared to code, calculate, design, and discover its way to a new era of American innovation.

The funds available for awards under each OSTEM program element described in this NOFO can range from less than $1 million to $5 million over the period of performance. This allows for selection of a few to as many as several dozen proposals per Appendix, depending on the proposed objectives and the submission of proposals of merit. Awards will be made as grants or cooperative agreements, depending on the extent of NASA's involvement with the award recipient and the nature of activities. Procurement contracts shall not be awarded in conjunction with this NOFO. NASA's ability to make awards is contingent upon the availability of appropriated funds from which payment can be made. Please see Appendices 1 and onward to view the anticipated number of awards, maximum award, and period of performance for each program element that may be made under this NOFO, pursuant to the authority of Title 2 Code of Federal Regulations (CFR) Part 200 (2 CFR §200) and the *NASA Grant and Cooperative Agreement Manual (GCAM)*.

The typical period of performance for an award is one to three years, although some program elements may specify a shorter or longer (maximum of five years) period. Details of the solicited opportunities and any changes or modifications to any of these guidelines will be specified in the descriptions of the relevant program element in the appendices to this NOFO.

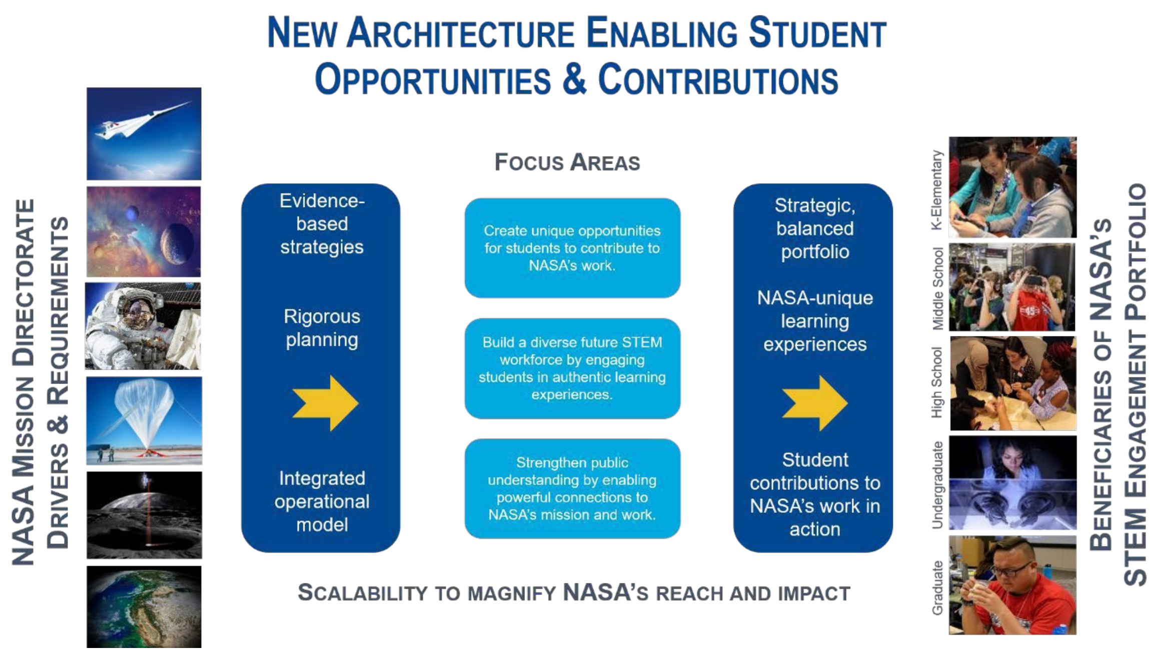
Proposal due dates are posted at the NASA Proposal Integrated Review and Evaluation System (NSPIRES) website and in Table 2 of this NOFO. Interested applicants are responsible for regularly monitoring NSPIRES for any amendments to this NOFO or additional new program elements.

A. PROGRAM DESCRIPTION

A.1 Background

NASA's OSTEM is committed to defining and implementing a portfolio of programs, projects, activities, and products intended to drive a coherent and coordinated set of activities from across the Agency. Ultimately, the work will contribute to achieving NASA's Public and Science, Technology, Engineering, and Mathematics (STEM) Engagement vision to immerse the public in the Agency's work, enhance STEM literacy, and inspire the next generation to explore.

Central to this effort is a new architecture designed to enable relevant student contributions to NASA's mission and work, relying on mission drivers and requirements from the Agency's Mission Directorates. This will facilitate alignment of the appropriated education programs, as well as existing and emerging relevant projects, activities and products from across NASA, to an overarching framework and strategy, which will result in a more effective and coherent approach and improved outcomes.



Please see the full NOFO and appendices for complete information about available funding opportunities and general rules for prospective proposers to follow.

A. 2Congressional Focus on Education

America COMPETES Reauthorization Act

The America COMPETES Reauthorization Act of 2010 (Public Law. No. 111-358) established a mandate for the development of a Federal Government-wide strategy for STEM education investments. Through the National Science and Technology Council's (NSTC) Committee on STEM Education (CoSTEM), federal agencies, including NASA, coordinate their investments in STEM education to magnify the impact of their work. In December 2018, CoSTEM released its five-year Federal STEM Education Strategic Plan that guides the work of these federal agencies. The strategic plan (or federal strategy) outlines goals and objectives for federal STEM education investments. This federal strategy is also written to engage the external community in fulfilling the vision of the plan.

As part of the implementation of the 2018 CoSTEM Federal STEM Education Strategic Plan, Federal departments and agencies that have STEM education programs, investments, and activities have identified the specific pathways and associated objectives that they will contribute to through mission-specific actions. As an agency, NASA has agreed to contribute to the following pathways and objectives:

- **Pathway 1:** Develop and Enrich Strategic Partnerships
    - **Objective 1:** Foster STEM Ecosystems that Unite Communities
    - **Objective 2:** Increase Work-Based Learning and Training through Educator-Employer Partnerships
- **Pathway 2:** Engage Students where Disciplines Converge
    - **Objective 3:** Encourage Transdisciplinary Learning
- **Pathway 3:** Operate with Transparency and Accountability

A.3 NASA Strategic Plan and Relevance to STEM Engagement

The NASA 2022 Strategic Plan includes a focus on building the next generation of explorers through STEM engagement investments. The Agency makes vital investments toward building a future diverse STEM workforce. The scope of STEM Engagement comprises all endeavors to attract, engage, and educate students and to support educators and educational institutions. The STEM engagement portfolio consists of a diverse set of opportunities, activities and products, encompassing internships; fellowships; student learning opportunities (challenges, competitions and other experiences); informal education and out-of-school learning activities; educational products, tools and platforms; educator support; competitive awards to educational institutions for research and development and institutional support.

NASA will implement strategies to broaden student participation to increase diversity, equity, inclusion, and accessibility (DEIA) in STEM through Agency opportunities and activities. While the number of women and underrepresented minorities earning STEM degrees has grown in broad science and engineering occupations over the last decade, significant underrepresentation remains in areas critical to NASA like engineering and computer and mathematical sciences. The Agency is committed to building a diverse, skilled future STEM workforce — our next generation of explorers with the technical skills needed to carry forward our Nation's vital mission and work in aeronautics and space into the future.

The NASA Strategic Goal and Objective relevant to OSTEM are set forth in the NASA 2022 Strategic Plan as follows:

> Strategic Goal 4: Enhance Capabilities and Operations to Catalyze Current and Future mission Success.
>
> Strategic Objective 4.3: Build the next generation of explorers (*Engage students to build a diverse future STEM workforce*).

Annually, NASA OSTEM collects performance data, participant data, and metrics from awardees to generate a body of evidence indicating progress towards achieving programmatic goals, objectives, and OSTEM performance goals. NASA OSTEM assesses progress of its investments towards achieving programmatic goals and objectives and progress in achieving the following performance goals (PGs) which directly align with the 2020-2023 NASA Strategy for STEM Engagement Strategic Goals 1, 2, and 3:

- **PG 4.3.1** Create unique opportunities for a diverse set of students to contribute to NASA's work in exploration and discovery.
- **PG 4.3.2** Build a diverse future STEM workforce by engaging students in authentic learning experiences with NASA's people, content, and facilities.
- **PG 4.3.3** Attract diverse groups of students to STEM through learning opportunities that spark interest and provide connections to NASA's mission and work.

In alignment with NASA's goals and priorities for STEM engagement, Federal Government evidence-based policy initiatives, and an increased need to add rigor to performance measures, NASA's OSTEM implements a comprehensive performance assessment and evaluation strategy that includes a Learning Agenda. The Learning Agenda is a systematic approach to identifying gaps in knowledge and conducting research to generate knowledge to fill these gaps through collaborative, iterative processes. The Learning Agenda provides a more robust, comprehensive approach to understanding the scope and impacts of investments and generates a portfolio of evidence that includes evaluative studies, literature reviews, benchmarking studies, and output, outcome, and milestone performance measures. The portfolio of evidence that is generated through the execution of the Learning Agenda is used to inform evidence-based budgetary, programmatic, and operational decisions. The Learning Agenda serves as the foundational document for building a culture of learning and continual improvement within NASA's OSTEM. The implementation of the Learning Agenda provides a systematic approach for building and using new knowledge about project and operational performance for evidence-based decision-making and continual improvement.

A.4 NASA's STEM Engagement Priorities

NASA's STEM Engagement vision is to immerse students in the Agency's work, enhance STEM literacy and inspire the next generation to explore. The Agency's STEM Engagement mission is to engage students in the Agency's missions. NASA's STEM Engagement has the following three strategic goals that support it in achieving its vision and mission: 1) Create unique opportunities for a diverse set of students to contribute to NASA's work in exploration and discovery; 2) Build a diverse future STEM workforce by engaging students in authentic learning experiences with NASA's people, content and facilities; and 3) Attract diverse groups of students to STEM through learning opportunities that spark interest and provide connections to NASA's mission and work. The objectives for each of these goals are:

Strategic Goal 1.0: Create unique opportunities for a diverse set of students to contribute to NASA's work in exploration and discovery.

Objective 1.1: Provide student work experiences that enable students to contribute to NASA's missions and programs, embedded with NASA's STEM practitioners.

Objective 1.2: Create structured and widely accessible, experiential learning opportunities for students to engage with NASA's experts and help solve problems that are critical to NASA's mission.

Strategic Goal 2.0: Build a diverse future STEM workforce by engaging students in authentic learning experiences with NASA's people, content and facilities.

Objective 2.1: Develop and deploy a continuum of STEM experiences through authentic learning and research opportunities with NASA's people and work to cultivate student interest, including students from underrepresented and underserved communities, in pursuing STEM careers and foster interest in aerospace fields.

Objective 2.2: Design the portfolio of NASA STEM engagement opportunities to contribute toward meeting Agency workforce requirements and serving the nation's aerospace and relevant STEM needs.

Strategic Goal 3.0: Attract diverse groups of students to STEM through learning opportunities that spark interest and provide connections to NASA's mission and work.

Objective 3.1: Develop and deploy targeted opportunities and readily available NASA STEM engagement resources and content, to attract students to STEM.

Objective 3.2: Foster student exposure to STEM careers through direct and virtual experiences with NASA's people and work.

Office of STEM Engagement Metrics

NASA annually generates a body of evidence (i.e., milestone accomplishments, performance and participation data, evaluation outcomes, and/or other metrics) that assesses STEM engagement investments. NASA currently utilizes the NASA STEM Gateway registration/application and data management system for analyzing performance data and conducts evaluation studies to assess outcomes. Principal Investigators (PIs) are required to respond to performance and evaluation (P&E) data calls as requested by NASA OSTEM and utilize this Agency-approved data management system for performance data reporting. Additional communications and guidance regarding P&E data calls and the NASA STEM Gateway will be sent to award recipients from the NASA OSTEM and Activity Management team. The PI shall ensure it has the appropriate staff and resources to facilitate data collection activities and complete all tasks required for reporting to meet established deadlines.

A.5 NASA Research Areas of Interest and Technology Development Priorities

The research priorities for OSTEM program elements are defined by the Exploration Systems Development, Space Operations, Aeronautics Research, Science, and Space Technology Mission Directorates, and NASA's nine Centers plus its only Federally Funded Research and Development Center, the Jet Propulsion Laboratory (JPL). Each Mission Directorate, Center, and JPL covers a major area of the Agency's research and technology development efforts. The Mission Directorates identify their priorities on the NASA website. Please reference the NASA website, **Appendix 8** of this NOFO, and subsequent appendices for information on the Agency's missions and research priorities.

A.6 STEM Engagement Program Elements

Please reference the appendices of this NOFO for specific requirements and a detailed description of the following program elements.

Established Program to Stimulate Competitive Research (EPSCoR)

Public Law 102-588, passed in 1992, authorized NASA to initiate NASA EPSCoR to strengthen the research capability of jurisdictions that have not historically participated equably in competitive aerospace and aerospace-related research activities. Public Law 114-329, Section 103, passed in 2017, reauthorized EPSCoR and states that the leadership of each federal agency administering an EPSCoR program shall:

(1) Consider modifications to EPSCoR proposal solicitations, award types, and project evaluation to:
  - (a) more closely align with current agency priorities and initiatives;
  - (b) focus EPSCoR funding on achieving critical scientific, infrastructure, and educational needs of that agency;
  - (c) encourage collaboration between EPSCoR eligible institutions and researchers, including with institutions and researchers in other states and jurisdictions;
  - (d) improve communication between state and federal agency proposal reviewers; and
  - (e) continue to reduce administrative burdens associated with EPSCoR;

(2) Consider modifications to EPSCoR award structures to:
   (a) emphasize long-term investments in building research capacity, potentially through the use of larger, renewable funding opportunities; and
   (b) allow the agency, states, and jurisdictions to experiment with new research and development funding models; and
(3) Consider modifications to the mechanisms used to monitor and evaluate EPSCoR awards to:
   (a) increase collaboration between EPSCoR-funded researchers and agency staff, including by providing opportunities for mentoring young researchers and for the use of federal facilities;
   (b) identify and disseminate best practices; and
   (c) harmonize metrics across participating federal agencies, as appropriate.

EPSCoR establishes partnerships with government, higher education and industry entities that are designed to effect lasting improvements in a state's or region's research infrastructure, research and development (R&D) capacity and hence, its national R&D competitiveness. Twenty-five states, the Commonwealth of Puerto Rico, the U.S. Virgin Islands, and Guam currently participate in EPSCoR. Six federal agencies conduct EPSCoR programs, including NASA. The goal of EPSCoR is to provide seed funding that will enable jurisdictions to develop an academic research enterprise directed toward long-term, self-sustaining, nationally competitive capabilities in aerospace and aerospace-related research. NASA EPSCoR objectives are to:

- Contribute to and promote the development of research infrastructure in EPSCoR jurisdictions in areas of strategic importance to the NASA mission;

- Improve the capabilities of the jurisdictions to gain support from sources outside the NASA EPSCoR program;

- Develop partnerships between and among NASA research assets, industry, and EPSCoR jurisdictions' academic institutions; and

- Contribute to the overall research infrastructure, science and technology capabilities, higher education, and/or economic development of the jurisdiction.

For more information visit the ESPCoR website.

Minority University Research and Education Project (MUREP)

The Minority University Research and Education Project (MUREP) is administered through NASA OSTEM. Through MUREP, the Agency provides financial assistance via competitive awards to Minority Serving Institutions (MSIs), including Historically Black Colleges and Universities (HBCU), Hispanic Serving Institutions (HSI), Asian American and Native American Pacific Islander Serving Institutions (AANAPISI), Alaska Native and Native Hawaiian-Serving Institutions (ANNH), Tribal Colleges and Universities (TCU), Native American-Serving Nontribal Institutions (NASNTI), and other MSIs, as required by MSI-focused Executive Orders (see below). These institutions recruit and retain underrepresented and underserved students, including women and girls, and persons with disabilities, into STEM fields.MSI-focused Executive Orders (listed in chronological order):

EO 13985: Advancing Racial Equity and Support for Underserved Communities through Federal Government, (Underserved/Underrepresented), January 20, 2021
EO 14031: Advancing Equity, Justice and Opportunity for Asian Americans, Native Hawaiians and Pacific Islanders, (AANAPISI, ANNH), May 28, 2021
EO 14041: Advancing Educational Equity, Excellence, and Economic Opportunity through Historically Black Colleges and Universities (HBCU), September 3, 2021 (HBCU), September 3, 2021
EO 4045: White House Initiative on Advancing Educational Equity, Excellent, and Economic Opportunity for Hispanics, (HSI), September 13, 2021
EO 14049: White House Initiative on Advancing Educational Equity, Excellence, and Economic Opportunity for Native Americans and Strengthening Tribal Colleges and Universities (TCU), October 11, 2021
EO 14050: White House Initiative on Advancing Educational Equity, Excellence, and Economic Opportunity for Black Americans, (HBCU/PBI), October 19, 2021

MUREP investments enhance the research, academic, and technology capabilities of MSIs through multiyear cooperative agreements. Awards assist faculty and students in research and provide authentic STEM engagement related to Agency missions. Additionally, awards provide NASA-specific knowledge and skills to learners who have historically been underrepresented and underserved in STEM. MUREP investments assist the Agency in meeting the goal of a diverse workforce through student participation in internships and fellowships at NASA Centers and JPL.

For more information visit the MUREP website.

National Space Grant College and Fellowship Program (Space Grant)

Public Law 100-147, passed in 1987, authorized NASA to initiate the National Space Grant College and Fellowship Program (Space Grant) in response to the need for a coordinated effort to help maintain America's preeminence in aerospace science and technology. Through the establishment of state-based consortia, consisting of universities, university systems, associations, government agencies, industries, and informal education organizations involved in aerospace activities, lead institutions provide leadership and support for program objectives in their state and nationally. Lead institutions accomplish this by collaborating with other universities, broadening joint activities with NASA and aerospace-related industries, and providing public service functions, such as support to schools (elementary and secondary), and to the public.

These institutions are working to expand opportunities for Americans to understand and participate in NASA's aeronautics and space projects by supporting and enhancing science and engineering education, research and public outreach efforts. The Space Grant national network includes over 1,000 affiliates from universities, colleges, industry, museums, science centers, and state and local agencies. These affiliates belong to one of 52 consortia in all 50 states, plus the District of Columbia and the Commonwealth of Puerto Rico.

Space Grant is a workforce development program. The 52 consortia fund fellowships, internships and scholarships for students pursuing careers in STEM, as well as curriculum enhancement and faculty development. The Consortia engage students in hands-on experiential projects, which provide invaluable experiences to make these students well-positioned workers in a broad array of technological fields. Member colleges and universities also administer pre-college and public service education projects in their states.

The goal of Space Grant is to contribute to the NASA mission, specifically in the areas of government and industry partnerships "to improve America's aerospace technologies and advance American leadership" by funding education, research, and informal education projects through a national network of university-based Space Grant consortia. Space Grant consortia are expected to develop innovative and integrated plans to advance aerospace knowledge and expand related activities.

The specific objectives of the Space Grant Program are:

National Space Grant Program Goals and Objectives

GOAL 1.0	GOAL 2.0	GOAL 3.0
Create unique opportunities for a diverse set of students to contribute to NASA's work in exploration and discovery.	Build a diverse future STEM workforce by engaging students in authentic learning experiences with NASA's people, content, and facilities.	Attract diverse groups of students to STEM through learning opportunities that spark interest and provide connections to NASA's mission and work.
Objective 1.1: Create opportunities that enable students to produce knowledge or products that will be used by NASA **Objective 1.2:** Create opportunities that enable students to support NASA mission work and research **Objective 1.3:** Establish and maintain a national network of universities that enable creating opportunities for students to contribute to NASA's work in exploration and discovery	**Objective 2.1:** Enhance students' STEM identity, skills, and knowledge by engaging them in NASA-based authentic STEM learning activities **Objective 2.2:** Provide opportunities for students to engage with NASA's aeronautics, space, and science people, content, and facilities in support of a diverse future NASA and aerospace industry workforce **Objective 2.3:** Broaden participation of students in Space Grant Programming that leverages authentic learning experiences with NASA's people, content, and facilities	**Objective 3.1:** Expand the reach of individual Consortia to collaborate regionally on efforts that directly support middle and high school student participation in hands-on, NASA-aligned STEM activities **Objective 3.2:** Attract diverse populations of traditionally underserved and underrepresented middle and high school students to STEM and equip them with the tools necessary for success in college STEM degree programs leading to STEM careers **Objective 3.3:** Promote a strong STEM education base for middle and high school students while training teachers in these grade levels to become more effective at improving student academic outcomes.

For more information visit the Space Grant website.

Next Gen STEM – Teams Engaging Affiliated Museums and Informal Institutions (TEAM II)

Next Gen STEM's mission is to spark and sustain interest in STEM in students in grades K-12, by connecting students and their formal and informal educators to NASA's endeavors in exploration and discovery. Next Gen STEM (NGS) creates, delivers and curates NASA STEM products and experiences that make connections to NASA and fuel STEM learning and identity. Next Gen STEM provides funding for informal institutions, such as museums and science centers in direct alignment with NASA's mission and operates NASA's Museum and Informal

Education Alliance (MIE Alliance), a robust community of practice within its overall online community of practice for educators, NASA CONNECTS (Connecting Our Network of NASA Educators for Collaborating Together in STEM). Under NASA's NGS project, initially there was the Competitive Program for Science Museums, Planetariums, and NASA Visitor Centers (CP4SMPVC). CP4SMPVC was authorized by Public Law (PL) 109-155, Sec. 616. MUSEUMS, which states: "The Administrator may provide grants to, and enter into cooperative agreements with, museums and planetariums to enable them to enhance programs related to space exploration, aeronautics, space science, earth science, or microgravity." NASA satisfies this Congressional guidance through the selected award portfolio.

Replacing the CP4SMPVC, is the Teams Engaging Affiliated Museums and Informal Institutions TEAM II effort, which targets a limited number of topics of specific interest to NASA, places a stronger emphasis on recipients' partnering and networking in order to increase the impact of awards in the informal education community, and supports the development of Informal Education Institutions (IEIs) as local community resources that are knowledgeable in NASA STEM and STEM Engagement-related opportunities and resources. (Ref: NASA Authorization Act of 2019, Section 602 STEM Engagement Activities). TEAM II also places significant emphasis on reaching students from communities underserved and underrepresented in STEM fields.

NASA TEAM II seeks to provide authentic STEM engagement opportunities for students, and for their learning support systems of families, informal and formal educators, and institutions, that also support NASA STEM Engagement Strategic Goals, Objectives, Strategies and Design Principles in order to:

- Provide authentic STEM engagement activities aligned with NASA mission-driven needs and priorities;
- Leverage NASA missions, content, people, and facilities to provide experiential authentic STEM opportunities that encourage innovation, critical thinking, and problem-solving skills;
- Use or develop evidenced-based educational strategies in designing and implementing the project and address state and local needs;
- Establish outcomes and define corresponding metrics and measures to demonstrate a measurable impact on learner interest in and positive attitudes towards STEM topics, and improve self-perception of the learner's ability to participate in STEM;
- Attract and sustain diversity in student participation, and incorporate approaches to foster and promote inclusion, particularly for groups historically underrepresented and underserved in STEM fields; and
- Utilize partnerships and regional and national networks of STEM- and STEM education-related IEIs to magnify reach and impact.

Beginning in 2021, TEAM II implemented a two-tier award structure, adding smaller Community Anchor awards to encourage participation by substantially more institutions and to create a cohort of Community Anchors to partner with NGS and NASA in advancing diversity, equity, and inclusion in STEM. The inaugural cohort was selected in 2022.

A.7 The ***NASA Proposer's Guide***

All policies and procedures for the preparation and submission of proposals, as well as those for NASA's review and selection of proposals for funding, are set forth in a separate document entitled the "*NASA Proposer's Guide"* (also referred to as the "*Proposer's Guide"*). This document is updated frequently (latest update can be found at the link provided), therefore the most current published version is referenced throughout this NOFO.

The *NASA Proposer's Guide* is hereby incorporated into this NOFO by reference, and proposers are responsible for understanding and complying with the *NASA Proposer's Guide* before preparing and submitting their proposals. Unless otherwise noted, proposals that do not conform to the standards in the *NASA Proposer's Guide* may be deemed noncompliant and rejected without full evaluation or peer review. The chapters and appendices in The *NASA Proposer's Guide* provide supplemental information about the entire NOFO process, including: NASA policies for the solicitation of proposals; guidelines for writing complete and effective proposals; NASA policies and procedures for the review and selection of proposals; as well as for issuing and managing the awards to the institutions that submitted selected proposals. Note that NASA's policy for proposals involving non-U.S. participants is provided in Appendix A of the *NASA Proposer's Guide*.

If there is a conflict between the content of this NOFO or its appendices and the *NASA Proposer's Guide*, this NOFO or its appendices takes precedence.

NOTE: If there is a conflict between the content of this NOFO and its appendix/appendices, the individual program elements described in the relevant appendix/appendices take precedence.

A.8 NASA Safety Policy

All proposals shall consider NASA's priority emphasis on safety.

Safety is the freedom from those conditions that can cause death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment. NASA's safety priority is to protect: (1) the public, (2) astronauts and pilots, (3) the NASA workforce (including employees working under NASA award instruments), and (4) high-value equipment and property.

OSTEM awardees shall act responsibly in matters of safety and shall take all reasonable safety measures in performing under this award. The recipient shall comply with all applicable Federal, state, and local laws relating to safety. The recipient shall maintain a record of and notify the NASA Grant Officer, within one workday of any accident involving death, disabling injury, or substantial loss of property in performing this award. If non-NASA personnel are injured, the recipient will follow its internal investigation process. If NASA personnel are injured and/or NASA property is damaged, the recipient, in coordination with the cognizant NASA Program Manager, Technical Officer, or designee, shall comply with NASA Procedural Requirement (NPR) 8621.1D, NASA Procedural Requirements of Mishap and Close Call Reporting, Investigating, and Recordkeeping. Upon request, NASA and the recipient agree to provide assistance to each other in the conduct of any investigation. The recipient will, within one workday, advise the NASA Grant Officer of hazards that come to its attention as a result any work performed. Where the work under this award involves flight hardware, the hazardous aspects, if any, of such hardware will be identified, in writing, by the recipient. Compliance with this term and condition by subawardees/subcontractors shall be the responsibility of the recipient.

A.9 Data Management Plan

All proposals submitted under this NOFO shall include a Data Management Plan (DMP), in accordance with the *NASA Plan for Increasing Access to the Results of Scientific Research*. The DMP shall include:

- Specific data requirements and expectations;
- An example DMP or outline for the specific type of data likely to result from the funded projects; or
- A statement that a DMP is not required because of the nature of the activity (e.g., no data or proprietary or personally identifiable data are expected).

See Senior Advisors for Research and Analysis (SARA) Q&A for more information on the DMP.

Proposers shall submit the DMP by responding to the section of the cover page for DMP in NSPIRES (limited to 4000 characters). DMPs shall describe how data generated by the proposed research will be shared and preserved, and how data collected will be made available to the public. If the proposer has determined that its data should not be publicly shared, the proposer shall provide a detailed explanation as to why data-sharing and/or preservation is not possible or scientifically appropriate. Additionally, the DMP shall describe how data sharing and preservation will enable validation of results, or how results could be validated if data are not shared or preserved. The DMP shall provide a plan for making all research data underlying results and findings in publications digitally accessible at the time of publication. NASA will review each proposer's DMP during the evaluation/peer review of proposals. Costs of the DMP shall be included in the proposed budget. For further information, see Section 2.11 in the *NASA Proposer's Guide*.

Any research project for which a DMP is not necessary shall provide an explanation in the DMP block. Example explanations include but are not limited to:

- This is a development effort for flight technology that will not generate any data that the proposer can release, so a DMP is not applicable;

- The data that the proposer will generate will be subject to International Traffic in Arms Regulation (ITAR); or

- The proposer may explain why the project will not generate any data.

The type of proposal that requires a DMP is described in the *NASA Plan for Increasing Access to Results of Scientific Research*. The DMP shall contain the following elements, as appropriate to the project:

- A description of data types, volume, formats, and (where relevant) standards;
- A description of the schedule for data archiving and sharing;
- A description of the intended repositories for archived data, including mechanisms for public access and distribution;
- A discussion of how the plan enables long-term preservation of data; and
- A discussion of roles and responsibilities of team members in accomplishing the DMP. (If funds are required for data management activities, these should be covered in the normal budget and budget justification sections of the proposal.)

Proposers that include a plan to archive data should allocate suitable time for this task. Unless otherwise stated, this requirement as stated in this NOFO supersedes the DMP described in the *NASA Proposer's Guide*. In addition, researchers submitting NASA-funded articles in peer-reviewed journals or papers from conferences shall make their work accessible to the public through NASA's PubSpace. PubSpace provides free access to NASA-funded and archived scientific publications. Research papers will be available within one year of publication to download and read.

B. AWARD INFORMATION

B.1 Award Type and Availability of Funds

Awards resulting from this NOFO will be issued as grants or cooperative agreements. A cooperative agreement is used when it's expected there will be "substantial involvement" from NASA. The type of award instrument used will be identified in each program element description in each appendix. The type of award to be offered to selected proposers will generally follow the policies in Appendix A of the *NASA Proposer's Guide*, although in a few cases, only one type of award may be offered (please refer to the individual program element descriptions). NASA will determine the appropriate award instrument for the selections resulting from this NOFO. Grants and cooperative agreements will be subject to the provisions of 2 CFR §200, 2 CFR §1800 (NASA's Supplement to 2 CFR §200), the *NASA Grant and Cooperative Agreement Manual* (GCAM), and Appendix A of the *NASA Proposer's Guide*.

Prospective proposers to this NOFO are advised that in general, funds are not available to award all solicited activities at the time of issuance of this NOFO release. The Government's obligation to make awards is contingent upon the availability of sufficient appropriated funds from which payment can be made and the receipt of proposals that NASA determines meet the criteria for award under this NOFO. Further, continuation of the awards in the second and subsequent years (if applicable) will be contingent on the availability of appropriated funds, the quality of project progress, and continued relevance of the project to the NASA mission.

The amount of funds expected to be available for new awards for proposals submitted in response to this NOFO is set forth in the *Summary of Key Information* at the end of each program element description in each appendix. Given the submission of meritorious proposals, the number of awards that may be made for each program element is also provided. A list of OSTEM-solicited activities is provided in Table 2. Additional OSTEM-related opportunities (e.g. fellowships) also may be solicited through this NOFO.

TABLE 2. Program Elements Ordered by Expected Release Date

Appendix	Program Element	Expected Release Date	Expected Proposal Due Date
9	MUREP Institutional Research Opportunity (MIRO)	November 15, 2023	February 14, 2024
10	EPSCOR ISS	January 08, 2024	April 15, 2024

NOTE: Amended due dates and new program elements will be released as EONS-2024 is amended during fiscal year (FY) 2024. Additional OSTEM-related opportunities also may be solicited through this NOFO.

B.2 Award Period of Performance

The typical period of performance for an award is one to three years, although some program elements may specify shorter or longer (maximum of five years) periods. Prospective proposers should refer to the *Summary of Key Information* at the end of each program element description for the maximum duration for awards made under this NOFO. Any proposed period of performance shall be justified in the proposal. The appropriateness of such period of performance will be evaluated during the peer review process. NASA reserves the right to select proposals for shorter award durations than proposed.

B.3 Cancellation of Notice of Funding Opportunity (NOFO)

NASA reserves the right not to make any awards under this NOFO and/or to cancel this NOFO at any time prior to the issuance of the first award. If this occurs, NASA assumes no liability (including for reimbursement of entities' proposal costs) for canceling the NOFO or for any entity's failure to receive the notice of cancellation. Prospective submitters are responsible for regularly checking NSPIRES to ensure they receive all updates (e.g. amendments) for specific NOFOs in a timely manner.

B.4 Schedule for Awards

Every effort will be made to announce selections within six to nine months from the proposal submission deadline. Selection notifications will be communicated electronically via NSPIRES to the institution's Authorized Organization Representative (AOR) and Principal Investigator (PI). When a selection announcement is made, NSPIRES sends a decision notice via email requesting the PI or AOR to log into NSPIRES. This decision notice email means that NSPIRES has been updated to indicate the status of a proposal in NASA's selection review process. When a PI or AOR logs into NSPIRES, the following are examples of the types of decisions possible:

- A "declined" status means: 1) NASA's review of the proposal is concluded, and 2) no NASA funds are available to support the proposed project.

- A "selected" or "selectable (pending)" status means the proposal's review continues, and the proposal has NOT received an award. A "selected" or "selectable (pending)" proposal status in NSPIRES is neither a commitment that a proposal has or will receive an award by the NASA Shared Services Center (NSSC), nor a promise that the funds have been or will be transferred from NASA Headquarters to a NASA Center.

Proposers are strongly cautioned that only a NASA Grant Officer may make commitments, obligations, or awards on behalf of NASA or authorize the expenditure of funds for this opportunity. **A commitment by NASA to fund an award is only made through a grant or cooperative agreement signed by a NASA Grant Officer.** A PI or organization that makes financial and/or personnel commitments in the absence of a grant or cooperative agreement signed by a NASA Grant Officer does so at their own risk. Please refer to Section 4.3 and Appendix A of the *NASA Proposer's Guide*.

B.5 Renewal Proposals and Resubmissions

Generally, researchers holding previous awards selected through any of the projects offered through earlier NOFOs may submit renewal proposals that seek to continue a previously funded line of work. However, each individual project will provide specific information on eligibility as outlined in the specific Appendix. For future offerings under continuing proposals, it is OSTEM's policy that renewal proposals will be considered along with new proposals submitted for that same program element. Renewal proposals will undergo the full peer review process and will not be advantaged or disadvantaged in the evaluation process because they were previously submitted. If a renewal proposal is selected, NASA will fund the proposal as a new award, and the starting date of a renewal award will follow the end date of the preceding award (i.e., the period of performance for a renewal award shall not overlap with the period of performance of the predecessor award). Instructions regarding renewal proposals may be found in Section 2.5 of the *NASA Proposer's Guide*.

Proposals that were submitted but not selected based on a previous NASA NOFO may be re-submitted in response to this NOFO in either in a revised or original form. Such proposals will undergo full peer review, along with new proposals that NASA receives, and will not be advantaged or disadvantaged in the evaluation process because they were previously submitted.

B.6 Funding Restrictions

All costs charged to awards covered by this NOFO must comply with the Uniform Administrative Requirements in 2 C.F.R. 200 and 1800, unless otherwise indicated in the NOFO, the terms and conditions of the award, and the Grants and Cooperative Agreement Manual (GCAM).

- All proposed funds shall be allowable, allocable and reasonable. Funds may only be used for the project. All activities charged under indirect cost shall be allowed under 2 CFR §200, Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards.

- Grants and cooperative agreements shall not provide for the payment of fee or profit to the Recipient.

- Unless otherwise directed in 2 CFR §200, for changes to the negotiated indirect cost rate that occur throughout the project period, the Recipient shall apply the rate negotiated for that year, whether it is higher or lower than the rate that was in place at the time of award.

- Proposals shall not include bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity (including universities), whether funded or performed under a no-exchange-of-funds arrangement.

- Any funds used for cost sharing or matching shall be allowable under 2 CFR §200.

- During the period of performance, a non-Federal entity shall use one of the methods of procurement as prescribed in 2 CFR §200.320, Methods of procurement to be followed. As defined in 2 CFR §200.1, the micro-purchase threshold for acquisitions of supplies or services made under grant and cooperative agreement awards issued to institutions of higher education, or related or affiliated nonprofit entities, or to nonprofit research organizations or independent research institutes is $10,000; or such higher threshold as determined appropriate by the head of the relevant executive agency and consistent with audit findings under Chapter 75 of Title 31, United States Code, Internal Institutional Risk Assessment, or state law.

NOTE: For funding opportunities that will result in fellowships or scholarships the following requirement also applies:

- Awards made under NASA Fellowship and Scholarship funding opportunities shall not provide for the payment to the Recipient for Facilities and Administration (F&A), overhead, or indirect costs.

In addition to the funding restrictions and requirements listed above, and those included in the *NASA Proposer's Guide* under Title 2 CFR §1800, the following restrictions are applicable to this EONS NOFO.

- As directed in the *NASA Proposer's Guide,* Section 2.18, other than the special cases discussed in the same Section 2.18, and unless specifically noted otherwise in the specific EONS program element Appendix, the proposing PI's institution shall subcontract the funding for all proposed Co-Investigators (Co-I) who reside at different non-Government institutions.

- The construction of facilities is not allowed for any of the activities solicited under this NOFO unless specifically stated. For further information on what costs are permissible, refer to the cost principles in Subpart E of 2 CFR §200.

- U.S. award recipients may directly purchase supplies and/or services from non-U.S. sources that do not constitute research, but award funds may not be used to fund research carried out by non-U.S. institutions. However, a foreign national may receive payment through a NASA award for the conduct of research while employed either full-time or part-time by a U.S. institution (see Section 2.2.1 and Appendix C of the *NASA Proposer's Guide*).

- Reasonable and justified travel by a participant in the research investigation, whether for the purpose of conducting the research, for collaboration, or for attending a conference, is considered to be a reasonable expense. NASA conducts its collaborations with foreign institutions on a no-exchange-of-funds basis. NASA funding may not be used for foreign institutions to conduct research efforts at any level. Therefore, NASA funding shall not be used for travel expenses for any participant who is not employed either full-time or part-time by a U.S. institution (see Section 2.2.1 and Appendix C of the *NASA Proposer's Guide)*.

B.7 Intellectual Property Resulting from Awards

Award and intellectual property information is available in Appendix J of the *NASA Proposer's Guide*.

B.7.1 Data Rights

NASA encourages the widest practicable dissemination of research results at any time during the course of the investigation. The award will contain the clause in the *NASA Grant and Cooperative Agreements Manual (GCAM)*, Appendix D, Terms and Conditions, D.11, Rights in Data, which allows a grant/cooperative agreement Recipient to assert copyright in any work that is subject to copyright and was developed, or for which ownership was acquired, under an award resulting from this NOFO. NASA will reserve a royalty-free, nonexclusive and irrevocable right to reproduce, publish, or otherwise use the work for Government purposes, and to authorize others to do so, in any such copyrighted work. Note that the Grant Officer may revise the language under this Rights in Data clause to modify each party's rights based on the particular circumstances of the program and/or the Recipient's need to protect its specific proprietary information.

B.7.2 Patent Rights

Awards are subject to the provisions of 37 CFR §401.3(a), which requires use of the standard clause set forth at 37 CFR §401.14, Patent Rights (Small Business Firms and Nonprofit Organizations), along with NASA's supplemental language as set forth in the *NASA Grant and Cooperative Agreement Manual (GCAM)*, Appendix D, Terms and Conditions, D.10., Patent Rights.

C. ELIGIBILITY INFORMATION

C.1 Proposing Institutions

The EONS NOFO is open to U.S. Institutions, Federal Government agencies (other than NASA), Federally Funded Research and Development Centers (FFRDCs) (other than NASA JPL), state government agencies, local government agencies, federally recognized tribal government agencies, non-profit science museums, planetariums, and other informal education organizations, for-profit companies, and non-U.S. institutions. These entities may participate as a lead proposer or through a partnership with the lead institution as noted by the specific program element guidelines. NOTE: Specific appendices may further limit the eligibility of applicants. Refer to each Appendix for more details.

Proposals from EPSCoR are, as stated in NASA EPSCoR legislation (NASA Authorization Act for Fiscal Year 1993, Public Law 102-588), able to be submitted in response to this NOFO by jurisdictions eligible to compete in the National Science Foundation (NSF) EPSCoR Research Infrastructure Improvement Grant Program (RII). The NSF eligibility is based on whether the most recent five-year level of NSF research support is equal to or less than 0.75 percent of the total RII budget. The most recent eligibility table is located at https://new.nsf.gov/funding/initiatives/epscor/epscor-criteria-eligibility

Proposals from Space Grant shall be coordinated through the awarded lead institution (academic or other) within each of the 52 Space Grant members (50 states, DC, or Puerto Rico). These awarded institutions shall be made aware of this NOFO and shall distribute information about opportunities throughout their eligible affiliates. Information about each Space Grant, awarded lead institution, and their current Director is located here.

Proposals from MUREP shall originate from a minority-serving U.S. college or university, currently designated and listed by the U.S. Department of Education as a minority-serving institution (MSI) depending on the requirements listed in each appendix. **A current list of institutions that NASA considers MSIs can be found here.** If a lead proposer's institution is not listed as an MSI by the proposal due date, the institution's AOR shall provide confirmation of its MSI status to NASA Research and Education Support Services (NRESS) via email at NASAEONS2024@nasaprs.com at least 24 hours before the proposal due date.

The following categories of U.S. institutions are eligible to propose to the various activities under MUREP:

TABLE 3. Eligibility for MUREP Lead Institutions

Institution Type
Alaska Native and Native Hawaiian-Serving Institutions (ANNH)
American Indian Tribally Controlled Colleges and Universities (TCCU)
Asian American and Native American Pacific Islander-Serving Institutions (AANAPISI)
Hispanic-Serving Institutions (HSI)
Historically Black Colleges and Universities (HBCU)
Native American-Serving Nontribal Institutions Program (NASNTI)
Predominately Black Institutions (PBI)
Minority-Serving Community Colleges (includes community colleges with the above designations)

If an institution serves a substantial Hispanic enrollment but has not been designated as a Hispanic-Serving Institution (HSI) or MSI by the Department of Education, or is not included on the NASA MSI Listing, that institution shall submit documentation demonstrating that its full-time undergraduate Hispanic enrollment is at least 25 percent of its total enrollment.

NASA Centers, Federal Government agencies (other than NASA), FFRDCs (including JPL), non-minority serving higher education institutions, state government agencies, local government agencies, federally recognized tribal government agencies, science museums, and planetariums, for-profit companies, non-U.S. institutions and other institutions including those types listed in Table 3 above may participate through a partnership with the lead proposing institution. However, all institutions proposed to receive funds under an award shall be listed on the proposal cover page.

Work to be performed through subcontracts/subawards shall be proposed following Section 2.18 of the *NASA Proposer's Guidebook.*

For more information on the national policy concerning MSIs, please see the following non-NASA websites:

Advancing Racial Equity and Support for Underserved Communities through Federal Government

- White House Initiative on Asian Americans, Native Hawaiians, and Pacific Islanders
- White House Initiative on Advancing Educational Equity, Excellence, and Economic Opportunity through Historically Black Colleges and Universities
- White House Initiative on Advancing Educational Equity, Excellence, and Economic Opportunity for Hispanics
- White House Initiative on Advancing Educational Equity, Excellence, and Economic Opportunity for Native Americans and Strengthening Tribal Colleges and Universities
- White House Initiative on Advancing Educational Equity, Excellence, and Economic Opportunity for Black Americans http://sites.ed.gov/whieeaa/
- White House Initiative on Asian American and Pacific Islanders

Arrangements or agreements to have the fiscal management and/or administration of an award performed by a third party (e.g., an affiliated Board of Regents, University System, or Foundation) shall be facilitated between the Recipient and the third party. Institutions not meeting these criteria are encouraged to partner with a college or university that meets the eligibility requirements as set forth above.

NOTE: Notwithstanding any other terms of this NOFO, proposals involving bilateral participation, collaboration, or coordination in any way with China or any Chinese-

owned company, whether funded or performed under a no-exchange-of-funds arrangement, shall be ineligible for award.

Note for Proposals from Space Grant: OSTEM has a Contract/Task Order with Guardians of Honor (GOH), LLC to support NASA's Space Grant program. To avoid any possible perception of a real or potential conflict of interest, GOH is not eligible to serve as a subcontractor, partner, or collaborator at any tier to an entity proposing under the Space Grant program.

All institutions receiving funds shall be listed on the proposal cover page. Work to be performed through subcontracts/subawards shall be proposed in accordance with Section 2.18 of the *NASA Proposer's Guidebook.*

NASA's Commitment to Diversity and Inclusion

NASA recognizes and supports the benefits of having diverse and inclusive scientific, engineering, and technology communities, and fully expects the reflection of such values in the composition of all panels and teams, including peer review panels, proposal teams, science definition teams, and mission and instrument teams. Per federal statutes and NASA policy, no eligible applicant shall experience exclusion from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from NASA on the grounds of their race, color, creed, age, sex, national origin, or disability. NASA welcomes proposals from all qualified and eligible sources, and strongly encourages proposals from HBCUs, MSIs, small disadvantaged businesses (SDBs), veteran-owned small businesses (VOSB), service-disabled veteran-owned small businesses (SDVOSB), HUBZone small businesses, and women-owned small businesses (WOSBs), as eligibility requirements allow.

C.2 Number of Proposals and Teaming Arrangements

Each individual Appendix contains specific requirements regarding the number of proposals an institution may submit as well as information regarding teaming arrangements. If more than one proposal is allowed per Appendix, each proposal shall be submitted as a separate, stand-alone, complete document to enable NASA to properly evaluate it.

C.3 Principal Investigator (PI) and Proposal Team Members

Every lead institution submitting a proposal in response to this NOFO shall designate a single individual, the PI, who is employed by the lead institution as of the date of proposal submission, and who will be responsible for the quality and direction of the entire proposed effort and for the use of all awarded funds. Because EONS does not accept the designation of a "Co-Principal Investigator," there shall be only **one PI** who is solely responsible for the proposed investigation. An individual shall be listed as PI on only **one** proposal per NOFO, unless stated otherwise in an Appendix. However, an individual may be listed as PI on one proposal, and a Co-Investigator or collaborator on another proposal, unless otherwise stated in an Appendix.

Individuals from institutions other than eligible lead institutions may **not** serve as the PI. Rather, such individuals shall be identified in a proposal as a **Co-Investigator** (Co-I) or other type of team member/collaborator. (See Sections 2.15, 2.16, and 2.17 of the *NASA Proposer's Guide*. Proposals that include the participation of an individual from a NASA Center or JPL shall include a statement of commitment acknowledging their participation and identify such team member's role in NSPIRES.

C.4 Cost-Sharing or Matching

Cost sharing is not required; however, NASA can accept cost-sharing if it is voluntarily offered. See 2 CFR §200.306, 2 CFR §1800.306 and the *NASA Grant and Cooperative Agreement Manual (GCAM)* for more information on Cost Sharing. It is important to note that proposals offering cost-sharing will not be advantaged (i.e., receive extra credit) in the evaluation process.

Controller Alert 23-04 and Public Law 96-205, Title VI, Section 601, requires agencies to waive any requirements for local matching funds under $200,000 for grants to four "insular areas" (the U.S. Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands). For local matching funds $200,000 and greater, agencies may waive the matching requirement for these four "insular areas."

For information about funding levels and cost-share requirements for proposed activities, please refer to the individual appendices of this NOFO.

C.5 Special Considerations for NASA Team Members

Any proposal that includes a NASA or JPL employee as a team member shall include the name of the NASA Center or JPL on the cover page. The total budget request for the NASA Center or JPL (as stipulated in the accompanying Letter of Support) shall also be specified under the NASA Partner team member. Since NASA funding sent to NASA Centers or JPL is required to be obligated in the same fiscal year (FY) in which it is received, proposals including NASA Centers or JPL shall provide a breakdown of funding by NASA Center or JPL and by fiscal year, utilizing the start date set forth in the *Summary of Key Information* table at the end of each Appendix (the default start date is six months after proposal submission).

Letters of Support from NASA or JPL Team Members

- Proposals that will include any NASA or JPL technical team collaboration shall include a letter of support from the NASA Center or JPL, naming the team member(s) involved, details on activities to be carried out should the proposal be funded, and the accompanying total budget request (if applicable).

  And/or

- If a proposal will include NASA or JPL student internships or fellowships, or other educational or STEM engagement activities, a letter of support shall be included from the

NASA Center's OSTEM (or JPL Education Office). The letter shall include the team member(s) involved, details on activities to be carried out, and the accompanying total budget request (if applicable). See NASA STEM Engagement Directors for contact information. **NOTE: The selection processes for NASA internships and fellowships are highly competitive, and selection of students attending Recipient institutions is not guaranteed. Proposers are encouraged to be prepared with alternative experiential learning placements in the event students are not selected for NASA internships or fellowships during the period of performance.**

NOTE: Proposers are encouraged to contact NASA Centers and/or JPL early in the proposal process to discuss potential proposal arrangements.

C.6 Submissions from Non-Domestic Entities

NASA may consider proposals from entities outside the U.S. However, foreign entities are generally not eligible to receive funding from NASA. Therefore, unless otherwise noted in this NOFO, proposals from foreign entities shall not include a Cost/Budget submission unless the proposal involves collaboration with a U.S. institution, in which case a Cost/Budget submission for only the U.S. entity's participation shall be included. Proposals from foreign entities and proposals from U.S. entities that include foreign participation shall be endorsed by the respective government agency or funding/sponsoring institution located in the country of the proposing foreign entity. Such endorsement shall indicate that the proposal merits careful consideration by NASA, and, if the proposal is selected, that sufficient funds will be made available to execute the activity as proposed.

Ineligibility of Proposals that Include Participation of China or Chinese-owned Companies: Proposals involving bilateral participation, collaboration, or coordination in any way with China or any Chinese-owned company (including universities), whether funded or performed under a no-exchange-of-funds arrangement, shall be ineligible for award.

C.7 Certifications of Compliance

On February 2, 2019, the System for Award Management (SAM) implemented a new process that allows financial assistance registrants to submit common Federal Government-wide certifications and representations. Individuals and businesses (entities) registering on SAM.gov can review and submit financial assistance certifications and representations online. The new process was required beginning January 1, 2020. Guidance on the new process and system change can be found here.

Certifications shall be uploaded within the completed proposal package (as a single pdf document) and certified by the Authorized Organization Representative (AOR) in NSPIRES. The AOR's signature on the proposal automatically certifies that the proposing organization has read, and is in compliance with, the identified certifications, assurances, and representations.

For additional guidance, see Section 2.9 of the *NASA Proposer's Guidebook*.

D. APPLICATION AND SUBMISSION INFORMATION

D.1 Proposal Submission Date and Time

All information needed to apply to this solicitation is contained in this EONS NOFO and in the *NASA Proposer's Guidebook*. For each opportunity provided in the appendices of this NOFO, the electronic proposal shall be submitted in its entirety by an AOR no later than the proposal deadline on the appropriate proposal due date listed in Table 2 of this NOFO. Unless stated otherwise, the proposal deadline is 11:59 p.m. Eastern time. Please refer to the program element descriptions in each Appendix for specific due dates. An on-time electronic submission is required for every proposal.

While every effort is made to ensure the reliability and accessibility of the websites and to maintain a help center via e-mail and telephone, difficulty may arise at any point on the internet, including with the user's own equipment. Accordingly, prospective proposers are urged to familiarize themselves with the NSPIRES site and to submit the required proposal materials well in advance of the proposal submission deadline. Difficulty in registering with or using the NSPIRES proposal submission system is not, in and of itself, a sufficient reason for NASA to accept a late proposal. Proposers may contact the NSPIRES help desk by email at nspires-help@nasaprs.com or by calling, Monday through Friday from 8:00 am to 6:00 pm Eastern Time at (202) 479-9376, excluding Federal Government holidays. **Please note that the NSPIRES Help Desk may close before the proposal submission deadline.**

D.2 Submission of Proposals

All proposals submitted in response to this EONS NOFO shall be submitted in a fully electronic form. Hard copy proposals (in full or partial submissions) will not be accepted.

Electronic proposals shall be submitted by the official at the PI's institution who is authorized to make such a submission, the AOR. The AOR's electronic submission of the proposal fulfills the requirement for signature of the proposal by an authorized official of the proposing institution.

Proposers shall submit proposals in response to this EONS NOFO via NSPIRES **only**. **Submissions to Grants.gov will not be accepted.** Additional information about NSPIRES can be found in Sections 3.2 of the *NASA Proposer's Guidebook.* Note that proposers may begin working in these systems as soon as the NOFO is released. Further, proposers may edit the required information as many times as needed until the proposal and accompanying cover sheet information are ready for submission.

D.3 Unique Entity Identifier (UEI) and System for Award Management (SAM)

Each applicant for NASA funding (unless the applicant is an individual or is excluded per 2 CFR 25.110) is required to:

- Be registered in SAM before submitting an application

- Maintain an active SAM registration with current information, including information on a recipient's immediate and highest-level owner and subsidiaries, as well as on all predecessors that have been awarded a Federal contract or grant within the last three years, if applicable, for all times during which it has an active Federal award or an application or plan under consideration by NASA; and
- Provide its UEI in each application or plan it submits to NASA. UEIs may be obtained by registering in SAM.gov

NASA may not issue an award or financial modification to an existing award to an applicant or recipient entity until the entity has complied with the requirements to provide a valid UEI and maintain an active SAM registration with current information. At the time of issuing an award, if the intended recipient has not complied with the UEI or SAM requirements, NASA may determine that the applicant is not qualified to receive an award and use that determination as a basis for making an award to another applicant.

D.4 Registration in NSPIRES

Once an organization has a SAM record, the listed Organization Point of Contact (POC) must register as a user with NSPIRES, log on, then begin the organization registration process. The proposing institutions and each team member shall then register with NSPIRES (if not already registered).

PLEASE NOTE: Linking a team member's registration with its institution will automatically associate all required numbers (UEI, CAGE, and EIN) with the same proposal. To identify the AOR, who can also register the institution if it is not already registered in SAM, a potential PI can contact the campus Sponsored Research Office (SRO). The point of contact (POC) from the SRO or Electronic Business POC will be able to register the institution in SAM.

Proposers to this NOFO are required to obtain/complete the following no later than the proposal due date:

1) a valid registration in SAM;

2) a valid CAGE Code; and

3) a valid registration with NSPIRES

D.5 Notice of Intent (NOI) to Propose

Individual appendices to this EONS NOFO may require the submission of a Notice of Intent (NOI) to Propose to assist NASA in the planning of the proposal evaluation process. If required, NOIs are to be submitted electronically by entering the requested information through NSPIRES at by the date/time given in the *Summary of Key Information*, found at the end of the relevant Appendix. Note that NOIs may be submitted within NSPIRES directly by the PI; an NOI is not required to be submitted by an institution's AOR.

All NOIs shall be submitted via NSPIRES. Interested proposers shall register with NSPIRES before it can be accessed for use. NSPIRES is open for the submission of NOIs for typically 30 days, starting on the day the NOFO is released. Since NOIs submitted after these deadlines may still be useful to NASA, late NOIs may be submitted as directed in Section 2.3 of the *NASA Proposer's Guidebook.*

A separate NOI is to be submitted for each planned proposal. The submission of a NOI is not a commitment to submit a proposal, nor is information contained therein binding on the submitter in any way. NOIs will be treated by NASA as competition-sensitive material. Additional information about NOIs is included in Section 2.3 of the *NASA Proposer's Guidebook.*

NOTE: Specific appendices may require submission of an NOI. Please refer to each Appendix for more details.

D.6 Team Member Confirmation

Every identified individual expected to have a role in the execution of the proposed effort shall be identified on the proposal cover page, using the most appropriate personnel as described in Appendix B of the *NASA Proposer's Guidebook*. Prior to proposal submission via NSPIRES, every individual named on the proposal's electronic cover page form as a team member (even Collaborators) must be registered in NSPIRES and confirm their commitment to that role. Team members will receive an email from NSPIRES indicating that they have been added to the proposal and must log into NSPIRES to corroborate. Through this electronic confirmation process, the organization through which they are participating in the proposed effort is also identified to enable organizational conflict of interest checks, which are required as part of the evaluation process. Such confirmation of participation is not needed for unnamed participants (e.g., students and postdoctoral associates). Any organization requesting NASA funds through the proposed project shall list each team member on the proposal cover page. Other than the category of PI, some NOFOs may explicitly disallow some or all of the categories in Appendix B and/or may add other categories.

D.7 Withdrawal of Proposals

Proposers may withdraw their proposals at any time before award. Proposers shall notify NASA in a timely manner if the proposal is funded by another institution, or of any other changed circumstances that necessitate withdrawal of the proposal.

D.8 Questions Related to this NOFO

Questions regarding this NOFO or its activities shall be directed to the cognizant Technical Officer identified in the *Summary of Key Information* subsection at the end of each program element description. Any published clarifications **(Amendments to EONS)** or questions and answers **("Frequently Asked Questions (FAQ)" Sheets)** will be posted on the relevant NSPIRES web page. Interested proposers shall routinely check for such information prior to submitting their proposals.

Questions regarding this NOFO shall be submitted in writing via e-mail to the designated POC given for each program element as soon as possible, but no later than ten days prior to the proposal due date. NASA is not required to respond to questions that are submitted after this deadline.

D.9 Conflict of Interest Check Information

NASA requires all peer reviewers and/or panelists to disclose any conflicts of interest (see Appendix E of the *NASA Proposer's Guidebook*). Peer reviewers are also expected to disclose situations that may give the appearance of bias, or that may cause a reasonable observer to question the ability of the reviewer to provide an unbiased or impartial evaluation of a proposal. Peer reviewers are required to sign a nondisclosure/conflict of interest form before they are given access to proposals. To facilitate adherence to the required conflict of interest disclosures, any institution requesting NASA funds through the proposal shall be listed on the proposal cover page.

D.10 Other Submission Requirements

All proposals shall comply with the general requirements of this NOFO. Upon receipt, proposals will be reviewed for compliance to ensure that the proposal includes the following:

- A complete proposal with all required elements;
- A proposal from an eligible proposer as specified in the Eligibility Information. (Section C of this NOFO);
- A budget narrative that includes details of any sub-awards and that is for a funding period consistent with this NOFO; and
- A proposal that is consistent with the page limitations and formatting guidelines specified in this NOFO and the *NASA Proposer's Guidebook*.

At NASA's sole discretion, non-compliant proposals may be rejected and eliminated for further consideration for award.

Collection of Demographic Information

NASA is implementing a process to collect demographic data from grant applicants for the purpose of analyzing demographic differences associated with its award processes. Information collected will include name, gender, race, ethnicity, and disability status. Submission of this information is completely voluntary and is not a precondition of award.

D.11 Content and Format of the Proposal Submission

Required elements of the proposal as described in Table 4 shall be submitted via the NSPIRES website. Proposers shall assemble their proposal into one PDF file (except the NSPIRES-generated Proposal Cover Page) prior to submitting the proposal. Proposers shall comply with all format requirements identified in this NOFO and in the *NASA Proposer's Guidebook*. Please refer to Section 2 of the *NASA Proposer's Guidebook* for more information on proposal submission procedures. Section 2.6 of the *NASA Proposer's Guidebook* provides important guidelines for style formats. A sample proposal cover page can be found in Appendix B of this NOFO.

TABLE 4. Required Proposal Elements

Proposal Elements	Page Guideline
NSPIRES Cover Page and Budget Form (Section 2.8 of the *NASA Proposer's Guidebook*): The NSPIRES Cover Page contains the following: **Proposal Information**: PI information, proposal title, proposed start and end dates, submitting institution information, certification and authorization. Certifications Regarding Lobbying, Disbarment, Suspension and Other Responsibility Matters: The AOR's signature on the Proposal Cover Page automatically certifies that the proposing organization has read and shall comply with these certifications. No additional form is necessary. See 2 CFR §1800, Appendix A. **Team Members:** Names, institution and contact information. (Note: Each team member shall register in NSPIRES and complete all required data. Each team member shall establish an organizational relationship; i.e., identify the organization or other information through which the person is participating in the proposal. A proposal cannot be submitted if an organizational relationship within NSPIRES is missing for any team member.) **Proposal Title:** Include a meaningful title for the proposed project applicable to specific appendix. (Note: Title length may not exceed 255 characters including spaces.) **Project Summary** (max. 4000 characters, Section 2.7 & 2.10 of the *NASA Proposer's Guidebook*): Provide a brief description of the project, including objectives, targeted audience, partners, method of approach, relevance to NASA themes, use of NASA content, and outcomes. **Budget Figures**: Include figures for each year (up to the number of years of the period of performance) of the proposed project in the spaces provided. This is the total budget, including any sub-awards. **Data Management Plan**: limited to 4000 characters	1 or more – NSPIRES will generate the necessary number of pages

Note: Sample Cover Pages are located in Appendix B of this NOFO. NASA is not permitted to fund institutions that are not listed on the Proposal Cover Page. This includes NASA Centers and JPL.	
Note: To improve proposal reviewability, Proposers shall submit one PDF file to NSPIRES beginning with the Table of Contents and including all information described below:	
Table of Contents (TOC): (Section 2.7 & 2.12 of the *NASA Proposer's Guidebook*. NSPIRES does not offer a stand-alone TOC file upload choice. The proposer shall include a TOC as the first page(s) of the project description, even if that results in the project description being longer than 15 pages. In other words, the TOC does not count against the established page limits.	
Project Description: A detailed description of the proposed plan. Page limit includes all illustrations, tables, and figures, where each "n-page" foldout counts as n-pages, and each side of a sheet containing text or an illustration counts as a page.	Maximum 15 pages
References and Citations: (Section 2.14 of the *NASA Proposer's Guidebook*)	1 or more (if applicable)
Biographical Sketches: Submit sketches for key personnel using the guidelines from Section 2.15 of the *NASA Proposer's Guidebook*.	PI: max 2 pages Each Co-I and Other Key Personnel: max 1 page
Current and Pending Support: (Section 2.16 of the *NASA Proposer's Guidebook* and references therein)	1 or more (if none, so state)
Statements of Commitment and Letters of Support: (Section 2.17 of the *NASA Proposer's Guidebook*.)	1 or more (if appropriate)
Special Notifications and/or Certifications	As needed

E. APPLICATION REVIEW INFORMATION

E.1 Application Evaluation Criteria

Unless specifically stated in the individual appendices, all NASA-sponsored STEM engagement activities are evaluated, at a minimum, against the following criteria for award: (1) **Intrinsic Merit**, (2) **Relevance to NASA**, and (3) **Budget/Cost** (see Appendix D of the *NASA Proposer's Guidebook*). Additional criteria for award may be added based upon the uniqueness of the requirement of the activity. Refer to each individual Appendix for specific details on the proposal evaluation criteria.

E.2 Review and Selection Process

Review of proposals submitted to this announcement will be consistent with the general policies and provisions set forth in the *NASA Proposer's Guidebook,* Appendix D. Evaluation criteria (described in Appendix D) are superseded by the evaluation criteria described in each EONS Appendix. Selection procedures will be consistent with the procedures identified in Appendix D.

Proposals will be evaluated by a merit review process composed of proposers' professional peers (Government and non-Government), including STEM education and evaluation experts, who have been screened in advance for any conflicts of interest. Unless specifically stated in the individual appendices (specific activities), each proposal will be evaluated and assessed based on its strengths and weaknesses for each of the three evaluation criteria for award (Intrinsic Merit, Relevance to NASA, and Budget/Cost) and their sub-elements.

NASA seeks a balanced project award portfolio. NASA also considers diverse factors in the final award portfolio, such as but not limited to: different types of institutional representation, participation by individuals traditionally underrepresented in STEM studies and careers, and geography.

The Selecting Official for each activity is identified in the Summary of Key Information at the end of each Appendix description.

E.3 Risk Analysis

The NASA Grant Officer will conduct a pre-award review of risk associated with the proposer as required by 2 CFR §200.206, Federal awarding agency review of risk posed by applicants. For all proposals selected for an award, the Grant Officer will review the submitting organization's information available through multiple government-wide repositories such as SAM (SAM.gov), the Contractor Performance and Assessment Reporting System (CPARS), the Federal Audit Clearinghouse (FAC), USAspending.gov, and Grant Solutions Recipient Insight.

E.4 Risk Review

For any federal award, if NASA anticipates the total federal share will be greater than the simplified acquisition threshold (SAT) (currently $250,000) during the period of performance:

i. Prior to making a federal award with a total amount of federal share greater than the SAT, NASA is required to review and consider any information about the applicant that is in the designated integrity and performance system accessible through SAM (see 41 U.S.C. §2313);

ii. An applicant, at its option, may review information in the designated integrity and performance systems accessible through SAM and comment on any information about itself that a federal awarding agency previously entered and is currently in the designated integrity and performance system accessible through SAM;

iii. NASA will consider any comments by the applicant, in addition to the other information in the designated integrity and performance system, in making a judgment about the applicant's integrity, business ethics, and record of performance under federal awards when completing the review of risk posed by applicants as described in 2 CFR §200.206, Federal awarding agency review of risk posed by applicants.

F. FEDERAL AWARD ADMINISTRATION INFORMATION

F.1 Notice of Award

NASA will notify successful grant recipients of funding via a Notice of Award (NASA Form 1687) signed by the Grant Officer. This Notice of Award is the authorizing document and will be sent to the recipient via email. NASA is committed to announcing selections and initiating awards as quickly as possible, consistent with ensuring the quality of the selection and award process and subject to the appropriation of federal funds for the initiation of new awards.

Selections are typically announced between 150-220 days after the proposal due date (see the *NASA Proposer's Guidebook*, Section 4.3, Selection).

NASA has no obligation to evaluate ineligible proposals or those not meeting all stated requirements of this NOFO (see *NASA Proposer's Guidebook,* Section 4.6. Proposal Rejected by NASA Without Review).

Upon approval of the Selecting Official, proposals recommended for funding will be forwarded to the NASA Grant Officer for final review of business, financial, and policy implications, and then processing and issuance of a grant or cooperative agreement will occur.

Proposers are strongly cautioned that only a NASA Grant Officer may make commitments, obligations or awards on behalf of NASA or authorize the expenditure of funds for this opportunity. The Grant Officer is also referred to as an Award Officer in the *NASA Proposer's Guidebook*. No commitment on NASA's part should be assumed based upon technical or budgetary discussions that the proposer has with any NASA employee other than the Grant Officer. Per 2 CFR §200.308, Revision of Budget and Program Plans, a PI and/or institution, at their own risk, may make financial or personnel commitments within the 90-day period preceding the effective date of their award in the absence of a written instrument signed by a NASA Grant Officer. Any costs that the proposer incurs in anticipation of a grant or cooperative agreement award will be subject to the rules at 2 CFR §1800.210, Pre-award costs.

Notification of both the selected and the non-selected proposals will be consistent with the policy stated in the *NASA Proposer's Guidebook,* Appendix D. For selected proposals, a NASA Grant Officer will contact the proposer's business office. The NASA NSSC will conduct the negotiation and award of any grants or cooperative agreements. Grant or cooperative agreement awards are made to the proposing institution, not to the PI or any other individual.

In order to announce selection decisions for grants and cooperative agreements as soon as possible, even in the presence of budget uncertainties, the Selection Official may defer selection decisions on some proposals while making selection decisions on others. If a Selection Official uses this option, then proposals will be either "selected," "selectable (pending)," or "not selected."

Proposals that are "selectable (pending)" may be considered for a supplemental selection if and when circumstances allow. All proposers that receive a "selectable (pending)" decision will eventually be notified whether their proposals are selected through a supplemental selection or are no longer being considered for a supplemental selection.

Proposers that are not selected will be notified by electronic mail and offered a debriefing consistent with the policy in Appendix D of the *NASA Proposer's Guidebook*.

F.2 Process for Appeals Prior to Formal Requests for Reconsideration

This NOFO is limited to the awarding of grants and cooperative agreements. Accordingly, the appeals and reconsideration processes under this NOFO do not include protest rights for proposers with the U.S. Government Accountability Office (GAO) or with the Agency, as defined in Federal Acquisition Regulation (FAR) 33.101. Furthermore, the provisions at FAR 52.233-2 (Service of Protest) and NASA FAR Supplement (NFS) 1852.233-70 (Protests to NASA) do not apply to this NOFO.

Per Section 5.9.5 of the *GCAM*, this section does not apply to proposals returned without review by NASA for an applicant's failure to:

1. Submit the proposal with enough lead time before the activity is to commence;

2. Submit a late proposal where information regarding the proposal deadline (i.e., date, time, and location) for submission had been previously specified;

3. Meet the NASA proposal preparation requirements, such as page limitations, formatting, instructions, and electronic submission as specified in the *NASA Proposer's Guidebook*, or the NOFO; or

4. Submit a proposal that is responsive to the NOFO or that contains sufficient detail.

F.2.1 Debriefing with Solicitation Activity Manager

PIs who receive a "not selected" decision on their proposal will be notified by electronic mail and offered a debriefing meeting consistent with the policy in Appendix D of the *NASA Proposer's Guidebook*. PIs who are interested in a debriefing shall first email the **Activity Manager** listed in the status letter with their questions and concerns. If a PI is not satisfied with the explanation provided for the basis of non-selection of their proposal, they may submit a **Request for Reconsideration**, as outlined in Section F.2.2 of EONS-2024.

F.2.2 Written Request for Reconsideration to Selecting Official

If a PI decides to have its institution's declined proposal reconsidered for funding, the PI shall, within 30 calendar days of receipt of the synopsis of reviewers' comments, submit a Request for Reconsideration in writing to the **Selecting Official.** If no synopsis of reviewers' comments was received, the Request for Reconsideration shall be submitted within 60 calendar days of notification that the proposal had been declined. The Selecting Official will respond to the Request for Reconsideration within 30 calendar days. If additional time is required to prepare a response, the Selecting Official will send an explanation of the need for more time to the PI within 30 calendar days of the Agency's receipt of the Request for Reconsideration.

F.2.3 Appeals Above the Selecting Official

Appeals of the Selecting Official's reconsideration decision shall be made within 30 calendar days of receipt of that decision. The written appeal shall be submitted to the Assistant Administrator of the Mission Directorate or Office issuing the NOFO. A response to the appeal will be provided to the PI within 30 calendar days of the Agency's receipt of the appeal.

Mr. Torry Johnson
Deputy Associate Administrator for The STEM Engagement Program
Office of STEM Engagement
NASA Headquarters
300 E Street SW, Mail Code N
Washington, DC 20546

F.2.4 Appeals Above the Deputy Associate Administrator

Appeals of the Deputy Associate Administrator for STEM Engagement Program's reconsideration decision shall be made within 30 calendar days of receipt of that decision. The written appeal shall be submitted to the Associate Administrator for STEM Engagement. A response to the appeal will be provided to the PI within 30 calendar days of the Agency's receipt of the appeal.

Finally, the NASA Procurement Ombudsman Program is available under this NOFO as an option to address any concerns/or and disagreements. Accordingly, the clause at NFS 1852.215-84, Ombudsman, is incorporated into this NOFO. The cognizant Ombudsman is:

Marvin Horne
Deputy Assistant Administrator for Procurement, Procurement Ombudsman and Competition Advocate
300 E Street SW
Washington, DC 20546
Email: marvin.l.horne@nasa.gov

F.3 Administrative and National Policy Requirements

Throughout the year, NASA may issue policies or guidance by way of a Grant Information Circular (GIC). GICs supplement, clarify, augment, remove, and/or alter information included in NASA grant policies and/or provide other important updates. NASA distributes GICs on the NASA website on the Grants Policy and Compliance Regulations and Guidance section under Active GICs. Expired GICs are stored on the GICs Archive webpage. GICs supersede the policy document referenced in the circular. As such, NASA grant applicants and recipients should ensure they stay informed by checking NASA's Grant Regulations and Guidance page for the most up-to-date policies and requirements. Recipients of NASA grant funding shall adhere to requirements set forth in 2 CFR §200, 2 CFR §1800, 2 CFR §170, 2 CFR §175, 2 CFR §182, and 2 CFR §183.

F.4 Award Reporting Requirements

The performance and financial reporting requirements for awards made through this NOFO will comply with the reporting requirements in 2 CFR §§200.328 - 200.330, Performance and Financial Monitoring and Reporting, and be consistent with any applicable NASA and federal regulations. Any additional requirements are specified in the program element appendices.

Research Terms and Conditions

Awards from this funding announcement that are issued under 2 CFR §1800 are subject to Federal Research Terms and Conditions (RTC). In addition to the RTC and NASA-specific guidance, three companion resources can also be found on the RTC website: Appendix A—Prior Approval Matrix, Appendix B—Subaward Requirements Matrix, and Appendix C—National Policy Requirements Matrix.

Federal Financial Reporting

Recipients of NASA funding must submit quarterly financial reports. Financial reports must be submitted via the Payment Management System (PMS):

- Quarterly Federal Financial Reports (FFR)are due no later than 30 days past the reporting period end date.
- Final Financial Status Reports/Final Federal Financial Report (FSR/FFR) are due no later than 120 days after the end of the award's period of performance.

Performance Reporting

NASA annually generates a body of evidence (i.e., milestone accomplishments, performance and participation data, evaluation outcomes, and/or other metrics) that assesses STEM engagement investments. NASA OSTEM currently utilizes the NASA STEM Gateway registration/application and data management system for analyzing performance data. PIs are required to respond to data calls as requested by NASA OSTEM and utilize this Agency-approved data management system for performance data reporting. Additional communications and guidance regarding data calls and the NASA STEM Gateway will be sent to award recipients from the NASA OSTEM and Activity Management team. The PI shall ensure it has the appropriate staff and resources to facilitate data collection activities and complete all tasks required for reporting. In addition, PIs are responsible for timely submitting the following:

- Annual Performance Report – used to describe a grant/cooperative agreement's scientific progress, identify significant changes, report on personnel, and describe plans for the subsequent reporting period. Due: 60 days prior to the anniversary date of the award.
- Final Performance Report—used as part of the grant closeout process to submit project outcomes in addition to the information submitted on the Annual Performance Report. Due: within 120 days after the end of the award's period of performance.

Recipient Integrity and Performance Matters

Awards under this solicitation that are $500,000 or more may be subject to the post-award reporting requirements reflected in 2 CFR §200 Appendix XII.

FFATA Reporting Requirements

Per 2 CFR §170, Reporting Subaward and Executive Compensation Information, award recipients that issue first-tier subawards above $30,000 shall report those subawards in the Federal Award Accountability and Transparency Act (FFATA) Subaward Reporting System (FSRS). 2 CFR §170 provides detailed guidance as to what information needs to be reported in these systems and the deadlines for submitting this information. Recipient information that is reported to FSRS is ultimately transferred to USAspending.gov for public display.

Suspension and Debarment Disclosure

This reporting requirement pertains to disclosing information related to government-wide suspension and debarment requirements. Before a Recipient enters into a grant award with NASA, the Recipient must notify NASA if it knows if it or any of its principals under the award fall under one or more of the four criteria listed at 2 CFR §180.335:

i. Are presently excluded or disqualified;

ii. Have been convicted within the preceding three years of any of the offenses listed in 2 C.F.R. § 180.800(a) or had a civil judgment rendered against it or any of the recipient's principals for one of those offenses within that time period;

iii. Are presently indicted for or otherwise criminally or civilly charged by a governmental entity (federal, state or local) with commission of any of the offenses listed in 2 C.F.R. § 180.800(a); or

iv. Have had one or more public transactions (federal, state, or local) terminated within the preceding three years for cause or default.

At any time after accepting the award, if the Recipient learns that it or any of its principals falls under one or more of the criteria listed at 2 CFR §180.335, the Recipient must provide immediate written notice to NASA in accordance with 2 CFR §180.350.

Additional Reporting Requirements

Recipients must conform to all reporting requirements outlined in the Required Publications and Reports section of the GCAM, currently Appendix F.

F.5 Additional Terms and Conditions

Personal Identity Verification (PIV) of Grant/Cooperative Agreement Personnel

Personnel who plan to work onsite at a NASA Center or JPL shall comply with the *NASA Proposer's Guidebook,* Appendix F and the *GCAM*, Appendix D. These sections provide information about Recipients requiring access to a NASA Center, facility, or computer system, or to NASA technical information, which requires "Personal Identity Verification of Recipient Personnel."

Environmental Statement

Awards of proposals related to this NOFO must comply with the National Environmental Policy Act (NEPA); thus, proposers are encouraged to plan and budget for any anticipated environmental impacts. While most research awards will not trigger action specific NEPA review, some activities (including international actions) will.

The majority of grant-related activities are categorically excluded as research and development (R&D) projects that do not pose any adverse environmental impact. A blanket NASA Grants Record of Environmental Consideration (REC) provides NEPA coverage for these anticipated activities. The NSPIRES award application cover page includes questions to determine whether a specific proposal falls within the Grants REC and must be completed as part of the proposal submission process. Activities outside of the bounding conditions of the Grants REC will require additional NEPA analysis. Examples of actions that will likely require NEPA analysis include but are not limited to suborbital-class flights not conducted by a NASA Program Office, activities involving ground-breaking construction/fieldwork, and certain payload activities such as the use of dropsondes.

Questions concerning environmental compliance may be addressed to the NASA NEPA Manager via the NASA program official listed in this NOFO.

Access to Research

As outlined in Appendix D.34 of the *NASA Proposer's Guidebook,* awards issued under this NOFO shall comply with the provision set forth in the *NASA Plan for Increasing Access to the Results of Scientific Research* including the responsibility for:

- Submitting (as approved) peer-reviewed manuscripts and metadata to a NASA-designated repository: and
- Reporting publications with the annual and final progress reports

Limited Release of Proposers' Confidential Business Information

(a) For proposal evaluation and other administrative processing, NASA may find it necessary to release information submitted by the proposer to individuals not employed by NASA. Business information that would ordinarily be entitled to confidential treatment may be included in the information released to these individuals. Accordingly, by submission of this proposal, the proposer hereby consents to a limited release of its confidential business information (CBI).

(b) Except where otherwise provided by law, NASA will permit the limited release of CBI only pursuant to non-disclosure agreements signed by NASA's support contractor or subcontractor, and their individual employees who may require access to the CBI to perform the applicable contract or subcontract.

G. POINTS OF CONTACT FOR FURTHER INFORMATION

General questions and comments about this NOFO may be directed to: NASAEONS2024@nasaprs.com

Note: Proposals shall not be submitted to the above address. Instead, proposals shall be submitted electronically as described in Section D of this NOFO.

Specific questions about a given activity in this NOFO shall be directed to the Activity Manager(s) listed in the *Summary of Key Information* subsection that concludes each activity description.

Instructions for using NSPIRES are available on the NSPIRES Online Help page. If additional help is needed, the NSPIRES Help Desk can be contacted at (202) 479-9376 or by email at nspires-help@nasaprs.com. This help center is staffed Monday through Friday, 8:00 a.m. – 6:00 p.m. Eastern Time, excluding Federal Government holidays.

H. OTHER INFORMATION

H.1 Announcement of Updates/Amendments to Solicitation

Because this NOFO is released in advance of many of the deadlines listed in Table 2, additional major programmatic information for certain elements may develop before proposal due dates. If so, such information will be added as a formal amendment to this NOFO and posted at the EONS-2024 landing page. Prospective proposers shall regularly check this NOFO's homepage for updates concerning the activity(s) of interest.

Any published clarifications or questions and answers will be posted on the relevant activity's NSPIRES page (select "Open" under the "Solicitations" heading, then "**NNH23ZAO001N,**" then "List of Activities," then choose the relevant activity). FAQs may be updated until 10 business days prior the proposal due date.

H.2 Access to NASA Facilities

All recipients shall work with NASA project/program staff to ensure proper credentialing for any individuals who need access to NASA facilities and/or systems. Such individuals include U.S. citizens, lawful permanent residents ("green card" holders), and foreign nationals (those who are neither U.S. citizens nor permanent residents)

APPENDIX 1: PIV Card Issuance Procedures

in Accordance with FAR Clause 52.204-9,

Personal Identity Verification of Contractor Personnel (Jan. 2011)

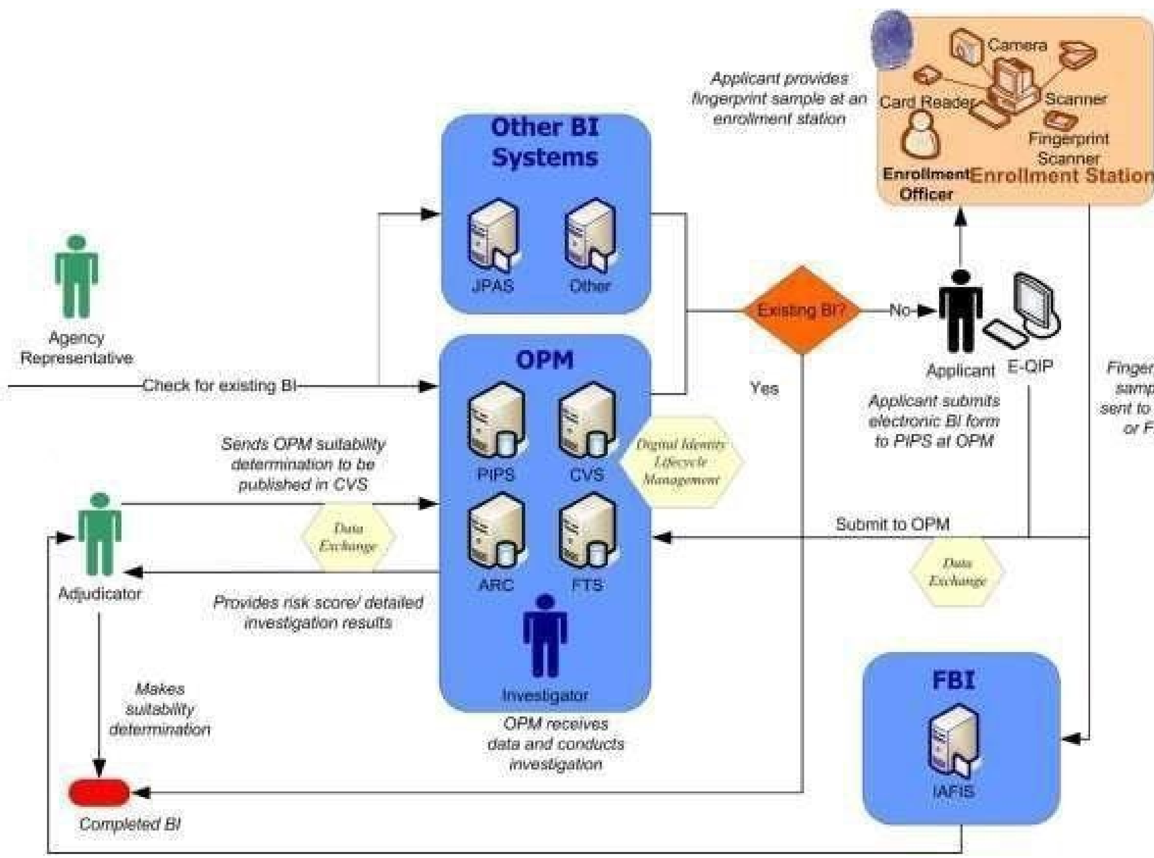


Figure 1. Review Process

The enrollment and processing of NASA identity data and the issuance of credentials to those identities shall be completed in the Identity Management and Account Exchange (IdMAX) system following the requirements found in NPR 1600.4. Figure 1 depicts the processes described in steps 2 through 5.

Step 1

The grantee or recipient submits a formal letter that provides a list of the names of individuals (applicants) who require access to a NASA-controlled facility or access to a NASA information technology (IT) system to the cognizant NASA Technical Officer (TO). In the case of a foreign national applicant, approval through the NASA Identify Management System (IdMAX) shall be obtained for the visit or assignment before any processing for a PIV or alternate agency credential can take place. Further, if the foreign national is not under a grant or cooperative agreement for which a technical officer has been officially designated, the foreign national will provide the information directly to the visit/assignment host, and the host sponsor will fulfill the duties of the technical officer mentioned herein.

In each case, the letter shall include the subject grant or cooperative agreement number, the NASA Center organization code, the applicant's full name (first, middle and last), countries of citizenship, email address, and phone number. If the applicant has a current satisfactorily completed Tier 1 or an equivalent or higher degree of background investigation, the letter shall indicate the type of investigation, the agency completing the investigation, and date the investigation was completed. Also, the letter shall specify the access requirements and the risk/sensitivity level associated with the position in which each applicant will be working (NPR 1600.3, §2.3 is germane). Further, the letter shall also acknowledge that applicants may be denied access to NASA facilities, information, and/or information systems based on an unsatisfactory background investigation/adjudication.

After reviewing the letter for completeness and concurring with the risk/sensitivity levels, the technical officer/host shall forward the letter to the Center Office of Protective Services (OPS).

Step 2

Upon acceptance of the letter/background information, the Center OPS shall create a remote identity invitation in IdMAX. The applicant shall utilize the invitation tool link and password in their email to review, correct, and submit additional personal data securely.

Upon receipt of the completed remote invite, the Center OPS shall ensure review of the OPM databases (e.g., DCII, PIPS, et al.) and validation of the applicant's investigation status.

Requirements for a Tier 1 or other investigation shall be initiated only if necessary. Applicants who do not currently possess the required level of background investigation shall be directed to the e-QIP web site to complete the necessary background investigation forms online. The Center OPS shall provide to the technical officer/host information and instructions on how to access the e-QIP for each grantee, recipient or foreign national employee requiring access.

Upon completion of the e-QIP, the Center OPS will advise the applicant that in order to complete the investigation process, he or she shall appear in-person before the authorized registrar and submit two forms of identity source documents in original form. The identity source documents shall come from the list of NASA-approved identity source documents, one of which shall be a Federal or State issued picture identification. The registrar will electronically scan the submitted documents; any document that appears invalid will be rejected by the registrar.

Fingerprints and a photograph will be taken at this time. The applicant shall appear no later than the entry on duty date. The information submitted by the applicant will be used to create or update the applicant identity record in IdMAX

Step 3

Upon the applicant's completion of the investigation forms, the Center OPS reviews the information, and resolves discrepancies with the applicant as necessary. When the applicant has appeared in person and completed fingerprints, the package is electronically submitted to initiate the background investigation. The Center OPS includes a request for feedback on the National Criminal History Check (NCHC) portion of the background investigation at the time the request is submitted.

Step 4

Prior to authorizing physical access of a grantee or recipient to a federally controlled facility or access to a Federal information system, the Center OPS will ensure that required database checks have been performed. If this process yields negative information, the Center OPS will immediately notify the Center Chief of Security (CCS) and the technical officer/host.

Step 5

Upon receipt of the completed NCHC, the Center OPS will update IdMAX and indicate the result of the suitability determination. If an unsatisfactory suitability determination is rendered, the technical officer will advise the grantee or recipient that the applicant is being denied physical access to all federally controlled facilities and Federal information systems.

Based on favorable results of the NCHC, National Crime Information Center (NCIC) Interstate Identification Index (III) check, and/or other required checks, the Center OPS will authorize the issuance of the appropriate credential in IdMAX. For foreign nationals the International Visit Coordinator (IVC), in consultation with other organizations, based on information provided in the access control plan, will determine what physical access the applicant should be granted once the appropriate credential is issued.

Step 6

Using the information provided by the applicant during his or her in-person appearance, the credential will be created and activated following necessary procedures for that credential.

Step 7

The applicant proceeds to the credential issuance facility to begin processing for receipt of his/her credential.

The applicant provides to the credential issuing operator the same identity source documents submitted for registration. The credential issuing operator will verify that the facial image, and optionally referenced fingerprint, matches the enrollment data used to produce the card. Upon verification of identity, the operator will locate the employee's record and modify the record to indicate the credential has been issued. If required, the applicant will select a PIN for use with his or her new credential.

Note: A non-PIV government identification badge, including the NASA Photo Identification Badge, SHALL NOT BE USED for the original issuance of a PIV-vetted credential

ALTERNATIVE FOR APPLICANTS WHO DO NOT HAVE A COMPLETED AND ADJUDICATED NCHC AT THE TIME OF ENTRANCE ON DUTY (EOD)

Steps 1 through 4 shall be accomplished for all applicants in accordance with the process described above. If the applicant is unable to appear in person until the time of entry on duty, or does not, for any other reason, have a completed and adjudicated NCHC portion of the background investigation at the time of entrance on duty, the following interim procedures shall apply for US citizens and legal permanent residents. These procedures are not applicable to foreign nationals who must have a completed fingerprint check before EOD.

If the documents required to submit the background investigation have not been completed prior to EOD, the applicant will be instructed to complete all remaining requirements for submission of the investigation request. This includes presentation of identity source documents and completion of fingerprints, if not already accomplished. If the applicant fails to complete these activities as prescribed in NPR 1600.4 (Chapters 3 & 4), it may be considered as failure to meet the conditions required for access to a NASA- controlled facility or access to a NASA IT system, and result in denial of such access.

Based on favorable results of the NCIC III, the applicant shall be issued an appropriate alternate agency credential for a period not-to-exceed six months. If at the end of the six-month period the NCHC results have not been returned, the agency will at that time make a determination as to whether an additional extension will be granted for the temporary alternate agency credential.

Upon return of the completed background investigation, the process will continue from Step 5.

APPENDIX 2: Sample Proposal Format

Cover Page for Proposal Submitted to the National Aeronautics and Space Administration	NASA Proposal Number

NASA PROCEDURE FOR HANDLING PROPOSALS

This proposal shall be used and disclosed for evaluation purposes only, and a copy of this Government notice shall be applied to any reproduction or abstract thereof. Any authorized restrictive notices that the submitter places on this proposal shall also be strictly complied with. Disclosure of this proposal for any reason outside the Government evaluation purposes shall be made only to the extent authorized by the Government.

SECTION I - Proposal Information

Principal Investigator	E-mail Address	Phone Number

Street Address (1)	Street Address (2)

City	State / Province	Postal Code	Country Code

Proposal Title :

Proposed Start Date	Proposed End Date	Total Budget	Year 1 Budget	Year 2 Budget	Year 3 Budget

SECTION II - Application Information

NASA Program Announcement Number	NASA Program Announcement Title

For Consideration By NASA Organization *(the soliciting organization, or the organization to which an unsolicited proposal is submitted)*

Date Submitted	Submission Method	Grants.gov Application Identifier	Applicant Proposal Identifier

Type of Application	Predecessor Award Number	Other Federal Agencies to Which Proposal Has Been Submitted

International Participation	Type of International Participation

SECTION III - Submitting Organization Information

DUNS Number	CAGE Code	Employer Identification Number (EIN or TIN)	Organization Type

Organization Name (Standard/Legal Name)	Company Division

Organization DBA Name	Division Number

Street Address (1)	Street Address (2)

City	State / Province	Postal Code	Country Code

SECTION IV - Proposal Point of Contact Information

Name	Email Address	Phone Number

SECTION V - Certification and Authorization

Certification of Compliance with Applicable Executive Orders and U.S. Code

By submitting the proposal identified in the Cover Sheet/Proposal Summary in response to this Research Announcement, the Authorizing Official of the proposing organization (or the individual proposer if there is no proposing organization) as identified below:

- certifies that the statements made in this proposal are true and complete to the best of his/her knowledge;
- agrees to accept the obligations to comply with NASA award terms and conditions if an award is made as a result of this proposal; and
- confirms compliance with all provisions, rules, and stipulations set forth in the two Certifications and one Assurance contained in this NRA (namely, (i) the Assurance of Compliance with the NASA Regulations Pursuant to Nondiscrimination in Federally Assisted Programs, and (ii) Certifications, Disclosures, and Assurances Regarding Lobbying and Debarment and Suspension.

Willful provision of false information in this proposal and/or its supporting documents, or in reports required under an ensuing award, is a criminal offense (U.S. Code, Title 18, Section 1001).

Authorized Organizational Representative (AOR) Name	AOR E-mail Address	Phone Number

AOR Signature *(Must have AOR's original signature. Do not sign "for" AOR.)*	**Date**

FORM NRESS-300 Version 3.0 Apr 09

PI Name:			NASA Proposal Number
O,ga tioo Name:			
Proposal Tille:			

Team Member Role	Team Miember Name	Contact Phone	E-mai Address.
Organiul.tian/Eusine:ss REiationship		Cage Gode	DUNSII
International Particip-ation	U.S. GoVemment Agency		Total Ftnds.Requested
Team Member Ro'le	Te-an, Me-l!Rber Name	Contact Phooe	E-maJ Address.
OrgaJiZ3.tioolEusine:ss REiationship		CageOode	DUNSII
International P'armcip-ation	U.S. GOVemment Agenc:,i		Total Ftnds.Reque-s.ted
Team Member Role	Team Member N:arne	Contact Phone	E-mal Address.
Organiz:.3.tion/Emine:ss REiationship		CageOode	DUNSII
International P'armcip-ation	U.S. GOVermientAgency		Total Ftnds.lReque-s.ted

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PI Name :	NASA Proposal Number
Organization Name :	
Proposal Title :	

SECTION VII - Project Summary

FORM NRESS-300 Version 3.0 Apr 09

PI Name :	NASA Proposal Number
Organization Name :	
Proposal Title :	

SECTION VIII - Other Project Information	
Environmental Impact	
Does this project have an actual or potential impact on the environment?	Has an exemption been authorized or an environmental assessment (EA) or an environmental impact statement (EIS) been performed?
Environmental Impact Explanation:	
Exemption/EA/EIS Explanation:	

FORM NRESS-300 Version 3.0 Apr 09

PI Name :	**NASA Proposal Number**
Organization Name :	
Proposal Title :	

SECTION IX - Program Specific Data

FORM NRESS-300 Version 3.0 Apr 09

PI Name :	NASA Proposal Number
Organization Name :	
Proposal Title :	

SECTION X - Budget

Cumulative Budget

Budget Cost Category	Funds Requested ($)			
	Year 1 ($)	Year 2 ($)	Year 3 ($)	Total Project ($)
A. Direct Labor - Key Personnel	0.00	0.00	0.00	0.00
B. Direct Labor - Other Personnel	0.00	0.00	0.00	0.00
Total Number Other Personnel	0	0	0	0
Total Direct Labor Costs (A+B)	0.00	0.00	0.00	0.00
C. Direct Costs - Equipment	0.00	0.00	0.00	0.00
D. Direct Costs - Travel	0.00	0.00	0.00	0.00
Domestic Travel	0.00	0.00	0.00	0.00
Foreign Travel	0.00	0.00	0.00	0.00
E. Direct Costs - Participant/Trainee Support Costs	0.00	0.00	0.00	0.00
Tuition/Fees/Health Insurance	0.00	0.00	0.00	0.00
Stipends	0.00	0.00	0.00	0.00
Travel	0.00	0.00	0.00	0.00
Subsistence	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00
Number of Participants/Trainees				0
F. Other Direct Costs	0.00	0.00	0.00	0.00
Materials and Supplies	0.00	0.00	0.00	0.00
Publication Costs	0.00	0.00	0.00	0.00
Consultant Services	0.00	0.00	0.00	0.00
ADP/Computer Services	0.00	0.00	0.00	0.00
Subawards/Consortium/Contractual Costs	0.00	0.00	0.00	0.00
Equipment or Facility Rental/User Fees	0.00	0.00	0.00	0.00
Alterations and Renovations	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00
G. Total Direct Costs (A+B+C+D+E+F)	0.00	0.00	0.00	0.00
H. Indirect Costs	0.00	0.00	0.00	0.00
I. Total Direct and Indirect Costs (G+H)	0.00	0.00	0.00	0.00
J. Fee	0.00	0.00	0.00	0.00
K. Total Cost (I+J)	0.00	0.00	0.00	0.00
Total Cumulative Budget				0.00

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PI Name :	NASA Proposal Number
Organization Name :	
Proposal Title : I523 Test 1	

SECTION X - Budget

Start Date :	End Date :	Budget Type :	Budget Period :

F. Other Direct Costs

	Funds Requested ($)
1. Materials and Supplies	0.00
2. Publication Costs	0.00
3. Consultant Services	0.00
4. ADP/Computer Services	0.00
5. Subawards/Consortium/Contractual Costs	0.00
6. Equipment or Facility Rental/User Fees	0.00
7. Alterations and Renovations	0.00
Total Other Direct Costs	0.00

G. Total Direct Costs

	Funds Requested ($)
Total Direct Costs (A+B+C+D+E+F)	0.00

H. Indirect Costs

	Indirect Cost Rate (%)	Indirect Cost Base ($)	Funds Requested ($)
Cognizant Federal Agency:		Total Indirect Costs	0.00

I. Direct and Indirect Costs

	Funds Requested ($)
Total Direct and Indirect Costs (G+H)	0.00

J. Fee

	Funds Requested ($)
Fee	0.00

K. Total Cost

	Funds Requested ($)
Total Cost with Fee (I+J)	0.00

FORM NRESS-300 Version 3.0 Apr 09

PI Name :	NASA Proposal Number
Organization Name :	
Proposal Title :	

SECTION X - Budget

Start Date :	End Date :	Budget Type :	Budget Period :

C. Direct Costs - Equipment

Item No.	Equipment Item Description	Funds Requested ($)
	Total Equipment Costs	0.00

D. Direct Costs - Travel

	Funds Requested ($)
1. Domestic Travel (Including Canada, Mexico, and U.S. Possessions)	0.00
2. Foreign Travel	0.00
Total Travel Costs	0.00

E. Direct Costs - Participant/Trainee Support Costs

		Funds Requested ($)
1. Tuition/Fees/Health Insurance		0.00
2. Stipends		0.00
3. Travel		0.00
4. Subsistence		0.00
Number of Participants/Trainees:	Total Participant/Trainee Support Costs	0.00

FORM NRESS-300 Version 3.0 Apr 09

PI Name :								NASA Proposal Number
Organization Name :								
Proposal Title :								
SECTION X - Budget								
Start Date :	End Date :		Budget Type :			Budget Period :		
A. Direct Labor - Key Personnel								
Name	**Project Role**	**Base Salary ($)**	**Cal. Months**	**Acad. Months**	**Summ. Months**	**Requested Salary ($)**	**Fringe Benefits ($)**	**Funds Requested ($)**
		0.00				0.00	0.00	0.00
							Total Key Personnel Costs	0.00

B. Direct Labor - Other Personnel							
Number of Personnel	**Project Role**	**Cal. Months**	**Acad. Months**	**Summ. Months**	**Requested Salary ($)**	**Fringe Benefits ($)**	**Funds Requested ($)**
0	**Total Number Other Personnel**					**Total Other Personnel Costs**	0.00
						Total Direct Labor Costs (Salary, Wages, Fringe Benefits) (A+B)	0.00

SAMPLE

FORM NRESS-300 Version 3.0 Apr 09

PI Name :	NASA Proposal Number
Organization Name :	
Proposal Title :	

SECTION X - Budget

Start Date :	End Date :	Budget Type :	Budget Period :

F. Other Direct Costs

	Funds Requested ($)
1. Materials and Supplies	0.00
2. Publication Costs	0.00
3. Consultant Services	0.00
4. ADP/Computer Services	0.00
5. Subawards/Consortium/Contractual Costs	0.00
6. Equipment or Facility Rental/User Fees	0.00
7. Alterations and Renovations	0.00
Total Other Direct Costs	0.00

G. Total Direct Costs

	Funds Requested ($)
Total Direct Costs (A+B+C+D+E+F)	0.00

H. Indirect Costs

	Indirect Cost Rate (%)	Indirect Cost Base ($)	Funds Requested ($)
Cognizant Federal Agency:		Total Indirect Costs	0.00

I. Direct and Indirect Costs

	Funds Requested ($)
Total Direct and Indirect Costs (G+H)	0.00

J. Fee

	Funds Requested ($)
Fee	0.00

K. Total Cost

	Funds Requested ($)
Total Cost with Fee (I+J)	0.00

FORM NRESS-300 Version 3.0 Apr 09

APPENDIX 3: EONS Policy on Late Proposals

NASA does not pre-approve the submission of late proposals. If a late proposal is submitted, it is NASA's sole decision whether to accept it. If NSPIRES is available for submissions, the site automatically captures the time the system received the proposal. Proposals submitted later than the stated time deadline on the due date of proposals are considered "LATE." The NSPIRES system may prevent the submission of proposals after the deadline.

NSPIRES generates an automatic acknowledgement when proposals are submitted. The acknowledgement for on time and late proposals is the same and will resemble the following:

Sample Acknowledgement of Submission

---Start Email---

From: nspires@nasaprs.com
Sent: <Name of the day of the Week>, Name of Month, Date, Year <Message Time Hour: Minute>
To: <email address of submitter> Cc: <email address of submitter>
Subject: NASA NSPIRES - Proposal has been submitted to NASA

The following proposal has been submitted for consideration of an award by NASA:
Proposal Number: xx-201?[EONS Appendix]-000X
Proposal Title: <Name as submitted by the AOR>
Submitting Organization: <Name that shows up in NSPIRES> Authorized Organization Representative: First and then Last NAME Principal Investigator: First then Last NAME Date submitted: Numeric Month/ Numeric Day /Numeric Year Hour:Minute:Second To log in to NSPIRES, click on this link: http://nspires.nasaprs.com/
If the above URL is not an active link, please cut and paste the entire URL into your web browser.

If you have questions or problems regarding this, or any other NSPIRES business, please contact the NSPIRES Help Desk:

> *E-mail: NSPIRES-HELP@nasaprs.com*
> *Phone Support: (202) 479-9376*
> *Hours: Monday through Friday, 8:00 AM to 6:00 PM EST/EDT*

This message is being sent from an outbound-only mail server. Please do not reply to this message.
---End Email---

If a proposer does not receive a notice similar to the sample above after proposal submission, first check spam filters and junk boxes. If unable to locate the email acknowledgement, then proposers shall contact the NSPIRES Help Desk or log in directly to NSPIRES to check a submission status.

Only the Selection Official or a designee may accept a late proposal for assignment to external review. If, for some known or unknown reason, an entity's proposal was not submitted by the proposal due date, the proposer shall send a detailed explanatory note via email to NASA's Support Contractor for this NOFO:

NASA Research & Education Support Services
2345 Crystal Drive, Suite 500
Arlington, VA 22202
202-479-9030
202-479-0511 (fax)
Email: help@nasaprs.com

Decisions about each proposal submitted—either on time or late—will be communicated electronically (not by phone or personalized email) to each PI and AOR via NSPIRES. While not the norm, it is possible a late proposer may not know whether its proposal was accepted for review until all proposers are notified approximately 3-6 months from the NOFO's proposal due date.

When decisions resulting from the evaluation process for proposals are made, a computer-generated email is sent requesting the PI/AOR to log in. It will resemble the following:

Sample Decision Notice Email

---Start Email--

From: nspires@nasaprs.com [mailto:nspires@nasaprs.com]
Sent: Name of Weekday, Month ??, 20?? H:Min PM/AM
To: NSPIRES-admin@nasaprs.com
Subject: NASA NSPIRES - Decision has been made.

A decision has been made by NASA for:
Solicitation Number: NNH???????? Solicitation Title: [EONS Appendix Reference]
Acronym: [EONS Appendix Reference] Proposal Due Date: 0?/??/20??
You may access information regarding this decision by logging in to NSPIRES:
http://nspires.nasaprs.com/

Decision information can be accessed in two ways:

After logging in, the Principal Investigator selects the "Proposals" link, the "Submitted Proposals/NOIs" link, and then clicks on the proposal submitted to the solicitation identified above. The document(s) provided by NASA will be displayed under the heading "PI Information Package" located at the bottom of the "View Proposal" page.

After logging in, the Authorized Organization Representative selects "Organization Mgmt" link and, from within the submitting organization, selects the "Organization Proposals" link, the "Submitted Proposals" link and then clicks on the proposal submitted to *the solicitation identified above. The document(s) provided by NASA will be displayed under the heading "PI Information Package" located at the bottom of the "View Proposal" page. If the above URL is not an active link, please cut and paste the entire URL into your web browser.*

If you have questions or problems regarding this, or any other NSPIRES business, please contact the NSPIRES Help Desk:
E-mail: nspires-help@nasaprs.com Phone Support: (202) 479-9376
Hours: Monday through Friday, 8:00 AM to 6:00 PM EST/EDT

This message is being sent from an outbound-only mail server. Please do not reply to this message.
--End of Email---

Proposers should be aware that neither NASA personnel nor the employees of the support contractor that receive and handle proposals for NASA have the authority to receive or accept a late proposal and, therefore, such proposers shall not request such permission. It is NASA's decision whether a late proposal will be accepted. Late proposals may be considered for review and possible selection only if they appear to offer a distinct benefit to NASA. In this regard, it is important to note that since almost every NOFO receives many more high-quality proposals than can be supported with the available funds, a NASA determination that a late proposal is of distinct benefit over its competitors is likely to be rare. Also, proposals or proposal modifications received after the latest date specified for receipt may be considered if a significant reduction in cost to the Government is probable or if there are significant technical advantages, as compared to proposals previously received.

Also see 48 FAR 1852.235-72 Instructions for Responding to NASA Research Announcements (July 2016).

Allowances for Technical Problems

In every NASA solicitation, proposers are advised that it is their responsibility to begin the proposal submission process early enough to account for any technical problems with computer systems and with the internet that may arise. If an emergency or unanticipated event interrupts normal Government processes so that proposals cannot be received at the Government office designated for receipt of proposals by the exact time specified in the solicitation, and urgent Government requirements preclude amendment of the solicitation closing date, the time specified for receipt of proposals will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which normal Government processes resume. For example, an unanticipated event includes an act of nature (e.g. hurricane or blizzard affecting NASA or a proposer's region) or an act of man (e.g. NSPIRES is offline). The proposer's failure to complete its proposal prior to the deadline, for whatever reason, does not constitute a technical problem. Also, the proposer's failure to meet a known delivery deadline does not constitute a technical problem. Other circumstances that may constitute a technical problem will be reviewed on a case-by-case basis. The NASA Selection Official may declare a proposal "on time" if NASA would have received the proposal before the proposal deadline in the absence of the technical problem; if the technical problem could not have been reasonably anticipated and was beyond the proposer's reasonable control; and if the proposer does not gain an unfair competitive advantage as a result of these circumstances.

NOTE: Any Changes or Revisions to a Proposal After the Due Date Make the Proposal Late. It is not possible for a proposal to be updated, particularly the substance of a proposal, without NASA considering such revisions/updates as a late proposal. If a proposer wants to provide new material, revise, clarify or change or expand a submitted proposal, such a substantial update is akin to submitting a new proposal after the proposal due date. Changes or updates to basic descriptive data (e.g., a PI has retired or the submitting organization has a new President) are not considered changes to the proposal's substance under the NOFO; however, such changes cannot be reflected in the proposal submission, nor can they be considered in the review of the proposal. If, during the time between the proposal due date and the award decision announcement, there have been changes to the AOR and PI, the proposer shall immediately notify the above-mentioned NSPIRES Support Contractor for this NOFO to confirm the proposing organization will still be able to access NSPIRES.

APPENDIX 4: Glossary of Acronyms and Definitions

ACRONYMS

AANAPISI	Asian American and Native American Pacific Islanders Serving Institution
ANNH	Alaska Native-Serving Institution or Native Hawaiian-Serving Institution
AM	Activity Manager
AOR	Authorized Organization Representative
APG	Annual Performance Goal
API	Annual Performance Indicator
ARC	Ames Research Center, Moffett Field, CA
AFRC	Armstrong Flight Research Center, Edwards, CA
ARMD	Aeronautics Research and Mission Directorate
CCE	Climate Change Education
CCR	Central Contractor Registry
CFR	Code of Federal Regulations
CO	Contracting Officer
CO-I	Co-Investigator
DMP	Data Management Plan
EIN	Employer Identification Number
EONS	Engagement Opportunities in NASA STEM
EPD	Educator Professional Development
EPSCOR	Established Program to Stimulate Competitive Research
ESDMD	Exploration Systems Development Mission Directorate
F&A	Facilities & Administration
FAQ	Frequently Asked Questions

FFRDC Federally Funded Research and Development Center

FY Fiscal Year (Federal) (October 1 – September 30)

GCAM *NASA Grant and Cooperative Agreement Manual*

GO Grant Officer

GRC Glenn Research Center, Cleveland, OH

GSFC Goddard Space Flight Center, Greenbelt, MD

HBCU Historically Black Colleges and Universities

HSI Hispanic-Serving Institution

IEI Informal Education Institution

JPL NASA Jet Propulsion Laboratory, Pasadena, CA

JSC Johnson Space Center, Houston, TX

KSC Kennedy Space Center, Cape Canaveral, FL

LaRC Langley Research Center, Hampton, VA

MAA MUREP Aerospace Academy

M-High Volume MUREP Aerospace High Volume Manufacturing Challenge

MAIANSE MUREP for American Indian and Alaskan Native STEM Engagement

MAIANSE CONNECT MAIANSE CONNECTing Indigenous Culture and Science Through Co-design of STEM Ecosystems

MCA MUREP Curriculum Awards

M-INCLUDES MUREP INCLUDES

MITTIC MUREP Innovation and Technology Transfer Idea Competition

MIRO MUREP Institutional Research Opportunity

M-STAR MUREP Space Technology Artemis Research

M-STTR MUREP Small Business Technology Transfer Research

MSIs Minority Serving Institutions (refers collectively to HBCUs, HSIs, TCUs, and other MSIs of higher education)

MSFC	Marshall Space Flight Center, Huntsville, AL
MUREP	Minority University Research and Education Project
MUREP PSI	MUREP Precollege Summer Institute
MUREP/SMD OCEAN	MUREP/Science Mission Directorate Research: Ocean Biology and Biogeochemistry
NASNTI	Native American-Serving Nontribal Institution
NCAS	NASA Community College Aerospace Scholars
NODIS	NASA Online Directives Information System
NOFO	Notice of Funding Opportunity
NOI	Notice of Intent
NIF	NASA Internships and Fellowships
NPD	NASA Policy Directive
NSF	National Science Foundation
NRESS	NASA Research and Education Support Services
NSPIRES	NASA Solicitation and Proposal Integrated Review and Evaluation System
NSSC	NASA Shared Services Center
NCTS	National Science and Technology Council
OSTEM	Office of STEM Engagement
PBI	Predominately Black Institution
PI	Principal Investigator
PL	Public Law
R&D	Research and Development
SE	STEM Engagement
SEA	STEM Education and Accountability
SMD	Science Mission Directorate

SOMD	Space Operations Mission Directorate
SRO	Sponsored Research Office
SSC	Stennis Space Center, Hancock County, MS
STEM	Science, Technology, Engineering, and Mathematics
STMD	Space Technology Mission Directorate
Space Grant	National Space Grant College and Fellowship Program
TCU	Tribal Colleges and Universities
TM	Technical Monitor
TO	Technical Officer

DEFINITIONS

American Indian or Alaskan Native: A person having origins in any of the original peoples of North and South America (including Central America) who maintains cultural identification through tribal affiliation or community attachment. (Source: IPEDS)

Asian: A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian Subcontinent, including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam. (Source: IPEDS)

Black or African American: A person having origins in any of the black racial groups of Africa. (Source: IPEDS)

Co-Investigator (Co-I): A Co-I is a member of the proposal's investigation team who may hold either a full-time or limited-term appointment and who is a critical "partner" for the conduct of the investigation through the contribution of unique expertise and/or capabilities. A Co-I shall have a well-defined and generally sustained and continuing role in the proposed investigation, serve under the direction of the PI, and may or may not receive funding through the award. Only an individual who has formally agreed to the role may participate as a Co-I even if his/her participation is at no cost (i.e., contributed) to the proposal.

Collaborator: A Collaborator is an individual who is less critical to the proposal than a Co-I but who is committed to provide a focused but unfunded contribution for a specific task. If funding support is requested in the proposal, such a person shall be identified in one of the other categories above.

Cooperative Agreement: An award of federal assistance used to carry out a public purpose of support or stimulation authorized by a law. A cooperative agreement is similar to a grant with the exception that NASA and the award recipient are each expected to be substantially involved with one another for the performance of the project. Cooperative agreements are managed pursuant to the policies set forth in 2 CFR §200, 2 CFR §1800, and the *NASA Grant and Cooperative Agreement Manual*.

EPD: Educator Professional Development uses NASA's missions, education resources, and unique facilities to provide high-quality STEM content and hands-on learning experiences to in-service, pre-service, and informal educators.

Executive Orders: Presidential Directives are considered a form of executive order issued by the President of the United States with the advice and consent of a major agency or department found within the Executive branch of the Government.

Hispanic or Latino: A person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin, regardless of race. (Source: IPEDS)

Independent Evaluator: The Independent Evaluator is a third party or a current employee of the awardee organization who is independent from the policy, operations, and management functions of the program element requiring evaluation. It is expected that the Independent Evaluator both works collaboratively with the Principal Investigator and retains independent objectivity in collecting and presenting evidence of effectiveness, impact on participants, proposed program outcomes, and progress toward achieving goals and objectives.

IE: Institutional Engagement increases the STEM capabilities at formal and informal educational institutions and organizations by incorporating content based on NASA's missions.

Jurisdiction: States or commonwealths eligible to submit proposals in response to this NOFO.

NASA Mission Directorates: There are four NASA Mission Directorates: Aeronautics Research (ARMD), Exploration Systems Development (ESDMD), Space Operations (SOMD), Space Technology (STMD), and Science (SMD).

NASA's Unique Facilities: There is an Office of STEM Engagement (OSTEM) at each of the following NASA facilities: Ames Research Center (ARC), Armstrong Flight Research Center (AFRC), Glenn Research Center (GRC), Goddard Space Flight Center (GFRC), Jet Propulsion Laboratory ("JPL Education Office"), Johnson Space Center (JSC), Kennedy Space Center (KSC), Langley Research Center (LaRC), Marshall Space Flight Center (MSFC), Stennis Space Center (SSC).

Native Hawaiian or Other Pacific Islander: A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands. (Source: IPEDS)

NIF: NASA Internships and Fellowships leverage NASA's unique missions and programs to enhance and increase the capability, diversity, and size of the Nation's future STEM workforce.

OMB: The Office of Management and Budget is the largest office within the Executive Office of the President of the United States. The main function of the OMB is to assist the President in preparing the budget and policy development and execution.

Partnership: A reciprocal and voluntary relationship between the project personnel and NASA, industry, or other partners, to cooperatively achieve the goals of the proposed research.

Principal Investigator (PI): The Principal Investigator is (are) the individual(s) a research organization designates as having an appropriate level of authority and responsibility for the proper conduct of the research, including the appropriate use of funds and administrative requirements such as the submission of scientific progress reports to the agency.

SE: STEM Engagement activities are designed to provide opportunities for participatory and experiential learning activities that connect learners to NASA-unique resources. The STEM Engagement line of business consists of Public Education Activities, Experiential Learning Opportunities and STEM Challenges

Targeted Disabled: A person having a physical or mental impairment that substantially limits one or more major life activities; who has a record of such impairment or who is regarded as having such impairment. (See the LEAD (Leadership for the Employment of Americans with Disabilities) pages at the U.S. Equal Employment Opportunity Commission.)

Technology Transferred for Commercialization: the development of dual use technologies that meet both NASA's mission needs and other national objectives.

Underrepresented: Populations that are not present in the STEM professions relative to the size of the population at large. Refers to racial and ethnic populations as well as women and persons with disabilities.

Underrepresented Minority: Refers to persons from racial and ethnic groups whose enrollment in STEM education or participation in STEM professions is much smaller than that group's representation in the general population. African Americans, Hispanics/Latinos, and Native Americans and Pacific Islanders currently fit this definition.

Underserved: Often used interchangeably with "underrepresented," particularly as it relates to the sciences and engineering. Specifically, it is used to promote access and opportunity to 23 persons of diverse backgrounds—racial, ethnic, gender, religious, age, sexual orientation, disabled, and other populations with limited access—to decent and affordable housing, gainful employment, and other services. In the STEM arena, "underserved" has typically referred to women and persons with disabilities.

White: A person having origins in any of the original peoples of Europe, the Middle East, or North Africa. (Source: IPEDS)

APPENDIX 5: Best Practices in Performance Assessment and Evaluation

NASA is enhancing the effectiveness of STEM engagement investments using performance assessment and evaluation-driven processes including the development and execution of a comprehensive performance assessment and evaluation strategy, Annual Performance Plan (APP) and a Learning Agenda. The Annual Performance Plan defines NASA Office of STEM Engagement (OSTEM) performance goals and success criteria in alignment with NASA's 2022 Strategic Plan. The NASA STEM Engagement Learning Agenda puts forth Learning Questions with associated sub-questions, Learning Activities and assessment methodologies, and Learning Products that will inform the NASA Office of STEM Engagement's understanding of the scope, methods, mechanisms, and impacts of its investments. The answers to these questions will enable the Office to prioritize and narrow the focus of STEM engagement investment areas by making evidence-based budgetary, programmatic, and operational decisions. Annually, a body of evidence (i.e., milestone accomplishments, performance and participation data, evaluation outcomes, and/or other metrics) was generated to assess progress of STEM engagement investments in achieving APP performance goals and success criteria and to assess outcomes.

Below are examples of federal and professional standards of evaluation practice and common guidelines for education research and development:

- Home for Federal Program Evaluation - Evaluation.gov
- The Office of Management and Budget (OMB) Memorandum M-21-27, "Evidence-Based Policymaking: Learning Agendas and Annual Evaluation Plans"
- The Office of Management and Budget (OMB) Memorandum M-20-12, "Phase 4 Implementation of the Foundations for Evidence-Based Policymaking Act of 2018: Program Evaluation Standards and Practices"
- The Office of Management and Budget (OMB) Memorandum M-19-23, "Phase 1 Implementation of the Foundations for Evidence-Based Policymaking Act of 2018: Learning Agendas, Personnel, and Planning Guidance"
- Federal Strategy for STEM Education and Engagement Charting a Course for Success: America's Strategy for STEM Education
- 2018 NASA Strategic Plan
- NASA Strategy for STEM Engagement
- Program Evaluation Standards developed by the Joint Committee on Standards Educational Evaluation[1]
- "Common Guidelines for Education Research and Development" http://ies.ed.gov/pdf/CommonGuidelines.pdf
- "Designing Evaluations" http://www.gao.gov/products/GAO-12-208G

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[1] Yarbrough, D. B., Shulha, L. M., Hopson, R. K., and Caruthers, F. A. (2011), The Program Evaluation Standards: A Guide for Evaluators and Evaluation Users (3rd ed.). Thousand Oaks, CA: Sage.

- What Works Clearinghouse[2]

APPENDIX 6: Restrictions on The Use of The NASA Seal, Insignia, Logotype, Program Identifiers, or Flags (DEC 2014)

(a) In accordance with 14 CFR §1221, the NASA Seal, NASA Insignia, NASA Logotype, NASA Program Identifiers, and the NASA Flags are protected and shall be used exclusively to represent NASA, its programs, projects, functions, activities, or elements.

(b) The use of these devices by recipients shall be governed by the requirements and restrictions set forth at 14 CFR §§ 1221.109-113. Requests for the use of these devices by recipients shall be subject to the prior written approval of the NASA Grant Officer in conjunction with the NASA Headquarters, Office of Communications.

(c) The use of these devices by recipients for any purpose other than as authorized by NASA regulations shall be prohibited. Their misuse shall be subject to the penalties authorized by statute, as set forth in 14 CFR §1221.115 and shall be reported as provided in 14 CFR §1221.116.

[2] U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, What Works Clearinghouse.

APPENDIX 7 – Examples of Costs Categories from 2 CFR 200 Subpart E

1. Direct Labor (salaries, wages, and fringe benefits): List number and titles of personnel, amounts of time to be devoted to the grant, and rates of pay.

2. Other Direct Costs:

   a. Subcontracts: Describe the work to be subcontracted, estimated amount, recipient (if known), and the reason for subcontracting.

   b. Consultants: Identify consultants to be used, why they are necessary, the time they will spend on the project, and rates of pay.

   c. Equipment: List separately. Explain the need for items costing more than $5,000 unless your institution has established a lower threshold for classifying such purchases as equipment. Describe the basis for the estimated cost. General-purpose equipment is not allowable as a direct cost unless specifically approved by the grant officer. Grant award constitutes approval for any equipment provided and requested in the original proposal. Requests by grant recipients for the acquisition of equipment shall be supported by written documentation setting forth the description, purpose, and acquisition value of the equipment.

   d. Supplies: For items below the threshold established for equipment, provide the general categories of needed supplies, the method of acquisition, and the estimated cost.

   e. Travel: Describe the purpose of the proposed travel in relation to the grant and provide the basis of the estimate, including information on destination and number of travelers where known.

   f. Other: Identify and support all other direct costs not covered by 2a through 2e. Provide an itemized list explaining the need for each item and the basis for the estimate.

3. Facilities and Administrative (F&A) Costs: Identify F&A cost rate(s) and base(s) as approved by the cognizant Federal agency, including the effective period of the rate. Provide the name, address, and telephone number of the Federal agency official having cognizance. If unapproved rates are used, explain why, and include the computational basis for the F&A expense pool and corresponding allocation base for each rate.

4. Other Applicable Costs: Provide description, detail, and necessity for each item.

5. <u>Subtotal-Estimated Costs</u>: Provide the sum of items 1 through 4.

6. <u>Less Proposed Cost Sharing (if any)</u>: Provide the amount proposed. If cost-sharing is based on specific cost items, identify each item and amount in an attachment.

7. <u>Carryover Funds (if any)</u>: Provide the dollar amount of any funds that are expected to be available for carryover from the prior budget period. Identify how the funds will be used if they are not used to reduce the budget. NASA officials will decide whether to use all or part of the anticipated carryover to reduce the budget. Not applicable to 2nd-year and subsequent-year budgets submitted for the award of a multiple-year grant.

8. <u>Total Estimated Costs</u>: Provide the total after subtracting items 6 and 7 from item 5.

APPENDIX 8: NASA Mission Directorates and Center Alignment with Points of Contact

NASA's Mission to drive advances in science, technology, aeronautics, and space exploration to enhance knowledge, education, innovation, economic vitality, and stewardship of Earth, draws support from four Mission Directorates, nine NASA Centers, and JPL, each with a specific responsibility and research requirements.

8.1 Aeronautics Research Mission Directorate (ARMD)

Aeronautics Research Mission Directorate (ARMD) conducts high-quality, cutting-edge research and flight tests that generate innovative concepts, tools, and technologies to enable revolutionary advances in our Nation's future aircraft, as well as in the airspace in which they will fly.

NASA Aeronautics is partnering with industry and academia to accomplish the aviation community's aggressive carbon reduction goals. Through collective work in three areas -- advanced vehicle technologies, efficient airline operations and sustainable aviation fuels – NASA is committed to supporting the U.S. climate goal of achieving net-zero greenhouse gas emissions from the aviation sector by 2050.

ARMD's current major missions include:

- Sustainable Aviation
- High Speed Commercial Flight
- Advanced Air Mobility
- Future Airspace
- Transformative Tools

Additional information on the Aeronautics Research Mission Directorate (ARMD) can be found at: https://www.nasa.gov/aeroresearch and in ARMD's Strategic Implementation plan that can be found at: https://www.nasa.gov/aeroresearch/strategy.

Areas of Interest - POC: Dave Berger, dave.e.berger@nasa.gov

Proposers are directed to the following:

- ARMD Programs: https://www.nasa.gov/directorates/armd/
- The ARMD current year version of the NASA Research Announcement (NRA) entitled, "Research Opportunities in Aeronautics (ROA)" is posted on the NSPIRES web site at http://nspires.nasaprs.com (*Key word:* Aeronautics). This solicitation provides a complete range of ARMD research interests.

8.2 Space Operations Mission Directorate (SOMD)

https://www.nasa.gov/directorates/space-operations-mission-directorate

POC: Marc Timm, marc.g.timm@nasa.gov

Warren Ruemmele, warren.p.ruemmele@nasa.gov

Commercial Space Capabilities (CSC)

The SOMD Commercial Space Division (CSD)'s Commercial Crew and Commercial Low Earth Orbit (LEO) Development Programs encompass Crew and Cargo Transportation to and from, and in-space Destinations and operations in, LEO. The purpose of this CSC focus area is to harness the capabilities of the U.S. research community to mature theoretical concepts that are of interest to U.S. commercial spaceflight companies into initial practice. The goal is that such companies can then apply and further evolve that initial practice to improve state-of-art of current capabilities, or to create new capabilities to benefit the growth of a robust near Earth orbit US economy. Such advances might also have eventual benefits to commercial operations on Moon or even Mars.

U.S. commercial spaceflight industry interests vary by company and change over time, so Researchers are encouraged to directly engage with industry to determine relevant interests. Before submitting proposals in this area, the Proposer is encouraged to contact the NASA CSC POCs to discuss the intended proposal. Some current high-level interests include:

- Low consumable environmental control and life support (ECLS), crew hygiene, and/or clothes washing. (Closed loop or nearly so. Includes waste product repurposing.)
- Small cargo return, Destination resupply systems, and related technologies
- In-Space Welding
- Materials and Processes Improvements for Chemical Propulsion State of Art
- Materials and Processes Improvements for Electric Propulsion State of Art
- Improvements to Space Solar Power State of Art (SoA)
- Other topics in this area that have demonstrable need and support from a U.S. company(ies)

8.3 Exploration Systems Development Mission Directorate (ESDMD)

https://www.nasa.gov/directorates/exploration-systems-development

POC: Matt Simon, matthew.a.simon@nasa.gov

The Exploration Systems Development Mission Directorate (ESDMD) provides the Agency with leadership and management of NASA space operations related to human exploration in and beyond low-Earth orbit. Through the Artemis missions, NASA will land the first woman and first person of color on the Moon, using innovative technologies to explore more of the lunar surface than ever before. NASA is collaborating with commercial and international partners to establish the first long-term human-robotic presence on and around the Moon. Then, we will use what we learn on and at the Moon to take the next giant leap: sending the first astronauts to Mars.

The Exploration Systems Development Mission Directorate (ESDMD) defines and manages systems development for programs critical to the NASA's Artemis program and planning for NASA's Moon to Mars exploration approach in an integrated manner. ESDMD manages the human exploration system development for lunar orbital, lunar surface, and Mars exploration. ESDMD leads the human aspects of the Artemis activities as well as the integration of science into the human system elements. ESDMD is responsible for development of the lunar and Mars architectures. Programs in the mission directorate include Orion, Space Launch System, Exploration Ground Systems, Gateway, Human Landing System, and Extravehicular Activity (xEVA) and Human Surface Mobility. Additional information about the Exploration Systems Development Mission Directorate can be found at:
https://www.nasa.gov/directorates/exploration-systems-development.

Engineering Research

- Spacecraft: Guidance, navigation, and control; thermal; electrical; structures; software; avionics; displays; high speed re-entry; modeling; power systems; interoperability/ commonality; advanced spacecraft materials; crew/vehicle health monitoring; life support.
- Propulsion: Propulsion methods that will utilize materials found on the moon or Mars, "green" propellants, on-orbit propellant storage, motors, testing, fuels, manufacturing, soft landing, throttle-able propellants, high performance, and descent.
- Robotic Systems for Lunar Precursor Missions: Precision landing and hazard avoidance hardware and software; high-bandwidth communication; in-situ resource utilization (ISRU) and prospecting; navigation systems; robotics (specifically environmental scouting prior to human arrival, and to assist astronaut with surface exploration); environmental analysis, radiation protection; small payloads to accomplish science and research objectives, as well as for risk reduction for human-rated systems.
- Data and Visualization Systems for Exploration: Area focus on turning precursor mission data into meaningful engineering knowledge for system design and mission planning of lunar and Mars surfaces; visualization and data display; interactive data manipulation and sharing; modeling of lighting and thermal environments; simulation of environmental interactions for pressurized and unpressurized vehicles.
- Research and technology development areas in ESDMD support exploration systems development including in-space vehicles, space communications, commercial space, and the International Space Station. Examples of research and technology development areas (and the associated lead NASA Center) with great potential include:
- Research and technology development areas in ESDMD support exploration systems development including in-space vehicles, space communications, commercial space, and the International Space Station. Examples of research and technology development areas (and the associated lead NASA Center) with great potential include:
  - Processing *and Operations*
    - Crew Health and Safety Including Medical Operations, Johnson Space Center (JSC)

    - Non-invasive diagnostic aides that work in a communication delay setting (JSC)
    - In-helmet Speech Audio Systems and Technologies (JSC)
    - Vehicle Integration and Ground Processing, Kennedy Space Center (KSC)
    - Mission Operations (JSC)
    - Portable Life Support Systems (JSC)
    - Pressure Garments and Gloves (JSC)
    - Air Revitalization Technologies (ARC)
    - In-Space Waste Processing Technologies (JSC)
    - Cryogenic Fluids Management Systems (MSFC)
  - *Space Communications and Navigation*
    - Coding, Modulation, and Compression, Goddard Spaceflight Center (GSFC)
    - Precision Spacecraft & Lunar/Planetary Surface Navigation and Tracking (GSFC)
    - Communication for Space-Based Range (GSFC)
    - Antenna Technology, Glenn Research Center (GRC)
    - Reconfigurable/Reprogrammable Communication Systems (GRC)
    - Miniaturized Digital EVA Radio (JSC)
    - Transformational Communications Technology (GRC)
    - Long Range Optical Telecommunications, Jet Propulsion Laboratory (JPL)
    - Long Range Space RF Telecommunications (JPL)
    - Surface Networks and Orbit Access Links (GRC)
    - Software for Space Communications Infrastructure Operations (JPL)
    - TDRS transponders for launch vehicle applications that support space communication and launch services (GRC)
  - *Space Transportation*
    - Optical Tracking and Image Analysis (KSC and GSFC)
    - Space Transportation Propulsion System and Test Facility Requirements and Instrumentation (Stennis Space Center (SSC)
    - Automated Collection and Transfer of Launch Range Surveillance/Intrusion Data (KSC)
    - Technology tools to assess secondary payload capability with launch vehicles (KSC)
    - Spacecraft Charging/Plasma Interactions (Environment definition & arcing mitigation), Marshall Space Flight Center (MSFC)
  - *Commercial Space Capabilities*
    - The goal of this area is to support research, development, and commercial adoption of technologies of interest to the U.S. spaceflight industry to further their space-related capabilities. (KSC)
    - These include capabilities for Moon, Mars, and Earth orbit. Such efforts are in pursuit of the goals of the National Space Policy and NASA’s strategic plans, to foster developments that will lead to education and job growth in science and engineering, and spur economic growth as capabilities for new space markets are created. (KSC)

- U.S. commercial spaceflight industry interests naturally vary by company. Proposers are encouraged to determine what those interests are by engagement with such companies in various ways, and such interests may also be reflected in the efforts of various NASA partnerships. (KSC)
- Proposals should discuss how the effort aligns with U.S. commercial spaceflight company interest(s) and identify potential alignments with NASA interests. (KSC)

8.4 Human Research Program

Space Operations Mission Directorate (SOMD)

https://www.nasa.gov/directorates/space-operations-mission-directorate

The Human Research Program (HRP) is focused on investigating and mitigating the highest risks to human health and performance to enable safe, reliable, and productive human space exploration. The HRP budget enables NASA to resolve health risks for humans to safely live and work on missions in the inner solar system. HRP conducts research, develops countermeasures, and undertakes technology development to address human health risks in space and ensure compliance with NASA's health, medical, human performance, and environmental standards.

8.4.1 Office of Chief Health and Medical Officer (OCHMO)

POC: Dr. Victor Schneider, vschneider@nasa.gov P: (202) 258-3645

Dr. James D. Polk, james.d.polk@nasa.gov P: (202) 358-1959

Areas of Research Interest:

- Development and elaboration of Functional aids and testing paradigms to measure activity for use by parastronauts during spaceflight. This may include egressing and exiting space capsules and donning and doffing spacesuits and other aids for parastronauts. The European Space Agency is establishing a parastronaut feasibility project. Since NASA offers its international partners access to NASA supported spacecraft and the International Space Station, NASA wants to establish appropriate functional testing measures to determine the time it takes fit astronaut-like subjects compared to fit parastronaut subjects to egress and exit simulated space capsules and simulated donning and doffing spacesuit. Research proposals are sought to establish appropriate functional testing.

- Evaluation space capsule and spacesuit activity in stable and fit lower or upper extremity amputees and compare their responses to non-amputee fit individuals. The European Space Agency is establishing a parastronaut feasibility project. Since NASA offers its international partners access to NASA supported spacecraft and the International Space Station, NASA wants to obtain research data measuring the time it takes fit astronaut-like subjects compared to fit parastronaut subject to egress and exit simulated space capsules and simulated donning and doffing spacesuit. Research proposals are sought to obtain data measuring the functional testing indicated

8.4.2 Human Research Program/Space Radiation Element

POC: Dr. Robin Elgart, shona.elgart@nasa.gov, P: (281) 244-0596

Research Overview:

Space radiation exposure is one of numerous hazards astronauts encounter during spaceflight that impact human health. High priority health outcomes associated with space radiation exposure are carcinogenesis, cardiovascular disease (CVD), and central nervous sytem (CNS) changes that impact astronaut health and performance.

Areas of Research Interest:

1. Research proposals are sought to **accelerate risk characterization for high priority radiation health risks and inform mitigation strategies the NASA Human Research Program (HRP) Space Radiation Element (SRE) by sharing animal tissue samples and data.** The proposed work should focus is on translational studies that support priority risk characterization (cancer, CVD, CNS), development of relative biological effectiveness (RBE) values, identification of actionable biomarkers, and evaluation of dose thresholds for relevant radiation-associated disease endpoints. Cross-species comparative analyses of rodent data/samples with higher order species (including human archival data and tissue banks) are highly encouraged.
    - Data can include but is not limited to behavioral tasks, tumor data, physiological measurements, imaging, omics', etc. that has already been, or is in the process of being, collected.
    - Tissue samples can include, but are not limited to, samples that have already been, or are in the process of, being collected and stored as well as tissues from other external archived banks (e.g., http://janus.northwestern.edu/janus2/index.php).
    - Relevant tissue samples and data from other externally funded (e.g., non-NASA) programs and tissue repositories/archives for comparison with high linear energy transfer (LET), medical proton, neutron and other exposures can be proposed.
    - A more detailed list of samples and tissues available from SRE can be found at our tissue sharing websites:
        - https://lsda.jsc.nasa.gov/Document/doc_detail/Doc13726
        - https://lsda.jsc.nasa.gov/Document/doc_detail/Doc13766
        - https://lsda.jsc.nasa.gov/Biospecimen by searching "NASA Space Radiation Laboratory (NSRL)" in the payloads field.
        - Instructions for accessing the tissue sharing information are posted at: https://spaceradiation.jsc.nasa.gov/tissue-sharing/.

2. Research proposals are sought to define the mechanisms underlying sexual dimorphism following exposure to space radiation. Research should focus on translational biomarkers relevant to changes in cognitive and/or behavioral performance, cardiovascular function,

and the development of carcinogenesis **in non-sex-specific organs**. Due to limited time and budget, researchers are encouraged to utilize radiation sources located at home institutions at space relevant doses (0-5 Gy of photons or proton irradiation). A successful proposal will not necessitate the use of the NASA Space Radiation Laboratory (NSRL) at Brookhaven National Laboratory at this phase. Collaborations between investigators and institutions for the sharing of data and tissue samples are highly encouraged. Samples available for use by SRE, can be found at https://lsda.jsc.nasa.gov/Biospecimen by searching "NASA Space Radiation Laboratory (NSRL)" in the payloads field (SRE approval required). Instructions for accessing the tissue sharing information are posted at: https://spaceradiation.jsc.nasa.gov/tissue-sharing/. Other topics include:

- Individual sensitivity
- Early disease detection (Cancer, CVD, neurological/behavioral conditions)
- Biomarker identification
- High-throughput countermeasure screening
- Sex-specific risk assessment
- Radiation quality and/or dose-rate effects

3. Research proposals are sought to establish screening techniques for compound-based countermeasures to assess their efficacy in modulating biological responses to radiation exposure relevant to the high priority health risks of cancer, CVD, and/or CNS. Techniques that can be translated into high-throughput screening protocols are highly desired, however high-content protocols will also be considered responsive.

4. Research proposals are sought to evaluate the role of the inflammasome in the pathogenesis of radiation-associated CVD, carcinogenesis, and/or central nervous system changes that impact behavioral and cognitive function. Although innate inflammatory immune responses are necessary for survival from infections and injury, dysregulated and persistent inflammation is thought to contribute to the pathogenesis of various acute and chronic conditions in humans, including CVD. A main contributor to the development of inflammatory diseases involves activation of inflammasomes. Recently, inflammasome activation has been increasingly linked to an increased risk and greater severity of CVD. Characterization of the role of inflammasome-mediated pathogenesis of disease after space-like chronic radiation exposure can provide evidence to better quantify space radiation risks as well as identify high value for countermeasure development.

8.4.3 Human Research Program/ Exploration Medical Capability (ExMC) Element

POC: Moriah Thompson: moriah.s.thompson@nasa.gov P: (713) 437-2500

Title: Non-Invasive Behavioral Health Diagnostic Capabilities for Mars

Description: Missions to Mars will involve increased stressors such as isolation, confinement, interpersonal issues, etc. The risk of behavioral health issues increases with such missions. Current behavioral health diagnostic and treatment techniques rely on real-time communication. Non-invasive diagnostic aides that work in a communication delay setting are needed to improve behavioral health support for exploration missions to Mars.

8.5 Science Mission Directorate (SMD)

SMD POC: Lin Chambers lin.h.chambers@nasa.gov

Science Mission Directorate (SMD) leads the Agency in five areas of research: Biological and Physical Sciences (BPS), Heliophysics, Earth Science, Planetary Science, and Astrophysics. SMD, using the vantage point of space to achieve with the science community and our partners a deep scientific understanding of our planet, other planets and solar system bodies, the interplanetary environment, the Sun and its effects on the solar system, and the universe beyond. In so doing, we lay the intellectual foundation for the robotic and human expeditions of the future while meeting today's needs for scientific information to address national concerns, such as climate change and space weather. SMD's high-level strategic objectives are presented in the 2022 NASA Strategic Plan. Detailed plans by science area corresponding to the science divisions of SMD: Heliophysics, Earth Science, Planetary Science, Biological and Physical Science, and Astrophysics appear in *SCIENCE 2020-2024: A Vision for Scientific Excellence Updated*", which is available at http://science.nasa.gov/about-us/science-strategy/. The best expression of specific research topics of interest to each Division within SMD are represented in by the topics listed in SMD's "ROSES" research solicitation, see ROSES 2023 and the text in the Division research overviews of ROSES. By perusing the tables of contents from this year at https://solicitation.nasaprs.com/ROSES2023table3 and last year at https://solicitation.nasaprs.com/ROSES2022table3, proposers can view all of the topics that are of interest, even if a given topic is not solicited in any given year.

Additional information about the SMD may be found at: https://science.nasa.gov/

8.5.1 Biological and Physical Sciences (BPS)

POC: Douglas Gruendel Douglas.J.Gruendel@nasa.gov

Dr. Francis Chiaramonte francis.p.chiaramonte@nasa.gov

The mission of BPS is two-pronged:

- Pioneer scientific discovery in and beyond low Earth orbit to drive advances in science, technology, and enhance knowledge, education, innovation, and economic vitality
- Enable human spaceflight exploration to expand the frontiers of knowledge, capability, and opportunity in space

Execution of this mission requires both scientific research and technology development.

BPS administers NASA's:

- Space Biology Program, which solicits and conducts research to use the space environment to advance our knowledge of how gravity affects the design and function of

living organisms, and to understand how biological systems accommodate to spaceflight environments
- Physical Sciences Program, which solicits and conducts research using the space environment as a tool to provide transformational insights in physics and engineering science, and to understand how physical systems respond to spaceflight environments, particularly weightlessness and the partial gravity of planetary bodies
- Commercially Enabled Rapid Space Science project (CERISS), which will develop transformative research capabilities with commercial space industry to dramatically increase the pace of research

BPS partners with the research community and a wide range of organizations to accomplish its mission. Grants to academic, commercial and government laboratories are the core of BPS's research and technology development efforts.

Additional information on BPS can be found at: https://science.nasa.gov/biological-physical

Space Biology Program

The Space Biology Program within NASA's Biological and Physical Sciences Division focuses on pioneering scientific discovery and enabling human spaceflight exploration. Research in space biology has the following goals:

- To understand how radiation, altered gravity, and the other characteristics of the space environment alter fundamental biological processes;
- To develop the scientific and technological foundations for a safe, productive human presence in space for extended periods and in preparation for exploration; and
- To apply this knowledge and technology to improve our nation's competitiveness, education, and the quality of life on Earth.

Research proposals for this opportunity are being solicited on the following topic:

- Mammalian Biology – biological and physiological responses of rodents to ionizing radiation and other spaceflight-relevant stressors such as altered gravity (*i.e.,* through hindlimb unloading or partial weightbearing, etc.).
    - Proposals must be for ground-based studies.
    - All proposals for rodent studies must address the five points outlined in the Vertebrate Animal and Higher Order Cephalopod Section (VACS) instructional document which can be found here. This response should be included as part of the research plan and should be limited to two pages. A sample VACS is provided in the VACS instructional document posted on NSPIRES alongside this document
    - Ionizing radiation and altered gravity regimes (partial gravity and microgravity) are a hallmark of the deep space environment. These stressors may cause direct physiological changes in the organisms or result in indirect effects such as loss of sleep in some organisms. Studies shall effectively delineate the biological effects of these factors, separately and/or in combination where possible.

- The proposed use of other spaceflight stressors, including altered atmospheric pressures, altered levels of CO2, altered light spectra/durations, etc., in lieu of altered gravity is acceptable, however, all proposed studies must include the use of ionizing radiation as the primary stressor.
- While all rodent studies involving radiation in combination with another spaceflight stressors will be considered responsive to this topic, Space Biology is particularly interested in studies that utilize rats as the model system to be investigated.
- Proposed investigators should focus on understanding the mechanistic bases of the changes induced by these stressor, preferably from a systems biology perspective, and could include genetic, cellular, or molecular biological effects. Further information for the Space Biology program are available at https://science.nasa.gov/biological-physical/programs/space-biology, and at https://science.nasa.gov/biological-physical/documents.
- Investigators are encouraged to propose experiments that use the radiation facilities at the NASA Space Radiation Laboratory (NSRL) located at the Brookhaven National Lab, however Space Biology cannot not directly pay the cost of their use. Proposers planning to use these facilities must contact NSRL (https://www.bnl.gov/nsrl/) for cost estimates and necessary logistical information and must appropriately account for the cost of beam-time and facility use in their budget

If a Space Biology research topic is proposed, other than Mammalian Biology research noted above, please reach out to the Space Biology POC listed above at spacebiology@nasaprs.com to discuss proposed research for consideration.

Investigators receiving awards from this opportunity for a proposal submitted to a Space Biology Focus Area will be required to upload all relevant data produced by their funded project in the GeneLab Data Systems (https://genelab.nasa.gov). They must also make the source code of any computational simulations developed via awards under this proposal available in an open source repository. Furthermore, articles published in peer-reviewed scholarly journals and papers published in peer-reviewed conference proceedings, should be made publicly accessible via NASA's PubSpace website (Submit to PubSpace - Scientific and Technical Information Program (nasa.gov)). Proposers submitting application that are responsive to this focus are will therefore be expected to address these requirements in their proposal's data management plan.

Further information for the Space Biology program is available at:

https://science.nasa.gov/biological-physical/programs/space-biology

https://science.nasa.gov/biological-physical/documents

Physical Science Program

The Physical Science Research Program conducts fundamental and applied research to advance scientific knowledge, to improve space systems, and to advance technologies that may produce new products offering benefits on Earth. Space offers unique advantages for experimental research in the physical sciences. NASA supports research that uses the space environment to make significant scientific advances. Many of NASA's experiments in the physical sciences reveal how physical systems respond to the near absence of gravity. Forces that on Earth are small compared to gravity can dominate system behavior in space. Understanding the consequences is a critical aspect of space system design. Research in physical sciences includes both basic and applied research in the areas of combustion science, fluid physics, materials science, soft matter physics and fundamental physics.

Combustion Science

The goal of the microgravity combustion science research program is to advance understanding of combustion processes, leading to added benefits to human health, comfort, and safety on both Earth and during crewed exploration missions. NASA's microgravity combustion science research focuses on effects that can be studied in the absence of buoyancy-driven flows caused by Earth's gravity. Research conducted without the interference of buoyant flows can lead to an improvement in combustion efficiency, producing a considerable economic and environmental impact. Combustion science is also relevant to a range of challenges for long-term human exploration of space that involve reacting systems in reduced and micro gravity. These challenges include: spacecraft fire prevention; fire detection and suppression; thermal processing of regolith for oxygen and water production; thermal processing of the Martian atmosphere for fuel and oxidizer production; and processing of waste and other organic matter for stabilization and recovery of water, oxygen and carbon. Substantial progress in any of these areas will be accelerated significantly by an active reduced- gravity combustion research program.

The research area of combustion science includes the following themes:

Spacecraft fire safety
Droplets
Gaseous – premixed and non-premixed
High pressure – transcritical combustion and supercritical reacting fluids

Fluid Physics

The goal of the microgravity fluid physics program is to understand fluid behavior of physical systems in space, providing a foundation for predicting, controlling, and improving a vast range of technological processes. Specifically, in reduced gravity, the absence of buoyancy and the stronger influence of capillary forces can have a dramatic effect on fluid behavior. For example, capillary flows in space can pump fluids to higher levels than those achieved on Earth. In the case of systems where phase-change heat transfer is required, experimental results demonstrate that bubbles will not rise under pool boiling conditions in microgravity, resulting in a change in the heat transfer rate at the heater surface. The microgravity experimental data can be used to verify computational fluid dynamics models. These improved models can then be utilized by future spacecraft designers to predict the performance of fluid conditions in space exploration systems such as air revitalization, solid waste management, water recovery, thermal control, cryogenic storage and transfer, energy conversion systems, and liquid propulsion systems.

The research area of fluid physics includes the following themes:

Adiabatic two-phase flow
Boiling and condensation
Capillary flow
Interfacial phenomena
Cryogenic propellant storage and transfer

Materials Science

The goal of the microgravity materials science program is to improve the understanding of materials properties that will enable the development of higher-performing materials and processes for use both in space and on Earth. The program takes advantage of the unique features of the microgravity environment, where gravity-driven phenomena, such as sedimentation and thermosolutal convection, are nearly negligible. On Earth, natural convection leads to dendrite deformation and clustering, whereas in microgravity, in the absence of buoyant flow, the dendritic structure is nearly uniform. Major types of research that can be investigated include solidification effects and the resulting morphology, as well as accurate and precise measurement of thermophysical property data. These data can be used to develop computational models. The ability to predict microstructures accurately is a promising computational tool for advancing materials science and manufacturing.

The research area of materials science includes the following themes:

Glasses and ceramics
Granular materials
Metals
Polymers and organics
Semiconductors

Soft Matter Physics

Granular material is one of the key focus areas of research areas in the field of soft matter. The fundamental understanding of physics of granular materials under different gravity condition is of key importance for deep space exploration and long-term habitation to sample collection from asteroids to improving the understanding of granular material handling on earth. Also, fundamental understanding of granular materials can help us understand motions in large bodies on earth (e.g.- landslides) that can help us save lives in case of natural emergencies. This research topic focuses on developing fundamental knowledge base in the field of-

- Rheology of granular materials (both wet and dry)

    - Impact of anisotropy and structure
    - Impact of electrostatic charging
- In depth understanding of stress distribution in granular materials
- Dynamics of interparticle interaction and short range forces in granular materials

Both experimental and theoretical/numerical work will be in scope.

Fundamental Physics

Quantum mechanics is one of the most successful theories in physics. It describes the very small, such as atoms and their formation into the complex molecules necessary for life, to structures as large as cosmic strings. The behavior of exotic matter such as superfluids and neutron stars is explained by quantum mechanics, as are everyday phenomena such as the transmission of electricity and heat by metals. The frontline of modern quantum science involves cross-cutting fundamental and applied research. For example, world-wide efforts concentrate on harnessing quantum coherence and entanglement for applications such as the enhanced sensing of electromagnetic fields, secure communications, and the exponential speed-up of quantum computing. This area is tightly coupled to research on the foundations of quantum mechanics, which involves exotica such as many-worlds theory and the interface between classical and quantum behavior. Another frontier encompasses understanding how novel quantum matter—such as high-temperature superconductivity and topological states—emerges from the interactions between many quantum particles. Quantum science is also central to the field of precision measurement, which seeks to expand our knowledge of the underlying principles and symmetries of the universe by testing ideas such as the equivalence between gravitational and inertial mass.

Quantum physics is a cornerstone of our understanding of the universe. The importance of quantum mechanics is extraordinarily wide ranging, from explaining emergent phenomena such as superconductivity, to underpinning next-generation technologies such as quantum computers, quantum communication networks, and sensor technologies. Laser-cooled cold atoms are a versatile platform for quantum physics on Earth, and one that can greatly benefit from space-based research. The virtual elimination of gravity in the reference frame of a free-flying space vehicle enables cold atom experiments to achieve longer observation times and colder temperatures than are possible on Earth. The NASA Fundamental Physics program plans to support research in quantum physics that will lead to transformational outcomes, such as the discovery of phenomena at the intersection of quantum mechanics and general relativity that inform a unified theory, the direct detection of dark matter via atom interferometry or atomic clocks, and the creation of exotic quantum matter than cannot exist on Earth.

Proposals are sought for ground-based theory and experimental research that may help to develop concepts for future flight experiments. Research in field effects in quantum superposition and entanglement are of particular interest.

For any Physical Sciences proposal selected for award, all data must be deposited in the Physical Sciences Informatics Database starting one year after award completion. They must also make the source code of any computational simulations developed via awards under this proposal available in an open-source repository.

The two NASA GRC drop towers described below are also available to augment research investigations. These facilities are typically used to conduct combustion or fluid physics experiments. Please go to link for further information. The Points of Contact for each research area are:
Fluid Physics: John McQuillen, john.b.mcquillen@nasa.gov
Combustion Science: Dan Dietrich, daniel.l.dietrich@nasa.gov

Since there is a cost involved to use these drop towers, please contact the appropriate POC for cost estimates for your proposal.

2.2 s tower: https://www1.grc.nasa.gov/facilities/drop/

The 2.2 Second Drop Tower has been used for nearly 50 years by researchers from around the world to study the effects of microgravity on physical phenomena such as combustion and fluid dynamics and to develop technology for future space missions. It provides rapid turnaround testing (up to 12 drops/day) of 2.2 seconds in duration.

5.2 s tower : https://www1.grc.nasa.gov/facilities/zero-g/

The Zero Gravity Research Facility is NASA's premier facility for ground based microgravity research, and the largest facility of its kind in the world. It provides researchers with a near weightless environment for a duration of 5.18 seconds. It has been primarily used for combustion and fluid physics investigations.

> Implementing Centers: NASA's Physical Sciences Research Program is carried out at the Glenn Research Center (GRC), Jet Propulsion Laboratory (JPL) and Marshall Space Flight Center (MSFC). Further information on physical sciences research is available at: https://science.nasa.gov/biological-physical/programs/physical-sciences

Commercially Enabled Rapid Space Science Project (CERISS)

The Commercially Enabled Rapid Space Science initiative (CERISS) will develop transformative research capabilities with commercial space industry to dramatically increase the pace of research. Long-range goals include conducting scientist astronaut missions on the International Space Station and commercial low-earth orbit (LEO) destinations and develop automated hardware for experiments beyond low Earth orbit, such as to the lunar surface.

The benefits will include a 10-to-100-fold faster pace of research for a wide range of research sponsored by Biological and Physical Sciences Division, the NASA Human Research Program, other government agencies, and industry. Another benefit will be the increased demand for research and development in low earth orbit, facilitating growth of the commercial space industry.

Area of particular interest include:

Sample preparation Characterization of materials (e.g. differential scanning calorimetry, x-ray diffraction, Fourier transform infrared spectroscopy, etc.) Analysis of samples (e.g. fluorescent activated cell sorting, protein and -omics, imaging, etc.)

Further information on CERISS is available at: https://science.nasa.gov/biological-physical/commercial

8.5.2 Heliophysics Division

POC: Patrick Koehn, Ph.D. NASA HQ patrick.koehn@nasa.gov

Madhulika Guhathakurta, Ph.D. NASA HQ madhulika.guhathakurta@nasa.gov

Heliophysics encompasses science that improves our understanding of fundamental physical processes throughout the solar system, and enables us to understand how the Sun, as the major driver of the energy throughout the solar system, impacts our technological society. The scope of heliophysics is vast, spanning from the Sun's interior to Earth's upper atmosphere, throughout interplanetary space, to the edges of the heliosphere, where the solar wind interacts with the local interstellar medium. Heliophysics incorporates studies of the interconnected elements in a single system that produces dynamic space weather and that evolves in response to solar, planetary, and interstellar conditions.

In this framework, the Heliophysics Research Program is guided by *Science 2020-2024: A Vision for Scientific Excellence* and any more up to date versions of the Science Plan (available at https://science.nasa.gov/about-us/science-strategy) and by the *2013 National Research Council Decadal Strategy for Solar and Space Physics report, Solar and Space Physics: A Science for a Technological Society* (www.nap.edu/catalog.php?record_id=13060).

The decadal survey articulates the scientific challenges for this field of study and recommends a slate of design reference missions to meet them, to culminate in the achievement of a predictive capability to aid human endeavors on Earth and in space. The fundamental science questions are:

- What causes the Sun to vary?
- How do the geospace, planetary space environments and the heliosphere respond?
- What are the impacts on humanity?

To answer these questions, the Heliophysics Division implements a program to achieve three overarching objectives:

- Explore and characterize the physical processes in the space environment from the Sun to the heliopause and throughout the universe

- Advance our understanding of the Sun's activity, and the connections between solar variability and Earth and planetary space environments, the outer reaches of our solar system, and the interstellar medium
- Develop the knowledge and capability to detect and predict extreme conditions in space to protect life and society and to safeguard human and robotic explorers beyond Earth.

The program supports theory, modeling, and data analysis utilizing remote sensing and in situ measurements from a fleet of missions; the Heliophysics System Observatory (HSO). Frequent CubeSats, suborbital rockets, balloons, and ground-based instruments add to the observational base. Investigations that develop new observables and technologies for heliophysics science are sought.

Supported research activities include projects that address understanding of the Sun and planetary space environments, including the origin, evolution, and interactions of space plasmas and electromagnetic fields throughout the heliosphere. The program seeks to characterize these phenomena on a broad range of spatial and temporal scales, to understand the fundamental processes that drive them, to understand how these processes combine to create space weather events, and to enable a capability for predicting future space weather events.

The program supports investigations of the Sun, including processes taking place throughout the solar interior and atmosphere and the evolution and cyclic activity of the Sun. It supports investigations of the origin and behavior of the solar wind, energetic particles, and magnetic fields in the heliosphere and their interaction with the Earth and other planets, as well as with the interstellar medium.

The program also supports investigations of the physics of magnetospheres, including their formation and fundamental interactions with plasmas, fields, and particles and the physics of the terrestrial mesosphere, thermosphere, ionosphere, and auroras, including the coupling of these phenomena to the lower atmosphere and magnetosphere. Proposers may also review the information in the ROSES-23 Heliophysics Research Program Overview for further information about the Heliophysics Research Program.

8.5.3 Earth Science Division

POC: Yaitza Luna-Cruz, yaitza.luna-cruz@nasa.gov NASA Headquarters (HQ)

Laura Lorenzoni, laura.lorenzoni@nasa.gov NASA HQ

Nancy Searby, nancy.d.searby@nasa.gov NASA HQ

The overarching goal of NASA's Earth Science program is to develop a scientific understanding of Earth as a system. The Earth Science Division of the Science Mission Directorate (https://science.nasa.gov/earth-science) contributes to NASA's mission, in particular, Strategic Objective 1.1: Understanding The Sun, Earth, Solar System, And Universe. This strategic objective is motivated by the following key questions:

- How is the global Earth system changing?

- What causes these changes in the Earth system?
- How will the Earth system change in the future?
- How can Earth system science provide societal benefit?

These science questions translate into seven overarching science goals to guide the Earth Science Division's selection of investigations and other programmatic decisions:

- Advance the understanding of changes in the Earth's radiation balance, air quality, and the ozone layer that result from changes in atmospheric composition (Atmospheric Composition)
- Improve the capability to predict weather and extreme weather events (Weather)
- Detect and predict changes in Earth's ecosystems and biogeochemical cycles, including land cover, biodiversity, and the global carbon cycle (Carbon Cycle and Ecosystems)
- Enable better assessment and management of water quality and quantity to accurately predict how the global water cycle evolves in response to climate change (Water and Energy Cycle)
- Improve the ability to predict climate changes by better understanding the roles and interactions of the ocean, atmosphere, land and ice in the climate system (Climate Variability and Change)
- Characterize the dynamics of Earth's surface and interior, improving the capability to assess and respond to natural hazards and extreme events (Earth Surface and Interior)
- Further the use of Earth system science research to inform decisions and provide benefits to society

In applied sciences, the ESD encourages the use of data from NASA's Earth-observing satellites and airborne missions to tackle tough challenges and develop solutions that improve our daily lives. Specific areas of interest include efforts that help institutions and individuals make better decisions about our environment, food, water, health, and safety (see http://appliedsciences.nasa.gov). In technological research, the ESD aims to foster the creation and infusion of new technologies – such as data processing, interoperability, visualization, and analysis as well as autonomy, modeling, and mission architecture design – in order to enable new scientific measurements of the Earth system or reduce the cost of current observations (see http://esto.nasa.gov). The ESD also promotes innovative development in computing and information science and engineering of direct relevance to ESD. NASA makes Earth observation data and information widely available through the Earth Science Data System program, which is responsible for the stewardship, archival and distribution of open data for all users.

The Earth Science Division (ESD) places particular emphasis on the investigators' ability to promote and increase the use of space-based remote sensing through the proposed research. Proposals with objectives connected to needs identified in most recent Decadal Survey (2017-2027) from the National Academies of Science, Engineering, and Medicine, *Thriving on our Changing Planet: A Decadal Strategy for Earth Observation from Space* are welcomed. (see https://www.nap.edu/catalog/24938/thriving-on-our-changing-planet-a-decadal-strategy-for-earth).

NASA's ability to view the Earth from a global perspective enables it to provide a broad, integrated set of uniformly high-quality data covering all parts of the planet. NASA shares this unique knowledge with the global community, including members of the science, government, industry, education, and policy-maker communities.

8.5.4 Planetary Science Division

POC: Erica Montbach, PhD (*she/her*), erica.n.montbach@nasa.gov

Manager, Planetary Exploration Science Technology Office (PESTO)

Planetary Science Division

Michael Lienhard, PhD (*he/him*), michael.a.lienhard@nasa.gov

Program Officer, Planetary Exploration Science Technology Office (PESTO)

Planetary Science Division

The Planetary Science Research Program, managed by the Planetary Science Division, sponsors research that addresses the broad strategic objective to "Ascertain the content, origin, and evolution of the Solar System and the potential for life elsewhere." To pursue this objective, the Planetary Science Division has strategic goals and objectives that guide the focus of the division's science research and technology development activities. As described in the NASA 2022 Science Strategic Plan (https://science.nasa.gov/about-us/science-strategy), these are:

Discover:

- Expand human knowledge through new scientific discoveries
    - 1.2: Understand the Sun, solar system, and universe

Explore:

- Extend human presence to the Moon and on towards Mars for sustainable long-term exploration, development, and utilization
    - 2.1: Explore the surface of the Moon and deep space

Innovate:

- Catalyze economic growth and drive innovation to address national challenges
    - 3.1: Innovate and advance transformational space technologies

The NASA Planetary Science strategic objective is to advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space.

In order to address these goals and objectives, the Planetary Research Program invites a wide range of planetary science and astrobiology investigations. Example topics include, but are not limited to:

- Investigations aimed at understanding the formation and evolution of the Solar System and (exo)planetary systems in general, and of the planetary bodies, satellites, and small bodies in these systems;
- Investigations aimed at understanding materials present, and processes occurring, in the early stages of Solar System history, including the protoplanetary disk;
- Investigations aimed at understanding planetary differentiation processes;
- Investigations of extraterrestrial materials, including meteorites, cosmic dust, presolar grains, and samples returned by the Apollo, Stardust, Genesis, and Hayabusa missions;
- Investigations of the properties of planets, satellites (including the Moon), satellite and ring systems, and smaller Solar System bodies such as asteroids and comets;
- Investigations of the coupling of a planetary body's intrinsic magnetic field, atmosphere, surface, and interior with each other, with other planetary bodies, and with the local plasma environment;
- Investigations into the origins, evolution, and properties of the atmospheres of planetary bodies (including satellites, small bodies, and exoplanets);
- Investigations that use knowledge of the history of the Earth and the life upon it as a guide for determining the processes and conditions that create and maintain habitable environments and to search for ancient and contemporary habitable environments and explore the possibility of extant life beyond the Earth;
- Investigations into the origin and early evolution of life, the potential of life to adapt to different environments, and the implications for life elsewhere;
- Investigations that provide the fundamental research and analysis necessary to characterize exoplanetary systems;
- Investigations related to understanding the chemistry, astrobiology, dynamics, and energetics of exoplanetary systems;
- Astronomical observations of our Solar System that contribute to the understanding of the nature and evolution of the Solar System and its individual constituents;
- Investigations to inventory and characterize the population of Near Earth Objects (NEOs) or mitigate the risk of NEOs impacting the Earth;
- Investigations into the potential for both forward and backward contamination during planetary exploration, methods to minimize such contamination, and standards in these areas for spacecraft preparation and operating procedures;
- Investigations which enhance the scientific return of NASA Planetary Science Division missions through the analysis of data collected by those missions;
- Advancement of laboratory- or spacecraft-based (including small satellites, e.g., CubeSats) instrument technology that shows promise for use in scientific investigations on future planetary missions; and
- Analog studies, laboratory experiments, or fieldwork to increase our understanding of Solar System bodies or processes and/or to prepare for future missions.

Additional information on technologies needed to support NASA Planetary Science Division missions may be found on the Planetary Exploration Science Technology Office website.

Proposers may also review the information in the ROSES-2023 Planetary Science Research Program Overview for further information about the Planetary Science Research Program. The use of NASA Research Facilities is available to supported investigators (see section IVe Demonstration of Access to Required Facility). If their use is anticipated, this use must be discussed and justified in the submitted proposals and include a letter of support from the facility (or resource) confirming that it is available for the proposed use during the proposed period.

8.5.5 Astrophysics Division

Science Mission Directorate (SMD)

POC: Dr. Hashima Hasan, hhasan@nasa.gov NASA Headquarters (HQ)

Dr. Mario Perez, mario.perez@nasa.gov NASA HQ

NASA's strategic objective in astrophysics is to discover how the universe works, explore how it began and evolved, and search for life on planets around other stars. Three broad scientific questions flow from this objective:

- How does the universe work?
- How did we get here?
- Are we alone?

Each of these questions is accompanied by a science goal that shapes the Astrophysics Division's efforts towards fulfilling NASA's strategic objective:

- Probe the origin and destiny of our universe, including the nature of black holes, dark energy, dark matter and gravity
- Explore the origin and evolution of the galaxies, stars and planets that make up our universe
- Discover and study planets around other stars, and explore whether they could harbor life

To address these Astrophysics goals, the Astrophysics Research Analysis and Technology Program invites a wide range of astrophysics science investigations from space that can be broadly placed in the following categories:

- The development of new technology covering all wavelengths and fundamental particles, that can be applied to future space flight missions. This includes, but is not limited to, detector development, and optical components such as primary or secondary mirrors, coatings, gratings, filters, and spectrographs.
- New technologies and techniques that may be tested by flying them on suborbital platforms such as rockets and balloons that are developed and launched by commercial

suborbital flight providers or from NASA's launch range facilities, or by flying them on small and innovative orbital platforms such as cubesats.

- Studies in laboratory astrophysics. Examples of these studies could include atomic and molecular data and properties of plasmas explored under conditions approximating those of astrophysical environments.
- Theoretical studies and simulations that advance the goals of the astrophysics program
- Analysis of data that could lead to original discoveries from space astrophysics missions. This could include the compilations of catalogs, statistical studies, algorithms and pattern recognition, artificial intelligence applications, development of data pipelines, etc.

Citizen Science programs, which are a form of open collaboration in which individuals or organizations participate voluntarily in the scientific process, are also invited. The current SMD Policy (https://smd-prod.s3.amazonaws.com/science-red/s3fs-public/atoms/files/SPD%2033%20Citizen%20Science.pdf) on citizen science describes standards for evaluating proposed and funded SMD citizen science projects. For more information see the https://science.nasa.gov/citizenscience webpage, that provides information about existing SMD-funded projects.

Proposals should address the goals of the Science Mission Directorate's (SMD) Astrophysics Research Program, defined in SMD's Science 2020-2024: A Vision for Scientific Excellence (available at http://science.nasa.gov/about-us/science-strategy). Proposers are encouraged to read this NASA Science Plan, the Astrophysics Roadmap (available at https://science.nasa.gov/astrophysics/documents/astrophysics-roadmap), and the report of National Academy of Sciences Decadal Survey on Astronomy and Astrophysics 2020, Pathways to Discovery in Astronomy and Astrophysics for the 2020s,(available at https://www.nap.edu/catalog/26141/pathways- to-discovery-in-astronomy-and-astrophysics for-the-2020s).

Investigations submitted to this program element should explicitly support past, present, or future NASA astrophysics missions. These investigations can include theory, simulation, data analysis, and technology development. Information on the Astrophysics research program and missions are available at https://science.nasa.gov/astrophysics.

8.6 Space Technology Mission Directorate (STMD)

POC: Damian Taylor, Damian.Taylor@nasa.gov

The Space Technology Mission Directorate (STMD) is where technology drives exploration and the space economy; and aims to transform future missions while ensuring American leadership in aerospace.

STMD rapidly develops, demonstrates, and infuses revolutionary, high-payoff technologies through transparent, collaborative partnerships, expanding the boundaries of the aerospace enterprise. STMD employs a merit-based competition model with a portfolio approach, spanning a range of discipline areas and technology readiness levels. By investing in bold, broadly applicable, disruptive technology that industry cannot tackle today, STMD seeks to mature the technology required for NASA's future missions in science and exploration while proving the capabilities and lowering the cost for other government agencies and commercial space activities.

Research and technology development takes place within NASA Centers, at JPL, in academia and industry, and leverages partnerships with other government agencies and international partners. STMD engages and inspires thousands of technologists and innovators creating a community of our best and brightest working on the nation's toughest challenges. By pushing the boundaries of technology and innovation, STMD allows NASA and our nation to remain at the cutting edge. Additional information on STMD can be found at: https://www.nasa.gov/about-stmd/.

STMD looks to engage new and diverse partners to garner different perspectives and approaches to our biggest technology challenges. An overarching principle guiding STMD's work is our commitment to inspiring and developing a diverse and powerful US aerospace technology community. As part of our strategic approach, STMD is committed to empowering innovators by expanding our work with and support for underrepresented communities. Furthermore, we are focused on demonstrating engaging practices for underserved and underrepresented communities through the R&D process that strengthens and supports economic growth for a diverse technology community. This is paramount to our ***Lead*** strategic thrust through which ***Go***, ***Land***, ***Live*** and ***Explore*** thrusts are realized.

STMD plans future investments to support our strategic thrusts as follows:

Lead: *Ensuring American global leadership in Space Technology*

- Advance US space technology innovation and competitiveness in a global context
- Encourage technology driven economic growth with an emphasis on the expanding space economy
- Inspire and develop a diverse and powerful US aerospace technology community

Go: *Rapid, Safe, & Efficient Space Transportation*

- Develop nuclear technologies enabling fast in-space transits.
- Develop cryogenic storage, transport, and fluid management technologies for surface and in-space applications.
- Develop advanced propulsion technologies that enable future science/exploration missions.

Land: *Expanded Access to Diverse Surface Destinations*

- Enable Lunar/Mars global access with ~20t payloads to support human missions.
- Enable science missions entering/transiting planetary atmospheres and landing on planetary bodies.
- Develop technologies to land payloads within 50 meters accuracy and avoid landing hazards.

Live: *Sustainable Living and Working Farther from Earth*

- Develop exploration technologies and enable a vibrant space economy with supporting utilities and commodities.
  - Sustainable power sources and other surface utilities to enable continuous lunar and Mars surface operations.
  - Scalable ISRU production/utilization capabilities including sustainable commodities on the lunar & Mars surface.
  - Technologies that enable surviving the extreme lunar and Mars environments.
  - Autonomous excavation, construction & outfitting capabilities targeting landing pads/structures/habitable buildings utilizing in situ resources.
- Enable long duration human exploration missions with Advanced Habitation System technologies. [Low TRL STMD: Mid-High TRL SOMD/ESDMD]

Explore: *Transformative Missions and Discoveries*

- Develop next generation high performance computing, communications, and navigation.
- Develop advanced robotics and spacecraft autonomy technologies to enable and augment science/exploration missions.
- Develop technologies supporting emerging space industries including: Satellite Servicing & Assembly, In Space/Surface Manufacturing, and Small Spacecraft technologies.
- Develop vehicle platform technologies supporting new discoveries.
- Develop technologies for science instrumentation supporting new discoveries. [Low TRL STMD/Mid-High TRL SMD. SMD funds mission specific instrumentation (TRL 1-9)]
- Develop transformative technologies that enable future NASA or commercial missions and discoveries.

Furthermore, the above strategic thrusts describe the STMD investment priority strategy and are further detailed in the Strategic Technology Architecture Roundtable (STAR) Process: https://techport.nasa.gov/framework.

STMD's Principal Technologists and System Capability Leads are available for consultation with proposers regarding the state-of-the-art, on-going activities and investments, and strategic needs in their respective areas of expertise. Proposers are encouraged to consult with the appropriate PT or SCLT early in the proposal process.

POC	Technology Area	NASA Email
Andrew Abercromby	ECLSS	andrew.f.abercromby@nasa.gov
Danette Allen	Autonomous Systems	danette.allen@nasa.gov
Jim Broyan	ECLSS Lead	james.l.broyan@nasa.gov
John Carson	EDL Precision Landing	john.m.carson@nasa.gov
John Dankanich	In Space Transportation	john.dankanich@nasa.gov
Bernie Edwards	Communications & Navigation	bernard.l.edwards@nasa.gov
Mark Hilburger	Structures/Materials; Excavation, Construction and Outfitting	mark.w.hilburger@nasa.gov
Kristen John	Dust Mitigation	kristen.k.john@nasa.gov
Julie Kleinhenz	In Situ Resource Utilization	julie.e.kleinhenz@nasa.gov
Angela Krenn	Thermal and Surface Systems	angela.g.krenn@nasa.gov
Ron Litchford	Propulsion Systems	ron.litchford@nasa.gov
Josh Mehling	Robotics	joshua.s.mehling@nasa.gov
Jason Mitchell	Communications & Navigation	jason.w.mitchell@nasa.gov
Michelle Munk	Entry, Descent and Landing (EDL)	michelle.m.munk@nasa.gov
Bo Naasz	Rendezvous & Capture	bo.j.naasz@nasa.gov
Denise Podolski	Sensors/Radiation/Quantum	denise.a.podolski@nasa.gov
Wes Powell	Avionics	wesley.a.powell@nasa.gov
Jerry Sanders	In Situ Resource Utilization	gerald.b.sanders@nasa.gov
John Scott	Space Power & Energy Storage	john.h.scott@nasa.gov
John Vickers	Advanced Manufacturing	john.h.vickers@nasa.gov
Arthur Werkheiser	Cryo Fluid Management	arthur.werkheiser@nasa.gov
Mike Wright	Entry, Descent and Landing (EDL)	michael.j.wright@nasa.gov

In recognition of NASA's leadership in developing advanced technologies for the benefit of all, research topics related to advancing national capabilities in the following climate-related and addressing orbital debris technology areas are of interest:

- Clean Energy and Emissions Technologies: Clean energy and emissions mitigation technology projects focusing on the research and development, demonstration, or deployment of systems, processes, best practices, and sources that reduce the amount of greenhouse gas emitted to, or concentrated in, the atmosphere.

- U.S. Climate Change Research Program: Earth-observing capabilities to support breakthrough science and National efforts to address climate change.
  - Specific topic areas could include:
    - Reductions in greenhouse gas emissions (including CO_2, CH_4, N_2O, HFCs)
      - Fuel Cells
      - Batteries and Energy Storage

- Carbon Capture, Utilization, and Storage
    - Processes that enhance industrial efficiency and reduce emissions
    - Production of clean energy including solar, hydrogen, nuclear, or other clean energy sources
  - Enabling platforms and early-stage instruments for climate-relevant science observations
- Addressing Orbital Debris: Control the long-term growth of debris population.

- POCs for additional information:
  - Clean energy: John Scott (john.h.scott@nasa.gov)
  - Nuclear systems: Anthony Calomino (anthony.m.calomino@nasa.gov)
  - Hydrogen: Jerry Sanders (gerald.b.sanders@nasa.gov)
  - Earth-observing capabilities: Chris Baker (christopher.e.baker@nasa.gov), Justin Treptow (justin.treptow@nasa.gov)
  - Carbon capture and utilization: James Broyan (james.l.broyan@nasa.gov)
  - Harnessing data for improved visualization: Lawrence Friedl (SMD) (lfriedl@nasa.gov)
  - Addressing Orbital Debris: Bo Naasz (Bo.j.naasz@nasa.gov)

Applicants are strongly encouraged to familiarize themselves with the 2020 NASA Technology Taxonomy (replaced the 2015 NASA Technology Roadmaps) and the NASA Strategic Technology Framework that most closely aligns with their space technology interests. The 2020 NASA Technology Taxonomy may be downloaded at the following link: https://www.nasa.gov/offices/oct/taxonomy/index.html. The NASA Strategic Technology Framework, including presentations describing the Envisioned Future and strategy for addressing each of the STMD capability areas and outcomes, can be found at: https://techport.nasa.gov/framework.

The National Aeronautics and Space Administration (NASA) Space Technology Mission Directorate (STMD) current year version of the NASA Research Announcement (NRA) entitled, "Space Technology Research, Development, Demonstration, and Infusion" has been posted on the NSPIRES web site at: http://nspires.nasaprs.com (select “Solicitations” and then “Open Solicitations”). The NRA provides detailed information on specific proposals being sought across STMD programs. Specifically, STMD supports research from universities through a number of other solicitations from early stage programs such as NASA’s Innovation Corps Pilot, NASA Innovative Concepts, Space Technology Research Grants, Small Business Technology Transfer, and Lunar Surface Innovation Consortium. Additionally, here’s a link to other STMD program opportunities that potentially could benefit from university research ideas.

8.7 NASA Centers Areas of Interest

“Engagement with Center Chief Technologists and the Agency Capability Leadership Teams is critical to value of the research and selection of proposals.” Examples of Center research

interest areas include these specific areas from the following Centers. If no POC is listed in the Center write-up and contact information is needed, please contact the POC listed in Appendix D for that Center and request contacts for the research area of interest.

8.7.1 Ames Research Center (ARC)

POC: Harry Partridge, harry.partridge@nasa.gov

- Entry systems: Safely delivering spacecraft to Earth & other celestial bodies
- Advanced Computing & IT Systems: Enabling NASA's advanced modeling and simulation
  - Supercomputing
  - Quantum computing, quantum sensors and quantum algorithms
  - Applied physics and Computational materials
- **Aero sciences**:
  - Wind Tunnels: Testing on the ground before you take to the sky
- **Air Traffic Management**:
  - NextGen air transportation: Transforming the way we fly
  - Airborne science: Examining our own world & beyond from the sky
  - Airspace Systems, Unmanned aerial Systems
- **Astrobiology and Life Science**: Understanding life on Earth - and in space
  - Biology & Astrobiology
  - Space radiation health risks
  - Biotechnology, Synthetic biology
  - Instruments
- **Cost-Effective Space Missions**: Enabling high value science to low Earth orbit & the moon
  - Small Satellites, Cube satellites
- **Intelligent/Adaptive Systems**: Complementing humans in space
  - Autonomy & Robotics: Enabling complex air and space missions, and complementing humans in space
  - Human Systems Integration: Advancing human-technology interaction for NASA missions
  - Nanotechnology-electronics and sensors, flexible electronics
- **Space and Earth Science:** *Understanding our planet, our solar system and everything beyond*
  - **Exoplanets**: Finding worlds beyond our own
  - **Airborne Science**: Examining our own world & beyond from the sky
  - Lunar Sciences: Rediscovering our moon, searching for water

8.7.2 Armstrong Flight Research Center (AFRC)

POC: Timothy Risch, timothy.k.risch@nasa.gov

POC	Technology Area	Email
Sean Clarke	Hybrid Electric Propulsion	sean.clarke@nasa.gov
Ed Hearing	Supersonic Research (Boom mitigation and measurement)	edward.a.haering@nasa.gov
Dan Banks	Supersonic Research (Laminar Flow)	daniel.w.banks@nasa.gov
Larry Hudson	Hypersonic Structures & Sensors	larry.d.hudson@nasa.gov
Matt Boucher Jeff Ouellette	Control of Flexible Structures, Modeling, System Identification, Advanced Sensors	matthew.j.boucher@nasa.gov jeffrey.a.ouellette@nasa.gov
Nelson Brown	Autonomy (Collision Avoidance, Perception, and Runtime Assurance)	nelson.brown@nasa.gov
Curt Hanson	Urban Air Mobility (UAM) Vehicle Handling and Ride Qualities	curtis.e.hanson@nasa.gov
Shawn McWherter	Urban Air Mobility (UAM) Envelope Protection	shaun.c.mcwherter@nasa.gov
Peter Suh Kurt Kloesel	Aircraft Electrical Powertrain Modeling	peter.m.suh@nasa.gov kurt.j.kloesel@nasa.gov
Bruce Cogan	Un-crewed Aerial Platforms for Earth and Planetary Science Missions	bruce.r.cogan@nasa.gov

8.7.3 Glenn Research Center (GRC)

POC: Kurt Sacksteder, kurt.sacksteder@nasa.gov

- **Power and Energy Storage Systems for Aviation and Space Applications:** sustainable, reduced- and zero-carbon emission approaches, substantial mass and efficiency improvements, and operability in challenging environments
- **Power System Architectures, Networks, and Systems Management and Integration Approaches:** including microgrids and power conversion and management electronics

- **Breakthrough Concepts in Photovoltaics, Electrochemistry, Photocatalysis, Photo/Thermal Energy Conversion:** including enabling manufacturing approaches and integration
- **Electronics for Extreme Temperature Environments:** devices, components, and subsystems
- **Microwave, Optical, and Cognitive Communications Devices, Components, and Systems:** expanded bandwidth and reductions in size and power consumption
- **Quantum Sensors, Communications, and Networks:** devices and simulations
- **Communication Architectures, Networks, and Systems:** integration and simulation
- **Intelligent and Autonomous Systems:** smart sensors, extreme environment instruments
- **Advanced Concepts in Systems Engineering for Aeronautical and Space Systems:** physics-based models, machine learning, and artificial intelligence applications
- **Electrified Aircraft:** architectures, components, systems, and system-level simulations
- **Space-Based Electric Propulsion:** advanced materials, components, and systems
- **Cryogenic Fluid Systems:** components, systems, and cryofluid management simulations
- **Thermal Management Systems:** propulsion and/or power systems for aviation and space
- **Acoustic Emission Mitigation:** aviation and space propulsion applications
- **Aircraft Icing:** prevention, mitigation, and simulation
- **Aviation Safety:** simulation, system concepts, architectures
- **Advanced Computational Fluid Dynamics and Systems Engineering** related to aviation propulsion systems including internal and external aerodynamics, aero-thermochemistry
- **Multi-Functional Materials:** concepts, components, and simulations engaging mechanical, structural, electrical, thermal, energy, communications, or propulsion features, especially including applications enabled by advanced manufacturing processes
- **Shape Memory Alloy Utilization:** actuation, harsh environments, high-strain applications
- **Advanced Metallic Alloy, Ceramic, Macromolecular, and Composite Materials and Coatings:** for extreme environments, especially where enabled by advanced manufacturing processes
- **Nanotechnology Applications:** enhanced mechanical, thermal, electrical, chemical, electrochemical, or catalytic properties
- **Fundamentals of Fluid Physics, Combustion Phenomena, Complex Fluids, and Bioengineering** in reduced- or near-zero gravitational environments
- **Transformational Technologies** such as In-Situ Resource Utilization ((ISRU), in-Space Assembly and Manufacturing (ISAM), and Thermal Management, that are optimized for reduced-gravity environments

8.7.4 Goddard Space Flight Center (GSFC)

8.7.4.1 Engineering Technology Directorate (ETD)

POC: Denise Cervantes, Ph.D. denise.cervantes@nasa.gov

NASA Goddard Space Flight Center is home to the nation's largest organization of scientists, engineers, and technologists who conceive, design and build new technology to study the solar system and universe.

The Engineering and Technology Directorate (ETD) is the engine that powers Goddard. ETD is the largest organization at Goddard and is home to approximately 1,300 engineers who provide multidisciplinary engineering expertise to NASA's many missions. Goddard has six distinctive facilities & installations. ETD has employees at the Greenbelt main campus in Maryland, Wallops Flight Facility in Virginia, and White Sands Test Facility Ground Stations in New Mexico.

ETD provides multi-disciplinary engineering expertise for the development of cutting-edge science and exploration systems and technologies in the following areas: Earth Science, Astrophysics, Solar System, Heliophysics and Exploration. In addition, ETD acquires and distributes science data worldwide. Goddard encompasses major laboratories and facilities for developing and operating unmanned scientific spacecraft.

GSFC ETD POCS:

- Code 500/GSFC ETD Workforce Development & OSTEM/Higher Education Manager, Dr. Denise Cervantes, denise.cervantes@nasa.gov
- Code 500/GSFC ETD Chief Technologist, Michael Johnson, michael.a.johnson@nasa.gov
    - Code 500/ETD Wallops Flight Facility Engineering Division
        - Associate Chief Technologist, Sarah Wright, sarah.wright@nasa.gov
    - Code 540/ETD Mechanical Systems Division
        - Associate Chief Technologist, Dr. Vivek Dwivedi, vivek.h.dwivedi@nasa.gov
    - Code 550/ETD Instrument Systems and Technology Division
        - Associate Chief Technologist, Renee Reynolds, renee.m.reynolds@nasa.gov
    - Code 560/ETD Electrical Engineering Division
        - Associate Chief Technologist, Chris Green, christopher.m.green-1@nasa.gov
    - Code 580/ETD Software Engineering Division
        - Associate Chief Technologist, Karin Blank, karin.b.blank@nasa.gov
    - Code 590/ETD Mission Engineering and Systems Analysis Division
        - Associate Chief Technologist, Cheryl Gramling, cheryl.j.gramling@nasa.gov
- Code 500/GSFC ETD New Business Leads

- Code 500/ETD Wallops Flight Facility Engineering Division
  - WFF New Business Lead, Benjamin Cervantes, benjamin.w.cervantes@nasa.gov
- Code 540/ETD Mechanical Systems Division
  - New Business Lead, Sharon Cooper, sharon.cooper@nasa.gov
- Code 550/ETD Instrument Systems and Technology Division
  - New Business Lead, Dr. Aprille Ericsson, aprille.j.ericsson@nasa.gov
- Code 560/ETD Electrical Engineering Division
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- Code 580/ETD Software Engineering Division
  - New Business Lead, Steve Tompkins, steven.d.tompkins@nasa.gov
- Code 590/ETD Mission Engineering and Systems Analysis Division
  - New Business Lead, Peter Knudtson, peter.a.knudtson@nasa.gov

ETD Research Areas:

- Advanced Manufacturing - facilitates the development, evaluation, and deployment of efficient and flexible additive manufacturing technologies. (ref: NAMII.org)
- Advanced Multi-functional Systems and Structures - novel approaches to increase spacecraft systems resource utilization
- Micro - and Nanotechnology - Based Detector Systems - research and application of these technologies to increase the efficiency of detector and optical systems
- Ultra-Miniature Spaceflight Systems and Instruments - miniaturization approaches from multiple disciplines - materials, mechanical, electrical, software, and optical - to achieve substantial resource reductions
- Systems Robust to Extreme Environments - materials and design approaches that will preserve designed system properties and operational parameters (e.g. mechanical, electrical, thermal), and enable reliable systems operations in hostile space environments.
- Spacecraft Navigation Technologies
  - Surface Localization algorithm for autonomous navigation based on sensor observation fusion
  - Spacecraft GNSS receivers, ranging crosslink transceivers, and relative navigation sensors
  - Optical navigation and satellite laser ranging
  - Deep-space autonomous navigation techniques
  - Software tools for spacecraft navigation ground operations and navigation analysis
  - Formation Flying
- Automated Rendezvous and Docking (AR&D) techniques
  - Algorithm development
  - Pose estimation for satellite servicing missions
  - Sensors (e.g., LiDARs, natural feature recognition)
  - Actuation (e.g., micro propulsion, electromagnetic formation flying)
- Mission and Trajectory Design Technologies

- Mission design tools that will enable new mission classes (e.g., low thrust planetary missions, precision formation flying missions)
  - Mission design tools that reduce the costs and risks of current mission design methodologies
  - Trajectory design techniques that enable integrated optimal designs across multiple orbital dynamic regimes (i.e. earth orbiting, earth-moon libration point, sun-earth libration point, interplanetary)
- Spacecraft Attitude Determination and Control Technologies
  - Modeling, simulation, and advanced estimation algorithms
  - Advanced spacecraft attitude sensor technologies (e.g., MEMS IMU's, precision optical trackers)
  - Advanced spacecraft actuator technologies (e.g. modular and scalable momentum control devices, 'green' propulsion, micropropulsion, low power electric propulsion)
- CubeSats - Participating institutions will develop CubeSat/Smallsat components, technologies and systems to support NASA technology demonstration and risk reduction efforts. Student teams will develop miniature CubeSat/Smallsat systems for: power generation and distribution, navigation, communication, on-board computing, structures (fixed and deployable), orbital stabilization, pointing, and de-orbiting. These components, technologies and systems shall be made available for use by NASA for integration into NASA Cubesat/Smallsats. They may be integrated into complete off-the-shelf "CubeSat/Smallsat bus" systems, with a goal of minimizing "bus" weight/power/volume/cost and maximizing available "payload" weight/power/volume. NASA technologists will then use these components/systems to develop payloads that demonstrate key technologies to prove concepts and/or reduce risks for future Earth Science, Space Science and Exploration/Robotic Servicing missions.

- On-Orbit Multicore Computing - High performance multicore processing for advanced automation and science data processing on spacecraft. There are multiple multicore processing platforms in development that are being targeted for the next generation of science and exploration missions, but there is little work in the area of software frameworks and architectures to utilize these platforms. It is proposed that research in the areas of efficient inter-core communications, software partitioning, fault detection, isolation & recovery, memory management, core power management, scheduling algorithms, and software frameworks be done to enable a transition to these newer platforms. Participating institutions can select areas to research and work with NASA technologists to develop and prototype the resulting concepts.

- Integrated Photonic Components and Systems - Integrated photonic components and systems for Sensors, Spectrometers, Chemical/biological sensors, Microwave, Sub-millimeter and Long-Wave Infra-Red photonics, Telecom- inter and intra satellite communications.

- Quantum Sensors and Quantum Networking

- Artificial Intelligence and Machine Learning

- Generative Design- leveraging an artificial intelligence-based iterative design process to optimize the design of systems.
- Radiation Effects and Analysis
  - Flight validation of advanced event rate prediction techniques
  - New approaches for testing and evaluating 3-D integrated microcircuits and other advanced microelectronic devices
  - End-to-end system (e.g., integrated component level or higher) modeling of radiation effects
  - Statistical approaches to tackle radiation hardness assurance (i.e., total dose, displacement damage, and/or single-event effects) for high-risk, low-cost missions.
- Model Based System Engineering (MBSE)

8.7.4.2 Sciences and Exploration Directorate

POC: Blanche Meeson, Blanche.W.Meeson@nasa.gov

Dr. Blanche Meeson (she/her/hers)

Chief for Higher Education and GSFC NASA Postdoctoral Program

The Sciences and Exploration Directorate at NASA Goddard Space Flight Center (http://science.gsfc.nasa.gov) is the largest Earth and space science research organization in the world. Its scientists advance understanding of the Earth and its life-sustaining environment, the Sun, the solar system, and the wider universe beyond. All are engaged in the full life cycle of satellite missions and instruments from concept development to implementation, analysis and application of the scientific information, and community access and services.

- The **Earth Sciences Division** plans, organizes, evaluates, and implements a broad program of research on our planet's natural systems and processes. Major focus areas include climate change, severe weather, the atmosphere, the oceans, sea ice and glaciers, and the land surface. To study the planet from the unique perspective of space, the Earth Science Division develops and operates remote-sensing satellites and instruments. We analyze observational data from these spacecraft and make it available to the world's scientists and policy makers. The Division conducts extensive field campaigns to gather data from the surface and airborne platforms. The Division also develops, uses, and assimilates observations into models that simulate planetary processes involving the water, energy, and carbon cycles at multiple scales up to global.

  POC: Eric Brown de Colstoun (eric.c.browndecolsto@nasa.gov)

- The **Astrophysics Science Division** conducts a broad program of research in astronomy, astrophysics, and fundamental physics. Individual investigations address issues such as the nature of dark matter and dark energy, which planets outside our solar system may harbor life, and the nature of space, time, and matter at the edges of black holes. Observing photons, particles, and gravitational waves enables researchers to probe astrophysical objects and processes. Researchers develop theoretical models, design experiments and hardware to test theories, and interpret and evaluate observational data.

POC: Rita Samburna (Rita.m.Sambruna@nasa.gov).

- The **Heliophysics Science Division** conducts research on the Sun, its extended solar-system environment (the heliosphere), and interactions of Earth, other planets, small bodies, and interstellar gas with the heliosphere. Division research also encompasses Geospace, Earth's magnetosphere and its outer atmosphere, and Space Weather—the important effects that heliospheric disturbances have on spacecraft and terrestrial systems. Division scientists develop spacecraft missions and instruments, systems to manage and disseminate heliophysical data, and theoretical and computational models to interpret the data. Possible heliophysics-related research include: advanced software environments and data-mining strategies to collect, collate and analyze data relevant to the Sun and its effects on the solar system and the Earth ("space weather"); and advanced computational techniques, including but not limited to parallel architectures and the effective use of graphics processing units, for the simulation of magnetized and highly dynamic plasmas and neutral gases in the heliosphere.

  POC: Doug Rabin (*Douglas.Rabin@nasa.gov*).

- The **Solar System Exploration Division** builds science instruments and conducts theoretical and experimental research to explore the solar system and understand the formation and evolution of planetary systems. Laboratories within the division investigate areas as diverse as astrochemistry, planetary atmospheres, extrasolar planetary systems, earth science, planetary geodynamics, space geodesy, and comparative planetary studies. To study how planetary systems form and evolve, division scientists develop theoretical models and experimental research programs, as well as mission investigations and space instruments to test them. The researchers participate in planetary and Earth science missions, and collect, interpret, and evaluate measurements.

  POC: Terry Hurford *(Terry.a.Hurford@nasa.gov)*

- **Artificial Intelligence, Machine Learning, Big Data Analytics:** The Data Science Group (DSG) supports science through the implementation and applications of artificial intelligence, machine learning, and big data analytics. The DSG supports all science divisions across a wide variety of applications using standard software engineering practices. The DSG is focused on accelerating science and enabling new discoveries through such activities as creation of AI/ML ready data sets, Foundation Models, uncertainty quantification, explainable AI/ML, reproducibility, and open science.

  POC: Dr. Mark Carroll *(mark.carroll@nasa.gov)*

Scientists in all four divisions and our computational and information science organization publish research results in the peer-reviewed literature, participate in the archiving and public dissemination of scientific data, and provide expert user support.

8.7.5 Jet Propulsion Laboratory (JPL)

POC: Dr. Tom Cwik, thomas.a.cwik@jpl.nasa.gov

- Solar System Science
  - Planetary Atmospheres and Geology
  - Solar System characteristics and origin of life
  - Primitive (1) solar systems bodies

  Lunar (9) science
  Preparing for returned sample investigations
- Earth Science
  Atmospheric composition and dynamics (Atmospheric Dynamics
  Land and solid earth processes (Solid Earth Processes
  Water and carbon cycles, Carbon Cycles, Water Cycles
  Ocean and ice
  Earth analogs to planets, Earth Analog
  Climate Science
- Astronomy and Fundamental Physics
  Origin, evolution, and structure of the universe, Origin Universe, Evolution Universe, Structure Universe
  Gravitational astrophysics and fundamental physics
  Extra-solar planets: Exoplanets; Star formation; Planetary formation
  Solar and Space Physics
  Formation and evolution of galaxies; Formation Galaxies; Evolution Galaxies
- In-Space Propulsion Technologies
  Chemical propulsion
  Non-chemical propulsion
  Advanced propulsion technologies
  Supporting technologies
  Thermal Electric Propulsion
  Electric Propulsion
- Space Power and Energy Storage
  Power generation
  Energy storage
- Human Exploration Destination Systems
  In situ resource utilization and Cross-cutting systems
- Science Instruments, Observatories and Sensor Systems
  Science Mission Directorate Technology Needs
  Remote Sensing instruments/Remote Sensing Sensors
  Observatory technologies
  In-situ instruments, Sensor technologies Sensors
  In situ technologies
  Instrument technologies
  Precision frequency
  Precision timing
- Entry, Descent and Landing Systems
  Aerobraking, Aerocapture and entry system; Descent; Engineered materials; Energy generation and storage; Propulsion; Electronics, devices, and sensors
  Nanotechnology
  Microtechnology
  Microelectronics
  Microdevice
  Orbital Mechanics
  Spectroscopy
- Modeling, Simulation, Information Technology and Processing
  Flight and ground computing; Modeling; Simulation; Information processing
- Materials, Structures, Mechanical Systems and Manufacturing
  Materials; Structures; Mechanical systems; Cross cutting
- Thermal Management Systems
  Cryogenic systems; Thermal control systems (near room temperature); Thermal protection systems

Power management & distribution Cross-cutting technologies Solar power, Photovoltaic Tethers Radioisotope Thermoelectric • Robotics, Tele-Robotics, and Autonomous Systems Sensing (Robotic Sensing) Mobility Manipulation technology Human-systems interfaces Autonomy Autonomous rendezvous & docking Systems engineering Vision Virtual reality Telepresence Computer Aided • Communication and Navigation Optical communications & navigation technology Radio frequency communications, Radio Technologies Internetworking Position navigation and timing Integrated technologies Revolutionary concepts Communication technology Antennas Radar Remote Sensing Optoelectronics	• Other Research Areas Small Satellite Small Satellite Technologies Balloons Radio Science MEMS Advanced High Temperature Spectroscopy Magnetosphere Plasma Physics Ionospheres Ground Data Systems Laser Drills High Energy Astrophysics Solar physics Interstellar Astrophysics Interstellar Medium Astrobiology Astro bio geochemistry Life Detection Cosmo chemistry Adaptive Optics Artificial Intelligence

8.7.6 Johnson Space Center (JSC)

POC: Schwing, Brian M. (JSC-AA211) brian.m.schwing@nasa.gov

Goodman, William {Doug} (JSC-XT)[Jacobs Technology, Inc.] doug.goodman@nasa.gov

Linda Ham, linda.j.ham@nasa.gov

Exploration Integration and Science Directorate https://beta.nasa.gov/johnson/frontdoor/capabilities/

Active Thermal Control

- Condensing heat exchanger coatings with robust hydrophilic, antimicrobial properties
- Development and demonstration of wax and water-based phase change material heat exchangers
- Lightweight heat exchangers and cold plates

ECLSS

- Advancements in Carbon Dioxide Reduction
- Habitation systems that minimize consumables
- Human thermal modeling
- Low toxicity hygiene and cleaning products and methods

EVA

- Portable Life Support System
- Power, Avionics and Software
- Pressure Garment

Entry, Descent, and Landing

- Innovative, Groundbreaking, and High Impact Developments in Spacecraft GN&C Technologies
- Deployable Decelerator Technologies
- High-Fidelity Parachute Fluid/Structure Interaction
- Mechanical Reefing Release Mechanism for Parachutes
- Next Generation Parachute Systems & Modeling
- Precision Landing & Hazard Avoidance Technologies
- Regolith – Rocket Plume Interaction: In-situ Measurements to Enable Multiple Landings at the Same Site
- Optical / Vision-Based Navigation for EDL Applications
- Sensors, including those embedded in thermal protection systems and proximity operations and landing
- Additive Manufacturing for Thermal Protection Systems
- Advanced Materials and Instrumentation for Thermal Protection Systems
- Predictive Material Modeling

Power Distribution and Control

- Lightweight, radiation tolerant cables and spools for Lunar/Mars surface power
- Dust tolerant electrical connectors
- Radiation hard power convertors.

Energy Storage technologies

- Batteries, Regenerative Fuel cells
- High energy, long-life fuel cell membranes

In-Situ Resource Utilization

- Lunar/Mars regolith processing and water-ice mining (Regolith collection, delivery, regolith processing, and drying; Water separation and capture, water cleanup ~~collection~~ and processing, water electrolysis)
- Mars atmosphere processing (CO2 collection; Dust filtering; Solid Oxide CO2 electrolysis; Sabatier; Reverse water gas shift)
- Methane/Oxygen liquefaction and storage
- ISRU regolith processing simulation and modeling

In-space propulsion technologies

- Human rated in-space propulsion systems (storable and cryogenic)
- EVA-IVA compatible miniature propulsion systems (including CubeSat)
- Propellant transfer and refueling
- Propellant gauging

Pyrotechnic device development and test

- Miniature pyrovalves
- Low energy, long duration pyrotechnic devices

Autonomy and Robotics

- Biomechanics
- Crew Exercise
- Human Robotic interface
- Autonomous Vehicle Systems/Management
- Data Mining and Fusion
- Robotics and TeleRobotics
- Simulation and modeling

Autonomous Rendezvous and Docking - Next generation In-space docking systems concepts addressing challenges of mass, environments, flight operations and including long duration missions, consider:

- New Rendezvous & Docking strategies i.e.,, greater vehicle reliance vs kinetic energy, addressing vehicle capabilities, sensors, etc.
- Simplification of soft capture system attenuation; less complex and lighter systems

- Docking independent LRU strategies vs Integrated vehicle solution
- Seals and sealing technology
- Consumables transfer technology (power, data, water, air, fluids)
- Maintenance

Surface Docking System Concepts addressing*:*

- System design and interfaces
- Environment's tolerance including long duration exposure

Human Research

- Behavioral health diagnostic and treatment techniques
- Non-invasive diagnostic aides that work in a communication delay setting

Inflatables and Attachments

- Inflatable Technology Archive/Database (Inflatables data from 30+ years being compiled/tech transfer)
- Advanced Material Development (Lunar/Martian Surface Protection)
- Inflatables Structural Design (hard structure Integration)
- Inflatable Attachment Technology Development (hatches, windows, handrails, floors, internal walls, grapple fixture, docking hatch, radiators, solar panels, etc.)
- Softgoods Structural Health Monitoring (Strain measurement, impact detection)
- Softgoods Folding and Packaging Testing (Cold temp folding)
- Softgoods Materials Testing (Creep test, Air barrier, Permeability)
- Sub-scale Structural Testing (Proof, Burst, Creep Testing)
- Full-scale Thermal Vacuum Testing (Chamber A environmental testing)

Spacecraft Glass & Windows

- Further the state of the art in light weight windows by advancing polymer materials as windowpanes.
    - Understand and mitigate the effects of UV/Radiation and other spaceflight environments on polymer windowpane materials and developing accurate testing techniques for environmental characterization
    - Produce accurate loads/stress modeling and correlation techniques of non-linear materials.
    - Conduct elevated temperature creep testing for polymer windowpane materials.
    - Develop mechanical material properties as a function of temperature, and optical material properties a function of wavelength for polymer windowpane materials.
    - Investigate methods of reducing flammability of polymer windowpane materials.
    - Understand storage effects of polymer window materials.
    - Develop inspection techniques correlated to residual polymer window materials.
    - Evolve the design of polymer windows to allow for long term spaceflight and enhanced viewability.

- Reduce the overhead of processing brittle material windowpanes by improving ground inspection and assessment techniques and developing on-orbit inspection techniques.

Computer Human Interfaces (CHI)

CHI - Human System Integration

- Human Computer Interaction design methods (Multi-modal and Intelligent Interaction) and apparatuses
- Human Systems Integration, Human Factors Engineering: state of the art in Usability, workload, and performance assessment methods and apparatus.
- Inclusion of Human Readiness Level into HSI
- Humans Systems Integration Inclusion in Systems Engineering
- Human-in-the-loop system data acquisition and performance modeling
- Trust computing methodology

CHI - Informatics

- Crew decision support systems
- Advanced Situation Awareness Technologies
- Intelligent Displays for Time-Critical Maneuvering of Multi-Axis Vehicles
- Intelligent Response and Interaction System
- Exploration Space Suit (xEMU) Informatics
- Graphic Displays to Facilitate Rapid Discovery, Diagnosis and Treatment of Medical Emergencies
- CHI machine learning methods and algorithms
- Imaging and information processing
- Audio system architecture for Exploration Missions

CHI - Audio

- Array Microphone Systems and processing
- Machine-learning front end audio processing
- Audio Compression algorithms implementable in FPGAs.
- COMSOL Acoustic modeling
- Front end audio noise cancellation algorithms implementable in FPGAs-example Independent Component Analysis
- Large bandwidth (audio to ultra-sonic) MEMs Microphones
- Sonification Algorithms implementable in DSPs/FPGAs
- Far-Field Speech Recognition in Noisy Environments

CHI - Imaging and Display

- Lightweight/low power/radiation tolerant displays
- OLED Technology Evaluation for Space Applications
- Radiation tolerant Graphics Processing Units (GPUs)
- Scalable complex electronics & software-implementable graphics processing unit

- Radiation-Tolerant Imagers
- Immersive Imagery capture and display
- H265 Video Compression
- Ultra High Video Compressions
- A Head Mounted Display Without Focus/Fixation Disparity
- EVA Heads-Up Display (HUD) Optics

Wearable Technology

- Tattooed Electronic Sensors
- Wearable Audio Communicator
- Wearable sensing and hands-free control
- Wearable Sensors and Controls
- Wearable digital twin/transformation sensor systems

Wireless and Communications Systems

- Computational Electromagnetics (CEM) Fast and Multi-Scale Methods/Algorithms
- EPCglobal-type RFID ICs at frequencies above 2 G
- Radiation Hardened EPCglobal Radio Frequency Identification (RFID) Readers
- Radiation robust 3GPP network technologies
- Robust, Dynamic Ad hoc Wireless Mesh Communication Networks
- Wireless Energy Harvesting Sensor Technologies
- Flight and Ground communication systems

Radiation and EEE Parts

- Mitigation and Biological countermeasures
- Monitoring
- Protection systems
- Risk assessment modeling
- Space weather prediction
-

8.7.7 Kennedy Space Center (KSC)

POC: Tim Griffin (timothy.p.griffin@nasa.gov)

- Storage, Distribution, and Conservation of Cryogenic Fluids and Commodities
- Tools and Techniques for Control, Operation, Inspection, Analysis and Repair
- Environmental and Green Technologies
- Safety Systems for Operations
- Communication and Tracking Technologies
- Robotic, Automated, and Autonomous Systems and Operations
- Operations Support and Advanced Studies Leveraging Primary Center Role Expertise
- Payload Processing and Integration Technologies

- Logistics
- Water/Nutrient Recovery and Management
- Food Production and Waste Management
- Plant Habitats and Flight Systems
- Robotic, Automated and Autonomous Food Production
- ISRU Development Planning/Strategy to Fit Into Architecture
- Resource Acquisition - Regolith/Trash & Gases Liquids
- Consumable Production - Extract/Produce Fuel
- In Situ Construction such as, Landing Pads, Roads, and Berms
- Distribution and Storage of In Situ Resources
- Scientific Instruments
- Resource Assessment/Prospecting

8.7.8 Langley Research Center (LaRC)

POC: Neyda Abreu, neyda.m.abreu@nasa.gov

POC	Technology Area - Topics	NASA Email
Alireza Mazaheri	Topic 1: Aerosciences	ali.r.mazaheri@nasa.gov
Topic 1: Aerosciences • Uncertainty quantification for high-fidelity multidisciplinary (e.g., aeroelastic, aeroacoustic) analysis for aircraft flight POC: Beth Lee-Rauch, e.lee-rausch@nasa.gov • Multi-physics high-fidelity approaches for advanced or emerging computer architectures POC: Beth Lee-Rauch, e.lee-rausch@nasa.gov • Machine learning for turbulent or transitional flow modeling POC: Beth Lee-Rauch, e.lee-rausch@nasa.gov • HYBRID turbulent simulation methods and models to simulate highly separated turbulent flows POC: Luther Jenkins, luther.n.jenkins@nasa.gov • Efficient synthetic turbulence generation methods POC: Luther Jenkins, luther.n.jenkins@nasa.gov • Wall models for compressible flows POC: Luther Jenkins, luther.n.jenkins@nasa.gov • High-order unstructured schemes for high-speed flows and aerothermodynamics POC: Alireza Mazaheri, ali.r.mazaheri@nasa.gov • Modular GPU-based chemically reacting solver with stiff integrator POC: Andrew Norris andrew.t.norris@nasa.gov • Uncertainty quantification for stochastic probability density function (PDF) methods		

POC: Andrew Norris andrew.t.norris@nasa.gov

- Gas lattice methods for continuum (high density) flows
  POC: Andrew Norris andrew.t.norris@nasa.gov
- Broadband noise prediction of advanced air mobility aircraft
  POC: Mike Doty, michael.j.doty@nasa.gov
- Novel material concepts to extend the frequency range of acoustic liners
  POC: Ran Cabell, randolph.h.cabell@nasa.gov
- Novel noise reduction concepts for urban air mobility (UAM) propulsors
  POC: Ran Cabell, randolph.h.cabell@nasa.gov

"Mike" Fremaux	Topic 2: Intelligent Flight Systems & Trusted Autonomy	c.m.fremaux@nasa.gov

Topic 2: Intelligent Flight Systems & Trusted Autonomy

Research in areas of advanced air mobility, increasingly automated and autonomous systems, robotics, and "smart cities" to enable current and future NASA missions and maintain U.S. aerospace preeminence. Development and validation of new architectures, technologies, and operations for increasingly complex and increasingly autonomous aerospace systems is accomplished by:

- Enabling robust control, vehicle performance, and mission management under nominal, and contingency management under off-nominal conditions.
- Ensuring robust and flexible human-machine integration and teaming.
- Advancing technologies for vehicle and system-autonomy, robotics, and flight vehicle environment awareness.
- Developing new methods and tools for the verification, validation, and safety assurance of complex and autonomous systems.
- Developing, maintaining, and utilizing experimental ground and flight test facilities and labs.

Chris Wohl	Topic 3: Advanced Materials, Manufacturing Technologies & Structural Systems	c.j.wohl@nasa.gov

Topic 3: Advanced Materials, Manufacturing Technologies & Structural Systems

- Rapid, scalable additive manufacturing
- Materials for extreme environments
- Materials manufacturing and characterization in extreme environments

• Computational modeling of the manufacturing process influence on metallic microscale and bulk properties • Computational modeling of polymer synthesis, processing, and additive manufacturing • Multifunctional materials supporting electric aircraft • Composite materials supporting green aviation • Process monitoring during composites fabrication • Materials systems supporting Human Landing System (HLS) and Environmental Control and Life Support System (ECLSS) objectives		
"Tony" Humphreys	Topic 4: Measurement Systems - Advanced Sensors and Optical Diagnostics	william.m.humphreys@nasa.gov

Topic 4: Measurement Systems - Advanced Sensors and Optical Diagnostics

- Measurement Systems - Advanced Sensors and Optical Diagnostics
  POC: "Tony" Humphreys - william.m.humphreys@nasa.gov
- Detectors and focal planes for Low Earth Orbit observing platforms
  POC: Alan Little, a.little@nasa.gov
- Electronics for both flight platforms and ground test facilities
  POC: Arthur Bradley, arthur.t.bradley@nasa.gov
- Optical components including adaptive optics based on phase change materials
  POC: Hyun Jung Kim, hyunjung.kim@nasa.gov
- Microwave, millimeter, and sub-millimeter wave detection systems
  POC: Jay Ely, jay.j.ely@nasa.gov
- Weather sensors for Advanced Air Mobility (AAM) applications
  POC: Jay Ely, jay.j.ely@nasa.gov
- Custom laser designs (wavelengths, pulse durations, etc.) for remote sensing and ground facility test applications
  POC: Paul Danehy, paul.m.danehy@nasa.gov
- Flow visualization methods for high-speed ground test facilities (supersonic to hypersonic)
- POC: Brett Bathel, brett.f.bathel@nasa.gov
- High spatial and temporal resolution velocimetry measurements, both seeded and seedless POC: Paul Danehy, paul.m.danehy@nasa.gov
- Global surface pressure and temperature measurements
  POC: Neal Watkins, anthony.n.watkins@nasa.gov
- Cryogenic and thermal sensors for ground test facilities
  POC: Lisa Le Vie, lisa.r.levie@nasa.gov
- Non-destructive evaluation (NDE) methods for crewed vehicle structural health
- POC: Patti Howell, patricia.a.howell@nasa.gov
- Automated non-destructive evaluation (NDE) methods and systems utilizing machine learning POC: Patti Howell, patricia.a.howell@nasa.gov

Ron Merski	Topic 5: Entry, Descent & Landing	n.r.merski@nasa.gov

Topic 5: Entry, Descent & Landing

- Advanced EDL architecture approaches
- Advanced EDL vehicle concepts – small spacecraft
- EDL systems analysis (empirical performance assessment tools, packaging)
- Aero-assist technologies -- Aerocapture concepts
- Aero maneuvering technologies – trim tabs, morphing, RCS, magneto-hydrodynamics (MHD)
- Decelerator technologies – ballutes, parachutes, supersonic retro-propulsion, hypersonic inflatable aerodecelerators (HIADs)
- High end computing for EDL modeling -- GPUs
- Flight mechanics and GNC methods
- Atmospheric model development
- Computational fluid dynamics methods and modeling
- Rarefied flow computations -- DSMC
- Complex fluid dynamics characterization -- plume surface interaction, supersonic retro-propulsion, RCS
- Unsteady aerodynamics measurement approaches
- Wind tunnel (subsonic, transonic, supersonic, hypersonic) aero and aeroheating instrumentation, flow characterization methods (MDOE), and testing approaches
- Entry systems structures, composites manufacturing and testing methods
- Landing system concepts
- Ultra-precise velocity and ranging methods -- lidar
- Flight test instrumentation and low-cost data acquisition
- Flight data reconstruction
- Uncertainty quantification

Allen Larar	Topic 6: Terrestrial and Planetary Atmospheric Sciences	allen.m.larar@nasa.gov

Topic 6: Terrestrial and Planetary Atmospheric Sciences

- Atmospheric science focus areas cover a broad range of measurements and applications, including:
    - Measurements of water vapor, carbon dioxide, ozone, methane, nitrogen oxides, and other important greenhouse gases
    - Aerosol and cloud properties

○ Atmospheric winds ○ Radiation budget ○ Atmospheric chemistry and air quality ○ Climate change		
Allen Larar	Topic 7: Innovative Concepts for Earth and Space Science Measurements	allen.m.larar@nasa.gov
Topic 7: Innovative Concepts for Earth and Space Science Measurements • Advanced active and passive remote sensing and in-situ concepts & sensors for new and improved measurements, including: ○ LiDAR ○ Radiometers ○ Spectrometers ○ Interferometers		

8.7.9 Marshall Space Flight Center (MSFC)

POC: John Dankanich, john.dankanich@nasa.gov and

https://www.nasa.gov/otps/center-chief-technologists/

These Principal Technologists and System Capability Leads are available for consultation with proposers regarding the state-of-the-art, on-going activities and investments, and strategic needs in their respective areas of expertise. Proposers are encouraged to consult with the appropriate PT or SCLT early in the proposal process.

POC	Technology Area	NASA Email
Danette Allen	Autonomous Systems	danette.allen@nasa.gov
Shaun Azimi	Robotics	shaun.m.azimi@nasa.gov
Jim Broyan	ECLSS[1] Deputy	james.l.broyan@nasa.gov
John Carson	EDL Precision Landing; HPSC	john.m.carson@nasa.gov
Scott Cryan	Rendezvous & Capture	scott.p.cryan@nasa.gov
John Dankanich	In Space Transportation	john.dankanich@nasa.gov
Terry Fong	Autonomous Systems	terry.fong@nasa.gov
Robyn Gatens	ECLSS Lead	robyn.gatens@nasa.gov
Julie Grantier	In Space Transportation	julie.a.grantier@nasa.gov
Mark Hilburger	Structures/Materials	mark.w.hilburger@nasa.gov

Michael Johansen	Dust Mitigation	michael.r.johansen@nasa.gov
Julie Kleinhenz	In Situ Resource Utilization	julie.e.kleinhenz@nasa.gov
Angela Krenn	Thermal Technologies	angela.g.krenn@nasa.gov
Ron Litchford	Propulsion Systems	ron.litchford@nasa.gov
Jason Mitchell	Communications & Navigation	jason.w.mitchell@nasa.gov
Michelle Munk	Entry, Descent and Landing (EDL)	michelle.m.munk@nasa.gov
Bo Naasz	Rendezvous & Capture	bo.j.naasz@nasa.gov
Denise Podolski	Sensors/Radiation/Comm.	denise.a.podolski@nasa.gov
Wes Powell	Avionics/Communications	wesley.a.powell@nasa.gov
Jerry Sanders	In Situ Resource Utilization	gerald.b.sanders@nasa.gov
John Scott	Space Power & Energy Storage	john.h.scott@nasa.gov
John Vickers	Advanced Manufacturing	john.h.vickers@nasa.gov
Sharada Vitalpur	Communications & Navigation	sharada.v.vitalpur@nasa.gov
Arthur Werkheiser	Cryofluid Management	arthur.wekheiser@nasa.gov
Mike Wright	Entry, Descent and Landing	michael.j.wright@nasa.gov

Propulsion Systems

- Launch Propulsion Systems, Solid & Liquid
- In Space Propulsion (Cryogenics, Green Propellants, Nuclear, Fuel Elements, Solar-Thermal, Solar Sails, Tethers)
- Propulsion Testbeds and Demonstrators (Pressure Systems)
- Combustion Physics
- Cryogenic Fluid Management
- Turbomachinery
- Rotordynamics
- Solid Propellant Chemistry
- Solid Ballistics
- Rapid Affordable Manufacturing of Propulsion Components
- Materials Research (Nano Crystalline Metallics, Diamond Film Coatings)
- Materials Compatibility
- Computational Fluid Dynamics
- Unsteady Flow Environments
- Acoustics and Stability
- Low Leakage Valves

Space Systems

- Surface Habitation
- Surface Construction and Manufacturing
- In Space Habitation (Life Support Systems and Nodes, 3D Printing)

- Mechanical Design & Fabrication
- Small Payloads (For International Space Station, Space Launch System)
- In-Space Asset Management (Automated Rendezvous & Capture, De-Orbit, Orbital Debris Mitigation, Proximity Operations)
- Radiation Shielding
- Thermal Protection
- Electromagnetic Interference
- Advanced Communications
- Small Satellite Systems (CubeSats)
- Structural Modeling and Analysis
- Spacecraft Design (CAD)

Space Transportation

- Mission and Architecture Analysis
- Advanced Manufacturing
- Space Environmental Effects and Space Weather
- Lander Systems and Technologies
- Small Spacecraft and Enabling Technologies (Nanolaunch Systems)
- 3D Printing/Additive Manufacturing/Rapid Prototyping
- Meteoroid Environment
- Friction Stir and Ultrasonic Welding
- Advanced Closed-Loop Life Support Systems
- Composites and Composites Manufacturing
- Wireless Data & Comm. Systems
- Ionic Liquids
- Guidance, Navigation and Control (Autonomous, Small Launch Vehicle)
- Systems Health Management
- Martian Navigation Architecture/Systems
- Planetary Environment Modeling
- Autonomous Systems (reconfiguration, Mission Planning)
- Digital Thread / Product Lifecycle Management (for AM and/or Composites)
- Material Failure Diagnostics

Science

- Replicated Optics
- Large Optics (IR, visible, UV, X-Ray)
- High Energy Astrophysics (X-Ray, Gamma Ray, Cosmic Ray)

- Radiation Mitigation/Shielding
- Regolith (simulants, ISRU applications, extraction)
- Gravitational Waves and their Electromagnetic Counterparts
- Solar, Magnetospheric and Ionospheric Physics
- Planetary Geology and Seismology
- Planetary Dust, Space Physics and Remote Sensing
- Surface, Atmospheres and Interior of Planetary Bodies
- Earth Science Applications
- Convective and Severe Storms Research
- Lightning Research
- Data Informatics
- Disaster Monitoring
- Energy and Water Cycle Research
- Remote Sensing of Precipitation

8.7.10 Stennis Space Center (SSC)

POC: Anne Peek anne.h.peek@nasa.gov

Intelligent Integrated System Health Management (ISHM) for Ground and Space Applications

Integrated system health management (ISHM) is a unified approach to assess the current and future state of a system. ISHM incorporates interdependencies with other systems, available resources, concepts of operations, and operational demands. Multiple sources of data are used to analyze the behavior of a system, identify trends, and estimate the remaining useful life of a system. SSC is interested in methodologies to assess the "health" of ground and space systems that enable sustainable lunar exploration and a commercial lunar economy. SSC creates and applies intelligent models of components that constitute systems. EPSCoR research could: (1) develop monitoring and diagnostic capabilities that use, or can be incorporated by, intelligent models to monitor and document the operation of the system; or (2) develop prognostics capabilities to accurately estimate the remaining useful life of a component or a system.

Autonomous Operations for Ground and Space Applications

Unprecedented levels of autonomy will be required by government and industry to enable sustainable space exploration of the Moon and Mars. Trust in these autonomous systems must be established. SSC is interested in creating robust, predictable, intelligent, hierarchical, distributed, autonomous systems to operate ground (Earth) systems, surface (Moon or Mars) systems, and space vehicles. EPSCoR research could: (1) create architectures and/or procedures to design predictable, safe autonomous systems (no black box approaches dependent on sparse training data); or (2) design and demonstrate edge-enabled autonomous operations (no connection to a cloud or off-premises/vehicle server) translatable to radiation-tolerant hardware suitable for Moon or Mars missions.

Advanced Propulsion Test Technology Development

Launch systems continue to undergo a design and manufacturing revolution. Rigorous testing mitigates design and manufacturing issues with these systems. However, as the launch industry grows dramatically, rocket propulsion testing must significantly lower the costs of testing and increase test throughput.

EPSCoR research could: (1) investigate the use of design-of-experiments techniques to optimize test operations to reduce the total number of tests required to accurately estimate the performance of a rocket engine or its components; (2) investigate options to transform the 2 design and manufacture of high-pressure (up to 15,000 psi), LOX-compatible, cryogenic tanks; (3) investigate the use of artificial intelligence and/or quantum computing to rapidly (and cost effectively) evaluate test site locations and optimize test stand configurations to meet customer needs, and generate the essential design information (preliminary design review level) for the best candidates; (4) improve capabilities and methods to accurately predict and model the transient fluid structure interaction between cryogenic fluids and immersed components to predict the dynamic loads and frequency response of facilities; and (5) improve capabilities to predict the behavior of components (valves, check valves, chokes, etc.) during the facility design process are needed. These capabilities are required for modeling components in high pressure (to 12,000 psi), with flow rates up to several thousand lb/sec, in cryogenic environments and must address two-phase flows. Challenges include accurate, efficient, thermodynamic state models; cavitation models for propellant tanks, valve flows, and run lines; reduction in solution time; improved stability; acoustic interactions; and fluid-structure interactions in internal flows

Advanced Rocket Propulsion Test Instrumentation

Rocket propulsion system development is enabled by rigorous ground testing to mitigate the propulsion system risks inherent in spaceflight. Test articles and facilities are highly instrumented to enable a comprehensive analysis of propulsion system performance. Advanced instrumentation has the potential for substantial reduction in time and cost of propulsion systems development, with substantially reduced operational costs and improvements in ground, launch, and flight system operational robustness.

EPSCoR research could design and demonstrate a wireless, highly flexible instrumentation solution capable of multiple types of measurements (e.g., heat flux, temperature, pressure, strain, and/or near-field acoustics). These advanced instruments should function as a modular node in a sensor network, capable of performing some processing, gathering data, and communicating with other nodes in the network. The sensor network must be capable of integration with data from conventional data acquisition systems adhering to strict calibration and timing standards (e.g., Synchronization with Inter-Range Instrumentation Group— Time Code Format B (IRIG-B) and National Institute of Standards and Technology (NIST) traceability is critical to propulsion test data analysis.)

Appendix 8.B: Contact/Inquiries

For inquiries regarding technical and scientific aspects of NASA's Research Focus Areas in this NOFO, please contact the designated POC.

8.B.1 Mission Directorates: Inquiries/Contacts

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8.B.2 NASA Centers: Inquiries/Contacts

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APPENDIX 9: MUREP Institutional Research Opportunity (MIRO)

9.1 PROGRAM DESCRIPTION

9.1.1 Overview of the Funding Opportunity

The Minority University Research and Education Project (MUREP) is administered through NASA's Office of STEM Engagement (OSTEM). Through MUREP, NASA provides financial assistance via competitive awards to Minority Serving Institutions (MSIs), including Historically Black Colleges and Universities (HBCU), Hispanic Serving Institutions (HSI), Asian American and Native American Pacific Islander Serving Institutions (AANAPISI), Alaska Native and Native Hawaiian-Serving Institutions (ANNH), Tribal Colleges and Universities (TCU), Native American-Serving Nontribal Institutions (NASNTI), and other MSIs, as required by MSI-focused Executive Orders. These MSI recipient institutions then provide their students financial assistance to study science, technology, engineering and mathematics (STEM) fields.

MUREP investments enhance the research, academic and technology capabilities of MSIs through multiyear cooperative agreements. Awards assist faculty and students in research and provide authentic STEM engagement related to Agency missions. Additionally, awards provide NASA specific knowledge and skills to MSI students who have historically been underrepresented and underserved in STEM. MUREP investments assist NASA in meeting the goal of a diverse workforce through student participation in internships and fellowships at NASA Centers and the Agency's Jet Propulsion Laboratory (JPL).

The NASA OSTEM MUREP Program solicits proposals from four-year colleges/universities designated by the U.S. Department of Education as MSIs. (see the NASA MSI List) for the MUREP Institutional Research Opportunity (MIRO) awards. MIRO develops significant scientific, engineering, and/or technology research centers. The purpose of MIRO is to strengthen and develop the research capacity and infrastructure of MSIs in areas of strategic importance and value to NASA's mission and priorities. MIRO awards promote STEM literacy and enhance and sustain the capability of institutions to perform NASA-related research and education. Additionally, MIRO strengthens student participation in research at MSIs in order to develop and diversify the next generation of the STEM workforce. MIRO awards directly support research pertinent to NASA's five Mission Directorates (MDs) – Aeronautics Research, Exploration Systems Development, Space Operations, Science, and Space Technology.

Background

The United States is becoming a minority-majority nation. As Science, Technology, Engineering, and Math (STEM) employment continues to grow at a faster pace, the STEM workforce must increasingly come from the nation's underrepresented population (Jackson & Rudin, 2019; Solomon, 2019). A catalyst tool that will advance this mission is Minority Serving Institutions (MSIs). MSIs are federally classified institutions that enroll diverse groups of students, particularly within STEM fields (Sansone & Sparks, 2022; Wilson & Chavela Guerra, 2021). Therefore, MSIs play a critical role in advancing diversity in STEM. As a result, it is imperative to focus on capacity building, which is developing the knowledge, attitude, and skills within these institutions (Jayachitra, 2023).

Strengthening and improving student learning among MSIs will significantly impact the success of underrepresented students and help fill the gap in the STEM workforce. Capacity-building initiatives fill the gap by equipping MSIs with the resources to develop more robust research programs and promote innovation. According to Kassu (2020), involving undergraduate students in research projects and practical laboratory experiences enhances students' learning. Students with undergraduate research experiences have better interest and motivation to advance in STEM-related professional careers (Kassu, 2020). Adding more sequenced and comprehensive courses and opportunities to engage in hands-on and culturally relevant research is also helpful (NASEM, 2019).

Partnering with local organizations fosters the student-teacher relationship in developing programs. It creates avenues for STEM jobs to be in more places so that people can contribute their ideas and talent where they live (Panchanathan, 2023). Success in capacity building often requires the institution to strengthen the participation of faculty and researchers at MSIs in the research programs. One study suggests faculty training on research, mentorship opportunities for MSI faculty with experienced research faculty, opportunities to meet future collaborators, and seed money for MSI faculty to learn from faculty at research-intensive institutions will build such capacity (Wilson & Chavela Guerra, 2021).

9.1.2 Goals and Objectives

MIRO cooperative agreements are competitively awarded to MSIs to promote research capacity, expand aerospace research, increase workforce diversity, and strengthen students' STEM skills.

The MIRO awards goals and objectives are to:

1. **Expand the nation's base for aerospace research and development by fostering new aerospace research and technology development concepts aligned with NASA research priorities as defined by NASA's MDs.**
   Objective 1.1 *Develop significant scientific, engineering, and/or technology research centers at the MSI that align and engage one or more programs of the NASA Mission Directorates.*

   Objective 1.2 *Increase the lead institution's capacity to contribute to the priorities of NASA's Mission Directorates (Aeronautics Research, Exploration Systems Development, Science, Space Operations and Space Technology) and NASA's Centers and facilities.*

2. **Promote institutional advancement and enhanced research capacity through partnerships among MSIs, other academic institutions, NASA, and industry.**

   Objective 2.1 *Increase the lead institution's ability to sustain research efforts through development of strategic partnerships.*

Objective 2.2 Increase the lead institution's pursuit of additional funding opportunities offered by NASA, industry, and other agencies.

Objective 2.3 Increase the ability of research leadership at the lead institution to leverage resources to enhance its research capacity at the project, program, department, college, and/or university levels.

3. **Strengthen participation of faculty, researchers, and students at MSIs in the research programs of NASA's MDs.**

   Objective 3.1 Increase faculty and researcher knowledge and skills in NASA-related research through professional development and NASA research opportunities.

   Objective 3.2 Increase capacity to develop student knowledge and skills in NASA-related research through curriculum enhancement, redesign, and development at the course, degree, and/or department levels

   Objective 3.3: Increase capacity to develop student knowledge and skills in NASA-related research through NASA internships and opportunities.

4. **Facilitate mechanisms to ensure degrees awarded to students from MSIs in NASA-related fields reflect the diversity of our nation and contribute to the diversity of the NASA workforce.**

   Objective 4.1 Increase the number of undergraduate and graduate degrees awarded to students from MSIs in NASA-related fields.

9.1.3 National Priorities

MIRO addresses Executive Orders 13985, 14031, 14041, 14045, 14049, 14050, and 14091 by providing funding to MSIs to build research capacity through curricular innovations aligned with NASA's missions and projects. Federal Register :: Executive Orders

As part of the implementation of the 2018 Committee on STEM Education (CoSTEM) Federal STEM Education Strategic Plan, federal departments and agencies that have STEM education programs, investments, and activities have identified the specific pathways and associated objectives that they will contribute to through mission-specific actions. The CoSTEM four Pathways to Success, Develop and Enrich Strategic Partnerships, Engage Students where Disciplines Converge, Build Computational Literacy, and Operate with Transparency and Accountability, should be evident in the goals and objectives that the funding will be used to implement. Applicants are highly encouraged to propose innovative and seemingly traditional or non-traditional STEM ideas that will incorporate the subcategories of the CoSTEM Pathways to Success; specifically, Foster STEM Ecosystems that Unite Communities, Increase Work-Based Learning and Training through Educator-Employer Partnerships, and Encourage Transdisciplinary Learning.

9.1.4 Agency Priorities

MIRO addresses the following NASA goals and objectives outlined in the 2022 NASA Strategic Plan including but not limited to:

- **Strategic Goal 2: Extend human presence to the moon and on towards Mars for sustainable long-term exploration, development, and utilization**
  Strategic Objective 2.3: Develop capabilities and perform research to safeguard explorers.

- **Strategic Goal 3: Catalyze economic growth and drive innovation to address national challenges.**
  Strategic Objective 3.1: Innovate and advance transformational space technologies.

- **Strategic Goal 4: Enhance capabilities and operations to catalyze current and future mission success.**
  Strategic Objective 4.1: Attract and develop a talented and diverse workforce.

  Strategic Objective 4.3: Build the next generation of explorers.

These measures will be supported by the agency's short-term Annual Performance Indicators, which set quantifiable targets for NASA offices, programs and projects. NASA's goals and objectives are subject to change over time to adapt to national and agency-wide priorities. NASA's Strategic Goals and Objectives relevant to education are outlined in the *2022 NASA Strategic Plan*.

9.1.4.1 Relevance to NASA and OSTEM

MIRO addresses the following strategic goals outlined in the 2020-2023 NASA Strategy for STEM Engagement:

- **Strategic Goal 1.0:** Create unique opportunities for a diverse set of students to contribute to NASA's work in exploration and discovery.
- **Strategic Goal 2.0:** Build a diverse future STEM workforce by engaging students in authentic learning experiences with NASA's people, content, and facilities.
- **Strategic Goal 3.0:** Attract diverse groups of students to STEM through learning opportunities that spark interest and provide connections to NASA's mission and work.

OSTEM monitors progress of its investments towards achieving programmatic goals and objectives by assessing recipients' achievements towards the following multi-year OSTEM Performance Goals (PGs) outlined in the Annual Performance Plan (APP), which directly align with the 2020-2023 NASA Strategy for STEM Engagement Strategic Goals 1,2 and 3:

Performance Goal 4.3.1: Create unique opportunities for a diverse set of students to contribute to NASA's work in exploration and discovery.

Performance Goal 4.3.2: Build a diverse future STEM workforce by engaging students in authentic learning experiences with NASA's people, content, and facilities.

Performance Goal 4.3.3: Attract diverse groups of students to STEM through learning opportunities that spark interest and provide connections to NASA's mission and work.

9.1.4.2 Research Priorities for NASA Mission Directorates (MDs) and Centers
MUREP is designed to capitalize on the unique facilities, capabilities, and staff of MSIs to contribute to the priorities of NASA's MDs. Through MIRO, NASA seeks to strengthen the research capacity of MSIs in areas of priority for NASA MDs and engage diverse students in authentic learning experiences with NASA's staff, content, and facilities. Each proposal shall identify the primary NASA research priorities to which the proposed activities will align. The following websites can be used to access additional information about NASA's MDs.

Aeronautics Research Mission Directorate (ARMD)

Exploration Systems Development Mission Directorate (ESDMD)

Space Operations Mission Directorate (SOMD)

Science Mission Directorate (SMD)

Space Technology Mission Directorate (STMD)

NASA's MD goals and objectives can also be found in EONS-2024, Appendix 8 and Appendix 9A of this Notice of Funding Opportunity (NOFO).

9.1.4.3 Relevance to Lead Institution
MIRO goals and objectives include strengthening institutional "research capacity and infrastructure" and increasing "the ability of research leadership at the lead institution to leverage resources to enhance its research capacity at the project, program, department, college, and/or university levels." Proposals shall demonstrate how the proposed project will be a significant element of the Lead Institution's long and short-term STEM strategic research plans, interests, and capabilities and how the project will result in enhanced research capacity at multiple levels. It is recommended that the proposal reference elements of department, college, and university strategic plan(s), research priorities, and/or other pertinent university documents.

9.1.4.4 Data Management Plan (DMP)
All proposals submitted under this Notice of Funding Opportunity (NOFO) are required to submit a Data Management Plan (DMP) in accordance with the NASA Plan for Increasing Access to the Results of Scientific Research at http://www.nasa.gov/sites/default/files/files/NASA_Data_Plan.pdf. Data resulting from funded programs may be quantitative or qualitative in nature.

In addition, Frequently Asked Questions (FAQ) were posted in a website that addresses questions about DMP requirements Note that although the questions pertain to the SMD ROSES Notice of Research Announcement (NRA), the requirements provided in the answers also apply to this opportunity.

Note: Proposers that include a plan to archive data shall allocate suitable time for this task.

9.1.4.5 Data Sharing Plan (DSP)

All proposals submitted in response to this NOFO shall include a DSP as part of the project description describing how data and information obtained through MIRO will be shared. Award recipients shall promptly prepare and submit for publication, with authorship that accurately reflects the contributions of those involved, all significant findings from work conducted under the MIRO cooperative agreement. MIRO recipients shall continuously develop technical paper(s)/journal article(s) during the five-year period of performance. MIRO recipients are expected to share their findings at appropriate professional conferences, meetings, and/or workshops. Recipients may also develop oral or poster presentations using the information generated through this cooperative agreement. NASA will review each proposer's DSP during the proposal evaluation phase. Costs of the DSP, including travel for PI, Co-Is, and students shall be included in the proposed budget. MIRO recipients shall ensure that all publications developed as a result of this cooperative agreement and authored or coauthored by investigators and sub-recipients and funded, in whole or in part by NASA, are submitted to the MIRO Activity Manager. Recipients shall also provide a list of these publications with its annual and final reports that are required to be submitted to the NASA Shared Services Center (NSSC) and the MIRO Activity Manager.

9.1.4.6 Roles and Responsibilities of Key

Personnel Principal Investigator (PI)

Every institution submitting a proposal shall identify a single individual as the PI, who will be responsible for the quality and direction of the entire proposed effort and for the use of all awarded funds. PIs shall meet all the following criteria on the date of the proposal submission:

1. Must be a tenure or tenure-track faculty member of the lead institution, if a tenure system is established. Eligible four-year institutions that do not have a tenure track system shall submit a letter of commitment to comply with guidance provided under section 9.6.2 Summary of Recipient Responsibilities (this document), which states that any proposed change to the PI under the agreement is subject to NASA approval.
2. Must have a Ph.D. or equivalent in an engineering, computer science, technology, mathematics, or science discipline relevant to NASA's research needs.

Eligible PIs are required to submit a letter of commitment to comply with the guidance under Section 2.17 of the *NASA Proposer's Guide*. Any proposed change to the PI under the cooperative agreement is subject to prior written NASA approval.

The PI's responsibilities include, but are not limited to:

- Provides visionary and contemporary leadership for the delivery of high-impact research and educational programs.
- Provides overall leadership, administration, implementation, and performance data collection and reporting of the project and its activities.
- Engages with the institution's department, college, and university leadership to promote institutional advancement and enhanced research capacity.

- Carries out supervisory responsibilities for project staff in accordance with the organization's policies and applicable state and federal laws.
- Provides day-to-day management of project budgets and ensuring that all applicable institutional and NASA rules, as well as state and federal guidelines, are followed in the utilization of such funding.
- Engages with the Independent Evaluator and project administration support staff to ensure evaluation and required reports are appropriately conducted, compiled, and reported.
- Participates in MIRO program teleconferences and meetings.
- Attends the annual conference hosted by OSTEM.
- Coordinates and administers MIRO data collection, analysis, and reporting of such data to NASA in alignment with guidance and the approved Gateway data management system.
- Coordinates intern placements and intern registration in Gateway.

Co-Investigator (Co-I)

A Co-I is a member of the proposal's investigation team who may hold either a full-time or limited-term appointment and who is a critical "partner" for the conduct of the investigation through the contribution of unique expertise and/or capabilities. A Co-I must have a well-defined, and generally sustained, continuing role in the proposed investigation, serve under the direction of the PI, and may or may not receive funding through the award. Only an individual who has formally agreed to the role may participate as a Co-I even if his/her participation is at no cost (i.e., contributed) to the proposal. There is no limit for the number of Co-Is that can participate in a MIRO project.

Independent Evaluator (IE)

Every institution submitting a proposal shall identify a single individual, an IE, who will be responsible for analyzing qualitative and quantitative data for the sites evaluation activities and assisting the PI in development and implementation of the site's comprehensive Evaluation Plan. Within three months after award, every institution submitting a proposal in response to this opportunity, shall submit a Comprehensive Evaluation Plan, for which both the PI and IE have concurred on in writing. The MIRO Management and OSTEM Performance and Evaluation (P&E) Team will provide guidance on the proposed plan. IE responsibilities include, but are not limited to:

- Develop a Comprehensive Evaluation Plan for proposed program in collaboration with the PI and the MIRO management;
- Coordinate and administer data collection, analysis, and reporting of proposed program evaluation data;
- Provide status updates to the PI on evaluation activities, progress, and challenges;
- Participate in annual kick-off meetings, virtual site visits, and evaluation technical assistance meetings with MIRO Management Team to review the proposed program's progress in achieving MIRO goals and objectives; and
- Develop an annual evaluation report and final evaluation report

9.2 FEDERAL AWARD INFORMATION

Subject to Congressional appropriation of sufficient funds and NASA's receipt of proposals of adequate merit, NASA expects to select **up to seven proposals** for MIRO. The **period of performance is five years**. Recipients of awards under this NOFO will be designated as NASA MIRO Group 8. Successful proposals for Group 8 will be funded as cooperative agreements. As cooperative agreements, substantial involvement is expected between recipients and NASA. For specific description of the substantial involvement required of recipients, see **Section 9.1.4.6 Roles and Responsibilities of Key Personnel** and **Section 9.6.1, Cooperative Agreement Award Reporting Requirements** of this NOFO. **Funding shall be up to a maximum of $4,999,999 per five-year award**. **Funding for each MIRO award may not exceed $1,250,000/per year in any given year and shall not exceed a total of $4,999,999 over the five-year performance period**. The total maximum amount of funds expected to be awarded is up to a maximum of $34,999,993 with up to $8,750,000 awarded annually for each of the five years. The period of performance is expected to begin two to three months from the date of the selection announcement.

Proposals shall cover the full five years of performance, with a maximum funding request of $1,250,000 each year. The continuation of NASA funding on each award annually is based on a satisfactory evaluation of documented progress; compliance with data reporting, applicable regulations and laws, other program requirements, fulfillment of fiduciary responsibilities, and the availability of appropriated funds.

9.2.1 Partnerships and Collaborations

Universities, industry, and government agencies play major roles in carrying out much of NASA's work and conducting research and development activities in related areas. Carefully constructed partnerships between MIRO recipients and other entities will lead to substantial benefits for all parties involved. MIRO recipients may gain access to special-purpose facilities, exposure to new work areas, leveraged support for their research efforts, and future funding sources. Industry and other universities and colleges may gain from the capabilities that the MIRO recipients bring in specialized work areas and from MIRO-funded students who may be recruited as future employees or graduate students. NASA benefits from the increased productivity that these partnerships bring to missions and projects.

Proposals shall demonstrate partnerships and collaborations among various entities, including academic institutions, government agencies, business and industry, private research foundations, and non-profit agencies. Proposals shall describe how the proposed partnerships and collaborations will increase student access to research opportunities; achieve MIRO goals and objectives; leverage significant sources of additional funding; obtain essential services that are not available at the proposer's home institution; and/or contribute to sustainability.

Partnerships shall be coordinated in advance and described in detail in the proposal. The budget narrative shall document how partnerships will contribute to the proposing institution's research capacity. (**See Section 9.2.2, Integration with NASA and Other OSTEM and/or Mission Activities of this NOFO**). Note: The lead MSI shall receive not less than 70 percent of the proposed budget.

At a minimum, proposals shall include each of the following partners:

- Lead MSI four-year college/university
- **At least one additional four-year institution of higher education** with established research capabilities. Additional institutions do not need to be MSIs. Also, proposers are strongly encouraged to partner with two-year institutions of higher education, to gain an advantage in proposal review, including those from which the lead institution receives a significant number of transfer students; and
- At least one NASA center (including JPL) can be considered for a partnership. Note: Proposers are strongly encouraged to contact a NASA Center or facility at least one month prior to the proposal due date to discuss collaborations. Contact information for Center/Mission Directorate personnel is listed in EONS-2024 Appendix 8. Points of contact for OSTEM offices at Centers (plus the Education Office at JPL) can be found here.

In addition, it is strongly encouraged that the proposal includes partnerships and/or collaborations with at least one industry or other government agency that is relevant to the scientific, engineering, and/or technology proposed. This will not impact the proposal score.

9.2.2 Integration with NASA and Other OSTEM and/or Mission Activities

The MIRO Management Team will facilitate communication between and among recipients, and NASA OSTEM and Subject Matter Experts to promote synergy, leverage ongoing work, and support relationship building during the five-year award period of performance. The MIRO Activity Manager will establish opportunities to share information with recipients and appropriate members of NASA OSTEM. To facilitate communication and networking, recipients shall participate in a MIRO kickoff meeting, training workshops, and activity meetings as required. PIs shall participate in one annual Agency OSTEM in-person meeting.

9.2.3 Budget Guidelines and Requirements

9.2.3.1 Total Budget Guidelines and Funding Restrictions

Proposed use of MIRO funds shall be for support of faculty and researchers to conduct research, engage in professional development, and redesign, enhance, or develop curriculum; for support of undergraduate students, graduate students, post-doctoral fellows and their research; for research-related equipment, travel, and materials; and to support project management, administration, and evaluation.

MIRO budget proposals shall address costs that will be incurred by NASA Centers and/or NASA JPL for the use of facilities and/or technical support. The costs of such NASA services shall be included in the proposal as part of the annual funding amount. For additional budget guidelines, see the *NASA Proposer's Guide*.

All costs charged to awards covered by this NOFO must comply with the Uniform Administrative Requirements in 2 CFR parts 200 and 1800, unless otherwise indicated in the NOFO, the terms and conditions of the award, and the *Grant and Cooperative Agreement Manual (GCAM).*

- All proposed funds must be allowable, allocable, and reasonable. Funds may only be used for the project. All activities charged under indirect cost must be allowed under 2 CFR 200 cost principles.
- Grants and cooperative agreements shall not provide for the payment of fee or profit to the recipient.
- Unless otherwise directed in 2 CFR 200, for changes to the negotiated indirect cost rate that occur throughout the project period, the recipient must apply the rate negotiated for that year, whether the rate is higher or lower than at the time the budget and application was awarded.
- Proposals must not include bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds basis.
- Any funds used for match or cost sharing must be allowable under 2 CFR 200.
- The award recipient/lead institution must use one of the methods of procurement as prescribed in 2 CFR 200.320, Methods of procurement to be followed.
- All awards under this NOFO will be made by NASA to the lead institution. Subcontracts, collaborations, and any other agreements described in the proposal are between that entity and the lead institution, not between that entity and NASA. No more than 30% of the total budget may be allocated to subcontracts or collaborations.
- Indirect costs including the lead institution's general and administrative (G&A) expenses and Facilities & Administrative (F&A) Costs are permitted under this NOFO. Any indirect costs must comply with the "Indirect Costs" section of the *NASA Grant and Cooperative Agreement Manual (GCAM),* currently section 5.14.2 and be consistent with the definition of "modified total direct costs" in 2 CFR 200.1, Definitions. The budget must clearly include information for the lead institution's overhead/ G&A expenses.
- Proposals shall clearly indicate key personnel roles, the division of labor, and labor costs. The funding distribution shall be commensurate with the roles of the team members in supporting project activities.
- Foreign travel costs are allowable with justification stated in the proposal (refer to sections 9.2.3.4 and 9.3.3 in this document for more details).

- The lead MSI must retain a minimum of 70 percent of the *total budget*; a maximum of 30 percent of the total budget may be distributed for subcontracts to teaming organizations and collaborators.
- Only student internships, research assistantships, and/or apprenticeships at NASA facilities or institutions of higher education shall be paid using funds awarded by NASA. Experiential learning opportunities (e.g., internships or apprenticeships) with industry collaborators shall not be funded with MIRO award funding.
- A maximum of 15 percent of the *total budget* may be used for acquiring direct NASA services related to the conduct of research (i.e., cost for use of NASA unique facilities, etc.).
- A maximum of 20 percent of the *total budget* may be used for infrastructure (equipment and laboratory facilities).
- A maximum of five percent of the *total budget* may be distributed to NASA Centers that are partnering with institutions. These funds may not be used for NASA civil servant salaries or travel. The maximum total five-year budget per recipient is $4,999,999. The proposed plan and evaluation shall have a five-year period of performance.
- A minimum of 20 percent and a maximum of 40 percent of the *annual budget* must be allocated for undergraduate and graduate student support (including fringe benefits and indirect costs, if any).
    - A minimum of five percent of the *annual budget* of 20-40% stated above must be allocated to fund students participating in internships at NASA Centers or JPL. Required funding for students participating in internships at NASA Centers or JPL is considered part of the 20 – 40% allocation for student support amount identified above. U.S Citizenship is required for individuals who need access to NASA Centers or JPL for participation in the internship experience. These internships are solely for students from the recipient institutions and its partners. At a minimum, students participating in an internship experience should receive funding commensurate with the current NASA standard stipends (contact a NASA OSTEM Office or JPL for current stipend rates). Current internship rates are included in **Section 9.5.3** of this document. Institutions have the flexibility to augment stipends.

9.2.3.2 Annual Budget Guidelines and Restrictions

- The maximum annual budget for each recipient is $1,250,000, not to exceed the total budget of $4,999,999 during the five-year period of performance.
- The budget shall include the IE's compensation, including travel to project annual meetings and site visits.
- Travel costs for required annual conference attendance by PIs shall be included in the budget. Proposers should include travel costs for this event in their budget.

Other Guidelines and Restrictions

- A maximum of 50 percent of the annual salary for the PI, Co-Is, and senior researchers may be charged to this award.
- The budget shall include support for an administrative assistant for the project, who will provide PI support for monitoring the budget, track project students, and assist with other administrative tasks. Alternatively, the proposal shall clearly indicate how other resources will support this role.

9.2.3.3 Cost Sharing or Matching

Cost sharing or matching is not required but may be offered. However, voluntary cost sharing or matching will not be considered in the evaluation of proposals.

9.2.3.4 Direct Costs Limitations

Foreign travel is discouraged, however may be considered on a case-by-case basis and approved by the MIRO Activity Manager and/or MUREP Program Manager. Inclusion of foreign travel will not impact the evaluation of proposals.

9.2.3.5 Indirect Facilities & Administrative (F&A) Costs

F&A costs are allowable.

9.2.4 Program Evaluation

NASA identifies evidence of effective practices of MIRO activities through program evaluation. Evidence is a key criterion in NASA's competitive processes for allocating resources, ensuring that the most effective activities are supported. Program evaluations are planned studies using research methods to collect and analyze data to assess to what extent activities/programs are being implemented and what, if any, impact can be measured. Evaluations answer specific questions about performance and may focus on assessing activity/program process and outcomes.

Proposers shall develop a Comprehensive Evaluation Plan that follows generally accepted professional standards for evaluation research. An initial plan is required as part of the original proposal and shall include strategies for collecting data for performance metrics for MIRO Reporting Requirements and independent program evaluation.

Effective evaluation models are evidence-based, meaning that they are based on verifiable data and information that has been gathered using the standards of professional research and evaluation organizations. Such data may be qualitative and/or quantitative. A wide variety of evaluation designs may be utilized, such as case studies, quasi-experimental designs, or experimental designs, as well as data collection methods, such as key informant interviews, surveys, direct observation, or focus group discussions. Regardless, such data shall pass the tests of reliability and validity, which are different for qualitative and quantitative data.

NASA sets concrete performance goals and is accountable to those goals through a framework that measures progress. Objective and verifiable performance metrics, internal and external review processes, valid and reliable data collection instruments, and evaluation studies are used to assess progress and performance across the portfolio. Through performance monitoring, assessment, and a meta-evaluation of the MIRO program, NASA will demonstrate its results-driven management approach focused on optimizing value to the American public. In accordance with this objective, the MIRO Management will provide feedback and negotiate the final evaluation plans with grantees to ensure commonality across evaluation methods so that this meta-evaluation may be achieved.

9.3 ELIGIBILITY INFORMATION

9.3.1 NASA's Commitment to Diversity and Inclusion

NASA recognizes and supports the benefits of having diverse and inclusive scientific, engineering, and technology communities and fully expects the reflection of such values in the composition of all panels and teams, including peer review panels, proposal teams, science definition teams, and mission and instrument teams. Per federal statutes and NASA policy, no eligible applicant shall experience exclusion from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from NASA on the grounds of their race, color, religion, age, sex, national origin, or disability. NASA welcomes proposals from all qualified and eligible sources, and strongly encourages proposals from HBCUs, MSIs, small disadvantaged businesses (SDBs), veteran-owned small businesses, service-disabled veteran-owned small businesses (SDVOSB), HUBZone small businesses, and women-owned small businesses (WOSBs), as eligibility requirements apply.

9.3.2 Eligible Applicants

To be eligible for this funding opportunity, all proposals shall originate from an institution designated and listed by the U.S. Department of Education (DOE) as four-year MSI college/university on the proposal due date (see NASA MSI List). Proposals from institutions that are not designated and listed by the DOE as an MSI on the proposal due date will result in NASA returning the proposal without review, as such proposals are not eligible to receive an award under this NOFO. Any arrangement or agreement to have the fiscal management and/or administration of the award performed by a third party is between the recipient and the third party, (e.g., an affiliated Board of Regents, University System or Foundation). Institutions not meeting these criteria are encouraged to **collaborate** with colleges or universities that satisfy the requirements.

Eligible lead institutions for this funding opportunity include

- Public and state-controlled institutions of higher education, and
- Private institutions of higher education

Further information defining the individual types of organizations are available on Grants.gov and 2 CFR Part 200.1: Education Organizations.

IMPORTANT: Universities awarded as part of MIRO Group 6, Group 6R, and Group 7 are ineligible to propose as a lead institution to this funding opportunity. These institutions are encouraged to consider partnering with an eligible institution.

Institutions that have not previously received MIRO (formerly referred to as URC or University Research Center) award funding will receive higher priority in the selection process.

9.3.2.1 Limit on the Number of Proposals per Unique Entity Identifier (UEI)

Eligible institutions shall submit only ONE lead proposal per UEI number. Eligible institutions that have multiple and/or different UEI numbers shall submit no more than one lead proposal from each different UEI number. If an eligible organization submits more than one lead proposal using the same UEI number, then none of the proposals will be evaluated.

Eligible institutions may submit a proposal as the lead institution in accordance with the above restriction, and/or be included as an unfunded partner or sub-awardee in any number of proposals in a non-lead role.

9.3.3 Proposals Involving Foreign Participation

Except as outlined in the certification regarding restriction on doing business with certain countries, NASA welcomes proposals that include the participation of non-U.S. organizations. However, proposals that offer research to be performed with a non-U.S. organization as part of a proposal submitted by a U.S. organization typically are supported on a no-exchange-of-funds basis. For additional guidance on foreign participation, see the *NASA Proposer's Guide*, Appendix A. Note: Foreign institutions are not eligible to submit a proposal in response to this NOFO.

9.3.4 Ineligibility of Proposals That Include Participation of China or Chinese-Owned Companies

Proposals involving bilateral participation, collaboration, or coordination in any way with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds basis, shall be ineligible for award.

9.3.5 Other Eligibility Criteria

All proposals shall identify at least one additional four-year US college or university collaborator (MSI or non-MSI), and at least one NASA center or facility collaborator. Proposals not meeting this requirement will not be eligible for award and will not be reviewed.

All collaborators must demonstrate their awareness of the proposal and summarize plans for participation via Letters of Support (see EONS-2024, and the *NASA Proposer's Guide*, for additional information).

9.3.6 Export Control

Recipients shall comply with all U.S. export control laws and regulations, including the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, in the performance of this cooperative agreement. In the absence of available license exemptions/exceptions, the Recipient shall be responsible for obtaining the appropriate licenses or other approvals, if required, for exports of hardware, technical data, and software, or for the provision of technical assistance.

The Recipient shall be responsible for obtaining export licenses, if required, before utilizing foreign persons in the performance of this cooperative agreement.

The Recipient shall be responsible for all regulatory record keeping requirements associated with the use of licenses and license exemptions/exceptions.

The Recipient shall be responsible for ensuring that the provisions of this clause apply to its contractors, subcontractors, and partners. See additional information in the *NASA GCAM* and the *NASA Proposer's Guide*.

9.4 APPLICATION AND SUBMISSION INFORMATION

9.4.1 Address to Request Application Package

Proposal applications are available via the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES).

9.4.2 Request for 'Notice of Intent'

Institutions planning to submit a proposal are strongly encouraged to submit a Notice of Intent (NOI) to propose. NOIs assist NASA in assessing the response to this funding opportunity and to determine the expertise required for the proposal review panel. NOIs are to be submitted by the PI to the NSPIRES website by no later than 75 days after posting. Eastern Time. Proposers shall register with NSPIRES before it can be accessed for use.

The NOI shall include:

1. Name of the lead institution.
2. College/University Minority Designation (HBCU, PBI, TCU, HSI, AANAPSI, ANNH, and/or NASNTI).
3. Name, title, regular mail and e-mail address, telephone, and fax number of the proposed PI.
4. Planned title and brief description of research focus.
5. Primary affiliated NASA Mission Directorate, NASA Center and other collaborators; and key words that describe the technical area of proposed research.

9.4.3 Proposal Preparation and Submission

All information needed for proposers to respond to this NOFO is contained in this Appendix, the EONS-2024 announcement, the *NASA GCAM* and the *NASA Proposer's Guide*. If the information contained in this Appendix conflicts with the *GCAM* or the *NASA Proposer's Guide*, the information in this NOFO takes precedence.

All proposed activities shall address the following requirements, as well the operating principles underlying the NASA STEM Engagement Strategic Plan, and contribute to the achievement of MIRO goals and objectives. Evidence-based strategies shall be used that rely on verifiable data, literature review, subject matter expert input, and information that has been gathered using the standards of professional research and evaluation organizations.

Please see the *NASA Proposer's Guide*, **Section 2.6, Standard Proposal Style Formats**, and **Section 2.7, Overview of Proposal**, for more details.

Required Parts of a Proposal (in order of assembly)	**No. of Pages**
Proposal Cover Page (NSPIRES web forms or Grants.gov forms) including: • Proposal Summary – limit to 4,000 characters (including spaces) • NSPIRES cover page budget • Proposal team members • Other required elements	Constrained by NSPIRES and Grants.gov
Table of Contents	As needed
Scientific/Technical/Management Plan including *but not limited to:* • Detailed plans to address the Goals and Objectives of MIRO and research priorities for NASA mission directorates and centers. • NASA Center or facility collaborator(s); • specific STEM laboratory equipment and supplies/materials to be purchased to support research and/or curriculum. • proposed number of internships/research assistantships per year, and proposed location of placements (e.g. NASA Center, college or university); • A timeline of all proposed activities, including the responsible personnel for each activity • Evaluation Plan • Data Sharing Plan (dissemination)	15
References and Citations	As needed
Biographical Sketches for: See Section 2.15 in *NASA Proposer's Guide*	
The Principal Investigator	2
Each Co-Investigator	1 (per Co-I)
Current and Pending Support	As needed
Statements of Commitment and Letters of Support	As needed

Proposal Budget (budget) – both the budget narrative and budget details	As needed
Facilities and Equipment	As needed
Table of Personnel and Work Effort	As needed
Data Management Plan	As prescribed in the NOFO

Note: NASA does not endorse or require proposers to use any specific source of information, but strongly encourages proposers to use research-based best practices described in peer-reviewed journals and/or conducted by credible institutions that specialize in STEM education research.

9.4.4 NASA Contact Information

The MIRO NOFO will be released on **Wednesday, November 15, 2023**, and remain open until **Wednesday, February 14, 2024, at 5:00 pm Eastern Time (ET)**. Potential applicants with questions or experiencing problems while the funding opportunity is open shall reach out to the NASA point of contact for MIRO, Dr. Gaffar Gailani. Contact information is provided below in **Section 9.4.5, Contact and Resource Information, Program Office Contact** of this NOFO.

9.4.4.1 Pre-proposal Webinars and Questions and Answers

Three optional pre-proposal webinars will be held prior to the proposal submission due date to provide potential applicants with the opportunity to ask questions and address problems.

The first pre-proposal webinar will take place on **Thursday, December 7, 2023 at 4:00 pm ET**. The second pre-proposal webinar will take place **Monday, January 8, 2024 at 4:00 pm ET**. **A final "office hour" will take place on Tuesday, February 6, 2024 at 4:00 pm ET**. Applicants shall refer to the MIRO landing page for connection details. Proposers shall submit any written questions no later than seven business days before the pre-proposal webinars so that NASA will be able to cover as much information as possible during the meeting. Prospective proposers may also ask questions they have about this opportunity during the teleconference. Proposers may also receive technical assistance from project staff at this time, which may include tips and guidance for proposing for this opportunity.

Potential applicants are strongly encouraged to register early in NSPIRES and sign up for notification emails so they will receive notice of the pre-proposal webinars. Refer to the MIRO landing page for question submission and schedule information.

Proposers shall submit any questions via email only as instructed on the NSPIRES announcement of this opportunity. Responses to questions submitted will be provided in a "Frequently Asked Questions (FAQ)" list that will be posted on the MIRO landing page. The list will be updated frequently during the open period of this NOFO.

9.4.5 Contact and Resource Information

Selection Official
TBD
MUREP Program Manager
NASA Headquarters
Washington, DC 20546

Program Office Contact
Dr. Gaffar Gailani
MIRO Activity Manager
NASA's Armstrong Flight Research Center
4800 Lilly Ave, Edwards, CA 93523
Email: NASAMIRO@nasaprs.com

9.4.6 Proposal Submission Method, Dates, and Times

Electronic proposal submission is required via NSPIRES **ONLY**. See *NASA Proposer's Guide*.

Application Materials	Required or Recommended	Due Date and Time
Notice of Intent	Recommended	Friday, January 12, 2024, 11:59 pm ET
Full Application	Required	Monday, February 14, 2024, 11:59 pm ET

NASA will not review or consider proposals that are received after the deadline. It is highly recommended that proposers do not wait until the final hours before the proposal deadline to submit their proposals.

Proposers experiencing technical problems outside of their control must notify NASA as soon as possible and before the deadline for receipt of proposals. Failure to notify NASA of the issue that prevented submission of the proposal on or before the required submission date may preclude consideration of the proposal.

For technical assistance with NSPIRES please contact the NSPIRES Help Desk at nspires-help@nasaprs.com or (202) 479-9376, Monday through Friday, 8:00 AM – 6:00 PM Eastern Time, except Federal Government holidays. All dates are subject to change. **Please regularly check the NSPIRES website for details.**

All information to be reviewed in support of a proposal must be uploaded together as a single PDF submission in NSPIRES. All proposals shall be submitted electronically through NSPIRES only. All organizations and the team members participating in the proposal must be registered in NSPIRES. Proposals delivered through any other means will be rejected and will not be reviewed.

Collection of Demographic Information
NASA has implemented a process to collect demographic data from grant applicants for the purpose of analyzing demographic characteristics associated with its award processes. Information collected will include name, gender, race, ethnicity, disability status, and citizenship status. Submission of this information is completely voluntary and is not required in order to receive an award.

9.5 APPLICATION REVIEW INFORMATION

The principal elements for proposal evaluation are : **Relevance to NASA Objectives** (40%), **Intrinsic Merit** (40%), and **Budget/Cost** (20%). Proposers shall review the following specific criteria for MIRO awards.

As stated above, priority will be given to institutions that have **not** previously received MIRO award funding. MIRO recipients from Group 5 and earlier are eligible to propose. (MIRO recipients in Group 6 and Group 7 are ineligible to submit proposals to this funding opportunity, however may serve as partners to eligible proposing MSIs). In addition, the following proposal features will be closely considered:

- The degree to which the proposal establishes synergetic partnerships and collaborations with other institutions and agencies, including members of NASA centers, NASA EPSCoR jurisdictions, NASA Space Grant Consortiums, and other government agencies; non-profits; community colleges, minority-serving institutions, and other universities; and industry and other organizations.
- The degree to which the proposal develops core expertise and institutional capacity to sustain the project and obtain funding support from non-MIRO sources.
- The degree to which the proposal succinctly articulates the strategic focus of the research activities, plan for building institutional capacity, and strategies for enhancing knowledge and skills of faculty, researchers, staff, and graduate/undergraduate students; and
- The degree to which the proposal increases the number of STEM degrees awarded to students at the graduate and undergraduate levels in fields that contribute to NASA's mission.

9.5.1 Relevance to NASA (weighted 40% in the evaluation)

Evaluation of Relevance to NASA considers the following sub-elements: Technical Relevance, Educational Relevance, and Institutional Capacity Building Relevance. Proposers shall adequately and clearly define how the activity proposes to address the following criteria:

1) Technical Relevance
    a) Identifies the primary Mission Directorate(s) to which proposed research is aligned.

b) Demonstrates how research findings, results, and products align with one or more of the research priorities of NASA Mission Directorates and Centers. See 9.1.4.2 and Appendix 9A for Research Priorities for NASA Mission Directorates and Centers.
c) Describes current publications related to the proposed research and how the project will enhance, extend, or challenge the status quo.
d) Demonstrates how designated research infrastructure will align with NASA technology and safety standards.
e) Describes the use of NASA content, personnel, and/or facilities in the execution of the research activities.
f) Develops mechanisms for increased participation by students, faculty, and researchers to engage in research activities.
g) Clearly identifies all members of the technical team and how they will contribute towards the research efforts of the proposed activity.
h) Describes how individuals in key positions are qualified in the proposed research and can facilitate all aspects of research development.
i) Describes how the lead institution will establish, maintain, and sustain a suitable infrastructure to support research efforts.
j) Demonstrates a strong evaluation plan that tracks the evolution of the research and research infrastructure over the life of the award.

2) Educational Relevance
   a) Demonstrates how project objectives align with the 2022 NASA Strategic Plan.
   b) Demonstrates innovative methods, approaches, and concepts that will ensure implementation of the proposed project by meeting MIRO objectives.
   c) Demonstrates capacity to support efforts to build a more diverse STEM workforce that reflects the diversity of the nation.
   d) Demonstrates how program activities will encourage continued student affiliation with NASA throughout their academic careers.
   e) Demonstrates culturally appropriate marketing and outreach plans that will engage students in NASA's mission, with emphasis on reaching geographically diverse underrepresented and underserved populations.
   f) Demonstrates easily accessible application materials and coordination of research and mentoring experiences.
   g) Demonstrates capacity of the institution to facilitate disbursement of scholarships and other funds.
   h) Demonstrates that collaboration with other educational institutions will enhance student recruitment and involvement.
   i) Demonstrates a strong evaluation plan that tracks student progress and program success.

3) Institutional Capacity Building
   a) Describes the value of the proposed research to the lead institution's strategic plan and research priorities (at the college and/or university levels) and articulates how the proposed research activities will build institutional capacity.

b) Demonstrates how research leadership will be involved in leveraging university, college, and department resources to support the project.
c) Provides an overview of how institutional capacity for research will be developed over the course of the award, including modification of existing center space and enhancement of facilities, equipment, and resources.
d) Describes how and what curriculum will be enhanced/modified over the course of the award, including new graduate and/or undergraduate program pathways, degree programs, courses, student research experiences, and/or instructional facilities and materials.
e) Describes how and what faculty and researcher professional development will be provided to enhance overall research capacity, including how NASA assets will be leveraged to support professional development needs.
f) Describes a plan for sustaining this capacity after award period ends.
g) Demonstrates a strong evaluation plan that tracks institutional capacity development.

9.5.2 Intrinsic Merit (weighted 40% in the evaluation)

Evaluation of Intrinsic Merit considers the following sub-elements: Management Plan, Collaboration Plan, Sustainability Plan, and Evaluation Plan. The proposer shall address these criteria to demonstrate the capability of the institution, staff, faculty, collaborators, and targeted students to achieve successful outcomes for the proposed activity.

1) **Management Plan**
    a) Demonstrates a management plan that aligns with at least (1) MIRO goals and objectives, (2) the 2022 NASA Strategic Plan, and (3) the recipient institution's mission and goals.
    b) Provides a project Logic Model that illustrates the relationship between MIRO goals and objectives and project objectives, activities, benchmarks, and results.
    c) Demonstrates a clearly organized and feasible management plan for achieving research and educational goals and objectives and includes clear lines of communication with NASA and other members of the collaborative team.
    d) Provides specific details of the organizational structure including the PI, administrative support, Co-Is, key partners and collaborators, the appropriate management oversight office at the lead institution, and an initial lead for the External Advisory Committee who will aid in the development of this committee. Provides organization chart for proposed management structure.
    e) Describes how the PI is qualified to serve as the PI for the project and includes biographical sketches for the PI and each Co-I.
    f) Identifies all populations served by the project (faculty, researchers, students, etc.), specifies their needs and explains how these needs will be addressed.
    g) Describes how proposed administrative assistance will be sufficient for scope of project.
    h) Demonstrates an achievable timeline for program activities, including benchmarks for success.

i) Provides a work breakdown structure for the proposed research plan that includes a timeline for project short and long-term outcomes.

2) **Collaboration Plan**
   a) Delineates mechanisms for building partnerships to enhance the ability of the lead institutions to achieve its objectives, to obtain and leverage sources of additional funding, and/or to obtain essential services not otherwise available.
   b) Includes a list of partners and collaborators, the organization to which they belong, their roles and responsibilities, the percentage of time allocated to support the proposed research, and capabilities that the partnership contributes. Collaborators may include, but are not limited to: individuals from NASA centers, NASA EPSCoR jurisdictions, NASA Space Grant Consortiums, and other government agencies; non-profits; community colleges, MSIs, and other universities; and industry and other organizations.
   c) Presents a plan that outlines each collaborator's responsibilities to the proposed activities.
   d) Details specific contributions (such as financial, personnel, assets, and facilities) being provided by each collaborator and how they will contribute to the goals and objectives of the proposed research.
   e) Provides a letter of support from each collaborator that specifies the unique responsibilities and contributions as outlined above.
3) **Sustainability Plan**
   a) Describes a strategic roadmap that demonstrates sustainability beyond the five-year award period and includes plans to apply for funding opportunities offered by NASA Mission Directorates, industry, and other funding agencies.
   b) Provides a multi-year plan demonstrating the process to acquire resources to sustain the project. Identifies resources or funding capabilities that are in place or will be pursued via the following entities: institutional support, federal or state agencies, contracting opportunities, etc.
   c) Identifies all long-term relationships that have been or will be established to ensure that the project will sustain educational programming, research activities, and utilization of research infrastructure.
   d) Describes how key project elements may be replicated and scalable in other environments.
   e) Identifies initial lead of the External Advisory Committee (EAC) and describes how the committee will support sustainability efforts.
   f) Demonstrates a strong evaluation plan that tracks sustainability efforts and successes.
4) **Evaluation Plan**
   a) Describes the planned approach that will be used to evaluate the proposed program, including processes to collect and analyze qualitative and quantitative data of indicators that may be utilized to track student engagement and progress; faculty, researcher, research, and curriculum development; quality of project

infrastructure and programming; and institutional change. Note, a Comprehensive Evaluation Plan template will be provided post award.

b) Identifies proposed evaluation questions, program measurable goals, objectives, outcomes, and data collection tools that describe progress towards meeting MIRO goals and objectives.

c) Identifies and justifies capabilities of an Independent Evaluator who will; develop the comprehensive evaluation plan; identify/develop tools or processes for data collection; carry out evaluation tasks; conduct analysis; and provide formative and summative feedback to the project leadership throughout the life cycle of the award.

d) Describes an appropriate evaluation plan/process that will document outcomes and demonstrate progress toward achieving the objectives of proposed education activities.

e) Evaluation methods shall be based upon reputable models and techniques that are appropriate to the content and scale of the project.

f) Describes methods that will be used to track student progress. Student progress shall be evaluated at different levels/phases of involvement with the proposed project such as across cohort groups, per education level, and post-involvement.

g) Provides a timeline of data collection, analysis, and reporting that aligns with MIRO Reporting Requirements outlined in H.6.2 Cooperative Agreement Award Reporting Requirements.

h) Describes how feedback from institutional staff, faculty, and students, collaborators partners and stakeholders will be obtained; shared with TRC, EAC, and MIRO Management Team members; and utilized to improve project activities.

9.5.3 Budget/Cost and Budget Narrative (weighted 20% in the evaluation)

Proposers shall clearly describe how the proposed budget is appropriate for the proposed effort. Proposals shall include a detailed implementation/costing plan with a clear narrative that demonstrates how funds requested will be fully utilized for the duration of the five-year award period of performance. The following elements will be considered in the evaluation of the Budget/Cost and Budget Narrative:

- Clarity of alignment between the proposal narrative and budget;
- Budget is adequate, appropriate, reasonable, and realistic for the development, implementation, and reporting of activities.
- Budget demonstrates effective use of funds for which outcomes justify total costs; and
- All budget line items are fully explained and justified.

In addition, the budget and budget narrative shall:

1) Align with budget guidelines and requirements outlined in 9.2.3 Budget Guidelines and Requirements (in this document).

2) Include sufficient travel funds to cover costs for the PI, other key staff, and students to attend critical meetings. Requested travel shall include purpose, the number of trips and expected location, duration of each trip, airfare, and per diem.
3) Include annual stipend/scholarship support for students to participate in internship opportunities at NASA Centers and research facilities during NASA's spring, summer, or fall session. The agency's current (implementation Summer 2024) rate is $8,200 for undergraduates and $9,900 for graduates (at the master's and doctoral levels). This rate is based on 40 hours a week for 10 weeks.
4) Indicate how the proposed budget is clearly aligned with the proposal narrative and budget narrative.
5) Describe how the proposed budget is adequate, appropriate, reasonable, and realistic.
6) Demonstrate effective use of funds in which outcomes justify total costs.
7) Include sufficient funds to support a project administrative assistant (or explanation of how project administration will be supported through other funding).
8) Include sufficient funds to support the Independent Evaluator, including necessary travel.
9) Provide a budget justification detailing how funds will be allocated to support project personnel, travel, student scholarships or support, research funding, and subcontracts.

9.5.4 Review and Selection Process

Reviewers and panelists with appropriate expertise will be identified to evaluate each proposal that is compliant and meets requirements that have been stated within the MIRO solicitation. Proposers shall provide sufficient detail to enable an effective evaluation by persons who are knowledgeable of, but not necessarily specialists in the proposed research area. The reviewers may include personnel from NASA, other government agencies, industry, and universities.

Proposals will be evaluated through a two-phased process to include an evaluation completed by reviewers and panelists. The first phase will be conducted online by reviewers, with the highest-rated proposals moving forward to panel review, which is the second phase. The MIRO Activity Manager will present the panel's final recommendations to the NASA Selection Official. Note: NASA reserves the right to implement a one-phase panel review process.

The Selection Official will use programmatic factors (including considering available funding) to achieve an award portfolio that meets the goals and objectives of MIRO. NASA seeks a balanced award portfolio, and considers diverse factors, including but not limited to, different types of institutional representation (e.g. MSI type), participation by individuals traditionally underrepresented in STEM studies and careers, receipt of prior NASA MUREP awards, and geography.

In evaluating the proposals, NASA will assign one of the following overall ratings:

- **Excellent** - A comprehensive and thorough proposal of exceptional merit with one or more significant strengths. No deficiency or significant weakness exists.
- **Very Good** - A proposal having no deficiency, and which demonstrates overall competence. One or more significant strengths have been found, and strengths outbalance any weaknesses that exist.

- **Good** - A proposal having no deficiency, and which shows a reasonably sound response. There may be strengths or weaknesses, or both. Weaknesses not offset by strengths do not significantly detract from the Proposer’s response.
- **Fair** - A proposal having no deficiency, and which has one or more weaknesses. Weaknesses outbalance strengths.
- **Poor** - A proposal that has one or more deficiencies or significant weaknesses that demonstrate a lack of overall competence or would require a major proposal revision to correct.

9.5.4.1 Successful Proposals

Upon selection of award recipients by the Selection Official, the PI of each successful proposal will receive a “Notice of Intent to Make a Federal Award” letter via NSPIRES with an explanation of the review process and reviewers’ comments about the proposal. It is anticipated that these letters will be released in May 2024. Proposers are strongly cautioned that only a NASA Grant Officer may make commitments, obligations, or awards on behalf of NASA or authorize the expenditure of funds for this opportunity. Pre-award costs will not be allowed for cooperative agreements awarded through this funding opportunity. It is this program’s practice to provide a letter indicating application selection and “Notice of Intent to Make a Federal Award” letter prior to the release of federal award funding. This letter is not an authorization to begin performance. If a submitter is selected for an award, and it incurs pre-award costs, this is at the submitter’s/recipient’s own risk and NASA will not reimburse such costs.

NASA will notify recipients of funding via a Notice of Award (NASA Form 1687) signed by the NASA Grant Officer. This Notice of Award is the authorizing document and will be sent to the proposing PI and the Authorized Organization Representative (AOR) listed in the proposal via electronic delivery. All expenses incurred on cooperative agreement activities prior to the period of performance start date listed on the Notice of Award are at the recipient’s risk of the non-Federal entity until the Notice of Award is received and period of performance commences.

9.5.4.2 Unsuccessful Proposals

Upon selection of award recipients, the PI of an unsuccessful proposal will receive a non-selection letter with an explanation of the review process and reviewers’ comments about the proposal via NSPIRES.

9.5.4.3 Anticipated Announcement and Federal Award Dates

Open Application Period: **November 15, 2023**
Pre-proposal Webinar 1: **December 7, 2023, 4:00 pm ET**
Pre-proposal Webinar 2: **January 8, 2024, 4:00 pm ET**
Pre-proposal Webinar 3: **February 6, 2024, 4:00 pm ET**
Application Period Closes: **February 14, 2024, 11:59 pm ET**
Anticipated Selection Announcement Date: **May 2024**
Anticipated Federal Award Date: **Prior to September 1, 2024**

9.6 FEDERAL AWARD ADMINISTRATION INFORMATION

9.6.1 Cooperative Agreement Award Reporting Requirements

The reporting requirements for award recipients under the MIRO will be consistent with the NASA *GCAM*.

Unless otherwise noted, the MIRO PI shall submit reports via secure transfer and following Personally Identifiable Information (PII) requirements to the NASA Shared Services Center (NSSC) with a courtesy copy to the MIRO Activity Manager. For additional information on PII, see NASA Privacy Procedural Requirements.

All reports shall include the following data elements on the report's cover page:

- Federal agency (i.e., NASA) and program office to which the report is submitted
- Award number
- Project title
- PI name, title, and contact information (e-mail address and phone number)
- Name of submitting official, title, and contact information (e-mail address and phone number), if other than PI
- Submission date
- UEI number and EIN number
- Recipient organization name and address
- Recipient identifying number or account number, if any
- Period of performance start and end date
- Reporting period end date
- Report term or frequency (annual, semi-annual, quarterly, other)
- Final Report? Indicate "Yes" or "No"
- Signature of submitting official (either handwritten or electronic)

In addition to the data elements above, all NASA performance reports shall report on one mandatory reporting category, "accomplishments."

Accomplishments data element:

1. What were the major goals and objectives of this project?
2. What was accomplished under these goals and objectives?
3. What opportunities for training and professional development has the project provided?
4. How were the results disseminated to communities of interest?
5. What do you plan to do during the next reporting period to accomplish the goals and objectives?

For further details on reporting project performance, please refer to the Post-Award Phase Section of the NASA *GCAM.* (Section 7.3.1)

Comprehensive Evaluation Plan (CEP) -

Within three months after award, using required report formats, recipients shall submit a Comprehensive Evaluation Plan (CEP) that:

- Is developed by the IE with concurrence by the PI.
- Provides a clearly articulated logic model.
- Describes an appropriate evaluation plan/process that is based on reputable models and techniques, documents outcomes and demonstrates progress toward achieving the goals and objectives of the proposed education activities.
- Identifies how progress toward achieving the objectives of proposed education activities will be measured; and
- Identifies a timeline and benchmarks for objectives that align with MIRO reporting requirements.

NOTE: The NASA OSTEM Performance and Evaluation (P&E) Team will provide guidelines and templates for the CEP and evaluation report deliverables. The CEP should be submitted to NSSC with a courtesy copy to the MIRO Activity Manager and the OSTEM P&E Team. The submitted CEP will be approved by the MIRO Management Team after the recipient dispositions any feedback and comments provided by the P&E Team.

Federal Financial Reporting

Recipients must submit quarterly financial reports. The following financial reports must be submitted via the Payment Management System (PMS):

- Quarterly Federal Cash Transaction Reports (FCTR) are due no later than 30 days past the reporting period end date
- Final Financial Status Reports/Final Federal Financial Report (FSR/FFR) are due no later than 120 days after the end of the period of performance

Performance Reporting

Recipients must also submit annual and final performance reports. Annual reports are due to NASA 60 days prior to the anniversary date of the award, except in the award's final year. Recipient of awards that are in their final year are required to submit final performance reports instead of the annual performance report. Descriptions of annual and final reporting requirements for MIRO are below:

Annual Report ***(due each year 60 days prior to the anniversary date of the award, except in the award's final year)***

Recipients shall submit an Annual Report every year not later than 60 days prior to the anniversary date of the award, except in the award's final year.

Annual Evaluation Report ***(Developed by the IE, as an Appendix to the Annual Report)*** that includes, at a minimum:

- The outcomes and demonstrated progress toward achieving the objectives of proposed activities aligned to the comprehensive evaluation plan; and
- An annual and formative/summative assessment of the evaluation questions identified in site evaluation plans using the methods and instruments previously identified

Final Report ***(120 days following the end of the performance period)***
Recipients shall submit a Final Report no later than 120 days following the end of the award's performance period.

Additional Reporting Requirements
Recipients must conform to all reporting requirements outlined in the Required Publications and Reports section of the *GCAM,* currently **Appendix F**. Additional reporting may be requested.

9.6.2 Summary of Recipient Responsibilities
Recipients have the primary responsibility for implementing, operating, and managing the project as described in their submitted proposal.

- Each recipient shall select a PI in support of this agreement, to be primarily responsible for the overall management of the award and serve as the primary point of contact for NASA. If the PI to be named is different from the individual identified in the proposal, the NASA Shared Services Center (NSSC) and the MIRO Activity Manager shall be notified in advance and in writing. Any proposed change to the PI under this Agreement is subject to NASA's written advance approval. Also, see the *GCAM,* **Section 7.7, Change of Principal Investigator or Recipient Institution**, for more information.
- Each recipient shall be present and participate during the kickoff meeting, training workshops, and monthly activity meetings as required.
- Each recipient shall travel to and participate in annual Agency OSTEM in-person meetings.
- Performance Outcomes: All institutional PIs with NASA OSTEM grants and/or cooperative agreements shall provide and verify performance data for the awarded project and submit such data to NASA in accordance with NASA guidance (i.e. NASA STEM Gateway system).
- The MIRO PI shall submit all required reports via email to the NSSC with a courtesy copy to the MIRO Activity Manager.
- The recipient institution, in concert with the PI, is responsible for the financial management of MIRO as specified in the basic award notice under the terms and conditions (T&Cs) issued by NASA and in the *GCAM*. Failure to comply with the T&Cs in an award may result in NASA terminating the award/cooperative agreement.
- NASA reserves the right to add requirements to the cooperative agreement during the period of performance in order to achieve broader MIRO or NASA objectives. Such requirements will be negotiated and agree to between NASA and the recipient before the cooperative agreement is modified in writing to include them.

9.6.3 Office of STEM Engagement Performance Metrics

NASA currently utilizes the NASA STEM Gateway registration/application and data management system (Gateway system) for analyzing performance data. PIs are required to respond to data calls as requested by NASA OSTEM and utilize the Gateway system for performance data reporting in a timely and proper manner. Additional communications and guidance regarding data calls and the Gateway system will be sent to award recipients from OSTEM and MIRO Activity Manager. The PI shall ensure that they have the appropriate staff and resources to facilitate data collection activities and properly complete tasks required for timely reporting to NASA.

9.6.4 Other Information

Access to NASA Facilities/Systems

All recipients shall work with NASA project/program staff to ensure proper credentialing for any individuals who require access to NASA facilities and/or systems during the period of performance of the cooperative agreement. Such individuals include U.S. citizens, lawful permanent residents ("green card" holders), and foreign nationals (i.e., individuals who are neither U.S. citizens nor permanent residents).

9.6.5 Summary of Key Information

Total ESTIMATED annual budget for the NASA MIRO ACTIVITY	~ up to $8,750,000
Number of new awards pending adequate proposals of merit	Up to seven
Start date (estimated)	October 1, 2024
Duration of awards	five years
Award Type	Cooperative Agreement
Release Date	November 15, 2023, 11:59 pm ET (DATE SUBJECT TO CHANGE); Check the MIRO landing page for details.
Pre-proposal Conference (Optional)	#1 - December 7, 2023, 4:00 pm ET (DATE SUBJECT TO CHANGE); Check the MIRO landing page for details. #2 - January 8, 2024, 4:00 pm ET (DATE SUBJECT TO CHANGE); Check the MIRO landing page for details.

	Final Office Hour – February 6, 2024, 4:00 pm ET (DATE SUBJECT TO CHANGE); Check the MIRO landing page for details.
Due date for Notice of Intent to propose (NOI) - OPTIONAL	January 12, 2024, 11:59 pm ET (DATE SUBJECT TO CHANGE); Check the MIRO landing page for details.
Proposal Due Date	**February 14, 2024, 11:59 pm ET** (DATE SUBJECT TO CHANGE); Check the MIRO landing page for details.
Page limit for the central Scientific-Educational-Management section of proposal	15pp (includes all illustrations, tables, and figures, where each "n-page" foldout counts as n-pages and each side of a sheet containing text or an illustration counts as a page.); See *NASA Proposer's Guide*
Detailed instructions for the preparation and submission of proposals	See *NASA Proposer's Guide*
Submission medium	Electronic proposal submission is required via NSPIRES only; hard copy proposals will not be accepted. See *NASA Proposer's Guide*
Web site for submission of proposal via NSPIRES	NSPIRES (Help Desk available at nspires-help@nasaprs.com or (202) 479-9376 from 8 am to 6 pm ET) Monday through Friday, excluding Federal Government holidays.
Selection Official	TBD MUREP Manager NASA Headquarters Washington, DC 20546
NASA Point of Contact for this project	Dr. Gaffar Gailani MIRO Activity Manager NASA's Armstrong Flight Research Center 4800 Lilly Ave, Edwards, CA 93523 Email: NASAMIRO@nasaprs.com

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Appendix 9A: NASA Mission Directorates Research Priorities

9A.1 INTRODUCTION

9A.1.1 Overview of Mission Directorates

NASA is organized with five Mission Directorates as listed below. The information provided herein is not a comprehensive listing of all NASA research priorities but is intended to provide a generalized representation of research interests as determined by the five directorates. Additional and more detailed information can be provided by directly contacting the Mission Directorates.

- Aeronautics Research Mission Directorate (ARMD)
- Exploration Systems Development Mission Directorate (ESDMD)
- Space Operations Mission Directorate (SOMD)
- Science Mission Directorate (SMD)
- Space Technology Mission Directorate (STMD)

9A.2 MISSION DIRECTORATES

9A.2.1 Aeronautics Research Mission Directorate (ARMD)

ARMD conducts high-quality, cutting-edge research that generates innovative concepts, tools, and technologies to enable revolutionary advances in our Nation's future aircraft, as well as in the airspace in which they will fly. ARMD programs will facilitate a safer, more environmentally friendly, and more efficient national air transportation system. Using a Strategic Implementation Plan, NASA ARMD sets forth the vision for aeronautical research aimed at the next 25 years and beyond. It encompasses a broad range of technologies to meet future needs of the aviation community, the nation, and the world for safe, efficient, flexible, and environmentally sustainable air transportation.

ARMD Areas of Interest

Researchers responding to ARMD research priorities shall propose a research project that is aligned with one or more of the ARMD programs. Proposers are directed to the following: ARMD Programs: https://www.nasa.gov/directorates/armd/

ARMD Topics Specific to MUREP MIRO Group 8

ARMD is specifically targeting the development of capabilities for conducting Zero Emission Aviation related research. NASA is looking to extend the Nation's capabilities at academic institutions for the development of future air transport technologies which limit or completely circumvent the environmental harm associated with air transportation. Although the focus is on methods for reducing the harm associated with air travel on the environment, the needs are not limited to subsonic flight. It is foreseen that sustainable methods for harnessing energy required for supersonic and hypersonic air transportation will also eventually be needed.

ARMD's Vision for Zero Emissions Aviation (ZEA) for 2050 and beyond looks past Sustainable Aviation Fuel (SAF) to alternative ways to provide propulsive power and eliminate the harmful emissions directly exhausted by air transport vehicles. This Vision challenges the research and development community to strive towards true zero and net negative sustainable lifecycle carbon emissions as well as the elimination of other harmful emissions.

Through experience gained in running NASA ARMD's University Leadership Initiative (ULI) Project as well as in the Advanced Air Transport Technologies (AATT) Project, NASA has generated the following list of potential capabilities which could be considered for development in an opportunity such as this one. This is by no means a list of ideas from which one must choose from.

Potential Research Areas

- Laboratory and modeling infrastructure for investigating metal fuels or completely new fuels developed using AI or Machine Learning techniques.
- Fuel cell laboratories for designing innovative high temperature cells and creating and testing new anodes, cathodes, advanced fuel cells, and fuel cell combustors.
- Advanced electric rotating machinery laboratories for creating new components and the eventual testing of integrated iron-bird drive systems.
- Laboratories for demonstrating power beaming techniques for use in aviation propulsion.
- Laboratories for safely testing concept systems utilizing LH_2 for propulsion system component cooling, LH_2 flight system development, and for educating a workforce with experience and knowhow for safely handling cryogenic fuels such as hydrogen.
- Laboratories for testing advanced, highly efficient thermodynamic cycles including new, innovative, and applicable hybrid and combined cycles.
- Capabilities for determining/measuring the construct of aircraft emissions and modeling the effects of those emissions on our climate.

9A.2.2 Exploration Systems Development Mission Directorate (ESDMD)

The Exploration Systems Development Mission Directorate defines and manages systems development for programs critical to NASA's Artemis program and planning for NASA's Moon to Mars exploration approach. ESDMD manages the human exploration system development for lunar orbital, lunar surface, and Mars exploration.

NASA has established the Moon to Mars Program Office within ESDMD to focus on hardware development, mission integration, and risk management functions for programs critical to the agency's exploration approach. Artemis missions will open a new era of scientific discovery and economic opportunity at the Moon while validating operations and systems and to prepare for human missions to Mars. The Moon to Mars Program Office oversees development of the Space Launch System rocket, Orion spacecraft, supporting ground systems, human landing systems, spacesuits, Gateway, and more related to deep space exploration. The new office will also lead planning and analysis for long-lead developments to support Mars missions.

9A.2.3 Space Operation Mission Directorate (SOMD)

The Space Operations Mission Directorate (SOMD) is responsible for enabling human exploration sustained operations of the solar system. SOMD manages NASA crewed space operations in and beyond low-Earth orbit (LEO) and commercial launch services. SOMD operates, and maintains exploration systems, develops and operates communications, and space transportation systems, and performs scientific research to enable sustained human exploration. In addition, SOMD is responsible for managing the space transportation services for NASA or NASA-sponsored payloads that require orbital launch, and the Agency's space communications and navigation services supporting all NASA space systems. Additional information on SOMD can be for found at: **https://www.nasa.gov/directorates/space-operations-mission-directorate**

SOMD Areas of Interest: Human Research Program

The Human Research Program (HRP) is focused on investigating and mitigating the highest risks to human health and performance to enable safe, reliable, and productive human space exploration. The HRP budget enables NASA to resolve health risks for humans to safely live and work on missions in the inner solar system. HRP conducts research, develops countermeasures, and undertakes technology development to address human health risks in space and ensure compliance with NASA's health, medical, human performance, and environmental standards.

The research falls into one or more categories corresponding to HRP's five elements: Space Radiation, Human Health Countermeasures, Exploration Medical Capability, Human Factors and Behavioral Performance, and Research Operations and Integration. Solicitation covers all aspects of research to provide human health and performance countermeasures, knowledge, technologies, and tools to enable safe, reliable, and productive human space exploration. Ground and Flight investigations within applied research and development; technology readiness level maturation; and technology demonstrations.

Human Research Program

The NASA Human Research Program (HRP) drives advances in scientific and technological research to enable human space exploration. It is a human-focused Program dedicated to providing solutions and mitigation strategies beyond low-earth orbit by reducing the risks to human health & performance through focused translational, applied and operational research. HRP's primary deliverables include:

- Human health, performance, and habitability standards
- Countermeasures and other risk mitigation solutions
- Advanced habitability and medical support technologies
- Recently, HRP has developed a strategy to deliver critical components for an evolvable Crew Health and Performance System by 2032. This will be central to how HRP characterizes spaceflight risks and produces mitigation strategies that enable optimal crew health and performance during exploration missions. HRP will demonstrate and mature this system in ground analogs, in LEO, and on and around the moon to support a 2039 Mars mission. The Human Research Roadmap

(https://humanresearchroadmap.nasa.gov) is a web-based version of an HRP Integrated Research Plan that allows users to search HRP risks, gaps, and tasks.

The HRP is organized into several research elements:

- Human Health Countermeasures
- Human Factors and Behavioral Performance
- Exploration Medical Capability
- Space Radiation

Each of the HRP Elements addresses a subset of the risks. Proposals should address specific gaps listed in the Human Research Roadmap (https://humanresearchroadmap.nasa.gov/Gaps/).

HRP Topic Specific to MUREP MIRO Group 8

ECLSS - Crew Health & Performance System Capability Leadership Team (SCLT)

A specific area of interest to NASA is terrestrial crop evaluations to increase the number and types of crops validated in spaceflight-relevant environments, augment crew diets with bioavailable nutrients, generate data on astronaut preferences and potential spaceflight countermeasures, and understand human-plant-microbial communities and changes over time.

This project would involve high throughput cultivar screening to assess horticultural compatibility under relevant environmental conditions. It is expected that technology demonstrations would be conducted with down-selected crops in analog growth chambers (i.e., Veggie, Advanced Plant Habitat). Experiments to improve crop performance may also be proposed. The overall intent is to advance crops from a variety of categories (i.e., leafy greens, fruiting crops, etc.) through the Crop Readiness Level evaluation.

9A.2.4 Science Mission Directorate (SMD)

In addition to reviewing the list of topics for any given division, one can get context by reading the overview, e.g., E.1 The Biological and Physical Sciences Research Overview. There is an overview for each division, for example: A.1 for Earth Science, B.1 for Heliophysics and so on.

9A.2.5 Space Technology Mission Directorate (STMD)

Technology drives exploration and the space economy. NASA's Space Technology Mission Directorate (STMD) aims to transform future missions while ensuring American leadership in aerospace. As NASA embarks on the next era of space exploration with Artemis, STMD is advancing technologies and testing new capabilities at the Moon. Many of the same systems will prove critical at Mars. STMD's portfolio spans a range of discipline areas and technology readiness levels.

STMD bolsters and funds diverse ideas from entrepreneurs, researchers, and innovators across the country. Space technology research and development occurs at NASA centers, universities, national labs, and small businesses. STMD leverages partnerships with other government agencies and commercial partners to quickly advance and demonstrate cross-cutting capabilities.

Investments in revolutionary, American-made space technologies provide solutions on Earth and in space. We make our innovations available to commercial companies to generate real-world benefits – everything from creating jobs to saving lives. Learn more at NASA TechPort - Strategic Framework.

APPENDIX 10: Space Grant Opportunities in NASA STEM FY2025-2028

10.1 PROGRAM DESCRIPTION

10.1.1 Overview of the Funding Opportunity

The Space Grant College and Fellowship Program (Space Grant) is administered through the National Aeronautics and Space Administration's (NASA) Office of STEM Engagement (OSTEM). Through Space Grant, NASA provides financial assistance via competitive awards to Consortia of Lead Institutions of a national network. The Space Grant national network includes over 1,000 affiliates from universities, colleges, industry, museums, science centers, and state and local agencies. These affiliates belong to one of 52 consortia in all 50 states, the District of Columbia and the Commonwealth of Puerto Rico. Space Grant was established by Congress in 1989 as a workforce development program in the United States that produces STEM-trained professionals.

The National Aeronautics and Space Administration (NASA)'s Office of Science, Technology, Engineering, and Mathematics (OSTEM) Engagement solicits proposals for the National Space Grant College and Fellowship Program (Space Grant) *Space Grant Opportunities in NASA STEM FY2025-2028*. Each funded proposal is expected to define a comprehensive consortium program devoted to increasing student and youth's understanding of space and aeronautics and to executing the assessment, development, and utilization of resources to bolster the STEM pipeline for aerospace. The funding opportunity is intended to provide four years of funding via an educational cooperative agreement.

Proposals will only be accepted from the lead institution of Space Grant consortia in each state along with the District of Columbia and the Commonwealth of Puerto Rico. NASA will only accept one proposal per consortium. For a list of eligible Space Grant lead institutions and Space Grant Directors, visit:
https://www.nasa.gov/stem/spacegrant/home/Space_Grant_Consortium_Websites.html

10.1.2 Goals and Objectives

The purpose of the Space Grant Program is to contribute to the 2022 NASA Strategic Plan, by "Strengthening STEM education through inspirational missions and collaboration with the academic community." Specifically, Strategic Objective 4.3 within the 2022 NASA Strategic Plan: Build the next generation of explorers, ***Engage students to build a diverse future STEM workforce.***

The OSTEM Performance Goals (PGs) are directly aligned with and support the 2022 NASA Strategic Plan and the OSTEM Learning Agenda. Additionally, the Space Grant Program also aligns with these performance goals. The following describes performance goals and associated objectives for the National Space Grant Program. These have been outlined below to assist Recipients in aligning OSTEM Performance Goals with the objectives for the National Space Grant Program:

Performance Goal 4.3.1: Create unique opportunities for a **diverse** set of students to contribute to NASA's work in exploration and discovery.

Objective 1.1: Create opportunities that enable students to produce knowledge or products that will be used by NASA

Objective 1.2: Create opportunities that enable students to support NASA mission work and research

Objective 1.3: Establish and maintain a national network of universities that enable creating opportunities for students to contribute to NASA's work in exploration and discovery

Performance Goal 4.3.2: Build a **diverse** future STEM workforce by engaging students in authentic learning experiences with NASA's people, content, and facilities.

Objective 2.1: Enhance students' STEM identity, skills, and knowledge by engaging them in NASA-based authentic STEM learning activities

Objective 2.2: Provide opportunities for students to engage with NASA's aeronautics, space, and science people, content, and facilities in support of a diverse future NASA and aerospace industry workforce

Objective 2.3: Broaden participation of students in Space Grant Programming that leverages authentic learning experiences with NASA's people, content, and facilities

Performance Goal 4.3.3: Attract **diverse** groups of students to STEM through learning opportunities that spark interest and provide connections to NASA's mission and work.

Objective 3.1: Expand the reach of individual Consortia to collaborate regionally on efforts that directly support middle and high school student participation in hands-on, NASA-aligned STEM activities

Objective 3.2: Attract diverse populations of traditionally underserved and underrepresented middle and high school students to STEM and equip them with the tools necessary for success in college STEM degree programs leading to STEM careers

Objective 3.3: Promote a strong STEM education base for middle and high school students while training teachers in these grade levels to become more effective at improving student academic outcomes.

Performance and Evaluation Strategy (Learning Agenda):

OSTEM continues to move beyond basic quantitative output measures of successful implementation, to a more robust, comprehensive approach to understand the scope and impacts of investments by generating a body of evidence that is increasing in rigor and focuses on outcomes. OSTEM's historic use of quantitative output measures provided a limited understanding of the scope of NASA's STEM engagement activities and did not provide the depth of understanding and quality of evidence needed to make meaningful programmatic decisions. To address this gap, OSTEM has been operating under a Learning Agenda since FY 2019, which serves as the foundational document for building a culture of learning and continual improvement. The implementation of the Learning Agenda provides a systematic approach for building and using new knowledge about project and operational performance for evidence-based decision making and continual improvement.

The purpose of this Learning Agenda is to put forth ***Learning Questions*** with associated sub-questions, ***Learning Activities*** and assessment methodologies, and ***Learning Products*** that will inform the NASA OSTEM's understanding of the scope, methods, mechanisms, and impacts of its investments. The answers to these questions will enable NASA OSTEM to more effectively prioritize and narrow the focus of STEM engagement investment areas by making evidence-based budgetary, programmatic, and operational decisions. Specifically, the FY 2022 – FY 2023 NASA OSTEM Learning Agenda is being executed to gain an understanding of the extent to which STEM engagement investments are:

Contributing to NASA's missions and work

Learning Question 1: *How can NASA STEM Engagement develop cross-project metrics that support internal and external contributions to STEM Engagement goals and objectives?*

Contributing to the diversity of the future aerospace industry's STEM workforce

Learning Question 2: *How do NASA Internships broaden participation of underrepresented and underserved students to advance equity and build a diverse future STEM workforce?*

Understanding how to attract K-12 students to STEM engagement investments

Learning Question 3: *How can NASA attract K-12 students, especially those underrepresented and underserved, to STEM?*

10.1.3 National Priorities

On January 20, 2021, President Biden issued Executive Order 13985 (Advancing Racial Equity and Support for Underserved Communities Through the Federal Government), which calls upon all Federal Government agencies to pursue a comprehensive approach to advancing equity for all, including people of color and others who have been historically underserved, marginalized, and adversely affected by persistent poverty and inequality. Affirmatively advancing equity, civil rights, racial justice, and equal opportunity is the responsibility of the whole of our government. Because advancing equity requires a systematic approach to embedding fairness in decision-making processes, executive departments and agencies must recognize and work to redress inequities in their policies and programs that serve as barriers to equal opportunity. This Executive Order (EO) also defines the terms of underserved and underrepresented groups that this funding opportunity plans to positively impact.

On May 28, 2021, President Biden issued EO 14031(Advancing Equity, Justice, and Opportunity for Asian Americans, Native Hawaiians, and Pacific Islanders). This EO establishes a White House initiative on Asian Americans, Native Hawaiians, and Pacific Islanders, as well as a Presidential Advisory Commission, both of which aim to advance equity, justice, and opportunities between and among these groups.

On June 25, 2021, President Biden issued EO 14035 (Diversity, Equity, Inclusion, and Accessibility in the Federal Workforce). This EO creates a Governmentwide initiative to promote diversity, equity, inclusion, and accessibility (DEIA). This EO is based on a growing body of evidence demonstrating that diverse, equitable, and accessible workplaces result in higher levels of employee performance. Awardees of the *Space Grant Opportunities in NASA STEM FY2025-2028* recipients shall serve as examples of how SG continues to evolve to meet changing national and agency priorities.

10.1.4 Agency Priorities

The National Aeronautics and Space Act (Space Act) at 51 U.S.C. § 20112(a)(3) directs NASA "to provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof." In support of this law, NASA engages students in its mission through a portfolio of STEM programs and activities.

The 2022 NASA Strategic Plan reinforces the agency's commitment to inspiring an informed society; engaging students in science, technology, discovery, and exploration; and providing unique STEM opportunities for diverse stakeholders. NASA's investments in these areas are guided by Strategic Goal 4: Enhance capabilities and operations to catalyze current and future mission success; and Strategic Objective 4.3: Build the next generation of explorers (reference section 10.1.2).

NASA's support of U.S. industry and academia seeks to foster economic development and growth, embody American ingenuity, and serve as a magnet for the STEM workforce. Additionally, the Agency has made a commitment to contribute to the diversity of the future aerospace STEM workforce and employs proactive efforts to diversify STEM pathways leading to NASA internships and employment.

10.1.4.1 Relevance to NASA OSTEM

NASA's OSTEM plays a critical role in achieving NASA Agency Strategic Objective 4.3 by implementing activities aligned to three Performance Goals for STEM engagement: 1) Create unique opportunities for a **diverse** set of students to contribute to NASA's work in exploration and discovery; 2) Build a **diverse** future STEM workforce by engaging students in authentic learning experiences with NASA's people, content, and facilities; and 3) Attract **diverse** groups of students to STEM through learning opportunities that spark interest and provide connections to NASA's mission and work. Within the body of the proposal, each consortium's proposal should clearly outline the consortium's plan to broaden the diversity of students whom they attract and engage. The consortium will be asked within their annual report to outline the tangible steps which were taken toward achieving these goals.

Annually, NASA OSTEM generates a body of evidence (e.g., performance data, participant data, metrics) collected from recipients to assess progress of its investments in achieving programmatic goals and objectives, as well as OSTEM's progress in achieving the following multi-year OSTEM Performance Goals (PGs):

- **PG 4.3.1** Create unique opportunities for a **diverse** set of students to contribute to NASA's work in exploration and discovery.

- **PG 4.3.2** Build a **diverse** future STEM workforce by engaging students in authentic learning experiences with NASA's people, content, and facilities.

- **PG 4.3.3** Attract **diverse** groups of students to STEM through learning opportunities that spark interest and provide connections to NASA's mission and work.

Proposals shall clearly and concisely describe the **relevance and alignment** of the proposed work to NASA's currently funded research priorities and programs of the NASA Mission Directorate(s). Proposals are required to address one or more priorities of the Mission Directorates and Centers, which are summarized in Appendix 8: EONS 2024 Omnibus (nasaprs.com) *NASA Mission Directorates and Center Alignment with Points of Contact.* The current NASA mission directorates are as follows:

- Aeronautics Research (http://www.aeronautics.nasa.gov/)
- Exploration Systems Division (Exploration Systems Development Mission Directorate - NASA)
- Science (http://science.nasa.gov/)
- Spaceflight Operations (Space Operations Mission Directorate - NASA)
- Space Technology (http://www.nasa.gov/directorates/spacetech/home/index.html)

Proposals shall address how the proposed Project and its programmatic elements directlyalign with the NASA Strategy for STEM Engagement (reference Section 10.1.2).

Consortia should strategically identify the areas consistent with the needs of their state and those which will contribute to the goals, objectives, and priorities of NASA. Consortia shall highlight in the proposal where these areas of emphasis will be implemented. Reference Section 10.1.2 for an overview of NASA's STEM Engagement Priorities.

10.1.4.2 Relevance to Consortium

One of the goals of Space Grant is to encourage cooperative programs among universities, aerospace industry, and Federal, state, and local governments. Proposals shall demonstrate how the proposed project will be a contributor to the respective state's long and short-term STEM strategic research plans, interests, and capabilities; and how the project will result in interdisciplinary training, research, and public service programs related to aerospace while promoting multi-faceted diversity amongst the students the project serves. It is strongly recommended that the proposal reference elements of department, college, and university strategic plan(s), research priorities, and/or other pertinent university documents.

10.2 FEDERAL AWARD INFORMATION

NASA's ability to make awards is contingent upon the availability of appropriated funds from which payment can be made.

Subject to Congressional appropriation of sufficient funds and NASA's receipt of proposals of adequate merit, NASA expects to select up to 52 proposals for *Space Grant Opportunities in NASA STEM FY2025-2028* awards. The period of performance for each proposal/resulting award is four (4) years. Successful proposals for this opportunity will be funded as cooperative agreements. As cooperative agreements, substantial involvement between awardees and NASA is expected. For specific description of the substantial involvement required of awardees, see Section **10.6.3 Summary of Space Grant Awardee Responsibilities** and Section **10.6.1 Cooperative Agreement Award Reporting Requirements** of this Notice of Funding Opportunity (NOFO).

Proposals shall cover the full four years of performance. The continuation of NASA funding on each award annually is based on a satisfactory evaluation of documented progress; compliance with data reporting, applicable regulations and laws, and other program requirements; fulfillment of fiduciary responsibilities, and the availability of appropriated funds. At the time of this Appendix release, NASA does not plan to extend funding beyond the initial performance period of four years. Should additional funds become available, OSTEM will encourage proposals for an augmentation of funds.

Each Recipient/Proposer (required to be from the lead Space Grant Consortium institution) is eligible to apply for funds in the amount not to exceed (NTE) $800k for the first year of the award. The amount not to exceed (NTE) for Years 2 through 4 shall have a Base Award of $800k, and each Recipient/Proposer is eligible to apply for augmentation funds (in addition to the yearly Base Awards) for Years 2 – 4 in an amount NTE $70k.

For augmentation funds to be awarded, each Space Grant Consortium must have demonstrated expenditures (**costed funds**) and not encumbered or obligated funds (i.e., "costed" refers to the amount of funding that has been withdrawn against the award in the U.S. Department of Human and Health Services' Payment Management System) as outlined below before any augmentation funds are released. If all the requirements as described below, are not met on a yearly basis the Consortia that do not meet these requirements will forfeit the additional augmentation funds for that year.

For example, if a consortium met the percent of costed funds requirement but submitted their CPR after the established deadline, the consortium will forfeit their augmentation funds for that year. However, if the consortium did not meet the requirements for Year 2 augmentation funds but does meet them for Year 3 then they shall be awarded the Year 3 augmentation funds.

Augmentation Eligibility Requirements:

1. To be eligible for Year 2 augmentation funds a consortium shall:
    a. Demonstrate expenditures (costed funds) of at least 30% of the prior year's (Year 1) total funding (i.e., base award only) by the last calendar day, of the month in which the consortium's last day of their period of performance falls.
    b. Have submitted the CPR and the APR on-time.

2. To be eligible for Year 3 augmentation funds a consortium shall:
    a. Demonstrate expenditures (costed funds) of at least 33% of the prior year's (Year 2) total funding (i.e., base and augmentation awards) by the last calendar day, of the month in which the consortium's last day of their period of performance falls.
    b. Have submitted the CPR and the APR on-time.
3. To be eligible for Year 4 augmentation funds a consortium shall:
    a. Demonstrate expenditures (costed funds) of at least 36% of the prior year's (Year 3) total funding (i.e., base and augmentation awards) by the last calendar day, of the month in which the consortium's last day of their period of performance falls.
    b. Have submitted the CPR and the APR on-time.

10.2.1 Funding

The Government's obligation to make an award is contingent upon the availability of appropriated funds from which payment can be made. In the event legislation is enacted that provides a lower/higher funding level than what is assumed in the solicitation, states will have to propose revised budgets that reflect those lower/higher amounts.

While the National Space Grant College and Fellowship Program is focused on higher education, it is understood that many K-12 activities are supported by the Consortia nationwide. However, it is important to note that the focus of the congressionally allocated funds to Space Grant shall be primarily focused on higher education.

Consortia are highly encouraged to financially support student teams to participate in the Artemis Student Challenges (Join Artemis | NASA)

In general, this solicitation is not restricted in the use of funds beyond the NIF requirement and the need for each consortium to hire an Independent Evaluator.

A. NIF activities shall be allocated as outlined in Section 10.2.4. See Sections 10.2.4, 10.4.3.6 and 10.4.3.7 for more information regarding the NIF requirements.

10.2.3 Budget Guidelines and Requirements

10.2.3.1 Total Budget Guidelines and Funding Restrictions

All costs charged to awards covered by this NOFO must comply with the Uniform Administrative Requirements in 2 C.F.R. 200, 2 C.F.R. 1800, and 14 C.F.R. 1259, unless otherwise indicated in the NOFO, the terms and conditions of the award, and the Grants and Cooperative Agreement Manual (GCAM).

- All proposed funds must be allowable, allocable, and reasonable. Funds may only be used for the project. All activities charged under indirect cost must be allowed under 2 CFR 200 cost principles.
- Grants and cooperative agreements shall not provide for the payment of fee or profit to the recipient.
- Unless otherwise directed in 2 CFR 200, for changes to the negotiated indirect cost rate that occur throughout the project period, the recipient must apply the rate negotiated for that year, whether higher or lower than at the time the budget and application was awarded.

- Proposals must not include bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds basis.
- Any funds used for match or cost sharing must be allowable under 2 CFR 200.
- The non-Federal entity must use one of the methods of procurement as prescribed in 2 CFR 200.320, Methods of procurement to be followed.
- Awards made under NASA Fellowship and Scholarship funding opportunities shall not provide for the payment of Facilities and Administration, overhead, or indirect costs per the definition of "modified total direct cost" in 2 CFR 200.1, Definitions.
- As directed in the *NASA Guidebook for Proposers*, Section 3.18, other than the specialcases discussed in the same Section 3.18, and unless specifically noted otherwise the proposing PI institution shall subcontract the funding of all proposed Co-Is who reside at other non-Government institutions.
- The construction of facilities is not allowed for any of the activities solicited in this CAN unless specifically stated. For further information on what costs are permissible, refer tothe cost principles in Subpart E of 2 CFR 200, Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards.
- U.S. award recipients may directly purchase supplies and/or services from non-U.S. sources that do not constitute research, but award funds may not be used to fund research carried out by non-U.S. institutions. However, a foreign national may receive payment through a NASA award for the conduct of research while employed either full-time or part-time by a U.S. institution (see Section 3.2 of the *NASA Guidebook for Proposers*).
- Reasonable and justified travel by a participant in the research investigation, whether for the purpose of conducting the research, for collaboration, or for attending a conference, is considered to be a reasonable expense. NASA conducts its collaborations with foreign institutions on a no-exchange-of-funds basis. NASA funding may not be used for foreign institutions to conduct research efforts at any level. Although Co-Investigator (Co-Is) or collaborators employed by non-U.S. organizations may be identified as part of a proposal submitted by a U.S. organization, NASA funding may not support research efforts by non-U.S. organizations, collaborators or subcontracts at any level, including travel by investigators at non-U.S. organizations. In other words, participants from U.S. organizations can receive travel funding, with the exception above for non-U.S. organizations (see Section 3.2 of the *NASA Guidebook for Proposers*; see also Appendix C).

10.2.3.2 Cost Sharing or Matching

Cost sharing/matching is required. Reference Sections 10.4.3.6 Budget Tables: Details and Narrative and 10.4.3.7 Cumulative Cost Share & Cumulative NIF Investment Tables for more details.

10.2.3.3 Direct Costs Limitations

Foreign travel shall be related to the goals of Space Grant. Foreign travel requires prior approval from the Space Grant Project Manager and shall not exceed $5,000 per year. Requested foreign travel shall include justification, the purpose, location, duration, airfare and per diem for each trip. The term “Space Grant” shall be included in verbal presentations and written acknowledgements when representatives of the institution are writing reports and publications. Within ten (10) business days of the trip’s conclusion, the institution’s representative shall submit to the Space Grant Program Office a post-trip summary report that describes the benefits gained as a result of the trip. If a summary report is not provided, the Space Grant Program Manager has the discretion to limit the Consortium’s future foreign travel request(s).

10.2.3.4 Pre-Award Costs

Per 2 CFR §1800.210, NASA waives the requirement for applicants to obtain prior approval for pre-award costs incurred 90 days or less before an award’s period of performance start date. Pre-award costs in excess of 90 days before an award’s period of performance start date are not allowable under this NOFO. Any costs that the applicant incurs in anticipation of a grant or cooperative agreement award is at the risk of the applicant and will be subject to the rules described in 2 CFR §1800.210, Pre-award costs and the “Pre-award Costs” section of the GCAM, currently section 5.14.1.

10.2.3.5 Indirect Facilities & Administrative (F&A) Costs

Under cooperative agreements, waived/unrecovered indirect costs can be used as cost-share. Please refer to the Code of Federal Regulations (2 CGF 200.306) regarding cost-sharing or matching of unrecovered indirect costs.

Funds utilized specifically for NASA or industry internships shall not be classified as a scholarship or fellowship. Additionally, it is the policy of the Space Grant Program that the awardee cannot charge management fees nor indirect costs to any NIF award under this Educational Cooperative Agreement.

10.2.4 NASA Internships and Fellowship Opportunities

Requesters/Proposers are required to meet the minimum NASA internship and fellowship (NIF) requirement for this announcement as outlined in Section 10.4.3.6 Budget Tables: Details and Narrative. All NIF awards, regardless of whether they meet the “significant” threshold (see below), are required to be reported in the NASA-approved data management system (i.e., the NASA STEM Gateway system). Longitudinal tracking is required to be completed by the Recipient for a significant student investment. A significant award is a monetary award, or experience that includes one or more of the following: (a) has a value of greater than or equal to $3,000 or (b) participation of greater than or equal to 160 hours annually.

For NIFs, Consortia shall allocate the established minimum NIF amounts referenced in Section 10.4.3.6. The purpose of this dollar threshold is to ensure that a significant amount of NASA’s investment is applied directly to student awards. Reference Appendix D for definitions of internships executed by NASA at NASA Centers and facilities, and any fellowship.

NASA no longer awards scholarships; however, Recipients are not prohibited from offering scholarships under their award. Recipients can make awards to undergraduate students, but those awards shall not be called fellowships.

For internships at a NASA Center, Consortia shall ensure that those awards adhere to the standard NASA internship stipend funding levels (reference Table 1). Funds utilized specifically for NASA or industry internships shall not be classified as a fellowship.

Table 1 – NASA Center Internship Student Stipends

NASA Internship Stipend Amounts		
Session	**Graduate Student**	**Undergraduate Student**
Fall and Spring (16 weeks)	$15,840	$13,120
Summer (10 weeks)	$9,900	$8,200

Application for and selection of NASA interns shall be performed through the NASA STEM Gateway system. Students applying for NASA Center Internships should be directed to the NASA Internship Programs website (https://intern.nasa.gov) for details on applicant qualifications (GPA, citizenship, enrollment status, the minimum number of required contact hours, etc.). As specified by the NASA internships guidelines on the above referenced website, typically a minimum of 400 contact hours (time spent on task completion under mentors' direction) are required for summer internships.

Proposals shall clearly demonstrate how internships, fellowships, and scholarships will be competitively awarded. A description of the recruitment of applicants, the selection process, and plans that demonstrate the inclusiveness of member/affiliate institutions shall be included.

Awards made under NIF funding opportunities shall not provide for the payment of Facilities and Administration (F&A), overhead, or indirect costs.

Note: All direct-funded participants regardless of the funding level, as well as those receiving significant awards shall be U.S. Nationals (reference 14 CFR part 1259.101 (c) for a definition of a U.S. National). This requirement applies to all sub-awards including, for example, participants funded from a faculty fellowship (i.e., **participants/students receiving direct funding under a faculty fellowship must meet this requirement**). A National of the United States is defined as a citizen of the United States or a native resident of a possession of the United States. Due to NASA security policies, all students who intern onsite at a NASA Center are required to be United States citizens.

10.2.5 Independent Evaluator (IE)

The proposer shall hire an Independent Evaluator in alignment with this solicitation/NOFO, and for the duration of this award. In addition to other responsibilities each consortium may require, the IE will be required to complete a Comprehensive Evaluation Plan (CEP) as well as a yearly assessment which shall be completed and provided as part of the Annual Performance Report.

In Appendix G, NASA has provided the Comprehensive Evaluation Plan (CEP) template which shall be used by the IE. This template is required to be used and no other format of a CEP will be accepted. The completed CEP by the IE shall be submitted (by either the IE or the consortium Director) to NASA HQ Space Grant at hq-space-grant@mail.nasa.gov no later than 45 calendar days after the start of the consortium's period of performance. If the CEP is not provided prior to the established deadline, the consortium will be considered not in good standing. This may require the consortium to hold a meeting/s with the Space Grant HQ and the Performance and Evaluation Teams to discuss why the deadline for the CEP was not met, and to ensure delivery of the completed CEP as soon as possible. Based on the results of the meeting, the consortium may be required to schedule additional follow-on meetings and may be required to meet additional reporting requirements. For any of these required follow-on meetings, NASA HQ may provide a list of consortium and lead institution personnel required to attend.

In addition to the CEP, the IE will be required to complete a yearly assessment of the consortium. This assessment shall be included as part of the Annual Performance Report submitted by each consortium. Appendix H includes an example template for the IE portion of the Annual Report and shall **only be used as a reference**. The final version to be used by the IE will be provided by the Space Grant main office (yearly) when the Annual Performance Report template is provided to the consortia. It should be noted that the final yearly assessment template for the IE may vary slightly from the example template in Appendix H. While the final template provided may have only slight variations from the provided example, the yearly template provided by the Space Grant main office (and not Appendix H) shall be used by the consortium and the IE. No other version of the report template shall be accepted.

10.2.6 NASA STEM Gateway

The NASA STEM Gateway system was initially used by the Space Grant consortia for direct student data reporting in 2023. For reporting reasons, this system was designed to replace the Office of Education Performance Measurement (OEPM) system. However, the NASA STEM Gateway system's capabilities extend beyond yearly reporting. Since its release, integration into OSTEM has slowly increased as system capabilities and access has also increased. The initial major use of the NASA STEM Gateway system, by OSTEM, has been for NASA internships. This requires that all students interested in participating in the NASA Space Grant internships, create a participant profile and apply through the NASA STEM Gateway system. This has allowed for more transparency into who is applying for NASA internships across the country, as well as who is being selected. To provide the consortia with more visibility, as well as allow for easier reporting capabilities, the Space Grant consortia have been provided access into the NASA STEM Gateway system including NASA badges and software system licenses.

The NASA STEM Gateway system is the required reporting system for the Space Grant consortia's yearly Closeout Performance Report (CPR) which has a deadline of no later than November 30th of each year. The CPR shall be completed within the NASA STEM Gateway system prior to the deadline, by all consortia.

In addition to using the NASA STEM Gateway system for reporting, in a similar fashion to its use for internships, the capabilities of the NASA STEM Gateway system continue to expand to allow data gathering of applicants and participants for opportunities outside of NASA internships. To gather full applicant and participant data, while still allowing each consortium to use their current software/systems for applicant review and awardee selection, it is necessary for some limited and basic information to be provided by the applicants in both the NASA STEM Gateway system as well as in whichever system is used by the consortia for their standard selection/awarding processes. Space Grant understands that any repetitive steps should be minimized. However, it is also understood that each consortium has their application, review, and selection process for each of their award opportunities with some including hundreds of applicants.

To allow for transparency, the consortia shall use the NASA STEM Gateway system to document applicants as well as participants for all awards. The implementation of this is outlined in Section 10.6.1 Additional Reporting Requirements. It should be noted that the intention of this is to document the demographics of the applicants and participants, not to have the applicants complete a full application (essay, transcript, resume, etc.) nor for the consortia to execute the selection process through the NASA STEM Gateway system. Most of the selection process/activities will remain within current consortia processes.

10.2.8 Consortium Performance Indicators

In collaboration with the Performance and Evaluation (P&E) Team and based on feedback gathered from the Space Grant consortia, metrics related to Performance Management, Budget Management, Milestones, Consortium Management, and Evaluation will be used to track and determine (on a yearly basis) the health of a consortium throughout the life of this cooperative agreement.

The intention of determining and tracking a consortium's health is to be able to identify specific areas of concern where the Space Grant Main Office may be able to provide additional assistance so that all consortia are successful.

The major categories used to track and establish the health of a consortium, as mentioned above, were developed based on inputs gathered from the Space Grant consortia during an Evaluation Workshop held at the 2023 Space Grant Spring National Conference, on how the consortia believed a consortium should be evaluated.

The evaluation data gathered within each category will primarily focus on items such as (but not limited to) the successful completion of Milestones and SMART Goals and Objectives, as well as the yearly data gathered from the IE on a consortium's: successes, areas of improvement, and overall impact. Additional items tracked will include execution of funds and timeliness of meeting reporting requirements.

Based on the results of the health tracking of a consortium, a consortium may receive feedback to assist with improvements in their performance. To track improvements more closely, a consortium may be required to participate/report in additional engagement activities with NASA. Specifics will depend on the resulting health performance and areas of concern, but may include quarterly or semi-annual virtual meetings, additional sections added to their consortium unique semi-annual or annual performance reports, and possibly a site visit if there are continued concerns beyond the performance of a single year (reference Section 10.6.1)

10.3 ELIGIBILITY INFORMATION

10.3.1 NASA's Commitment to Diversity and Inclusion

NASA recognizes and supports the benefits of having diverse and inclusive scientific, engineering, and technology communities and fully expects the reflection of such values in the composition of all panels and teams, including peer review panels, proposal teams, science definition teams, and mission and instrument teams. In accordance with Federal statutes and NASA policy, no eligible applicant shall experience exclusion from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from NASA on the grounds of their race, color, creed, age, sex, national origin, or disability.

10.3.2 Eligible Applicants

Proposals will only be accepted from the lead institution of Space Grant consortia in each state along with the District of Columbia and the Commonwealth of Puerto Rico. NASA will only accept one proposal per consortium. For a list of eligible Space Grant lead institutions and Space Grant Directors, visit:
https://www.nasa.gov/stem/spacegrant/home/Space_Grant_Consortium_Websites.html

10.3.2.1 Principal Investigator (PI)

A PI shall be appointed (i.e., Space Grant Director) in support of this Agreement. The SG director shall be from and employed by the lead institution. If the PI to be named is different from the individual identified in the proposal, the NASA Space Grant Program Office shall be notified in writing per the Guidelines for Space Grant Director & Lead Institution Changes. Any proposed change to the PI under this Agreement is subject to NASA approval. NOTE: If NASA approves the proposed change, the NASAGrant Officer will issue a formal written modification to the Agreement to reflect such change. If NASA does not approve the change in the PI, the recipient will propose another PI until NASA approval is obtained.

10.3.2 Proposals Involving Foreign Participation

Except as outlined in the certification regarding restriction on doing business with certain countries, NASA welcomes proposals that include the participation of non-U.S. organizations. Proposals that propose research to be performed with a non-U.S. organization as part of a proposal submitted by a U.S. organization typically are supported on a no-exchange-of-funds basis. For additional guidance on foreign participation, see the *NASA Guidebook for Proposers*, Appendix A.

10.3.3 Ineligibility of Proposals That Include Participation of China or Chinese-Owned Companies

Proposals involving bilateral participation, collaboration, or coordination in any way with China or any Chinese-owned company, whether funded or performed under a no-exchange-of-funds basis, shall be ineligible for award.

10.4 APPLICATION SUBMISSION INFORMATION

10.4.1 Address to Request Application Package

Proposal applications are available via the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES).

10.4.2 Proposal Preparation and Submission

All information needed for proposers to respond to this NOFO is contained in this Appendix, the EONS-2024 announcement, the NASA Grant and Cooperative Agreement Manual (GCAM) and the *NASA Guidebook for Proposers*. If the information contained in this Appendix conflicts with the GCAM or the *NASA Guidebook for Proposers*, then the information in this NOFO takes precedence.

Required *Space Grant Opportunities in NASA STEM FY2025-2028* - Proposal Sections	**Page Limit**
Volume I – *Multi-Year Base Award*	
Proposal Cover Pages	As needed (NSPIRES generated)
Table of Contents	None
Proposal Executive Abstract	4000 characters, including spaces
Data Management Plan	8000 characters, including spaces
Consortium Profile	1
Body of Proposal	15 pages
Consortium Management	3
Appendices	
A. Budget Tables: Details and Narrative	None
B. Cumulative Cost Share & Cumulative NIF Investment Tables *	None
C. Estimated Costing Schedule Table: Details and Narrative	None
D. Milestones	None
E. Summarized Table of SMART Goals, Objectives, and Targets	None
F. Principal Investigator (PI) Curriculum Vitae	2 pages
G. Affiliate Concurrences	None
H. Summary Cost Match Table	None
I. Letters of Resource Support	None
J. List of Affiliates	None
K. Consortium Programmatic Summary	2 pages
L. Guam/US VI Proposal Narrative (Statement of Work) **	5 pages
M. Guam/US VI Budget Details & Narrative **	None
N. Guam/US VI Milestones **	None
Optional Proposal Section	**Page Limit**
Volume II – *Augmentations (Years 2 – 4)*	
Proposal Narrative (Statement of Work)	5 pages
Budget Tables: Details and Narrative	None
Milestones	None

* These two tables are small enough that they can both be placed on the same page within their required Appendix section. Reference Tables 3 and 4.

** These Appendixes are only to be included in the HI and SC proposals to include the details provided by Guam and US Virgin Islands (respectively) for their planned use, budget, and goals associated with those funds.

10.4.2.1 Proposal Submission Guidelines

Detailed instructions for the preparation and submission of proposals are available in the *NASA Guidebook for Proposers*. Applicants shall submit their proposals using electronic proposal submission via NSPIRES (http://nspires.nasaprs.com) or Grants.gov (http://www.grants.gov). Registration in NSPIRES is required for proposal submission regardless of the proposer's intent to submit via NSPIRES or Grants.gov.

All required documentation shall be provided as a single document with up to two Volumes clearly delineated. Volume I of that document shall be used to include all required information pertaining to the proposal for the Base Awards of the multi-year across the four years, Volume II shall include all required information pertaining to the Augmentations of the multi-year across years 2-4 (if desired to be submitted).

Proposals shall use standard size 8 ½" x 11" paper with at least a 12-point font with a minimum 1" margin on all sides of each page. Proposals shall use an easily readable font such as Times New Roman, Calibri, Arial, Helvetica, Georgia, or Garamond. Illustrations, tables, and charts shall not be smaller than an 8-point font. **The required appendices set forth above are to be labeled as listed above (e.g., the Budget Tables with details and narrative shall be Appendix A within the proposal, the Cumulative Cost Share & Cumulative NIF Investment Tables shall be included as Appendix B, Affiliate Concurrences shall be included as an Appendix G, Letters of Resource Support shall be provided as Appendix I, etc.).** Proposals shall be uploaded into NSPIRES in PDF format with applicable section bookmarks.

It is essential that all PDF files generated and submitted meet the NASA requirements below. This will ensure that the submitted files can be transferred into NSPIRES. At a minimum, it is the proposer's responsibility to: (1) ensure that all PDF files are unlocked and that edit permission is enabled – this is necessary to allow NSPIRES to concatenate submitted files into a single PDF document; and (2) ensure that all fonts are embedded in the PDF file and that only Type 1 or TrueType fonts are used. In addition, any proposer who creates files using TeX or LaTeX is required to first create a DVI file and then convert the DVI file to Postscript and then to PDF. See http://nspires.nasaprs.com/tutorials/PDF_Guidelines.pdf for more information on creating PDF documents that are compliant with NSPIRES. PDF files that do not meet the NASA requirements may be declared noncompliant and not submitted to peer review for evaluation.

10.4.3 Volume I – Multi-Year Base Award

10.4.3.1 Proposal Executive Abstract

This section shall summarize the larger consortium-wide project. The proposal shall concisely describe the content and scope of the project, and identify the objective(s), methodology, and intended results.

10.4.3.2 Data Management Plan

While Space Grant awardees typically do not create the types of data normally captured and covered under a Data Management Plan (DMP), Space Grant awardees are required to capture and maintain the integrity of personally identifiable information (PII). As such, the program requires a DMP to address the collection, storage, security, and maintenance of PII data.

All proposals submitted under this NOFO are required to submit a DMP in accordance with the *NASA Plan for Increasing Access to the Results of Scientific Research* located at http://www.nasa.gov/sites/default/files/files/NASA_Data_Plan.pdf.

At a minimum, the following are required elements in a DMP**:**

- Specify the roles and responsibilities of all parties with respect to the DMP activities;
- Specify the types of data or products that will be generated (e.g., survey responses, images, data tables, video or audio data, software, curricular, or exhibit materials);
- Specify how these data or products are to be stored, preserved, and shared;
- Specify any restrictions on data or product storage, access, preservation or sharing;
- Specify what data formats will be used (e.g., XML files, websites, image files, data tables, software code, text documents, or physical materials);
- Specify how long access to data and products, and sharing of data or products, will be maintained after the life of the project, and how any associated costs will be covered and by whom;
- If data or products are to be preserved by a third party, please refer to their preservation plans if available.

Any research project that does not require a DMP to be submitted shall explicitly indicate this fact in the DMP block. The type of proposal that requires a DMP is described in the NASA Plan for Increasing Access to Results of Scientific Research (see link below): https://www.nasa.gov/sites/default/files/atoms/files/206985_2015_nasa_plan-for-web.pdf

For additional information related to DMP requirements, please reference the following websites (NASA's Scientific and Technical Information Program's DMP FAQ at https://sti.nasa.gov/faq/ and the Science Mission Directorate's DMP FAQ at FAQs - NASA Science.

Proposers that include a plan to archive data shall allocate suitable time for this task. Unless otherwise stated, the requirement for a DMP supersedes the Data Sharing Plan that is described in the *NASA Guidebook for Proposers*.

10.4.3.3 Consortium Profile

Describe the environment of the Consortium, including state demographics, unique consortium aspects as well as any consortium-wide themes or specialization. Provide a brief analysis of the state's needs and discuss how they align with NASA priorities. This section should convey how the unique mix of projects proposed by the Consortium is strategically designed to respond to the state's needs and NASA priorities.

10.4.3.4 Body of Proposal

The proposal shall clearly convey how the Project's goals and objectives align with Space Grant goals and objectives, the state's STEM needs, and with NASA Mission Directorate needs. Reference Appendix 8: EONS 2024 Omnibus (nasaprs.com) *NASA Mission Directorates and Center Alignment with Points of Contact* for more information on the Mission Directorate needs.

This section shall clearly identify the consortium project's goals and objectives, and describe the proposed integrated and comprehensive project, including all its programmatic elements and activities, as directed above. Describe how these elements and activities meet the proposed goals and objectives. Describe how each element and activity supports NASA Mission Directorate needs and priorities, and clearly identify how each individual activity aligns with NASA's Strategy as outlined in Section 10.1.2 and 10.1.4. In this section, the first time a multi-disciplinary activity is mentioned, the Proposer shall identify to which Mission Directorate(s) the activity aligns. Proposed activities that are to be competitively awarded at the Consortium-level, can be written under "Competitive Projects". This category can be used for activities that have yet to be selected. In general, the proposal shall be outlined to align with the budget table. Each Consortium has the discretion to determine which Mission Directorate(s) its work will be aligned with, but every activity should align to at least one Mission Directorate, unless the activity falls under a "Competitive Project." However, the activities/opportunities which are competed and fall under the Competitive Project category shall also ultimately align with a Mission Directorate.

NASA Internships and Fellowships: The proposal shall describe in detail, proposed internship and fellowship projects and opportunities. As described in Sections 10.2.6 and 10.6.1, student data for awardees (including NIF) must be entered into the NASA STEM Gateway system.

This section shall outline how the consortium will collect student information and obtain the necessary approvals at the institutional level to fulfill grant reporting requirements. This section shall clearly identify the number of projected awards, and a plan to longitudinally track all significant student investments. Proposers may categorize funding that is a direct student award under the category called NIF. While all direct funded student awards are not required to be included within the NIF category, all direct funded student awards are still required to meet the citizenship requirements.

All funds meant to be included in the NIF investment calculation (Reference Section 10.4.3.7, Cumulative NIF Investment Table) which are not directly listed within the NIF budget section (Category G), **shall be clearly identified throughout the budget table** allowing the quantities listed in the NIF Investment Table to be easily/clearly confirmed.

Proposers shall ensure **that the budget table and budget justification/narrative directly align, and funding quantities match exactly**. See Appendix D for NIF definitions.

Funds utilized specifically for NASA or industry internships shall not be classified as a scholarship or fellowship. Additionally, it is Space Grant Program policy that Recipients cannot charge management fees nor indirect costs to <u>any NIF award</u> under this Cooperative Agreement. Management fees may be applied to all awards outside of the NIF category.

The proposal shall clearly demonstrate how internships and fellowships will be competitively awarded at the lead, member, and affiliate institutions. A description of the recruitment of applicants, the selection process, and plans that show the inclusiveness of member/affiliate institutions and student eligibility shall be included. **All direct funded participants receiving either a NASA internship or <u>any fellowship</u> award shall be a U.S. National, see <u>policy</u> concerning citizenship.**

Note that the proposers should focus on the definition as provided in Appendix D, of the term fellowship and not only the term itself. Some institutions may use terms other than research "fellowship" for their various opportunities (i.e., research opportunity, research experience, etc.). If the activity defines as a research fellowship, regardless of the name the proposer establishes, any participant of a direct funded research "fellowship" shall be a U.S. National. This requirement extends to all sub-awards including, for example, participants funded from a faculty fellowship (i.e., **participants/students receiving direct funding under a faculty fellowship must meet this requirement)**.

Should a proposal include support for non-U.S. citizens and the support is not classified as a NASA internship or a fellowship of any type, then the Recipient must work with the Technical Officer in coordination with the NASA Office of International and Interagency Relations (OIIR) to ensure that there are no additional restrictions related to the country of origin of that individual.

<u>NOTE</u>: The consortia of Hawaii and South Carolina may include Appendixes L, M, and N within their proposals (Reference Section 10.4.2). These Appendixes are required to be provided by Guam and the U.S. Virgin Islands and included within the Hawaii and South Carolina proposals (respectively) if the intention is to request the additional $150k for each Guam and US VI. These appendixes provide Guam and US VI an opportunity to describe how they plan to collaborate and contribute to the Hawaii and South Carolina consortium's respective goals and objectives. Guam and US VI shall Reference: Section 10.4.3.4 for guidelines related to the requirements associated with Appendix L, Section 10.4.3.6 for guidelines for the Budget Details and Narrative requirements associated with Appendix M, and Section 10.4.3.9 for guidelines for the required Milestone Schedule in Appendix N.

<u>NOTE</u>: Consortia Strategic Plans are not a required component of the proposal; however, if a proposer references a strategic plan, then such a plan shall be included as an appendix to the proposal.

10.4.3.5 Consortium Management

The proposer shall describe the following aspects of the management of the Consortium. This section shall include budget figures for all Consortium administrative costs (labor, benefits, supplies, etc.).

A. *Consortium Management*: Describe the Consortium's management structure, and operational policies and procedures.

B. *Consortium Structure/Network (Internal)*: Describe the composition of institutions that comprise the Consortium; include the number, demographics, and characteristics. Describe the roles and responsibilities of campus/organization representatives in terms of on-campus effectiveness, communication of the program to their constituents, the process to build a NASA presence at the location, and participation and involvement in Consortium operations. Also, describe the Consortium's strategy and specific objectives for seeking opportunities to develop new relationships and/or sustain and strengthen existing institutional relationships with minority-serving institutions (MSI) (i.e., Historically Black Colleges and Universities, Hispanic Serving Institutions, Tribal Colleges and Universities, Other Minority Universities, and institutions of higher education that have a higher enrollment of minority students) internal or external to the consortium. Describe plans that will ensure "meaningful involvement" of MSIs through collaborations and partnerships.

C. *Consortium Operations:* Describe staffing levels at the lead institution, and support provided by other institutions or organizations (FTEs for director, program coordinator, support staff, affiliate representatives, etc.). Staffing levels and costs shall allow for the maximum amount of funds being made available to Consortium programs/projects. Describe how staff resources are allocated in terms of management and administrative tasks, resource development, and/or project implementation. Include a discussion of the composition, role/purpose, and meeting frequency of Advisory/Executive Committee(s)/Boards (i.e., internal and external groups). Describe the Consortium policy for adding and removing members to/from the Consortium.

D. *Collaborations and Partnerships Outside the Consortium:* Describe collaborations and partnerships (number, characteristics, and purpose) outside the membership of the consortium. Discuss how these collaborations/ partnerships benefit the consortium. Discuss Publicity/Outreach plans, if applicable.

E. *Recruiting of Underrepresented/Underserved students in STEM:* Describe how the consortium plans to broaden the **diversity** of the students whom they attract and engage in its programs to increase the quantity of underrepresented/underserved students impacted in achieving the three performance goals (reference Section 10.1.2 *Goals and Objectives*)
   - Include established policies, plans, and processes to address Diversity, Equity, and Inclusion (DEI) priorities within the consortium.
   - Include performance metrics planned to be used to measure progress of plans/strategies to broaden participation of students from underserved communities in STEM

- Include plans, strategies, and specific steps to engage and broaden participation of students from underserved communities in STEM
- **The consortium will be asked within their annual report to outline the tangible steps which were taken toward achieving these goals.**

10.4.3.6 Budget Tables: Details and Narrative

The proposal shall provide a budget spreadsheet for each year (FY2025-2028) of proposed work. A single cumulative budget for the four (4) year award period is not required. These budget spreadsheets **shall not include any augmentation funds being requested in Volume II** of the proposal. The budget spreadsheet format to be used **must be that as shown in Appendix A, and other formats will not be accepted**. The proposer may recreate this table as shown, or an excel version of the budget table will be provided to the proposer upon request to the Space Grant Program Office at NASA HQ.

A budget narrative/description is also required and shall accompany the spreadsheet. The budget narrative/description shall provide funding values which exactly match those included in the budget spreadsheet and provide a clear alignment and description of the items listed in the budget. The proposed budget/s shall be adequate, appropriate, reasonable, realistic, and demonstrate the effective and appropriate use of funds to align with the proposed projects and consortium grant type. The budget and budget justification shall clearly align with the content. The scope of the proposed effort, budget and budget narrative shall contain sufficient cost detail and supporting information to facilitate a prompt evaluation and award.

Table 2 - Award Funding Requirements

	NASA Funding Amount	**Minimum Requirement for NASA Internships and Fellowships Allocation [1][2]**	**Minimum Cost-Share Requirement [3]**
Year 1	$800,000	$200,000	$512,000
Years 2 - 4	$800,000	$200,000	$480,000

The U.S. territories of Guam and U.S. Virgin Islands (US VI) may not submit proposals for full Consortium-status; however, Hawaii and South Carolina, respectively, are eligible to receive an additional $150,000 per year for each territory. The supplemental funds for US VI and Guam are exempt from cost-share requirements.

Proposers shall meet the minimum cost-share requirement for this announcement. If the proposed budget is less than the maximum NASA budget, the amount of the cost-share shall be determined based on the following information and formula:

NOTES:

[1] The Minimum Required NASA Internship and Fellowship Allocation, shall be met using only NASA awarded funds. The minimum $200k requirement shall not be met by a combination of NASA funds and cost match funds (i.e., using only $100k of NASA funds and using $100k of cost match funds to meet the $200k minimum is not allowable).

[2] Regardless of the proposed funding amount, the minimum NIF quantity must first be met. I.e., if a consortium proposes for only $300k in the first year, $200k of that total amount must first be allocated toward NIF.

[3] If the proposed budget is less than the maximum allowable NASA budget, the minimum required yearly cost share for the Year 1 funding shall be 64% of the yearly proposed funding amount, and 60% of the yearly proposed funding amount for Years 2-4 (Reference equations 1 and 2 below).

Total Actual Year 1 Requested NASA Funds	**x**	**0.64**	**=**	**Actual Minimum Required Cost Share**	**(1)**
Total Actual Years 2-4 Requested NASA Funds	**x**	**0.60**	**=**	**Actual Minimum Required Cost Share**	**(2)**

Proposers shall use NASA funds for support of students, faculty, and researchers to conduct research, execute student-centric programs, engage in professional development, and redesign, enhance, or develop curriculum; for support of undergraduate students, graduate students, and their research; for research-related equipment, travel, and materials; and to support project management, administration, and evaluation. While equipment purchases are allowable, per 2 CFR §200.439 and GCAM Section 7.10 Approval of Equipment, any equipment purchase over $5,000 requires prior written approval of the Federal awarding agency.

Proposers shall submit a budget spreadsheet/table, budget justification, and cost share for the proposed work. Please note:

- A budget justification is required, shall accompany the budget table, and the values presented in both the budget and the justification shall match (i.e., it is required that the categories and their subcomponents referenced between the budget and budget justification match). It is highly recommended that the proposal text reference specific and consistent budget categories and vice-versa.

- Significant dollar amounts proposed with no accompanying explanation may result in a determination of proposal unacceptability, or cause delays in funding. All costs shall be explained in reasonable detail.

- Proposers shall provide a summary table that details all Projected Cost Share (reference Table 3 – Cumulative Projected Cost Share Table)

- Proposers shall provide a summary table that details all NIF investments (reference Table 4 – Cumulative NIF Investment Table)

- Each budget and associated budget justification shall reflect and detail where in the NIF category the requested funds are being spent.

- Costs budgeted for the Independent Evaluator shall be included in either Section E – Services or Section N – Subcontracts, of the proposed budget.

- Subcontracts to an individual (including the Independent Evaluator) or organization: Refer to the *NASA Proposer's Guide*. **Subcontract awards shall include a separate budget, work statement, and/or a breakout of hourly ratesfor direct labor.**

- Direct Labor costs shall be separated by titles (e.g., director, program manager, program coordinator, graduate research assistant, clerk, etc.) **with estimated hours, FTE, hourly rates, and total amounts of each**. The certified negotiated indirect costs for the institution shall be explained sufficiently whether they are being requested from NASA funds or from thecost-share portion.

- **Labor costs for all Key Personnel** shall be included in Sections A (Personnel/Direct Labor) and B (Fringe Benefits) of the budget table regardless of the project/work in which the individuals will be participating. Key Personnel shall include at a minimum the Director/PI, Associate Directors, Assistant Directors, Space Grant Coordinators, and any personnel associated as primary personnel within that consortium's main Space Grant office.

- Other costs (within each significant category detailed) shall be explained in reasonable detail and substantiated whenever possible.

- Domestic travel shall include the purpose, the number of trips and expected location, duration of each trip, airfare, and per diem. Domestic travel shall be appropriate and reasonable to conduct proposed activities and all in support of Space Grant activities. Proposals may include travel, registrationfees, and per diem for national meetings and regional meetings only up to the duration of activities directly including NASA Space Grant activities (estimated at up to three days). Space Grant funds shall not to be used for expenses (lodging and per diem) on any day(s) at the national, regional, and other meetings in which non-NASA meetings and activities are being conducted.

- Proposers **shall** include sufficient estimated travel funding for attendance of an annual NASA OSTEM National Conference to ensure that availability of travel funds specifically intended for this conference is available. The travel funding should be sufficient to cover attendance by at least two consortia members from the lead consortium's office. **Attendance of the annual NASA OSTEM National Conference is required.** It is expected that one of the attendees be the award PI/Director and the second attendee be an additional Key Personnel from the lead Space Grant consortium. The location of the annual NASA OSTEM National Conference will be communicated to Recipients once those details are available.

10.4.3.7 Cumulative Cost Share & Cumulative NIF Investment Tables

Proposers shall provide a cumulative projected cost share table, which tracks all cost share amounts across the lifetime of the multi-year cooperative agreement. Reference Table 3 below.

Table 3 – Cumulative Projected Cost Share Table

Cumulative Cost-Share				
Year 1 Total	Year 2 Total	Year 3 Total	Year 4 Total	Cumulative Total Cost – Share (Years 1 – 4)
$	$	$	$	$
Required Minimum Cost-Share *				$ 1,952,000

* Note: Actual cumulative minimum cost-share requirement may be a lesser number if the amount of total funds being requested each year is lesser than the maximum allowed. Reference equations 1 and 2 in section 10.4.3.6.

Please note that cost-share minimum requirements are not flexible. Unrecovered indirect costs on NIF awards can be used as cost-share amounts. Funding above the minimum NASA Internship and Fellowship allocation amount is allowed; however, proposers shall still meet the required minimum cost-share amount. See 2 CFR 200.306 and 2 CFR 1800.306 for more information on Cost Sharing.

The total required minimum NIF investment for this multi-year award is $800,000 and must be met using only NASA awarded funds (not including cost match). Proposers shall provide a cumulative NIF investment table, which tracks all NIF investments across the lifetime of this multi-year cooperative agreement. Reference Table 4 below.

Table 4 – Cumulative NIF Investment Table

Cumulative NIF Investment				
Year 1 Total	Year 2 Total	Year 3 Total	Year 4 Total	Cumulative Total NIF Investment (Years 1 – 4)
$	$	$	$	$
Required minimum NIF Investment **				$ 800,000

** Note: Actual cumulative minimum NIF investment may be a lesser amount only if a consortium proposes for a total award amount lesser than the minimum yearly NIF required investments. Reference Note [2] in Section 10.4.3.6.

10.4.3.8 Estimated Costing Schedule Table: Details and Narrative

The proposal shall include an estimated budget costing table for the Base Award funds, for **each year** of the four-year award (not required for the augmentation funds) which aligns with the major budget categories using the table as presented in Appendix B. The table shall show the planned intent to cost 100% of the funds, of each year, within 15 months of the start of each period of performance. For example, the table shall show a plan to cost 100% of the funds for Year 2, no later than 15 months after the start of the Year 2 period-of-performance.

A narrative specifically addressing items 1 through 3 listed under the example table in Appendix B shall accompany the table. For any identified risks to the costing schedule, specific actionable items shall be included within the mitigation plan for each identified risk.

The costing table shall clearly align with the budget table.

As a reminder, per the Performance Management System (PMS), current year funding, except during the first year, cannot begin to be costed until 100% of prior year funds have been costed. This means that prior year costing will impact current year costing. Percent costed across and at the end of each period-of-performance will be metric-tracked and will be one factor used to determine the status and health of a consortia

10.4.3.9 Milestones

Proposers are required to complete a milestone chart (see Appendix F, Sample Milestone Chart for Base Award and Augmentation Award). Milestones shall be broken down by programmatic element, e.g., Mission Directorate, Competitive Projects, etc. and then by activity. The timescale shall be listed by month, and a **separate table** shall be provided for **each of the four years** of the award such that each year is in alignment with the consortium's period of performance.

These milestones shall align with the proposed activities, and budget narrative and justification.

10.4.3.10 Summarized Table of SMART Goals, Objectives, and Targets

Proposers shall complete the provided S.M.A.R.T. matrix as shown in Appendix E. The format shown in Appendix E shall be used and no other format will be accepted. Each of the years to which the consortium is proposing (total of four) shall have three separate tables (total of 12 tables). Each table breaks down the focus of the SMART goals into three categories: NIF Activities, Mission Directorate/Competitive Projects, and Diversity.

Reference Appendix E for more details instructions on how to complete the required S.M.A.R.T. matrix

10.4.3.11 Comprehensive Evaluation Plan (CEP)

The proposer shall have their Independent Evaluator (reference section 10.2.5 Independent Evaluator (IE)) complete a CEP using the provided template in Appendix G. This template is required to be used and no other CEP format will be accepted. The CEP is **not required as part of the proposal** for this solicitation but is **required to be submitted by the IE within 45 calendar days of the start of the period of performance of this award**. The completed CEP by the IE shall be submitted via email to NASA HQ Space Grant (hq-space-grant@mail.nasa.gov) with the email subject line: XX CEP- Space Grant Opportunities in NASA STEM FY2025-2028, where XX is the 2 letter state/consortium designation.

If the CEP is not provided prior to the established deadline, the consortium will be considered not in good standing. This may require the consortium to hold a meeting/s with the Space Grant HQ and the Performance and Evaluation Teams to discuss why the deadline for the CEP was not met, and to ensure delivery of the completed CEP as soon as possible. Based on the results of the meeting, the consortium may be required to hold additional follow-on meetings and may be required to meet additional reporting requirements. For any of these required follow-on meetings, NASA HQ may provide a list of consortium and lead institution personnel required to attend.

10.4.3.12 Affiliate Concurrences

In Appendix G of the proposal, proposers shall provide a listing of all affiliate members including the institution name and the name of the affiliate member and/or their designated representative, who will provide concurrence on the content of the proposal. The designated representative from the lead institution (Director) and each affiliate representative must sign the concurrence document. The signature represents the affiliate's agreement with the contents of the proposal. Email concurrences also are acceptable as long as the email contains sufficient information to unambiguously identify the sender, the affiliate institution, and the affiliate representative's position, name, and concurrence.

10.4.3.13 Summary Cost Match Table

In Appendix H of the proposal, the proposer shall provide a Summary Cost Match Table in addition to the Letters of Resource Support. Reference Appendix C of this solicitation for the **required format** to be used for the Summary Cost Match Table. The format shown in Appendix C is required to be used, and no other format of the table will be accepted.

10.4.3.14 Letters of Resource Support

Separate, and in addition, to the Affiliate Concurrences and the Summary Cost Match Table, proposers shall provide the actual Letters of Resource Support to be included within Appendix I of the proposal to substantiate the total required cost-share over the lifetime of the award. Each written statement shall be addressed to the PI, may be a facsimile of an original statement or the copy of an email (the latter must have sufficient information to unambiguously identifythe sender), and is required even if the Co-I, or Collaborator is from the proposing lead institution.

Letters of resource support are required when an agreed level of resource support is established. For example, instances of faculty/staff time and/or fringe benefits and/or waived/reduced F&A costs/IDCs that are used as cost-match, will require a letter of resource support from the institution.

Letters of Resource Support are required to address the following items: expected cost-match and contributions (programmatic and budget) the institution will provide. Also, in cases where an individual's time is used as cost-match, a Letter of Resource Support from the respective institution is required. In the case where a Consortium receives cost-match from competitive awards run by the Consortium, a Letter of Resource Support is not required since the known value of the cost-match will not be known by the date of the proposal submission. Additionally, Letters of Resource Support are only required when an agreed-upon level of support is established. This letter shall at a minimal include signatures from an official at the institution/organization who is able to commit the institution, e.g., Provost, Dean, etc. Letters must be recent; addressed to the Consortium Director; written specifically for this proposal; and dated within 45 days prior to the solicitation due date.

10.4.3.15 List of Affiliates

Appendix J of the proposal shall be a continuously numbered (not bulletized) list of all affiliates of the proposing consortium (see example below). These shall be split into two categories. Category 1 is a list of the Academic Affiliates and Category 2 shall list all other affiliates. Apart from the name of the institution, no additional details are needed in this list.

Example:

Category 1 (Academic Affiliates)

1. Name of an academic affiliate
2. Name of an academic affiliate
3. Name of an academic affiliate
4. Etc.

Category 2 (All other non-academic affiliates)

5. Name of a non-academic affiliate
6. Name of a non-academic affiliate
7. Name of a non-academic affiliate
8. Etc.

10.4.3.16 Consortium Programmatic Summary

Appendix K of the proposal shall include a 1-2 page (max of 2 pages) descriptive project abstract of the main programmatic activities planned to be conducted by the consortium. This is NOT intended to be a detailed overview of all activities, and hence why it is limited to 2 pages.

These abstracts will be placed as a link under each consortium's appropriate section within the Space Grant Consortium Directors and Websites - NASA. This location will allow for all consortia to gain high level knowledge on the activities being executed at other consortia. If consortia are interested to learn more about a specific topic, they may reach out to the consortium performing that activity. If a consortium submits more than two pages, that consortium will be notified that they are required to modify and resubmit to remain within the two-page limit.

NASA understands the uniqueness of each consortium and wants to provide you with the flexibility to showcase your consortium's activities in a way that's most meaningful to each consortium. Therefore, you are not required to use a specific format (apart from the minimal information listed below) but should keep in mind that this summary will be made available to all consortia with the intent of providing them with a broad overview of the activities being executed as part of this FY25 – FY28 Space Grant multi-year award.

Instructions: Provide a maximum two-page summary (and include it as Appendix K of your proposal) outlining the major activities that you believe highlight the activities your consortium intends to execute as part of the FY25 – FY28 Space Grant multi-year award. Your two-page summary must include the minimum contact information on at least one of the two pages:

- Name of Space Grant Director
- Contact Email (email of your choice)
- Each page must be numbered
- All information, including the contact information, must be limited to 2 pages

10.4.4 Volume II – Augmentations (Years 2 – 4)

10.4.4.1 Overview

Proposers are invited, but not required to request in their proposals, additional augmentation funds above the Base Award funding for Years 2 through 4. The overarching goal of these augmentation funds is to provide additional funding to support or enhance existing projects or fund new initiatives and endeavors as a part of the base awards in Years 2 - 4.

For this funding augmentation opportunity, each recipient/proposer shall submit a budget table/s (**separate from the base award budget**), not to exceed $70,000 **for each year** of the Years 2, 3, and 4 of this multi-year award, as well as a detailed budget narrative, justification, and scope of work explaining how the additional funds will be spent. Proposers shall ensure **that the budget table and budget justification/narrative directly align, and funding quantities match exactly.**

The period of performance will not change. For these additional augmentation funds only, no increase will be made to the stated cost-share minimums listed in Section 10.4.3.7.

Note that it is not required to submit a proposal for each of the three years (Year 2, 3, and 4). If a proposer wishes to only propose for 1 or 2 of the three years, or none, that is acceptable. However, a budget table and accompanying budget narrative shall be provided for each proposed augmentation year.

To be eligible for awarding of these augmentation funds, **each Space Grant Consortium must have demonstrated expenditures (costed funds) and not encumbered or obligated funds (i.e., "costed" refers to the amount of funding that has been withdrawn against the award in the U.S. Department of Human and Health Services' Payment Management System) as outlined below** before any augmentation funds are released. If all the requirements as described below, are not met <u>on a yearly basis</u> the Consortia that do not meet these requirements will forfeit the additional augmentation funds for that year.

For example, if a consortium met the percent of costed funds requirement but submitted their CPR after the established deadline, the consortium will forfeit their augmentation funds for that year. However, if the consortium did not meet the requirements for Year 2 augmentation funds but does meet them for Year 3 then they shall be awarded the Year 3 augmentation funds. **The eligibility requirements for the augmentation funds do not impact awarding of Base funds.**

Augmentation Eligibility Requirements:

1. To be eligible for Year 2 augmentation funds a consortium shall:
    a. Demonstrate expenditures (costed funds) of at least 30% of the prior year's (Year 1) total funding by the last calendar day, of the month in which the consortium's last day of their period of performance falls.
    b. Have submitted all the following on-time: the Year 1 CPR, semi-annual report, and longitudinal tracking data (Reference Section 10.6.1 for deadlines).

2. To be eligible for Year 3 augmentation funds a consortium shall:
    a. Demonstrate expenditures (costed funds) of at least 33% of the prior year's (Year 2) total funding by the last calendar day, of the month in which the consortium's last day of their period of performance falls.
    b. Have submitted all the following on-time: Year 2 CPR, semi-annual report, and longitudinal tracking data (Reference Section 10.6.1 for deadlines).
3. To be eligible for Year 4 augmentation funds a consortium shall:
    a. Demonstrate expenditures (costed funds) of at least 36% of the prior year's (Year 3) total funding by the last calendar day, of the month in which the consortium's last day of their period of performance falls.
    b. Have submitted all the following on-time: the Year 3 CPR, semi-annual report, and longitudinal tracking data (Reference Section 10.6.1 for deadlines).

10.4.4.1 Use of Funding

In general, this solicitation is not restricted in the use of funds beyond the NIF requirement and the need for each consortium to hire an Independent Evaluator.

A. NIF activities shall be allocated as outlined in Section 10.2.4. See Sections 10.2.4, 10.4.3.6 and 10.4.3.7 for more information regarding the NIF requirements.

B. While the National Space Grant College and Fellowship Program is focused on higher education, it is understood that many K-12 activities are supported by the Consortia nationwide. However, it is important to note that the focus of the congressionally allocated funds to Space Grant shall be primarily focused on higher education.

10.4.4.2 Cost Sharing

Cost-sharing for these additional augmentation funds is not required, but Recipients may voluntarily offer it. Recipients offering cost-sharing will not receive additional credit in the evaluation for doing so.

<u>Note</u>: This only pertains to the Augmentation funds and not the cost share requirements outlined for the Base Award funding.

10.4.4.3 Budget Table

The proposal shall provide a separate budget spreadsheet for the total amount of augmentation funds being requested for each of the Year 2, 3, and 4 periods of performance of proposed work for a total of 3 budget spreadsheet. The budget spreadsheet format to be used **must be that as referenced in Appendix A, and other formats will not be accepted**. The proposer may recreate this table as shown, or an excel version of the budget table will be provided upon request from the proposer to the Space Grant Program Office at NASA HQ.

A budget narrative/description is also required and shall accompany each spreadsheet. The budget narrative/description shall provide funding values which exactly match those included in the budget spreadsheet and provide a clear alignment and description of the items listed in the budget. The proposed budget/s shall be adequate, appropriate, reasonable, realistic, and demonstrate the effective and appropriate use of funds to align with the proposed projects and consortium grant type. The budget and budget justification shall clearly align with the content. The scope of the proposed effort, budget and budget narrative shall contain sufficient cost detail and supporting information to facilitate a prompt evaluation and award.

Table 5 – Augmentation Funding Requirements

	Total NASA Augmentation Funding Amount for each year	Additional Min/Max Requirement for NASA Internships and Fellowships (NIFs) Allocation [2]	Additional Minimum Cost-Share Requirement [1]
Years 2 – 4 Augmentation	$70,000	$0	$0

NOTES:
[1] Cost-sharing is not required for these augmentation funds.
[2] No minimum/maximum NIF requirement is present for these augmentation funds (i.e., all or none of these funds may be used for NIF).

Proposers shall submit a budget spreadsheet/table, budget justification, (and cost share if applicable) for the proposed work to be augmented. Please note:

- A separate budget table is required and shall be provided for each augmentation year (separately) of funds being proposed (Reference Appendix A for the required budget table format)
- A budget justification/narrative is required for each separate augmentation budget and shall accompany each budget table. This justification/narrative must exactly match the proposed budget.
- Each budget justification shall indicate where in the category/ies the requested funds are being spent and the companion budget narrative shall match the values exactly.
- Significant dollar amounts proposed with no accompanying explanation may result in a determination of proposal unacceptability, or cause delays in funding. All costs shall be explained in reasonable detail.

10.4.4.4 Budget Restrictions

The following restrictions apply to the use of the NASA Space Grant funds:

- In total, these NASA Space Grant augmentation funds are not to exceed $70,000 for each of the Years 2 - 4.
- NASA Space Grant funds shall not be used for civil-service personnel, labor, or travel.
- Refer to Section 10.2.3.1 **Total Budget Guidelines and Funding Restrictions** for additional restrictions.

10.4.4.5 Milestones

Proposers shall provide a separate milestone chart from that provided for the Base Award (reference Appendix F) for the Augmentation funds. The milestones shall be broken down by programmatic element, i.e., Mission Directorate, Competitive Projects, etc. and then by activity. The timescale shall be listed by month, aligning with each individual consortium's period of performance.

These milestones shall align with the proposed activities, and budget narrative and justification. Upon selection, if a Recipient needs to update its milestone chart, a Recipient will have up to 30 days after award notification from the NSSC to provide an updated milestone chart.

10.4.5 NASA Contact Information

The *Space Grant Opportunities in NASA STEM FY2025-2028* NOFO will be released on Friday, March 8, 2024, and remain open until July 10, 2024. Potential applicants with questions or experiencing problems while the funding opportunity is open shall reach out to the NASA Research and Education Support Services (NRESS) Support Team point of contact for the *Space Grant Opportunities in NASA STEM FY2025-2028*, as listed in Section 10.6.6. Contact information is provided below in **Section 10.4.6, Contact and Resource Information, Program Office Contact of this NOFO.**

10.4.5.1 Pre-proposal Webinars and Questions and Answers

A pre-proposal webinar will be held in the weeks following release of this solicitation. Details will be communicated with all Space Grant consortia. During this time, a summary of the solicitation will be provided, pre-gathered questions will be answered, and as time is available questions brought up by the prospective proposers during the webinar will be addressed.

Applicants shall refer to the *Space Grant Opportunities in NASA STEM FY2025-2028* landing page on NSPIRES for connection details. Prospective proposers may also ask questions they have about this opportunity during the teleconference. Proposers may also receive technical assistance from project staff at this time, which may include tips and guidance for proposing for this opportunity.

Potential applicants are strongly encouraged to register early in NSPIRES and sign up for notification emails so they will receive notice of the pre-proposal webinars. Refer to the *Space Grant Opportunities in NASA STEM FY2025-2028* landing page on NSPIRES for question submission and schedule information.

Proposers shall submit any questions via email only as instructed on the NSPIRES announcement of this opportunity. Responses to questions submitted will be provided in a "Frequently Asked Questions (FAQ)" list that will be posted on the *Space Grant Opportunities in NASA STEM FY2025-2028* landing page on NSPIRES. The list will be updated frequently during the open period of this NOFO.

10.4.6 Contact and Resource Information

Selection Official
Tomas Gonzalez-Torres
Manager, Space Grant Program
NASA Headquarters
Washington, DC 20546

NRESS Contact
NASA Research and Education Support Services (NRESS) Support Team regarding inquiries and assistance for submission of the electronic proposal materials into NSPIRES

Email: spacegrant@nasaprs.com

10.4.7 Proposal Submission Method, Dates, and Times

Electronic proposal submission is required via NSPIRES or Grants.gov. See *NASA Guidebook for Proposers*.

Application Submission Deadline

Application Materials	Required or Encouraged	Due Date and Time
Full Application	Required	July 10, 2024, at 11:59pm ET

All applications **must** be received by the established deadline.

NASA **will not review applications that are received after the deadline or consider these late applications for funding**.

Applicants experiencing technical problems outside of their control must notify NASA as soon as possible and before the application deadline. Failure to timely notify NASA ofthe issue that prevented the timely filing of the application may preclude consideration of theaward.

For technical assistance with NSPIRES, please contact the NSPIRES Help Desk at nspires-help@nasaprs.com or (202) 479-9376, Monday through Friday, 8:00 AM – 6:00 PM ET. PLEASE NOTE: The NSPIRES Help Desk closes at 6:00 pm Eastern Time, Monday through Friday, and is closed on federal holidays. Respondents experiencing difficulty using Grants.gov may contact the Help Desk at Support@Grants.gov or call 1-800-518-4726, 24 hours a day, seven days a week, except for Federal Government Holidays when Grants.gov support is closed.

While every effort is made to ensure the reliability and accessibility of the websites and to maintain a help center via email and telephone, difficulty may arise at any point on the Internet, including with the user's own equipment. Therefore, prospective proposers are urged to familiarize themselves with the NSPIRES and Grants.gov sites and to submit the required proposal materials well in advance of the proposal submission deadline.

Collection of Demographic Information
NASA is implementing a process to collect demographic data from grant applicants for the purpose of analyzing demographic differences associated with its award processes. Information collected will include name, gender, race, ethnicity, disability status, and citizenship status. Submission of the information is voluntary and is not a precondition of award.

10.5 APPLICATION REVIEW INFORMATION

10.5.1 Review and Selection Process

Proposals will be reviewed and evaluated by both NASA and external (non-NASA) subject matter experts based on standards established by NASA OSTEM and the Space Grant Program Manager. All sections of the proposal (see Proposal and Submission Guidance) will be individually evaluated against the same evaluation criteria. Quality of content and adherence to specified format as described in this solicitation will be considered. Funding will not be awarded unless at a minimum, the proposal meets all solicitation requirements. If a proposer remains non- responsive/non-compliant to this solicitation 45 days after the Cooperative Agreement's anniversary date, i.e., the period of performance end date, then planned funding for that proposal will be reprogrammed by NASA OSTEM.

Any proposal that does not meet the requirements as outlined in this solicitation will be deemed non-compliant, will not be considered for initial funding, but may be allowed to resubmit according to solicitation guidelines.

10.5.2 Successful Proposals

Upon selection of the awardee, recipients by the Selection Official, the PI of each successful proposal will receive a "Notice of Intent to Make a Federal Award" letter via NSPIRES with an explanation of the review process and reviewers' comments about the proposal. Proposers are strongly cautioned that only a NASA Grant Officer may make commitments, obligations, or awards on behalf of NASA or authorize the expenditure of funds for this opportunity. During the awarding process, the NSSC will perform a final budget and budget narrative review. Any issues and inconsistencies they note will require the proposer to update prior to awarding.

Pre-award costs will not be allowed for cooperative agreements awarded through this funding opportunity. It is this program's practice to provide a letter indicating application selection and "Notice of Intent to Make a Federal Award" letter prior to the release of Federal award funding. This letter is not an authorization to begin performance. If a submitter is selected for an award, and it incurs pre-award costs, this is at the submitter's/recipient's own risk and NASA will not pay them.

NASA will notify successful grant recipients of funding via a Notice of Award (NASA Form 1687) signed by the Grant Officer. This Notice of Award is the authorizing document and will be sent to the proposing PI and the Authorized Organization Representative (AOR) listed in the proposal via electronic delivery. All expenses incurred on grant activities prior to the period of performance start date listed on the Notice of Award are at the risk of the non-Federal entity until the Notice of Award is received and period of performance commences.

10.6 FEDERAL AWARD ADMINISTRATION INFORMATION

10.6.1 Cooperative Agreement Award Reporting Requirements

The reporting requirements for award recipients under the *Space Grant Opportunities in NASA STEM FY2025-2028* will be consistent with the *NASA Grant and Cooperative Agreement Manual (GCAM).*

Unless otherwise noted, the *Space Grant Opportunities in NASA STEM FY2025-2028* PI shall submit reports as described below via secure transfer and following Personally Identifiable Information (PII) requirements to the NASA Shared Services Center (NSSC) as well as the NASA Space Grant Program Office. For additional information on PII, see NASA Privacy Procedural Requirements.

For further details on reporting project performance, please refer to the Post-Award Phase Section of the GCAM.

Federal Financial Reporting

Recipients of NASA funding must submit quarterly financial reports. Financial reports must be submitted via the Payment Management System (PMS):

- Quarterly Federal Financial Reports (FFR) are due no later than 30 days past the reporting period end date
- Final Financial Status Reports/Final Federal Financial Report (FSR/FFR) are due no later than 120 days after the end of the period of performance

Performance Reporting

NASA award recipients must submit annual and final performance reports. Annual reports are due to NASA 60 days prior to the anniversary date of the award, except in the award's final year. Awards that are in their final year are required to submit final performance reports instead of the annual performance report. Descriptions of annual and final reporting requirements for *Space Grant Opportunities in NASA STEM FY2025-2028* are below:

Comprehensive Evaluation Plan (CEP) ***(due within 45 days after award period has started)***

The CEP is not required as part of the proposal for this solicitation but is required to be submitted by the Independent Evaluator (IE) within 45 calendar days of the start of the period of performance of this award. The completed CEP by the IE shall be submitted to NASA HQ Space Grant at hq-space-grant@mail.nasa.gov with the subject line: CEP- Space Grant Opportunities in NASA STEM FY2025-2028.

The template to be used by the IE shall be that provided as a template in Appendix G, and no other CEP format will be accepted. Reference Sections 10.2.5 and 10.4.3.11 for additional details.

Semi-Annual Progress Report ***(due each year at 6 months)***

Award recipients shall submit a Semi-Annual Progress Report every year no later than 6 months plus 15 days after the start of their award. In other words, if a consortium's award date (start of their period of performance) is Feb 15^{th} then their semi-annual report is due no later than August 15^{th} + 15 days (6 months + 15 days later). The template for the Semi-Annual Report will be provided by the main Space Grant office. Only the template provide shall be used and will be accepted for the report.

Annual Progress Report ***(due each year 60 days prior to the anniversary date of the award, except in the award's final year)***
Award recipients shall submit an Annual Progress Report (APR) every year no later than 60 days prior to the anniversary date of the award, with the exception of the award's final year. The template for the Annual Report will be provided by the main Space Grant office. That template will include sections to be completed by the consortium PI as well as an appendix to be completed by the consortium's Independent Evaluator. The combined report (PI and IE sections) **shall be submitted jointly, as a single document**. Only the template provided shall be used and will be accepted for the report.

Final Report ***(90 days following the end of the performance period)***
Recipients shall submit a Final Report no later than 90 days of the expiration of the project. The template for this report will be provided to the consortia by the Space Grant Program Office. That template will include sections to be completed by the consortium PI as well as an appendix to be completed by the consortium's Independent Evaluator and will cover the entire project's period-of-performance. The combined report (PI and IE sections) shall be submitted jointly. Only the template provided shall be used and will be accepted for the report.

Awardees shall also complete all required reports as requested by the NASA Shared Services Center (NSSC) as listed on the cooperative agreement Required Publications and Reports within the award document (i.e., NF1687).

Additional Reporting Requirements
In addition to the yearly semi-annual and annual (or final) reports, the consortia shall:

1. Submit the CPR performance data into the NASA STEM Gateway system (Gateway) by November 30th of each calendar year. The awardee shall adhere to the Gateway reporting guidelines provided by the OSTEM P&E team (i.e., the submitted data shall include data for a full year of performance and participant data, etc.). Gateway report training will be provided by Space Grant HQ Office & OSTEM P&E Team. <u>Note</u>: Unless otherwise directed by the OSTEM P&E team, for consistency, the data reported in Year X shall include data from fall semester Year X-1, spring semester Year X, and summer semester Year X. CPR reporting for Year 1 of this solicitation shall be completed by November 30, 2026. The CPR data provided into the NASA STEM Gateway system shall:
    a. Reporting for Year 1: Provide at a minimum, full awardee demographics via completed participant profiles (Participant List Only – PLO), within the STEM Gateway system.
    b. Reporting for Years 2 – 4: Provide full applicant as well as awardee demographics via completed applicant and awardee profiles within the STEM Gateway system

    <u>Note</u>: Demographics into the NASA STEM Gateway system shall only be reported directly from participant completed profiles. The consortia may not report demographics on behalf of the participants.

2. Submit an accurate Student Longitudinal Tracking table by November 30th of the next calendar year (in similar fashion as the deadline for the CPR described in number 1 above).

Awardees will report the status of longitudinal tracking results annually to the NASA Office of STEM Engagement (OSTEM). The template for these reports will be provided to the consortia each year by the main Space Grant office.

3. Dependent on the results of the health tracking of a consortium, as determined by the OSTEM Performance and Evaluation Team based on various factors as outlined in 10.2.8 Performance Indicators, a consortium may be required to participate in additional engagement activities with NASA. Specifics will depend on the resulting health performance, but may include a singular virtual meeting, quarterly or semi-annual virtual meetings, additional sections added to their consortium unique semi-annual or annual performance reports to gather additional insight into the areas of specific issues, and possibly a site visit if there are continued concerns beyond the performance of a single year.

NASA recipients must conform to all reporting requirements outlined in the Required Publications and Reports section of the GCAM, currently Appendix F.

10.6.2 Administrative and National Policy Requirements

In addition to the requirements in this section and in this NOFO, NASA may place specific terms and conditions on individual awards in accordance with 2 C.F.R. Part 200. Recipients of NASA grant funding shall adhere to requirements set forth in 2 CFR 200, 2 CFR 1800, 2 CFR 170, 2 CFR 175, 2 CFR 182, and 2 CFR 183.

10.6.3 Summary of Space Grant Awardee Responsibilities

The *Space Grant Opportunities in NASA STEM FY2025-2028* award recipients have the primary responsibility for implementing, operating, and managing the project as described in their submitted proposal.

- Space Grant Lead Institutions (i.e., recipients) shall assume primary responsibility for implementing, operating, and managing the project as described in their original proposaland as modified in subsequent proposals for continuation beyond the initial period.
- The recipient shall appoint a PI (i.e., Space Grant Director) in support of this Agreement. If the PI to be named is different from the individual identified in the proposal, the NASA Space Grant Program Office shall be notified in writing per the Guidelines for Space Grant Director & Lead Institution Changes. Any proposed change to the PI under this Agreement is subject to NASA approval. NOTE: If NASA approves the proposed change, the NASA Grant Officer will issue a formal written modification to the Agreement to reflect such change. If NASA does not approve the change in the PI, the recipient will propose another PI until NASA approval is obtained.
- The recipient shall provide a written response as to how the recommendations by the NASA Space Grant Program will be integrated into the programmatic and/or administrative plan.
- The recipient shall submit a variety of reports and data, including quarterly progress reports, performance and participant data, evaluation data, and annual

reports. The recipient may be required to host an annual on-campus or virtual (NASA will determine how) NASA site visit, following the schedule in the Management Guidelines. See additional information regarding reporting under **10.6.1 Cooperative Agreement Award Reporting Requirements**.

- The recipient, in concert with the Space Grant PI (Director), is responsible for the financial management of the Consortium as specified in the basic award notice under the terms and conditions issued by NASA and in the *NASA* GCAM. A recipient's failure to comply with the terms and conditions of an award can result in termination of the award by NASA.
- The recipient shall ensure that all peer-reviewed scientific research publications authored or co-authored by investigators and sub-recipients and funded, in whole or in part by NASA, are submitted to PubSpace System.
- NASA reserves the right to impose additional requirements during the Cooperative Agreement's period of performance to achieve broader Space Grant or NASA objectives.
- Recipients shall utilize all data collection tools and complete all assigned data entry tasks for NASA's approved data management system.
- Recipients may also be required to collaborate with a third party in support of a program- level evaluation of the Space Grant Consortia. The Space Grant Program Office will provide additional communications and guidance regarding data calls, activity tracking and future program-level evaluation efforts.
- Recipients shall send at least two consortia representatives from the lead consortium's office to the NASA OSTEM National Conference. It is expected that one of the attendees be the award PI/Director and the second attendee be an additional Key Personnel from the lead Space Grant consortium.

10.6.4 Office of STEM Engagement Performance Metrics

NASA currently utilizes the NASA STEM Gateway registration/application and data management system (Gateway system) for analyzing performance data. PIs are required to timely and properly respond to data calls as requested by NASA OSTEM and utilize the Gateway system for performance data reporting. Additional communications and guidance regarding data calls associated with *Space Grant Opportunities in NASA STEM FY2025-2028* and the Gateway system will be sent to award recipients from the NASA OSTEM and Space Grant Program or Integration Manager. The PI shall ensure that it has the appropriate staff and resources to facilitate data collection activities and properly complete tasks required for timely reporting to NASA.

10.6.5 Other Information

Access to NASA Facilities/Systems

All recipients shall work with NASA project/program staff to ensure proper credentialing for any individuals who need access to NASA facilities and/or systems. Such individuals include U.S. citizens, lawful permanent residents ("green card" holders), and foreign nationals (those who are neither U.S. citizens nor permanent residents).

10.6.6 Summary of Key Information

Total ESTIMATED annual budget for *Space Grant Opportunities in NASA STEM FY2025-2028*	Year 1 – \$800k Year 2 – \$870k Year 3 – \$870k Year 4 – \$870k
Anticipated number of new awards, pending adequate proposals of merit	52
Estimated Start Date	Varied (dependent on current period of performance)
Duration of awards	Four (4) years
Award Type	Cooperative Agreement
Release Date for *Space Grant Opportunities in NASA STEM FY2025-2028* NOFO	**March 8, 2024** (DATE SUBJECT TO CHANGE); Check NSPIRES for details
DUE DATE FOR PROPOSALS	**July 10, 2024, 11:59pm Eastern Time** (DATE SUBJECT TO CHANGE); Check NSPIRES for details
Page limit for the Narrative Section of proposal	15 pp. See *NASA Guidebook for Proposers*
Detailed instructions for the preparation and submission of proposals	See *NASA Guidebook for Proposers*
Submission medium	Electronic proposal submission is required via NSPIRES or Grants.gov. See *NASA Guidebook for Proposers*
Selection Official	Tomas Gonzalez-Torres Manager, Space Grant Program NASA Headquarters Washington, DC 20546
NRESS contact regarding inquiries and assistance for submission of the electronic proposal materials into NSPIRES	NASA Research and Education Support Services (NRESS) Support Team Email: spacegrant@nasaprs.com

Appendix 10A – Budget Tables

Notes:

a. This budget spreadsheet format shown below is the required format, and no other formats will be accepted. The proposer may recreate this table as shown, or an excel version of the budget table will be provided to the proposer upon request to the Space Grant Program Office at NASA HQ.

b. This same table format shall be used for the various required proposed budget tables, with **updated titles** as listed below to match:
   - i. Year 1, Fiscal Year 2025 Base Award – *example shown below*
   - ii. Year 2, Fiscal Year 2026 Base Award
   - iii. Year 3, Fiscal Year 2027 Base Award
   - iv. Year 4, Fiscal Year 2028 Base Award
   - v. Year 2, Fiscal Year 2026 Augmentation
   - vi. Year 3, Fiscal Year 2027 Augmentation
   - vii. Year 4, Fiscal Year 2028 Augmentation

c. No cumulative budget is required to be submitted

d. Budget tables for the Augmentation dollars are only required if proposing for those funds.

e. Add rows as needed.

	Year 1, Fiscal Year 2025 Base Award		
	NASA Funds	**Cost-Share**	**Total Funding**
A. Personnel/ Direct Labor			
1. Principal Investigator/ Director			
2. Program Manager			
3. Research Associate			
4. Staff Support			
Total Salaries			
B. Fringe Benefits			
1. Principal Investigator/ Director			
2. Program Manager			
3. Research Associate			
4. Staff Support			
Total Fringe			
C. Equipment			
D. Materials and Supplies			
E. Services			
F. Domestic Travel			

G. NASA Internships and Fellowships			
1. Internships			
2. Fellowships			
Total NASA Internships and Fellowships			
H. Aeronautics Mission Directorate Projects			
1. Project 1			
2. Project 2			
Total Aeronautics Mission Directorate Projects			
I. Spaceflight Operations Mission Directorate Projects			
1. Project 1			
2. Project 2			
Total SO Mission Directorate Projects			
J. Exploration Systems Development Mission Directorate Projects			
1. Project 1			
2. Project 2			
Total ESD Mission Directorate Projects			
K. Science Mission Directorate Projects			
1. Project 1			
2. Project 2			
Total Science Mission Directorate Projects			
L. Space Technology Mission Directorate Projects			
1. Project 1			
2. Project 2			
Total Space Technology Mission Directorate Projects			
M. Competitive Projects			
1. Project 1			
2. Project 2			
Total Competitive Projects			
Total Direct Project Costs (A-L)			
N. Subcontracts			

O. Total Direct Costs			
P. Indirect Cost (% rate of item O)			
Q. Total Costs			

Appendix 10B – Base Award Estimated Costing Schedule Table and Rationale

Note: This table is required to be included in Appendix C of the proposal. The **format shown below is the required format,** and a separate table must be completed for each of the funding years (1 thru 4).

Budget Category	**Year X, Fiscal Year 202X Base Award Estimated Costing Schedule**					
	Total Funding	**% Costed by end of Q1 PoP**	**% Costed by end of Q2 PoP**	**% Costed by end of Q3 PoP**	**% Costed by end of Q4 PoP**	**% Costed by end of PoP + additional Quarter**
A + B						
C + D + E + F						
G						
H						
I						
J						
K						
L						
M						
N						

Notes:

a. An Estimated Costing Schedule Table and its accompanying Rationale must be provided for each of the 4 years of this multi-year award (total of 4 tables).
b. Update the title of each table to be:
    a. Year 1, Fiscal Year 2025 Base Award
    b. Year 2, Fiscal Year 2026 Base Award
    c. Year 3, Fiscal Year 2027 Base Award
    d. Year 4, Fiscal Year 2028 Base Award
c. This is not required for proposed augmentation funds
d. Values for estimated % costed maybe rounded to the nearest 10%.

Rationale for the three items listed below is required to be provided. If the rationale/information is NOT expected to be the same across all four award years, then the points which are specific to only certain award years must be clarified.

1. Please explain how your current draw-down schedule is sufficient in scope and timing to meet the spending expectations outlined in the costing table above.

2. If your current draw-down schedule presents any risks to your proposed costing schedule in the table above, please enumerate those risks **and provide a corresponding mitigation plan** to address each risk. Note that both the risk and a mitigation plan is required. **If no risks are expected, that needs to be specifically stated.**

3. Please list all other perceived risks **along with** a corresponding mitigation plan for each. Note that both the risk and a mitigation plan is required. **If no additional risks are perceived to exist, that needs to be specifically stated.**

Appendix 10C – Summary Cost-Match Table

Note: The 3 tables below are required to be included in Appendix H of the proposal. The **format shown below is the required format,** and a separate table must be completed for each of the funding years (1 thru 4). If the value is zero for any of the tables, please include the table and enter “0” for the same table(s).

<Enter State Name Here> Space Grant Consortium Cost-Matching Funds Table for Year 1, Fiscal Year 2025 Base Award for the Lead Institution: **<Enter Name of Lead Institution Here>**	
Cost-Share Amount from the Lead Institution	Letter of Resource Support Included to reflect the **total** cost-share from the Lead Institution? (Y/N)
$XX, XXX	

<Enter State Name Here> Space Grant Consortium Cost-Matching Funds Table for Year 1, Fiscal Year 2025 Base Award for Affiliates to be determined after competitive competitions.	
Total Cost-Share Amount from Affiliates to be determined after competitive competitions	Letters of Resource Support are not required since awardees will not be determined until after competitive competitions
$XX, XXX	**X**

<Enter State Name Here> Space Grant Consortium Affiliate Cost-Matching Funds Table for Year 1, Fiscal Year 2025 Base Award			
Cost-Share Amount from Affiliate	Institution Name	Letter of Resources Support Included in Proposal? (Y/N)	If No, provide rationale
$XX,XXX	Institution A		
$XX,XXX	Institution B		
$XX,XXX	Institution C		
$XX,XXX	Institution D		
$XX,XXX	Institution E		
$XX,XXX	Institution F		
$XX,XXX	Institution G		
Total Affiliate Cost- Match			

Appendix 10D - OSTEM NASA Internships and Fellowships Definitions

The definitions in this appendix (Appendix D) are applicable to NASA Center Internships, and all Fellowships regardless of whether they are managed by NASA or not. These definitions are provided to proposers and reviewers as guidance, so that proposers and reviewers understand certain differences between internships vs. fellowships.

The Space Grant program recognizes that each respective proposing institution may have different guidance and policy on what constitutes an internship. The Space Grant program wants to ensure that each proposing institution has the necessary flexibility to execute its respective programs, including internships, in alignment with its institution's policies and practices. The following definitions are representative of the types of direct student awards that OSTEM offers.

- **Internships** are educational hands-on traineeships that provide unique NASA-related research and operational experiences for educators and high school, undergraduate, and graduate students. Internships integrate participants with career professionals emphasizing mentor-directed, degree-related, project task completion. NASA internships shall consist of at least 400 contact hours (320 for H.S. students or teachers) ofmentored, degree-relevant, work-activity.

- **Fellowships** are designed to support independently conceived or designed research by highly qualified faculty, and graduate students, in disciplines needed to help advance NASA's missions. Fellowships afford students the opportunity to directly contribute to advancements in NASA's STEM-related areas of study or STEM Education fields. NASA fellowship opportunities are focused on innovation and generate measurable research results that contribute to NASA's current and future science and technology goals.

Appendix 10E – Sample Table of Consortia S.M.A.R.T. Goals, Objectives and Performance Measures Matrix

Instructions: Develop consortium unique S.M.A.R.T. goals, objectives, and indicators of success (performance measures), using the provided tables below. The format shown below shall be used and no other format will be accepted.

For each S.M.A.R.T. goal developed, it is required that the proposer show how it is in alignment with at least one of the OSTEM Performance Goals (listed below) and one associated Objective (listed under each of the aligned Performance Goals). The totality of the consortium S.M.A.R.T. goals should align with at least two of the Performance Goals. Each consortium S.M.A.R.T. goal does not need to align with two Performance Goals, but throughout the entirety of the list of the consortium's S.M.A.R.T. goals, there shall be a focus encompassing at least two of the Performance Goals.

A total of 12 tables are shown below, outlining three tables for each of the four years of this multi-year cooperative agreement. Each of the four years has three tables which break down the focus of the SMART goals into three categories: NIF Activities, Mission Directorate/Competitive Projects, and Diversity.

Within the NIF S.M.A.R.T. goals matrix, the proposer shall develop S.M.A.R.T. goals, objectives, and indicators of success for the activities associated with the funds budgeted within the NIF category. The proposer shall do the same for the Mission Directorate/Competitive Projects.

In the third table of each proposed year, the proposer shall develop S.M.A.R.T. goals, objectives, and indicators of success (using the Diversity SMART goals matrix) showing how the consortium's planned activities will **broaden the diverse set of students with whom the consortium attracts and engages**.

Note: Examples have been included in the tables shown below. These are examples only and these specific items are NOT required to be included in the final tables provided in the consortium's proposal.

Performance Goal 4.3.1: Create unique opportunities for a diverse set of students to contribute to NASA's work in exploration and discovery.

- **Objective 1.1:** Create opportunities that enable students to produce knowledge or products that will be used by NASA
- **Objective 1.2:** Create opportunities that enable students to support NASA mission work and research
- **Objective 1.3:** Establish and maintain a national network of universities that enable creates opportunities for students to contribute to NASA's work in exploration and discovery

Performance Goal 4.3.2: Build a diverse future STEM workforce by engaging students in authentic learning experiences with NASA's people, content, and facilities.

- **Objective 2.1:** Enhance students' STEM identity, skills, and knowledge by engaging them in NASA-based authentic STEM learning activities

Objective 2.2: Provide opportunities for students to engage with NASA's aeronautics, space, and science people, content, and facilities in support of a diverse future NASA and aerospace industry workforce
Objective 2.3: Broaden participation of students in Space Grant Programming that leverages authentic learning experiences with NASA's people, content, and facilities

Performance Goal 4.3.3: Attract diverse groups of students to STEM through learning opportunities that spark interest and provide connections to NASA's mission and work.
Objective 3.1: Expand the reach of individual Consortia to collaborate regionally on efforts that directly support middle and high school student participation in hands-on, NASA-aligned STEM activities
Objective 3.2: Attract diverse populations of traditionally underserved and underrepresented middle and high school students to STEM and equip them with the tools necessary for success in college STEM degree programs leading to STEM careers
Objective 3.3: Promote a strong STEM education base for middle and high school students while training teachers in these grade levels to become more effective at improving student academic outcomes.

Consortium Goals: Statements about overall intent or purpose of the program to which program objectives and activities are expected to contribute. Goal(s) focus on the desired outcomes and are broad (Your Destination). Note that these are consortium goals associated with the Performance Goals listed above, but should not be a copy/paste of those.

- What outcome do you hope to achieve?
- What will the results look like?
- Where do you want to be after each award year concludes?
- Think: SMART (Specific, Measurable, Achievable, Relevant/Realistic, and Time-based
- *Example: Build a diverse future STEM workforce by engaging students in authentic learning experiences with NASA's people, content, and facilities.*

Consortium Objectives: Brief, clear statements that describe the actions and activities that contribute to achievement of the program goal(s). Objectives are the highest level result the program can affect or achieve towards accomplishment of the program goal(s). They are statements of the condition(s) or state(s) the program is expected to achieve within the timeframe and resources of the program.

- What specific actions will help you to achieve your goal?
- What steps will you take to reach your goal?
- Also Think: SMART (but the time would be shorter, typically within a year)
- *Example: Increase the number of URMs participating in STEM engagement activities.*

Consortium Performance Measures: Parameters used to measure progress/success. Target quantitative measure (e.g., percentage, number, increase, etc.) if appropriate and/or evidence of success indicating objective(s) are achieved.

- How will you measure your progress toward the objective(s)?
- What variable (e.g., data/evidence) will you examine to see if you have actualized your objective?

Consortium Deadline: Target date for accomplishment/completion.

Note: The S.M.A.R.T. Goals, Objectives, and Performance Metrics Matrix tables shown on the next few pages are required to be included in Appendix E of the proposal. The **format shown below is the required format, and no other format will be accepted**.

Sample Table of Consortium S.M.A.R.T. Goals, Objectives, and Performance Metrics Matrix

Consortium ________________

Year 1 (FY 2025) - NIF Activity SMART Goals, Objectives, and Performance Metric										
Performance Goal Alignment	**Space Grant Objective Alignment**	**Mission Directorate Alignment**					**Consortium Year 1 (FY 2025) Performance**			
		ARMD	**SMD**	**STMD**	**ESDMD**	**SOMD**	**Consortium Goal**	**Consortium Objective**	**Consortium Performance Measure**	**Consortium Deadline**
Performance Goal 4.3.1	*Objectives 1.1 and 1.2*	*X*	*X*	*X*	*X*	*X*	*Enable students to contribute to NASA Mission Directorate activities through internships.*	*Support the placement of students at NASA centers where they will be able to directly support the NASA mission.*	*Successful placement of 2 fall, 2 spring, and 2 summer interns at NASA centers*	*4/1/2026*

Year 1 (FY 2025) – Mission Directorate/Competitive Project SMART Goals, Objectives, and Performance Metric										
Performance Goal Alignment	**Space Grant Objective Alignment**	**Mission Directorate Alignment**					**Consortium Year 1 (FY 2025) Performance**			
		ARMD	**SMD**	**STMD**	**ESDMD**	**SOMD**	**Consortium Goal**	**Consortium Objective**	**Consortium Performance Measure**	**Consortium Deadline**
Performance Goal 4.3.2	*Objectives 2.1*	*X*	*X*	*X*	*X*	*X*	*Contribute to NASA Mission Directorate activities by engaging students with NASA's people and facilities.*	*Provide students with team-based learning opportunities that promote real-world STEM experiences.*	*Support X collegiate student competition teams (i.e., Student Artemis Challenges, Student Launch, First Nations Launch, etc.).*	*4/22/2026*

Year 1 (FY 2025) – Diversity SMART Goals, Objectives, and Performance Metric										
Performance Goal Alignment	Space Grant Objective Alignment	Mission Directorate Alignment					Consortium Year 1 (FY 2025) Performance			
		ARMD	SMD	STMD	ESDMD	SOMD	Consortium Goal	Consortium Objective	Consortium Performance Measure	Consortium Deadline
Performance Goal 4.3.1	*Objectives 1.3*	*X*	*X*	*X*	*X*	*X*	*Broaden participation from a more diverse set of participants across the consortium beyond those who have historically participated.*	*Actively engage students at affiliate member institutions who have historically not been involved with lead institution consortium events and awarding opportunities.*	*Award a minimum of 40% female students from academic affiliates (non-lead institution)*	*6/10/2026*
Performance Goal 4.3.2	*Objectives 2.3*	*X*	*X*	*X*	*X*	*X*	*Broaden participation from a more diverse set of participants across the consortium beyond those who have historically participated.*	*Actively engage with student groups, across affiliate campuses, who are currently underrepresented participants in consortium activities*	*Reach out to and present at X number of student organizations who have a large percentage of underrepresented /underserved members.*	*6/10/2026*

Year 2 (FY 2026) - NIF Activity SMART Goals, Objectives, and Performance Metric										
Performance Goal Alignment	Space Grant Objective Alignment	Mission Directorate Alignment					Consortium Year 2 (FY 2026) Performance			
		ARMD	SMD	STMD	ESDMD	SOMD	Consortium Goal	Consortium Objective	Consortium Performance Measure	Consortium Deadline

Year 2 (FY 2026) – Mission Directorate/Competitive Project SMART Goals, Objectives, and Performance Metric										
Performance Goal Alignment	Space Grant Objective Alignment	Mission Directorate Alignment					Consortium Year 2 (FY 2026) Performance			
		ARMD	SMD	STMD	ESDMD	SOMD	Consortium Goal	Consortium Objective	Consortium Performance Measure	Consortium Deadline

Year 2 (FY 2026) – Diversity SMART Goals, Objectives, and Performance Metric										
Performance Goal Alignment	Space Grant Objective Alignment	Mission Directorate Alignment					Consortium Year 2 (FY 2026) Performance			
		ARMD	SMD	STMD	ESDMD	SOMD	Consortium Goal	Consortium Objective	Consortium Performance Measure	Consortium Deadline

Year 3 (FY 2027) - NIF Activity SMART Goals, Objectives, and Performance Metric										
Performance Goal Alignment	Space Grant Objective Alignment	Mission Directorate Alignment					Consortium Year 3 (FY 2027) Performance			
		ARMD	SMD	STMD	ESDMD	SOMD	Consortium Goal	Consortium Objective	Consortium Performance Measure	Consortium Deadline

Year 3 (FY 2027) – Mission Directorate/Competitive Project SMART Goals, Objectives, and Performance Metric										
Performance Goal Alignment	Space Grant Objective Alignment	Mission Directorate Alignment					Consortium Year 3 (FY 2027) Performance			
		ARMD	SMD	STMD	ESDMD	SOMD	Consortium Goal	Consortium Objective	Consortium Performance Measure	Consortium Deadline

Year 3 (FY 2027) – Diversity SMART Goals, Objectives, and Performance Metric										
Performance Goal Alignment	Space Grant Objective Alignment	Mission Directorate Alignment					Consortium Year 3 (FY 2027) Performance			
		ARMD	SMD	STMD	ESDMD	SOMD	Consortium Goal	Consortium Objective	Consortium Performance Measure	Consortium Deadline

Year 4 (FY 2028) - NIF Activity SMART Goals, Objectives, and Performance Metric										
Performance Goal Alignment	Space Grant Objective Alignment	Mission Directorate Alignment					Consortium Year 4 (FY 2028) Performance			
		ARMD	SMD	STMD	ESDMD	SOMD	Consortium Goal	Consortium Objective	Consortium Performance Measure	Consortium Deadline

Year 4 (FY 2028) – Mission Directorate/Competitive Project SMART Goals, Objectives, and Performance Metric										
Performance Goal Alignment	Space Grant Objective Alignment	Mission Directorate Alignment					Consortium Year 4 (FY 2028) Performance			
		ARMD	SMD	STMD	ESDMD	SOMD	Consortium Goal	Consortium Objective	Consortium Performance Measure	Consortium Deadline

Year 4 (FY 2028) – Diversity SMART Goals, Objectives, and Performance Metric										
Performance Goal Alignment	Space Grant Objective Alignment	Mission Directorate Alignment					Consortium Year 4 (FY 2028) Performance			
		ARMD	SMD	STMD	ESDMD	SOMD	Consortium Goal	Consortium Objective	Consortium Performance Measure	Consortium Deadline

Appendix 10F – Sample Milestone Chart

Notes:

a. This table is required to be included in Appendix D of the proposal. The **format shown below is the required format,** and a separate table must be completed for each of the funding years (1 thru 4).
b. Provide an estimate as to when a proposed activity will occur/be awarded, within the period of performance (dates should be adjusted to align with the specific consortium's period of performance). The items listed below shall align with the content of the proposal, budget, and budget narrative.
c. Provide a separate chart for each of the four years of the award period, such that they align with the consortium's period of performance.

YEAR: 202X													
Extension Base Award Activity		Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	Oct-25	Nov-25	Dec-25	Jan-26	Feb-26	Mar-26
1	Example: Graduate Student Awards					X							
2	Example: TBD Award		X										
Augmentation Award Activity		Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	Oct-25	Nov-25	Dec-25	Jan-26	Feb-26	Mar-26

GUIDELINES FOR SUBMITTAL OF EVALUATION PLANS

NASA's Office of STEM Engagement requires recipients of its cooperative agreements to conduct an independent evaluation of its sponsored activities. To facilitate awardees efforts to meet this obligation they will use the uniform format presented here in reporting their evaluation results to the Office of STEM Engagement. This template benefits awardees by providing clarity on report elements and standardization of the types of information required to assist in comparing outputs and outcomes.

This template is the result of the Office of STEM Engagement Performance and Evaluation Strategy (Learning Agenda). Among the priorities of this learning agenda, is to improve the overall data quality, integrity and analysis/reporting capabilities. In purist of this goal the components, format, and reporting requirements laid out below focus data collection in alignment with Federal, Agency and Office of STEM Engagement (OSTEM) legislative directives, priorities, and metrics of interest while reducing the volume of data collected by eliminating duplication, reducing the burden placed on recipients of cooperative agreements, and standardization.

In compiling and submitting their evaluation reports cooperative agreements recipients are expected to adhere to the instructions and requirements developed for each component of their report as outlined but may provide additional site-specific information as necessary.

Evaluation Plan Elements

The cooperative agreement awardees shall submit a Comprehensive Evaluation Plan within 45 days of the start of the period of performance via email to NASA Shared Service Center (NSSC), the NASA Space Grant Project Management Team personnel, and NASA Performance & Evaluation (P&E) Team personnel.

All Evaluation Plans submitted to NASA's Office of STEM Engagement by cooperative agreement awardees must include the following elements:

- Cover Page
- Table of Contents
- Introduction
- Evaluation Design Methodology
- Timeline
- Risk Mitigation Strategy
- Works Cited
- Appendices

Cover Page

All evaluation plans submitted to NASA's Office of STEM Engagement must contain a title page with the following elements:

- Project Title
- Institutional Affiliation
  - College/Department
  - Address
- Federal Award Identification Number (FAIN) or Other Identifying Number
- Project Principal Investigator (PI)
  - Name
  - Title
  - Contact Information (Email Address and Phone Number)
- Project Independent Evaluator
  - Name
  - Title
  - Contact Information (Email Address and Phone Number)
- Submission Date
- Cooperative Agreement Period (Start Date, End Date)

A template outlining how awardees are to organize and present these elements is located on the following pages.

Table of Contents

The table of contents is a formatted list of the report's sections and subsections, including References and Appendices with page numbers. In drafting your Table of Contents please:

- List only pages that appear after the table of contents
- Ensure the table of contents is number correctly and match the actual page each section/subsection is found on
- Do not include Tables and Figures in your Table of Contents
  - These may optionally be listed in their own "List of Table" and "List of Figures" each in their own tables and on their own successive pages

A template outlining how awardees are to organize and present the Table of Contents is located on the following pages.

Comprehensive Evaluation Plan

Program Title

Grant: NX#######

Cooperative Agreement Awarded Month Day, Year - Month Day, Year

Institution Name

Department/College

Street Name, Building

City, State Zip code

Period of Performance: Month Day, Year - Month Day, Year

Submitted Month Day, Year

By

Principal Investigator:
Name
Origination
Email & Phone Number

Independent Evaluator:
Name
Origination
Email & Phone Number

Table of Contents

Introduction

Provide background information on the Space Grant Consortium Program; outline consortium goals, objectives, and outcomes; and place the evaluation plan in context of operations.

Background

Program Information

Provide a brief description and background of the program being evaluated including (re: milestones):

- Proposed implementation dates, timing, and frequency of activities
- Proposed type of content and how the content is delivered (e.g. Saturday, summer, or after school)
- The goals and objectives or performance measures of your program as they relate to those of the agency-wide initiative, note each laid for the initiative by the Office of STEM Engagement must relate to one or more goals or performance measures specific to your program
- The target audience of this project (if multiple activities were held, include all target audiences; e.g. Students, Teachers, Parents/caregivers)

For each consortium milestone, please use Table 1 to describe the status (on-target, delayed, or cancelled), progress, and (if applicable) the reason for delay or cancellation.

Table 1: Consortium Milestones Table

Consortium Milestones	Status (on-target, delayed, cancelled)	Describe Progress towards achieving milestones	Indicate reason for delay or cancellation (if applicable)
Milestone #1			
Milestone #2			
Milestone #3			

SMART Goals Table

Space Grant PIs should work with the Independent Evaluator to develop SMART goals unique to their consortium (see Table 3). As a reference, the following SMART Goals Matrix (see Table 2) provides a poor, good, and strong example.

Table 2: Example SMART Goals Matrix

	Strategic/ Performance Goal Alignment	Space Grant Objective Alignment	Mission Directorate Alignment					Consortium Year 5 Performance			
			ARMD	SMD	STMD	ESDMD	SOMD	Consortium Goal	Consortium Objective	Consortium Performance Measure	Consortium Deadline
Instructions:	***Select*** *one Strategic Goal/ Performance Goal*	***Select*** *one relevant Space Grant Objective*	***Select*** *at least one (or more) of aligned NASA Mission Directorates. (Not all MDs need to be selected).*					***Write*** *in your consortium goal*	***Write*** *in your consortium objective that aligns to the goal*	***Write*** *how you will measure this objective*	***Write*** *in the target deadline for this goal/ objective*
Poor Example	Strategic Goal 3.0 (Performance Goal 4.3.3) *Attract diverse groups of students to STEM through learning opportunities that spark interest and provide connections to NASA's mission and work*	Objective 3.1 *Expand the reach of individual consortia to collaborate regionally on efforts that directly support middle and high school student participation in hands-on, NASA-aligned STEM activities*	N/A	N/A	N/A	N/A	N/A	Involve students in STEM	Fly high altitude balloon missions with middle school students	Balloons were launched	End of PoP
Good Example	Strategic Goal 1.0 (Performance goal 4.3.1) *Create unique opportunities for a diverse set of students to contribute to NASA's work in exploration and discovery*	Objective 1.1 Create opportunities that enable students to produce knowledge or products that will be used by NASA	X	X	X	X	X	Support authentic undergraduate and graduate STEM learning experiences that will enhance NASA and the STEM workforce	Support college students with STEM- and NASA-relevant research fellowships	Fund 10 college students with research fellowship awards	Annually
Strong Example	Strategic Goal 2.0 (Performance goal 4.3.2) *Build a diverse future STEM workforce by engaging students in authentic learning experiences with NASA's people, content, and facilities.*	Objective 2.2 *Provide opportunities for students to engage with NASA's aeronautics, space, and science people, content, and facilities in support of a diverse future NASA and aerospace industry workforce.*	X	X	X	X	X	Support authentic undergraduate and graduate STEM learning experiences that will enhance NASA and the STEM workforce	Increase the number of women participating in a NASA Internship	Fund 5 college students with a NASA internship each year, including at least 2 internships awarded to women	Annually

Table 3. Blank SMART Goals Matrix for Independent Evaluators

Strategic/ Performance Goal Alignment	Space Grant Objective Alignment	Mission Directorate Alignment					Consortium Year X Performance			
		ARMD	SMD	STMD	ESDMD	SOMD	Consortium Goal	Consortium Objective	Consortium Performance Measure	Consortium Deadline

Purpose of the Evaluation

State the purpose of the evaluation; consider the stakeholders who will receive the report and how each will use the results (for example ensuring accountability, documenting progress, identifying successes, compile recommendations for continued improvement). Additionally, this section of the report should include:

- A Logic Model that summarizes program inputs, activities, outputs and outcomes, you may optionally divide outcomes between short and long term

Evaluation Design and Methodology

This section details the evaluation plan and includes the following elements:

- Evaluation Questions
- Data Collection Strategy
- Evaluation Methods

Evaluation questions

Layout each of the evaluation question assessed in the proposed evaluation. Each question must:

- Must relate to a specific site goal or objective/performance measure
  - Note that each site goal or objective/performance measure must have at least one associated evaluation question.
- Are clear, concise, and falsifiable
- Do not contain normative or subjective language
- Address measurable concepts
- Focus on a specific program component.

Data Collection Strategy

This component lays out the strategy for obtaining the data necessary to address the proposed evaluation questions. This includes:

- Clearly defined indicators for each concept identified in evaluation questions
- Each indicator clearly operationalized and associated with specific data collection instruments/protocols
- Instruments are valid and reliable
- Adequately described the strategy or method used to recruit respondents
- A statement of the proposed sampling method (e.g. convenience, random, PPS, Snowball, etc.)

Evaluation Methods

This section lays out the proposed evaluation methods to analyze the data collected for the evaluation. For each of the proposed instruments listed above provide a detailed discussion of the analysis process and should:

- Be based upon reputable models and techniques that are appropriate to the content and scale of the Space Grant Program
- Detail the methods used to analyze the data (e.g. descriptive statistics, T-test, ANOVA, Regression, etc.)
- Indicate the variable(s) derived from the instrument that will be analyzed using the method(s) discussed
- An explicit indication of the unit of analysis

Using Table 4, provide a description of the evaluation questions, instrument(s) used, data collection method(s) and sampling strategy, and data analysis method(s) and approach.

Table 4. Data Collection Summary Table

Evaluation Question	Instrument(s) Used	Data Collection Method(s) & Sampling Strategy	Data Analysis Method(s) & Approach
[To what degree does the program attract and serve historically underserved and underrepresented students?]		*[-Sign in sheets at weekly events and summer camp registration logs. -Initial registration demographic survey filled out by parents. -Field observations, and journaling]*	*[Descriptive Statistics, coding themes qualitatively using MaxQDA software]*
[To what extent does the collaboration result in a valued experience by the organization?]		*[Researcher will conduct semi-structured interviews with various stakeholders including parents, teachers, administrators, assistant superintendent, and school board members. Teachers will complete survey questionnaire assessing student groups during the Summer course.]*	*[Open coding and coding themes qualitatively using MaxQDA software.]*

Timeline

This section lays out the proposed timing of the evaluation and should include a Gantt chart (Table 5) or similar figure that:

- Includes all evaluation activities and milestones
    - Data collection
    - Data analysis
    - Periodic reporting of evaluation findings to stakeholders
    - Drafting of the Evaluation Report
- Indicates the responsible party for each activity or milestone
- Activities and milestones are scheduled with a resolution at the quarterly level

Table 5. Example Gantt Chart for Evaluation Milestones

Activity	2025	2026		
	Fall	Spring	Summer	Fall
Data Collection				
Disseminate student pre-surveys				
Disseminate student post-surveys				
Conduct student interviews				
Data Analysis				
Analysis of data collected in 2025				
Analysis of data collected in 2026				
Analysis of interview data				
Reporting				
Statewide Meeting/Reporting to Stakeholder				
Year 1 Report				
Year 2 Report				
Year 3 Report				
Year 4 Report				

Note: This example table reflects a trimester academic schedule. Please change the intervals and milestones to match your consortium's unique timelines.

Risk Mitigation Strategy

This section outlines contingency plans to respond to events and or changes in the implementation of the program that poses a risk to the successful completion of the evaluation consider:

- How data collection activities will be rescheduled if activities are canceled or postponed
- Will any of the evaluation activities require IRB approval, if so specify which activities will require submission to the IRB and the timing of that submission as a strategy to overcome any delays obtaining clearance
- How analysis methods will be affected by the potential of low response rates
- How to ensure continuity in the event of turnover in evaluation staff
- How you will communicate to stakeholders at NASA's Office of STEM Engagement or others in the event these or other unforeseen adversities materialize

Works Cited

A reference section lists any research or instruments used in the Evaluation Report.

- All works cited in the body of the report should have a corresponding entry in the works cited list
- All citations must follow MLA, Chicago, APA, APSA or other commonly used formatting guidelines
- Entries must appear in alphabetical order
- Entries are single-spaced and spacing between entries is double spaced

Appendices

Appendices provide additional information and reference material. There are two required elements to be included although additional elements may be included as required.

Copies of Instruments

Include copies of your instruments (i.e. surveys, interview protocols, coding guidelines, etc.). Each instrument used must be placed in its own Appendix and appear in the Table of Contents.

Independent Evaluator’s Resume or CV

Include a copy of the Independent Evaluator’s resume or CV highlighting qualifications, past achievements, prior work, and any published reports

GUIDELINES FOR SUBMITTAL OF SPACE GRANT ANNUAL / FINAL EVALUATION REPORT

NASA's Office of STEM Engagement requires recipients of its cooperative agreements to conduct an independent evaluation of its sponsored activities. To facilitate awardees efforts to meet this obligation they will use the uniform format presented here in reporting their evaluation results to the Office of STEM Engagement. This template benefits awardees by providing clarity on report elements and standardization of the types of information required to assist in comparing outputs and outcomes.

This template is the result of the Office of STEM Engagement Performance and Evaluation Strategy (Learning Agenda). Among the priorities of this learning agenda, is to improve the overall data quality, integrity and analysis/reporting capabilities. In purist of this goal the components, format, and reporting requirements laid out below focus data collection in alignment with Federal, Agency and Office of STEM Engagement (OSTEM) legislative directives, priorities, and metrics of interest while reducing the volume of data collected by eliminating duplication, reducing the burden placed on recipients of cooperative agreements, and standardization.

In compiling and submitting their evaluation reports cooperative agreements recipients are expected to adhere to the instructions and requirements developed for each component of their report as outlined but may provide additional site-specific information as necessary.

Annual/Final Evaluation Report Elements

The cooperative agreement awardees shall submit the annual evaluation report 60 days prior to the Anniversary Date and the final evaluation report 90 days after the Anniversary Date via email to NASA Shared Service Center (NSSC), the NASA Deputy Space Grant Manager, the NASA Performance Assessment and Evaluation Program Manager (Rick Gilmore – richard.l.gilmore@nasa.gov) and appropriate support personnel. The purpose of the annual/final evaluation report is to 1) Document project activities and accomplishments measured against proposed goals and objectives over the period of performance of the award. 2) Provide evidence the project has advanced stakeholder priorities. 3) Report the extent to which awardees have fostered and developed collaborations and/or partnerships. 4) Summarize data collection activities and relevant evaluation findings. 5) Establish a set of recommendations based on empirical evidence findings to enhance the program.

All annual/final evaluation reports submitted to NASA's Office of STEM Engagement by Space Grant Program-Level Independent Evaluation cooperative agreement awardees must include the following elements:

- Cover Page
- Table of Contents
- Executive Summary
- Introduction
- Accomplishments and Preliminary Results

- Preliminary Conclusions and Recommendations
- Works Cited
- Appendices

Cover Page

All final evaluation reports submitted to NASA's Office of STEM Engagement must contain a cover page with the following elements:

- Report Term (Annual/Final)
- Project Title
- Institutional Affiliation
  - College/Department
  - Address
- Federal Award Identification Number (FAIN) or Other Identifying Number
- Project Principal Investigator (PI)
  - Name
  - Title
  - Contact Information (Email Address and Phone Number)
- Project Independent Evaluator
  - Name
  - Title
  - Contact Information (Email Address and Phone Number)
- Submission Date
- Cooperative Agreement Period (Start Date, End Date)

Please note that when submitting a final report, the cooperative agreement period and the performance period will have the same start and end dates. A template outlining how awardees are to organize and present these elements is located on the following pages.

Table of Contents

The table of contents is a formatted list of the report's sections and subsections, including References and Appendices with page numbers. In drafting your Table of Contents please:

- List only pages that appear after the table of contents
- Ensure the table of contents is number correctly and match the actual page each section/subsection is found on
- Do not include Tables and Figures in your Table of Contents
  - These may optionally be listed in their own "List of Table" and "List of Figures" each in their own tables and on their own successive pages

A template outlining how awardees are to organize and present the Table of Contents is located on the following pages. NOTE, the Table of Contents has sample page numbers included that should be updated after removal of the Guidelines information (pages 1-2).

Appendix 10H – Example Template for IE Evaluation Report

Annual/Final Evaluation Report

Program Title

Grant: 80NSSC#######

Cooperative Agreement Awarded Month Day, Year - Month Day, Year

Institution Name

Department/College

Street Name, Building

City, State Zip code

Period of Performance: Month Day, Year - Month Day, Year

Submitted Month Day, Year

By

Principal Investigator:
Name
Origination
Email & Phone Number

Independent Evaluator:
Name
Origination
Email & Phone Number

Table of Contents

Executive Summary

The Executive Summary is an abstract or report synopsis of the program description, population reach, evaluation, and performance results with highlights and recommendations. This section provides a brief overview of the information located in the body of the report.

Overview

Briefly describe the project and outline the major activities during the reporting period, answering the following questions:

- What was the target audience of this project?
- What activities were conducted as part of this project (e.g. afterschool, summer program, professional development workshops)?

- What was the frequency and timing of these activities?
- What consortiums participated in the evaluation?
- What were the goals and objectives of this project?

Summary of Accomplishments and/or Preliminary Results

Briefly review the accomplishments and/or preliminary results of the evaluation, discussing key outcomes and preliminary findings. Present each evaluation question in turn and for each include:

- An explicit statement of the evaluation question
- List instrument(s) used to collect data
- Describe methods used to analyze these data
- Present the accomplishments and/or preliminary results of this analysis in a bulleted list

You may include downsized Tables and Figures in the Executive Summary as appropriate if 1) used sparingly 2) included in the body of the report in their full size 3) have their own numbering system (e.g. Table ii or Figure i) and 4) **not** be listed in the List of Figures or List of Tables if included.

Summary of Preliminary Conclusions and Recommendations

Briefly review the preliminary accomplishments and/or results framing them in a discussion of their relation to the stated goals of the project (both meet and not meet). Discuss any obstacles in implementing this activity as well as conducting the evaluation. Include any recommended enhancements to evaluation plan. Finally, include a bulleted list summarizing lessons learned and/or recommendations for improving the activity. Recommendations should:

- Address specific obstacles or undesirable results
- Be specific, comprehensive, and evidence-based

The primary purpose of providing lessons learned and/or recommendation is to facilitate continual improvement and therefore, must include recommendations for refining program implementation. You may optionally include additional recommendations at refining the evaluation process.

Introduction

Provide background information, outline the major activities and accomplishments during the reporting period, and place the evaluation in context.

Background

Office of STEM Engagement

Briefly discuss and review the Space Grant Program and its major goals and objectives.

Program Information

Appendix 10H – Example Template for IE Evaluation Report

Provide a brief description and background of your program including but not limited to the following:

- Implementation dates, timing, and frequency of activities
- Type of content and how the content is delivered (e.g. Saturday, summer, or after school)
- Frequency and timing of these activities
- Target audiences (e.g. Students, Teachers, and Parents/caregivers, etc.)
- The goals and objectives or performance measures of your program as they relate to those of the agency-wide initiative, note each laid for the initiative by the Office of STEM Engagement must relate to one or more goals or performance measures specific to your program

Purpose of the Evaluation

State the purpose of the evaluation; consider the stakeholders who will receive the report and how each will use the results (for example ensuring accountability, documenting progress, identifying successes, compile recommendations for continued improvement). Additionally, this section of the report should include but not be limited to the following element:

- A Logic Model that summarizes program inputs, activities, and outcomes, you may optionally divide outcomes between short and long term

Evaluation Design and Methodology

This section summarizes the evaluation design and methodology. Additionally, this section of the report should include but not be limited to the following element:

- A Table detailing each evaluation question and its connection to your program goals and objectives or performance measures, as well as the instruments or data collection activities associated with each question

Accomplishments and Results

This section details the accomplishments and results of the evaluation with a subsection dedicated to each evaluation question assessed. These subsections may include:

- A statement of the evaluation question; this requirement may be met by titling each subsection with the text of the question.
- Discuss the status of milestones
- Discuss the status of SMART goals
- Discuss the instruments or protocol used
- Provide details of the data collection strategy or method used to recruit respondents
- State the sampling method used (e.g. continence, random, PPS, Snowball, etc.)
- Detail the methods used to analyze the data (e.g. descriptive statistics, T-test, ANOVA, Regression, etc.)
- State the results of the analysis
- Include figures and tables where appropriate.
  - Each Figure or Table should be consecutively numbered (e.g. Table 1, Figure 1)

  - Each Figure or Table should include a caption with a brief title and its number (e.g. Figure 1 Pre and Post Student STEM Interest)
  - A narrative to explain the diagram should accompany each Figure or Table.
  - A reference to Figure or Table discussed should appear in the narrative (e.g. Table 2 reviews, Results indicate an increase in STEM knowledge (Figure 2))
- Interpret the empirical results and state how they answer the evaluation question.

Conclusions and Recommendations

This section summarizes the evaluation process and its results providing information on the cumulative findings of the project as well as outlining recommendations for continued improvement based on the empirical findings.

Summary

Review evaluation findings and integrate results into a cohesive statement on the progress made and success to date of your program.

- Use empirical results to summarize which of the site's milestones and SMART goals and objectives/performance measures your program achieved and which it did not
- Connect site's achievement of its goals and objectives/performance measures to goals and objectives of the overall initiative as laid out by the NASA's Office of STEM Engagement
- Discuss the limitations (methodological and/or data collection) in conducting this evaluation and indicate what if any impacts these limitations have in the interpretation of the empirical results and the overall findings presented in the report

Recommendations & Lessons Learned

Finally, include a bulleted list of lessons learned and/or recommendations for improving the activity and/or the evaluation. Recommendations should:

- Address specific obstacles or undesirable results
- Be specific, comprehensive, and evidence-based
- Include a statement of what the proposed recommendation will address, its goal or purpose, how it will accomplish that goal or purpose.
- Include, to the extent possible a link to research demonstrating the efficacy of the proposal.

For example, consider the following template:
In our interviews with parents/caregivers, 55 percent indicated a need for more information about the resources available in making their child's college aspirations financially obtainable. To meet this need we suggest bolstering support and access to financial aid information by:

- *Providing additional training on Federal Student Aid programs to staff facilitating family events*
- *Dedicating one family event to financial planning for college, inviting if possible, a representative from the financial aid office to give a presentation, research has shown that children of parents who have attended at least one similar presentation are 35 percent more likely enroll in college (Citation 2010).*

The primary purpose of providing lessons learned and/or recommendation is to facilitate continual improvement and therefore must include recommendations for refining program implementation. You may optionally include additional recommendations at refining the evaluation process.

Works Cited

A reference section lists any research or instruments used in the Evaluation Report.

- All works cited in the body of the report should have a corresponding entry in the works cited list
- All citations must follow MLA, Chicago, APA, APSA or other commonly used formatting guidelines
- Entries must appear in alphabetical order
- Entries are single-spaced and spacing between entries is double spaced

Appendices

Appendices provide additional information and reference material (e.g., S.M.A.R.T. Goals, milestone charts, survey instruments, etc.). There are two required elements to be included although additional elements may be included as well.

Performance Indicator Matrix

The first appendix must be a performance indicator matrix as outlined on the following page. This table summarizes the evaluation results and provides explicit linage to the program's goals and objectives (see example matrix on the next page).

Copies of Instruments

Include copies of your instruments (i.e. surveys, interview protocols, coding guidelines, etc...). Each instrument used must be placed in its own Appendix and appear in the Table of Contents

Appendix 10H – Example Template for IE Evaluation Report

Example of Summary Performance Indicator Matrix

	NASA's (Initiative) Objective	Site Goal or objective /Performance Target	Evaluation Question	Instrument(s) Used	Data Collection Method(s) & Sampling Strategy	Data Analysis Method(s)	Results	Goal/ Objective Achieved
Initiative Goal 1	***[Improve STEM literacy by engaging students, family members, and teachers through the integration of emerging technologies]***				**Yes/No**			
	[Increase the number of historically underserved and underrepresented students interested in NASA specific STEM careers]	*[85% of participants from underserved or underrepresented communities]*	*[To what extent is the program engaging students from underserved or underrepresented communities]*	*[Enrollment Forms]*	*[Data collected when registering for the program from all participants]*	*[Descriptive Statistics]*	*[87% of students were from underserved or underrepresented communities Black 54% Hispanic 35% Native American 5% Female 49%*	*[Yes]*
	[Provide skills to parents/care givers to work with and encourage their children in STEM activities and programs]							
Initiative Goal 2	***[TEXT OF THE OBJECTIVE]***				**Yes/No**			

APPENDIX 11: MUREP Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (MUREP INCLUDES)

11.1 PROGRAM DESCRIPTION

11.1.1 Overview of the Funding Opportunity

The National Aeronautics and Space Administration's (NASA or Agency) Office of Science, Technology, Engineering, and Mathematics Engagement (OSTEM) Minority University Research and Education Project (MUREP) solicits proposals from four-year colleges/universities and two-year institutions designated by the US Department of Education as Minority-Serving Institution (MSI) (see the NASA MSI List) for the MUREP Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (MUREP INCLUDES) awards. The MUREP INCLUDES concept directly responds to the needs noted in the National Academies of Sciences, Engineering, and Medicine report and leveraging the academic contributions of MSIs. MUREP collaborates with the National Science Foundation (NSF) to complement and contribute to the NSF Eddie Bernice Johnson INCLUDES National Network.

MUREP is administered by OSTEM. Through MUREP, NASA provides financial assistance via competitive awards to MSIs, including Historically Black Colleges and Universities (HBCU), Hispanic Serving Institutions (HSI), Asian American and Native American Pacific Islander Serving Institutions (AANAPISI), Alaska Native and Native Hawaiian-Serving Institutions (ANNH), Tribal Colleges and Universities (TCU), Native American-Serving Nontribal Institutions (NASNTI), and other MSIs, as required by MSI-focused Executive Orders (EOs). These MSI recipient institutions subsequently provide their students financial assistance to study science, technology, engineering, and mathematics (STEM) fields. MUREP investments enhance the research, academic, and technology capabilities of MSIs through multiyear cooperative agreements. Awards assist faculty and students in research and provide authentic STEM engagement related to Agency missions. Additionally, awards provide NASA-specific knowledge and skills to MSI students historically underrepresented and underserved in STEM. MUREP investments assist NASA in meeting the goal of a diverse workforce through student participation in internships and fellowships at NASA Centers and the Agency's Jet Propulsion Laboratory (JPL).

As the need for STEM employees in the United States continues to increase, the nation's STEM workforce must increasingly come from the nation's underrepresented population (Jackson & Rudin, 2019; Solomon, 2019). A catalyst tool that will advance this mission is MSIs. MSIs are federally classified institutions that enroll diverse groups of students, particularly within STEM fields (Sansone & Sparks, 2022; Wilson & Chavela Guerra, 2021). Therefore, MSIs play a critical role in advancing diversity in STEM. As a result, it is imperative to focus on capacity building, which is developing the knowledge, attitude, and skills within these institutions (Jayachitra, 2023).

Additionally, the National Academies of Sciences Engineering and Medicine, Minority-Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce, states, "Given the projected demographic profile of the country, the educational outcomes and STEM readiness of students of color will have direct implications on the nation's economic growth, national security and global prosperity" (2019, p.1). According to this report, "efforts to boost the number of students of color in the STEM workforce are not new. Previous studies by the National Academies and other organizations have underscored this urgency. The report builds on and extends this work by recognizing a second national resource, the nation's more than 700 MSIs [Minority-Serving Institutions], and their collective potential to help strengthen, expand, and diversify the rapidly evolving STEM workforce." (2019, p.23).

Strengthening and improving student learning among MSIs will significantly impact the success of underrepresented minorities (URMs) and help fill the gap in the STEM workforce. According to Kassu (2020), involving undergraduate students in research projects and practical laboratory experiences enhances students' learning. Students with undergraduate research experiences have better interest and motivation to advance in STEM-related professional careers (Kassu, 2020). Adding more sequenced and comprehensive courses and opportunities to engage in hands-on and culturally relevant research is also helpful (NASEM, 2019). Recent government reports and research studies indicate a need for more professionals with diverse backgrounds in STEM. MSIs, including HBCUs, HSIs, TCUs, AANAPISI, as leaders in cultivating future STEM talent (Toldson, 2019).

The MUREP INCLUDES construct supports networks among academia, industry, and communities of learning. Partners offer additional expertise, knowledge, perspective, and experiences to address complex problems. Having multiple partners enables the coalition to expand its reach, replicate best practices, and establish new paths for reaching students and educators. Partnering with local organizations fosters the student-teacher relationship in development programs. It creates avenues for STEM jobs to be in more places so that people can contribute their ideas and talent where they live (Panchanathan, 2023).

The Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey report notes the following data points for graduation with Science and Engineering degrees. In 2018, among US citizens and permanent residents, Whites earned 57.9% of bachelor's degrees in science and engineering (S&E) fields and Asians achieved 10.7%. Hispanic and Latino graduates were awarded 15.1% of S&E bachelor's degrees; Black or African Americans, 8.5%; and American Indian or Alaska Natives, 0.4%. All three groups of underrepresented minorities earned a larger share of bachelor's degrees in science fields than in engineering fields in 2018 (annotation: underrepresented minority groups include Black or African American, Hispanic, or Latino, and American Indian or Alaska Native).

MUREP INCLUDES coalitions work strategically to improve the number of URMs pursuing engineering disciplines and to provide a multifaceted network of interconnected systems for the success of Black, Indigenous, (and) People of Color (BIPOC), and Latinx students throughout their academic duration. MUREP INCLUDES leverages MSI’s expertise, methodology, best practices, and the focus on a sense of belonging in support of educating and preparing URMs in engineering-related disciplines and fields. MUREP INCLUDES facilitates the formulation of MSI-led coalitions to broaden participation in engineering disciplines and fields, and the learning of engineering principles. These awards enable MSIs to organize and lead partnerships of multiple organizations, institutions, agencies, and industries to implement novel programmatic endeavors or support the expansion of successful programs or methods to address the nation’s critical challenges with broad impact. MUREP INCLUDES transitioned from planning grants (2020) to a fully funded cohort (2021) of MSI-led coalitions. MUREP INCLUDES coalitions contribute to the programmatic goals through evidence-based approaches to identify barriers URMs encounter when considering or pursuing engineering academic pathways.

MUREP INCLUDES coalitions endeavor to apply numerous approaches to expand the awareness and involvement of URMs in engineering with a focus on cultural competence. MUREP INCLUDES implements activities explicitly to heighten students' engineering skills; develops a pool of engineers in fields relevant to NASA; supports the design and deployment of new engineering courses and/or degree programs; infuses NASA content into engineering curriculum; provides authentic and diverse research experiences for students; enables educators to present engineering concepts and activities to students effectively; empower students into transitioning into engineering degrees through bridging programs, and capstone projects; and disseminates MSI-led coalitions successes through conference papers/journal/publication. Finally, the various coalition projects seek to provide improved access for URMs in engineering fields, establish inclusive environments, deliver culturally diverse activities, and offer novel approaches to retain URMs in engineering degree pathways.

MUREP INCLUDES functions as a cohort, resulting in a systemic approach towards achieving shared measures and collective impact. MUREP INCLUDES coalitions are fortified by an external Advisory Council recruited by the coalition's leadership to reflect its vision. The Advisory Council provides guidance, advocacy, and programmatic assessment to support the alliance. The Advisory Council members represent various accomplished stakeholders with expertise in STEM and successful experiences in multiple areas of the STEM ecosystem (e.g., education research, diversity and inclusion careers, evaluation and assessment, industry experts, etc.). MUREP INCLUDES coalitions shall incorporate an Advisory Council into the functionality of the alliance, allowing for a checks-and-balances approach and ensuring implementation alignment with MUREP INCLUDES and the coalitions' stated objectives and goals.

MUREP INCLUDES coalitions focus on a precise aspect of broadening participation. The coalitions address barriers facing URM students by implementing novel interventions. Although a coalition may address more than one barrier, each barrier addressed shall be supported by citations specific to the barrier. As such, interventions shall be supported by education evidence-based practice. The focus for each alliance is to challenge the status quo, making tangible improvements by attracting, retaining, and supporting additional undergraduates and graduate URMs in engineering disciplines and fields. MUREP INCLUDES seeks to offer unique approaches that are scalable and replicable that will expand learning pathways and are responsive to the nation's workforce needs using NASA's inspirational missions and success in solving complex problems.

A significant aspect to MUREP INCLUDES and its coalitions is the partnership with the NSF Eddie Bernice Johnson INCLUDES National Network. As an element of the NASA and NSF partnership, MUREP INCLUDES awardees will have direct access to the INCLUDES National Network. NSF's INCLUDES National Network and Coordination Hub are designed to broaden participation and expand opportunities in STEM to underrepresented populations nationwide. Also, MSI-led coalitions will participate in the NSF INCLUDES National Network Convenings to discuss challenges, barriers and explore solutions.

11.1.2 Goals and Objectives

The multiyear goals of the NASA MUREP INCLUDES Activity are as follows:

- **Goal 1: Establish strategic partnerships to broaden participation in engineering through innovative educational interventions and fundamental/applied research opportunities.**
  - Objective 1.1: Foster significant transformation of cultural, institutional, and individual engagement of underrepresented/underserved students in engineering fields.
  - Objective 1.2: Establish diverse networks of partners and collaborators to identify, and prioritize, and to effectively address barriers associated with broadening participation in engineering disciplines and fields.
  - Objective 1.3: Leverage systems, networks, and processes established by NSF INCLUDES Initiative to engage stakeholders and to evolve and expand engineering MUREP INCLUDES coalitions.
- **Goal 2: Identify, catalogue, and foster strategies based on shared goals, shared measures, objectives, and specific methodologies designed to promote the leadership role of MSIs in diversifying and expanding the engineering workforce.**
  - Objective 2.1: Significantly increase the opportunity for MSIs to share successful practices and research associated with increasing underrepresented/underserved groups with a specific focus on URMs entering engineering fields.
  - Objective 2.2: Address NASA's Mission Directorates' engineering priorities and increase MSIs efforts to align with NASA's critical needs effectively.
  - Objective 2.3: Categorize shared measures and detail the shared impact of each coalition and the cohort.
- **Goal 3: Implement novel or proven strategies to support the achievement of academic success in engineering for underrepresented/underserved students.**
  - Objective 3.1: Increase the number of underrepresented/underserved and URM students pursuing engineering disciplines and fields through strategic, sustainable, and replicable engineering programmatic engagements.
  - Objective 3.2: Contribute to the strengthening of underrepresented/underserved and URMs engineering research skills and enhance the learning of engineering principles.
  - Objective 3.3: Support educators' proficiency in delivering theories and engineering concepts through an improved curriculum or professional development activities.
  - Objective 3.4: Employ science and evidence-based strategies to attract and retain URMs in engineering fields.
  - Objective 3.5: Provide underrepresented/underserved students holistic assistance to acquire Human Skills/soft skills while emphasizing engineering norms.
  - Objective 3.6: Demonstrate tangible contributions to expanding pathways for students to enter engineering fields and disciplines through articulation agreements, new courses, or degree offerings.

Each proposer shall address each MUREP INCLUDES goals and objectives on Table A, labeled "Required". The table also highlights Goal 3, Objectives 3.2, 3.3, and 3.6 as an additional requirement for those proposers offering activities to improve engineering skills through experiential learning experiences, capstone projects, bridging and transitional programs designed to help students move into the next phase of their education (high school to college or two-year college to four-year college or university), engineering-focused educator professional development programs designed to improve engineering content delivery, new engineering interactives, curriculum improvement for the infusion of NASA content, or developing new engineering degree programs.

MUREP INCLUDES Goals and Objectives Table A

Goal 1: Establish strategic partnerships to broaden participation in engineering through innovative educational interventions and fundamental/applied research opportunities.	Objective 1.1: Foster significant transformation of cultural, institutional, and individual engagement of underrepresented/underserved students in engineering fields.	Objective 1.2: Establish diverse networks of partners and collaborators to identify, and prioritize, and to effectively address barriers associated with broadening participation in engineering disciplines and fields.	Objective 1.3: Leverage systems, networks, and processes established by NSF INCLUDES Initiative to engage stakeholders and to evolve and expand engineering MUREP INCLUDES coalitions.
Required	Required	Required	Required

Goal 2: Identify, catalogue, and foster strategies based on shared goals, shared measures, objectives, and specific methodologies designed to promote the leadership role of MSIs in diversifying and expanding the engineering workforce.	Objective 2.1: Significantly increase the opportunity for MSIs to share successful practices and research associated with increasing underrepresented/underserved groups with a specific focus on URMs entering engineering fields.	Objective 2.2: Address NASA's Mission Directorates' engineering priorities and increase MSIs efforts to align with NASA's critical needs effectively.	Objective 2.3: Categorize shared measures and detail the shared impact of each coalition and the cohort.
Required	Required	Required	Required

Goal 3: Implement novel or proven strategies to support the achievement of academic success in engineering for underrepresented/underserved students.	Objective 3.1: Increase the number of underrepresented/underserved and URM students pursuing engineering disciplines and fields through strategic, sustainable, and replicable engineering programmatic engagements.	Objective 3.2: Contribute to the strengthening of underrepresented/underserved and URMs engineering research skills and enhance the learning of engineering principles.	Objective 3.3: Support educators' proficiency in delivering theories and engineering concepts through an improved curriculum or professional	Objective 3.4 Employ science and evidence-based strategies to attract and retain URMs in engineering fields.	Objective 3.5: Provide underrepresented/underserved students holistic assistance to acquire Human Skills/soft skills while emphasizing engineering norms.	Objective 3.6: Demonstrate tangible contributions to expanding pathways for students to enter engineering fields and disciplines through articulation agreements, new courses, or degree offerings.
Required	Required	***Additional*** *If* proposing student engineering skill development experiences (e.g., internships, summer camps, capstone projects engineering challenges).	***Additional*** *If* proposing Educator Professional Development or engineering curriculum improvement.	Required	Required	***Additional*** *If* proposing a new transitional college program, courses, and degree programs.

MUREP INCLUDES coalitions proposals shall implement engineering interventions that significantly engages and invest in undergraduate students. MUREP INCLUDES defines significant investment as a value of $3K or greater with engagement or 160 hours of direct engagement per participant within each performance year.

Interventions with a creative and/or pioneering approach to involve community groups, STEM non-profits, museums and NASA OSTEM or NASA Mission Directorate programs for after-school or summer engagement is highly desirable. Proposers should seek to implement interventions with a curriculum that infuses NASA content. The curriculum should include a broad range of voices, perspectives, approaches, concepts, research methods, and research questions. Employing the four types of curriculum design (i.e., subject-area, discipline, broad-field, and correlation) should be considered when developing a curriculum.

Proposers shall institute a registration process for each activity implemented that documents the participant's name, email address, and demographics (e.g., gender, race, ethnicity, education level). This data shall be reported to the MUREP INCLUDES management team annually and as an appendix to the Cooperative Agreement annual progress report.

11.1.3 National Priorities

MUREP INCLUDES addresses E.O. 13985, 14031, 14041, 14045, 14049, 14050, and 14091 by funding MSIs to increase the participation of underrepresented/underserved students in engineering fields. MSI-led coalitions employ innovative and evidence-based STEM engagements that align with NASA missions and projects to construct pathways, improve engineering skills, support engineering literacy, conduct NASA-related research, and enhance curricula for the success of students. Federal Register: Executive Orders.

11.1.4 Agency Priorities

MUREP INCLUDES addresses NASA goals and objectives outlined in the 2022 NASA Strategic Plan, including but not limited to:

- **Strategic Goal 4: Enhance capabilities and operations to catalyze current and future mission success.**
- **Strategic Objective 4.3: Build the next generation of explorers**.

These measures will be supported by the Agency's short-term Annual Performance Indicators, which set quantifiable targets for NASA offices, programs, and projects. NASA's goals and objectives are subject to change over time to adapt to national and agency-wide priorities.

11.1.4.1 Relevance to NASA and NASA's OSTEM

OSTEM monitors progress of its investments towards achieving programmatic goals and objectives by assessing recipients' achievements towards the following multiyear OSTEM Performance Goals (PGs) which are directly aligned with and support the 2022 NASA Strategic Plan and the NASA STEM Engagement Learning Agenda as follows:

Performance Goal 4.3.1: Create unique opportunities for a diverse set of students to contribute to NASA's work in exploration and discovery.

Performance Goal 4.3.2: Build a diverse future STEM workforce by engaging students in authentic learning experiences with NASA's people, content, and facilities.

Performance Goal 4.3.3: Attract diverse groups of students to STEM through learning opportunities that spark interest and provide connections to NASA mission and work.

Annually, NASA OSTEM generates a body of evidence (e.g., performance data, participant data, and metrics) from award recipients to assess progress towards achieving programmatic goals, objectives, and OSTEM performance goals. To learn more about NASA's efforts to meet its performance goals, visit the NASA STEM Engagement Impacts website. MUREP INCLUDES recipients shall provide performance data, participant data, and metrics supporting these progress measurement efforts.

11.1.4.2 Research Priorities for NASA Mission Directorates and Centers

By design, MUREP INCLUDES capitalize on the unique facilities, capabilities, and staff of MSIs to contribute to the priorities of NASA's Mission Directorates (MDs). Through MUREP INCLUDES, NASA seeks to strengthen the leadership capacity of MSIs in areas of priority for NASA MDs and engage diverse students in authentic learning experiences with NASA and/or JPL staff, content, and facilities. Proposers may use the following websites to access additional information about NASA MDs.

Aeronautics Research Mission Directorate (ARMD)

Exploration Systems Development Mission Directorate (ESDMD)

Space Operations Mission Directorate (SOMD)

Science Mission Directorate (SMD)

Space Technology Mission Directorate (STMD)

NASA MD goals and objectives can also be found in EONS-2024, Appendix 8, and Appendix 9A of this Notice of Funding Opportunity (NOFO).

Proposers are strongly encouraged to review NASA Engineering for information about Aerospace Engineers at NASA.

11.1.4.3 Data Sharing Plan

All proposals submitted in response to this NOFO shall include a Data Sharing Plan (DSP) describing how data and information obtained through the MUREP INCLUDES will be shared. Award recipients (recipients) shall promptly prepare and submit for publication, with authorship that accurately reflects the contributions of those involved, all significant findings from work conducted under the MUREP INCLUDES Cooperative Agreement. MUREP INCLUDES recipients shall develop one or more published technical paper(s)/journal article(s) during the three years of performance. The publication(s) shall be developed to share the novel concepts, innovative models, and technical information gained through the MUREP INCLUDES cooperative agreement and may be published in peer-reviewed or non-refereed sources. MUREP INCLUDES recipients shall present these paper(s) at appropriate professional conferences, meetings, and/or workshops. Recipients may also develop oral or poster presentations using the information generated through this cooperative agreement. NASA will review each proposer’s DSP during the evaluation/peer review of proposals. Costs of the DSP, including travel for the Principal Investigator (PI) and up to two additional team members (e.g., Co-Investigator (Co-I), graduate student, or other staff) who worked on the project to present paper(s) at professional conferences, meetings, and/or workshops, shall be included in the proposed budget. MUREP INCLUDES recipients shall ensure that all publications developed because of this cooperative agreement, authored, or co-authored by investigators and sub-recipients, and funded, in whole or in part by NASA, are submitted to the MUREP INCLUDES Activity Manager. The recipient shall also provide a list of these publications with its annual and final reports that are required to be submitted to the NASA Shared Services Center and the MUREP INCLUDES Activity Manager. All NASA-funded researchers, whether internal or external, must submit to PubSpace.

11.1.4.5 Roles and Responsibilities of Key Personnel

Every institution submitting a proposal shall identify a single individual, the PI, who will be responsible for the quality and direction of the entire proposed effort, for the use of all awarded funds, and for the timely and complete submission of performance data and reports to NASA. The only required key personnel is the PI. All PIs shall meet the following criteria at the time the proposal is submitted:

1. Eligible four or two-year institutions are required to submit a letter of commitment to comply with guidance provided under **Section 11.6 Federal Award Administration**

Information of this NOFO, which states that any proposed change to the PI under the cooperative agreement is subject to prior written NASA approval.

2. The PI shall be a tenure or tenure-track faculty member if a tenure system is established currently employed at the lead institution. A Ph.D. in a STEM field is required. A PhD in electrical engineering, bioengineering, materials science, chemical engineering, biological engineering, polymer science and engineering, mechanical engineering, civil engineering, computer engineering, industrial engineering, system engineering, environmental engineering, or nuclear engineering is highly desirable.

The PI's responsibilities include, but are not limited to:

- Provides visionary and contemporary leadership for the delivery of high-impact research and educational programs.
- Provides overall leadership, administration, implementation, and performance data collection and reporting of the project and its activities.
- Identifies and selects Advisory Council members.
- Engages and influences the institution's department, college, and university leadership to promote substantial institutional impacts in broadening engineering participation.
- Carries out supervisory responsibilities for project staff in accordance with the organization's policies and applicable state and federal laws.
- Provides day-to-day management of project budgets and ensures that all applicable institutional and NASA rules, as well as state and federal guidelines, are followed in utilizing such funding.
- Participates in MUREP INCLUDES program teleconferences and meetings.
- Attends the annual conference(s) hosted by OSTEM.
- Attends NSF Convenings relevant to MUREP INCLUDES
- Coordinates and administers MUREP INCLUDES data collection, analysis, and reporting of such data to NASA in alignment with guidance and the approved Gateway data management system.
- Responsible for accurately reporting data, demographics, metrics, and achievements of the coalition and sub-awardees, including monthly, six-month progress, and annual progress reports.
- Responsible for the coordinating and planning of annual site visits (i.e., pre-assessment rubric, formal presentations, student forum, etc.)
- Coordinates intern placements and intern registration in NASA's Gateway system.
- Submits copies of peer-reviewed publications and associated data into PubSpace.
- Submits the Coalition's goals, objectives, metrics, and Key Performance Indicators (KPIs) annually. Year one's goals, objectives, metrics and KPIs are due within 30 days after award. Years Two and Three are due 30 days after each renewal date.
- Participate in performance assessment and evaluation activities (i.e., performance data planning and reporting in NASA-approved registration/application and data management system, focus groups, interviews, complete and/or administer surveys, documentation review, lessons learned discussions, etc.) in alignment with Federal, Agency, and OSTEM performance and evaluation priorities and requirements.

Also, Co-Is are required. Proposers may include one Co-I from the same institution as the PI, and three Co-Is may be from a partner institution. A Co-I is a member of the proposal's investigation team who may hold either a full-time or limited-term appointment and is a critical partner for conducting the investigation through the contribution of unique expertise and/or capabilities. A Co-I must have a well-defined and generally sustained continuing role in the proposed investigation, serve under the direction of the PI, and may or may not receive funding through the award. Only an individual who has formally agreed to the role may participate as a Co-I, even if their participation is at no cost (i.e., contributed) to the proposal.

1. Eligible MSIs proposing a Co-I are required to submit a letter of commitment to comply with guidance provided under **Section 11.6, Federal Award Administration Information** of this NOFO. Any proposed change to the Co-I under the cooperative agreement is subject to prior written NASA approval.
2. The Co-I(s) shall be a full-time faculty member at the lead or partner institution with a current position in science, technology, engineering, mathematics, or STEM education. education. A Co-I with a background in Diversity, Equity, Inclusion, and Accessibility (DEIA) is encouraged.

Independent Evaluator
Every institution submitting a proposal shall identify an Independent Evaluator (IE) who will be responsible for analyzing qualitative and quantitative data for the project's evaluation activities and assisting the PI in development and implementation of the project's comprehensive Evaluation Plan. Within three months after award, recipients shall submit a Comprehensive Evaluation Plan, for which both the PI and IE have concurred on in writing. The MUREP INCLUDES Activity Manager and OSTEM Performance Assessment and Evaluation Program Manager will provide guidance on the proposed plan.

- The IE's responsibilities include but are not limited to: Developing a Comprehensive Evaluation Plan for proposed program in collaboration with the PI, the MUREP INCLUDES Management Team and OSTEM Performance and Evaluation (P&E) Management Team.
- Coordinating and administering data collection, analysis, and reporting of proposed program evaluation data. Data should be focused on outcomes.
- Providing status updates to the PI on evaluation activities, progress, and challenges.
- Participating in annual kick-off meeting, virtual site visits, and evaluation technical assistance meetings with MUREP INCLUDES Management Team to review proposed program's progress in achieving MUREP INCLUDES goals and objectives; and
- Developing and submitting to NASA an annual evaluation and final evaluation report based on the recipient's evaluation data demonstrating outcomes of the activity.

11.2 FEDERAL AWARD INFORMATION

Subject to Congressional appropriation of sufficient funds and NASA's receipt of proposals of adequate merit, **NASA expects to select up to six proposals for MUREP INCLUDES awards. The period of performance for each proposal/resulting award is three years.** Successful proposals for this opportunity will be funded as cooperative agreements, and as such, substantial involvement between recipients and NASA is expected. For specific description of the substantial involvement required of awardees, see Section 11.1.4.5, Roles and Responsibilities of Key Personnel and Section 11.6.1, Cooperative Agreement Award Reporting Requirements of this NOFO. **Funding shall be up to $1,200,000 per three-year award or $400,000 per year. The total maximum amount of funds expected to be awarded is $7,200,000 with a maximum of $2,400,000 awarded annually for each of the three years.** The period of performance is expected to begin two to three months from the selection announcement. Proposals shall cover the entire three years of performance. The continuation of NASA funding on each award annually is based on a satisfactory evaluation of documented progress; compliance with data reporting, applicable regulations and laws, and other program requirements; fulfillment of fiduciary responsibilities; and the availability of appropriated funds. At the time of this Appendix release, NASA does not plan to extend funding beyond the initial performance period of three years.

11.2.1 Partnerships and Collaborations

NASA MUREP INCLUDES aims to introduce creative solutions executed by STEM authorities and teams of advocates. Academia, industry, and government agencies are critical in achieving the goal of diversifying the future workforce and the broadening of participation in engineering in general. A diverse team of partners collectively impacts students' achievement in engineering fields. Proposals shall demonstrate carefully constructed partnerships that connect a wide range of stakeholders to achieve the goals of the proposed effort. Specifically, NASA is interested in partnership teaming with the aerospace industry that will address critical skills and increase the employment of underrepresented/underserved and URM graduates. Proposals inclusive of multiple diverse organizations and agencies (including industry), offering perspectives from traditional and non-traditional stakeholders, are recommended. A comprehensive structuring of the core partnership can deliver the depth and breadth of a novel approach or enhance the expansion of a successful methodology that can effectively broaden participation of URMs in engineering disciplines and fields.

Proposals shall describe how the coalition partnerships will contribute to MUREP INCLUDES goals and objectives, leverage significant additional funding sources, obtain essential services unavailable at the proposer's home institution, and describe how the proposed effort will contribute to sustainability. Sustainability will be a significant focus for Year Three of the award. Proposers shall identify various resources that will be pursued to ensure sustained progress beyond NASA's funding. The sustainability plan shall be implemented during Year Three. Proposed partners can make practical contributions to resolving the critical problem of broadening participation and involving their stakeholders and relationships to support the proposed efforts. The responsibilities of each partner shall be specific, measurable, achievable, relevant, and time-bound (SMART). MUREP INCLUDES coalition partners will be assessed individually for their unique contribution to the collective implementation at the end of each performance year. Additionally, each partner's metrics, output, and outcomes shall be evaluated annually.

Proposers shall coordinate partnerships in advance and describe in detail the benefit of the collaboration in the proposal. The budget narrative shall document how each partnership will contribute to the proposing institution's coalition's concept. (**See Section 11.2.2, Integration with NASA and Other OSTEMs and/or Mission Activities of this NOFO**). The proposal shall include a plan for collection of Gateway data, from the lead institution, and sub-awardees. Data requirements includes but is not limited to participants' names and email address, demographics, and investment. Note: The lead MSI shall receive at least 40 percent of the proposed budget.

At a minimum, the proposal shall include four external partners (academic institutions/organizations located on the campus or property of the lead institution are not viewed as external for this NOFO). One partner shall be an industry company to assist with the identification of needed skills, opportunities for apprenticeships/traineeships, and to provide a gateway into employment. Suitable partnerships would include one or more of the following (in no particular order):

- Aerospace Industry
- Non-MSI (2 or 4 year)
- MSI (2 or 4 year)
- Federal, state, and local government agencies
- Local and state school districts
- Museums/science and technology centers
- Non-profit STEM professional organizations
- Career and Technical Training Institutions

Institutions receiving MUREP INCLUDES awards may choose to build collaborations with NASA Centers and JPL when such collaborations will mutually benefit the concept implementation and the goals of NASA's MDs. **Letters of support from partners are required to be submitted with proposals.** Please see the *NASA Proposers Guidebook* (Section 3.17) and EONS-2024 (Section C.5) for guidance on letters of support. US citizenship is required for individuals who need access to NASA Centers or JPL for participation in the internship experience. Internships at NASA centers or JPL are solely for students from the recipient institutions and its partners. At a minimum, students participating in an internship experience should receive funding commensurate with the current NASA standard stipends (contact a NASA OSTEM Office or JPL for current stipend rates). Institutions have the flexibility to augment stipends from their own funding sources.

Scientific literature and articles state the significance of research internships in increasing URMs' self-efficacy. Proposers, including an internship component in industry or at NASA or JPL, shall offer a concept that enhances the internship experience for students and sets them up for success. The approach shall employ best practices and provide preparatory activities that prepare the student for a successful research experience. Further, the concept should demonstrate the learning and skills developed pre- and post-assessments.

Responses to this Appendix that include only the lead MSI, and no other collaborators will be determined non-compliant and ineligible for selection. Such proposals will NOT be evaluated.

11.2.2 Integration with NASA (Other OSTEM and/or Mission Activities) and NSF INCLUDES Initiative

Institutions receiving MUREP INCLUDES awards are encouraged to build collaborations with NASA Centers and/or Facilities (including JPL), and NSF INCLUDES when such collaborations will mutually benefit MUREP INCLUDES recipients' abilities to accomplish the MUREP INCLUDES goal and objectives. Engagement with the NSF INCLUDES National Network is required to leverage systems and efforts to increase the number of URM students engaged in

STEM activities and pursuing STEM fields. MUREP INCLUDES coalitions shall utilize a variety of methods to have meaningful interactions and connections with NSF INCLUDES Initiative staff, partners, PIs, or stakeholders.

If collaborating with a NASA Center or Facility, proposers shall obtain formal letters of commitment indicating the agreed-upon collaboration or commitment of resources and include these letters of commitment in the proposal. Formal letters of commitment shall be written by 1) NASA employees who are authorized to make the stated commitments and indicate that the NASA Center/Facility representative agrees to all specified details of the partnership or collaboration; or 2) JPL employees who are authorized to make to make the stated commitments of JPL resources. Further, any visits to NASA Centers or Facilities shall require recipients to follow all appropriate protocols and procedures when scheduling, arranging, and visiting these locations.

The NASA MUREP INCLUDES Team will facilitate communication between and among awardees and NASA OSTEM and Subject Matter Experts (SMEs) to promote synergy, leverage ongoing work, and support relationship building during the award period of performance (three years). The NASA MUREP INCLUDES Activity Manager will schedule periodic teleconference and/or web conference discussions with recipients and appropriate members of the NASA OSTEM to share information.

To facilitate communication and networking, proposers shall plan to participate in a virtual MUREP INCLUDES kickoff, training workshops, and monthly activity meetings as required. Proposers shall also plan two trips annually for travel to participate in OSTEM-related in-person meetings. The NASA MUREP INCLUDES Team will also use social networking tools to create an interactive environment for the MUREP INCLUDES community.

11.2.3 Budget Guidelines and Requirements

11.2.3.1 Total Budget Guidelines and Funding Restrictions

All costs charged to awards covered by this NOFO must comply with the Uniform Administrative Requirements in 2 CFR 200 and 2 CR1800, unless otherwise indicated in the NOFO, the terms and conditions of the award, and the *NASA Grants and Cooperative Agreement Manual (GCAM)*.

- All proposed funds must be allowable, allocable, and reasonable. Funds may only be used for the project. All activities charged under indirect costs must be allowed under 2 CFR 200 cost principles.
- Grants and cooperative agreements shall not provide for the payment of fees or profit to the recipient.
- Unless otherwise directed in 2 CFR 200, for changes to the negotiated indirect cost rate that occur throughout the project period, the recipient must apply the rate negotiated for that year, whether higher or lower when the budget and application were awarded.
- Proposals must not include bilateral participation, collaboration, or **coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds basis.**
- Any funds used for match or cost sharing must be allowable under 2

CFR 200.

- The non-Federal entity must use one of the methods of procurement as prescribed in 2 CFR 200.320, Methods of procurement to be followed.
- NASA will make all awards under this NOFO to the lead institution. Subcontracts, collaborations, and any other agreements described in the proposal are between that entity and the lead institution, not between that entity and NASA. No more than 60% of the total budget may be allocated to subcontracts or collaborations.
- The maximum allowable budget for activities is $400,000 per year. The proposed plan and all elements shall have a full performance period of three years.
- Proposers shall request only the amount of funding estimated to be utilized within the stated period of performance.
- Proposals shall clearly indicate key personnel roles, the division of labor, and labor costs. The funding distribution shall be commensurate with the team members' roles in supporting project activities.
- The budget shall clearly include information for the lead institution's overhead/general and administrative (G&A) expenses.
- Indirect costs including the lead institution's general and administrative (G&A) expenses and Facilities & Administrative (F&A) costs are permitted under this NOFO. Any indirect costs must comply with the "Indirect Costs" section of the NASA Grant and GCAM, currently section 5.14.2 and be consistent with the definition of "modified total direct costs" in 2 CFR 200.1, Definitions. The budget must clearly include information for the lead institution's overhead/ G&A expenses.
- Funding can be allocated for undergraduate, graduate, and faculty researchers connected with the execution of student-centric programs, engagement in professional development, and curriculum redesign, enhancement, or development.
- Research-related equipment, travel, and materials and to support project management and administration needed to implement proposed strategies and approaches.
- Cost-sharing is not required but may be voluntarily offered. However, proposals that offer cost-sharing will not receive an advantage in the evaluation.
- Foreign travel costs are not allowable.
- Only student internships, research assistantships, and/or apprenticeships at NASA facilities or institutions of higher education shall be paid using funds awarded by NASA. Experiential learning opportunities (e.g., internships or apprenticeships) with industry collaborators shall not be funded with MUREP INCLUDES award funding. Stipends are fixed dollar amounts paid to award participants to cover their work-related and living

expenses.
- A maximum of 2% of the total budget may be distributed to NASA Centers that are partnering with recipient institutions. These funds may not be used for NASA civil servant salaries or travel. Also, funds may be used for a JPL collaborator's facility use, travel, or a percentage of salary equal to the level of effort.
- MUREP INCLUDES funds may not be used for tuition, health insurance or other fees. Proposers should ensure budget alignment with their institution's federal grant allowable costs/activities.

11.2.3.2 Annual Budget Guidelines and Restrictions

- The maximum annual budget for each recipient is $400,000, not to exceed the total budget of $1,200,000 during the three-year period of performance.
- The budget shall include the IE compensation, including travel to project annual meetings and to the respective coalition's site visit.
- Travel for the PI and up to two additional team members (e.g., Co-I, graduate student, or other staff) who worked on the project to present paper(s) at professional conferences, meetings, and/or workshops, shall be included in the proposed budget**.**
- Annual travel for PI to the Washington, DC area for NSF Convening events relevant to this award.
- Annual travel for PI to California for NASA Meeting (MUREP PI Meeting, MUREP INCLUDES Meeting or OSTEM Better Together Conference).
- Annual travel for students to a NASA Center or JPL for undergraduate internship.
- Materials or supplies for engineering workshops, educators' trainings, and interactives.

Other Guidelines and Restrictions

- A maximum of 20% of the annual salary for the PI, Co-Is, and senior researchers may be charged to this award.
- The budget shall include support for an administrative assistant for the project, who will provide PI support for monitoring the budget, tracking project students, and assisting with other administrative tasks. Alternatively, the proposal shall clearly indicate how other resources will support this role. Participant funding is restricted to undergraduate students enrolled in institutions of higher education (including community colleges), except for bridging or capstone projects and programs for incoming first year or transferring college students (recent high school graduates and/or incoming transfers).

11.2.3.3 Cost Sharing or Matching

Cost sharing or matching is <u>not</u> required. Voluntary cost sharing or matching will not be considered in the evaluation of a proposal.

11.2.3.4 Direct Costs Limitations

- Foreign travel costs are not permitted under this award.

11.2.3.5 Pre-Award Costs

Per 2 CFR 1800.210, NASA waives the requirement for applicants to obtain prior approval for pre-award costs incurred 90 days or less before an award's period of performance start date. Pre-award costs in excess of 90 days before an award's period of performance start date are not allowable under this NOFO. Any costs that the applicant incurs in anticipation of a grant or cooperative agreement award is at the risk of the applicant and will be subject to the rules described in 2 CFR 1800.210, Pre-award costs and the "Pre-award Costs" section of the GCAM, currently section 5.14.1.

11.2.3.6 Indirect Facilities & Administrative (F&A) Costs

Indirect Facilities and Administrative costs are allowable under this award.

11.2.4 Program Evaluation

Proposals shall provide an approach to measure project accomplishments against their proposed goal(s) and objectives (see **Sections 11.5, Application Review Information/Management Plan and 11.5.1. Cooperative Agreement Award Reporting Requirements/Final Report** of this NOFO). Through program evaluation, NASA identifies evidence of effective practices of NASA STEM Engagement investments. Evidence is a key criterion in NASA's competitive processes for allocating resources and ensuring the most effective activities are supported. Program evaluations are planned studies using research methods to collect and analyze data to assess to what extent activities/programs are being implemented and what, if any, impact can be measured. Evaluations answer specific questions about performance and may focus on assessing activity/program process and outcomes.

Effective evaluation models are evidence-based, meaning they are based on verifiable data and information gathered using the standards of professional research and evaluation organizations. Such data may be qualitative and/or quantitative. A wide variety of evaluation designs may be utilized, as well as data collection methods, such as key informant interviews, surveys, direct observation, or focus group discussions. Regardless, such data shall pass the tests of reliability and validity, which are different for qualitative and quantitative data.

NASA sets concrete performance goals and is accountable to those goals through a framework that measures progress. Objective and verifiable performance metrics, internal and external review processes, valid and reliable data collection instruments, and evaluation studies are used to assess progress and performance across the portfolio, including programs, projects, and activities.

NASA utilizes a data management system for analyzing performance data. To facilitate data input into the system, the MUREP INCLUDES Activity Manager will collect performance and evaluation data via required reports (see **Section 11.6.1, Cooperative Agreement Award Reporting Requirements** of this NOFO). MUREP INCLUDES award recipients shall provide and verify performance data for the awarded activity with the MUREP INCLUDES Activity Manager. Award recipients may also be required to respond to data calls and/or participate in future program evaluation data collection efforts at NASA OSTEM's request. The MUREP INCLUDES Activity Manager will provide additional communications and guidance regarding data calls, future program evaluation efforts, and timelines. Through performance monitoring, assessment, and evaluation of NASA STEM Engagement investments, NASA will demonstrate its results-driven management approach that is focused on optimizing value to the American public.

11.3 ELIGIBILITY INFORMATION

11.3.1 NASA's Commitment to Diversity and Inclusion

NASA recognizes and supports the benefits of having diverse and inclusive scientific, engineering, and technology communities and fully expects the reflection of such values in the composition of all panels and teams, including peer review panels, proposal teams, science definition teams, and mission and instrument teams. Per Federal statutes and NASA policy, no eligible applicant shall experience exclusion from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from NASA on the grounds of their race, color, creed, age, sex, national origin, or disability. NASA welcomes proposals from all qualified and eligible sources and strongly encourages proposals from HBCUs, MSIs, small, disadvantaged businesses (SDBs), veteran-owned small businesses, service-disabled veteran-owned small businesses (SDVOSB), HUBZone small businesses, and women-owned small businesses (WOSBs), as eligibility requirements apply.

11.3.2 Eligible Applicants

To be eligible for this funding opportunity, all proposals shall originate from an institution designated and listed by the US Department of Education as a MSI at the time of proposal submission (see NASA MSI List). Proposals from institutions that are not designated and listed by the US Department of Education as a MSI at the time of proposal submission will result in NASA returning the application without review. Any arrangement or agreement to have the fiscal management and/or administration of the award performed by a third party is between the awardee and the third party, (e.g., an affiliated Board of Regents, University System or Foundation). Institutions not meeting these criteria are encouraged to partner with colleges or universities that satisfy the requirements. Eligible entities for this funding opportunity include the following:

- Public and state-controlled institutions of higher education
- Private institutions of higher education

Further information defining the individual types of organizations are available on Grants.gov and 2 CFR 200.1: Education Organizations.

IMPORTANT: Priority will be given to institutions that have not previously received MUREP INCLUDES full implementation award funding as a lead institution. Institutions that have previously received a MUREP INCLUDES award are ineligible to propose as a lead institution to this funding opportunity. These institutions are encouraged to consider partnering with an eligible institution. MSIs receiving subawards from current MUREP INCLUDES awardees are eligible to propose, as are previous MUREP INCLUDES Planning Grant awardees. Institutions that have yet to receive MUREP INCLUDES award funding will receive higher priority in the selection process.

11.3.2.1 Limit on Number of Proposals per Unique Entity Identifier

There is no limit on the number of proposals submitted per unique entity identifier (UEI). However, each proposal shall have a different PI. However, a PI on one proposal may serve as a Co-I on a separate proposal, either from the same institution or a different lead MSI.

11.3.2.2 Principal Investigator (PI)

Every institution submitting a proposal in response to this opportunity shall designate a single individual, the PI, who will be responsible for the quality and direction of the entire proposed effort and for the proper use of all awarded funds.

11.3.3 Proposals Involving Foreign Participation

Except as outlined in the certification regarding restrictions on doing business with certain countries, NASA welcomes proposals that include the participation of non-US organizations. Proposals that propose research to be performed with a non-US organization as part of a proposal submitted by a US organization typically are supported on a no-exchange-of-funds basis. For additional guidance on foreign participation, see the *NASA Proposers Guide*, Appendix A.

11.3.4 Ineligibility of Proposals That Include Participation of China or Chinese-Owned Companies

Proposals involving bilateral participation, collaboration, or coordination in any way with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds basis, shall be ineligible for award.

Other Eligibility Criteria

All proposals shall identify one additional US college or university collaborator (MSI or non-MSI), at least one industry collaborator, and, at a minimum, a third collaborator. NASA Centers accepting internship placements will be considered a coalition collaborator, which denotes relevance to NASA. Proposals must meet this requirement to be eligible for award and be reviewed.

All collaborators must demonstrate their awareness of the proposal and summarize plans for participation via Letters of Support (see EONS-2024, and the *NASA Proposer's Guide,* for additional information).

11.4 APPLICATION SUBMISSION INFORMATION

11.4.1 Address to Request Application Package

Proposal applications are available via the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES).

11.4.2 Proposal Preparation and Submission

All information needed for proposers to respond to this NOFO is contained in this Appendix, the EONS-2024 announcement, the *NASA GCAM* and the *NASA Proposer's Guide*. If the information contained in this Appendix conflicts with the *GCAM* or the *NASA Proposer's Guide*, the information in this NOFO takes precedence.

All proposed activities shall address the following requirements, as well the operating principles that underlie the NASA STEM Engagement Strategic Plan and contribute to the achievement of MUREP INCLUDES goals and objectives using evidence-based strategies that rely on verifiable data, literature review, subject matter expert input, and information that has been gathered using the standards of professional research and evaluation organizations.

11.4.2.1 Proposal Submission Guidelines

Detailed instructions for the preparation and submission of proposals are available in the *NASA Proposer's Guide*. Applicants shall submit their proposals using electronic proposal submission via NSPIRES ONLY. Registration in NSPIRES is required for proposal submission. Proposals shall be written in 12-point font with 1-inch margins. The narrative section of the proposal shall be a maximum of 15 pages. See the *GCAM* for details. Each proposal shall include the following: a Title Page (not counted against the 15-page limit), a Table of Contents (not counted against the 15-page limit), Project Summary (up to 4000 characters, not counted against the 15-page limit).

Required Parts of a Proposal (in order of assembly)	**Number of Pages**
Proposal Cover Page (NSPIRES web form including spaces) • Proposal Summary—limit to 4,000 characters (including spaces) • NSPIRES cover budget page. • Proposal team members • Other required elements	Constrained by NSPIRES
Table of Contents	As needed
Scientific/Technical/Management Plan including *but not limited to:* • Detailed plans to address the Goals and Objectives of MUREP and research priorities for NASA Mission Directorates and centers. • NASA Center or facilities collaborator(s). • Supplies/materials for curriculum testing, engineering camps, or internship research. • Proposed number of internships per year and location of placements (e.g., NASA center or installation, college or university, industry). • Barrier(s) that the coalition proposes to address, how the alliance will address the barrier(s), and what the expected outcomes and impacts are to broaden the participation of URM students in engineering disciplines and fields. • A timeline for all proposed activities with annual and cumulative metrics, and Key Performance Indicators (KPIs) mapped to MUREP INCLUDES objectives and goals. • A plan for bi-annual NASA Gateway participant count, demographics collection and validation. • Data Sharing Plan (dissemination) • Evaluation Approach	15

References and Citations	As needed
Biographical Sketches for: See Section 2.15 in *NASA Proposer's Guide*	
The Principal Investigator	2
Co-Investigator(s)	1 page per CO-I
Current and Pending Support	As needed
Statements of Commitment and Letters of Support	As needed
Proposal Budget (both the budget narrative and budget details)	As needed
Table of Personnel and Work Effort	As needed
Data Management Plan	As prescribed in the NOFO

Each proposal shall include:

- Proposal Summary (4,000 characters including spaces)
- Data Management Plan (See EONS-2024, **Section A.9, Data Management Plan**, for details)
- NSPIRES cover page budget.
- Proposal team members
- Table of Contents (not counted against the 15-page limit) Scientific/Technical/Management Plan (**maximum of 15 pages**)
- Detailed plans to address the Goals and Objectives outlined in **Section 11.1.2** of this NOFO.
    - Specific plans for addressing the identified barrier(s).
    - Specific area(s) of priority for NASA's MDs that will be addressed through engineering research experiences or learning modules (include the name(s) and title(s) of NASA Center or facility collaborator(s).
    - Plans for executing engagements in culturally relevant and responsive instruction (include the name(s) of partners that will support this effort).
    - Identify specific STEM laboratory equipment and supplies/materials to be purchased to support teaching and learning.
    - Detailed explanation of recruitment strategy for attracting diverse students into engineering engagement activities; and
    - Plans for experiential learning experiences for students, including the proposed number of internships/research assistantships per year, and proposed location of placements (e.g. NASA Center, college, or university).
- Details on how proposed activities address National and Agency-wide priorities, relevance to NASA and OSTEM, and research priorities for NASA's MDs and Centers (See **Sections 11.1.4.1 and 11.1.4.2** of this NOFO)
- A timeline of all proposed activities (by each year), including the responsible personnel for each activity
- Evaluation Plan (See **Section 11.1.4.5** of this NOFO)
- DSP describing how information obtained through MUREP INCLUDES will be shared, including developing one or more published technical paper(s) / journal article(s) during the 3-year period of performance and presenting these paper(s) at appropriate professional

conferences, meetings, and/or workshops.
- References and citations (not counted against the 15-page limit)
- Biographical Sketches for PI and each Co-I (not counted against the 15-page limit)
- Current and Pending Support (not counted against the 15-page limit)
- Statements of Commitment and Letters of Support from collaborators, including NASA Centers or facilities, indicating specific agreed-upon roles and responsibilities (not counted against the 15-page limit).
- Proposal Budget and Budget Narrative (not counted against the 15-page limit)
- Facilities and Equipment (not counted against the 15-page limit)
- Table of Personnel and Work Effort (not counted against the 15-page limit)

Please see the *NASA Guidebook for Proposers*, **Section 2.6, Standard Proposal Style Formats**, and Section 2.7**, Overview of Proposal**, for more details.

Note: NASA does not endorse or require proposers to use any specific source of information, but strongly encourages proposers to use research-based best practices described in peer-reviewed journals and/or conducted by credible institutions that specialize in STEM education research.

11.4.3 NASA Contact Information

The MUREP INCLUDES NOFO will be released on April 5, 2024, and remain open until June 6, 2024, at 11:59 pm Eastern Time. Potential applicants with questions or experiencing problems while the funding opportunity is open shall reach out to the NASA point of contact for the MUREP INCLUDES, is Brenda Collins. Contact information is provided below in **Section 11.4.3, Contact and Resource Information, Program Office Contact of this NOFO.**

#.4.3.1 Pre-proposal Webinars and Questions and Answers

Three optional pre-proposal webinars will be held prior to the proposal submission due date to provide potential applicants with the opportunity to ask questions and address problems. The first pre-proposal webinar will take place on April 24, 2024, at 3:00 pm Eastern Time. The second pre-proposal webinar will take place May 15, 2024, at 3:00 pm Eastern Time. The third pre-proposal webinar will take place on May 30, 2024, at 3:00 pm Eastern Time. Applicants shall refer to the MUREP INCLUDES landing page on NSPIRES for connection details. Proposers shall submit any written questions no later than seven business days before the pre-proposal webinars so that NASA will be able to cover as much information as possible during the meeting. Prospective proposers may also ask questions they have about this opportunity during the teleconference. Proposers may also receive technical assistance from project staff at this time, which may include tips and guidance for proposing for this opportunity.

Potential applicants are strongly encouraged to register early in NSPIRES and sign up for notification emails so they will receive notice of the pre-proposal webinars. Refer to the MUREP INCLUDES landing page on NSPIRES for question submission and schedule information.

Proposers shall submit any questions via email only as instructed on the NSPIRES announcement of this opportunity. Responses to questions submitted will be provided in a

"Frequently Asked Questions (FAQ)" list that will be posted on the MUREP INCLUDES landing page on NSPIRES. The list will be updated frequently during the open period of this NOFO.

11.4.4 Contact and Resource Information

Selection Official

Torry Johnson
MUREP Project Manager (Acting), Deputy Associate Administrator for STEM Program
NASA Headquarters
Washington, DC 20546

Program Office Contact

Brenda Collins
MUREP INCLUDES Activity Manager
NASA Ames Research Center
Mail Stop 226-8
Moffett Field, CA 94035
Email: NASAMUREP-INCLUDES@nasaprs.com

11.4.5 Proposal Submission Method, Dates, and Times

Electronic proposal submission is required via NSPIRES ONLY. See *NASA Proposer's Guide*.

Application Submission Deadline

Application Materials	Required or Encouraged	Due Date and Time
Letter of Intent	Strongly encouraged	Monday, May 6, 2024 11:59 pm EASTERN TIME
Full Application	Required	Thursday, June 6, 2024, at 11:59 pm EASTERN TIME

All applications **must** be received by the established deadline.

NASA **will not review applications that are received after the deadline or consider these late applications for funding**.

Applicants experiencing technical problems outside of their control must notify NASA as soon as possible and before the application deadline. Failure to timely notify NASA ofthe issue that prevented the timely filing of the application may preclude consideration of the award.

For technical assistance with NSPIRES, please contact the NSPIRES Help Desk at nspires-help@nasaprs.com or (202) 479-9376, Monday through Friday, 8:00 AM – 6:00 PM ET, except on Federal Government holidays. It is highly recommended that proposers do not wait until the final hours before the proposal deadline to submit their proposals.

All dates listed in this NOFO are subject to change. Please regularly check the NSPIRES website for details. All information to be reviewed in support of a proposal must be uploaded together as a single PDF submission in NSPIRES. All proposals shall be submitted electronically through

NSPIRES only. All organizations and the team members participating in the proposal must be registered in NSPIRES. Proposals delivered through any other means will be rejected and will not be reviewed. Also, late proposals (i.e., those received after the stated deadline) will be rejected and will not be reviewed.

Collection of Demographic Information
NASA is implementing a process to collect demographic data from grant applicants for the purpose of analyzing demographic differences associated with its award processes. Information collected will include name, gender, race, ethnicity, disability status, and citizenship status. Submission of the information is purely voluntary and is not a precondition of award.

11.5 APPLICATION REVIEW INFORMATION
The three criteria (and their weights) for proposal evaluation and award selection are: Intrinsic Merit (60 percent), Relevance to NASA (25 percent), and Budget/Cost and Budget Narrative (15 percent). Proposers shall carefully review the following specific evaluation criteria for MUREP INCLUDES awards.

As stated in **Section 11.3.2 of this NOFO**, priority will be given to institutions that have not previously received MUREP INCLUDES full implementation award funding as a lead institution. Current MUREP INCLUDES recipients are ineligible to submit proposals to this funding opportunity; however, they may serve as partners to eligible proposing MSIs. In addition, the following proposal features will be closely considered:

- The degree to which the proposal establishes partnerships and collaborations with other institutions and agencies, including members of NASA centers, NASA EPSCoR jurisdictions, NASA Space Grant Consortiums, and other government agencies; non-profits; community colleges, minority-serving institutions, and other universities; and industry and other organizations.
- The degree to which the proposal identifies barrier(s) for URM students pursuing engineering disciplines and fields and offers a novel approach to address the barrier(s) through strategic interventions using evidence-informed (or research-based) practices.
- The degree to which each activity is supported by a citation and is linked to the overall goals and objectives of MUREP INCLUDES.
- The degree to which the proposal demonstrates how the coalition partnerships will contribute to MUREP INCLUDES goals and objectives, leverage significant additional funding sources, obtain essential services unavailable at the proposer's home institution, and describe how the proposed effort will contribute to sustainability. Proposed partners make practical contributions to resolving the critical problem of broadening participation and demonstrates their commitment for involving their stakeholders and relationships to support the proposed efforts.
- The degree to which the proposal demonstrates the ability to increase the number of new URM students to successfully transition into NASA and/or the nation's workforce.
- The degree to which the proposal supports the success of current engineering URM students through new concepts for retention and academic attainment through a progression of interventions.
- The degree to which the coalition will institute a significant investment in URMs real-world, hands-on engineering experiences culminating documentation (e.g., scientific poster, research paper).

- The degree to which the budget clearly supports the proposed activities and is aligned with the guidelines.

11.5.1 Intrinsic Merit (weighted 60 percent in the evaluation)

Evaluation of Intrinsic Merit. Proposers shall address all the following elements and sub-elements to demonstrate the capability of the institution, PI, program staff, and partners/collaborators to achieve successful outcomes for the proposed activity and reach targeted students.

Management Approach (weighted 15 percent in the evaluation)

- Describes the alignment of the proposed program to MUREP INCLUDES goals, required objectives, and priorities and how the proposed program will contribute to the overall achievement of these measures of success.
- Provides a logic model that illustrates the relationship between MUREP INCLUDES goals and objectives the project's objectives, activities, benchmarks, and results.
- Presents a clearly organized and workable management plan for achieving MUREP INCLUDES program goals and objectives and includes clear lines of communication with NASA, the coalition, and the cohort.
- Presents a realistic schedule/timeline and/or other description of how activity goals, objectives, and major milestones will be achieved.
- Provides details of the organizational structure inclusive of an Advisory Council.
- Identifies and proposes target audience (e.g., education/grade level, demographic targets).
- Includes approach to collecting required NASA performance metrics (i.e., metrics demonstrating progress in achieving the MUREP INCLUDES goal and objectives; and see Section 9.6.3 Office of STEM Engagement Performance Metrics of this NOFO) and identifies the position/individual responsible for reporting performance metrics to NASA.
- Includes an evaluation or assessment approach to measure project accomplishments against the proposed goal(s) and objectives of broadening participation in engineering fields; and
- Denotes the selection process and the responsibilities of Advisory Council members.

Data Sharing Plan (weighted 5 percent in the evaluation)

- Demonstrates a clear plan for data sharing; and
- Describes plan to present published paper(s) at appropriate professional conferences, meetings, and/or workshops.

Recruitment and Retention Plan (weighted 10 percent in the evaluation)

- Demonstrates an understanding of the unique challenges faced by undergraduate and graduate students from groups traditionally underrepresented and/or underserved in the engineering areas (i.e., women, racial and ethnic minorities, and persons with disabilities).
- Provides evidence of the successful ability to attract and retain students from target populations, sets forth selection criteria and procedures, and provides a demographic profile of the community/communities being served.
- Provides the expected number of student participants in proposed capstone projects, bridging programs, student experiential engineering research, and engineering skills development activities.

Partnership and Collaboration Approach (weighted 20 percent in the evaluation)
Delineates mechanisms for building partnerships to enhance the ability of the lead institutions to achieve its objectives, to obtain and leverage sources of additional funding, and/or to obtain essential services not otherwise available.

- Details a plan for measuring each partner's achievement towards the coalition's objectives and goals.
- Presents a plan that outlines each collaborator's responsibilities to the proposed activities.
- Includes formal letters of commitment from all partners and collaborators that clearly explain their roles and responsibilities, specific outputs, and outcomes with acknowledgement of agreement to, these roles and responsibilities (These letters are not counted against the 15-page limit).

Sustainability Plan (weighted 10 percent in the evaluation)

- Describes a strategic roadmap that demonstrates sustainability beyond the three-year award period and includes plans to apply for funding opportunities offered by NASA Mission Directorates, industry, and other funding agencies.
- Identifies all long-term relationships that have been or will be established to ensure that the project will sustain educational programming.
- Describes how key project elements may be replicated and scalable in other environments.
- Identifies the initial lead of the Advisory Committee and describes how the committee will support sustainability efforts.
- Demonstrates a strong evaluation plan that tracks sustainability efforts and successes.

11.5.2 Relevance to NASA (weighted 25 percent in the evaluation)
Evaluation of Relevance to NASA considers the following scientific relevance and educational relevance elements and sub-elements:

Scientific Relevance (weighed 10 percent in the evaluation)

- References applicable NASA missions, Mission Directorates and/or research areas that will serve as the context for student authentic STEM activities (see Section 9.1.4.3 Research Priorities for NASA Mission Directorates and Centers of this NOFO); and
- Uses evidence-based strategies and/or practices in the development of any proposed activities, and/or other evidence supporting the rationale for the proposed approach, tools, and/or techniques. NASA does not endorse or require the use of any specific source of information but strongly encourages proposers to use research-based best practices described in peer-reviewed journals and/or conducted by credible institutions that specialize in STEM education research.
- Provides evidence that the proposed effort cultivates diversity, inclusiveness, and belonging and extends access to existing NASA content.
- Addresses how selected NASA content will help meet the documented needs of groups URMs in engineering disciplines and fields.
- Provides connections to NASA's or JPL's engineering divisions for internships.

Educational Relevance (weighted 15 percent in the evaluation)

- The proposed effort offers innovative methods, approaches, and concepts to deliver MUREP INCLUDES experiences by meeting the following objectives: increasing students' engineering identity, skills, and knowledge by engaging student participants in real-world NASA-based authentic STEM activities.
- Experiences and interventions are supported by educational research and evidence-based practice.
- Increase students' awareness and understanding of engineering careers and access to internships and potential employers by enabling connections to engineering professionals.
- The proposed effort builds on lessons learned and/or best practices of past education and/or research and learning activities.

11.5.3 Budget/Cost and Budget Narrative (weighted 15 percent in the evaluation)
Proposers shall clearly describe how the proposed budget is appropriate for the proposed effort. Proposals shall include a detailed implementation/costing plan with a clear narrative that demonstrates how funds requested will be fully utilized for the duration of the three-year award period of performance. The following elements will be considered in the evaluation of the Budget/Cost and Budget Narrative:

- The lead institution retains at least 40% of the annual budget amount of $400,000.
- The total for subawards to partners is equal to or less than 60% of the annual budget amount of $400,000.
- Alignment with budget guidelines and requirements outlined in **11.2.3 Budget Guidelines and Requirements** (in this document).
- Include sufficient travel funds to cover costs for the PI, other key staff, and students to attend critical meetings. Requested travel shall include the purpose, the number of trips and the expected location, duration of each trip, airfare, lodging, and per diem.
- Include annual stipend support for students to participate in internship opportunities at NASA Centers, JPL and research facilities during NASA's spring, summer, or fall session. The agency's current (implementation Summer 2024) rate is $8,200 for undergraduates and $9,900 for graduates (at the master's and doctoral levels). This rate is based on 40 hours a week for 10 weeks.
- Materials and supplies are well justified with detailed vendor quotes and proposed use.
- Indicate how the proposed budget is clearly aligned with the proposal narrative and budget narrative.
- Describe how the proposed budget is adequate, appropriate, reasonable, and realistic.
- Demonstrate effective use of funds in which outcomes justify total costs.
- Include sufficient funds to support a project administrative assistant (or explanation of how project administration will be supported through other funding).
- Include sufficient funds to support an IE, including necessary travel.
- Provide a budget justification detailing how funds will be allocated to support project personnel, travel, student support, student research, and subcontracts.

11.5.4 Review and Selection Process
Reviewers and panelists with appropriate expertise will be identified to evaluate each proposal that is compliant and meets the requirements that have been stated in this NOFO. Proposers must

provide enough detail to enable an effective evaluation by persons knowledgeable of but not necessarily specialists in, the proposed area. The reviewers may include personnel from NASA, other Federal Government agencies, industry, colleges, and universities.

Proposals will be evaluated through a two-phased process to include an evaluation completed by reviewers and panelists. The first phase of the evaluation will be conducted online by reviewers, with the highest-rated proposals moving forward to panel review, which is the second phase. The MUREP INCLUDES Activity Manager will present the panel's final recommendations to the NASA Selection Official. **Note: NASA reserves the right to utilize only a panel review.**

The Selection Official will use programmatic factors (including funding available) to achieve an awardee portfolio that meets the goals and objectives of MUREP INCLUDES. NASA seeks a balanced award portfolio, and considers diverse factors, including but not limited to, different types of institutional representation, participation by individuals traditionally underrepresented in STEM studies and careers, and geography.

In evaluating proposals, NASA will assign one of the following overall ratings:

• **Excellent -** A comprehensive and thorough proposal of exceptional merit with one or more significant strengths. No deficiency or significant weakness exists.
• **Very Good** - A proposal having no deficiency, and which demonstrates overall competence. One or more significant strengths have been found, and strengths outbalance any weaknesses that exist.
• **Good** - A proposal having no deficiency, and which shows a reasonably sound response. There may be strengths or weaknesses, or both. Overall, weaknesses not offset by strengths do not significantly detract from the Proposer's response.
• **Fair** - A proposal with no deficiency, and which has one or more weaknesses. Weaknesses outbalance strengths.
• **Poor** - A proposal that has one or more deficiencies or significant weaknesses that demonstrate a lack of overall competence or would require a major proposal revision to correct.

11.5.4.1 Successful Proposals

Upon selection of the awardee recipients by the Selection Official, the PI of each successful proposal will receive a "Notice of Intent to Make a Federal Award" letter via NSPIRES with an explanation of the review process and reviewers' comments about the proposal. The "Notice of Intent to Make a Federal Award" letter does not release award funding and is not an authorization to the selected proposer to begin performance. It is anticipated that these letters will be released in July 2024. Proposers are strongly cautioned that only a NASA Grant Officer may make commitments, obligations, or awards on behalf of NASA or authorize the expenditure of funds for this opportunity. Pre-award costs will not be allowed for cooperative agreements awarded through this funding opportunity. If a submitter is selected for an award and it incurs pre-award costs, this is at the submitter's/recipient's own risk and NASA will not pay them.

NASA will notify successful grant recipients of funding via a Notice of Award (NASA Form 1687) signed by the Grant Officer. This Notice of Award is the authorizing document and will be sent to the proposing PI and the award recipient's Authorized Organization Representative (AOR) listed in the proposal via electronic delivery. All expenses incurred by recipients or their sub-awardees on grant activities prior to the period of performance start date listed on the Notice of Award are at the risk of recipient or sub-awardee until the Notice of Award is received and period of performance commences.

11.5.4.2 Unsuccessful Proposals

Upon selection of award recipients, the PI of an unsuccessful proposal will receive a non-selection letter with an explanation of the review process and reviewers' comments about the proposal via NSPIRES.

#.5.4.3 Anticipated Announcement and Federal Award Dates

Open Application Period: April 5, 2024, to June 6, 2024
Pre-proposal Webinar: April 24,2024, at 3:00 pm Eastern Time
Pre-proposal Engineering Roundtable: May 15, 2024, at 3:00 pm Eastern Time
Final Office Hours: May 30, 2024, at 3:00 pm Eastern Time
Application Period Closes: June 6, 2024, at 11:59pm Eastern Time
Anticipated Selection Announcement Date: late July 2024
Anticipated Federal Award Date: Prior to September 30, 2024

11.6 FEDERAL AWARD ADMINISTRATION INFORMATION

11.6.1 Cooperative Agreement Award Reporting Requirements

The reporting requirements for award recipients under the MUREP INCLUDES will be consistent with the *NASA GCAM.*

Unless otherwise noted, the MUREP INCLUDES PI shall submit reports as described below via secure transfer and following Personally Identifiable Information (PII) requirements to the NASA Shared Services Center (NSSC) with a courtesy copy to the MUREP INCLUDES Activity Manager. For additional information on PII, see NASA Privacy Procedural Requirements.

All reports shall include the following data elements on the report's cover page:

- Federal agency (i.e., NASA) and program office to which the report is submitted
- Award number
- Project title
- Principal Investigator name, title, and contact information (e-mail address and phone number)
- Name of submitting official, title, and contact information (e-mail address and phone number), if other than PI
- Submission date
- Unique Entity Identifier (UEI) number and Employer Identification Number (EIN) number
- Recipient organization name and address
- Recipient identifying number or account number if any
- Period of performance start and end date
- Reporting period end date
- Report term or frequency (annual, semi-annual, quarterly, other)
- Final Report? Indicate "Yes" or "No"
- Signature of submitting official (either handwritten or electronic)

In addition to the data elements above, all NASA performance reports shall report on one mandatory reporting category, “accomplishments.”

Accomplishments data element:
1. What were the major goals and objectives of this project?
2. What was accomplished under these goals and objectives?
3. What opportunities for training and professional development has the project provided?
4. How were the results disseminated to communities of interest?
5. What do you plan to do during the next reporting period to accomplish the goals and objectives?

For further details on reporting project performance, please refer to the Post-Award Phase Section of the *GCAM*.

In addition to the data elements above, all NASA performance reports shall report on one mandatory reporting category, “accomplishments.”

Accomplishments data element:
1. What were the major goals and objectives of this project?
2. What was accomplished under these goals and objectives?
3. What opportunities for training and professional development has the project provided?
4. How were the results disseminated to communities of interest?
5. What do you plan to do during the next reporting period to accomplish the goals and objectives?

Comprehensive Evaluation Plan

Within three months after award, using the required template, recipients shall submit a Comprehensive Evaluation Plan (CEP) that:

- Is developed by the IE with concurrence by the PI.
- Provides a clearly articulated logic model.
- Describes an appropriate evaluation plan/process that is based on reputable models and techniques, documents outcomes and demonstrates progress toward achieving the goals and objectives of the proposed education activities.
- Identifies how progress toward achieving the objectives of proposed education activities will be measured; and
- Identifies a timeline and benchmarks for objectives that align with MUREP INCLUDES reporting requirements.

Federal Financial Reporting
Recipients of NASA funding must submit financial reports. Financial reports must be submitted via the Payment Management System (PMS) as follows:

- Semi-annual Federal Financial Reports (FFR) due no later than 30 days past the reporting period end date.
- Final Financial Status Reports/Final Federal Financial Report (FSR/FFR) are due no later than 120 days after the end of the period of performance.

Performance Reporting
NASA award recipients must also submit annual and final performance reports. Annual reports are due to NASA 60 days prior to the anniversary date of the award, except in the award's final year. Awards that are in their final year are required to submit final performance reports instead of the annual performance report. Descriptions of annual and final reporting requirements for MUREP INCLUDES are below:

Annual Report *(due each year 60 days prior to the anniversary date of the award, except in the award's final year)*

Award recipients shall submit an Annual Report every year no later than 60 days prior to the anniversary date of the award, with the exception of the award's final year.

Annual Evaluation Report *(Developed by the IE, as an Appendix to the Annual Report)* that includes, at a minimum:

- The outcomes and demonstrated progress toward achieving the objectives of proposed activities aligned to the comprehensive evaluation plan; and
- An annual and formative/summative assessment of the evaluation questions identified in site evaluation plans using the methods and instruments previously identified.

Final Report *(120 days following the end of the performance period)*
Recipients shall submit a Final Report no later than 120 days following the end of the performance period.

Additional Reporting Requirements
NASA recipients must conform to all reporting requirements outlined in the Required Publications and Reports section of the *NASA GCAM*, currently Appendix F.

11.6.2 Administrative and National Policy Requirements
In addition to the requirements in this section and in this NOFO, NASA may place specific terms and conditions on individual awards in accordance with 2 CFR Part 200. Recipients of NASA grant funding shall adhere to requirements set forth in 2 CFR 200, 2 CFR 1800, 2 CFR 170, 2 CFR 175, 2 CFR 182, and 2 CFR 183.

11.6.3 Summary of MUREP INCLUDES Awardee Responsibilities
The MUREP INCLUDES award recipients have the primary responsibility for implementing, operating, and managing the project as described in their submitted proposal.

- Each recipient shall select a PI in support of this agreement to be primarily responsible for the overall management of the award and serve as the primary point of contact for NASA. If the PI to be named is different from the individual identified in the proposal, the NASA Shared Services Center (NSSC) and the MUREP INCLUDES Activity Manager shall be notified in advance and in writing. Any proposed change to the PI under this Agreement is subject to NASA's written advance approval. See the *NASA GCAM*, Section 7.7, Change of Principal Investigator or Recipient Institution, for more information.
- Each recipient shall participate and present during the virtual kickoff meeting, training

workshops, and monthly activity meetings as required.

- Each recipient shall travel to and participate in one annual Agency OSTEM in-person meetings.
- Each recipient shall travel to and participate in at least one NSF convening in event that is relevant to this award Washington, D.C.
- Each recipient shall annually submit a an MUREP INCLUDES Engagement Plan within 60 days of each award year, an Annual Progress Report, and submit one Final Report as described in 11.6.1 Cooperative Agreement Award Reporting Requirements, in this NOFO.
- Performance Outcomes: All institutional PIs with NASA OSTEM grants and/or cooperative agreements shall provide and verify performance data for the awarded project and submit such data to NASA for review, prior to entry in the NASA STEM Engagement Gateway system, in accordance with NASA guidance.
- The MUREP INCLUDES PI shall submit all required reports via email to the NSSC with a courtesy copy to the MUREP INCLUDES Activity Manager.
- The awarded institution, in concert with the PI, is responsible for the financial management of MUREP INCLUDES as specified in the basic award notice under the terms and conditions issued by NASA and in the *GCAM*. Failure to comply with the terms and conditions of an award may result in NASA terminating the award.
- NASA reserves the right to impose additional requirements during the period of performance of the cooperative agreement to achieve broader MUREP INCLUDES or NASA objectives.

11.6.4 Office of STEM Engagement Performance Metrics

NASA currently utilizes the NASA STEM Gateway registration/application and data management system (Gateway system) for analyzing performance data. PIs are required to timely and properly respond to data calls as requested by NASA OSTEM and utilize the Gateway system for performance data reporting. Additional communications and guidance regarding data calls and the Gateway system will be sent to award recipients from the NASA OSTEM and MUREP INCLUDES Activity Manager. The PI shall ensure that it has the appropriate staff and resources to facilitate data collection activities and properly complete tasks required for timely reporting to NASA.

11.6.5 Other Information

Access to NASA Facilities/Systems

All recipients shall work with NASA project/program staff to ensure proper credentialing for any individuals who need access to NASA facilities and/or systems. Such individuals include US citizens, lawful permanent residents (green card holders), and foreign nationals (those who are neither US citizens nor permanent residents).

11.6.6 Summary of Key Information

Total ESTIMATED annual budget for MUREP INCLUDES	~2.4M
Anticipated number of new awards, pending adequate proposals of merit	4-6 new awards, up to $400k per year for 3 years (maximum $1.2M of for all 3 years)

Estimated Start Date	October 1, 2024
Duration of awards	3 years
Award Type	Cooperative Agreement
Release Date for MUREP INCLUDES NOFO	April 5, 2024, 12:00 pm, Eastern Time (DATE SUBJECT TO CHANGE); Check MUREP INCLUDES landing page for details
Pre-proposal Webinar 1 (optional)	April 24, 3:00 pm, Eastern Time (DATE SUBJECT TO CHANGE); Check MUREP INCLUDES landing page for details
Pre-proposal Webinar 2 (optional)	May 15, 2024, 3:00 pm, Eastern Time (DATE SUBJECT TO CHANGE); Check MUREP INCLUDES landing page for details
Pre-proposal Webinar 3 (optional)	May 30 , 2024, 3:00 pm, Eastern Time (DATE SUBJECT TO CHANGE); Check MUREP INCLUDES landing page for details
DUE DATE FOR PROPOSALS	June 6, 2024, 11:59 pm, Eastern Time (DATE SUBJECT TO CHANGE); Check MUREP INCLUDES landing page for details
Page limit for the Narrative Section of proposal	15 pp. See *NASA Proposer's Guide*
Detailed instructions for the preparation and submission of proposals	See *NASA Proposer's Guide*
Submission medium	Electronic proposal submission is required via NSPIRES ONLY. See *NASA Proposer's Guide*
Selection Official	Torry Johnson, MUREP Project Manager (Acting), Deputy Associate Administrator for STEM Program NASA Headquarters Washington, DC 20546
NASA's Point of Contact for this NOFO	Brenda Collins Manger, MUREP INCLUDES NASA Ames Research Center Mail Stop 226-8 Moffett Field, CA 94035 Email: NASAMUREP-INCLUDES@nasaprs.com

APPENDIX 12: Next Gen STEM (NGS) FY 2024 Teams Engaging Affiliated Museums and Informal Institutions (TEAM II)

Guidance for Potential Applicants Reading Appendix 12: This FY2024 TEAM II Notice of Funding Opportunity includes information for both the TEAM II Community Anchor tier and the newly added TEAM II Innovator tier. Each section below begins with information that is applicable for *all* TEAM II applicants regardless of tier. There are sub-headers within each section designating specific information relevant to only Community Anchor tier applicants and only STEM Innovator tier applicants.

For example, Section 12.1.1.1 (New FY2024 TEAM II Awards Tier Structure) begins with a general information on TEAM II awards and project requirements applicable to all TEAM II awards. Section 12.1.1.2 (Community Anchor Awards for TEAM II (TEAMIIANCHR)) focuses on project requirements applicable only to Community Anchor awards and Section 12.1.1.3 (STEM Innovator Awards for TEAM II (TEAMIIINOV)) focuses on project requirements applicable only to STEM Innovator awards.

Applicants are strongly encouraged to read the beginning section of each major heading and the parts specifically labeled for the tier of their interest.

12.1 PROGRAM DESCRIPTION

12.1.1 Overview of the Funding Opportunity

NASA's Office of Science, Technology, Engineering, and Mathematics (STEM) Engagement (OSTEM), through its Next Gen STEM (NGS) Project, collaborating closely with the Mission Directorates, and also in cooperation with NASA Headquarters' Office of Communications (OCOMM) and the Office of Diversity and Equal Opportunity (ODEO), solicits proposals led by Informal Education Institutions (IEIs) to provide inquiry- or experiential-based educational opportunities with direct alignment to major NASA missions for students and the public, and their learning support systems of families and informal and formal educators and institutions, in support of federal and agency strategies, goals, objectives and priorities relevant to STEM education and engagement.

Through TEAM II, NASA seeks to enhance IEIs' and partners' ability to deliver and participate in NASA-based activities, to build the capacity of institutions to utilize NASA resources, and to empower students to contribute to NASA's mission using innovative tools and platforms. TEAM II seeks projects featuring the latest in NASA space exploration, missions, engineering, and technologies to support NASA STEM Engagement objectives, strategies, and outcomes. The TEAM II initiative supports with the following NASA STEM Engagement Strategic Goals and Priority Areas outlined in the 2022 NASA Strategic Plan and the NASA STEM Engagement Strategic Implementation Plan: NASA STEM Engagement Strategic Implementation Plan:

- Attract diverse groups of students to STEM through learning opportunities that spark interest and provide connections to NASA's mission and work.
- Create unique opportunities for a diverse set of students to contribute to NASA's work in exploration and discovery.
- Build a diverse future STEM workforce by engaging students in authentic learning experiences with NASA's people, content, and facilities
- Advance diversity, equity, inclusion, accessibility, and belonging in NASA's STEM engagement opportunities to broaden participation in STEM
- Build and strengthen strategic partnerships and networks to engage students, educators, and educational institutions in NASA's portfolio of STEM engagement opportunities

- Create a beneficiary-focused organizational framework of STEM engagement opportunities and resources based on NASA's diverse STEM engagement portfolio
- Facilitate evidence-driven, continuous improvement of NASA's STEM engagement portfolio to ensure NASA's STEM engagement opportunities are responsive to evolving beneficiary needs

The only eligible technical subject areas for TEAM II proposals are NASA-themed space exploration, aeronautics, space science, Earth science, and/or microgravity. TEAM II proposals shall be designed to contribute to NASA Strategic Goals for STEM Engagement and to the priorities of the agency's five Mission Directorate Offices, as described in Section 12.1.2.2 below, as well as the Offices listed under Collaborating Offices in Section 12.1.2.3 below.

12.1.1.1 New FY2024 TEAM II Awards Tier Structure
In 2024, TEAM II expanded the current program from a two-tier to a three-tier system by adding a mid-level funding tier. Table 1 below provides a comparison of field components for each TEAM II Program tier. The Community Anchor tier opportunity will be offered each fiscal year, and the STEM Innovator and National Connector tiers will be offered in alternating years. The FY2024 NOFO will include the Community Anchor and STEM Innovator tiers and the FY2025 NOFO will focus on the Community Anchor and National Connector tiers. By adding the mid-level tier, NASA and Next Gen STEM aim to broaden the number and type of awards made to Informal Education Institutions for creating innovative, NASA-inspired programming for K-12 students and their families.

Table 1. Comparison Chart of TEAM II Tiers

	Community Anchor	**STEM Innovators**	**National Connectors** ***(expected for FY2025)***
Plans for Solicitation Inclusion	Every year	Every other year, starting FY2024	Every other year, starting FY2025
Schedule of Awards	Every year	Every 2 years	Every 2 years
Anticipated Funding Value	Up to $50,000	Up to $250,000	Up to $900,000
Award Type	Grants	Cooperative Agreement	Cooperative Agreement
Period of Performance	1-2 years	2-3 years	2-4 years
Project Focus	• Reach: local • Projects enhancing local engagement	• Reach: regional • Scalable projects available on regional level through networks, partnerships, etc.	• Reach: national • Scalable projects with capacity to implement on national level
Target Audience	• K-12 youth • Priority on grades 5-8 • Second priority on grades k-4 • Encouraged to reach 500 students/year	• K-12 youth • Priority on grades 5-8 • Second priority on early learner innovations (ages 3-6)	• K-12 youth • Priority on grades 5-8 • Second priority on grades k-4 • Innovations for early learners or high school students
Project Requirements	• Provide 3 learning experiences / activities annually	• Share innovative approaches with community	• Develop a partnership and network plan • Prepare two PD

	• Join CONNECTS & TEAM II Groups • Participate in IE Learning Cohort • Submit 1 Success Story • Annual & Final Performance Reports • Annual Activity Detail Report • Attend annual conference	• Prepare one PD webinar • Join CONNECTS • Submit 1 Success Story annually • Annual & Final Performance Reports • Annual Activity Detail Report • Attend annual conference • Implement proposed project	webinars • Join CONNECTS • Submit 1 Success Story annually • Annual & Final Performance Reports • Annual Activity Detail Report • 2 team members attend annual conference • Implement proposed project
Program Evaluation	• Not required	• 8% of total budget • Strongly encourage independent evaluation, but internal evaluation is acceptable • Strongly encourage Logic Model	• 8% of total budget • Independent evaluation • Logic Model
Page Count Details	3-page project description	7-page project description	15-page project description

The TEAM II program is aligned with the 2022 NASA Strategic Plan, specifically Objective 4.3 "Build the next generation of explorers," as well as the NASA STEM Engagement Strategic Implementation Plan TEAM II opportunities focus on informal education and seek to broaden participation in NASA-related STEM engagement experiences through the following goals:

- Strengthen an institution's capacity to serve as a local or regional NASA STEM informal education community resource.
- Increase access to NASA STEM learning opportunities and materials that address the needs of a diverse set of K-12 youth in local communities or region, with priority on students of upper elementary and middle school age, in grades 5-8.
    - **Community Anchor secondary priority** is students in grades K-4
    - **STEM Innovator secondary priority** is proposals utilizing innovative methods for targeting other specific age groups such as early learners (ages 3-6) and/or high school age students.
- Plan, develop, or implement the proposed activities in collaboration with the local/regional community.
- Improve NASA connections to local or regional networks or coalitions that support learners to pursue varied pathways in STEM education and engagement, and serve to unite their communities and regions, particularly those that are inclusive of diverse organizations or agencies that offer perspectives from both traditional and non-traditional constituents.

NASA further encourages, but does not require, Proposers to:

- Tie the proposed NASA STEM learning experiences or activities to NASA mission milestones, such as the operation of the James Webb Space Telescope, Artemis launches, missions, and splashdowns, Commercial Lunar Payload Services launches and deliveries of payloads to the lunar surface, and X-59 Supersonic Flights; national STEM days such as Earth Day, Astronomy Day, and International Observe the Moon Night; celestial events such as solstices, equinoxes, eclipses, planetary apparitions, and meteor showers; annual commemorations promoting diversity and inclusion such as Black History

Month, National Native American Indian Heritage Month, Asian American and Pacific Islander Heritage Month, and Women's History Month; and use of educational opportunities and resources available from NASA.
  - The Artemis II mission is planned to launch no earlier than September 2025 and may be an ideal opportunity for TEAM II awardees to align programming with a significant NASA initiative.
  - See Section 12.7.2 of this NOFO, NASA Resources and Calendar Web References, and note that launch dates and other mission events are subject to change.
- Direct the activities at audiences consisting of talented individuals from all backgrounds and life experiences who have not been previously exposed to NASA STEM, or related engagement resources and activities.
- Integrate their emerging expertise and audience activities with a STEM learning network, STEM Ecosystem or coalition, if applicable.
- Use or adapt existing NASA STEM Engagement programs, opportunities, or products to suit the objectives of the proposed project.

Selected proposals shall:
- Prepare reports as described in Sections 12.6.1 and 12.6.2 of this NOFO, Reporting Requirements.
- Join NASA Connecting Our NASA Network of Educators for Collaborating Together in STEM (CONNECTS). CONNECTS is an overall community of practice for formal and informal educators, and is also where TEAM II awardees-only content is shared and archived, and the new home of NASA's Museum & Informal Education Alliance to share opportunities available resulting from recipient's project to formal and informal educators in the CONNECTS community and to share opportunities available resulting from recipient's project to formal and informal educators in the CONNECTS community.
- Commit up to two team members, including the Principal Investigator (PI), to participate in NASA PI (virtual) activities as well as an in-person NASA conference (generally annually) with the wider community of award recipients and partners from across OSTEM programs, or with other TEAM II award recipients.

12.1.1. Community Anchor Awards for TEAM II (TEAMIIANCHR) will provide financial support of up to $50,000 total to cover activities for a period of one to two years, which enable IEIs to strengthen their service as a local NASA STEM informal education community resource, implement NASA STEM experiences that benefit a significant population of diverse audiences in their local community or region, and participate in the NASA Informal Education (IE) Learning Cohort.

Selected Community Anchor projects shall:
- Build the proposing IEI's capacity to serve as a local or regional NASA STEM informal education community resource. The IEI will be a resource in addressing an identified community need related to STEM engagement, share knowledge of NASA STEM Engagement learning resources and opportunities that can help meet that need, and hold programs/activities that utilize and grow that knowledge and positively impact the audience need.
- Participate in the NASA IE Learning Cohort led by TEAM II and Museum and Informal Education (MIE) Alliance personnel, which will allow up to three project personnel to directly grow and share their skills in implementing NASA-themed activities, and further develop ideas, facilitate collaborative teams and future engagement, and engage stakeholder perspectives for support. Cohort interactions will be supported by the Connecting Our NASA Network of Educators for Collaborating Together in STEM (CONNECTS) educator community of practice platform. Cohort activities will consist of: (1) a sequence of three virtual half-day gatherings per year, during which award recipients will learn about NASA

grant/cooperative agreement management, introduce their project to the cohort and identify areas of mutual interest and benefit, identify MIE Alliance assistance and NASA resources needed, share experiences and expertise in reaching their audiences, and share successes and lessons learned, including submission of a Success Story[1] and accompanying photos with NASA release forms; and (2) NASA Principal Investigator (PI) activities, including an annual in-person conference/event with the wider community of award recipients and partners from across OSTEM programs. (Some PI opportunities may also be open to participation by a limited number of other project team members.) Additionally, cohort members may be offered special NASA-related opportunities to make available to their audiences.

- Facilitate the participation of the proposed target audience in a minimum of three engaging NASA STEM learning experiences or activities annually. These activities and authentic STEM learning experiences (see Appendix 12.7.3, Authentic STEM Experience Framework) shall target audiences of youth in grades K-12 (special emphasis on grades 5-8 and secondarily grades K-4), and their learning support systems of families and informal and formal educators and institutions. The target grade range within K-12 shall be clearly defined.
    - During each full year of the project, it is encouraged that a minimum of 500 students shall be reached in the proposed authentic STEM learning experiences.
    - The proposed activities shall meet a defined need of the local community and be culturally and developmentally appropriate to the proposed audience.

12.1.1. STEM Innovator Awards for TEAM II (TEAMIIINOV) will provide financial support up to $250,000 total to cover activities for a period of two to three years, which enable IEIs to expand their reach as a regional NASA STEM informal education resource, enhance innovative practices in STEM informal education, implement NASA STEM experiences that benefit a significant population of diverse audiences in their local community or region, and participate in the NASA Informal Education (IE) Learning Cohort.

Selected STEM Innovator projects shall:

- Build the proposing IEI's capacity to serve as a regional NASA STEM informal education resource sharing innovative practices with a broader population. Regional refers to a large geographic area of considerable extent, such as one that encompasses multiple states or larger areas within a state.
- Submit an annual Success Story and accompanying photos with NASA release.
- Develop an innovative project, opportunity, or product capable of reaching a diverse set of students. Share innovative approaches with the broader, regional community.
    - The proposed activities shall meet a defined need of the target regional area and be culturally and developmentally appropriate to the proposed audience.
- Provide experiential authentic STEM opportunities that encourage innovation, critical thinking, and problem-solving skills.
- Utilize one or more regional or national networks, consortia, or associations of STEM- and STEM education-related IEIs (formal or informal STEM Ecosystems) to magnify and maximize the reach and impact of the proposed work.
- Be prepared to propose and present one professional development webinars to the NASA Informal Education Learning Cohort (see Section 12.1.1 Overview of the Funding Opportunity), in order to share information learned through their project. One presentation shall be during the project's first year, and the second in a year of the project's choosing.
- Include substantial contributions to or leadership in local, regional, or national support networks focusing on long-term, shared, sustainable, and flexible STEM missions that bridge, integrate, and strengthen the

[1] Success Stories are brief, engaging descriptions of meaningful outcomes. NASA uses Success Stories to show the impact of funding; award recipients are encouraged to share them with their own stakeholder audiences as well.

learning opportunities offered by organizations across sectors (formal or informal STEM Ecosystems). Use of such networks that provides pathways for learners to pursue varied pathways in STEM education and engagement, particularly those are inclusive of diverse organizations or agencies that offer perspectives from traditional and non-traditional constituents, is strongly encourages and will be more favorably reviewed.

12.1.2 National and Agency-Wide Priorities and Relevance to NASA

See the EONS-2024 NOFO Section A.4, NASA Strategic Plan and Relevance to STEM Engagement.

12.1.2.1 Relevance to NASA and NASA's OSTEM

The only eligible technical subject areas for this TEAM II Appendix are NASA-themed space exploration, aeronautics, space science, Earth science, and/or microgravity. Proposals focused exclusively on non-NASA themes or other NASA themes will be disqualified from award consideration.

The TEAM II activity is designed to contribute to NASA Strategic Goals for STEM Engagement and to the priorities of the agency's five Mission Directorate Offices, described in Section 12.1.2.2, as well as the Offices listed under Collaborating Offices in Section 12.1.2.3.

12.1.2.2 Research Priorities for NASA Mission Directorates and Centers

NASA's Mission to drive advances in science, technology, aeronautics, and space exploration to enhance knowledge, education, innovation, economic vitality and stewardship of Earth, draws support from five Mission Directorates, nine NASA Centers, and JPL, each with a specific responsibility. TEAM II proposals shall be designed to contribute the one or more priorities of the Mission Directorates listed below.

12.1.2.2.1 Aeronautics Research Mission Directorate (ARMD)

Building on a legacy of more than a century of aeronautical research that can trace its origins to the earliest days of powered, heavier-than-air flight, NASA's Aeronautics Research Mission Directorate remains committed to transforming aviation by dramatically reducing its environmental impact, improving efficiency while maintaining safety in more crowded skies, and paving the way to revolutionary aircraft shapes and propulsion that opens new possibilities for commercial air travel including supersonic flight over land. To do this, we also look at ways we can broaden student participation and excitement through workforce development, bilingual STEM opportunities, and helping students and public better understand how aeronautics impacts their lives both directly and indirectly.

12.1.2.2.2 Exploration Systems Development Mission Directorate (ESDMD)

NASA ESDMD defines and manages systems development for programs critical to NASA's Artemis program and planning for NASA's Moon to Mars exploration approach. ESDMD manages the human exploration system development for lunar orbital, lunar surface, and Mars exploration. Artemis missions will open a new era of scientific discovery and economic opportunity at the Moon while validating operations and systems and to prepare for human missions to Mars.

NASA has established the Moon to Mars Program Office within ESDMD to focus on hardware development, mission integration, and risk management functions for programs critical to the agency's exploration approach. The Moon to Mars Program Office oversees development of the Space Launch System (SLS) rocket, Orion spacecraft, supporting ground systems, human landing systems, spacesuits, Gateway, and more related to deep space exploration.

The Strategy and Architecture Office within ESDMD leads definition, documentation, and disposition of the overarching Moon to Mars Architecture. NASA's Moon to Mars Architecture defines the elements needed for long-term, human-led scientific discovery in deep space. NASA's architecture approach distills agency-developed objectives into operational capabilities and elements that support science and exploration goals. Working with experts across the agency, industry, academia, and the international community, NASA continuously evolves the blueprint for crewed exploration, setting humanity on a path to the Moon, Mars, and beyond. NASA publishes an updated Architecture Definition Document each year that explains the latest Moon to Mars Architecture in deep technical detail. See nasa.gov/architecture for more information.

STRATEGIC GOAL 2: Extend human presence to the moon and on towards Mars for sustainable long-term exploration, development, and utilization.

- Explore the surface of the Moon and deep space
- Develop a human spaceflight economy enabled by a commercial market
- Develop capabilities and perform research to safeguard explorers
- Enhance space access and services

12.1.2.2.3 Science Mission Directorate (SMD)

NASA's SMD leads the Agency in five areas of research: Astrophysics, Biological and Physical Sciences (BPS), Earth Science, Heliophysics, and Planetary Science.

SMD uses the vantage point of space to achieve, with the science community and our partners, a deep scientific understanding of our planet, other planets and solar system bodies, the interplanetary environment, the Sun and its effects on the solar system, and the universe beyond. In so doing, we lay the intellectual foundation for robotic and human expeditions of the future while meeting today's needs for scientific information to address national concerns, such as climate change and space weather. SMD's high-level strategic objectives are presented in the 2022 NASA Strategic Plan.

Detailed plans by priority and science area appear in *SCIENCE 2020-2024: A Vision for Scientific Excellence (2023 Update)*. Since 2016, SMD has sustained an award-winning competitive program, Science Activation (SciAct), which helps learners of all ages "do" science. SciAct resources, as well as teams and infrastructure projects, may provide useful materials to be leveraged by TEAM II proposers. SMD also conducts more than 40 rigorous citizen science projects connecting volunteers with professional scientists in pursuit of advancing knowledge and doing science.

Additionally, NASA welcomes TEAM II proposals that engage diverse learners in informal educational settings with the Global Learning and Observations to Benefit the Environment Program (GLOBE) and its rich resources and vibrant community. Led by SMD Earth Science Division, GLOBE is a worldwide, interagency science and education program that provides opportunities to better understand, sustain, and improve Earth's environment at local, regional, and global scales. Proposers interested in learning more about GLOBE can contact Amy Chen (Amy.P.Chen@nasa.gov).

12.1.2.2.4 Space Operations Mission Directorate (SOMD)

NASA's Space Operations Mission Directorate is the heart of the agency's space exploration efforts, enabling missions to low Earth orbit, the Moon, and beyond through communication and navigation, launch services, research capabilities, and crew health and support.

- Space Operations is working around the clock supporting astronauts aboard the International Space Station. For nearly 25 years, NASA and its international partners have maintained one of humanity's most complex technological achievements – an orbiting laboratory that enables researchers from around the world to take advantage of microgravity, exposure to the extreme environment of space, and a unique perspective of Earth to conduct groundbreaking experiments in an environment accessible only through the space station.

- Exploration is a continuum from low Earth orbit to the Moon and beyond. Space Operations is demonstrating how people live, work, and maintain a home in low Earth orbit that paves the way for exploration to the Moon with the Artemis missions, and eventually Mars. Space Ops performs foundational crew health, scientific and technological capabilities research to help protect astronauts, and enables communications and navigation throughout the solar system.
- Space Ops enables the launch of spacecraft to conduct groundbreaking science missions that help us better understand the Earth, solar system and universe – from weather satellites to telescopes to Mars rovers and more.

NASA's Space Operations Mission Directorate is opening space to more people, science, and commercial opportunities, and ensuring humanity's long-term presence in space.

- The International Space Station advances scientific understanding of our planet, improves human health on Earth and in space, develops advanced technologies for human exploration, and provides a space platform that inspires and educates the leaders of tomorrow—a legacy and influence that will be felt for decades to come.
- NASA is fostering the space economy by investing in American industry to create innovative, cost effective, and reliable space services. Such services benefit people on Earth through jobs, technology development, breakthroughs in science and medical research, and opportunities for more people to fly to space.

The Space Operations Mission Directorate missions and people serve as an inspiration for the next generation of explorers.

- NASA's investments in the American space industry for reliable transportation services has enabled a commercial space market where private citizens may fly to space on commercially-owned and operated missions.
- Space Operations brings space "down to Earth" for humanity through downlink opportunities with astronauts, opportunities to send research investigations to space aboard CubeSats or the International Space Station, STEM demonstrations in microgravity, and classroom resources for education and discovery.

12.1.2.2.5 Space Technology Mission Directorate (STMD)

NASA's Space Technology Mission Directorate (STMD) is the nation's tech base for civil space. STMD rapidly develops and demonstrates new technologies to support NASA's mission to explore the unknown in space, innovate for the benefit of life on Earth, and inspire the world through discovery. STMD's portfolio spans a range of disciplines that address the aerospace community's most pressing challenges, investing in technologies needed to go, land, and live in space, expand our current capabilities, and enable future missions. The following are a few areas of interest to STMD:

1. NASA's First Woman Graphic Novels and Digital Resources

Fictional astronaut Callie Rodriguez explores space as the first woman to walk on the Moon in NASA's *First Woman* interactive graphic novels. Available digitally in English and Spanish, *First Woman* follows Callie and her crewmates as they work together to explore the unknown, make scientific discoveries, and accomplish their mission objectives. Through the series, NASA aims to inspire the next generation of explorers – the Artemis generation.

- First Woman Issue 1: Dream to Reality follows Callie's trailblazing path as the first woman on the Moon. Callie and her robot sidekick, RT, overcome setbacks, disappointment, and tragedy along the way. From her childhood dreams of space travel to being selected as an astronaut candidate, Callie takes us on her journey to the Moon.
- First Woman Issue 2: Expanding Our Universe picks up where we left off with Callie, RT, and Dan in a treacherous situation on the Moon. Callie and her new team, Astronaut Meshaya Billy and Canadian Astronaut Martin Tremblay, use their training and human ingenuity to deploy a next-generation space telescope. See how teamwork and perseverance help the crew overcome the challenges of living and working on other worlds.

2. Optical Communications

Future deep space missions are expected to transmit huge volumes of science data, including high-definition images and video, significantly increasing the bandwidth required. Radio frequency communications from space have limited bandwidth, raising the need for upgraded communications systems. Therefore, NASA is developing optical communications. Optical communications use light as a means of transmitting information over long distances, sending data across space using optical instead of radio frequencies.

Optical, or laser, communications will provide significant benefits for missions, including bandwidth increases of 10 to 100 times more than radio frequency systems. Additionally, optical communications systems provide decreased size, weight, and power requirements. A smaller package could leave more room on a spacecraft for science instruments. Less weight means a less expensive launch. Less power means less drain on the spacecraft's batteries. With optical communications supplementing radio, missions will have unparalleled communications capabilities.

Learn more about NASA's optical communications plans:

- NASA's Deep Space Optical Communications Mission
- DSOC Streams First Video from Deep Space, featuring Taters the cat
- NASA's Laser Communication Relay Demonstration Mission
- NASA's Optical Communication Overview

3. Lunar Surface Innovation

As NASA embarks on the next era of space exploration with Artemis, STMD is advancing technologies and testing new capabilities at the Moon. As we work to enhance our understanding of the challenging lunar environment, new knowledge and opportunities from these pursuits return technology advancements that inform our plans for the exploration of Mars and other planets and celestial bodies, while transferring technology applications that can improve everyday life on our home planet. STMD's Lunar Surface Innovation Initiative works across NASA and with academia, industry, and other government agencies to advance technology systems in six key capability areas:

- In-Situ Resource Utilization: collecting, processing, storing, and using materials found and/or manufactured on the lunar surface – such as water ice to convert to breathable oxygen or metal to use for building infrastructure.
- Surface Power: generating, distributing, and storing energy to support continuous power through the lunar day and night is essential for productive crew and robotic missions.
- Excavation and Construction: technologies that enable affordable, autonomous manufacturing or construction, as well as long-term system maintenance.
- Extreme Environment: cross-cutting technologies built to withstand rapid temperature changes and permanently shadowed regions are essential for safe and successful crew and robotic operations.

- Dust Mitigation: strategies that diminish dust hazards to lunar surface systems, such as cameras, solar panels, space suits, habitats, and instrumentation, will allow astronauts and robotics to fulfill mission objectives safely and efficiently.
- Extreme Access: human and robotic systems will need to efficiently access, navigate, and explore previously inaccessible lunar surface or subsurface areas.

4. Fission Surface Power

Exploration on the Moon and Mars requires power. Therefore, NASA's Artemis plans include the development of a fission surface power system for safe, efficient, and reliable electrical power. Fission surface power – in conjunction with solar cells, batteries, and fuel cells – can provide the power to operate rovers, conduct experiments, and use the Moon's in-situ, or on site, resources to produce water, propellant, and other supplies for life support systems.

A fission reactor works by splitting atoms and releasing energy in the form of heat, which is converted into electricity. This process is also used on Earth to generate power, including for homes and businesses! Fission power is especially important for exploration near the Moon's South Pole, which contains water ice. Fission systems will offer power, regardless of access to solar energy, in shadowy craters and during the weeks-long lunar night.

Learn more about NASA's Fission Power plans:
- NASA's Fission Surface Power
- https://www.energy.gov/ne/articles/5-things-you-need-know-about-fission-surface-power-systems

5. NASA's Spinoff Technologies

Have you ever wondered how space exploration and research impact your daily life? "Spinoffs" are commercial products and services derived from NASA technology or improved through NASA partnerships. The NASA Home & City interactive website allows visitors to explore spinoff technologies that can be found in everyday life, demonstrating the wider benefits of America's investments in its space program. NASA Home & City features about 130 spinoff technologies in a virtual space, such as water filtration systems, firefighter gear, snow goggles, and even cell phone cameras.

12.1.2.3 Potential Collaborating Offices and Priorities

The following are examples (not a complete inventory) of priorities for the NASA offices that typically collaborate on the TEAM II Program Tiers Appendix. The priorities of these offices may be addressed in the proposal.

12.1.2.3.1 Office of Communications (OCOMM)

At NASA, sharing information is a mandate within our founding legislation. Throughout our history, it has been a priority to make data from science missions, research, and other discoveries available for the benefit of the nation. OCOMM is responsible for finding ways to inspire the next generation to join NASA in its work one day. Additionally, OCOMM informs and directly engages the public in the work NASA is doing through a range of activities and methods, including media relations, multimedia products, social media, the web, special events, exhibits, speakers, strategic partnerships, and the NASA History Office. An American public that is knowledgeable and interested in science, aeronautics, and exploration will value the impact of advances in these fields that help maintain global competitiveness and a robust economy.

Opening pathways for the public to actively participate in NASA's activities is consistent with the whole of government approach to transparency. OCOMM seeks to include the general public in the adventure and excitement of our activities and tap into individual creativity and capabilities to enhance the public's understanding and interest in science, discovery, and exploration. OCOMM is most interested in proposals that explore new tools, techniques and capabilities to reach the public and engage their interest, especially mechanisms through which the public can directly and specifically contribute to our missions. Of special interest are innovative proposals that encourage sustained engagement with NASA.

NASA websites host a wealth of mission and program information, and specific program and project information through information-sharing portals, around the topics of Humans in Space, Aeronautics, Technology, Earth & Climate, Solar System, and Universe. Start your exploration at http://www.nasa.gov.

12.1.2.3.2 Office of Diversity and Equal Opportunity (ODEO)

NASA has awarded, and currently manages, approximately $1 billion in grants to traditional and non-traditional education institutions across the country, including universities and museums.

With this money comes the responsibility of ensuring that all program beneficiaries, including students, faculty, administrative staff, and visitors to science centers and museums, have an equal opportunity (EO) to participate and succeed in these federally funded programs, regardless of gender, race, age, ethnicity or disability. NASA ODEO is responsible for advancing EO and diversity and inclusion among the NASA workforce and our grantee institutions, including universities and colleges, museums, planetariums, science centers and space camps nationwide that benefit from NASA dollars. In turn, these recipients provide year-round cultural and informal educational opportunities for their communities and for visitors traveling nationally and internationally.

NASA communicates its support for EO and diversity through a multi-pronged approach, consistent with our strategic objective to: "Attract and advance a highly skilled, competent, and diverse workforce, cultivate an innovative work environment, and provide the facilities, tools, and services needed to conduct NASA's missions." Among the many ways NASA demonstrates its support for EO and diversity and inclusion, in 2020 the Agency made "inclusion" an Agency Core Value, adding to its other Core Values of "Excellence," "Integrity," "Safety" and "Teamwork." In alignment with this Core Value the Agency supports diversity and inclusion in STEM through numerous programs and activities. As just one example: NASA conducts STEM outreach to talented individuals from all backgrounds and life experiences though its many STEM engagement/education programs, including the Minority University Research and Education Program (see the MUREP homepage). Another example: NASA participates in annual commemorations such as Black History Month, Hispanic Heritage Month, Women's History Month, and more. In the grant recipient context, NASA ODEO conducts EO compliance reviews of grant recipient institutions to better ensure EO for program beneficiaries, such as STEM students and science museum patrons. ODEO posts the reports of its reviews on ODEO's MissionSTEM website. The MissionSTEM website is designed to offer the Agency's recipients and their beneficiaries comprehensive information on complying with EO laws as well as promising practices for advancing diversity and inclusion in STEM. For example, the site contains videos of NASA diverse scientists and technologists working on many different kinds of STEM activities the Agency does that benefit society (see the NASA Innovations Impact the World page). Proposals relating to EO and diversity and inclusion are appropriate as long as there is a focus on at least one NASA Mission priority—not general STEM. To learn more about diversity and inclusion in STEM at NASA visit: https://www.nasa.gov/odeo and https://www.nasa.gov/learning-resources/stemengagement/.

Note: TEAM II is not intended as a primary funding source to meet accessibility compliance requirements.

12.1.2.4 Relevance to Lead Institution

12.1.2.4.1 Community Anchor Awards for TEAM II (TEAMIIANCHR)

Through this TEAMIIANCHR opportunity, NASA seeks to increase the capacity of institutions to utilize NASA resources and to provide a diverse group of students to participate in authentic NASA STEM experiences. Proposals shall demonstrate how the proposed work will contribute to the proposing institution's strategic direction and strengthen its ability to deliver NASA STEM Engagement learning resources and opportunities.

12.1.2.4.2 STEM Innovator Awards for TEAM II (TEAMIIINOV)

Through the TEAMIIINOV opportunity, NASA seeks to increase the capacity of institutions to utilize NASA resources and to provide students with the opportunity to contribute to NASA's mission using innovative tools and platforms**.** Proposals shall demonstrate how the proposed work will contribute to the proposing institution's strategic direction and strengthen its ability to deliver NASA STEM Engagement learning resources and opportunities within the proposing institution's region.

12.1.2.5 Roles and Responsibilities of Key Personnel

Every institution submitting a proposal shall identify a single individual, the Principal Investigator (PI), who will be responsible for the quality and direction of the entire proposed effort and for the use of all awarded funds.

The PI shall be currently employed at the lead institution. The PI shall be a manager and/or have leadership responsibility for the applicant. Please see section C.3 of EONS-2024 for information regarding proposal team members in addition to the PI.

Please note that all proposed changes to a PI must be submitted to the Technical Officer, per the process described in the *NASA Grant and Cooperative Agreement Manual (GCAM)* Section 7.9, and are subject to the NASA grant officer's prior written approval.

STEM Innovator Evaluators

Institutions submitting a proposal addressing the STEM Innovator tier are strongly encouraged to identify a potentially internal, but Independent Evaluator (IE). An IE is responsible for analyzing qualitative and quantitative data for the project's evaluation activities; developing a plan for evaluating impact and outcome measures; utilizing a logic model as applicable; and coordinating and administering data collection, analysis, and dissemination of proposed program evaluation data.

12.2 FEDERAL AWARD INFORMATION

Community Anchor Awards for TEAM II (TEAMIIANCHR)

Subject to Congressional appropriation of sufficient funds and NASA's receipt of proposals of adequate merit, NASA expects to select up to 10-15 proposals for **TEAMIIANCHR** awards. The period of performance for each proposal/resulting award is 1-2 years. Successful proposals for this opportunity will be funded as grants. Funding shall be up to $50,000 per award. The total maximum amount of funds expected to be awarded is $750,000. The period of performance is expected to begin two to three months from the selection announcement. Proposals shall cover the full 1-2 years of performance. The continuation of NASA funding on each award annually is based on a satisfactory evaluation of documented progress; compliance with data reporting, applicable regulations and laws, and other program requirements; fulfillment of fiduciary responsibilities; and the availability of appropriated funds. At the time of this Appendix release, NASA does not plan to extend funding beyond the initial performance period of 1-2 years.

STEM Innovator Awards for TEAM II (TEAMIIINOV)

Subject to Congressional appropriation of sufficient funds and NASA's receipt of proposals of adequate merit, NASA expects to select up to 10-13 proposals for **TEAMIIINOV** awards. The period of performance for each proposal/resulting award is 2-3 years. Successful proposals for this opportunity will be funded as cooperative agreements. As cooperative agreements, substantial involvement between awardees and NASA is expected. For specific description of the substantial involvement required of awardees, see **Section 12.1.2.5, Roles and Responsibilities of Key Personnel** and **Section 12.6.2 Cooperative Agreement Award Reporting Requirements** of this NOFO. Funding shall be up to $250,000 per award. The total maximum amount of funds expected to be awarded is $3,250,000. The period of performance is expected to begin two to three months from the selection announcement. Proposals shall cover the full 2-3 years of performance. The continuation of NASA funding on each award annually is based on a satisfactory evaluation of documented progress; compliance with data reporting, applicable regulations and laws, and other program requirements; fulfillment of fiduciary responsibilities; and the availability of appropriated funds. At the time of this Appendix release, NASA does not plan to extend funding beyond the initial performance period of 2-3 years.

12.2.1 Collaborations and Interactions with NASA, and other Partnerships

Proposers are encouraged to collaborate with relevant NASA Center(s), or other NASA facilities (Points of Contact are listed in Section 12.2.3 of Appendix 12), and encouraged to build collaborations with universities and other schools or educational institutions currently or previously funded by NASA programs such as Space Grant and MUREP, to enhance the ability of the project to deliver NASA-unique STEM content.

STEM Innovator proposers are strongly encouraged to utilize at least one regional network, consortium, or association of STEM- and STEM education-related IEIs to magnify and maximize the reach and impact of the proposed work (formal or informal STEM Ecosystems).

To facilitate the use of NASA's assets and help provide mission-driven, meaningful engagement in NASA content and missions, projects may propose a collaboration with one or more NASA entities (directorates, offices, Centers, etc. (excluding JPL), and/or NASA civil servant employees and support contractor employees (excluding Caltech, which manages JPL for NASA under a contract). Depending on the proposed TEAM II Program Tier, there are different requirements for collaboration.

Table 2. Partner Collaborations for Each TEAM II Tier

	Community Anchor	STEM Innovator	National Connector
Collaboration with NASA Center(s) or other NASA facilities	Encouraged	Strongly Encouraged	One or more required
Collaboration with universities and other schools or educational institutions currently or previously funded by NASA programs	Encouraged	Encouraged	Strongly Encouraged
Regional or national networks, consortia, or associations of STEM- and STEM education-related IEIs	Encouraged	Strongly Encouraged, at Least Regionally	One or more required

NASA Centers receive and respond to many requests for education and public outreach activities and resources that require no special resource commitments because: 1) they are part of the regular business practices and are already in a Center's budget, or 2) such requests are handled on a case-by-case personnel availability basis. Entities seeking these types of interactions with NASA can contact NASA directly, independent of proposal preparation. For example, the *Speakers Bureau* is a standard of NASA's public communication and outreach programs. Details about requesting speakers can be found at: https://www.nasa.gov/about/exhibits/index.html. Similarly, the Museum & Informal Education Alliance is available to informal education professionals at https://stemgateway.nasa.gov/connects/s/mie-alliance-landing-page.

Collaborations, however, come in many varieties, including some that require significant resource demands on NASA in terms of facilities, equipment, personnel, etc., and others that do not require any significant demands on NASA resources. Regardless of the level of NASA involvement, proposals shall detail the nature of the requested or agreed-to collaboration in the budget narrative and reference it as part of the project description. In addition, a statement from the relevant NASA organization is required and shall, at a minimum, acknowledge and list the agreed-to interaction and tasks to be provided by the NASA collaborator under the proposal. For more in-depth NASA involvement, the NASA entity may instead make the choice to provide a more formal Letter of Support.

The following is a sample template that can be adapted for a proposer to request a NASA Center collaborator or other type of partner to complete and return to your organization for inclusion with the proposal:

TITLE: Approved Statement of Commitment from <insert name of NASA entity or proposed partner>

> *The following <Describe Asset(s) e.g. facilities access, persons, interaction, other> has been requested by <name of Principal Investigator> to support this proposal to the NASA Notice of Funding Opportunity <alpha-numeric identifier>. The NASA Center (or other provider) has agreed to provide this asset (contingent or not contingent) on the proposal being selected for funding and awarded.*

If contact with a NASA Center or Mission Directorate or Office at NASA Headquarters does not receive a response, the proposer shall document the details of the requested NASA assets and the attempts to reach NASA within the budget justification of the proposal. For proposers that are unable to obtain a Statement of Commitment from the proposed collaborating NASA entity, the following template is provided to assist in justifying the budget request:

TITLE: Request Pending for Statement of Commitment from <insert name of proposed collaborating NASA Center or proposed partner>

> *The date of my first request for a statement of commitment was <insert date>. The following <Describe Asset(s) e.g. facilities access, persons, other> has/have been requested by <name of Principal Investigator> to support this proposal to the NASA Notice of Funding Opportunity <alphanumeric identifier>. Ultimately, the <proposed collaborating Center or proposed partner> did not reply to my request, but I estimated in the budget based on publicly available documents or calls to the <proposed collaborating Center or proposed partner> that the total cost to provide this asset to be <insert amount>.*

Note: If a particular contribution of a partnering institution, or a collaboration with a NASA Center, is essential to the performance of the proposed project, then a letter of commitment outlining and confirming that commitment, signed by a management official authorized to commit that institution, shall be submitted with the proposal's required forms and certificates. Each commitment letter shall refer to the TEAMII Appendix, and indicate agreement with the nature of the collaboration and state the specific resources being committed.

Note: The NASA MIE Alliance will serve as the main contact for a PI or representative's participation in the NASA IE Learning Cohort and for post-award access to services and assistance in connecting to NASA STEM engagement resources and personnel in support of their proposed work. Please do not contact MIE Alliance personnel for Letters of Support or assistance in developing a proposal. Due to conflict of interest concerns, Proposers shall not contact Museum & Informal Education Alliance personnel regarding a TEAM II proposal. **Please note that TEAM II POCs including NASA, JPL, and Guardians of Honor) are not permitted to pre-review, co-write, or contribute in any way to TEAM II proposals.**

Proposers requesting access to NASA technical services or materials shall contact the NASA Centers (excluding JPL) from which services or materials will be requested in order to ascertain the availability of such services or materials. All costs that NASA Centers incur for the use of facilities and technical support shall be paid by non-TEAM II funds.

12.2.2 Points of Contact for NASA Mission Directorates, Centers, and Support Offices
Prospective Proposers are encouraged to contact the NASA TEAM II POCs listed below in the mission directorates, centers, and support offices for general information about NASA missions, science, technology, facilities, and education programs. Questions relating to what is considered NASA scientific or technical content eligible for projects submitted to this solicitation shall be directed to the appropriate contacts identified below.

These POCs are not eligible to be listed as key team members in any proposal submitted in response to a TEAM II Program Tiers Appendix. Note: NASA employees and agency support contractors have the option (not obligation) to respond to a Proposer who desires to include non-specific NASA resources (human or material) in a proposed project.

Table 3. NASA Mission Directorate Contacts

NASA Mission Directorate Contacts
Aeronautics Research Mission Directorate Dave Berger dave.e.berger@nasa.gov
Exploration Systems Development Mission Directorate Matt Simon matthew.a.simon@nasa.gov
Science Mission Directorate Lin Chambers lin.h.chambers@nasa.gov
Space Operations Mission Directorate Marc Timm marc.g.timm@nasa.gov Warren Ruemmele warren.p.ruemmele@nasa.gov
Space Technology and Mission Directorate Damian Taylor damian.taylor@nasa.gov

Table 4. NASA Headquarters and Shared Services Contacts

NASA Headquarters and Shared Services Contacts
Office of Communications

Lauren Katz
Exhibits and Artifacts Manager NASA Headquarters
Phone: (202) 358-1716
lauren.t.katz@nasa.gov

Office of Procurement
Racheal Down ***
Grants/Contracting Officer
NASA Shared Services Center (NSSC)
Phone: (877) 677-2123
racheal.a.down@nasa.gov

Office of Diversity and Equal Opportunity
Miriam Moore
Equal Opportunity Programs Division
https://www.nasa.gov/offices/odeo/external-compliance
Phone: (202) 358-0964
hq-civilrightsinfo@mail.nasa.gov

12.2.3 Budget Guidelines and Requirements

Proposals may include, but are not limited to, support for staff time, professional development, travel, meetings, partners, consultants, specialized resources, and technical expertise and support needed to develop and implement proposed strategies and approaches.

12.2.3.1 Total Budget Guidelines and Funding Restrictions

All costs charged to awards covered by this NOFO must comply with the Uniform Administrative Requirements in 2 C.F.R. 200 and 1800, unless otherwise indicated in the NOFO, the terms and conditions of the award, and the Grants and Cooperative Agreement Manual (GCAM).

- All proposed funds must be allowable, allocable, and reasonable. Funds may only be used for the project. All activities charged under indirect cost must be allowed under 2 CFR 200 cost principles.
- Grants and cooperative agreements shall not provide for the payment of fee or profit to the recipient.
- Unless otherwise directed in 2 CFR 200, for changes to the negotiated indirect cost rate that occur throughout the project period, the recipient must apply the rate negotiated for that year, whether higher or lower than at the time the budget and application was awarded.
- Proposals must not include bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds basis.
- Any funds used for match or cost sharing must be allowable under 2 CFR 200.
- The non-Federal entity must use one of the methods of procurement as prescribed in 2 CFR 200.320, Methods of procurement to be followed.

12.2.3.2 Additional Funding Restrictions

The following are funding restrictions that apply to this Appendix, in addition to those outlined in the EONS-2024 NOFO. Note: Refer to Section 12.4.2.1 of Appendix 12 for specific information on the budget submission and project description to be included in the proposal.

- Each individual identified as key personnel shall be funded at no more than fifty (50) percent of direct cost salaries annually. K-12 and/or informal educators, post-doctoral researchers and students implementing or benefiting as project participants for the proposed effort are not subject to this limitation.
- The proposed budget shall include sufficient funds for participation in the NASA IE Learning Cohort

and an annual trip by the PI or the Co-I or other PI designee or/and one other key personnel (e.g., the project's evaluator) to an annual in-person NASA conference, with the wider community of award recipients and partners from across OSTEM programs, or with other TEAM II award recipients. Also, Proposers shall use a farther destination (e.g., Washington, D.C. or California) to estimate travel costs for this trip in the project budget.

- The TEAM II opportunity is not intended to be a primary funding source to meet accessibility compliance requirements.
- A maximum of 50 percent of the total budget shall be allocated for external costs, including costs in support of external project personnel and travel, and project-related subawards/subcontracts. Example costs that are not considered external include but are not limited to: support of the institution's project personnel and travel, expenses for student and educator support such as transportation and stipends, supplies, and institutional indirect costs.
- The IEIs may use NASA funds for support of regular and consultant staffing; for engagement, education, evaluation, or policy research; for STEM engagement and education programming serving students and their supporting families and formal and informal education providers; and for exhibit design, fabrication, installation, and evaluation. NASA funds may be also used for STEM engagement, education, evaluation, or related equipment, travel, and materials. Basic facilities support, such as leasing of space or acquisition of capital assets (e.g., vehicles) that are not related to STEM engagement and education, is not allowable.

12.2.3.2.1 Community Anchor Awards for TEAM II (TEAMIIANCHR)

- **Each award will be funded for no more than $50,000 in total**.
- No TEAMIIANCHR funds may be budgeted for a NASA Center or facility. All costs that NASA Centers incur for the use of their facilities and technical support must be paid from non-TEAM II funds.

12.2.3.2.2 STEM Innovator Awards for TEAM II (TEAMIIINOV)

- **Each award will be funded for no more than $250,000 in total.**
- The costs of evaluation, reporting, and sharing project results shall be included in the project budget. Examples of relevant costs associated with evaluation include payments for consultants or qualified project staff, development of effective instruments, information collection, and analysis of project data. The evaluation budget is a minimum of 8% of the overall project budget.
- Budget Restrictions on Federal Government Partnerships (including NASA Centers). If a proposer's budget request includes funds for a federal partnership, and the project is selected, and sub-awards are appropriate, such funds will be deducted and separately provided by NASA to the federal partner. Sub-awards to federal entities shall not be budgeted as using NASA funds beyond the first year of the award. Such sub-awards shall be included in the proposal and include a detailed budget narrative and justification with detail for any civil servant/support contractor salary or travel for work that is to be performed by civil servant or contractor workforce. However, award funds shall not be used to pay salaries or travel for civil servants. Requests for funds for federal partners shall be no more than twenty (20) percent of the total proposed project's budget. Furthermore, the proposing institution may not request nor receive indirect costs on the amount budgeted for NASA Centers or other federal entities. Proposers requesting NASA technical services or materials must contact the NASA Centers from which services or materials will be requested in order to ascertain the availability and anticipated costs of such services or materials.

12.2.3.3 Cost Sharing or Matching

Cost sharing or matching is strongly recommended, but <u>not</u> required. Stated another way, this Appendix does not prohibit voluntary cost sharing. Responders to this Appendix are not required to propose or provide matching funds; however, NASA can accept cost sharing if it is voluntarily offered (see 2 CFR 200.306, Cost sharing or matching). Proposed voluntary cost sharing will not advantage or disadvantage a proposal during the peer review evaluation process and is not an evaluation factor in the consideration of which proposals receive awards.

12.2.3.4 Pre-Award Costs
Per 2 CFR §1800.210, NASA waives the requirement for applicants to obtain prior approval for pre-award costs incurred 90 days or less before an award's period of performance start date. Pre-award costs in excess of 90 days before an award's period of performance start date are not allowable under this NOFO. Any costs that the applicant incurs in anticipation of a grant or cooperative agreement award is at the risk of the applicant and will be subject to the rules described in 2 CFR §1800.210, Pre-award costs and the "Pre-award Costs" section of the GCAM, currently section 5.14.1.

12.2.3.5 Indirect Facilities & Administrative (F&A) Costs
Indirect costs (e.g., facilities and administration) are included in the award amounts, with the remaining funds to be used in supporting project personnel (including partner's personnel), travel, scholarships or support for exhibit design, fabrication, evaluation, and project-related subcontracts. Furthermore, the proposer shall not request nor receive indirect costs on the amount budgeted for other Federal Government entities. Indirect costs shall be explained to the extent that such explanation allows the Government to understand the basis of the estimates.

12.2.4 Program Evaluation; Measurable Impact on Learner Interest
NASA identifies evidence of effective practices in STEM education and engagement through program evaluation. Evidence is a key criterion in NASA's competitive processes for allocating resources, ensuring that the most effective STEM education and engagement activities are supported. Program evaluations are planned studies using research methods to collect and analyze data to assess to what extent activities/programs are being implemented and what, if any, impact can be measured. Evaluations answer specific questions about performance and may focus on assessing activity/program process and outcomes.

Community Anchor Awards for TEAM II (TEAMIIANCHR)
Community Anchor projects are not required to conduct evaluations. Collection of metrics and data are highly encouraged.

STEM Innovator Awards for TEAM II (TEAMIIINOV)
STEM Innovator projects are strongly encouraged to conduct an independent evaluation in order to improve and assess the effectiveness of strategies used in the project. Internal evaluations are acceptable. Evaluation plans shall include measurement of the project's effectiveness in meeting the project goals and objectives as well as the NASA and federal strategic objectives. NASA OSTEM is interested in understanding the impact of NASA K-12 STEM Engagement programming on participants' STEM Identity, Self-Efficacy, STEM Interest, 21st Century Skills, and Sense of Belonging (see Section 12.7.). Evaluation activities shall also include a component to examine the extent to which participants report positive STEM identities, self-efficacy, interest, sense of belonging, and 21st century skills. As appropriate to the project, evaluation activities should include a component that focuses on broadening participation and how to attract youth to STEM, especially talented individuals from all backgrounds and life experiences. Proposers shall follow best practices for evaluating the type of project proposed and establish an evaluation plan that is appropriate to the proposed project. See Appendix 5 of EONS-2024 and Section 12.7 for definitions and relationships related to evaluation practice and common guidelines, plus a non-exhaustive list of recent literature pertaining to evaluation of informal science education projects.

Proposed TEAMIIINOV evaluation shall follow generally-accepted professional standards for evaluative research. Evaluations are evidence-based, meaning that they are based on verifiable data and information that have been gathered using the standards of professional research and evaluation organizations. Such data can be both qualitative and quantitative. A wide variety of evaluation designs may be utilized, as well as a variety of data collection methods, such as key informant interviews, surveys, direct observation, or focus group discussions. Regardless, such data shall pass the tests of reliability and validity, which are different for qualitative and quantitative data. Proposers are strongly encouraged to consider their project and evaluation impacts, outcomes, and metrics in terms of the evidence and categories of informal science education impacts as stated in the National Science Foundation (NSF) report *Framework for Evaluating Impacts of Informal Science Education Projects*.

The impact of the proposed project on the target audiences shall be measurable during the award period, and preferably be measured over time throughout the life of the project. Proposals shall describe potential impacts of the project beyond the award period. During the award period, the lead institution is required to report both outputs and outcomes for the project.

Proposers shall include specific and sufficient resources dedicated to evaluation activities in their detailed work plan, project budget, and schedule of completion. **A minimum of 8% of the total project budget is required to support evaluation activities.** Project evaluation shall be handled by an independent evaluator who may a current employee of the applicant organization with independence from the policy, operations, and management functions of the proposed project, i.e., reporting responsibility independent of the proposed project. The evaluator shall develop a comprehensive evaluation plan, develop or identify tools or processes or data collection, carry out evaluation tasks, conduct analysis, and provide formative and summative feedback to the project leadership throughout the life cycle of the award.

12.3 ELIGIBILITY INFORMATION

12.3.1 NASA's Commitment to Diversity and Inclusion

NASA recognizes and supports the benefits of having diverse and inclusive scientific, engineering, and technology communities and fully expects the reflection of such values in the composition of all panels and teams, including peer review panels, proposal teams, science definition teams, and mission and instrument teams. Per Federal statutes and NASA policy, no eligible applicant shall experience exclusion from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from NASA on the grounds of their race, color, creed, age, sex, national origin, or disability. NASA welcomes proposals from all qualified and eligible sources, and strongly encourages proposals from Historically Black Colleges and Universities (HBCUs), Minority Serving Institutions (MSIs), small disadvantaged businesses (SDBs), veteran-owned small businesses, service-disabled veteran-owned small businesses (SDVOSB), HUBZone small businesses, and women-owned small businesses (WOSBs), as eligibility requirements apply.

12.3.2 Proposing Institutions

The TEAM II Program Appendix is open to (solicited from) U.S. Institutions, state government agencies, local government agencies, federally recognized tribal government agencies, science museums and planetariums, libraries, youth-serving organizations, non-profit organizations, and non-domestic entities (see Section C.6 of this NOFO). These entities may participate as a lead institution as noted by the specific program tier guidelines.

NASA Centers, Federal Government agencies (including NASA), Federally Funded Research and Development Centers (FFRDCs) (other than NASA JPL), higher education institutions, state government agencies, local government agencies, federally recognized tribal government agencies, science museums and planetariums, libraries, youth-serving organizations, for-profit companies, non-domestic entities, and other institutions including those types listed in the table below may participate through a partnership with the lead institution.

Work to be performed through subcontracts/subawards shall be proposed following Section 2.18 of the 2023 *NASA Proposers Guide*.

Note: Award tier may further limit the eligibility for lead Proposers, subawards, and unfunded collaborations. Refer to each TEAM II Program Tier in the edibility requirements for specific eligibility details.

Table 5. Summary of Eligibility by Type of Organization

Organization type	**Eligibility to submit a proposal as a lead organization**	**Eligibility for a sub-award or as a team member**	**Eligibility for unfunded collaborator named in proposal**
Non-Profit	Only if also an IEI	Yes	Yes
NASA Center (excluding JPL)	Only as a NASA Visitor Center	No	Yes
Other Federal Agency	No	No	Yes
Federally Funded Research and Development Centers (excluding JPL)	No	Yes	Yes
Unaffiliated Individual	No	Yes	Yes
State, Local, or Federally-Recognized Tribal Government Agency	Only if also an IEI, or on behalf of an IEI that is integrated within the Institution	Yes	Yes
Higher Education Institution	Only on behalf of an IEI that is integrated within the Institution	Yes	Yes
Commercial Organization	No	Yes	Yes
JPL*	No	No	No
Non-Domestic Organizations	No	No	Yes

Organizations submitting a proposal under the TEAM II Appendix (TEAMIIANCHR and TEAMIIINOV) are certifying that they meet the following criteria to propose as the lead or managing IEI organization:

- Are legally recognized by a federal, state or local authority as a non-profit organization;
- Are located in the United States or its Territories; and
- Provide STEM education programming; identify as or have a component that meets the definition of a museum, youth-serving organization, or library; and can partner with other IEIs, K-12 schools, commercial entities, higher education institutions, and/or other agencies that support Federal STEM education goals.

An eligible IEI is not required to have the words museum, visitor center, science, planetarium, youth, or library in its legal name.

Eligible IEIs generally include those that are established or chartered in order to enhance learning and/or engagement, including but not limited to: the study and display of STEM; established to honor NASA history, personnel, and missions. The following are examples of the types of organizations that are generally eligible to compete under the TEAM II Full and Community Anchors appendices: air and space centers, aviation museums, children's museums, natural history museums, observatories, planetariums, science-technology centers; aquariums, arboretums, aviaries, zoos; botanical gardens, nature centers; federal and non-federal NASA Visitor Centers and affiliates, non-profit foundations, or Congressionally-authorized NASA memorials such as Challenger Centers based in the United States; theaters and auditoriums dedicated to astronomical shows; State, Local, or Federally-Recognized Tribal Government museums or planetariums; or associations of eligible institutions as recognized by the Internal Revenue Service. All types of NASA Visitor Centers (e.g., private, state or federal entities) are eligible to propose (see Table 5 of this Appendix for a list of specific entities that qualify).

Eligible non-profit IEIs also include, but are not limited to: amateur astronomy groups, community-based organizations, cultural/historical institutions that focus specifically on delivering STEM content to talented populations from all backgrounds and life experiences and have a STEM programming component, libraries, out-of-school-time organizations, youth-serving organizations, scientific and or engineering societies, or associations that include both eligible institutions and ineligible institutions.

Important Note: NASA expects pre-submission eligibility issues to be raised to the proposing organization's highest leadership; e.g., boards, authorized organization representative (AOR), legal counsel, chief financial manager, president, etc., who are qualified to certify an organization's type and PI status for federal funding.

The entities that are **not** eligible to submit a proposal in a lead role include: other Federal Government agencies; NASA Centers and Offices; Federally Funded Research and Development Centers (FFRDCs) including JPL; unaffiliated individuals; non-U.S. institutions; Institutions of Higher Education; Commercial or for-profit organizations. However, these entities may be proposed by an eligible IEI as sub-awardees/recipients or team members.

Jet Propulsion Laboratory (JPL): As NASA's only FFRDC, JPL has a Task Order with NASA's OSTEM under NASA prime contract 80NM0018D0004 to provide technical support for the planning and implementation of NASA Headquarters' STEM Engagement Portfolio, including the TEAM II Program Tiers Appendix. To avoid any real or potential organizational conflict of interest (or the perception of such), JPL is not eligible to serve as a subcontractor, partner, or collaborator to an entity proposing under NASA TEAM II. Eligible institutions *shall not contact JPL for statements of commitment or support* prior to proposal submission, nor shall they contact JPL for cost estimates or to discuss the utilization of Museum & Informal Education (MIE) Alliance services or any potential collaboration related to a TEAM II proposal. Post-award, all TEAM II awardees/recipients shall cooperate with the JPL-managed TEAM II community of practice, as well work to integrate their proposed work to strengthen the JPL-managed Museum & Informal Education Alliance. Outside of the TEAM II Opportunities and recipients, JPL supports the IEI community through the MIE Alliance.

12.3.2.1 Limit on Number of Proposals per Unique Entity Identifier (UEI)

Organizations shall submit only one proposal per Unique Entity Identifier (UEI). If an organization submits more than one proposal using the same UEI, then none of its proposals will be considered or evaluated. However, there is no limit on the number of times an entity may be proposed by another institution as an unfunded partner or as a sub-awardee. Eligible institutions may submit a proposal as a lead organization or be proposed as a sub-awardee or team member as part of other organizations' proposals, or both.

Proposers that have previously submitted proposals to TEAM II and were not selected for awards during FY2022 and FY23, may submit proposals. If NASA makes additional selections in FY 2024, proposals from the same UEI will not be selected for awards both under TEAMIIANCHR and TEAMIIINOV.

12.3.2.2 Prior Community Anchor Award Recipients

Current, active TEAM II award recipients are not eligible to submit a proposal to the TEAM II tier where they have an active award.

12.3.3 Organizational Type Definitions and Self-Certification Requirement

Proposers are required through the Program Specific Data (PSD) form in NSPIRES to self-certify that the organization qualifies as or meets one or more of the following definitions:

1. **Museum (including planetarium)** as defined in Federal Management Regulation (FMR) 102-37-C-1 Amendment Appendix C—Glossary of Terms For Determining Eligibility Of Public Agencies And Nonprofit Organizations:

   "Museum" means a public or nonprofit institution that is organized on a permanent basis for essentially educational or aesthetic purposes and which, using a professional staff, owns or uses tangible objects, either animate or inanimate; cares for these objects; and exhibits them to the public on a regular basis (at least 1000 hours a year). As used in this part, the term "museum" includes, but is not limited to, the following institutions if they satisfy all other provisions of this definition: Aquariums and zoological parks; botanical gardens and arboretums; nature centers; museums relating to art, history (including historic buildings), natural history, science, and technology; and planetariums. For the purposes of this definition, an institution uses a professional staff if it employs at least one fulltime staff member or the equivalent, whether paid or unpaid, primarily engaged in the acquisition, care, or public exhibition of objects owned or used by the institution. This definition of "museum" does not include any institution that exhibits objects to the public if the display or use of the objects is only incidental to the primary function of the institution.

2. **Youth-serving organization (YSO):**
   For the purposes of this Appendix, youth is defined as children in grades K-12. Additionally, a youth-serving organization (YSO) is defined as a non-profit institution that is organized to provide positive youth development activities on a permanent basis for educational, recreational, service-learning, or research purposes. Solicited organizations use a professional staff primarily engaged to meet the basic needs of youth for safety, caring relationships, and connections to the larger community while striving to build academic, vocational, personal, creative, or social skills. For purposes of this definition, YSOs use at least one full-time staff member or the equivalent, whether paid or unpaid, primarily engaged in the recurring development, delivery, or evaluation of the youth development; teaching youth new knowledge or allowing youth to practice life or technical skills, etc.

   YSOs can include national programs, public institutions such as recreational departments and local libraries, private organizations like churches and civic groups, and grass roots community efforts. YSOs can also include public or private K-12 schools, school districts, membership-limited organizations such as scouting or Boys and Girls Clubs, and community-based organizations that provide youth recurring opportunities to learn physical, intellectual, psychological, emotional, and social skills; exposure to intentional learning experiences; opportunities to learn cultural literacies, media literacy, communication skills, and good habits of mind; preparation for adult employment; and opportunities to develop social and cultural capital. An organization responding to a TEAM II Program Tiers Appendix is not required to have the term youth, child, boy or girl in its name. YSOs selected for funding may be required to self-certify that the organization is an entity dedicated to addressing youth development and has an element promoting STEM awareness or authentic STEM research by youth, particularly talented individuals from all backgrounds and life experiences who have not previously been exposed to STEM.

3. **Library:**
An organization responding to a TEAM II Program Tiers Appendix is not required to have the term library in its name. Eligible libraries are non-profit institutions that include the following:

- Public libraries;
- Public elementary and secondary school libraries;
- College (including community college) and university libraries;
- A library agency that is an official agency of a State or other unit of government and is charged by the law governing it with the extension and development of public library services within its jurisdiction;
- A library consortium that is a local, statewide, regional, interstate, or international cooperative association of library entities that provides for the systematic and effective coordination of the resources of eligible libraries, as defined above, and information centers that work to improve the services delivered to the clientele of these libraries;
- A library association that exists on a permanent basis; serves libraries or library professionals on a national, regional, state, or local level; and engages in activities designed to advance the well-being of libraries and the library profession.

12.3.4 Requirements for IEIs Within a Non-Solicited Organization
An IEI **within** a non-solicited organization, such as a college, university etc., may apply if it:
1) Is able to independently fulfill all the eligibility requirements of this NOFO;
2) Functions as a discrete unit; i.e., has its own board of trustees or directors separate from the non-solicited entity's board;
3) Has its own fully segregated and itemized operating budget; and
4) Has the authority to make the application on its own.

If any of the above four conditions are not met, an IEI may apply through its non-solicited organization **only** when the non-solicited organization provides a statement of commitment from its CEO, AOR, or an equivalent higher-level official who is authorized to make the financial commitment. The statement of commitment must include assurances that NASA funds shall be used and tracked exclusively for the proposed project and not for the non-solicited entity's costs. Failure to include such a statement of commitment in the proposal will render the proposal non-responsive and disqualify it from award consideration. If the IEI has its own Unique Entity Identifier (UEI), then a non-profit IEI within a non-solicited entity does not need to submit a statement of commitment.

12.3.5 Identification of Entities as NASA Visitor Centers Special Guidance
This section defines the only entities eligible to identify themselves as a NASA Visitor Center (VC) on the PSD sheet required by the Program Tiers Appendix. Note: These organizations are **not** considered NASA facilities for the purposes of satisfying a requirement for a collaboration with NASA. As of the issuance date of the TEAM II Program Tiers Appendix, NASA has not issued a policy directive or policy requirement or separate rules under the Code of Federal Regulations (CFR) to establish common visitor center criteria. For purposes of the TEAM II Program Tiers Appendix, there are nine NASA Centers (excluding JPL). Of those, the following institutions may identify as a NASA VC on the PSD Form:

- Ames Research Center (ARC)- ARC's VC is Chabot Space and Science Center, which is a 501(c)(3), not a NASA facility nor located on NASA property.
- Chabot Space and Science Center (not ARC) is eligible to apply as the designated VC.

https://chabotspace.org/

- Armstrong Flight Research Center (AFRC) – The Visitor Center located on NASA property (inside-the-gate federal) is eligible to submit a proposal.
- Langley Research Center (LaRC) –LaRC's VC is the Virginia Air and Space Center, which is a 501(c)(3), not a NASA facility nor located on NASA property.
  http://www.vasc.org/
  Virginia Air and Space Center (not LaRC) is eligible to apply as the designated VC.
- Goddard Space Flight Center (in Greenbelt) includes Wallops Island Visitors Center (GSFC) – Both are NASA facilities and located on NASA property and are eligible to submit a proposal. GSFC VCs have two home pages. s://www.nasa.gov/goddard/visitor-center
  https://www.nasa.gov/wallops/visitor-center
- Glenn Research Center (GRC) – Existing VC partner is Great Lakes Science Center (GLSC) established by a Space Act Agreement signed by GRC. GLSC is a 501(c)(3) that is not a NASA facility nor located on NASA Property.
  http://www.greatscience.com/
  GLSC (not GRC itself) is eligible to apply as the designated VC.
- Stennis Space Center (SSC) – Existing VC partner is Infinity Science Center at NASA Stennis Space Center, a private 501(c)(3) that is located on NASA property and established as the VC under the Space Act.
  http://www.visitinfinity.com/
  Infinity (not SSC itself) is eligible to apply as the designated VC.
- Marshall Space Flight Center (MSFC)—Existing Partner is the U.S. Space & Rocket Center (USSRC), a state of Alabama-owned entity that is not a NASA facility nor located on NASA property.
  http://rocketcenter.com/
  USSRC (not MSFC itself) is eligible to apply as the designated VC.
- Johnson Space Center (JSC) – Existing Partner is Space Center Houston (SCH), a private 501(c)(3) facility on NASA property established under the Space Act. http://www.spacecenter.org/
  SCH (not JSC itself) is eligible to apply as the designated VC.
- Kennedy Space Center (KSC) – Existing Partner Kennedy Space Center Visitor Complex (KSCVC) has operated for more than 43 years as a concession activity. As such, no appropriated dollars are received for its development, operation, or maintenance. All revenues are generated through the sale of admission, food, retail and education programs without cost to the federal budget.
  http://www.kennedyspacecenter.com/
  KSCVC (not KSC itself) is eligible to apply as the designated VC.

12.3.6 Proposals Involving Foreign Participation

Except as outlined in the certification regarding restriction on doing business with certain countries, NASA welcomes proposals that include the participation of non-U.S. organizations. Proposals that propose research to be performed with a non-U.S. organization as part of a proposal submitted by a U.S. organization typically are supported on a no-exchange-of-funds basis. For additional guidance on foreign participation, see the *NASA Guidebook for Proposers*, Appendix A.

12.3.7 Ineligibility of Proposals That Include Participation of China or Chinese-Owned Companies

Proposals involving bilateral participation, collaboration, or coordination in any way with China or any Chinese-owned company, whether funded or performed under a no-exchange-of-funds basis, shall be ineligible for award.

12.4 APPLICATION SUBMISSION INFORMATION

12.4.1 Address to Request Application Package

Proposal applications are available via the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES).

12.4.2 Proposal Preparation and Submission
All information needed for proposers to respond to this NOFO is contained in this Appendix, the EONS-2024 announcement, the NASA Grant and Cooperative Agreement Manual (GCAM) and the *NASA Guidebook for Proposers*. If the information contained in this Appendix conflicts with the GCAM or the *NASA Guidebook for Proposers*, then the information in this NOFO takes precedence.

A list of additional resources on proposal preparation, writing, and submission is as follows:

- NSPIRES Help on Proposals and NOIs
- Proposal Development Workshop
- Tips for Preparing Grant Applications

All proposed activities shall address all of the following requirements, as well the operating principles that underlie the NASA STEM Engagement Strategic Plan and contribute to the achievement of TEAM II goals and objectives using evidence-based strategies that rely on verifiable data, literature review, subject matter expert input, and information that has been gathered using the standards of professional research and evaluation organizations.

Proposers shall provide sufficient detail to enable review by persons who are knowledgeable in, but not necessarily specialists in, the proposed technical area. The reviewers may include personnel from NASA, individuals working in federal, state or local agencies, industry, philanthropic foundations, K-12 and institutions of higher education, firms providing evaluation of educational projects, and all types of non-competing IEIs.

12.4.2.1 Proposal Submission Guidelines
Proposals shall include the Required Elements as described in Table 4 of EONS-2024 Section D.11. Details specific to TEAMIIANCHR and TEAMIIINOV proposals for the Project Description length and content, and the Budget Narrative and Detail, follow in this section. A simplified checklist is provided below as a guideline; however, Proposers must refer to the Table 4 of EONS-2024 Section D.11 for details on required elements not described below.

Table 6. Proposal Checklist

	TEAM II Community Anchor (TEAMIIANCHR)	**TEAM II STEM Innovator (TEAMIIINOV)**
Proposal Element	**Page Limit**	**Page Limit**
NSPIRES Cover Page and Budget Form	1 or more – NSPIRES will generate the necessary number of pages	1 or more – NSPIRES will generate the necessary number of pages
Table of Contents	1-2 pages	1-2 pages
Project Description	Maximum 3 pages	Maximum 8 pages
References and Citations	1 or more (include only if applicable)	1 or more (include only if applicable)
Biographical Sketches	PI: max 2 pages; Each Co-I and Other Key Personnel: max 1 page	PI: max 2 pages; Each Co-I and Other Key Personnel: max 1 page
Pending Support	1 or more (if appropriate)	1 or more (if appropriate)

	TEAM II Community Anchor (TEAMIIANCHR)	TEAM II STEM Innovator (TEAMIIINOV)
Proposal Element	**Page Limit**	**Page Limit**
Statements of Commitment and Letters of Support	1 or more (if appropriate)	1 or more (if appropriate)
Proposal Budget – Both Narrative and Details	1 or more as needed	1 or more as needed
Table of Personnel and Work Effort	1 or more as needed	1 or more as needed

12.4.2.1.1 Community Anchor Awards for TEAM II (TEAMIIANCHR)

Project Description (Maximum 3 pages)

The Project Description is restricted to three (3) pages (not including references). It shall reflect the unique abilities of the lead institution and its partners, if any, to further the goals outlined in this Appendix. The project description shall clearly and concisely address the following elements:

- The proposed organizational and management structure of the project, including: reporting structure of the proposed project within the IEI; how the proposing institution qualifies as or meets the definition of a museum, youth-serving organization, or library (see Appendix 12, Section 12.3.4, Organizational Type Definitions and Self-Certification Requirement); leadership experience of the proposed IEI PI; and roles of key personnel and team members.
- The capacity of the proposing organization and proposed project personnel to implement the proposed work, including demonstrated significant and successful direct service in promoting and delivering STEM activities to talented individuals from all background and life experiences. Also demonstrate the organization's capacity for planning, implementing, communicating, and coordinating internally and with external parties that offer participation opportunities to the proposing organization.
- A description of the proposed specific target audience, the outreach plan for recruiting the audience into the proposed activities, and a clear articulation defining the local area or region covered by the proposed activities. If applicable, include a description of how the audience consists of populations new to NASA content and/or also consists of talented individuals from all backgrounds and life experiences who have not previously been exposed to STEM fields.
- A description of the identified community need related to STEM engagement that is being addressed, the intended change in or outcome for the target audience and how it will be measured, and how the community will benefit from the proposed work. If possible, provide this in a tabular, logic model format. As appropriate to the proposed project, measures also shall be included related to: (1) attracting youth to STEM, especially youth from all backgrounds and life experiences, and (2) the extent to which participants report positive STEM identities, self-efficacy, interest, sense of belonging, and 21st century skills (see Section 12.7.3, NASA STEM Evaluation Constructs and Operational Definitions).
- The NASA content, Mission Directorates/Offices (Section 12.1.2.2 NASA Mission Directorate Priorities, and 12.1.2.3 Potential Collaborating Offices and Priorities), and projects and resources (Section 12.7.2, NASA Resources and Calendar Web References.) that are relevant to the NASA STEM learning experiences and other key project activities in which the Proposer's institution and constituents will engage.
- A description of the proposed STEM engagement activities, the NASA resources to be utilized, and the planned schedule.
- A description of the current baseline state of use of the NASA content and resources by the proposing institution and by the target audience, and the anticipated increase in each as a result of the proposed

work.

- How the proposed work will further develop the institution as a local NASA STEM informal education community resource, and the benefit to the institution and audiences through building its skills and connections through participation in the Museum & Informal Education (MIE) Alliance and NASA IE Learning Cohort.
- If proposing to participate in a STEM learning network or coalition, describe the coalition, the existing or envisioned connection, and how the proposed activities will contribute to the work of the coalition.

Budget Narrative and Details (1 or more pages)
The proposed budget and the implementation/costing plan for the award's period of performance shall clearly show how the awarded funds will be utilized for the duration of the award and indicate the approach for distributing funds among the various proposed activities. The proposed budget shall provide sufficient budget justification and data to enable the peer reviewers to appropriately evaluate the cost realism, reasonableness, and acceptability of the proposed effort.

The budget information included in the proposal document is divided into two sections: 1) the budget narrative, and 2) the budget details. Each proposal shall provide a proposed budget for each year of the proposed effort supported by an appropriate budget narrative and specifics. There shall be a direct parallel between the items described in the budget narrative (written description of purchase), those set forth in the budget details (actual estimates of costs, in whole dollars, for the purchase), and the figures entered in the proposal cover page NSPIRES forms.

The budget narrative shall not include any information that belongs in the Project Description. Instead, it shall:

- Cite the basis of estimate and rationales for each proposed component of cost, including direct labor, subawards, consultants, other direct costs (including travel), and facilities and equipment.
- Present the rationale for planned work commitments set forth in the table of personnel and work effort based upon the assigned tasks.
- Provide the source of cost estimates (e.g., based on quote, previous purchases for same or similar item(s), cost data obtained from internet research) including the company name(s) and/or URL and date, if known, but the actual price quote or screen captures from the website do not need to be included.
- Describe the need to acquire items costing more than $5,000 and include the source of the cost estimates as described above.
- Explain the purpose of any proposed travel concerning the award and provide the basis of estimate. Identify the destination, number of trips, duration of each trip, conferences fee, air fare, per diem, miscellaneous travel expenses (e.g. rental car expenses, airport parking).
- The budget details are the actual or estimated costs that correspond with the budget narrative. In this section, Proposers shall break out the costs, as needed, for the items listed in the general budget on the proposal cover page. (See the NASA Proposers Guide Section 2.18 and Appendix C.)

12.4.2.1.2 STEM Innovator Awards for TEAM II (TEAMIIINOV)

Project Description (Maximum 8 pages)
The Project Description shall reflect the unique ability of the lead institution and any potential partners to further the goals and objectives outlined in this Appendix. NASA encourages proposals to clearly and concisely illustrate the alignment with NASA's 2022 Strategic Plan and the NASA and federal education priorities and strategic directions. The Project Description shall contain, at a minimum, the following elements: (1) Relevance to NASA's and this NOFO's Objectives, (2) Technical Project Plan, and (3) Management and Evaluation. Refer to section 12.5 of this NOFO for weighting factors of proposal evaluation criteria.

Relevance to NASA's and this NOFO's Objectives:

- Describe the relevance of the proposed work to NASA's research and technology development priorities and the alignment with the proposed primary NASA Mission Directorate; other Mission Directorate(s) and Offices; NASA's 2022 Strategic Plan and federal education priorities and strategic directions; this NOFO and its themes/priorities.

Technical Project Plan: Provide a Technical Project Plan that describes in detail:

- The proposed specific project/activity goals and objectives; the target audience(s); the use of NASA content and resources; the expected outcomes; methods, approaches, concepts, or technologies to be used; and the potential impact of the proposed project.
- The proposing institution's capabilities, related experience, facilities, techniques, or unique combinations of these that are integral factors for achieving the proposal's objectives, and if applicable, present evidence of past successes in NASA-funded informal education activities.
- The qualifications, capabilities, and experience of the proposed PI and all other key personnel who are proposing to help achieve the proposal's objectives.
- The relationship of the proposed work to the state-of-the-art in the field, including any unique and innovative methods, approaches, concepts, or advanced technologies and evidence-based strategies to be used, and how they will enhance the expected outcomes.

Management and Evaluation:

- Present the proposed organizational and management structure of the project, including: reporting structure of the proposed project within the IEI; leadership experience of the proposed IEI PI; and key personnel and team members.
- Describe any network and other partnerships or mechanisms to build partnerships (with other IEIs, colleges and universities, industry, community partners, NASA, and/or other government agencies) to enhance the ability to achieve its objectives or in order to obtain essential services not otherwise available; the network description shall outline the purpose, structure, and membership of the required network, and how the network and partnerships will enhance the expected outcomes. All networks and partnerships shall have well-defined roles and responsibilities.
- Describe the plans for interaction and dissemination of information among project investigators and partners.
- Present in table format the planned number, including demographics, of participants or beneficiaries of the proposed project and a pre-award baseline to which these numbers will be compared.
- Describe the metrics that will be used to evaluate impact and outcomes, the means by which the necessary information will be acquired and aggregated, and any other means by which the IEI progress will be evaluated. Applicants may include a logic model in table format that identifies the project inputs, strategies, and beneficiaries, and expected outputs and outcomes. The outcomes shall include a description of expected changes in the beneficiaries' knowledge, skills, behaviors, and/or attitudes, and as appropriate to the proposed project, the extent to which participants report positive STEM identities, self-efficacy, interest, sense of belonging, and 21st century skills (see Section 12.7). Describe how the products generated during the project and the evaluation results will be shared.
- Describe the project-level evaluation plan performed by an evaluator. The use of internal, but independent evaluators is strongly encouraged.
- Describe the plans for dissemination of results externally beyond the project team and institutions.

Budget Narrative and Details (1 or more pages)

The budget format in NSPIRES is divided into two sections: 1) the budget narrative, and 2) the budget details. There shall be a direct parallel between the items described in the narrative (written description of purchase), those set forth in the details (actual estimates of costs, in whole dollars, for the purchase), and the figures entered in the proposal cover page NSPIRES forms.

Each proposal shall provide a proposed budget for each year of the proposed effort.
The budget narrative shall not include any information that belongs in the Project Description. Instead, it shall:

- Cite the basis of estimate and rationales for each proposed component of cost, including direct labor, subawards, consultants, other direct costs (including travel), and facilities and equipment.
- Present the rationale for planned work commitments set forth in the table of personnel and work effort based upon the assigned tasks.
- Provide the source of cost estimates (e.g., based on quote, previous purchases for same or similar item(s), cost data obtained from internet research) including the company name and/or URL and date, if known, but the actual price quote or screen captures from the website do not need to be included.
- Describe the need to acquire items costing more than $5,000 and include the source of the cost estimates as described above.
- Explain the purpose of any proposed travel concerning the award and provide the basis of estimate. Identify the destination, number of trips, duration of each trip, conferences fee, air fare, per diem, miscellaneous travel expenses (e.g., rental car expenses, airport parking).
- The budget details are the actual or estimated costs that correspond with the budget narrative. In this section, Proposers shall break out the costs, as needed, for the items listed in the general budget on the proposal cover page. (See the *NASA Proposers Guide* Section 2.18 and Appendix C.)

The first line of the Budget Justification Narrative shall, in the case of proposals from NASA Visitor Centers, a task order, intra-agency transfer of funds, or other commercial agreement.
Justify any network and partnership roles in the budget narrative and include sufficient detail as to the assets the partner brings to the project or, if appropriate, a detailed estimated budget for a sub-award.

Proposers shall provide sufficient budget justification and data to allow the peer reviewers to appropriately evaluate the cost realism, reasonableness, and acceptability of the proposed effort. The proposal shall contain sufficient cost detail and supporting information to facilitate a speedy evaluation and award. Dollar amounts proposed with no detail or explanation (e.g., merely stating Equipment: $5,000 or Labor: $23,000) may cause delays in funding if the proposal is selected. The proposed costing information shall be sufficiently detailed to allow the Government to identify cost elements for evaluation purposes. Each category shall be explained. Proposers are to exercise prudent judgment since the amount of detail necessary varies with the complexity of the proposal.

Direct labor costs shall be separated by titles or disciplines such as PI and clerical support, with percent of time. Estimates shall include the basis, such as currently paid rates or outstanding offers to prospective employees. With regard to other costs, each significant category shall be detailed, explained, and substantiated. For example, proposed equipment purchases shall specify the type of equipment, number of units, and unit cost. Requested travel allowances shall include the number of trips, duration of each trip, air fare, per diem, rental car expenses, etc.
Proposers requesting access to NASA technical services or materials shall contact the NASA Centers (excluding JPL) from which services or materials will be requested in order to ascertain the availability and anticipated costs of such services or materials (For points of contact, see Section 12.2.3 of Appendix 12).

12.4.3 NASA Contact Information

The TEAM II NOFO will be released on June 28, 2024, and remain open until August 27, 2024, for Community Anchor proposals and September 26, 2024, for STEM Innovator proposals. Potential applicants with questions or experiencing problems while the funding opportunity is open shall reach out to the NASA point of contact for TEAM II, Beverly Girten. Contact information is provided below in **Section 12.4.4, Contact and Resource Information, Program Office Contact of this NOFO.**

12.4.3.1 Pre-proposal Webinars and Questions and Answers

The first pre-proposal webinar will be held on July 25, 2024, from 12:30-2pm Eastern Time. A second pre-proposals webinar will be held on August 13, 2024, from 12:30-2pm Eastern Time. Please refer to the 2024 Teams Engaging Affiliated Museums and Informal Institutions TEAMIIANCHR or TEAMIIINOV NSPIRES landing pages for connection details. During this time, prospective Proposers may verbally ask questions about this opportunity. Proposers may also ask technical assistance questions from project staff, which may include tips and guidance for submitting proposals. Prospective Proposers are requested to submit any written questions no later than seven business days before the webinar so that NASA will be able to cover as much information as possible at the webinar. Responses to questions submitted will be provided in a "Frequently Asked Questions (FAQ)" list that will be posted on the TEAM II landing page on NSPIRES. The list will be updated frequently during the open period of this NOFO.

An opportunity to ask questions and solicit clarification also will be provided at the webinar.

Prospective Proposers are strongly encouraged to register in NSPIRES as soon as possible and sign up for notification emails to receive notice of this webinar. Refer to the 2024 TEAMII landing page on NSPIRES for questions regarding proposal submission and schedule information.

12.4.4 Contact and Resource Information

Selection Official
Carrie Olsen
Project Manager, Next Gen STEM
NASA Headquarters
Washington, DC 20546

Program Office Point of Contact
Beverly Girten
Manager, Informal Education and Engagement
NASA Headquarters
Washington, DC 20546

Email: teamii@nasaprs.com

12.4.5 Proposal Submission Method, Dates, and Times

Electronic proposal submission is required via NSPIRES ONLY. See *NASA Guidebook for Proposers*.

Application Submission Deadline

Application Materials	Required or Encouraged	Due Date and Time
Letter of Intent	Not Applicable	Not Applicable
Community Anchor Full Application	Required	Tuesday, August 27, 2024 11:59pm Eastern Time

STEM Innovator Full Application	Required	Thursday, September 26, 2024 11:59pm Eastern Time

All applications **must** be received by the established deadline.

NASA will not review applications that are received after the deadline or consider these late applications for funding.

Applicants experiencing technical problems outside of their control must notify NASA as soon as possible and before the application deadline. Failure to timely notify NASA ofthe issue that prevented the timely filing of the application may preclude consideration of theaward.

For technical assistance with NSPIRES, please contact the NSPIRES Help Desk at nspires-help@nasaprs.com or (202) 479-9376, Monday through Friday, 8:00 AM – 6:00 PM ET. PLEASE NOTE: The NSPIRES Help Desk closes at 6:00 pm Eastern Time, Monday through Friday, and is closed on federal holidays. It is highly recommended that proposers do not wait until the final hours before the proposal deadline to submit their proposals. All dates are subject to change. Please regularly check the NSPIRES website for details. All information to be reviewed in support of a proposal must be uploaded together as a single PDF submission in NSPIRES. All proposals shall be submitted electronically through NSPIRES only. All organizations and the team members participating in the proposal must be registered in NSPIRES. Proposals delivered through any other means will be rejected and will not be reviewed. Also, late proposals (i.e., those received after the stated deadline) will be rejected and will not be reviewed.

Other Submission Requirements
All proposals shall comply with the general requirements of the EONS-2024 NOFO, and this Appendix. Upon receipt, proposals will be reviewed for compliance to ensure that each proposal includes the following:

- Featuring of NASA-themed space exploration, aeronautics, space science, Earth science, and/or microgravity.
- Submission of a complete proposal with all required elements.
- Submission of a proposal from an eligible Proposer as specified in the Eligibility Information. (Section 12.3 TEAM II Eligibility Information of this NOFO.)
- Submission of a budget narrative that includes details of any subawards for a funding period consistent with this Appendix.
- Submission of a proposal that is consistent with the page limitations and formatting guidelines specified in this Appendix and the 2023 *NASA Proposers Guide*.

At NASA's sole discretion, non-compliant proposals may be rejected and not considered or evaluated further.

Disqualified proposals that were submitted through NSPIRES will be returned without review using the NSPIRES "Return Proposal" function.

Submission of late proposals in response to this NOFO are strongly discouraged. NASA very rarely accepts late proposals and does so only in extenuating circumstances. Submission issues of a technical nature that result because the Proposer decided to complete its submission very close to the proposal due date are not legitimate reason for NASA to accept a late proposal.

Collection of Demographic Information
NASA is implementing a process to collect demographic data from grant applicants for the purpose of analyzing demographic differences associated with its award processes. Information collected will include name, gender, race, ethnicity, disability status, and citizenship status. Submission of the information is voluntary and is not a

precondition of award.

12.5 APPLICATION REVIEW INFORMATION

Proposals will be evaluated based on the following criteria: (1) **Intrinsic Merit**, (2) **Relevance to NASA,** and (3) **Budget/Cost**. The evaluation criteria are based upon the NASA, the 2023 *NASA Proposers Guide*, and the 2018 CoSTEM Federal STEM Education Strategic Plan.

12.5.1 Community Anchor Awards for TEAM II (TEAMIIANCHR)

12.5.1.1 Intrinsic Merit (40%)

The degree to which the proposal:

- Has clearly expressed intended outcome(s)/change, measures of success, and target audience(s); addresses the expectations described in the announcement; and is consistent with the proposed budget; effectively details and utilizes the program management, including the PI and contributions of all team members and collaborators; and demonstrates a high probability for successful implementation.
- Demonstrates the relevancy of the proposed work to the institution where the supported activities will be led, and the proposing institution's capacity and experience for conducting the proposed activities, and to take advantage of special opportunities offered by NASA, when appropriate.
- Includes evidence of the proposing institution's past and present significant and successful direct service in promoting and delivering STEM to talented individuals from all backgrounds and life experiences and how this will benefit the proposed work.
- Clearly describes and defines how the project will interact with any NASA collaborators. (May include financial or in-kind letters of support from partners and collaborators.)
- Anticipated benefits from participation in the NASA IE Learning Cohort and MIE Alliance, as well as potential contributions to those communities by the Proposer, are described and appropriate to the proposed work.
- Clearly explains how the proposed activities meet the need identified in the proposal, defines the local or regional area being served, and demonstrates how the target audience will be recruited and how they will benefit. If appropriate to the proposed work, also explains how students/youths are served through their learning support systems of families and informal and formal educators and institutions.

12.5.1.2 Relevance to NASA (40%)

The degree to which the proposal clearly:

- Describes plans for the proposing institution to further develop its visibility, presence, and capacity in the community as a NASA STEM informal education community resource, and its baseline state of use of NASA content and resources and the anticipated increase.
- Articulates plans for participation in the required number of NASA STEM experiences and for reaching the required number of participants.
- Articulates how the proposed work and project goals are aligned with the appropriate Mission Directorate(s), NASA Center(s), and/or other participating NASA Offices. Clearly identifies and addresses NASA content as outlined in this Appendix.
- Demonstrates the direct use of appropriate NASA content, people, facilities, educational and engagement resources, current and former NASA award recipients and their work and results (including award recipients under TEAM II and its precursor CP4SMPVC), and/or other related partners.
- Demonstrates alignment with NASA, OSTEM, and/or TEAM II strategies, goals, objectives, and priorities.
- Demonstrates that any plans aimed at audiences who have not yet been exposed to NASA STEM engagement resources and activities, and/or talented individuals from all backgrounds and life experiences, are clear and appropriate to the audience.

12.5.1.3 Budget/Cost and Budget Narrative (20%)

- The proposed budget shall be adequate, appropriate, reasonable, and realistic, and demonstrate the effective use of funds that align with the content and text of the proposed work.
- All proposed budget line items are well explained and justified.

12.5.2 STEM Innovator Awards for TEAM II (TEAMIIINOV)

12.5.2.1 Intrinsic Merit (40%)

The degree to which the proposal:

Quality and Feasibility

- Has clearly expressed intended outcome(s)/change, measures of success, and target audience(s); addresses the expectations described in the announcement; and is consistent with the proposed budget; effectively details and utilizes the program management, including the PI and contributions of all team members and collaborators; and demonstrates a high probability for successful implementation.
- Demonstrates clear goals and objectives that are aligned with the emphasis of this NOFO, NASA Strategic Objective 3.3, and the NASA STEM Engagement Objectives and Strategies that TEAM II supports.
- Presents a clearly organized and workable management plan for achieving educational goals and objectives, and includes clear lines of communication with NASA and/or other partners regarding responsibilities.
- Demonstrates the use or development of evidenced-based educational strategies in designing and implementing the project.
- Clearly describes and defines how the project will interact with any NASA collaborators. (May include financial or in-kind letters of support from partners and collaborators.)
- Demonstrates the relevancy of the proposed work to the institution where the supported activities will be led, and the proposing institution's capacity and experience for conducting the proposed activities, and to take advantage of special opportunities offered by NASA, when appropriate.
- Includes evidence of the proposing institution's past and present significant and successful direct service in promoting and delivering STEM to talented individuals from all backgrounds and life experiences on how this will benefit the proposed work.

Partnerships/Collaborations

- Includes any identified partners in the design, development, evaluation, and dissemination of the proposed project.
- Includes partners and collaborators with well-defined roles and responsibilities, including (as appropriate) for project expansion or sustainability, and indicates the capabilities that the partner is contributing to the effort.

Project Evaluation

- Includes an appropriate evaluation plan/process that documents outputs, impacts, and outcomes that demonstrate progress toward achieving objectives of proposed project activities and the objectives/priorities of the NOFO.
- Demonstrates how the proposed project's plans lead to a measurable impact on learner interest in and positive attitudes towards STEM topics and improve self-perception of the learner's ability to participate in STEM including constructs described in Section 12.6.4 and outlines how this will be measured.
- Includes specific and sufficient resources dedicated to evaluation activities in the detailed work plan, project budget, and schedule of completion. The evaluation budget is a minimum of 8% of the overall project budget.

12.5.2.2 Relevance to NASA (40%)

The degree to which the proposal clearly:

- Clearly articulates plans for experiential authentic STEM opportunities that encourage innovation, critical thinking, and problem-solving skills.
- Articulates how the proposed work and project goals are aligned with the appropriate Mission Directorate(s), NASA Center(s), and/or other participating NASA Offices. Clearly identifies and addresses NASA content as outlined in this Appendix.
- Demonstrates the direct use of appropriate NASA content, people, facilities, educational and engagement resources, current and former NASA award recipients and their work and results (including award recipients under TEAM II and its precursor CP4SMPVC), and/or other related partners.
- Demonstrates alignment with NASA, OSTEM, and/or TEAM II strategies, goals, objectives, and priorities.
- Makes a demonstrable contribution to attracting diverse populations to NASA missions or NASA-STEM related educational activities and to future careers in STEM.
- Describes a strong outreach plan to effectively reach appropriate audiences, using appropriate means to include talented individuals from all backgrounds and life experiences.
- Addresses geographical diversity, especially in outreach and retention efforts.

12.5.2.3 Budget/Cost and Budget Narrative (20%)

- The proposed budget shall be adequate, appropriate, reasonable, and realistic, and demonstrate the effective use of funds that align with the content and text of the proposed work.
- All proposed budget line items are well explained and justified.

12.5.3 Review and Selection Process

The authority and responsibility for eligibility determinations and award selection decisions lies with NASA. Proposals will be reviewed as follows:

1. Eligibility or Compliance with the EONS NOFO-2024, Appendix 12, and this Appendix: Proposals will be assessed by the NASA Point of Contact or designees for eligibility with regard to the institution and technical content. If a proposal fails to meet one or more of the eligibility criteria, NASA reserves the right to disqualify that proposal from further review and award consideration.
2. TEAMIIANCHR and TEAMIIINOV proposals will be peer reviewed by both NASA subject matter experts and experts external to NASA, which may include, but are not limited to: individuals working in STEM education in federal, state or local agencies, industry, at non-competing IEIs, philanthropic foundations, K-12 schools or districts, institutions of higher education, firms providing evaluation of educational projects, etc.
3. Reviewed proposals and reviewer comments will be provided to NASA Headquarters employees who will recommend to the Selecting Official which proposals have a higher or lower priority for funding.

12.5.3.1 Successful Proposals

Upon selection of the awardee recipients by the Selection Official, the PI of each successful proposal will receive a "Notice of Intent to Make a Federal Award" letter via NSPIRES with an explanation of the review process and reviewers' comments about the proposal. It is anticipated that these letters will be released in April 2025. Proposers are strongly cautioned that only a NASA Grant Officer may make commitments, obligations, or awards on behalf of NASA or authorize the expenditure of funds for this opportunity. Pre-award costs will not be allowed for cooperative agreements awarded through this funding opportunity. It is this program's practice to provide a letter indicating application selection and "Notice of Intent to Make a Federal Award" letter prior to the release of Federal award funding. This letter is not an authorization to begin performance. If a submitter is selected for an award, and it incurs pre-award costs, this is at the submitter's/recipient's own risk and NASA will not pay them.

NASA will notify successful grant recipients of funding via a Notice of Award (NASA Form 1687) signed by the Grant Officer. This Notice of Award is the authorizing document and will be sent to the proposing PI and the Authorized Organization Representative (AOR) listed in the proposal via electronic delivery. All expenses incurred on grant activities prior to the period of performance start date listed on the Notice of Award are at the risk of the non-Federal entity until the Notice of Award is received and period of performance commences.

12.5.3.2 Unsuccessful Proposals

Upon selection of award recipients, the PI of an unsuccessful proposal will receive a non-selection letter with an explanation of the review process and reviewers' comments about the proposal via NSPIRES.

12.5.3.3 Anticipated Announcement and Federal Award Dates

Community Anchor Open Application Period: June 28, 2024 – August 27, 2024 (60 days)
STEM Innovator Open Application Period: June 28, 2024 – Sept. 26, 2024 (90 days)
Pre-proposal Webinar 1: Thursday, July 25, 2024, at 12:30pm ET
Pre-proposal Webinar 2: Tuesday, August 13, 2024, at 12:30pm ET
Community Anchor Application Period Closes: Tuesday, August 27, 2024
STEM Innovator Application Period Closes: Thursday, September 26, 2024
Anticipated Selection Announcement Date: March/April 2025
Anticipated Federal Award Date: Prior to May/June 2025

12.6 FEDERAL AWARD ADMINISTRATION INFORMATION

12.6.1 Grant Award Reporting Requirements for Community Anchor Awards for TEAM II (TEAMIIANCHR)

Recipients shall complete all required reports as requested by NASA OSTEM and the NASA Shared Services Center (NSSC) as listed on the grant award required reports and publications document. Grant reporting requirements are detailed in Section 7.3 Performance Report Requirements of the *NASA Grants and Cooperative Agreement Manual.* Proposers shall be aware that, if selected for an award, they must comply with the reporting requirements listed in 2 CFR 180.335 and 180.350.

Award recipients may also be required to respond to data calls and/or participate in future program evaluation data collection efforts at NASA OSTEM's request. The NASA TEAM II managers will provide additional communications and guidance regarding data calls, future program evaluation efforts and timelines. Types of data requested may include evaluation, NASA relationships, audiences served, publication/presentations, products created, and details on activities. The TEAMIIANCHR PI is required to promptly respond to OSTEM data calls as requested by NASA TEAM II Co-Manager and utilize the NASA approved data management system (NASA STEM Gateway) for performance data reporting.

Award recipients shall also submit a report to the NASA Grant Officer at the NSSC, with copies the TEAM II Activity Manager and to TEAMII@jpl.nasa.gov, on the results pertaining to this award no later than 120 days after the award end date.

12.6.2 Cooperative Agreement Award Reporting Requirements for STEM Innovator Awards for TEAM II (TEAMIIINOV)

The reporting requirements for award recipients under the TEAMIIINOV will be consistent with the *NASA Grant and Cooperative Agreement Manual (GCAM)*.

TEAM II STEM Innovator PIs shall submit reports as described below via secure transfer and following Personally Identifiable Information (PII) requirements to the NASA Shared Services Center (NSSC) with a courtesy copy to the

TEAM II Activity Manager and to TEAMII@jpl.nasa.gov. For additional information on PII, see NASA Privacy Procedural Requirements.

All reports shall include the following data elements on the report's cover page:

- Federal agency (i.e., NASA) and program office to which the report is submitted
- Award number
- Project title
- Principal Investigator name, title, and contact information (e-mail address and phone number)
- Name of submitting official, title, and contact information (e-mail address and phone number), if other than PI
- Submission date
- Unique Entity Identifier (UEI) number and EIN number
- Recipient organization name and address
- Recipient identifying number or account number, if any
- Period of performance start and end date
- Reporting period end date
- Report term or frequency (annual, semi-annual, quarterly, other)
- Final Report? Indicate "Yes" or "No"
- Signature of submitting official (either handwritten or electronic)

In addition to the data elements above, all NASA performance reports shall report on one mandatory reporting category, "accomplishments."

Accomplishments data element:

1. What were the major goals and objectives of this project?
2. What was accomplished under these goals and objectives?
3. What opportunities for training and professional development has the project provided?
4. How were the results disseminated to communities of interest?
5. What do you plan to do during the next reporting period to accomplish the goals and objectives?

For further details on reporting project performance, please refer to the Post-Award Phase Section of the GCAM.

Federal Financial Reporting
Recipients of NASA funding must submit quarterly financial reports. Financial reports must be submitted via the Payment Management System (PMS):

• Quarterly Federal Financial Reports (FFR) are due no later than 30 days past the reporting period end date
• Final Financial Status Reports/Final Federal Financial Report (FSR/FFR) are due no later than 120 days after the end of the period of performance

Performance Reporting
NASA award recipients must also submit annual and final performance reports. Annual reports are due to NASA 60 days prior to the anniversary date of the award, except in the award's final year. Awards that are in their final year are required to submit final performance reports instead of the annual performance report. Descriptions of annual and final reporting requirements for TEAMIIANCHR and TEAMIIINOV awards are below:

Annual Report *(due each year 60 days prior to the anniversary date of the award, except in the award's final year)*

Award recipients shall submit an Annual Report every year no later than 60 days prior to the anniversary date of the award, with the exception of the award's final year.

Final Report ***(120 days following the end of the performance period)***
Recipients shall submit a Final Report no later than 120 days following the end of the performance period.

Additional Reporting Requirements
NASA recipients must conform to all reporting requirements outlined in the Required Publications and Reports section of the GCAM, currently Appendix F.

12.6.3 Administrative and National Policy Requirements
In addition to the requirements in this section and in this NOFO, NASA may place specific terms and conditions on individual awards in accordance with 2 C.F.R. Part 200. Recipients of NASA grant funding shall adhere to requirements set forth in 2 CFR 200, 2 CFR 1800, 2 CFR 170, 2 CFR 175, 2 CFR 182, and 2 CFR 183.

12.6.4 Office of STEM Engagement Performance Metrics
PIs are required to timely and properly respond to data calls as requested by NASA OSTEM. Additional communications and guidance regarding data calls will be sent to award recipients from the NASA OSTEM and TEAM II Activity Manager. The PI shall ensure that it has the appropriate staff and resources to facilitate data collection activities and properly complete tasks required for timely reporting to NASA.

12.6.5 Other Information
Access to NASA Facilities/Systems
All recipients shall work with NASA project/program staff to ensure proper credentialing for any individuals who need access to NASA facilities and/or systems. Such individuals include U.S. citizens, lawful permanent residents ("green card" holders), and foreign nationals (those who are neither U.S. citizens nor permanent residents).

12.6.6 Table 7. Summary of Key Information

	Community Anchor Applications	**STEM Innovator Applications**
Total ESTIMATED annual budget for TEAM II awards	$750,000	$3,250,000
Anticipated number of new awards, pending adequate proposals of merit	10-15	10-13
Estimated Start Date	May 2025	May 2025
Duration of awards	1-2 years	2-3 years
Award Type	Grant	Cooperative Agreement
Release Date for FY2024 TEAM II NOFO	Friday, June 28, 2024 12pm Eastern Time (DATE SUBJECT TO CHANGE); Check NSPIRES for details	Friday, June 28, 2024 12pm Eastern Time (DATE SUBJECT TO CHANGE); Check NSPIRES for details
Pre-proposal Webinar 1 – (optional)	Thursday, July 25, 2024 12:30pm Eastern Time (DATE SUBJECT TO CHANGE); Check NSPIRES for details	
Pre-proposal Webinar 2 –	Tuesday, August 13, 2024	

	Community Anchor Applications	STEM Innovator Applications
(optional)	12:30pm Eastern Time (DATE SUBJECT TO CHANGE); Check NSPIRES for details	
DUE DATE FOR PROPOSALS	Community Anchors Due: Tuesday, August 27, 2024 11:59pm Eastern Time (DATE SUBJECT TO CHANGE); Check NSPIRES for details	STEM Innovators Due: Thursday, September 26, 2024 11:59pm Eastern Time (DATE SUBJECT TO CHANGE); Check NSPIRES for details
Page limit for the Narrative Section of proposal	3 pp. See *NASA Guidebook for Proposers*	8 pp. See *NASA Guidebook for Proposers*
Detailed instructions for the preparation and submission of proposals	See *NASA Guidebook for Proposers*	
Submission medium	https://nspires.nasaprs.com Help Desk available at nspires-help@nasaprs.com or (202) 479-9376 from 8 am to 6 pm Eastern Time) Monday through Friday, excluding federal holidays. See *NASA Guidebook for Proposers*	
Selection Official	Carrie Olsen Project Manager, Next Gen STEM NASA Headquarters Washington, DC 20546	
NASA Point of Contact for this NOFO	Beverly Girten Manager, Informal Education and Engagement NASA Headquarters Washington, DC 20546 Email: teamii@nasaprs.com	

12.7 ADDITIONAL INFORMATION

12.7.1 Program Specific Data Form – For Community Anchor and STEM Innovator Awards

Each Proposer to a TEAM II tier shall complete one Program Specific Data (or PSD) questionnaire through the NSPIRES system. A preview of the requested items follows. There may be minor inconsistencies (e.g., punctuation, italics) between the following text and what is provided in NSPIRES. Note that the NSPIRES PSD questionnaire **does not provide** unlimited text for responses or the ability to use bulleting.

Note: The PSD questions below are applicable to both Community Anchor and STEM Innovator Tiers. The final question listed – Question 15 – is only applicable to STEM Innovator proposals.

Program Specific Data Questions

Item 1. (Optional) Request for Input on Clarity of TEAM II NOFO. Please comment on your organization's perception in crafting and submitting a proposal to Appendix 12 regarding the clarity of the description and requirements of the opportunity, and the proposal evaluation criteria.
It is important to note that this response will not be shared with any individuals who are involved in the peer review or selection process for this opportunity and will not be considered in any way as part of the evaluation or selection process for this opportunity.

Item 2. Certification of organizational eligibility to submit proposal to Appendix 12 TEAM II (TEAMIIANCHR or TEAMIIINOV). Check ONLY one:
Museum or Planetarium
NASA Visitor Center
Youth Serving Organization
Library

Item 3. Submitting Organization's URL:

Item 4. Select one or more Institution Type:
Air and space center
Alaska Native-Serving Institution or Native Hawaiian-Serving Institution (ANNH)
Amateur astronomy group
Aquarium
Arboretum
Asian American and Native American Pacific Islander-Serving Institution (AANAPISI)
Association of eligible institutions as recognized by the Internal Revenue Service
Association that includes eligible institutions and ineligible institutions
Aviary
Aviation museum
Botanical garden
Boys and Girls Club
Children's museum
Congressionally-authorized NASA memorial; e.g. Challenger Center
College (4-year)
Community College
Community-based Organization
Cultural/historical institution that focuses specifically on populations of talented individuals from all backgrounds and life experiences who may not have been previously exposed to STEM
Hispanic-Serving Institution (HSI)
Historically Black College or University (HBCU)
K-12 School or School System
Library (school, local, regional)
Minority Serving Institution (MSI) (Title IV college or university)
National, state or local park
Natural history museum
Nature center
NASA Visitor Center (federal)
NASA Visitor Center (non-federal)
Non-profit Foundation
Observatory visitor center
Out-of-school-time organization
Parks and recreation department
Planetarium
Science-technology center
Scientific or engineering society
State, local or federal museum
State, local, or federally-recognized tribal government museum or planetarium
Theater or auditorium dedicated to astronomical shows
Tribal College or University (TCU)
University

Youth-serving organization (national)
Youth-serving organization (independent)
Zoo
Unlisted Type/Other

Item 5. Explain "Other or Unlisted Institution Type" or enter "Not Applicable"

Item 6. Select the Technical Content Area(s) that are most directly applicable for the proposal. Select one or more:
Aeronautics
Earth Science
Microgravity
Space Exploration (includes human space flight)
Space Science

Item 7. Select one or more NASA Mission Directorates or Offices that have content and/or educational priority(s) primarily aligned with the proposal (refer to EONS-2024 and Section 12.1.2.2 and Section 12.1.2.3 of Appendix 12). (Reminder: all proposals are also expected to align with NASA STEM Engagement priorities – see section A.4 of EONS-2024.)
Aeronautics Research Mission Directorate (ARMD)
Exploration Systems Development Mission Directorate (ESDMD)
Science Mission Directorate (SMD)
Space Operations Mission Directorate (SOMD)
Space Technology Mission Directorate (STMD)
Office of Communications (OCOMM)
Office of Diversity and Equal Opportunity (ODEO)

Item 8. Activities with NASA Center(s) (NC)/JPL or NASA/JPL Visitor Center(s) (VC)—Select one or more:
No specific activity with any NC or VC
Planned activities with NCs or VCs
Confirmed activities with NCs or VCs
Ames Research Center (ARC Mountain View, CA) NC
Armstrong Flight Research Center (AFRC Edwards, CA) NC
Chabot Space and Science Center - ARC's non-federal VC
Glenn Research Center (OH) NC
Great Lakes Science Center-GRC's non-federal VC
Goddard Space Flight Center (GSFC, Greenbelt, MD) NC
Wallops Island VC (federal)
Greenbelt VC (federal)
Maryland Science, Exploration, and Education Center at Goddard (non-federal)
Please confirm whichever we should use and we will update accordingly.
von Karman Visitor Center-JPL's non-federal VC
Johnson Space Center (JSC TX) NC
Space Center Houston-JSC's non-federal VC
Kennedy Space Center (KSC FL) NC
KSC Visitor Center (federal concession)
Langley Research Center (LaRC Hampton, VA) NC
Virginia Air and Space Center-LaRC's non-federal VC
Marshall Space Flight Center (MSFC Huntsville, AL) NC
U.S. Space and Rocket Center-MSFC's non-federal VC
Stennis Space Center (SSC Bay Saint Louis, MS) NC
Infinity Science Center –SSC's non-federal VC

Item 9. List any other NASA collaborators (individuals or facilities) *Note: other NASA collaborators are not a requirement and therefore will not receive an advantage in the review process.*:

Item 10. List any federal or non-federal institutional network and/or partner organizations (e.g., Boys and Girls Clubs, school districts, 4-H. etc.) and include the cities and states of the local/regional branches of the network and/or partner that are intended to be part of the involvement.

Item 11. If the project involves targeted activities predominantly serving populations of talented individuals from all backgrounds and life experiences that previously have not been exposed to STEM, or a partnership with such an institution, please indicate type or check "not applicable."

American Indian or Alaskan Native Asian/Pacific Islanders
Black/African American
Hispanic or Latino
Native Hawaiian or other Pacific Islander
Rural
Urban/Inner City
Veterans
Women and/or Girls
Alaska Native-Serving Institution or Native Hawaiian-Serving Institution (ANNH)
Asian American and Native American Pacific Islander-Serving Institution (AANAPISI)
Hispanic-Serving Institution (HSI)
Historically Black College or University (HBCU)
Minority Serving Institution (MSI) (Title IV college or university)
Tribal College or University (TCU)
Other (give specific answer in Item 12)
Not applicable

Item 12. Explain "Other" from Item 11 or enter "Not Applicable."

****Item 13 FOR STEM INNOVATOR APPLICATIONS ONLY****
Item 13. Select one or more primary types of STEM engagement/educational product and/or program that this project plans to utilize through the network or develop:
Badge/project guide
Course
Citizen science/design challenge
Educator guide/manual
Educator professional development
e-learning experience (distance learning/social media)
Exhibit – permanent
Exhibit – temporary or traveling
Field trip
Internship/apprenticeship (short-term STEM-related work/opportunities)
Interpretive programming
Kiosk interactive
Museum outreach program
Planetarium show
Public special event
Research/study publication
SOS/spherical display/show
Student guide
Student or teacher research experience
Symposium/conference

Video/video clips
Website
Youth STEM learning program (summer, afterschool, weekend, etc.)
Other

---End of PSD

12.7.2 NASA Resources and Calendar Web References

Outside the Classroom: Explore STEM Resources for Parents and Families, Youth Groups and Community Organizations, Museums and Planetariums, and Citizen Scientists

https://www.nasa.gov/learning-resources/outside-the-classroom/

TEAM II Awards Products List
https://www.nasa.gov/learning-resources/teams-engaging-affiliated-museums-and-informal-institutions/

The availability of each product varies; check the listing.

Next Gen STEM Resources – innovative products, experiences, challenges, competitions and opportunities for K-12 students and educators:

- Next Gen STEM for Educators engagement resources, including live virtual connections to NASA STEM role models (including astronauts in space), annual contests and challenges such as rocket launches, educational activities, and curriculum support materials (such as slides, posters, videos) https://www.nasa.gov/learning-resources/for-educators/
- NASA CONNECTS community of practice https://stemgateway.nasa.gov/connects/s/
- Join the Artemis Mission to the Moon. Make, launch, teach, compete, and learn. Find your favorite way to be part of the Artemis mission. https://www.nasa.gov/learning-resources/join-artemis

Search STEM Resources and Opportunities https://www.nasa.gov/learning-resources/search/
Filter the list under "Education Opportunity" and "Grade Levels" to find "Contests and Challenges," "Exhibits and Museums," and "Other Opportunities".

NASA MIE Alliance Calendar
https://www.trumba.com/calendars/NASAMuseum
Filter the list by selecting Annual/Historic, Celestial Event, Mission Event, Online Presentation/Interaction

NASA Launches and Landings Calendar
https://www.nasa.gov/events/

NASA Science Mission Directorate Planetary Events and Missions Calendar
https://nssdc.gsfc.nasa.gov/planetary/upcoming.html

12.7.3 Authentic STEM Experience Framework

Definition:

An Authentic STEM Experience (ASE) is an experience inside or outside of school designed to engage learners directly or indirectly with practitioners and in developmentally- appropriate practices from the STEM disciplines that promote real- world understanding.

Context:	**ASE Characteristics:**
• *Authentic STEM Experience* = the acronym	• Active-Doing: Directly engages

STEM addresses the disciplines of Science, Technology, Engineering and Mathematics. Each discipline, and even within each discipline, has a distinct focus and methodology. • *is an experience* = can be designed or impromptu • *inside or outside of school* = any environment is a possible ASE location • *designed to engage learners* = interaction and active doing, when possible • *directly or indirectly* = the interaction is not always face-to-face • *with practitioners* = which includes teammates and/or experts/practitioners of any of the STEM disciplines • *and in developmentally-appropriate* = the ASE will be designed to be age/skills appropriate • *practices from the STEM disciplines* = each discipline, and even within each discipline, has an identified process methodology that shall be included in the experience • *that promote real-world understanding* = the experience shall provide a realization of how the discipline is used in actual activities applicable to current or future issues, problems and associated potential solutions	in actions that model the distinctive practices of the STEM disciplines. • Collaborative: Interacts/shares with a team and/or a practitioner/subject matter expert in the STEM disciplines. • Meet learners where they are: Developmentally and culturally appropriate learning experiences that illustrate or demonstrate the topic's relevancy to the learners. • Appropriate learning approach/practice: Applies relevant disciplinary methodology(ies)/practices. • Real-World Understanding: Connects applied and/or theoretical aspects of the STEM disciplines to the learner's world.

12.7.4 Performance Assessment and Evaluation Resources

The following is a non-comprehensive list of references to professional standards of evaluation practice for informal education projects.

Effective Practices for Evaluation STEM Out-Of-School Time Programs https://files.eric.ed.gov/fulltext/EJ1021960.pdf

Framework for Evaluating Impacts of Informal Science Education Projects - Report from a National Science Foundation Workshop http://www.informalscience.org/framework-evaluating-impacts-informal-scienceeducation-projects

Framework for Evaluating Impacts of Broadening Participating Projects - Report from a National Science Foundation Workshop https://nsf-gov-resources.nsf.gov/2022-03/framework-evaluating-impactsbroadening-participation-projects_1101.pdf

User-Friendly Handbook for Project Evaluation https://www.informalscience.org/2010-user-friendly-handbook-project-evaluation

Identifying and Implementing Educational Practices Supported by Rigorous Evidence: A User Friendly Guide
https://ies.ed.gov/ncee/pubs/evidence_based/evidence_based.asp

Principal Investigator's Guide: Managing Evaluation in Informal STEM Education Projects
https://www.informalscience.org/principal-investigators-guide-managingevaluation-informal-stem-education-projects-pi-guide

12.7.5 TEAM II GLOSSARY OF ACRONYMS AND DEFINITIONS

ASE	Authentic STEM Experience
CAGE Code	Commercial and Government Entity Code
CBI	Confidential Business Information
CEO	Chief Executive Officer
CFDA	Catalog of Federal Domestic Assistance
CoSTEM	Committee on STEM Education (National Science & Technology Council)
CP4SMPVC	Competitive Program for Science Museums, Planetariums, and NASA Visitor Centers
DEIA	Diversity, Equity, Inclusion and Accessibility
EO	Equal Opportunity
F&A	Facilities and Administrative
FAPIIS	Federal Awardee Performance and Integrity Information System
FAR	Federal Acquisition Regulation
FMR	Federal Management Regulation
FY	Fiscal Year (Federal) (October – September)
GAO	U.S. Government Accountability Office
GLSC	Great Lakes Science Center
IE	Informal Education
KSCVC	Kennedy Space Center Visitor Complex
LEO	Low-Earth Orbit
MD	Mission Directorate
MIE Alliance	Museum & Informal Education Alliance
MUSIC	MUREP Sustainability and Innovation Collaborative
NASA	National Aeronautics and Space Administration
NASA HQ	NASA Headquarters
NC	NASA Center
NFS	NASA FAR Supplement
NEPA	National Environmental Policy Act
NPR	NASA Procedural Requirements
OC	Office of Communications
ODEO	Office of Diversity and Equal Opportunity
OMB	Office of Management and Budget
PG	Performance Goal
POC	Point of Contact
PSD	Program Specific Data
REC	Record of Environmental Consideration
SAM	System for Award Management
SAT	Simplified Acquisition Threshold

SCH	Space Center Houston
TEAM II	Teams Engaging Affiliated Museums and Informal Institutions
TEAMIIANCHR	NSPIRES structure for Appendix 12. Community Anchor Awards
TEAMIIINOV	NSPIRES structure for Appendix 12. STEM Innovator Awards
TOC	Table of Contents
UEI	Unique Entity Identifier
U.S.C.	US Code
USSRC	US Space & Rocket Center
VC	[NASA] Visitor Center
YSO	Youth-serving Organization

Grants.gov

Grants.gov is the government-wide electronic grants portal and interested parties can search for grant opportunities on this site. For technical assistance with Grants.gov, call the customer support hotline 24 hours per day,7 days per week (except federal holidays) at (800) 518-4726 or e-mail support@grants.gov.

Appendix 13: Minority University Research and Education Project (MUREP) Earth Systems Science Research (MUREP ESSR)

13.0 PROGRAM DESCRIPTION

13.1.1 Overview of Funding Opportunity

NASA's Office of Science, Technology, Engineering, and Mathematics Engagement (OSTEM) Minority University Research and Education Project (MUREP) and the Earth Science Division (ESD) solicit proposals from 4-year Minority Serving Institutions (MSIs) to establish MUREP Earth Systems Science Research (ESSR) Institutes to enhance the research, academic and technological capabilities of MSIs through multiyear cooperative agreements. MUREP and the Earth Science Division (ESD) seek partnerships with MSIs to build research and education Institutes to study the ecosystem impacts, environmental hazards, and fragility of the MSI's region. Eligible MSIs include: Historically Black Colleges and Universities (HBCUs), Predominately Black Institutions (PBIs), Hispanic-Serving Institutions (HSIs), Asian American and Native American Pacific Islander Serving Institutions (AANAPISIs), Alaska Native and Native Hawaiian-Serving Institutions (ANNHs), American Indian Tribal Colleges and Universities (TCUs), Native American-Serving Nontribal Institutions (NASNTIs) and other MSIs, as required by MSI-focused Executive Orders.

NASA ESD has an inspiring mission—we are innovating and collaborating to explore and understand the Earth system, make new discoveries, and enable solutions for the benefit of all. Our science is at its most impactful when pressed into action and informing decisions. Within a decade, we will advance and integrate Earth science knowledge to empower humanity to create a more resilient world. The trusted, actionable Earth science will focus on resilience and critical systems that enable humanity to prosper. These include (but are not limited to):

- Agriculture production
- Air quality
- Biodiversity and ecological change
- Disasters and extreme events
- Environmental justice, water quality, and infectious disease
- Sea level change and coastal risk and resilience

We live on a dynamic, living planet. Land shifts. Seas rise. Volcanoes erupt. Storms rage. Snow melts. Plants grow. Cities expand. These ever-changing, interconnected systems affect all life on Earth, and the planet itself. Aligned with the Decadal Survey objectives, the ESD places particular emphasis on promoting and increasing the use of space-based remote sensing, the integration of space-based remote sensing data with other datasets (e.g., surface-based, airborne), using these datasets in models, and the delivery of actionable Earth science — making Earth science data more usable and impactful for the benefit of humanity. To understand these natural and human-caused changes, ESD uses unique global observations from space, air, sea, and on land. These data enable informed decision making for agriculture, water and food security, urban planning, disaster preparedness and response, transportation, climate and weather, and myriad other things that benefit life on Earth. ESD's newly released Earth Science to Action Strategy 2024-2034 plan further seeks to accelerate and advance the impact of NASA's Earth science for the benefit of all humankind by aligning NASA assets to provide actionable information for a wide range of actors and decisionmakers, and to do so for a variety of impactful areas identified for their strategic importance to national and international priorities.

This Notice of Funding Opportunity (NOFO) seeks to establish MUREP ESSR Institutes led by MSIs that can accelerate discovery and innovation in a broad array of Earth Science research categories aligned with the Earth Science to Action focus areas, outlined in the NASA Earth Science to Action Strategy 2024-2034 plan. **Proposals shall respond to one of the seven Science Research Case Concepts associated with a research area listed in Appendix 13-A, MUREP ESSR Science Research Case Concepts and Contacts. Proposals that do not meet this requirement will not be reviewed or considered for award. Proposals must demonstrate a clear link and central use of past, present, or future NASA Earth science data and/or models.** This link could include but is not limited to: NASA satellite remote sensing data (including joint missions of NASA and its interagency and international partners), remote sensing data that pertain to future NASA observing systems, remote sensing and in situ data from NASA or NASA affiliated suborbital activities such as airborne campaigns and surface-based networks, and data acquired via NASA's Commercial Small sat Data Acquisition (CSDA) Program. While other non-NASA data sources can be utilized, the main source of data should be from NASA. All data must be aligned with NASA's Open Science Management Plan guidelines.

13.1.2 Goals and Objectives

The NASA MUREP ESSR has the following goals and objectives. Proposals shall address all goals and objectives.

Goals:

(1) Advance knowledge of Earth as a system to meet the challenges of environmental change and to improve life on Earth.
(2) Create unique opportunities for a diverse set of students/faculty to contribute to NASA's work in exploration and discovery.
(3) Build a diverse, future STEM workforce by engaging students in authentic learning experiences with NASA's people, content, and facilities.
(4) Design opportunities to meet Agency workforce requirements and serve the nation's aerospace and Earth science systems, with a focus on advancing human knowledge and understanding the Earth's climate.

Objectives:

(1) Build research and education Institutes to study the ecosystem impacts, environmental hazards, and fragility of the MSI's region. Development of the ESSR Institute involves collaboration with stakeholder groups. See section 13.2.1 Partnerships and Collaborations.
(2) Bridge the gap between observations and decision makers who could benefit from this research and accelerate and advance the impact of NASA's Earth science for the benefit of all humankind.
(3) Observe and understand our planet and manage resources to respond to threats from natural and human-induced environmental changes.

13.1.3 National Priorities

NASA relies on the science community to identify and prioritize leading-edge scientific questions and the observations required to answer them. One principal means by which NASA's Science Mission Directorate engages the science community in this task is through the National Research Council (NRC). The NRC conducts studies that provide a science community consensus on key questions posed by NASA and other U.S. government agencies. The broadest of these studies in NASA's areas of research are decadal surveys. As the name implies, NASA and its partners ask the NRC once each decade to look out 10 or more years into the future and prioritize research areas, observations, and notional missions to make those observations.

The 2017 Decadal notes that comprehensive observations of Earth's changes help us understand the myriad natural and man-made changes to the planet and are essential to ensure a thriving society. The 2017 Decadal addresses 35 key science and applications questions, and those with objectives prioritized as most important fell into six categories:

- Coupling of the water and energy cycles.
- Ecosystem Change.
- Extending and Improving Weather and Air Quality Forecasts.
- Reducing Climate Uncertainty and Informing Societal Response.
- Sea Level Rise.
- Surface Dynamics, Geological Hazards, and Disasters.

13.1.4 Agency Priorities

NASA Earth Science has an inspiring mission—to advance scientific discoveries for our nation and the world. Our science is at its most impactful when pressed into action and informing decisions. Our Earth to Action Strategy does just that. This is a transformational moment for Earth Systems Science. The pace of change in the Earth system due to the accelerating rate of climate change drives urgency in our actions. Applications of Earth science in business, government, and civil society are primed to expand and thrive – driven by demand and enabled by the possibilities introduced by widely available compute power, powerful new analytics tools, fast and readily available worldwide communication, and partnerships that can provide broad and user-friendly access. To realize the full impact of NASA Earth Science this decade, we are counting on the Earth to Action Strategy to rise to this challenge. This will mean that proposers must pursue cutting edge ways to expand the scale, scope, and reach of Earth science applications – using only our familiar, traditional ways won't get us there. Earth and space are intrinsically linked. NASA's ESD discovers new insights about the planet and the complex interactions within the Earth system but needs solutions to problems. ESD mentors will support with institutions worldwide in applying Earth Science to Action principles and objectives, powering innovations and improved decisions and actions. This NOFO draws on NASA connections with academia to bring feedback and solutions to division colleagues to further improve NASA's Earth science research and technology.

13.1.4.1 Relevance to NASA and NASA's OSTEM

The MUREP ESSR Activity addresses the following OSTEM Performance Goal and Objectives:

OSTEM Goal 4.3.1: Create unique opportunities for a diverse set of students to contribute to NASA's work in exploration and discovery.

> Objective 1.1: Create opportunities that enable students to produce knowledge or products that will be used by NASA.
>
> Objective 1.2: Create opportunities that enable students to support NASA mission work and research.
>
> Objective 1.3: Build capacity through mutually beneficial partnerships by cross-promoting events, products, and/or opportunities with NASA's Mission Directorates (Aeronautics Research, Exploration Systems Development, Science, Space Operations, and Space Technology) and NASA Centers.
>
> Objective 1.4: Develop strategic partnerships with industry, academia, non-profit organizations, and/or educational institutions to enhance and extend the impact of NASA's efforts in STEM engagement.

The STEM engagement element of this NOFO seeks to expand faculty participation in disciplinary and interdisciplinary MUREP Earth Systems Science Research through experiential opportunities that attract and retain students in Earth Science fields and prepares them for STEM careers, and to broaden graduate and undergraduate participation in Earth Science Systems research. Projects shall effectively engage first year and second-year undergraduates as well as graduate students in research. STEM engagement research projects may be carried out during the summer months, the academic year, or both to extend research opportunities to a larger number of undergraduate students. Proposers are welcome to incorporate approaches that make use of Earth observations satellites, drones or other advanced technologies that facilitate research, learning, and collaboration over distances ("virtual projects"). Projects shall encourage continued interaction of mentors with students during the academic year, to help connect students' research experiences to their overall course of study.

The MUREP ESSR Institutes will support convergence between Earth and space science, engineering, and applied research in communities at risk with climate change. In addition, the MUREP ESSR Institutes will enable breakthroughs in exploring and testing ways to address environmental issues facing underserved communities. Institutes shall contribute to diverse research of Earth science and geospatial information by working with community organizations to tailor projects to community needs and local decision making. Through collaboration, these institutes will co-design, and implement an interdisciplinary approach to new and innovative ideas.

13.1.4.2 Research Priorities for NASA Mission Directorates and Centers

Science Mission Directorate (SMD) leads the Agency in four areas of research: Earth Science, Heliophysics, Planetary Science, and Astrophysics. SMD, using the vantage point of space to achieve with the science community and our partners a deep scientific understanding of our planet, other planets and solar system bodies, the interplanetary environment, the Sun and its effects on the solar system, and the universe beyond. In so doing, SMD lays the intellectual foundation for the robotic and human expeditions of the future while meeting today's needs for scientific information to address national concerns, such as climate change and space weather. At every step, SMD shares the journey of scientific exploration with the public and partners with others to substantially improve STEM education nationwide.

This planet is changing on all spatial and temporal scales and studying the Earth as a complex system is essential to understanding the causes and consequences of climate change and other global environmental concerns. The purpose of NASA's Earth science program is to advance the scientific understanding of Earth as a system and its response to natural and human induced changes and to improve the ability to predict climate, weather, and natural hazards. NASA's ability to observe global change on regional scales and conduct research on the causes and consequences of change position it to address the Agency strategic objective for Earth science, which is to advance knowledge of Earth as a system to meet the challenges of environmental change, and to improve life on Earth.

NASA addresses the issues and opportunities of climate change and environmental sensitivity by answering the following key science questions through its Earth science program:

- How is the global Earth system changing?
- What causes these changes in the Earth system?
- How will the Earth system change in the future?
- How can Earth Systens Science provide societal benefit?

13.1.5 Data Management Plan (DMP)

All proposals shall contain a Data Management Plan (DMP). The DMP shall be included in a special section of the proposal, entitled "Data Management Plan." The DMP may not exceed two pages in length and shall immediately follow the references and citations for the Scientific/Technical/Management Section of the proposal. The two-page DMP section does not count against the 15-page limit of the Scientific/Technical/Management Section of the proposal. Formatting requirements for DMPs are the same as for the Scientific/Technical/Management Section. The DMP section shall include, as relevant to the type of study being proposed:

- The types of data and data products or other materials to be produced during the project, the standards to be used for data and metadata format and plans for providing access to and/or archiving the data and other research products in compliance with NASA Data Science and Information Policy.

- The following questions shall be addressed in the DMP:
  1. What are the data types, volumes, formats, and data standards, where relevant?
  2. What repository do the proposers intend to make these data available?
  3. When will these data be made available?
  4. Who will do the archiving and what experience do they have with this kind of data, archive, etc.?
  5. How will software be developed and released (if applicable)?

The principles related to this data management plan shall be an **integral part of the proposer research planning:**

- Open access to federally funded scientific research has the potential to increase the pace of scientific discovery, advance technology development, speed up exploration, and promote more efficient and effective use of government funding and resources.
- Sharing and preserving publications, data, and software are central to protecting the integrity of science by facilitating validation of results, as well as advancing science by broadening the value of research data to disciplines other than the originating one and to society at large.
- The degree to which research data needs to be shared or preserved varies across and within scientific disciplines; flexibility must be allowed for program-specific needs/requirements and consideration of benefits and costs, including preserving and promoting U.S. competitiveness.

13.1.6 Data Sharing Plan (DSP)

All proposals submitted in response to this NOFO shall include a Data Sharing Plan (DSP) describing how data and information obtained through MUREP ESSR will be shared. Award recipients (recipients) shall promptly prepare and submit for publication, with authorship that accurately reflects the contributions of those involved, all significant findings from work conducted under the MUREP ESSR cooperative agreement.

MUREP ESSR recipients shall develop one or more published technical paper(s)/journal article(s) during the three-year period of performance. The publication(s) shall be developed to share the novel concepts, innovative models, and technical information gained through the MUREP ESSR cooperative agreement. Recipients may also develop oral or poster presentations using the information generated through this cooperative agreement. NASA will review each proposer's DSP during the evaluation/peer review of proposals. Costs of the DSP, including travel for the Principal Investigator (PI) and up to two additional team members (e.g., Co-Investigator (Co-I), graduate student, or other staff) who worked on the project to present paper(s) at professional conferences, meetings, and/or workshops, shall be included in the proposed budget.

MUREP ESSR recipients shall ensure that all publications developed because of this cooperative agreement and authored or co-authored by investigators and sub-recipients are submitted to the MUREP ESSR Activity Manager. The recipient shall also provide a list of these publications with its annual and final reports that are required to be submitted to the NASA Shared Services Center and the MUREP ESSR Activity Manager.

13.1.7 Roles and Responsibilities of Key Personnel

Every institution submitting a proposal shall identify a single individual, the Principal Investigator (PI), who will be responsible for the quality and direction of the entire proposed effort, for the use of all awarded funds, and for the timely and complete submission of performance data and reports to NASA. The only required key personnel is the PI. PIs shall meet the following criteria at the time the proposal is submitted:

1. The PI shall be a full-time faculty member with a PhD currently employed at the MSI lead institution with demonstrated expertise in the field of Earth Systems Science.
2. Eligible MSIs are required to submit a letter of commitment to comply with guidance provided under Section 13.6 Federal Award Administration Information of this NOFO. Any proposed change to the PI under an awarded cooperative agreement is subject to prior written NASA approval.

PI responsibilities include, but are not limited to:

- Delivering a final, actionable implementation plan for responding to MUREP ESSR goals and objectives.
- Providing visionary and contemporary leadership for the planning and delivery of high-impact research and educational programs.
- Providing overall leadership, administration, and evaluation of the project and its activities.
- Engaging with the institution’s departmental, college, and university leadership to promote institutional advancement and enhanced research capacity.
- Carrying out supervisory responsibilities for project staff in accordance with the organization’s policies and applicable state and federal laws.
- Providing day-to-day management of project budgets and ensuring that all applicable institutional and NASA rules, as well as state and federal guidelines, are followed in the utilization of such funding.
- Participating in one conference per year directly related to the chosen Science Research Case Concept and participating in the NASA OSTEM Better Together conference (every other year,) both which shall be reflected in the budget.
- Participating in performance assessment activities with NASA Gateway in alignment with Federal, Agency, and OSTEM performance and evaluation priorities, guidelines, and requirements.
- Ensuring that all progress reports are delivered, annual/closeout performance report and responses to data calls are completed in compliance with NASA guidance and delivered to MUREP ESSR management in a timely manner.
- Engaging with the independent evaluator (IE) and project administration support staff to ensure that evaluation and required reports are transparent, appropriately conducted (maintaining independence from programmatic, regulatory, policymaking, and stakeholder activities), compiled, and reported.

- Other duties as requested by NASA MUREP.

Proposers may include one Co-I from the same institution as the PI, and one Co-I from each partner institution. If one or more Co-I(s) are offered, proposers shall provide a well-defined description of the Co-I's sustained and continuing role in the proposed program. Co-Is shall meet the following criteria at the time the proposal is submitted:

- The Co-I(s) shall be a faculty member at the MSI lead or a partner institution with a current position in the field of Earth Systems Science or an interdisciplinary field that enables science research or STEM education such as life sciences/physical sciences, Computer/Data Sciences, Engineering or Scientific Communication/Visualization to be essential compliment to the goals and objectives of the MUREP ESSR Institutes.

- Eligible MSIs proposing one or more Co-I(s) are required to submit a letter of commitment to comply with guidance provided under Section 13.6 Federal Award Administration Information of this NOFO. Any proposed change to the Co-I under an awarded cooperative agreement is subject to prior written NASA approval.

Co-I responsibilities shall be specified by the site. Co-Is are key personnel who have responsibilities like that of a PI on research projects. While the PI has ultimate responsibility for the conduct of a research project, Co-Is are obligated to ensure the project is conducted in compliance with applicable laws, regulations, and institutional policy governing the conduct of sponsored research.

Other Key Personnel

Faculty Participants – may be involved in projects as key personnel without the same level of responsibility of a PI or Co-I. These faculty are not responsible for the conduct of the project. Faculty participants may participate in the research, may collect salary, and may have a role in publications.

Independent Evaluator (IE) – Every institution submitting a proposal shall identify a single individual, an IE, who will be responsible for analyzing qualitative and quantitative data for the site's evaluation activities and assisting the PI in development and implementation of the site's Comprehensive Evaluation Plan (CEP). The MUREP ESSR Management Team will provide recipients with a CEP template. Within two months after awards are issued, each recipient shall submit a CEP, for which both the PI and IE have concurred in writing. The MUREP ESSR Management Team and OSTEM Performance and Evaluation (P&E) Team will provide guidance on the proposed plan.

IE responsibilities include, but are not limited to:

- Developing a CEP for the proposed activity in collaboration with the PI and the MUREP ESSR Management Team.
- Coordinating and administering activity metrics, data collection, analysis, and reporting of proposed activity evaluation data.
- Providing status updates to the PI on evaluation activities, progress, and challenges.

- Participating in an annual kick-off meeting, virtual site visits, and evaluation technical assistance meetings with the MUREP ESSR Management Team to review proposed activity's progress in achieving MUREP ESSR goals.
- Developing an annual evaluation report and final evaluation report based on awardee evaluation data demonstrating outcomes of the activity.

13.2 FEDERAL AWARD INFORMATION

Subject to Congressional appropriation of sufficient funds and NASA's receipt of proposals of adequate merit, **NASA expects to select up to 4-6 proposals for MUREP ESSR awards**. The period of performance for each award is three years. Successful proposals for this opportunity will be funded as cooperative agreements. As cooperative agreements, substantial involvement between awardees and NASA is expected. **For specific description of the substantial involvement required of awardees, see Section 13.1.7, Roles and Responsibilities of Key Personnel and Section 13.6.1 Cooperative Agreement Award Reporting Requirements of this NOFO. Funding shall be up to $1,200,000 per three-year award, or up to $400,000 per year.** The period of performance is expected to begin two to three months from the selection announcement. Proposals shall cover the full three years of performance. The continuation of NASA funding for each award annually is based on a satisfactory evaluation of documented progress, compliance with data reporting, applicable regulations and laws, and other program requirements, fulfillment of fiduciary responsibilities, and the availability of appropriated funds. At the time of this Appendix release, NASA does not plan to extend funding beyond the initial performance period of three years.

13.2.1 Partnerships and Collaborations

Earth Systems Science is complex and research requires synergistic partnerships. It crosses local and regional borders, and mitigation and adaptation require a mix of scientific, technological, and policy knowledge, and an inclusive approach to the development of the ESSR Institute involves collaboration with stakeholder groups to develop the informed approaches, responses, and actions.

The selection will be based on the problem statement and additional Institute design features. Collaboration with the life sciences, physical sciences, computer sciences and engineering driving research such as:

- Life Sciences/Physical Sciences – Faculty and Student researchers developing additional capacity to leverage NASA's openly-available Earth observation data, a powerful tool communities can use to conduct breakthrough science and bring greater equity and environmental justice to vulnerable regions.
- Computer Science/Data Science - Faculty and Student researchers using machine learning, Big Data analysis that leverages NASA's open science application products for modeling and visualization of historical and future directions of key research phenomena.
- Engineering – Faculty and Students developing smart networked systems with embedded sensors, processors and actuators that are designed to sense and interact with the physical

world (in-situ data facilitation i.e., cube-sats, drones, broad spectrum cameras and remote sensing instruments).

Carefully constructed partnerships between MUREP ESSR recipients and other entities may lead to substantial benefits for all parties involved. Specifically, MUREP ESSR recipients can benefit from access to special purpose facilities, exposure to new work areas, leveraged support for their research efforts, and/or potential sources of future funding from partners. Industry and other universities and colleges may benefit from the capabilities MUREP ESSR recipients bring in specialized work areas, and from the MUREP ESSR students who may be recruited as future employees or graduate students. NASA also benefits from the increased innovation that these partnerships bring to the Agency's missions and projects.

NASA Subject Matter Experts (SMEs) are also available to collaborate on the development of proposed activities within the MUREP ESSR Institutes during the award period of the performance. (See **Appendix 13 A: Science Research Case Concepts and Point of Contact.)**

Proposers are required to demonstrate collaborations with one additional MSI and one additional partner, which may be an MSI OR a community college, industry, or community partner. Proposals shall describe how the proposed teams/collaborations will increase student access to the MUREP ESSR Institutes opportunities, achieve MUREP ESSR's goal and objectives, leverage significant sources of additional funding, obtain essential services that are not available at the proposer's home institution, and/or contribute to sustainability. Institutions receiving MUREP ESSR awards may choose to build collaborations with NASA Centers and the NASA Jet Propulsion Laboratory (JPL) when such collaborations will mutually benefit the MUREP ESSR recipients' and NASA Centers'/JPL's abilities to accomplish MUREP ESSR goals. Proposers are strongly encouraged to identify professional learning opportunities for faculty, postdocs, and researchers. Letters of support from collaborating partners are required with the submitted proposal package.

13.2.2 Integration with NASA and Other OSTEM and/or Mission Activities

Proposals shall demonstrate a clear link and central use of past, present, or future NASA Earth science data and/or models connected to the **MUREP ESSR Science Research Case Concepts and Contacts (Appendix 13-A of this NOFO.)** This link could include but is not limited to: NASA satellite remote sensing data (including joint missions of NASA and its interagency and international partners), remote sensing data that pertain to future NASA observing systems, remote sensing and in situ data from NASA or NASA affiliated suborbital activities such as airborne campaigns and surface-based networks, and data acquired via NASA's Commercial Smallsat Data Acquisition (CSDA) Program.

Institutions receiving MUREP ESSR awards are encouraged to build collaborations with NASA Centers and/or Facilities (including JPL) when such collaborations will mutually benefit MUREP ESSR recipients' abilities to accomplish the MUREP ESSR goals and objectives. If collaborating with a NASA Center or Facility, proposers shall obtain formal letters of commitment indicating the agreed upon collaboration or commitment of resources and include these letters of commitment in the proposal. Formal letters of commitment shall be written by NASA employee representatives who are qualified to make the stated commitments and indicate that the NASA Center/Facility representative agrees to all specified details of the partnership or collaboration. Further, any visits to NASA Centers or Facilities shall require recipients to follow all appropriate protocols and procedures when scheduling, arranging, and visiting these locations.

The MUREP ESSR Management Team will facilitate communication between and among awardees, and NASA OSTEM and SMEs to promote synergy, leverage ongoing work, and support relationship building during the award period of performance (three years). The NASA MUREP ESSR Activity Manager will schedule periodic teleconference and/or web conference discussions with awardees and appropriate members of the NASA OSTEM to share information. To facilitate communication and networking, proposers shall plan to participate in a virtual MUREP ESSR kickoff, training workshops, and monthly activity meetings as required. Proposers shall also plan to travel to and participate in annual Agency OSTEM in-person meetings. The MUREP ESSR Management Team will also use social networking tools to create an interactive environment for the MUREP ESSR community.

13.2.3 Budget Guidelines and Requirements

13.2.3.1 Total Budget Guidelines and Funding Restrictions

All costs charged to awards covered by this NOFO must comply with the Uniform Administrative Requirements in 2 CFR 200 and 1800, unless otherwise indicated in the NOFO, the terms and conditions of the award, and the [Grants and Cooperative Agreement Manual (GCAM)].

- All proposed funds must be allowable, allocable, and reasonable. Funds may only be used for the project. All activities charged under indirect cost must be allowed under 2 CFR 200 cost principles.
- Grants and cooperative agreements shall not provide for the payment of fee or profit to the recipient.
- Unless otherwise directed in 2 CFR 200, for changes to the negotiated indirect cost rate that occur throughout the project period, the recipient must apply the rate negotiated for that year, whether higher or lower than at the time the budget and application was awarded.
- Proposals must not include bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds basis.
- Any funds used for match or cost sharing must be allowable under 2 CFR 200.
- The non-federal entity must use one of the methods of procurement as prescribed in 2 CFR 200.320, Methods of procurement to be followed.
- Budget shall include travel to at least one (1) Earth Science conference for faculty and students' participation.
- Budget shall include travel for NASA OSTEM Better Together conference for faculty and students according to guidelines from Activity Manager.
- If applicable, each proposer shall identify the total number of interns it is requesting for the award's period of performance.

13.2.3.2 Annual Budget Guidelines and Restrictions

The maximum annual budget for each recipient is $400,000, not to exceed the total budget of $1,200,000 during the three-year period of performance.

13.2.3.3 Cost Sharing or Matching

Cost sharing or matching is not required. Voluntary cost sharing or matching will not be considered in the evaluation of a proposal.

13.2.3.4 Direct Cost Limitations

Foreign travel is discouraged, however may be considered on a case-by-case basis and approved by the MUREP ESSR Activity Manager and/or MUREP Program Manager. Inclusion of foreign travel will not impact the evaluation of proposals.

13.2.3.5 Pre-Award Costs

Per 2 CFR §1800.210, NASA waives the requirement for applicants to obtain prior approval for pre-award costs incurred 90 days or less before an award's period of performance start date. Pre-award costs more than 90 days before an award's period of performance start date are not allowable under this NOFO. Any costs that the applicant incurs in anticipation of a grant or cooperative agreement award is at the risk of the applicant and will be subject to the rules described in 2 CFR §1800.210, Pre-award costs and the "Pre-award Costs" section of the *GCAM,* currently section 5.14.1.

13.2.3.6 Indirect Facilities and Administrative (F&A) Costs

F&A costs are allowable.

13.2.4 Program Evaluation

Proposals shall provide an approach to measure project accomplishments against their proposed goal(s) and objectives. NASA identifies evidence of effective practices of NASA STEM Engagement investments through program evaluation. Evidence is a key criterion in NASA's competitive processes for allocating resources and ensuring that the most effective activities are supported. Program evaluations are planned studies using research methods to collect and analyze data to assess to what extent activities/programs are being implemented and what, if any, impact can be measured. Evaluations answer specific questions about performance and may focus on assessing activity/program process and outcomes. Effective evaluation models are evidence-based, meaning that they are based on verifiable data and information that has been gathered using the standards of professional research and evaluation organizations. Such data may be qualitative and/or quantitative. A wide variety of evaluation designs may be utilized, as well as data collection methods, such as key informant interviews, surveys, direct observation, or focus group discussions. Regardless, such data shall pass the tests of reliability and validity, which are different for qualitative and quantitative data.

NASA sets concrete performance goals and is accountable to those goals through a framework that measures progress. Objective and verifiable performance metrics, internal and external review processes, valid and reliable data collection instruments, and evaluation studies are used to assess progress and performance across the portfolio, including programs, projects, and activities.

NASA utilizes a data management system for analyzing performance data. To facilitate data input into the system, the MUREP ESSR Activity Manager will collect performance and evaluation data via required reports (see **Section 13.6.1, Cooperative Agreement Award Reporting Requirements** of this NOFO). MUREP ESSR recipients shall provide and verify performance data for the awarded activity with the MUREP ESSR Activity Manager. Recipients may also be required to respond to data calls and/or participate in future program evaluation data collection efforts at NASA OSTEM's request. The MUREP ESSR Activity Manager will provide additional communications and guidance regarding data calls, future program evaluation efforts, and timelines. Through performance monitoring, assessment, and evaluation of NASA STEM Engagement investments, NASA will demonstrate its results-driven management approach that is focused on optimizing value to the American public.

Performance Indicators

An initial performance plan is required as part of the original proposal and shall include strategies for collecting data for performance metrics for MUREP reporting requirements and independent program evaluation.

A wide variety of evaluation designs may be utilized, such as case studies, quasi-experimental designs, or experimental designs, as well as data collection methods, such as key informant interviews, surveys, direct observation, or focus group discussions. Regardless, such data shall pass the tests of reliability and validity, which are different for qualitative and quantitative data.

NASA sets concrete performance goals and is accountable to those goals through a framework that measures progress. Objective and verifiable performance metrics, internal and external review processes, valid and reliable data collection instruments, and evaluation studies are used to assess progress and performance across the portfolio. Through performance monitoring, assessment, and evaluation activities of the MUREP ESSR program, awardees and NASA will demonstrate its results-driven management approach focused on optimizing value to the American public. In accordance with this objective, award receipt will develop and submit a CEP within two months of award issue. The MUREP ESSR Activity Manager and P&E Team will provide feedback and negotiate the final evaluation plans with awardees to ensure they meet the evaluation standards and best practices. To assist in development of a CEP, PIs and IEs are encouraged to read the following resources:

The Office of Management and Budget (OMB) Memorandum M 20-12 "Phase 4 Implementation of the Foundations for Evidence-Based Policymaking Act of 2018: Program Evaluation Standards and Practices."
"Common Guidelines for Education Research and Development."
"Designing Evaluations."

13.3 ELIGIBILITY INFORMATION

13.3.1 NASA Commitment to Diversity and Inclusion

NASA recognizes and supports the benefits of having diverse and inclusive scientific, engineering, and technology communities and fully expects the reflection of such values in the composition of all panels and teams, including peer review panels, proposal teams, science definition teams, and mission and instrument teams. Per federal statutes and NASA policy, no eligible applicant shall experience exclusion from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from NASA on the grounds of their race, color, creed, age, sex, national origin, or disability. NASA welcomes proposals from all qualified and eligible sources, and strongly encourages proposals from Historically Black Colleges and Universities (HBCUs), Minority Serving Institutions (MSIs), small, disadvantaged businesses (SDBs), veteran-owned small businesses, service-disabled veteran-owned small businesses (SDVOSB), HUBZone small businesses, and women-owned small businesses (WOSBs), as eligibility requirements apply.

13.3.2 Eligible Applicants

To be eligible for this funding opportunity, **all proposals shall originate from a four-year institution, designated and listed by the U.S. Department of Education as a MSI at the time of proposal submission** (see NASA MSI List). **Proposals from institutions that are not designated and listed by the U.S. Department of Education as MSI at the time of proposal submission will result in NASA returning the application without review**. Any arrangement or agreement to have the fiscal management and/or administration of the award performed by a third party is between the awardee and the third party, (e.g., an affiliated Board of Regents, University System or Foundation). Institutions not meeting these criteria are encouraged to partner with colleges or universities that do satisfy the requirements. Eligible entities for this funding opportunity include the following:

- Public and state-controlled institutions of higher education
- Private institutions of higher education

Further information defining the individual types of organizations are available on Grants.gov and 2 CFR Part 200.1: Education Organizations.

13.3.2.1 Limit on Number of Proposals per Unique Entity Identifier (UEI)

Eligible organizations may submit multiple lead proposals per UEI; however, each proposal shall have a different Principal Investigator (PI), and the highest rated proposal submitted under that UEI number will be awarded, and any remaining proposal(s) will be rejected.

13.3.2.2 Principal Investigator

Every institution submitting a proposal in response to this opportunity shall designate a single individual, the PI, who will be responsible for the quality and direction of the entire proposed effort and for the proper use of all awarded funds.

13.3.2.3 Proposal Involving Foreign Participation

Except as outlined in the certification regarding restriction on doing business with certain countries, NASA welcomes proposals that include the participation of non-U.S. organizations. Proposals that propose research to be performed with a non-U.S. organization as part of a proposal submitted by a U.S. organization typically are supported on a no-exchange-of-funds basis. For additional guidance on foreign participation, see the *NASA Proposers Guide*, Appendix A.

13.3.2.4 Ineligibility of Proposals That Include China or Chinese-Owned Companies

Proposals involving bilateral participation, collaboration, or coordination in any way with China or any Chinese-owned company, whether funded or performed under a no-exchange-of-funds basis, shall be ineligible for award.

13.3.2.5 Other Eligibility Criteria

All proposals shall identify an institute comprised of at least three entities:

- A lead, four-year MSI institution,
- One additional four-year MSI US college or university collaborators,
- At least one collaboration with additional institutions or laboratory organizations with relevant research SME that can increase outcomes and impact of research. These include community colleges, Federal Laboratories (i.e., JPL, NOAA, EPA, USDA, U.S. Forest Service, etc.) or Regional, State or Local Resiliency Offices.
- **A non-MSI institution may be included in the research collaboration with a maximum sub-award amount of 20% of the total award**.
- All research concepts are required to be responsive to MUREP ESSR goals and objectives and must utilize NASA Earth Science Earth Observing Satellite Constellation Data and Applications. Proposals not meeting these requirements will not be eligible for award and will not be reviewed.
- All collaborators must demonstrate their awareness of the proposal and summarize plans for participation via Letters of Support (see EONS-2024, and the *NASA Proposer's Guide*.

13.4 APPLICATION SUBMISSION INFORMATION

13.4.1 Address to Request Application Package

Proposal applications are available via the [NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES)](#).

13.4.2 Proposal Preparation and Submission

All information needed for proposers to respond to this NOFO is contained in this Appendix, the **EONS-2024** announcement, the GCAM and the *NASA Proposer's Guide*. If the information contained in this Appendix conflicts with the GCAM or the NASA Proposer's Guide, then the information in this NOFO takes precedence.

All proposed activities shall address all the following requirements, as well the operating principles that underlie the NASA STEM Engagement Strategic Plan and contribute to the achievement of MUREP ESSR goals and objectives using evidence-based strategies that rely on verifiable data, literature review, subject matter expert input, and information that has been gathered using the standards of professional research and evaluation organizations.

13.4.2.1 Proposal Submission Guidelines

Detailed instructions for the preparation and submission of proposals are available in the *NASA Proposer's Guide*. Applicants shall submit their proposals using electronic proposal submission via NSPIRES ONLY. Registration in NSPIRES is required for proposal submission. Proposals shall be written in 12-point font with 1-inch margins. The narrative section of proposal shall be no longer than 15-pages. See the GCAM for details.

Each proposal shall include:

- A Science/Technical/Management (S/T/M) section, containing a detailed plan of the proposed research and may be no more than 15 pages including figures and tables. See the GCAM for details.
- Title Page (not counted against the 15-page limit), a Table of Contents (not counted against the 15-page limit), Project Summary (up to 4,000 characters, not counted against the 15-page limit), References (not counted against the 15-page limit), Letters of Commitment (not counted against the 15-page limit).
- A performance plan including strategies for collecting data for performance metrics for MUREP reporting requirements and independent program evaluation.
- A timeline for each year of proposed activities:
  - MUREP ESSR Program Year One: January 2025 (Start-up), Spring and Summer 2025, Fall 2025: Proposers will organize the teams, develop the institute framework, and the summer research field work and plan, and conduct educational sessions and hands-on activities to facilitate skills development as an outcome to the Research and Education approach as a national and regional strategy for Earth Science literacy.
  - MUREP ESSR Program Year Two: Winter 2026, Spring 2026, Summer 2026, Fall 2026: Develop a work plan for identifying necessary imagery, training data, and processing methods to address Earth science research question;

    Develop new training data if needed to address the research and conduct the research to completion; Validate results using established methods; Synthesize results into documentation and manuscripts for publication in peer reviewed journals.
  - MUREP ESSR Program Year Three**:** Winter 2027, Spring 2027, Summer 2027; Conduct the research to completion; Validate results using established methods; Synthesize results into documentation and manuscripts for publication in peer reviewed journals. Completion of the research.
- Description of the authentic STEM activities related to NASA missions or research (e.g., scientific inquiry experiments/research, engineering design challenges, and/or technology development activities) for the MUREP ESSR Institutes that the students will complete.
- Description of the engagement opportunities with STEM professionals, including the names, roles, and commitments of partners/collaborators.
- Letters of commitment from partners/collaborators, including NASA Centers or facilities, indicating specific agreed upon roles and responsibilities (not counted against the 15-page limit).
- Data sharing plan describing how information obtained through MUREP ESSR will be shared, including developing one or more published technical paper(s)/journal article(s) during the three-year period of performance and presenting these paper(s) at appropriate professional conferences, meetings, and/or workshops.
- Data management plan.
- Budget and a Budget Justification
- References as needed, not counted against the 15-page limit.
- Reference to applicable NASA missions and/or research areas that will serve as the context for student authentic STEM activities, the evidence-based strategies and/or practices used in the development of any proposed activities, and/or other evidence supporting the rationale for their approach, tools, and/or techniques.

Note: NASA does not endorse or require proposers to use any specific source of information, but strongly encourages proposers to use research-based best practices described in peer-reviewed journals and/or conducted by credible institutions that specialize in STEM education research.

Additional Requirements

- Proposals shall respond to any of the required research areas (see Appendix 13- A).
- All proposals shall identify an institute comprised of at least three entities. (see Section 13.3.2.5)
- There is no limit to the number of proposals submitted from an MSI; however, if multiple proposals receive a competitive score from the same MSI, only the one with the highest score will be considered for selection. No faculty member will be funded on more than one proposal award.

13.4.3 NASA Contact Information

The MUREP ESSR NOFO will be released on **July 30, 2024,** and remain open until **October 30, 2024**. Potential applicants with questions or experiencing problems while the funding opportunity is open shall reach out to the NASA point of contact for the MUREP ESSR Activity Manager James Harrington. Contact information is provided below in Section 13.4.4, Contact and Resource Information, Program Office Contact of this NOFO.

13.4.3.1 Pre-Proposal Webinars and Questions and Answers

Two optional pre-proposal webinars and a final Online Office Hour will be held prior to the proposal submission due date to provide potential applicants with the opportunity to ask questions and address problems. The first pre-proposal webinar will take place on **8/15/2024** at **4:00** pm Eastern Time (ET). The second pre-proposal webinar will take place **9/19/202**4 at **4:00** pm ET. The proposal deadline is **October 30, 2024 at 11:59 pm ET.**
Applicants shall refer to the MUREP ESSR landing page on NSPIRES for connection details. Proposers shall submit any written questions no later than seven business days before the pre-proposal webinars so that NASA will be able to cover as much information as possible during the meeting. Prospective proposers may also ask questions they have about this opportunity during the teleconference. Proposers may also receive technical assistance from project staff at this time, which may include tips and guidance for proposing for this opportunity.

Potential applicants are strongly encouraged to register early in NSPIRES and sign up for notification emails so they will receive notice of the pre-proposal webinars. Refer to the MUREP ESSR landing page on NSPIRES for question submission and schedule information.

Proposers shall submit any questions via email only as instructed on the NSPIRES announcement of this opportunity. Responses to questions submitted will be provided in a "Frequently Asked Questions (FAQ)" list that will be posted on the MUREP ESSR landing page on NSPIRES The list will be updated frequently during the open period of this NOFO.

13.4.4. Contact and Resource Information

Selection Officer
Keya Briscoe
MUREP Acting Program Manager
Mary W. Jackson - NASA Headquarters
300 E Street, SW.
Washington, DC 20546

Program Office Contact
James Harrington MUREP ESSR Activity Manager
Email: NASAESSR@nasaprs.com.

13.4.5 Proposal Submission Method, Dates, and Times

Electronic proposal submission is required via NSPIRES ONLY. See NASA Proposer's Guide.

Application Submission Deadline

Application Materials	Required or encouraged	Due Date and Time
Letter of Intent	Not Required	N/A
Full Application	Required	October 30, 2024, at 11:59 pm ET

All applications **must** be received by the established deadline.

NASA will not review applications that are received after the deadline or consider these late applications for funding.

Applicants experiencing technical problems outside of their control must notify NASA as soon as possible and before the application deadline. Failure to timely notify NASA of the issue that prevented the timely filing of the application may preclude consideration of the award.

For technical assistance with NSPIRES, please contact the NSPIRES Help Desk at nspires-help@nasaprs.com or (202) 479-9376, Monday through Friday, 8:00 AM – 6:00 pm ET. PLEASE NOTE: The NSPIRES Help Desk closes at 6:00 pm PT, Monday through Friday, and is closed on federal holidays. It is highly recommended that proposers do not wait until the final hours before the proposal deadline to submit their proposals. All dates are subject to change. Please regularly check the NSPIRES website for details. All information to be reviewed in support of a proposal must be uploaded together as a single PDF submission in NSPIRES. All proposals shall be submitted electronically through NSPIRES only. All organizations and the team members participating in the proposal must be registered in NSPIRES. Proposals delivered through any other means will be rejected and will not be reviewed. Also, late proposals (i.e., those received after the stated deadline) will be rejected and will not be reviewed.

Collection of Demographic Information

NASA is implementing a process to collect demographic data from grant applicants for the purpose of analyzing demographic differences associated with its award processes. Information collected will include name, gender, race, ethnicity, disability status, and citizenship status. Submission of the information is voluntary and is not a precondition of award.

13.5 APPLICATION REVIEW INFORMATION

The three criteria (and their weights) for proposal evaluation and award selection are: Intrinsic Merit (40%), Relevance to NASA (40%), and Budget/Cost and Budget Narrative (20%). Proposers shall carefully review the following specific evaluation criteria for MUREP ESSR proposals.

13.5.1 Intrinsic Merit (weighted 40% in the evaluation)

Evaluation of intrinsic merit. Proposers shall address all the following elements and sub-elements to demonstrate the capability of the institution, PI, program staff, and partners/collaborators to achieve successful outcomes for the proposed activity and reach targeted students.

Management Approach

- Demonstrates the Lead Institution has goals and objectives that are aligned with NASA Strategic Goal 4, NASA Strategic Objective 4.3, and NASA's STEM Engagement goals (see Section 13.1.4.1 Relevance to NASA and NASA's OSTEM of this NOFO).
- Describes the alignment of the proposed program to MUREP ESSR goals, objectives, and priorities and how the proposed program will contribute to the overall achievement of these measures of success.
- Presents a clearly organized and workable management plan for achieving MUREP ESSR program goals and objectives and includes clear lines of communication with NASA.
- Clearly describes and defines how the site will interact with NASA and its identified stakeholders (both internal and external).
- Presents a realistic schedule/timeline and/or other description of how activity goals, objectives, and major milestones will be achieved.
- Provides details of the organizational structure.
- Clearly identifies the Principal Investigator and the appropriate office at the lead institution that is ultimately responsible for the overall performance of the MUREP ESSR award.
- Includes a detailed approach to provide instructional staff with training and ongoing support to effectively implement the ESSR program.
- Identifies and proposes a target audience (e.g., grade level, demographic targets).
- Includes an approach to collecting required NASA performance metrics (i.e., metrics demonstrating progress in achieving the MUREP ESSR goals and objectives; and see Section 13.6.4 Office of STEM Engagement Performance Metrics of this NOFO) and identifies the position/individual responsible for reporting performance metrics to NASA.
- Includes an evaluation or assessment approach to measure project accomplishments against the proposed goal(s) and objectives of the MUREP ESSR Institute; and
- Addresses and describes relevant past experiences conducting similar programs to MUREP ESSR if applicable.

Data Sharing Plan

- Demonstrates a clear plan for data sharing.
- Describes plan for publishing at least one technical paper/journal article during the award's three-year period of performance; and
- Describes plan to present published paper(s) at appropriate professional conferences, meetings, and/or workshops.

Recruitment and Retention Plan

- Demonstrates an understanding of the unique challenges faced by college students from talented individuals from all backgrounds and life experiences in the STEM areas (i.e., women, racial and ethnic minorities, and persons with disabilities).
- Provides evidence of the ability to attract and retain students from target populations, sets forth selection criteria and procedures, and provides a demographic profile of the community/communities being served.

Relevance to NASA (weighed 40% in the evaluation)

Evaluation of Relevance to NASA considers the following scientific relevance and educational relevance elements and sub-elements:

Scientific Relevance

Provides evidence that the activity utilizes NASA's unique contributions to science, engineering, technology, and exploration. Identifies current NASA content, which the proposing institution has selected and will be utilizing for its activities.

- References applicable NASA missions, Mission Directorates and/or research areas that will serve as the context for student authentic STEM activities (see Section 13.1.4.2 Research Priorities for NASA Mission Directorates and Centers of this NOFO).
- Uses evidence-based strategies and/or practices in the development of any proposed activities, and/or other evidence supporting the rationale for the proposed approach, tools, and/or techniques.
- Offers innovative methods, approaches, and concepts to engage students in other NASA activities.
- Provides evidence that the proposed effort cultivates diversity and extends access to existing NASA content.

Educational Relevance

- Describes how the proposed MUREP ESSR program is aligned to applicable Earth science college curriculum.
- Increase students' preparedness for STEM degree programs by building a powerful connection with NASA workforce between faculty mentors/advisors, and peers and NASA Science Mission Experts.
- Increase students' awareness and understanding of Earth Science careers, as well as access to internships and potential employers, by enabling connections to Earth Science professionals.
- The proposed effort builds on lessons learned and/or best practices of past education and/or research and learning activities. Specific examples of how the students will benefit with an Earth science program and the future workforce.

- Designs a program aligned to evidence-based effective strategies that lead to achieving the program goals, objectives, and intended outcomes.

Budget/Cost and Budget Narrative (weighted 20% in the evaluation)

Proposers shall clearly describe how the proposed budget is appropriate for the proposed effort. Proposals shall include a detailed implementation/costing plan with a clear narrative that demonstrates how funds requested will be fully utilized for the duration of the three-year award period of performance. The following elements will be considered in the evaluation of the Budget/Cost and Budget Narrative:

- Clarity of alignment between the proposal narrative and budget.
- Budget is adequate, appropriate, reasonable, and realistic for the development, implementation, and reporting.
- Budget demonstrates effective use of funds for which outcomes justify total costs; and
- All budget line items are fully explained and justified.

13.5.2 Review and Selection Process

Reviewers and panelists with appropriate expertise will be identified to evaluate each proposal that is compliant and meets requirements that have been stated in this NOFO. Proposers must provide enough detail to enable an effective evaluation by persons who are knowledgeable of, but not necessarily specialists in the proposed area. The reviewers may include personnel from NASA, other federal government agencies, industry, colleges, and universities.

Proposals will be evaluated through a two-phased process to include an evaluation completed by reviewers and panelists. The first phase of the evaluation will be conducted online by reviewers, with the highest-rated proposals moving forward to panel review, which is the second phase. The MUREP ESSR Activity Manager will present the panel's final recommendations to the NASA Selection Official. **Note: NASA reserves the right to utilize only a panel review.**

The Selection Official will use programmatic factors (including considering available funding) to achieve an awardee portfolio that meets the goals and objectives of MUREP ESSR. Although not part of the peer review evaluation of the proposal, as a programmatic factor the selection official may consider whether the proposed research broadens participation of non- Research II (R2) MSI's, Carnegie designations for classifying research level capacity for higher level institutions (Carnegie Classification of Institutions of Higher Education® (acenet.edu)). NASA seeks a balanced award portfolio, and considers diverse factors, including but not limited to, different types of institutional representation, previous MUREP awards received, participation by individuals traditionally underrepresented in STEM studies and careers, and geography.

In evaluating the proposals, NASA will assign one of the following overall ratings:

- **Excellent -** A comprehensive and thorough proposal of exceptional merit with one or more significant strengths. No deficiency or significant weakness exists.

- **Very Good** - A proposal having no deficiency, and which demonstrates overall competence. One or more significant strengths have been found, and strengths outbalance any weaknesses that exist.
- **Good** - A proposal having no deficiency, and which shows a reasonably sound response. There may be strengths or weaknesses, or both. Weaknesses not offset by strengths do not significantly detract from the proposer's response.
- **Fair** - A proposal having no deficiency, and which has one or more weaknesses. Weaknesses outbalance strengths.
- **Poor** - A proposal that has one or more deficiencies or significant weaknesses that demonstrate a lack of overall competence or would require a major proposal revision to correct.

13.5.2.1 Successful Proposals

Upon selection of the awardee recipients by the Selection Official, the PI of each successful proposal will receive a "Notice of Intent to Make a Federal Award" letter via NSPIRES with an explanation of the review process and reviewers' comments about the proposal. It is anticipated that these letters will be released in late January 2025. Proposers are strongly cautioned that only a NASA Grant Officer may make commitments, obligations, or awards on behalf of NASA or authorize the expenditure of funds for this opportunity. Pre-award costs will not be allowed for cooperative agreements awarded through this funding opportunity. It is this program's practice to provide a letter indicating application selection and "Notice of Intent to Make a Federal Award" letter prior to the release of Federal award funding. This letter is not an authorization to begin performance. If a submitter is selected for an award, and it incurs pre-award costs, this is at the submitter's/recipient's own risk and NASA will not pay them.

NASA will notify successful grant recipients of funding via a Notice of Award (NASA Form 1687) signed by the Grant Officer. This Notice of Award is the authorizing document and will be sent to the proposing PI and the Authorized Organization Representative (AOR) listed in the proposal via electronic delivery. All expenses incurred on grant activities prior to the period of performance start date listed on the Notice of Award are at the risk of the non-Federal entity until the Notice of Award is received and period of performance commences.

13.5.2.2 Unsuccessful Proposals

Upon selection of recipients, the PI of an unsuccessful proposal will receive a non-selection letter with an explanation of the review process and reviewers' comments about the proposal via NSPIRES.

13.5.2.3 Anticipated Announcement and Federal Award Dates

Open Application Period: July 30, 2024
Pre-proposal Webinar 1: August 15, 2024
Pre-proposal Webinar 2: September 19, 2024
Final Office Hour: October 24, 2024
Application Period Closes: October 30, 2024

Anticipated Selection Announcement Date: January, 2025
Anticipated Federal Award Date: Prior to March, 2025

13.6 FEDERAL AWARD ADMINISTRATION INFORMATION

13.6.1 Cooperative Agreement Award Reporting Requirements

The reporting requirements for recipients under the MUREP ESSR will be consistent with the GCAM.

Unless otherwise noted, the MUREP ESSR PI shall submit reports as described below via secure transfer and following Personally Identifiable Information (PII) requirements to the NSSC with a courtesy copy to the MUREP ESSR Activity Manager. For additional information on PII, see NASA Privacy Procedural Requirements.

All reports shall include the following data elements on the report's cover page:

- Federal agency (i.e., NASA) and program office to which the report is submitted
- Award number
- Project title
- PI name, title, and contact information (e-mail address and phone number)
- Name of submitting official, title, and contact information (e-mail address and phone number), if other than PI
- Submission date
- UEI number and EIN number
- Recipient organization name and address
- Recipient identifying number or account number if any
- Period of performance start and end date
- Reporting period end date
- Report term or frequency (annual, semi-annual, quarterly, other)
- Final Report? Indicate "Yes" or "No"
- Signature of submitting official (either handwritten or electronic)

In addition to the data elements above, all NASA performance reports shall report on one mandatory reporting category, "accomplishments."

Accomplishments data element:
1. What were the major goals and objectives of this project?
2. What was accomplished under these goals and objectives?
3. What opportunities for training and professional development has the project provided?
4. How were the results disseminated to communities of interest?
5. What do you plan to do during the next reporting period to accomplish the goals and objectives?

For further details on reporting project performance, please refer to the Post-Award Phase Section of the GCAM.

Federal Financial Reporting

Recipients of NASA funding must submit financial reports. Financial reports must be submitted via the Payment Management System (PMS) as follows:

- Semi-annual Federal Financial Reports (FFR) due no later than 30 days past the reporting period end date.
- Final Financial Status Reports/Final Federal Financial Report (FSR/FFR) are due no later than 120 days after the end of the period of performance.

Comprehensive Evaluation Plan (CEP)

Within two months after award, using required report formats, recipients shall submit a CEP that:

- Is developed by the IE with concurrence by the PI.
- Provides a clearly articulated logic model.
- Describes an appropriate evaluation plan/process that is based on reputable models and techniques, documents outcomes and demonstrates progress toward achieving the goals and objectives of the proposed education activities.
- Identifies how progress toward achieving the objectives of proposed education activities will be measured; and
- Identifies a timeline and benchmarks for objectives that align with MUREP high volume reporting requirements.

NOTE: The NASA OSTEM P&E Team will provide guidelines and templates for the CEP and evaluation report deliverables. The submitted CEP will be approved by the MUREP ESSR Management Team after the recipient dispositions any feedback and comments provided by the P&E Team.

Performance Reporting

NASA award recipients must also submit annual and final performance reports. Annual reports are due to NASA 60 days prior to the anniversary date of the award, except in the award's final year. Awards that are in their final year are required to submit final performance reports instead of the annual performance report. Descriptions of annual and final reporting requirements for MUREP ESSR are below:

Annual Report (due each year 60 days prior to the anniversary date of the award, except in the award's final year)

Award recipients shall submit an Annual Report every year no later than 60 days prior to the anniversary date of the award, except for the award's final year.

Final Report (120 days following the end of the performance period)

Recipients shall submit a Final Report no later than 120 days following the end of the performance period.

Additional Reporting Requirements

NASA recipients must conform to all reporting requirements outlined in the Required Publications and Reports section of the GCAM, currently Appendix F.

13.6.2 Administrative and National Policy Requirements

In addition to the requirements in this section and in this NOFO, NASA may place specific terms and conditions on individual awards in accordance with 2 C.F.R. Part 200. Recipients of NASA grant funding shall adhere to requirements set forth in 2 CFR 200, 2 CFR 1800, 2 CFR 170, 2 CFR 175, 2 CFR 182, and 2 CFR 183.

13.6.3 Summary of MUREP ESSR Awardee Responsibilities

The MUREP ESSR award recipients have the primary responsibility for implementing, operating, and managing the project as described in their submitted proposal.

- Each recipient shall select a PI in support of this agreement, to be primarily responsible for the overall management of the award and serve as the primary point of contact for NASA. If the PI to be named is different from the individual identified in the proposal, the NSSC and the MUREP ESSR Activity Manager shall be notified in advance and in writing. Any proposed change to the PI under this Agreement is subject to NASA's written advance approval. See the NASA GCAM, Section 7.7, Change of Principal Investigator or Recipient Institution, for more information.
- Each recipient shall participate and present during the virtual kickoff meeting, training workshops, and monthly activity meetings as required.
- Each recipient shall participate in one conference per year directly related to the chosen Science Research Case Concept and NASA OSTEM Better Together conference (every other year) and shall be reflected in the budget.
- Performance Outcomes: All institutional PIs with NASA OSTEM grants and/or cooperative agreements shall provide and verify performance data for the awarded project and submit such data to NASA for review, prior to entry in the NASA STEM Engagement Gateway system, in accordance with NASA guidance.
- Each recipient shall submit all required reports via email to the NSSC with a courtesy copy to the MUREP ESSR Activity Manager.
- The awarded institution, in concert with the PI, is responsible for the financial management of MUREP ESSR as specified in the basic award notice under the terms and conditions issued by NASA and in the GCAM. Failure to comply with the terms and conditions of an award may result in NASA terminating the award.
- Each recipient shall engage with the IE and project administration support staff to ensure that evaluation and required reports are transparent, appropriately conducted (maintaining independence from programmatic, regulatory, policymaking, and stakeholder activities), compiled, and reported.

- NASA reserves the right to impose additional requirements during the period of performance of the cooperative agreement to achieve broader MUREP ESSR or NASA objectives.

13.6.4 Office of STEM Engagement Performance Metrics

NASA currently utilizes the NASA STEM Gateway registration/application and data management system (Gateway system) for analyzing performance data. PIs are required to timely and properly respond to data calls as requested by NASA OSTEM and utilize the Gateway system for performance data reporting. Additional communications and guidance regarding data calls and the Gateway system will be sent to recipients from the NASA OSTEM and MUREP ESSR Activity Manager. The PI shall ensure that it has the appropriate staff and resources to facilitate data collection activities and properly complete tasks required for timely reporting to NASA.

13.6.5 Other Information

Access to NASA Facilities/Systems

All recipients shall work with NASA project/program staff to ensure proper credentialing for any individuals who need access to NASA facilities and/or systems. Such individuals include U.S. citizens, lawful permanent residents ("green card" holders), and foreign nationals (those who are neither U.S. citizens nor permanent residents).

13.6.6 Summary of Key Information

Total Estimated annual budget for MUREP ESSR award	Up $3,000,000
Anticipated number of awards pending adequate proposals of merit	4-6 collaborative awards
Estimated Start Date	March 1, 2025
Duration of Awards	Three Year
Award Type	Cooperative Agreement
Release Date for MUREP ESSR NOFO	July 30, 2024, 5:00 pm ET (Date Subject to Change); Check MUREP ESSR landing page for details.
Pre-proposal Webinar 1	August 15, 2024, 4:00 pm ET
Pre-proposal Webinar 2	September 19, 2024, 4:00 pm ET
Final Office Hour	October 24, 2024, 4:00 pm ET
Due Date for Proposals	October 30, 2024, at 11:59pm ET
Page limit for the Narrative Section of proposal	15 pages *NASA Proposer's Guide*

Detailed instructions for the preparation and submission of proposals	See *NASA Proposer's Guide*
Submission medium	Electronic proposal submission is required via NSPIRES ONLY. See *NASA Proposer's Guide*
Selection Official	Keya Briscoe Mary W. Jackson – NASA Headquarters Washington, DC 20546
NASA Point of Contact for this NOFO	James Harrington, Activity Manager NASAESSR@nasaprs.com.

Appendix 13-A: MUREP ESSR Science Research Case Concepts and Contacts

1. Coastal Resiliency/Sea Level

Coastal zones, including Great Lakes coastlines, are areas of active and important biogeochemical exchange between the land and the ocean, including carbon sequestration, and support a wide range of ecosystems that play important roles in tangible and intangible services provided to humanity (e.g., climate mitigation via blue carbon ecosystems, recreation and tourism via reefs and beaches, storm protection via above and submerged aquatic vegetation). They are also areas where nearly 40% of the U.S. population live and represent economic engines for the Nation. However, coastal zones are vulnerable to both natural and anthropogenic threats, including sea level rise and storm surge, erosion, oil spills, harmful algal blooms, intense storms and hurricanes, wildfires, and other and hazards exacerbated by climate change. The progressive and fast warming of our planet is anticipated to intensify existing coastal pressures and impact coastal biogeochemistry and ecology, affect ecosystem structure and function and biodiversity, ultimately impacting the ecosystem services humans depend on and threatening economic prosperity. Increasing coastal resilience for both social and natural systems is critical to mitigate climate change impacts in these regions and halt or reverse degradation of coastal ecosystems and their services.

Goal: Address research that contributes to furthering support priorities related to coastal resilience and provide foundational information and evidence-based knowledge that will help inform solutions to increase resilience of coastal communities.

Objective 1: Exploration of the underlying physical, biological, and/or geological impacts that threaten coastal human and natural communities, and potential mitigation strategies. Research responsive to this objective may include studies focused on (i) sea level rise, coastal erosion/retreat, and salt-water intrusion, and their impacts on ecosystems; (ii) coastal erosion and the role of urban development on land subsidence, and their impacts on natural ecosystems; (iii) impacts of hazards related to climate extremes, such as storms and heat waves, on biogeophysical aspects of the coast and ecosystem services, etc.

Objective 2: Exploration of Nature-Based Solutions focusing on biodiversity restoration and enhancement of carbon sequestration. Research responsive to this objective may include studies involving (i) analysis of past destructive events (e.g., storms, wildfires, etc) in a particular region by quantifying and attributing coastal resilience along different carbon pathways (ii) analysis of ongoing events in a region by linking observations to different timescales of resilience across different carbon and biodiversity pathways, (iii) diagnostic and mechanistic modeling exploring quantifiable hypotheses across biodiversity, coastal resilience, and carbon sequestration.

Objective 3: Integration of existing and upcoming observational and modeling assets into a conceptual or digital coastal framework that enables the prediction of future scenarios (e.g. digital twins). Research responsive to this objective may leverage vast amounts of physical and social data to better predict coastal resilience (clearly defined and quantifiable in the context of a specific study) for a region(s) or event(s) of interest, through machine learning or other high-throughput models.

The proposed investigations should be of regional (beyond local, 1,000+ km) focus, preferably in areas of high potential population growth, e.g. U.S. East, West, or Gulf coasts and island that are impacted by climate change and/or socio-economic disadvantages. Proposals must provide a rationale for their region of choice. Proposed investigations must utilize remotely sensed observations (e.g., PACE, MODIS, Landsat, ECOSTRESS, EMIT, Sentinel 2-3, etc.) for data analysis and as a primary research tool. Proposers are also encouraged to use data acquired via the NASA CSDAP (https://csdap.earthdata.nasa.gov/)A description of NASA's fleet of Earth observing satellites and sensors can be found at https://science.nasa.gov/missions-page/ with more details about related airborne missions at https://airbornescience.nasa.gov/. Information about data access and discovery can be found at https://earthdata.nasa.gov/.

Coastal resilience is defined here as "the capacity of the social and natural systems in the coastal environment to cope with disturbances, induced by factors such as sea level rise, extreme events, and human impacts, by adapting and mitigating while maintaining their essential functions[1]." Coastal areas are also socially complex, involving a wide range of people, governing structures, and values, requiring a tight link between social and natural scientists and stakeholders; thus, truly working towards resilience requires a well-integrated interdisciplinary approach.

This research opportunity will not fund the acquisition of new in situ data but seeks to further leverage the large quantities of remotely sensed and/or in situ data that NASA has already collected over the years.

[1]Masselink, G. and Lazarus, E.D., 2019. Defining coastal resilience. *Water*, *11*(12), p.2587.

POCs: Laura Lorenzoni, Neumann, Tom (GSFC-6100) thomas.neumann@nasa.gov

2. Air Quality / Health (Urban Heat Island)

Air pollution is a significant threat to human health and our environment. Instruments on NASA satellites, along with airborne and ground-based sensors, are constantly collecting data on major pollutants in our atmosphere.

According to the World Health Organization, air pollution contributes to millions of premature deaths around the world each year. Pollution also dirties our skylines and harms animal and plant life. NASA instruments — on satellites, planes, and the ground — constantly collect data on major pollutants. NASA-funded scientists track the sources and concentrations of these pollutants and their movement through the atmosphere. They provide managers and policymakers with Earth observations that can inform air quality standards, public policies, and government regulations for economic and human welfare. Air Quality - NASA Science

Goal: Address air quality research relevant to public health

Objective 1: Advance air quality research to provide useful information to decision makers.

Example: The air across the entire United States is cleaner than ever – but there's more to do. Air pollution data from satellites, airplanes, and ground sensors can be combined with data on race, ethnicity, poverty, and health. In doing so, both the big picture of air pollution and individual neighborhood effects can be unveiled. Information then lets community leaders and other decision makers to make better decisions and address long standing inequities.

https://science.nasa.gov/wp-content/uploads/2024/02/dc-aq-main-16x9-1.webm#t=0.3
Identifying data assimilation gaps in in local in-situ at-risk communities is an excellent research concept for improving research breakthroughs and mitigation strategies as identified in the visualization above.

Objective 2: Research and identify urban heat islands using remote sensing assets.

Example: Heat is often intensified or amplified in cities, a phenomenon known as the urban heat island effect. Asphalt, concrete, and similar materials absorb and retain significantly more heat than vegetation, so temperatures in urban areas are often 10 degrees Fahrenheit hotter than surrounding suburbs or rural regions. In neighborhoods with fewer trees and green spaces, this heat often disproportionately affects older adults, low-income communities and some communities of color. NASA GISS: NASA News & Feature Releases: NASA Researcher Finding Ways to Turn Down the Heat in Cities
https://youtu.be/lnBO4vX82Fs
https://youtu.be/WAqNDArb70M

POCs: Chapman, Helena (HQ-DK000)[BOOZ ALLEN & HAMILTON INC] helena.chapman@nasa.gov ; Neumann, Tom (GSFC-6100) thomas.neumann@nasa.gov

3. **Water Quality**

Goal: Advance research and develop new solutions to address water quality challenges in inland and coastal communities.

The Water Resources program area helps identify needs, co-develop research and applications, and demonstrate new practical uses for NASA's Earth observations in the water resources management community. It aims to bridge water information derived from NASA remote sensing assets and capabilities with partners in the water resources management and decision-making community for real world impact.

As access to clean water supplies continue to come under pressure in many regions of the world, water resource decisions are becoming increasingly complex. Recent advances in sensor technology, satellite data products (including commercial sector offerings), modeling, and ML/AI have revolutionized our ability to monitor and forecast freshwater and nearshore marine water quality with unprecedented precision.

The physical, chemical, biological, and microbiological constituents of water determine its suitability for use; this is referred to as its "quality." Thinking holistically about water quality involves recognizing the relationship between environmental drivers and water quality parameters. NASA's Earth observation capabilities uniquely enable monitoring of not only environmental drivers, but also water quality parameters such as chlorophyll, turbidity, colored dissolved organic matter (cDOM), dissolved organic carbon, and surface temperature. This integrated approach enhances our understanding of how environmental factors impact water quality, informing decisions for water quality management (drinking water, recreational waters, safe seafood, and human-ecosystem health) in fresh waters and coastal environments.

Factors affecting water quality include:

- Land use, land use change (urban, industrial, and agricultural use)
- Eutrophication - runoff of nutrients to the water, especially excess nutrients
- Waste water, pollution, and poor water infrastructure.
- Water temperature
- Food web changes and aquatic life
- Wildfire and disaster impacts including aquatic debris, erosion and sediment, and contamination.
- Changes in water flow, such as after events like hurricanes, drought, or floods

Objective 1: Advance water quality research and solutions to provide actionable information to water resource managers and decision-makers.

Pursue activities related to monitoring and forecasting water quality in freshwater and nearshore coastal ecosystems, with a focus on delivering solutions that meet the diverse needs of the water management community.

Proposed investigations must utilize remotely sensed observations (e.g., PACE, MODIS, Landsat, ECOSTRESS, EMIT, Sentinel 2-3, etc.) for data analysis and as a primary research tool. Proposers are also encouraged to use data acquired via the NASA CSDAP (https://csdap.earthdata.nasa.gov/). A description of NASA's fleet of Earth observing satellites and sensors can be found at https://science.nasa.gov/missions-page/, with more details about related airborne missions at https://airbornescience.nasa.gov/. Information about data access and discovery can be found at https://earthdata.nasa.gov/.

Proposed investigations that are developing water quality applications and tools are strongly encouraged to work in collaboration with a water quality management end-user or organization to ensure solutions are addressing water quality challenges and needs.

Useful links:
Water Resources | NASA Applied Sciences
Water Quality Data Pathfinder | Earthdata (nasa.gov)

POCs: Jephson, Erin Urquhart (HQ-DK000) erin.urquhart@nasa.gov; Pahlevan, Nima Pahlevan {he,his} (GSFC-619.0)[SCIENCE SYSTEMS AND APPLICATIONS INC] nima.pahlevan@nasa.gov

4. **Agriculture/Food Security on Earth and in space**

The Agriculture Program Area promotes the use of Earth observations to strengthen food security, support market stability and protect human livelihoods.

Goal: Help grow food security, improve agricultural resilience, and reduce price volatility for vulnerable communities.

Objective 1: Conduct research to support a deeper understanding of U.S. agricultural land use, productivity, and sustainability.

Objective 2: Strengthen environmental and human resilience to climate change and global hazards, especially by increasing diversity, equity, inclusion, and justice in agricultural work.

Example: NASA Acres consortium is NASA's U.S. focused agriculture program element established in March 2023. It was commissioned by NASA and is led by the University of Maryland. NASA Acres focuses on applying Earth observation information to the most pressing agricultural and food security challenges facing U.S. farmers, ranchers, and agrifood systems. NASA Acres works with stakeholders across the agricultural spectrum to develop Earth observatory-based data and tools that help increase production, while protecting and restoring land, water, atmosphere, and human health.

In 2022, the NASA Harvest team used Planet satellite base maps together with environmental, economic, and social science impact data to forecast how wheat harvests in Ukraine were affected by the country's conflict with Russia, critical information for food security specialists. During the COVID-19 pandemic, NASA Harvest supported the Government of Togo's food security relief efforts with cropland maps that used data from Planet and other sources.

POCs: Whitcraft, Alyssa (GSFC-4070) [REI SYSTEMS INC] alyssakw@umd.edu; Hannah Kerner hkerner@umd.edu

Objective 3: Pursue research related to optimizing plant growth in enclosed spaces, especially as it relates to space exploration.

The first vertical farm in the U.S. provided a foundation for expanding the controlled environment agriculture industry. NASA has been working for decades to tackle similar agricultural problems on Earth for space exploration. Reusing a limited water supply, minimizing energy consumption, and eliminating soil as a growth medium are just a few ways the agency stretches the limited resources available in space. Research into solving these challenges to grow plants in a closed environment like a spacecraft inspired NASA to build the first vertical farm in the United States, creating a foundation for the controlled environment agriculture industry to build on.

Called controlled environment agriculture or CEA, this combination of plant science and environmental control techniques optimizes plant growth inside an enclosed space. Unlike a traditional greenhouse, this new vertical approach to cultivation leverages technology and data to maintain ideal growing conditions in a completely closed structure. These tools make it possible to filter contaminants from water for crops (keeping them out of food) and deliver the exact nutrient balance to feed any crop throughout its life cycle. Artificial lighting can eliminate the effects of fluctuating solar light, nurturing growth with a precise mix of beneficial red, blue, and green light at the right intensity and duration. Environmental controls also maintain proper temperature and humidity to prevent disease.

POCs: Smith, Trent M. (KSC-UBA00) trent.m.smith@nasa.gov; Vannorman, Delvin D. (KSC-UBT00) delvin.vannorman@nasa.gov

5. Environmental Justice

NASA's ESD not only aims to diversify Earth science research and applications communities with representation from all backgrounds, but also support Environmental Justice (EJ) communities by expanding awareness, accessibility, and use of Earth science data and enabling contributions to Earth science research and applications.
While EJ themes crosscut through all the appendix topics listed here, this NOFO also solicits directly related to environmental justice as a research topic.

Goal: Ensure that the investment the nation has made in NASA satellites and science benefits people across the U.S. and helps them make informed decisions about the very real challenges they face in their communities.

Objective 1: Assess ongoing environmental justice engagements, barriers, gaps, and opportunities, especially as it relates to NASA science and using NASA data.

Objective 2: Engage with EJ organizations to harvest lessons and build potential partnerships.

Objective 3: Host data accessibility and utility sessions.

Objective 4: Enable transdisciplinary science and applications that integrate physical and social science using NASA datasets.

POC: Luna-Cruz, Yaitza (HQ-DK000) yaitza.luna-cruz@nasa.gov

6. Biological Diversity and its Conservation

Biological diversity, or biodiversity, refers to the variety of all life on Earth — from genes to species, ecosystems, and biomes. Research has shown that globally biodiversity is declining. NASA studies how and why global biodiversity is changing, and the effects of these changes on, and interactions with, Earth system processes.

Sensors on a suite of NASA satellites, combined with airborne platform products, in-situ observations, and models, provide measurements of marine, freshwater, and terrestrial biodiversity and relevant environmental variables both affecting and affected by biodiversity change, including climate and human interactions with the environment. These measurements enable better understanding of Earth's biodiversity and how it is changing.

These same measurements may also be used to promote the conservation of biodiversity through decision making tools enabling better decisions by resource managers and the public. NASA co-designs conservation solutions directly with end users who have the authority for sustainable management of Nature and natural resources. These conservation activities operate across all spatial scales from local to regional to national to global and within marine, freshwater, and terrestrial ecosystems.

Goal:

a. **Address how Earth system processes affect biodiversity and/or are affected by biodiversity.**
b. **Use NASA data products to co-design conservation efforts with end users working at scales ranging from local to global.**

Earth system changes include changes in the distribution and/or abundance of plants, animals, fungi, and forms of microbial life.

Goal: Advance understanding of changes in the distribution and abundance of marine, freshwater, and terrestrial biodiversity as well as the drivers and impacts of these changes. Promote the conservation of marine, freshwater, and terrestrial biodiversity using NASA data products to co-design conservation tools for resource managers.

Objective: Use NASA data to advance understanding of biodiversity and promote its conservation.

POCs: Turner, Woody (HQ-DK000) woody.turner@nasa.gov , Gaddis, Keith D. (HQ-DK000) keith.gaddis@nasa.gov

7. **Carbon cycle and greenhouse gas mitigation**

Goal: Use satellite and airborne remote sensing to advance understanding of Earth's carbon cycle and terrestrial ecosystems, changes in their structure and functioning, and their roles in supporting human life and maintaining planet Earth's habitability

An important feature associated with the continuing emission of carbon dioxide (CO2) into the Earth’s atmosphere from human activities (e.g., fossil fuel emissions, land use, cement production) is that, on average, only about half of the increased emissions remain in the atmosphere; the remainder are taken up by biophysical processes in Earth’s biosphere (land and ocean). The Global Carbon Program estimates that, between 2013 and 2022, terrestrial ecosystems have absorbed ~33% of anthropogenic carbon emissions, although these estimates contain significant uncertainty and interannual variability. There are still significant gaps in our understanding of the processes controlling the fluxes and feedbacks of carbon between the atmosphere and Earth’s ecosystems. While ecosystem processes might continue to take up a significant fraction of fossil fuel and land use change emissions, it is also possible that these sinks might diminish, disappear, or reverse in the future as human activities influence environmental and climate change.

Objective 1: Use NASA data to advance understanding of how ecosystem processes and carbon sinks might change if/or when atmospheric CO2 concentrations continue to increase, decrease, or level off.

Remote sensing holds immense promise for understanding the role of animals in the carbon cycle within terrestrial ecosystems. By providing comprehensive, large-scale, and real-time data, remote sensing enables the monitoring of animal movements, behaviors, and population dynamics across various landscapes. This technology can track changes in vegetation and soil health caused by animal activities such as grazing, foraging, and migration. For example, satellite imagery and aerial drones can capture detailed data on land use changes and vegetation patterns influenced by herbivores, directly linking these activities to carbon sequestration and release. Remote sensing can also detect alterations in forest structure and composition resulting from animal interactions, such as the role of keystone species like elephants in forest dynamics. By integrating remote sensing data with ecological research, scientists can gain a deeper understanding of how terrestrial animals contribute to the global carbon cycle, enhancing conservation efforts and informing climate change mitigation strategies.

Objective 2: Use NASA data to advance understanding of how animals influence the terrestrial carbon cycle and other ecosystem processes.

The increasing frequency of extreme weather events, such as wildfires, hurricanes, droughts, and floods, are affecting the ability of terrestrial ecosystems to uptake and store carbon. These events not only disrupt current carbon storage but also may long-term impacts on ecosystem structure and function, potentially pushing ecosystems past critical threshold. Once these thresholds are crossed, ecosystems may shift to a new state with diminished capacity to sequester carbon, creating feedback loops that exacerbate climate change.

Objective 3: Use NASA to advance understanding of how extreme events are impacting terrestrial carbon storage and/or how these impacts are changing over time.

Proposed investigations must utilize NASA satellite (e.g., EMIT, ECOSTRESS, MODIS/VIIRS, Landsat, OCO-2/3, etc.) or airborne (e.g. AVIRIS, UAVSAR, G-LiHT, LVIS, etc.) remote sensing observations for data analysis and as a primary research tool. Proposers are also encouraged to use data acquired via the NASA CSDAP (https://csdap.earthdata.nasa.gov). A description of NASA's fleet of Earth observing satellites and sensors can be found at https://science.nasa.gov/missions-page/, with more details about related airborne missions at https://airbornescience.nasa.gov/. Information about data access and discovery can be found at https://earthdata.nasa.gov/.

POCs: Pavlick, Ryan P. (HQ-DK000) ryan.p.pavlick@nasa.gov; Lefer, Barry L. (HQ-DK000) barry.lefer@nasa.gov

Relevant NASA Resources

The following text contains resources that may be useful for teams as they prepare their proposal and are optional to leverage in this NOFO.

- The Capacity Building Program provides individuals and institutions with workforce development, training activities, and collaborative projects to strengthen understanding of Earth observations and expand their use around the world. Through our unique program elements, we work with everyone at every level — from first-time users to long-time professional users of Earth observation data. The program is composed of unique ways to connect with unique users, and includes ARSET, DEVELOP, SERVIR, and the Indigenous Peoples Initiative.
- Help with data visualization is available through the NASA Scientific Visualization Studio (SVS), NASA SVS | Home. The SVS produces visualizations, animations, and images to promote a greater understanding of Earth and Space Sciences. The SVS works closely with scientists — both within the NASA community, and within the broader academic research community — to create high-quality, data-backed visualizations.
- NASA's ESDS program oversees the life cycle of NASA's Earth science data—from acquisition through processing and distribution. The primary goal of ESDS is to maximize the scientific return from NASA's missions and experiments for research and applied scientists, decision makers, and society at large.

POC: Elizabeth Joyner, (GSFC-613.0] Elizabeth.r.joyner@nasa.gov

- These agency contacts are provided so that regional and local office Points of Contacts can be provided to collaborate and potentially support science research and community goals for resiliency, mitigation, and communication.

  United States Department of Agriculture (USDA) – Davis-Slay, Jacqueline - NRCS, Washington, DC jacqueline.davis-slay@usda.gov

  United States Environment Protection Agency (EPA) - Williamson, Jeannie williamson.jeannie@epa.gov

  United States Department of Energy (DoE) - Trina Bilal, Program Manager, Office of Minority Economic Impact and Diversity & Co-Chair, White House Initiative on HBCUs Federal Funding Opportunities Cluster.
  Emily Kessel-Qureshi, M.A. serves as a Management and Program Analyst in the Office of Energy Justice and Equity (Minority Educational Institutions Division) at the Department of Energy (DOE).
- The NASA SMD Science Activation (SciAct) program is a competitively selected network of collaborative projects that seek to connect NASA Science with diverse learners of all ages in ways that activate minds and promote a deeper understanding of our world and beyond.

Appendix 14: Established Program to Stimulate Competitive Research (EPSCoR) Basic Research FY 2025

14.0 Program Description

The NASA Authorization Act for Fiscal Year 1993, Public Law 102-588, and the Established Program to Stimulate Competitive Research (EPSCoR) Reauthorization Act of 2017, Public Law 114-32 authorized the National Aeronautics and Space Administration (NASA) to initiate NASA EPSCoR to strengthen the research capability of jurisdictions that have not historically participated equably in competitive aerospace research activities. The goal of NASA EPSCoR is to provide seed funding that will enable jurisdictions to develop an academic research enterprise directed toward long-term, self-sustaining, nationally competitive capabilities in aerospace and aerospace-related research. This capability will, in turn, contribute to the jurisdiction's economic viability and expand the nation's base for aerospace research and development.

Based on the availability of funding, NASA will continue to help jurisdictions achieve these goals through NASA EPSCoR. Funded jurisdictions' proposals shall be selected through a merit-based, peer-review competition and presented for review to a NASA HQ Mission Directorate Review Panel.

The following are the specific objectives of NASA EPSCoR:

- Contribute to and promote the development of research capability in NASA EPSCoR jurisdictions in areas of strategic importance to NASA's mission;
- Improve the capabilities of the NASA EPSCoR jurisdictions to gain support from sources outside the NASA EPSCoR programs;
- Develop partnerships among NASA research assets, academic institutions, and industry; Contribute to the overall research infrastructure and economic development of the jurisdiction; and
- Focus on research of important priority to NASA.

This Notice of Funding Opportunity (NOFO) solicits proposals that will result in awards to establish research activities that will make significant contributions to NASA's strategic research and technology development priorities and contribute to the overall research infrastructure, science, and technology capabilities of higher education. Awards resulting from successful proposals will also contribute to the economic development of the jurisdiction receiving funding. Each funded NASA EPSCoR proposer shall work closely with a NASA researcher to focus on developing competitive research and technology for the solution of scientific and technical issues of importance to the NASA Mission Directorates, Centers, and NASA's Jet Propulsion Laboratory (JPL) as listed in the Appendix-A, NASA Mission Directorates and Center Alignment. This collaboration will allow EPSCoR researchers to work alongside NASA and commercial partners and is intended to strengthen the bonds among NASA EPSCoR jurisdictions, NASA, commercial partners, and other entities.

NASA will designate a Technical Monitor (TM) for every cooperative agreement award. The TM's role will encompass monitoring research progress and ensuring ongoing alignment with the established project objectives. Each award recipient is required to furnish an annual report detailing research advancement. These reports will encompass anticipated performance goals, key indicators, target outcomes, baseline data, data collection methods, and other resulting insights. Following evaluation by the TM, these reports will be subject to approval by the NASA EPSCoR Project Manager. Also, they will be disseminated among the NASA Mission Directorates, NASA Centers, and JPL for broader awareness and visibility.

Jurisdictions shall submit electronic progress reports to the NSSC at NSSC-Grant-Report@mail.nasa.gov and the technical officer at agency-epscor@mail.nasa.gov. The reporting requirements for awards made through this NOFO shall be consistent with the NASA Grant and Cooperative Agreement Manual (GCAM), (https://www.nasa.gov/grants-policy-and-compliance-team/#Regulations). Applicants to this NOFO should be aware that awards made on or after October 1, 2024, will need to comply with the new Title 2 regulations which are posted here. The regulations posted on ecfr.gov will be updated as of October 1. Recipients also shall comply with performance report requirements, and Financial Reporting. Additionally, if the federal share of any award issued under this NOFO is more than $500,000 over the total award's period of performance, additional reporting requirements will apply. See 2 CFR § 200 Appendix XII, — Award Term and Condition for Recipient Integrity and Performance Matters (https://www.ecfr.gov/current/title-2/subtitle-A/chapter-II/part-200/appendix-Appendix%20XII%20to%20Part%20200).

14.1.1 Overview of the Funding Opportunity

The program parameters are:

- Each Jurisdiction responding to this NOFO may submit only one proposal in accordance with Section C, Eligibility Information of this NOFO. Proposals will be selected from this solicitation for FY 2025 funding.
- The maximum funding request per proposal is $750,000. This amount is to be expended over a three-year period.
- Cost-sharing by proposers is required at a level of at least 50% of the requested NASA funds. Also, in-kind cost-sharing is allowable.
- It is anticipated that 10 to 15 awards may be made under this NOFO in accordance with the rules and policies set forth in Title 2 Code of Federal Regulations (CFR) Part 200, Uniform Administrative Requirements, Cost Principles and Audit Requirements for Federal Awards (https://www.ecfr.gov/current/title-2/subtitle-A/chapter-II/part-200?toc=1), as adopted and supplemented by NASA through Title 2 CFR Part 1800: Grants and Agreements (https://www.ecfr.gov/current/title-2/subtitle-A/chapter-II/part-200?toc=1), and in the NASA GCAM.
- The Government's obligation to make an award is contingent upon the availability of appropriated funds from which payment can be made.
- This NOFO is available in electronic form through the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) and Grants.gov. However, all proposals shall be submitted through NSPIRES.

To access this NOFO through NSPIRES, go to http://nspires.nasaprs.com and click on Solicitations.

To access this NOFO through Grants.gov, go to https://www.grants.gov/search-grants.html and select the link for NASA under Agency.

14.1.2 Data Management Plan (DMP)

All proposals submitted under this NOFO are required to submit a Data Management Plan (DMP) in accordance with the *NASA Plan for Increasing Access to the Results of Scientific Research* located at http://www.nasa.gov/sites/default/files/files/NASA_Data_Plan.pdf.

In keeping with the *NASA Plan for Increasing Access to the Results of Scientific Research*, new terms and conditions, consistent with the Rights in Data clause in the award, information about making manuscripts and data publicly accessible may be included in each award document. As a general rule, proposals are required to provide a DMP or the proposer shall provide an explanation as to why a DMP is not necessary given the nature of the work proposed. *The DMP shall be submitted by responding to the NSPIRES cover page question about the DMP (limited to 4000 characters)*. Any research project for which a DMP is not necessary shall provide an explanation in the DMP block. Example explanations are as follows:

- This is a development effort for flight technology that will not generate any data that the proposer/recipient can release, so a DMP is not necessary;
- The data that the proposer/recipient will generate will be subject to ITAR; or
- The proposer/recipient may explain why its project is not going to generate data.

- The proposal type that requires a DMP is described in the NASA Plan for Increasing Access to the Results of Scientific Research (see above link). The DMP shall contain the following elements, as appropriate to the project:
- A description of data types, volume, formats, and (where relevant) standards;
- A description of the schedule for data archiving and sharing;
- A description of the intended repositories for archived data, including mechanisms for public access and distribution;
- A discussion of how the plan enables long-term preservation of data; and
- A discussion of roles and responsibilities of team members in accomplishing the DMP. (If funds are required for data management activities, these should be included in the budget and budget justification sections of the proposal).

Proposers that include a plan to archive data should allocate suitable time for this task. Unless otherwise stated, this requirement supersedes the data sharing plan mentioned in the GCAM.

In addition, researchers submitting NASA-funded articles in peer-reviewed journals or papers from conferences shall make their work accessible to the public through NASA's *PubSpace* at https://sti.nasa.gov/submit-to-pubspace/#.YD5lRJNKhTY.

See NASA's Scientific and Technical Information Program's DMP FAQ at https://sti.nasa.gov/faq/ and the Science Mission Directorate's DMP FAQ at http://science.nasa.gov/researchers/sara/faqs/ for more information.

14.1.3 Unique Entity Identifier (UEI) and System for Award Management (SAM.gov)

Each applicant for NASA funding (unless the applicant is an individual or is excluded per 2 CFR 25.110) is required to:

- Be registered in the System for Award Management (SAM.gov) before submitting a proposal;
- Maintain an active SAM.gov registration with current information, including information on a recipient's immediate and highest-level owner and subsidiaries, as well as on all predecessors that have been awarded a Federal contract or grant within the last three years, if applicable, for all times during which it has an active Federal award or an application or plan under consideration by NASA; and
- Provide its Unique Entity Identifier (UEI) in each application or plan it submits to NASA. UEIs may be obtained by registering in SAM.gov
- Each individual team member (e.g., Principal Investigator (PI), co-investigators), including all personnel named on the proposal's electronic cover page, shall be individually registered in NSPIRES.

NASA may not issue an award or financial modification to an existing award to an applicant or recipient entity until the entity has complied with the requirements to provide a valid UEI and maintain an active SAM.gov registration with current information. At the time of award issuance, if the intended recipient has not complied with the UEI or SAM.gov requirements, NASA may determine that the applicant is not qualified to receive an award and use that determination as a basis for making an award to another applicant.

14.1.4 Federal Award Information

Subject to Congressional appropriation of sufficient funds and NASA's receipt of proposals of adequate merit, NASA expects to select 10-15 proposals for Basic Research awards. The period of performance for each proposal/resulting award is three years. Successful proposals for this opportunity will be funded as cooperative agreements. As cooperative agreements, substantial involvement between awardees and NASA is expected. Funding shall be up to $750,000 per award. The period of performance is expected to begin four months from the selection announcement.

14.2.1 Award Guidelines

- Available Total Funding for this NOFO is approximately $10 Million.
- Projected Number of Awards: Between 10 to 15 awards of up to $750,000 each.
- Maximum Award Amount (Per Proposal): $750,000
- Anticipated Period of Performance: NASA EPSCoR awards will support cooperative agreements, each with a three-year period of performance (PoP). It is anticipated that this PoP will enable the researchers to achieve the performance task objectives of the proposal and/or as included in any amendments submitted with the recipient's annual progress reports and accepted by the NASA EPSCoR project office.
- Projected PoP Start Date(s): For planning purposes, PIs should assume that the award start date will be approximately six months after the proposal deadline date. The project start date may be negotiated with the NASA Shared Services Center (NSSC) Grant Officer.
- Projected PoP End Date(s): The PoP end date will be three years after the PoP start date.
- Funding Instrument Type(s): Cooperative Agreement
- NASA will assign a TM for each award. Cooperative Agreements have substantial government involvement to support the recipient's performance of the project. Therefore, the TM will monitor the progress of the research and collaborate as required to keep the research aligned with the approved project's objective(s). Each recipient shall provide an annual report on the progress of the research; this report shall be reviewed by the TM and approved in writing by the NASA EPSCoR Project Manager. These reports also will be shared with the NASA Mission Directorates, NASA Centers, and JPL.

14.2.2 Budget Guidelines and Requirements

14.2.2.1 Funding Restrictions

All costs charged to awards covered by this NOFO must comply with the Uniform Administrative Requirements in 2 CFR 200 and 2 CFR 1800, unless otherwise indicated in the NOFO, the terms and conditions of the award, and the [Grants Policy and Compliance Team - NASA](). Additionally, the following restrictions apply:

1. All proposed funds must be allowable, allocable, and reasonable. Funds may only be used for the proposed project. All activities charged under indirect costs must be allowed under 2 CFR 200 cost principles.
2. Grants and cooperative agreements shall not provide for the payment of fee or profit to the recipient.
3. Proposals must not include bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds basis.
4. Any funds used for cost sharing or matching must be allowable under 2 CFR 200.
5. The non-Federal entity must use one of the methods of procurement as prescribed in 2 CFR 200.320, Methods of procurement to be followed (https://www.ecfr.gov/current/title-2/subtitle-A/chapter-II/part-200/subpart-D/subject-group-ECFR45ddd4419ad436d/section-200.320).
6. Funds may not be used to fund research carried out by non-U.S. institutions. However, U.S. research award recipients may directly purchase supplies and/or services that do not constitute research from non-U.S. sources. Subject to export control restrictions, a foreign national may receive payment through a NASA award for the conduct of research while employed either full- or part-time by a U.S. institution. For additional guidance on foreign participation in awards, see the GCAM and the NASA FAR Supplement (NFS) part 1835.016-70 (https://www.acquisition.gov/nfs/1835.016-70-foreign-participation-under-broad-agency-announcements-baas).
7. Subject to export control restrictions, a foreign national may receive payment through a NASA award for the conduct of research while employed either full- or part-time by a U.S. institution. For additional guidance on foreign participation, see the GCAM and NFS part 1835.016-70.
8. EPSCoR support shall be acknowledged by the EPSCoR research project number in written reports and publications. Note that there is no limit for domestic travel, defined as travel that does not require a U.S. passport, and shall be appropriate and reasonable to conduct the proposed research.
9. NASA EPSCoR funding shall not be used to purchase general purpose equipment, e.g. desktop workstations, office furnishings, reproduction, and printing equipment as a direct charge. However, special purpose equipment purchases (i.e., equipment that is used only for research, scientific, and technical activities directly related to the proposed research activities) are allowed and shall be reflected as a direct charge as per cost principles cited in the GCAM. In addition, proposers shall comply with 2 CFR 200.216: Prohibition on certain telecommunication and video surveillance services or equipment. Equipment and other capital expenditures, special purchase equipment items with a unit cost of $5,000 or more must have the prior written approval of the Federal awarding agency (i.e., the NASA Grant Officer).
10. NASA EPSCoR funding shall not be used to support NASA employees' (full- time equivalent or FTE) participation in a research project unless that funding is provided through a separate funding instrument between the

jurisdiction and NASA Center, such as a Space Act Agreement or other reimbursable agreement. NASA EPSCoR will not set aside award funding to send to a NASA Center for FTE support, including travel.

11. NASA EPSCoR funds shall be spent on NASA EPSCoR institutions. If a Co- Investigator (Sc-I/Co-I) with NASA EPSCoR award transfers to a non-EPSCoR institution, the EPSCoR funding amount, or the amount that remains unobligated at the time of the Sc-I/Co-I transfer, shall not be transferred to the non-EPSCoR institution.
12. This NOFO is not for the renewal or augmentation of existing projects, which are not eligible to compete against proposals submitted in response to this NOFO. Thus, only new proposals will be considered for awards.
13. Procurement contracts shall not be awarded as a result this NOFO.
14. 14. Pre-award costs are those incurred prior to the effective date of an award directly pursuant to the negotiation and in anticipation of the award where such costs are necessary for efficient and timely performance of the scope of work. Once the award is announced, then pre-award costs less than 90 days are allowed.
15. Domestic travel, defined as travel that does not require a U.S. passport, does not have a funding limit and shall be appropriate and reasonable to conduct the proposed research.

14.2.2.2 Direct Costs Limitations

Travel, including foreign travel, is allowed for the meaningful completion of the proposed investigation, as well as for reporting results at appropriate professional meetings. Foreign travel to meetings and conferences in support of the jurisdiction's NASA EPSCoR research project is an acceptable use of NASA EPSCoR funds, with a limit of $3,000 per trip for up to two separate years of a jurisdiction's proposal (i.e., the maximum amount the jurisdiction can request for foreign travel is $3,000 total in any one year and a limit of $6,000 total for each research proposal). NASA EPSCoR support shall be acknowledged by the NASA EPSCoR research project number in written reports and publications.

14.2.2.3 Pre-Award Costs

Pre-award costs are those incurred prior to the effective date of an award that are directly pursuant to the negotiation and in anticipation of the award where such costs are necessary for efficient and timely performance of the scope of work. Per 2 CFR §1800.210, Pre-award costs, NASA waives the requirement for applicants to obtain prior approval for pre-award costs incurred 90 days or less before an award's PoP start date. Pre-award costs more than 90 days prior to an award's PoP start date are not allowable under this NOFO. Any costs that the applicant incurs in anticipation of an award is at the applicant's risk and will be subject to the rules described in 2 CFR §1800.210 and the "Pre-award Costs" section of the GCAM.

14.2.2.4 Indirect Facilities & Administrative (F&A) Costs

Unless otherwise directed in 2 CFR § 200, for changes to the negotiated indirect cost rate that occur throughout the project period, the proposer/recipient shall apply the rate negotiated for that year, regardless of whether it is higher or lower than at the time the proposal (including the submitted budget) was awarded.

14.2.2.5 Cost Sharing or Matching

The maximum funding that a jurisdiction can request from NASA is $750,000 per proposal. This amount is to be spent in accordance with the budget details and budget narrative in the approved proposal.

Cost-sharing is required at a level of at least 50% of the requested NASA funds. Although the method of cost-sharing is flexible, NASA encourages the EPSCoR jurisdiction committees to consider methods that would add value to the jurisdiction's existing research capabilities. All contributions, including cash or in-kind, shall meet the criteria set forth in 2 CFR 200.306, Cost sharing or matching (https://www.ecfr.gov/current/title-2/subtitle-A/chapter-II/part-200/subpart-D/section-200.306).

NASA-funded and/or in-kind services provided by Mission Directorates, NASA Centers, or JPL shall be identified as "NASA responsibilities" in the proposals and shall not be included in the 50% cost matching requirement.

Pre-award costs are those incurred prior to the effective date of an award directly pursuant to the negotiation and in anticipation of the award where such costs are necessary for efficient and timely performance of the scope of work. Once the award is announced, then pre-award costs less than 90 days are allowed.

14.2.2.6 Other Submission Requirements

Applicants must include a statement detailing their use of undergraduate students, graduate students, and/or postdoctoral fellows' support. The use of NASA EPSCoR funds for support of undergraduate and/or graduate research assistants shall be detailed in the budget justification and described in the narrative and evaluation sections of the proposal.

Proposers are encouraged to seek collaboration with NASA subject matter experts, listed in Section A. Proposals budgets may not include civil servant FTE/WYE for research collaboration or advisement. Letters of support or commitment from collaborators are encouraged. NASA civil servants are not allowed to write letters of endorsement for any particular candidate.

Proposals that include flight activities (not normal passenger travel) such as aircraft or helicopter flight services, including Unmanned Aircraft Systems (UAS)/Drone operations or the acquisition or construction of such flight vehicles, must comply with NASA Policy Directive 7900.4 (https://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPD&c=7900&s=4E). Questions concerning flight compliance requirements may be addressed to Norman Schweizer (norman.s.schweizer@nasa.gov) Aircraft Capability Management Office (ACMO) or Grant Watson (grant.m.watson@nasa.gov) Institutional Safety Management Division (ISMD), or Richard Schlatter (Richard.schlatter-1@nasa.gov) ISMD.

14.2.2.7 Collection of Demographic Information

NASA is implementing a process to collect demographic data from grant applicants for the purpose of analyzing demographic differences associated with its award processes. Information collected will include name, gender, race, ethnicity, disability status, and citizenship status. Submission of the information is voluntary and is not a precondition of award.

Therefore, NASA requests additional demographic data to ensure its compliance with Title VI of the Civil Rights Act of 1964, 42 U.S.C. § 2000d et seq., Title IX of the Education Amendments of 1972, 20 U.S.C. § 1681 et seq., Section 504 of the Rehabilitation Act of 1973, 29 U.S.C. § 701 et seq. and NASA's implementing regulations at 14 CFR 1250, 1251, and 1253. Submission of the requested information on NASA Form 1839 is purely voluntary and will not affect the organization's eligibility for an award.

14.2.2.8 Statements of Commitment and Letters of Support

Statements of commitment and letters of support are important components of the proposal. However, NASA does not solicit or evaluate letters of endorsement. Review the GCAM (https://www.nasa.gov/grants-policy-and-compliance-team/#Regulations) for the distinctions among statements of commitment, letters of support, and letters of endorsement.
Letters of support are only required if there is a facility or resource essential to the implementation of the proposal, and a proposal team member does not have guaranteed access to such facility or resource. By submitting a statement of commitment, the team member confirms that any facilities or resources needed for the proposal are readily available for the proposal team members(s) who require its use.

14.3 Eligibility Information

14.3.1 NASA's Commitment to Diversity and Inclusion

NASA recognizes and supports the benefits of having diverse and inclusive scientific, engineering, and technology communities and fully expects the reflection of such values in the composition of all panels and teams, including peer review panels, proposal teams, science definition teams, and mission and instrument teams. Per federal statutes and NASA policy, no eligible applicant shall experience exclusion from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from NASA on the grounds of their race, color, religion, age, sex, national origin, or disability. NASA welcomes proposals from all qualified and eligible sources, and strongly encourages proposals from Minority Serving Institutions (MSIs), small-disadvantaged businesses (SDBs), veteran-owned small businesses, service-disabled veteran-owned small businesses (SDVOSB), HUBZone small businesses, and women-owned small businesses (WOSBs), as eligibility requirements apply. Note that all proposals must be approved and submitted by the NASA EPSCoR Jurisdiction Director.

14.3.2 Eligible Applicants

The National Science Foundation (NSF) determines overall jurisdiction eligibility for NASA EPSCoR. The latest available NSF eligibility tables are used to determine overall jurisdiction eligibility for NASA EPSCoR. The NSF 2023 eligibility table is available at: https://nsf-gov-resources.nsf.gov/2022-06/EPSCoR%20Eligibility%20Table%20Fiscal%20Year%202023.pdf.

The following jurisdictions are eligible to submit a proposal in response to this NOFO: Alabama, Alaska, Arkansas, Delaware, Guam, Hawaii, Idaho, Iowa, Kansas, Kentucky, Louisiana, Maine, Mississippi, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Dakota, Oklahoma, Puerto Rico, Rhode Island, South Carolina, South Dakota, U.S. Virgin Islands, Vermont, West Virginia, and Wyoming.

While proposals can be accepted only from institutions for which the NASA EPSCoR Directors are serving currently, all institutions of higher education within the jurisdiction shall be given the opportunity to propose by making them aware of this NOFO. Only one proposal per jurisdiction shall be accepted, which must be submitted by the NASA EPSCoR Jurisdiction Director (or their designee). The list of NASA EPSCoR jurisdiction directors can be found at:

https://www.nasa.gov/learning-resources/established-program-to-stimulate-competitive-research/epscor-directors/ .

All proposals submitted in response to this NOFO shall be submitted electronically via NSPIRES (http://nspires.nasaprs.com). Hard copy proposals will not be accepted. Electronic proposals must be submitted in their entirety by 11:59 p.m., Eastern Time on January 29, 2025.

Proposers without access to the internet or who experience difficulty using the NSPIRES proposal site (http://nspires.nasaprs.com) may contact the **Help Desk at** nspires-help@nasaprs.com **or call 202-479-9376 between 8:00 a.m. and 6:00 p.m. (EDT), Monday through Friday, except on Federal Government holidays.** Proposals received after the due date may be returned without review and not considered for award. If a late proposal is returned, it is entirely at the proposer's discretion whether to resubmit it in response to a subsequent opportunity.

All EPSCoR institutions in eligible jurisdictions shall be made aware of this solicitation. *All proposals shall be submitted through the jurisdiction's NASA EPSCoR Director's office*. Existing EPSCoR awards that already demonstrate partnerships or cooperative arrangements among academia, government agencies, business and industry, private research foundations, jurisdiction agencies, and local agencies shall not be submitted. No requests for renewals or extensions of previous projects will be accepted in response to this NOFO.

14.3.3 Inter-University/Jurisdiction Collaboration

Proposers are encouraged to seek collaboration with other institutions within their EPSCoR jurisdiction and/or with institutions located in other EPSCoR jurisdictions. Collaboration allows for leveraging diverse perspectives, potentially leading to more impactful research outcomes.

Potential Benefits of Collaboration:

- **Complementary Strengths:** Universities excel in different areas. Collaboration allows you to address all aspects of the research question effectively.
- **Diverse Perspectives:** Embrace the unique methodologies and viewpoints other universities bring. Shared passion for the research topic fuels collaboration.
- **Enhanced Research Outcomes:** Collaboration fosters diverse perspectives, leading to potentially more impactful research.

Making Collaboration Effective:

- **Identify Partners:** Explicitly highlight how your research aligns with another university's work. Document the planned collaboration in the proposal.
- **Resource Sharing:** Document your plan to share data, equipment, and technical expertise to strengthen the joint proposal.
- **Tackle Complex Challenges:** Explain how your collaborative work is tackling complex research questions beyond the scope of a single university.

Proposers are encouraged to use this opportunity to build long-term research partnerships between institutions.

14.3.4 Limit on Number of Proposals per Jurisdiction

- While proposals can be accepted only from institutions for which the NASA EPSCoR Directors are currently serving, all institutions of higher education within the jurisdiction shall be given the opportunity to propose by making them aware of this NOFO. Only one proposal per jurisdiction shall be accepted, and it must be submitted by the NASA EPSCoR Jurisdiction Director (or their designee).
- If more than the maximum allowable proposals are submitted from any single Jurisdiction, any proposals received after the first is subject to return without review.

14.3.5 Ineligibility of Proposals

Proposals involving bilateral participation, collaboration, or coordination in any way with China or any Chinese-owned company, whether funded or performed under a no-exchange-of-funds basis, shall be ineligible for award.

14.4 Application and Submission Information

14.4.1 Address to Request Application Package

All proposals submitted in response to this NOFO shall be submitted electronically via NSPIRES (http://nspires.nasaprs.com). Hard copy proposals will not be accepted.

14.4.2 Content and Form of Application Submission

The Scientific and Technical Plan for all compliant proposals, including detailed information on subawards, must not exceed 15 pages. Additionally, a Budget Justification Narrative and Details for each subaward must be clearly documented, providing the basis of estimates. This includes the proposed budget, an itemized list detailing expenses within major budget categories, detailed subawards, and a summary of personnel. Refer to the GCAM for the Required Budget Details.

Required Proposal Sections (in order of assembly)	**Page / Character Limits**
Proposal Cover Page	NSPIRES proposal cover page that is available at http://nspires.nasaprs.com/
Proposal Summary (abstract)	4,000 characters including spaces
Data Management Plan	4,000 characters, including spaces
Table of Contents	As needed (not included in 15-page limit)
Scientific/Technical Plan	15 pages*
Management Plan	As needed (not included in 15-page limit)
References and Citations	As needed (not included in 15-page limit)
Biographical Sketches for (not included in 15-page limit):	
The Principal Investigator	2 pages(per PI)
The Science Investigator (Sc-I)	2 pages (per Sci-I)
each Co-Investigator (Co-I)	1 page (per Co-I)
Current and Pending Support	As needed (not included in 15-page limit)
Statements of Commitment and Letters of Support	As needed (not included in 15-page limit)
Budget Justification: Narrative and Details	As needed (not included in 15-page limit)

• *Includes proposed budget, itemized list detailing expenses within major budget categories, Facilities and Equipment, detailed subawards and summary of personnel*	
• *For grants/cooperative agreements, the table of personnel and work effort shall immediately follow the proposal budget and is not included in the budget.*	
Facilities and Equipment	As needed (not included in 15-page limit)
Special Notifications and/or Certifications	As needed (not included in 15-page limit)
• *For grants/cooperative agreements, the table of personnel and work effort shall immediately follow the proposal budget and is not included in the budget.*	
** includes all illustrations, tables, and figures, where each "n-page" fold-out counts as n-pages and each side of a sheet containing text or an illustration counts as one page.*	

14.4.3 Submission Method, Dates and Times

14.4.3.1 Submission Method

All proposals submitted in response to this NOFO shall be submitted electronically via NSPIRES (http://nspires.nasaprs.com). Hard copy proposals will not be accepted. Electronic proposals must be submitted in their entirety by 11:59 p.m., Eastern Time on January 29, 2025.
Proposers without access to the Web or who experience difficulty using the NSPIRES proposal site (http://nspires.nasaprs.com) may contact the **Help Desk at** nspires-help@nasaprs.com **or call 202-479-9376 between 8:00 a.m. and 6:00 p.m. (EDT), Monday through Friday, except on Federal Government holidays.** Proposals received after the due date may be returned without review. If a late proposal is returned, it is entirely at the proposer's discretion whether to resubmit it in response to a subsequent solicitation.

14.4.3.2 Submission Deadline

Proposal Submission Deadline: 01/29/2025 at 11:59 PM ET

All proposals **must** be received by the established deadline.

NASA will not review proposals that are received after the deadline or consider these late applications for funding. However, NASA may extend the application deadline upon the request of any applicant that can demonstrate good cause exists to justify extending the deadline. Good cause for an extension may include technical problems outside of the applicant's control that prevented submission of the proposal by the deadline or other exigent or emergency circumstances.

Applicants experiencing technical problems outside of their control must notify NASA as soon as possible and before the application deadline. Failure to notify NASA in a timely manner of the issue that prevented the on-time submission of the proposal may prevent the proposal from being considered for award.

While every effort is made to ensure the reliability and accessibility of the NSPIRES site and to maintain a help center via e-mail and telephone, difficulty may arise at any point on the internet, including with the user's own equipment. Prospective proposers are strongly urged to familiarize themselves with the NSPIRES site and to submit the required proposal materials well in advance of the proposal submission deadline. Difficulty in registering with or using NSPIRES is not, in and of itself, a sufficient reason for NASA to consider a proposal that is submitted after the proposal due date.

14.4.4 NASA Contact Information

Program Office Contact
Technical and scientific questions about this NOFO may be directed to:

EPSCoR

Kathleen B. Loftin, Ph.D.
Project Manager, NASA EPSCoR
NASA Kennedy Space Center
Kennedy Space Center, FL 32899-0001
E-mail: kathleen.b.loftin@nasa.gov
Telephone: (321) 603-9971

Inquiries regarding the submission of proposals via NSPIRES may be addressed to:

Althia Harris
NASA Research and Education Support Services (NRESS)
2345 Crystal Drive, Suite 500
Arlington, VA 22202-4816
E-mail: aharris@nasaprs.com
Telephone: (202) 479-9030 x310
Fax: (202) 479-0511

Questions concerning environmental compliance may be addressed to:

NASA EPA Manager
Tina Norwood
E-mail: tina.norwood-1@nasa.gov
Telephone: (202)358-7323

14.4.5 Systems Information

NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES)
NSPIRES is a web-based system that supports the entire lifecycle of NASA research solicitation and selection, from the release of solicitation announcements through proposal submission, the peer review process, and the award decision. Applicants may search for and apply for funding opportunities available at NASA through NSPIRES. For technical assistance with NSPIRES, please contact the NSPIRES Help Desk at nspires-help@nasaprs.com or (202) 479-9376, Monday through Friday, 8:00 AM – 6:00 PM ET, except on Federal Government holidays.

Grants.gov
Grants.gov is the government-wide electronic grants portal and interested parties can search for grant opportunities on this site. For technical assistance with Grants.gov, call the customer support hotline

24 hours per day, seven days per week (except on Federal Government holidays) at (800) 518-4726 or e-mail support@grants.gov.

14.4.6 Collection of Demographic Information

NASA is implementing a process to collect demographic data from grant applicants for the purpose of analyzing demographic differences associated with its award processes. Information collected will include name, gender, race, ethnicity, disability status, and citizenship status. Submission of the information is purely voluntary and is not a precondition of award.

14.4.7 Cancellation of Program Announcement

NASA Headquarters (HQ) Office of STEM Engagement (OSTEM) reserves the right to not make any awards under this NOFO and to cancel this NOFO at any time. NASA assumes no liability (including bid and proposal costs) for cancelling this NOFO or for any entity's failure to receive such notice of cancellation.

14.4.8 Intellectual Property

Data Rights: NASA encourages the widest practicable dissemination of research results at any time during the investigation. The award will contain the Rights in Data clause in the Terms and Conditions. This clause allows a recipient to assert copyright in any work that is subject to copyright and was developed or for which ownership was acquired under the NASA award.

NASA will reserve a royalty-free, nonexclusive, and irrevocable right to reproduce, publish, or otherwise use the work for Government purposes and to authorize others to do so in any such copyrighted work. Note that the Grant Officer may revise the language under the Rights in Data clause to modify each party's rights based on the circumstances of the program and/or the recipient's need to protect specific proprietary information.

Patent Rights: Recipients will be allowed to elect to retain title to any inventions made under the award. Awards will include the provisions of 37 CFR 401.3(a), which requires use of the standard clause set forth at 37 CFR 401.14 "Patent Rights (Small Business Firms and Nonprofit Organizations)," and the Award Terms and Conditions, the clause titled "Patent Rights."

14.4.9 Announcement and Updates/Amendments to Solicitation

This NOFO will be announced via NSPIRES and Grants.gov, but proposals shall be submitted on-time and electronically only via NSPIRES (http://nspires.nasaprs.com). Proposers shall carefully note the information described in the paragraph below for submission of an electronic proposal via NSPIRES.

While every effort is made to ensure the reliability and accessibility of the web site and to maintain a help center via e-mail and telephone, difficulty may arise at any point on the internet, including with the user's own equipment. Therefore, proposers are strongly urged to familiarize themselves with the NSPIRES site and to submit the required proposal materials well in advance of the proposal submission deadline. Difficulty in registering with or using NSPIRES is not, in and of itself, a sufficient reason for NASA to consider a proposal that is submitted after the proposal due date. Additional programmatic information for this NOFO may become available before the proposal due date. If so, such information shall be added as a formal amendment to this NOFO and posted on its homepage at http://nspires.nasaprs.com.

It is the proposer's responsibility to regularly check this NOFO's homepage for updates.

14.4.10 Access to NASA Facilities/Systems

Proposers including the use of NASA Unique facilities must include a letter of support from the hosting center. EPSCoR funds may not be used to support Civil Servant or NASA Contractor participation in the research; however, such support can be used for labor associated with testing or use of facilities. Funding for the use of NASA-unique facilities must be explicitly included in the Budget section of the proposal with the basis of estimate and justification. The funds planned for NASA-unique facilities must be clearly identified in the proposal.

All recipients shall work with NASA project/program staff to ensure proper credentialing for individuals needing access to NASA facilities and/or systems. Such individuals include U.S. citizens, lawful permanent residents (green card holders), and foreign nationals (those who are neither U.S. citizens nor permanent residents). Please note that foreign nationals are normally not allowed access to NASA facilities. Foreign nationals from "designated" countries, i.e., countries designated by the U.S. State Department and listed by NASA as being sponsors of terrorism, cannot be allowed on any NASA facilities unless they are green card holders.

14.4.11 Limited Release of Proposers' Confidential Business Information

- For proposal evaluation and other related administrative processing actions (i.e., funding actions), NASA may find it necessary to release information submitted by the proposer to individuals not employed by NASA (e.g., agency support contractor or subcontractor employees). Business information that would ordinarily be entitled to confidential treatment may be included in the information released to these individuals. Accordingly, by submission of this proposal the proposer hereby consents to a limited release of its confidential business information (CBI).
- Except where otherwise provided by law, NASA will permit the limited release of CBI only pursuant to non-disclosure agreements signed by employees of the support contractor and/or subcontractor, who may require access to the CBI in order to perform their support contract or subcontract.
- Proposal abstracts from those proposals selected for award will be posted on NASA's public website (www.NASA.gov).

14.5 Proposal Review Information

Successful research proposals shall provide sound contributions to both immediate and long-term scientific and technical needs of NASA as explicitly expressed in current NASA documents and communications, as well as contribute to the overall research infrastructure, science, and technology capabilities of higher education, and economic development of the jurisdiction.

Successful proposals shall also include pragmatic plans for generating sustained non-EPSCoR support.

Proposals will be evaluated based on the following criteria for the award: Intrinsic Merit, Project Management, and Budget Justification. The bulleted lists after each criterion below should not be construed as any indication of priority or relative weighting. Rather, the bullets are provided for clarity and facilitation of proposal development. **Note:** Each proposer shall provide specific information on how the relevance of the proposed effort to NASA and the jurisdiction was determined.

14.5.1 Proposal Evaluation Criteria

Intrinsic Merit (35% of overall score)

- Proposed research shall have clear goals and objectives, address the expectations described in the announcement, be consistent with the budget, effectively utilize the program management, and demonstrate a high probability for successful implementation.
- Proposals shall provide a narrative of the proposed research activity, including the scientific and/or technical merit of the proposed research, unique and innovative methods, approaches, concepts, or advanced technologies, and the potential impact of the proposed research on its field.
- Existing research proposals shall provide baseline information about current research activities within the jurisdiction in the proposed research area, including projects currently funded under NASA EPSCoR.
- If the proposed research represents a new direction for the jurisdiction, the technical team's ability to conduct the research shall be explained. Other relevant research and technology development programs within the jurisdiction shall also be included

NASA Alignment and Partnerships (35% of overall score)

- Proposals shall discuss the value of the proposed research to NASA and to the jurisdiction's research priorities.
- Proposals shall describe the use of NASA content, people, or facilities in the execution of the research activities.
- Proposals shall describe current and/or previous interactions, partnerships, and meetings with NASA researchers, engineers, and scientists in the area of the proposed research, and discuss how future partnerships will be fostered between or among the institution's researchers and personnel at the Mission Directorates, NASA Centers, and/or JPL.
- The name(s) and title(s) of NASA researchers with whom the proposers will partner shall be included.
- Proposals shall clearly articulate how the proposed research activities build capacity in the jurisdiction.
- In particular, proposers shall explain how the proposed research is related to the strategic plan for NASA EPSCoR-related research in the jurisdiction.
- Proposals shall state how they plan to develop research competitiveness both in the jurisdiction and nationally.

Proposals shall delineate mechanisms for building partnerships with universities, industry, and/or other government agencies to enhance the ability of the jurisdiction to achieve its objectives, to obtain and leverage sources of additional funding, and/or to obtain essential services not otherwise available.

Management and Evaluation (15% of overall score)

NOTE: The following information shall be included in the proposal with page limits as required; the content of this section does not count toward the 15-page limit for the Scientific, Technical, or

Management section.

- Personnel: The proposal shall include a list of the personnel participating in this research program, including the Principal Investigator (PI), Science-Investigator (Science-I), and all Co-Investigators (Co-I), Research Associates, Post-Doctoral Fellows, Research Assistants, and other research participants. The credentials of the researchers are important; however, one of the goals of EPSCoR is to encourage and help new researchers.
- Research Project Management: A description shall be included of the Science-I's management structure of the proposed research project, and the extent to which the project's management and research team will lead to a well-coordinated, efficiently managed, and productive effort.
- Multi-Jurisdiction Projects: If the proposed research is a collaboration between or among more than one NASA EPSCoR jurisdiction, one jurisdiction shall be identified as the lead with additional partners identified as sub-awardees. The proposal shall detail the inter-jurisdiction management structure of the proposed research project, including a list of the participating jurisdictions and the universities and agencies within each jurisdiction. Multi-jurisdictional proposals shall not exceed the $750,000 per award limit.
- Project Evaluation: Each proposal shall document the intended outcomes and offer metrics to demonstrate progress toward and achievements of these outcomes. The proposal shall discuss metrics to be used for tracking and evaluating project progress. Milestones and timetables for achievement of specific objectives during the award period shall be presented. The proposal also shall describe an appropriate evaluation plan/process to document outcomes and demonstrate progress toward achieving the objectives of proposed project elements. The evaluation methodology shall be based upon reputable models and techniques appropriate to the content and scale of the project. Projects shall implement improvements throughout the entire period of performance based on ongoing evaluation evidence.
- Results of Prior NASA EPSCoR Research Support: Examples of accomplishments commensurate with the managerial and administrative expectations of the award shall be provided. The EPSCoR Director will not be assessed on their expertise in the specific proposed research area since the Science-PI is tasked with managing the scientific/technical development progress. However, the following information shall be provided: the NASA EPSCoR award number(s), the title of the projects(s); and period(s) of performance; primary outcomes resulting from the NASA EPSCoR award, including a summary discussion of accomplishments compared to the proposed outcomes from the original proposal; coordination with the research and technical development priorities of NASA, and contribution(s) to the overall research capacity of the jurisdiction.

Budget Justification: Narrative and Details (15% of overall score)

- The proposed budget shall be adequate, appropriate, reasonable, and realistic, and demonstrate the effective use of funds that align with the project as set forth in the proposal. Preparation guidelines for the budget can be found in the GCAM. This section shall include detailed budgets for each of the three years of the award period and a summary budget for all three years. All sources of cost-sharing shall be thoroughly described and documented.

- The budget will be evaluated based upon the clarity and reasonableness of the funding request. A budget narrative shall be included that discusses relevant budgetary issues such as the extent and level of jurisdiction, industrial, and institutional commitment and financial support, including resources (e.g., staff, facilities, laboratories, indirect support, waiver of indirect costs).
- Proposers including the use of NASA Unique facilities must include a letter of support from the hosting center. EPSCoR funds may not be used to support civil servant or NASA contractor participation in the research. Funding for the use of NASA-unique facilities must be explicitly included in the Budget section with the basis of estimate and justification.
- Investigators are encouraged to prioritize requests for funding of research equipment and instrumentation requests early in the award to maximize its availability for research in the following years.

14.5.2 Review and Selection Process

Review of proposals submitted in response to this NOFO shall be consistent with the general policies and provisions contained in the GCAM. However, the evaluation criteria described in this NOFO in Section 5.1, Proposal Evaluation, takes precedence.

Evaluation by peer review will be used to assess each proposal's overall merit. The evaluation criteria are Intrinsic Merit, NASA Alignment and Partnerships, Management and Evaluation, and Budget Justification: Narrative and Details. See Section 14.5.1 of this NOFO, Proposal Evaluation Criteria. A NASA HQ Mission Directorate panel will use the results of the peer evaluation to make funding recommendations to the Selecting Official. The awarded proposals are likely to be provide sound contributions to both immediate and long-term scientific and technical needs of NASA as explicitly expressed in current NASA documents and communications. Also, successful proposals are likely to contribute to the overall research infrastructure and economic development of the proposed jurisdiction.

14.5.3 Risk Analysis

NASA Grant Officers will conduct a pre-award review of risk associated with the proposer as required by 2 CFR 200.206, Federal awarding agency review of risk posed by applicants. For all proposals selected for award, the Grant Officer will review the submitting organization's information available through multiple government-wide repositories such as SAM.gov, the Contractor Performance and Assessment Reporting System (CPARS), the Federal Audit Clearinghouse (FAC), USAspending.gov, and GrantSolutions Recipient Insight.

Risk Review

For any federal award, if NASA anticipates that the total federal share of funds provided to the recipient will be greater than the simplified acquisition threshold (SAT) (currently $250,000) during the award's PoP:

- Prior to making a federal award with a total amount of Federal share greater than the SAT, NASA is required to review and consider any information about the applicant that is in the designated integrity and performance system accessible through SAM.gov (see 41 U.S.C. §2313);

- An applicant, at its option, may review information in the designated integrity and performance systems accessible through SAM.gov and comment on any information about itself that a Federal awarding agency previously entered and is currently in the designated integrity and performance system accessible through SAM.gov;

- NASA will consider any comments by the applicant, in addition to the other information in the designated integrity and performance system, in making a judgment about the applicant's integrity, business ethics, and record of performance under Federal awards when completing the review of risk posed by applicants as set forth in 2 CFR 200.206.

14.5.4 Anticipated Announcement and Federal Award Dates

Open Solicitation Period:	October 16, 2024, to January 29, 2025
Solicitation Period Closes:	January 29, 2025, 11:59 PM ET
Anticipated Award Announcement date:	September 2025
Federal Award Date:	Prior to September 30, 2025

14.6 Federal Award Administration Information

NASA's stated goal is to announce selections as soon as possible. However, NASA does not usually announce new selections until the funds needed for those awards are approved through the federal budget process. Therefore, a delay in NASA's budget process may result in a delay of the selection date(s). Additional delays may be caused by:

- The need for additional materials from the proposer (e.g., revised budgets and/or budget details) before NASA may legally obligate Federal funds; and
- A delay in NASA receiving its appropriation from Congress for the current fiscal year.

After 180 days past the proposal's submitted date, proposers may contact the NASA EPSCoR Project Manager for a status.

NASA will notify successful grant recipients of funding via a Notice of Award (NASA Form 1687) signed by the Grant Officer. This Notice of Award is the authorizing document and will be sent to the business office of the proposer's institution via email and NSPIRES. All expenses incurred related to grant activities prior to the PoP start date listed on the Notice of Award are the sole responsibility of the proposer/recipient until the Notice of Award is received and the PoP commences.

NASA's goal is to issue Notices of Award as soon as possible after selections are announced (anticipated in the September 2025 timeframe) to the proposers. However, delays may be caused by:

- The need for additional materials from the proposer (e.g., revised budgets and/or budget details) before NASA may legally obligate federal funds; and/or
- A delay in NASA receiving its appropriation from Congress for the current fiscal year.

A proposer has the right to be informed of the major factor(s) that led to the acceptance or rejection of its proposal. Debriefings will be available upon written request. Again, it is emphasized to proposers that proposals of nominally high intrinsic and programmatic merits may be declined for reasons entirely unrelated to any scientific or technical weaknesses.

14.6.1 Administrative and National Policy Requirements

In addition to the requirements in this section and in this NOFO, NASA may incorporate specific terms and conditions into individual awards in accordance with 2 CFR Part 200. Specifically, recipients of NASA grant funding shall adhere to requirements set forth in 2 CFR 200, 2 CFR 1800, 2 CFR 170, 2 CFR 175, 2 CFR 182, and 2 CFR 183, and the NASA GCAM. These are available at: https://www.nasa.gov/offices/ocfo/gpc/regulations_and_guidance.

Research Terms and Conditions

Awards from this funding announcement that are issued under 2 CFR 1800 are subject to the Federal Research Terms and Conditions (RTC) located at http://www.nsf.gov/awards/managing/rtc.jsp. In addition to the RTC and NASA-specific guidance, three companion resources can also be found on the website: Appendix A— Prior Approval Matrix, Appendix B—Subaward Requirements Matrix, and Appendix C—National Policy Requirements Matrix.

Environmental Statement

Awards of proposals related to this NOFO must comply with the National Environmental Policy Act (NEPA); thus, proposers are encouraged to plan and budget for any anticipated environmental impacts. While most research awards will not trigger action specific NEPA review, some activities (including international actions) will.

The majority of grant-related activities are categorically excluded as research and development (R&D) projects that do not pose any adverse environmental impact. A blanket NASA Grants Record of Environmental Consideration (REC) provides NEPA coverage for these anticipated activities. The NSPIRES award application cover page includes questions to determine whether a specific proposal falls within the Grants REC and must be completed as part of the proposal submission process. Activities outside of the bounding conditions of the Grants REC will require additional NEPA analysis. Examples of actions that will likely require NEPA analysis include but are not limited to: suborbital-class flights not conducted by a NASA Program Office, activities involving ground-breaking construction/fieldwork, and certain payload activities such as the use of dropsondes.

Questions concerning environmental compliance may be addressed to the NASA NEPA Manager via the NASA program official listed in this NOFO.

14.6.2 Federal Financial Reporting

Recipients of NASA funding must submit quarterly financial reports. Financial reports must be submitted via the Payment Management System (PMS):

• Quarterly Federal Financial Reports (FFR) are due no later than 30 days past the reporting period end date
• Final Financial Status Reports/Final Federal Financial Report (FSR/FFR) are due no later than 120 days after the end of the period of performance

14.6.3 Performance Reporting

Recipients of NASA awards are required to submit both annual and final performance reports. These annual reports should be submitted to NASA no later than 60 days before the award's anniversary date, unless the award is in its final year or if the award's performance period is less than a year. In such cases, only final performance reports need to be submitted for awards in their final year or with a performance period of less than a year. Descriptions of reporting requirements are below:

Annual Performance Report – Used to describe a grant's scientific progress, identify significant changes, report on personnel, and describe plans for the subsequent reporting period.

Due: 60 days prior to the anniversary date of the award (PoP- start date)

Final Performance Report – Used as part of the grant closeout process to submit project outcomes in addition to the information submitted on the annual Performance Report.

Due: within 120 days after the end of the award's PoP (PoP end date)

For all NASA awards, recipients must utilize the Research Performance Progress Report (RPPR) format. The RPPR is not a template or form but rather a set of standard data elements against which award recipients will report. The RPPR is not available as a template or form from NASA. All performance reports must contain the mandatory data elements and reporting category required for RPPRs.

All reports shall include the following data elements on the report's cover page:

- Federal agency (i.e., NASA) and program office to which the report is submitted.
- Award number.
- Project title
- Principal Investigator (PI) name, title, and contact information (e-mail address and phone number).
- Name of submitting official, title, and contact information (e-mail address and phone number), if other than PI.
- Submission date.
- UEI number and Employer Identification EIN Number (EIN).
- Recipient organization name and address.
- Recipient identifying number or account number, if any.
- PoP start and end date.
- Reporting period end date.
- Report term or frequency (annual, semi-annual, quarterly, other).
- Final Report? Indicate "Yes" or "No"
- Signature of submitting official (either handwritten or electronic)

In addition to the data elements above, all NASA performance reports shall report on one mandatory reporting category, "accomplishments."

Accomplishments data elements are:

1. What were the major goals and objectives of this project?
2. What was accomplished under these goals?
3. What opportunities for training and professional development has the project provided?
4. How were the results disseminated to communities of interest?
5. What do you plan to do during the next reporting period to accomplish the goals and objectives?

Recipients shall submit a report to the NASA Grant Officer at the NSSC at NSSC-Grant-Report@mail.nasa.gov with copies to the EPSCoR Technical Officer (TO) at agency-epscor@mail.nasa.gov, and to the supported organization on the results pertaining to this award no later than 120 days after the project's end date. The EPSCoR Project Office Program Coordinator shall notify the Jurisdiction PI in advance and in writing when a report is coming due and provide specific formats and data entry forms. The Program Manager shall also provide a Research Project Progress/Performance Reporting Outline, which is a template of the required data. This will be followed by notification from the NSSC that the report is due. The reporting requirements for awards made through this NOFO will be consistent with the reporting requirements outlined in the GCAM, Section 7.3.

The NASA TM shall evaluate accomplishments toward project goals by reference to indicators such as, but not limited to, the metrics outlined above. NASA may approve no-cost extensions in writing when requested by the recipient and in accordance with the GCAM.

The EPSCoR TO shall review the final report for completeness. A recipient's failure to provide a final report with Invention Disclosures shall delay or preclude the participation of the respective jurisdiction in other funding opportunities related to NASA EPSCoR.

For further details on reporting project performance, please refer to the Post-Award Phase section of the GCAM.

Section 14.6.4 Access to Research

Awards issued under this NOFO must comply with the provision set forth in the NASA Plan for Increasing Access to the Results of Scientific Research (http://www.nasa.gov/sites/default/files/files/NASA_Data_Plan.pdf) including the responsibility for:

- Submitting as-accepted peer-reviewed manuscripts and metadata to a designated repository; and
- Reporting publications with the annual and final performance reports.

Section 14.6.5 Recipient Integrity and Performance Matters

Awards under this solicitation that are $500,000 or more may be subject to post-award reporting requirements reflected in 2 CFR 200 Appendix XII.

Section 14.6.6 FFATA Reporting Requirements

Per 2 CFR 170, Reporting Subaward and Executive Compensation Information, award recipients that issue first-tier subawards above $30,000 shall report those subawards in the Federal Award Accountability and Transparency Act (FFATA) Subaward Reporting System (FSRS). The regulation at 2 CFR 170 provides detailed information regarding what information needs to be reported in these systems and the deadlines for submitting this information. Recipient information that is reported to FSRS is ultimately transferred to USAspending.gov, where such information is publicly available.

Section 14.6.7 Suspension and Debarment Disclosure

This reporting requirement pertains to disclosing information related to government-wide suspension and debarment requirements. Before a recipient enters into a grant award with NASA, the recipient must notify NASA if it knows if it or any of the recipient's principals under the award fall under one or more of the four criteria listed at 2 CFR Part 180.335, What are the causes for debarment?, as follows:

- Are presently excluded or disqualified;
- Have been convicted within the preceding three years of any of the offenses listed in 2 CFR 180.800(a) or had a civil judgment rendered against it or any of the recipient's principals for one of those offenses within that time period;

- Are presently indicted for or otherwise criminally or civilly charged by a governmental entity (federal, state or local) with commission of any of the offenses listed in 2 CFR 180.800(a); or
- Have had one or more public transactions (federal, state, or local) terminated within the preceding three years for cause or default.

At any time after accepting the award, if the recipient learns that it or any of its principals falls under one or more of the criteria listed at 2 CFR 180.335, the recipient must provide immediate written notice to NASA in accordance with 2 CFR 180.350.

14.6.8 Additional Reporting Requirements

NASA recipients must conform to all reporting requirements outlined in the Required Publications and Reports section of the GCAM.

14.6.9 Summary of Key Information

Total estimated annual budget for Basic Research awards	$10 Million
Anticipated number of new awards, pending adequate proposals of merit	10 to 15
Estimated PoP Start Date	April 16, 2025
Duration of awards	3 years
Award Type	Cooperative Agreement
Release Date for Basic Research NOFO	October 16, 2024 Check NSPIRES for details
Pre-proposal Webinar 1 (optional)	November 8, 2024 2:00 PM Eastern Time (Date Subject to Change); Check NSPIRES for details
Pre-proposal Webinar 2 (optional)	November 22, 2024 2:00 PM Eastern Time (Date Subject to Change); Check NSPIRES for details
Due Date for Proposals	January 29, 2025, 11:59 PM Eastern Time Check NSPIRES for details
Page limit for the Narrative Section of proposal	15 pp. See NASA GCAM
Detailed instructions for the preparation and submission of proposals	See NASA GCAM
Submission medium	Electronic proposal submission is required via NSPIRES ONLY. See NASA GCAM
Selection Official	Program Manager: Kathleen B. Loftin, Ph.D. EPSCoR Project Manager NASA Headquarters Washington, DC 20546

NASA Point of Contact for this NOFO	Althia Harris NASA Research and Education Support Services (NRESS) 2345 Crystal Drive, Suite 500 Arlington, VA 22202-4816 Email: aharris@nasaprs.com

14.A Basic Research Topics

14.A.1 Human Research Program

Space Operations Mission Directorate (SOMD)

https://www.nasa.gov/directorates/space-operations-mission-directorate

Dr. Kristin Fabre kristin.m.fabre@nasa.gov

The NASA Human Research Program (HRP) drives advances in scientific and technological research to enable human space exploration. It is a human-focused Program dedicated to providing solutions and mitigation strategies beyond low-earth orbit by reducing the risks to human health & performance through focused translational, applied, and operational research. HRP's primary deliverables include:

- Human health, performance, and habitability standards
- Countermeasures and other risk mitigation solutions
- Advanced habitability and medical support technologies

Recently, HRP has developed a strategy to deliver critical components for an evolvable Crew Health and Performance System by 2032. This will be central to how HRP characterizes spaceflight risks and produces mitigation strategies that enable optimal crew health and performance during exploration missions. HRP will demonstrate and mature this system in ground analogs, in Low Earth Orbit (LEO), and on and around the moon to support a 2039 Mars mission. The Human Research Roadmap (https://humanresearchroadmap.nasa.gov) is a web-based version of an HRP Integrated Research Plan that allows users to search HRP risks, gaps, and tasks.

The HRP is organized into several research Elements:

- Human Health Countermeasures
- Human Factors and Behavioral Performance
- Exploration Medical Capability
- Space Radiation

Each of the HRP Elements addresses a subset of the risks. Proposals should address specific gaps listed in the Human Research Roadmap (https://humanresearchroadmap.nasa.gov/Gaps/). Researchers from proposals selected for this research opportunity should consider attending the Human Research Program Investigators' Workshop (HRP IWS) in Galveston, TX (February 2025).

14.A.1.1 Development or Adaptation of Analog Facilities for Human Behavioral Health and Performance Research in Long-duration Lunar and Mars Missions

Point of Contact:

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This call addresses the need for terrestrial research platforms that replicate future exploration spaceflight missions as highlighted by ongoing research in NASA HRP Human Factors Behavioral Performance Element, or HFBP. Research is needed to characterize and mitigate individual and team behavioral health and performance outcomes relative to future lunar missions and Mars missions; hence, platforms (i.e., analogs) that accurately reflect future spaceflight scenarios, are needed. Proposals are encouraged to build innovative approaches for the development, adaptation, and/or operationalization of analog environments that address the unique challenges of long-duration space missions.

Research Focus

Future missions will extend beyond current LEO capabilities, requiring crew face prolonged periods of confinement, with extreme environmental exposures in context of increased crew autonomy due to the vast distance from Earth of these anticipated missions. Depending on the target mission (e.g., lunar long, Mars) and research goals, current and/or future analogs will require enhancements or modifications to accurately simulate the range of these mission-specific conditions. The primary objective of this solicitation is to foster research that either proposes novel and relevant analog facilities, or modifications to existing ones to simulate the unique challenges of long-duration lunar and Mars missions. This encompasses environmental, operational, and psychological fidelity to real space missions, with an emphasis on addressing human behavioral health and performance risks.

Description of the Problem

To align analog facilities with the forefront of behavioral health and performance-focused space exploration research, a concerted effort is needed to ensure these environments accurately simulate the range of mission-specific characteristics outlined in NASA's Design Reference Missions (DRM). This requires an accurate understanding of the unique demands of each mission type, and a commitment to advancing the capabilities of analog facilities to mirror these requirements precisely. The goal is to augment research platforms, analogs, and facilities to accelerate the development, testing, and validation of technologies, strategies, and countermeasures.

The development of new analog research facilities can pose practical and financial constraints. It can be a more practical approach to identify and/or modify existing research platforms or facilities that share one or more characteristics with a spaceflight environment, such an isolated, confined, and extreme platform (ICE) or an isolated, confined, and controlled platform (ICC). The augmentation of certain analog characteristics can expedite research advancement, verification of mission-critical technologies, operational strategies, and human performance countermeasures for prolonged space missions. Additionally, securing adequate funding and institutional support is essential for the advancements and accessibility of spaceflight analog research, underscoring the need for a unified commitment to enhancing the fidelity, accessibility, and effectiveness of analog research platforms.

Areas of Research Interest

Target Analog Missions and Facility Designs: The proposal scope should be built around the development and/or enhancement of an analog environment that will facilitate research needed to mitigate risks related to behavioral health and performance for individuals and teams. Proposers are encouraged to consider enhancements not only related to facility improvements, but towards the implementation of research missions as a whole. Collaborations with technology developers, interdisciplinary research teams, and academic or industry partners to pool expertise and resources can be considered. Proposals should describe how the use of funds will assist the development or modification of their analog/facility and infrastructure to address one or more of HFBP's target platforms/risks outlined in the [Human Research Roadmap](). Approaches may also address efforts to enhancing the fidelity of their simulation or target-mission, analog infrastructure design, scenario developments, or technology integration for research or testing.

Alignment with NASA's DRM Specifications: Proposed analogs should accurately replicate the specific conditions detailed in NASA's Design Reference Missions (DRM) for lunar long missions or Mars missions, to customize their simulations, research inquiries, and additional mission-related elements to enhance the relevance and applicability of research findings. This includes accurately simulating mission length, the distance from Earth, the size and functionality of habitats, the impact of communication delays, and the nature of in-flight or surface extravehicular activities (EVAs).

Ability to Measure Behavioral Health and Performance Metrics: Proposed analogs should facilitate the implementation of sensitive, reliable, and validated measures for assessing crew behavioral health and performance risks, leveraging the systematic approach currently used in other spaceflight analogs. This includes the utilization of multi-modal data collection tools and physiological measurements to monitor crew health and performance unobtrusively. A list of standard measures currently used in several spaceflight analogs can be found here.

Repeated Simulations Across Diverse Missions: The significance of conducting research or simulations across a variety of missions cannot be overstated, as reliance on single-mission or short-duration simulations provides a limited view of certain variables, constraining applicability of findings to long-duration missions. A comprehensive approach, featuring repeated simulations of varying durations, ensures a broader understanding of mission-critical factors.

Infrastructure Adaptation for Diverse Mission Simulations: An adaptive analog infrastructure should support a range of mission simulations, from short-duration lunar stays to extended Mars missions. This includes the flexibility to modify habitat designs and test protocols to reflect the variable internal design of habitats and vehicles across different missions, addressing the challenges highlighted in the consideration of missions' variability.

Mission Characteristics

Once a target mission for an analog is identified, proposals should mirror mission-specific characteristics (e.g., mission durations, habitat, and space-analogous environmental conditions) to measure effects of isolation, confinement, crew autonomy, and performance. Proposals should consider the following characteristics in reference to their target mission:

- **Duration:** Analog facilities are often bounded by logistical constraints in their capability of simulating the extended periods astronauts will spend in space, ranging from months to potentially years. This includes creating environments that sustain resources and scientific research over long durations, enabling the tracking of performance changes over time, challenging crews with the psychological and physical aspects of time spent away from Earth.

- **Distance from Earth:** Simulations should account for the vast distances of lunar and Mars missions, which impact communication times, visible views of Earth, delay emergency support, and necessitate a higher degree of crew autonomy. Analogs should incorporate delayed communication systems to simulate the time it takes for messages to travel between Earth and the spacecraft, affecting decision-making and operational independence.

- **Habitat Volume and Capacity:** The design of analog habitats should reflect the actual dimensions of constrained living and working spaces expected on lunar or Mars missions, including considerations for storage, habitability, and the functionality required to support crew health and mission objectives. This entails designing versatile spaces that can adapt to various mission scenarios and crew sizes.

- **Communication Delays:** Analogs should implement systems that replicate the communication delays encountered in deep space missions. This includes not only the technical aspects of delayed communication but also training crews to manage the psychological and operational challenges posed by these delays, such as decision-making autonomy and the maintenance of morale and team cohesion over time.

- **In-Flight or Surface Activities:** Including realistic extravehicular activities (EVAs) in analog simulations is crucial. Facilities should offer diverse EVA scenarios, from routine maintenance tasks to emergency situation drills, that reflect the surface conditions of the Moon or Mars. This involves simulating the gravitational differences, terrain challenges, and the use of EVA suits and equipment designed for these environments. This also includes the application of virtual reality to enhance the realism of environmental simulations, the use of advanced robotics to mimic extravehicular activities.

Selection and Recruitment of Analog Participants

- The selection criteria for participants should closely mimic the astronaut selection requirements as closely as possible. Selection should extend beyond physical fitness and technical expertise to include psychological fitness through a comprehensive evaluation process, targeting the selection of astronaut-like individuals.

- Selection and pre-mission training process should focus on interpersonal skills, such as conflict resolution and effective communication, which are vital for maintaining team cohesion and performance in confined and isolated environments. The ability to cope with monotony, manage uncertainty, and maintain motivation over extended periods should also be key considerations.

- Generalizability of future research conducted in these analog platforms, to future exploration missions, is key.

Impact

The advancement of analog facilities and research methodologies in line with these objectives is vital for preparing astronauts for the unprecedented challenges of lunar and Mars missions. Improved analog fidelity and research capabilities will enable more accurate characterization of behavioral health and performance risks, and development of effective countermeasures. Proposals that address these needs have the potential to significantly impact the preparation and resilience of crews undertaking long-duration space missions, enhancing their safety, well-being, and performance.

14.A.1.2 Human Research Program/Space Radiation Element

POC: Janice Zawaski janice.zawaski@nasa.gov

Research Overview: Space radiation exposure is one of numerous hazards astronauts encounter during spaceflight that impact human health. High priority health outcomes associated with space radiation exposure are carcinogenesis, cardiovascular disease (CVD), and central nervous sytem (CNS) changes that impact astronaut health and performance.

Areas of Research Interest:

1. Research proposals are sought to **accelerate risk characterization for high priority radiation health risks and inform mitigation strategies the NASA Human Research Program (HRP) Space Radiation Element (SRE) by sharing animal tissue samples and data.** The proposed work should focus is on translational studies that support priority risk characterization (cancer, cardiovascular disease (CVD), central nervous ystem (CNS), development of relative biological effectiveness (RBE) values, identification of actionable biomarkers, and evaluation of dose thresholds for relevant radiation-associated disease endpoints. Cross-species comparative analyses of rodent data/samples with higher order species (including human archival data and tissue banks) are highly encouraged.
   - Data can include but is not limited to behavioral tasks, tumor data, physiological measurements, imaging, omics', etc. that has already been, or is in the process of being, collected.
   - Tissue samples can include, but are not limited to, samples that have already been, or are in the process of, being collected and stored as well as tissues from other external archived banks (e.g., http://janus.northwestern.edu/janus2/index.php).
   - Relevant tissue samples and data from other externally funded (e.g., non-NASA) programs and tissue repositories/archives for comparison with high linear energy transfer (LET), medical proton, neutron and other exposures can be proposed.
   - A more detailed list of samples and tissues available from SRE can be found at our tissue sharing websites:
     - https://lsda.jsc.nasa.gov/Document/doc_detail/Doc13726
     - https://lsda.jsc.nasa.gov/Document/doc_detail/Doc13766
     - https://lsda.jsc.nasa.gov/Biospecimen by searching "NASA Space Radiation Laboratory (NSRL)" in the payloads field.
     - Instructions for accessing the tissue sharing information are posted at: https://spaceradiation.jsc.nasa.gov/tissue-sharing/.

2. Research proposals are sought to establish innovative screening techniques for compound-based countermeasures to assess their efficacy in modulating biological responses to radiation exposure relevant to the high priority health risks of cancer, CVD, and/or CNS. Techniques that can be translated into high-throughput screening protocols are highly desired, however high-content protocols will also be considered responsive.

Research Topic: Use of human-based tissue engineered models for characterization of space stressor and/or hazard effects.

POC: Janapriya Saha janapriya.saha@nasa.gov

3. Complex *in vitro* models that mimic component of human physiology continue to evolve and show promise for various research. These tissue-engineered models, including organoids and tissue chips, could be ideal in better understanding space flight stressors and hazards such as chronic effects of low-dose radiation exposure to the human, microgravity, etc.. ***Research proposals are sought to establish translational value of human-based tissue models for characterization of space flight hazards and/or stressor, and countermeasure studies. Such research should include models relevant to cancer, cardiovascular health, neurocognitive health, bone, immune, retinal etc. (For additional information concerning areas of interest please visit***

https://humanresearchroadmap.nasa.gov/Risks/) Selected stressor and or hazard levels should be relevant to space exploration missions.

Respondents can propose the following types of activities:

- Conduct research on HUMAN tissue models and compare to existing human data on vascular, cancer, cardiovascular health, neurocognitive health, bone, immune, retinal etc.. Structural and functional sturdies should be included, in addition to cell/molecular biomarker readouts. Selected stressor and or hazard levels should be relevant to space exploration missions.
- Conduct research on ANIMAL tissue models and compare to existing in vivo data on vascular, cancer, cardiovascular health, neurocognitive health, bone, immune, retinal etc.. Structural and functional sturdies should be included, in addition to cell/molecular biomarker readouts. Selected stressor and or hazard levels should be relevant to space exploration missions
- Obtain relevant preliminary data from either activities 1 or 2 that can be used in a future HRP OMNIBUS or FLAGSHIP grant application

Research Topic: Aging related effects of space radiation
POC: Gregory Nelson gregory.a.nelson@nasa.gov
Janice Zawaski janice.zawaski@nasa.gov

Normal aging processes have been shown to include many cellular processes that are shared with the pathogenesis of late degenerative diseases. Aging involves a progressive loss of physiological integrity and impaired function and is considered a primary risk factor for cancer, diabetes, cardiovascular disorders, and neurodegenerative diseases. Recently aging processes have been organized into a unified framework called the Hallmarks of Aging (e.g. López-Otin 2013, http://dx.doi.org/10.1016/j.cell.2013.05.039). The nine identified hallmarks of aging are: genomic instability, telomere length reduction, epigenetic changes, altered protein homeostasis, deregulated nutrient sensing, mitochondrial dysfunction, cellular senescence, stem cell depletion, and altered intercellular communication. Many of these processes have been investigated in detail in the context of low LET radiation exposure and "accelerated aging" has been proposed as a conceptual framework for radiation effects. However, much less understood about the effects of high LET space-like radiation exposure, especially at low doses and dose rates. These processes underly impairments to human risk imposed by space radiation exposure and an understanding of their responses is required for astronaut risk estimation, health management and countermeasure development. ***Research proposals are sought to explore the pathogenic processes associated with aging and late degenerative diseases that are also elicited by charged particle radiation of composition and dose corresponding to spaceflight exposures. Such research should include models relevant to, but not limited to, cancer, cardiovascular and central nervous system health.***

Respondents can propose the following types of activities:

- Conduct research on adult animals (sexually and immunologically mature) exposed to space-like radiation that characterize pathogenic processes common to aging and radiation injury. Outcome measures that relate to altered protein homeostasis, mitochondrial dysfunction, cellular senescence, and inflammation are of particular interest as well as those that can be used as predictive biomarkers for translation to humans. Use of both wild type and transgenic animals of both sexes is appropriate. Selected radiation doses, dose rates and sources should be relevant to space exploration missions.
- Conduct research comparing human and animal tissue models using engineered tissue and organoid models. Structural and functional studies should be included, in addition to cell/molecular biomarker readouts. Selected radiation doses and sources should be relevant to space exploration missions.

14.A.1.3 Human Research Program/ Exploration Medical Capability(ExMC) Element

POC: Jay Lemery, MD,jay.lemery@nasa.gov

Topic : Artificial Intelligence Solutions to Support Exploration Spaceflight Autonomous Medical Systems
Research Focus: Earth Independent Medical Operations
Description of the problem : As long-term mission planning shifts from a paradigm of LEO to Lunar and subsequently Martian missions, there is a commensurate imperative for Earth-based medical authority to transition to space-based assets for the continued assurance of optimal astronaut health and performance. The transition to Earth Independent Medical Operations (EIMO) will be a process that enables progressively resilient systems and crews to reduce risk and enhance wellness and overall mission success for deep space exploration. Terrestrial assets will be paramount in pre-mission screening, planning, maintenance, and prevention. Yet on-board care, response to unexpected medical events, and management of communication delays and dropouts will increasingly become the purview of the crew for primary management. A key strategy for this is utilizing artificial intelligence (AI) as an integrated platform for crew health and performance that is robust, nimble, malleable, and capable to evolve over time. Crew health and performance will need to be supported across multiple habitats, vehicles, and suits, in some cases designed over many years and with differing requirements.

Areas of Research Interest (your objectives/needs): An ideal solution end state would be able to synthesize large and variable sources of data, including prior medical history, reference databases, real time monitoring using wearable sensors, environmental controls, point of care diagnostics, laboratory results, etc. that can be utilized to diagnose, treat, and perhaps even predict medical events and performance decrements. Inclusion of advanced training tools will enable the increasingly autonomous medical care that can aid a crew medical officer in the circumstance where ground support is unavailable or where availability is time-delayed to the point of being irrelevant as in an emergent medical situation.

Examples of such solutions may include use of natural language processing or large language models that can provide guidance to crew medical officers of varying levels of knowledge, skills, and abilities to aid in medical decision-making in the absence or delay of medical operations ground support. Other attributes may address medical decision-making support tools that can provide task off-loading, autonomous decision support, or just-in-time training with concomitant benefits in cognitive load reduction.

Impact: Impact of this technology will increase inflight medical capabilities and identify new capabilities that (a) maximize benefit and (b) reduce “costs” on the human system/mission/vehicle resources.

14.A.1.4 Office of Chief Health and Medical Officer (OCHMO)

POC: Dr Victor Schneider, vschneider@nasa.gov
Dr James D. Polk; james.d.polk@nasa.gov

Areas Of Research Interest
Development and elaboration of the current state of the science for the manufacture of biologics using synthetic biology and 3-D printing of drugs. On long duration space exploration missions, potential medical problems could occur during the ~3 year Mars mission (6-8 months in microgravity to the

planet, 1 year on Mars, and 6-8 months return to Earth) that would require prevention and therapy. Although the risk of illness can be approximated, which illnesses will occur and what medications are needed will be unknown. A best risk accessed pharmacy will be provided as depot storage of pills, capsules, and liquid based medications. However, both the length of the mission and the potential of other illnesses occurring suggests the need for de novo manufactured medications. Research proposals are sought to establish the current state of potential use of the use of synthetic biology and 3-D drug printing.

14.A.2 Space Operations Mission Directorate (SOMD)

https://www.nasa.gov/directorates/space-operations-mission-directorate

POC: Marc Timm, marc.g.timm@nasa.gov
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Commercial Space Capabilities (CSC)

The SOMD Commercial Space Division (CSD)'s Commercial Crew and Commercial Low Earth Orbit (LEO) Development Programs encompass Crew and Cargo Transportation to and from, and in-space Destinations and operations in, LEO. The purpose of this CSC focus area is to harness the capabilities of the U.S. research community to mature theoretical concepts that are of interest to U.S. commercial spaceflight companies into initial practice. The intent is that such companies can then apply and further evolve that initial practice to improve state-of-art of current capabilities, or to create new capabilities to benefit the growth of a robust near-Earth orbit US economy. The overall goal of this area is to encourage and facilitate a robust and competitive U.S. low Earth orbit economy. Efforts that primarily benefit near-Earth commercial activities but that may might also be extensible Moon and/or Mars are also in scope.

U.S. commercial spaceflight industry interests vary by company and change over time, so Researchers are encouraged to directly engage with industry to determine relevant interests. Before submitting proposals in this area, the Proposer is encouraged to contact the NASA CSC POCs to discuss the intended proposal. Some current high level interests include:

- Low consumable environmental control and life support (ECLS), crew hygiene, and/or clothes washing. (Closed loop or nearly so. Includes waste product repurposing.)
- Small cargo return, Destination resupply systems, and related technologies
- In-Space Welding
- Materials and Processes Improvements for Chemical Propulsion State of Art
- Materials and Processes Improvements for Electric Propulsion State of Art
- Improvements to Space Solar Power State of Art (SoA)
- Other topics in this area that have demonstrable need and support from a U.S. company(ies)

14.A.3 Exploration Systems Development Mission Directorate (ESDMD)
POC: Matt Simon, matthew.a.simon@nasa.gov

With Artemis missions, NASA will land the first woman and first person of color on the Moon, using innovative technologies to explore more of the lunar surface than ever before. We will collaborate with our commercial and international partners to establish the first long-term human-robotic presence on and around the Moon. Then, we will use what we learn on and at the Moon to take the next giant leap: sending the first astronauts to Mars.

The Exploration Systems Development Mission Directorate defines and manages systems development for programs critical to NASA's Artemis program and planning for NASA's Moon to Mars exploration approach. ESDMD manages the human exploration system development for lunar orbital, lunar surface, and Mars exploration. Programs in the mission directorate include Orion, Space Launch System, Exploration Ground Systems, Gateway, Human Landing System, and Extravehicular Activity (xEVA) and Human Surface Mobility. Additional information about the Exploration Systems Development Mission Directorate can be found at: https://www.nasa.gov/exploration-systems-development-mission-directorate

ESDMD is also designing a roadmap for the long-term exploration of the lunar surface, our first steps on Mars, and the journey beyond, working with our partners in industry, academia, and the international community. NASA's "Moon to Mars Objectives" document establishes an objectives-based approach to the agency's human deep space exploration efforts. This approach focuses on the big picture, the "what" and "why" of deep space exploration, before prescribing the "how." Capabilities needed to enable these missions are decomposed from NASA's Moon to Mars Objectives, and will require NASA to master the following areas of research interest:

- **Communications, Navigation, Positioning, and Timing Systems:** Enable transmission and reception of data, determination of location and orientation, and acquisition of precise time.
- **Habitation Systems:** Ensure the health and performance of astronauts in controlled environments.
- **Human Systems:** Execute human and robotic missions; this includes crew, ground personnel, and supporting systems.
- **Logistics Systems:** Package, handle, transport, stage, store, track, and transfer items and cargo.
- **Mobility Systems:** Move crew and cargo around the lunar and Martian surfaces.
- **Power Systems:** Generate, store, condition, and distribute electricity for architectural elements.
- **Transportation Systems:** Convey crew and cargo to and from Earth to the Moon and Mars.
- **Utilization Systems:** Enable science and technology demonstrations.
- **Data Systems and Management:** Transfer, distribute, receive, validate, secure, decode, format, compile, and process data and commands.
- **In-situ Resource Utilization (ISRU) Systems:** Extract resources in space or on the Moon or Mars to generate products.
- **Infrastructure Support:** Includes facilities, systems, operations planning and control, equipment, and services needed on Earth, in space, and on planetary surfaces.
- **Autonomous Systems and Robotics:** Employ software and hardware to assist the crew and operate during uncrewed periods.

More information on future plans for exploring the Moon and Mars and capabilities needed can be found at: https://www.nasa.gov/MoonToMarsArchitecture.

Proposers are directed to the resources linked above to guide areas of potential interest to ESDMD.

14.A.4 Science Mission Directorate (SMD)

Science Mission Directorate (SMD) leads the Agency in five areas of research: Heliophysics, Earth Science, Planetary Science, Astrophysics and Biological and Physical Sciences (BPS). SMD, using the vantage point of space to achieve with the science community and our partners a deep scientific understanding of our planet, other planets and solar system bodies, the interplanetary environment, the Sun and its effects on the solar system, and the universe beyond. In so doing, we lay the intellectual foundation for the robotic and human expeditions of the future while meeting today's needs for scientific information to address national concerns, such as climate change and space weather.

Additional information about the SMD may be found at: https://science.nasa.gov/

14.A.4.1 Heliophysics Division

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Heliophysics encompasses science that improves our understanding of fundamental physical processes throughout the solar system, and enables us to understand how the Sun, as the major driver of the energy throughout the solar system, impacts our technological society. The scope of heliophysics is vast, spanning from the Sun's interior to Earth's upper atmosphere, throughout interplanetary space, to the edges of the heliosphere, where the solar wind interacts with the local interstellar medium. Heliophysics incorporates studies of the interconnected elements in a single system that produces dynamic space weather and that evolves in response to solar, planetary, and interstellar conditions.

In this framework, the Heliophysics Research Program is guided by *Science 2020-2024: A Vision for Scientific Excellence* and any more up to date versions of the Science Plan (available at https://science.nasa.gov/about-us/science-strategy) and by the *2013 National Research Council Decadal Strategy for Solar and Space Physics report, Solar and Space Physics: A Science for a Technological Society* (www.nap.edu/catalog.php?record_id=13060).
The decadal survey articulates the scientific challenges for this field of study and recommends a slate of design reference missions to meet them, to culminate in the achievement of a predictive capability to aid human endeavors on Earth and in space. The fundamental science questions are:

- What causes the Sun to vary?
- How do the geospace, planetary space environments and the heliosphere respond?
- What are the impacts on humanity?

To answer these questions, the Heliophysics Division implements a program to achieve three overarching objectives:

- Explore and characterize the physical processes in the space environment from the Sun to the heliopause and throughout the universe
- Advance our understanding of the Sun's activity, and the connections between solar variability and Earth and planetary space environments, the outer reaches of our solar system, and the interstellar medium
- Develop the knowledge and capability to detect and predict extreme conditions in space to protect life and society and to safeguard human and robotic explorers beyond Earth.

The program supports theory, modeling, and data analysis utilizing remote sensing and in situ measurements from a fleet of missions; the Heliophysics System Observatory (HSO). Frequent CubeSats, suborbital rockets, balloons, and ground-based instruments add to the observational base. Investigations that develop new observables and technologies for heliophysics science are sought.

Supported research activities include projects that address understanding of the Sun and planetary space environments, including the origin, evolution, and interactions of space plasmas and electromagnetic fields throughout the heliosphere. The program seeks to characterize these phenomena on a broad range of spatial and temporal scales, to understand the fundamental processes that drive them, to understand how these processes combine to create space weather events, and to enable a capability for predicting future space weather events.

The program supports investigations of the Sun, including processes taking place throughout the solar interior and atmosphere and the evolution and cyclic activity of the Sun. It supports investigations of the origin and behavior of the solar wind, energetic particles, and magnetic fields in the heliosphere and their interaction with the Earth and other planets, as well as with the interstellar medium.
The program also supports investigations of the physics of magnetospheres, including their formation and fundamental interactions with plasmas, fields, and particles and the physics of the terrestrial mesosphere, thermosphere, ionosphere, and auroras, including the coupling of these phenomena to the lower atmosphere and magnetosphere. Proposers may also review the information in the ROSES-24 Heliophysics Research Program Overview B.01_Helio Overview.pdf (nasaprs.com) for further information about the Heliophysics Research Program.

14.A.4.2 Earth Science Division

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The overarching goal of NASA's Earth Science program is to develop a scientific understanding of Earth as a system. The Earth Science Division (ESD) within SMD (https://science.nasa.gov/earth-science) contributes to NASA's mission, in particular, Strategic Objective 1.1: Understanding The Sun, Earth, Solar System, And Universe. This strategic objective is motivated by the following key questions:

- How is the global Earth system changing?
- What causes these changes in the Earth system?
- How will the Earth system change in the future?
- How can Earth system science provide societal benefit?

These science questions translate into seven overarching science goals to guide ESD's selection of investigations and other programmatic decisions:

- Advance the understanding of changes in the Earth's radiation balance, air quality, and the ozone layer that result from changes in atmospheric composition (Atmospheric Composition)
- Improve the capability to predict weather and extreme weather events (Weather)
- Detect and predict changes in Earth's ecosystems and biogeochemical cycles, including land cover, biodiversity, and the global carbon cycle (Carbon Cycle and Ecosystems)
- Enable better assessment and management of water quality and quantity to accurately predict how the global water cycle evolves in response to climate change (Water and Energy Cycle)
- Improve the ability to predict climate changes by better understanding the roles and interactions of the ocean, atmosphere, land and ice in the climate system (Climate Variability and Change)
- Characterize the dynamics of Earth's surface and interior, improving the capability to assess and respond to natural hazards and extreme events (Earth Surface and Interior)
- Further the use of Earth system science research to inform decisions and provide benefits to society

ESD has a new Earth Science to Action Strategy that leverages the foundational science that NASA, as a space and science agency with unique end-to-end capabilities, generates to enable society and decision-makers everywhere to address the most pressing challenges posed by the changing environment. Within this framework, the ESD also aims to foster the creation and infusion of new technologies – such as data processing, interoperability, visualization, and analysis as well as autonomy, modeling, and mission architecture design – in order to enable new scientific measurements of the Earth system or reduce the cost of current observations (see http://esto.nasa.gov). The ESD also promotes innovative development in computing and information science and engineering of direct relevance to ESD. NASA makes Earth observation data and information freely and widely available through the Earth Science Data System program, which is responsible for the stewardship, archival and distribution of open data for all users.

ESD places particular emphasis on the investigators' ability to promote and increase the use of space-based remote sensing through the proposed research. Proposals with objectives connected to needs identified in most recent Decadal Survey (2017-2027) from the National Academies of Science, Engineering, and Medicine, *Thriving on our Changing Planet: A Decadal Strategy for Earth Observation from Space* are welcomed. (see https://www.nap.edu/catalog/24938/thriving-on-our-changing-planet-a-decadal-strategy-for-earth).

NASA's ability to view the Earth from a global perspective enables it to provide a broad, integrated set of uniformly high-quality data covering all parts of the planet. NASA shares this unique knowledge with the global community, including members of the science, government, industry, education, and policy-maker communities.

14.A.4.3 Planetary Science Division

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The Planetary Science Exploration Technology Office (PESTO), managed by the Planetary Science Division, sponsors technology development that addresses the broad strategic objective to "Ascertain the content, origin, and evolution of the Solar System and the potential for life elsewhere." To pursue this objective, the Planetary Science Division has strategic goals and objectives that guide the focus of the division's science research and technology development activities. As described in the NASA 2023 Science Strategic Plan (https://science.nasa.gov/about-us/science-strategy), these are:

Discover:

- Expand human knowledge through new scientific discoveries
  - 1.2: Understand the Sun, solar system, and universe

Explore:

- Extend human presence to the Moon and on towards Mars for sustainable long-term exploration, development, and utilization
  - 2.1: Explore the surface of the Moon and deep space

Innovate:

- Catalyze economic growth and drive innovation to address national challenges
  - 3.1: Innovate and advance transformational space technologies

The NASA Planetary Science strategic objective is to advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space.

In order to address these goals and objectives, PESTO invites a wide range of planetary science and astrobiology technology development investigations. Example topics for technology developments include, but are not limited to the following:

- Technology developments for supporting the understanding the formation and evolution of the Solar System and (exo) planetary systems in general, and of the planetary bodies, satellites, and small bodies in these systems;
- Technology developments for supporting the understanding materials present, and processes occurring, in the early stages of Solar System history, including the protoplanetary disk;
- Technology developments the supporting the understanding planetary differentiation processes;
- Technology developments for supporting evaluation of extraterrestrial materials, including meteorites, cosmic dust, presolar grains, and samples returned by the Apollo, Stardust, Genesis, and Hayabusa missions;
- Technology developments for supporting the understanding of properties of planets, satellites (including the Moon), satellite and ring systems, and smaller Solar System bodies such as asteroids and comets;
- Technology developments for supporting the understanding of the coupling of a planetary body's intrinsic magnetic field, atmosphere, surface, and interior with each other, with other planetary bodies, and with the local plasma environment;
- Technology developments for supporting the understanding of the origins, evolution, and properties of the atmospheres of planetary bodies (including satellites, small bodies, and exoplanets);
- Technology developments for supporting the understanding of the knowledge of the history of the Earth and the life upon it as a guide for determining the processes and conditions that create and maintain habitable environments and to search for ancient and contemporary habitable environments and explore the possibility of extant life beyond the Earth;
- Technology developments for supporting the understanding of the origin and early evolution of life, the potential of life to adapt to different environments, and the implications for life elsewhere;
- Technology developments for supporting the understanding to provide the fundamental research and analysis necessary to characterize exoplanetary systems;
- Technology developments for supporting the understanding of the chemistry, astrobiology, dynamics, and energetics of exoplanetary systems;
- Technology developments for supporting astronomical observations of our Solar System that contribute to the understanding of the nature and evolution of the Solar System and its individual constituents;
- Technology developments for supporting the inventory and characterization of the population of Near Earth Objects (NEOs) or mitigate the risk of NEOs impacting the Earth;
- Technology developments for evaluating and preventing forward and backward contamination during planetary exploration, methods to minimize such contamination, and standards in these areas for spacecraft preparation and operating procedures;
- Technology developments for supporting the enhancement of the scientific return of NASA Planetary Science Division missions through the analysis of data collected by those missions;
- Advancement of laboratory- or spacecraft-based (including small satellites, e.g., CubeSats) instrument technologies that shows promise for use in scientific investigations on future planetary missions; and

- Analog studies, laboratory experiments, or fieldwork to increase our understanding of Solar System bodies or processes and/or to prepare for future missions.

The technologies needed to support NASA Planetary Science Division may be found in the Planetary Science Technology Strategy document (https://www1.grc.nasa.gov/space/pesto/tech-dev-plan/), which includes the Planetary Science Prioritized Technology Focus Areas:

- Instrumentation, with an emphasis on:
  - In Situ Search for Life/Astrobiology
- Sample Containment and Return
  - Planetary Protection and Contamination Control
  - Sample Thermal Management
  - Sample Acquisition and Handling
- Autonomy
  - Global Positioning System (GPS) deprived navigation
  - Surface (planetary) operations
  - On-board science data processing
  - Ground Operations
- Robotics, with an emphasis on Advanced Mobility for:
  - Aerial Platforms
  - Subsurface Access (including drilling)
- Higher-efficiency power conversion technology for radioisotope system

Proposers may also review the information in the ROSES Planetary Science Research Program Overview for further information about the Planetary Science Research Programs. The use of NASA Research Facilities is available to supported investigators (see section IVe Demonstration of Access to Required Facility). If their use is anticipated, this use must be discussed and justified in the submitted proposals and include a letter of support from the facility (or resource) confirming that it is available for the proposed use during the proposed period.

14.A.4.4 Astrophysics Division

Science Mission Directorate (SMD)

Dr. Hashima Hasan, hhasan@nasa.gov NASA Headquarters (HQ)
Dr. Mario Perez, mario.perez@nasa.gov NASA HQ

NASA's strategic objective in astrophysics is to discover how the universe works, explore how it began and evolved, and search for life on planets around other stars. Three broad scientific questions flow from this objective:

- How does the universe work?
- How did we get here?
- Are we alone?

Each of these questions is accompanied by a science goal that shapes the Astrophysics Division's efforts towards fulfilling NASA's strategic objective:

- Probe the origin and destiny of our universe, including the nature of black holes, dark energy, dark matter and gravity
- Explore the origin and evolution of the galaxies, stars and planets that make up our universe
- Discover and study planets around other stars, and explore whether they could harbor life

To address these Astrophysics goals, the Astrophysics Research Analysis and Technology Program invites a wide range of astrophysics science investigations from space that can be broadly placed in the following categories.

- The development of new technology covering all wavelengths and fundamental particles, that can be applied to future space flight missions. This includes, but is not limited to, detector development, and optical components such as primary or secondary mirrors, coatings, gratings, filters, and spectrographs.
- New technologies and techniques that may be tested by flying them on suborbital platforms such as rockets and balloons that are developed and launched by commercial suborbital flight providers or from NASA's launch range facilities, or by flying them on small and innovative orbital platforms such as cubesats.
- Studies in laboratory astrophysics. Examples of these studies could include atomic and molecular data and properties of plasmas explored under conditions approximating those of astrophysical environments.
- Theoretical studies and simulations that advance the goals of the astrophysics program
- Analysis of data that could lead to original discoveries from space astrophysics missions. This could include the compilations of catalogs, statistical studies, algorithms and pattern recognition, artificial intelligence applications, development of data pipelines, etc.

Citizen Science programs, which are a form of open collaboration in which individuals or organizations participate voluntarily in the scientific process, are also invited. The current SMD Policy (https://smd-prod.s3.amazonaws.com/science-red/s3fs-public/atoms/files/SPD%2033%20Citizen%20Science.pdf) on citizen science describes standards for evaluating proposed and funded SMD citizen science projects. For more information see the https://science.nasa.gov/citizenscience webpage, that provides information about existing SMD-funded projects.

Proposals should address the goals of the Science Mission Directorate's (SMD) Astrophysics Research Program, defined in SMD's Science 2020-2024: A Vision for Scientific Excellence (available at http://science.nasa.gov/about-us/science-strategy). Proposers are encouraged to read this NASA Science Plan, and the report of National Academy of Sciences Decadal Survey on Astronomy and Astrophysics 2020, Pathways to Discovery in Astronomy and Astrophysics for the 2020s,(available at https://www.nap.edu/catalog/26141/pathways- to-discovery-in-astronomy-and-astrophysics for-the-2020s).

Investigations submitted to this program element should explicitly support past, present, or future NASA astrophysics missions. These investigations can include theory, simulation, data analysis, and technology development. Information on the Astrophysics research program and missions are available at https://science.nasa.gov/astrophysics.

14.A.4.5 Biological and Physical Sciences (BPS)

Dr. Francis Chiaramonte francis.p.chiaramonte@nasa.gov

14.A.4.5.1 Fundamental Physics
POC: Mike Robinson michael.p.robinson@nasa.gov

Research Overview: Space offers a unique environment for experimental physics in many areas. Current areas of focus for NASA's Fundamental Physics program are cold atom physics, the application of cold atom technologies to research in quantum science and general relativity.

A primary objective of NASA's solicitations in Fundamental Physics is to engage the skills of the U.S. research community to establish and maintain a world-leading program in space-based quantum science. Quantum mechanics is one of the most successful theories in physics. It describes the very small, such as atoms and their formation into the complex molecules necessary for life, to structures as large as cosmic strings. The behavior of exotic matter such as superfluids and neutron stars is explained by quantum mechanics, as are everyday phenomena such as the transmission of electricity and heat by metals. The frontline of modern quantum science involves cross-cutting fundamental and applied research. For example, world-wide efforts concentrate on harnessing quantum coherence and entanglement for applications such as the enhanced sensing of electromagnetic fields, secure communications, and the exponential speed-up of quantum computing. This area is tightly coupled to research on the foundations of quantum mechanics, which involves exotica such as many-worlds theory and the interface between classical and quantum behavior. Another frontier encompasses understanding how novel quantum matter— such as high-temperature superconductivity and topological states—emerges from the interactions between many quantum particles. Quantum science is also central to the field of precision measurement, which seeks to expand our knowledge of the underlying principles and symmetries of the universe by testing ideas such as the equivalence between gravitational and inertial mass.

Quantum physics is a cornerstone of our understanding of the universe. The importance of quantum mechanics is extraordinarily wide ranging, from explaining emergent phenomena such as superconductivity, to underpinning next-generation technologies such as quantum computers, quantum communication networks, and sensor technologies. Laser-cooled cold atoms are a versatile platform for quantum physics on Earth, and one that can greatly benefit from space-based research. The virtual elimination of gravity in the reference frame of a free-flying space vehicle enables cold atom experiments to achieve longer observation times and colder temperatures than are possible on Earth. The NASA Fundamental Physics program plans to support research in quantum physics that will lead to transformational outcomes, such as the discovery of phenomena at the intersection of quantum mechanics and general relativity that inform a unified theory, the direct detection of dark matter via atom interferometry or atomic clocks, and the creation of exotic quantum matter than cannot exist on Earth.

Focus areas for research in fundamental physics:

- Quantum coherence and entanglement
- Quantum interferometry and precision measurements
- Properties of quantum matter
- Quantum phenomena in many-body systems
- Particle Physics
- General Relativity

14.A.4.5.2 Soft Matter/Complex Fluids
POC: Mike Robinson michael.p.robinson@nasa.gov

Research Overview: Research goals of the soft matter program is to investigate the fundamental principles that organize the structure and functionality of materials such as active and soft mater, and to study the fundamental laws that govern the behavior of systems that are far from equilibrium.

Soft Matter comprises a large class of deformable materials, including colloids, microemulsions, foams, liquid crystals, and granular material. Studying these systems focuses on gaining insight into many diverse fields such as phase transitions, nucleation and crystal growth, coarsening, glass formation, chaos, field theory, dusty plasmas and much more. Complex fluids are a subset of soft materials that can flow and exhibit non-Newtonian rheology. Research in soft matter and complex fluids can provide foundational knowledge for NASA's exploration of planetary surfaces such as, forces on particles, particle charging and agglomeration in complex plasmas or the complex rheology during the flow of a lunar regolith derived slurry to produce construction materials. Furthermore, terrestrial applications are relevant in industries such as pharmaceutical, chemical, plastics, soap and detergent, electronic display, and petroleum. Because of the relatively large size of the basic structures, gravitational forces dominate and cause sedimentation, buoyancy-driven convective flows, hydrostatic pressure gradients, jamming, drainage, etc. Weaker forces such as surface tension and entropic forces, completely masked on Earth, can become dominant in space. In addition, particles can remain suspended without gravitational forces. In weightlessness external fields such as thermal, magnetic, electric and acoustic can be used without the impediments of gravity to create and investigate tunable soft matter (e.g. colloidal) systems.

The research area of soft matter/complex fluids includes the following themes:

- Colloids
- Emulsions
- Liquid crystals
- Foams
- Gels
- Granular flows
- Dusty or complex plasmas

14.A.4.5.3 Fluid Physics
POC: Brad Carpenter bcarpenter@nasa.gov

Research Overview: The goal of the microgravity fluid physics program is to understand fluid behavior of physical systems in space, providing a foundation for predicting, controlling, and improving a vast range of technological processes. Specifically, in reduced gravity, the absence of buoyancy and the stronger influence of capillary forces can have a dramatic effect on fluid behavior. For example, capillary flows in space can pump fluids to higher levels than those achieved on Earth. In the case of systems where phase-change heat transfer is required, experimental results demonstrate that bubbles will not rise under pool boiling conditions in microgravity, resulting in a change in the heat transfer rate at the heater surface. The microgravity experimental data can be used to verify computational fluid dynamics models. These improved models can then be utilized by future spacecraft designers to predict the performance of fluid conditions in space exploration systems such as air revitalization, solid waste management, water recovery, thermal control, cryogenic storage and transfer, energy conversion systems, and liquid propulsion systems. Some examples include: Nuclear fission Rankine power cycle for future space missions (Moon, Mars) and deep space missions, Vapor Compression heat pump for planetary bases (Moon, Mars), Thermal Control Systems and advanced Life Support Systems for spacecraft and Cryogenic systems, such as nuclear thermal propulsion, fuel depots, tank chill-down.

One of the most important directions of research that is partly addressed by the Zero Boiloff series of experiments is development of innovative and transformative pressure control strategies that allows efficient, reliable and lossless storage and transfer of cryogenic propellants. Understanding the phase change and transport of volatile fluids in microgravity is essential to preserve propellants on orbit and allowing refueling operation is space to carry out and sustain long-duration human planetary exploration missions to Moon, Mars and beyond. The need for scientific understanding and discoveries of liquid/vapor phase change phenomena in the absence of gravity will remain valuable in providing the foundation for development of next generation of light weight thermal management and power generation systems. Novel technologies will be based on multi-physics phenomena, such as the electro-hydrodynamically driven cooling devices. Also, there is a need to develop a fundamental understanding of two-phase flow condensation heat transfer in reduced gravity. Areas of interest include the observation of the condensate film and relevant temperature measurements. Condensation research is relevant to spacecraft thermal control, humidity control, water recovery and certain power generation systems.

NASA has a growing need for improved passive thermal management of electronics, batteries, high capability sensors, power system heat rejection, etc. for future spacecraft and planetary habitat systems. Due to the potential to extract heat at significantly higher heat flux levels, oscillating heat pipes (OHP) offer the promise of significantly higher efficiencies compared to conventional heat pipes used on today's spacecraft. However, the underlying liquid-vapor fluid dynamics (distinct liquid plugs and vapor plugs), interfacial phenomena, and two-phase heat transfer in the pulsating flows of OHPs are not well understood. It is imperative that a physical model that can predict the performance of an OHP be developed. As a first step, NASA is seeking proposals for an instrumented, ground-based OHP experiment to provide insight into the mechanisms, fundamental processes and governing equations. The resulting high-fidelity data will be used for computational fluid dynamics model validation to better predict OHP performance and limits of operation. NASA is currently funding the development of an advanced OHP computer model at JPL. The experimental data from this project will be provided to the JPL OHP numerical modeling team. Specifically, NASA is interested in fundamental experimental research to address some or all of the topics below. The list of needs is given in a somewhat prioritized order. Please note: all OHP proposals must include liquid film characterization.

The research area of fluid physics includes the following themes:

- Adiabatic two-phase flow
- Boiling and condensation
- Capillary flow
- Interfacial phenomena
- Cryogenic propellant storage and transfer

14.A.4.5.4 Combustion Science

POC: Brad Carpenter bcarpenter@nasa.gov

Research Overview: One of the goals of the microgravity combustion science research program is to improve combustion processes, leading to added benefits to human health, comfort, and safety. NASA's microgravity combustion science research focuses on effects that can be studied in the absence of buoyancy-driven flows caused by Earth's gravity. Research conducted without the interference of buoyant flows can lead to an improvement in combustion efficiency, producing a considerable economic and environmental impact. Combustion science is also relevant to a range of challenges for long-term human exploration of space that involve reacting systems in reduced and low gravity. These challenges include - spacecraft fire prevention; fire detection and suppression; thermal processing of regolith for oxygen and water production; thermal processing of the Martian atmosphere for fuel and oxidizer production; and processing of waste and other organic matter for stabilization and recovery of water, oxygen and carbon. Substantial progress in any of these areas will be accelerated significantly by an active reduced-gravity combustion research program.

Research is needed in the flammability of solid fuels to advance fire safety research. Specifically, testing is necessary to understand the fire performance of representative spacecraft and planetary habitat materials at all g-levels (Microgravity, Lunar, Martian, and Earth gravity). Study is needed of these materials at a research level - ignition, flame spread, size, heat output, radiation, O2 level, g level, etc. In 1-g and drop tower. Also, to organize results by type of materials. Also, to use these gravity dependent data for the improvement of computational models. The goal is to use the experimental results and numerical simulations to support NASA material flammability testing, material controls, and habitat/vehicle designs which depend on g-level. Use of the NASA Glenn Research Center (GRC) drop is a useful method to achieve 5 seconds of microgravity and, with the use of the centrifuge drop rig, any partial gravity levels as well. The POCs for the GRC 5 second drop tower facility are David Urban, david.urban@nasa.gov and Nancy Hall, nancy.r.hall@nasa.gov
Research is needed to develop carbon-free and carbon-neutral transportation fuels. Airlines have committed to reduce carbon emissions by 50% by 2050 (relative to 2005 levels). Doing this requires (1) moving to carbon-neutral feedstocks that are drop-in replacements for petroleum-based fuels (PBFs, i.e., biofuels that have a closed-carbon cycle) and (2) moving whenever possible to carbon-free fuels (e.g., ammonia) that have no carbon footprint. Given the capital cost of aircraft an airplane put into service today will still be in operation 20+ years from today. There are needs for drop-in replacements for PBFs that will enable current generation aircraft to remain in service for their entire service life. Low-gravity research proposals that will improve our understanding of the kinetics, flame structure, and product emission from carbon-free and carbon-neutral fuels will facilitate use of these fuels in the transportation sector.

The research area of combustion science includes the following themes:

- Spacecraft fire safety
- Droplets
- Gaseous – premixed and non-premixed
- High pressure – transcritical combustion and supercritical reacting fluids
- Solid fuels
- Carbon free fuels

14.A.4.5.5 Materials Science

POC: Brad Carpenter BCarpenter@nasa.gov

Research Overview: The goal of the microgravity materials science program is to improve the understanding of materials properties that will enable the development of higher-performing materials and processes for use both in space and on Earth. The program takes advantage of the unique features of the microgravity environment, where gravity-driven phenomena, such as sedimentation and thermosolutal convection, are nearly negligible. On Earth, natural convection leads to dendrite deformation and clustering, whereas in microgravity, in the absence of buoyant flow, the dendritic structure is nearly uniform. Major types of research that can be investigated include solidification effects and the resulting morphology, as well as accurate and precise measurement of thermophysical property data. These data can be used to develop computational models. The ability to predict microstructures accurately is a promising computational tool for advancing materials science and manufacturing. Research is needed to demonstrate the feasibility of creating lunar construction "concrete" materials by alkali-activation of regolith simulant. Specifically, to conduct 1-g ground studies to understand the solidification, microstructure and properties of the construction material using alternative binders (regolith simulant replacing cement) and alkaline solution (replacing water) to form a geopolymer. Also, to measure the mechanical properties of the solidified material. Future applications of lunar construction materials include launch pads, habitats, and other components of lunar infrastructure. The research area of materials science includes the following themes:

- Glasses and ceramics
- Granular materials
- Composite materials
- Metals
- Polymers and organics
- Semiconductors

14.A.4.5.6 Growth of plants in "deep space-relevant" Earth soils or conditions
POC: Sharmila Bhattacharya SpaceBiology@nasaprs.com

Research Overview: As human exploration continues to move further out beyond Low Earth Orbit (BLEO), exploration missions will need to become increasingly self-sufficient, and will not be able to rely as heavily on resupply efforts from Earth, as they now do within Low Earth Orbit (LEO). The NASA Space Biology Program is interested in basic research that will ultimately translate into the ability to grow edible plants and crops in deep space environments. Research supported by our program has already demonstrated that 1) edible plants can be grown in the LEO environment of the International Space Station (Massa *et al*., 2017), and that 2) model (non-edible) plant organisms can germinate from seeds planted in lunar regolith obtained from the Apollo 11, 12, and 17 missions (Paul *et al.*, 2022; for a historic perspective refer to Ferl and Paul, 2010). While both these results are very promising, there is still much work that needs to be done to move exploration efforts to the point where astronauts can begin to think about practicing agriculture in harsh deep space environments such as the lunar and Martian surfaces.

While much of Space Biology's funded plant research efforts have focused on experiments conducted in spacecraft, or in the presence of simulated spaceflight/deep-space stressors, the program is interested in exploring other potential niches that exist here on Earth that may provide important insights into how both plants and the surrounding environment can be manipulated to support crop growth under harsh, inhospitable conditions. As early humans spread out across the globe, they have repeatedly encountered extreme environments that were far from being innately supportive of agriculture and settlement. Despite these challenges, humans have often found ways to live and even flourish in such environments, either by finding food sources that were robust enough to grow under such conditions, and/or by altering the terrain through irrigation and natural farming (soil modification with natural composts, crop rotation, etc.) to enable crop growth. Therefore, for this research focus area, Space Biology is soliciting proposals that will provide insights into how plants grow and continue to adapt to Earth's extreme geochemically diverse environments, as well as how these environments can be manipulated to support such growth.

Research Focus: This Space Biology Research Emphasis requests proposals for hypothesis-driven studies that will either provide a better understanding of the mechanisms by which some plants are able to grow and thrive in extreme or geochemically diverse environments on Earth or will identify plants and/or alternative methods that can be used to facilitate plant/crop growth in such extreme environments. Ideally, studies funded from this opportunity will in the future translate to improved agricultural methods and tools that can be utilized in extreme environments on Earth and eventually in harsh environments of the lunar and Martian surfaces.

Such topics of study may include, but are not limited to:

- Characterizing the molecular and/or biological mechanisms by which plants already known for their agricultural robustness are able to grow in soil types found in Earth's more extreme environments, including volcanic soils and sands (deserts), clay, etc. Particular emphasis may be given to edible plants.
- Identifying new plants that are able to grow in such soil samples and characterizing their growth and vitality.
- Genetic modification of plants to improve growth and robustness in such soils.
- Identifying or engineering microbiomes that will optimize plant growth and vitality in such soils.
- Testing or developing new composting methods or other natural methods to enrich such soils which will enable them to better support plant growth.

If logistics and costs permit, proposed studies may be conducted on location directly in the types of environments mentioned above, however, proposed studies may also use soil samples collected (or purchased) from these environments. It will be up to the proposer to identify the extreme environment/soil samples they will use for their studies, as well as provide justification in their proposal as to why these environments/soils were chosen and have relevance to space exploration.

Additional Information: While the Space Biology Program can be contacted at SpaceBiology@nasaprs.com for general questions about this RFA, the program itself is not able to foster collaborations between applicants and NASA scientists or NASA-funded scientists. If potential applicants are seeking to establish such collaborations for their project, then we recommend that they consult the NASA Task Book (at https://taskbook.nasaprs.com) to identify potential collaborators. The NASA Task Book is a database that contains information about all the projects that the NASA Space Biology Program has funded since 2004. Here applicants will also find the names of investigators that have been funded by our program as well as their contact information.

All publications that result from an awarded EPSCOR study shall acknowledge the Space Biology Program within NASA's Biological and Physical Science (BPS) Division. If the NASA GeneLab Data Systems (genelab.nasa.gov) is used, GeneLab shall be referenced in the resulting publication and included in the keyword list. All omics data obtained from this study shall be uploaded to the NASA GeneLab (https://genelab.nasa.gov).

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14.A.4.5.7 The impact of space-associated stressors on energy metabolism and oxidative stress

POC: Sharmila Bhattacharya SpaceBiology@nasaprs.com

Research Overview: The spaceflight environment is known to impose cellular and physiological changes in living systems that are common across species and even across the taxonomic biological kingdoms. These changes can not only adversely impact the well-being of entire organisms, but of entire ecosystems in spacecraft and planetary habitats. In order to help enable life to thrive in space, an understanding of both the effects of these changes, and the mechanisms by which these changes occur, is critical. Recent Space Biology-funded research that employed muti-omics and system biology approaches to profile the transcriptomic, proteomic, metabolomic, and epigenetic responses to spaceflight in tissue samples collected from astronauts, as well as other organisms flown in space, showed that mitochondrial dysfunction is a common consequence of exposure to the spaceflight environment across diverse biological systems (da Silveira *et al*., 2020). These results, however, are not the only findings that indicate that space travel has an impact on biological pathways responsible for cellular and physiological energy metabolism. There are a plethora of studies demonstrating that exposure to space-associated stressors induces oxidative stress and changes within the biological pathways responsible for redox responses in plant, animal, and fungal model systems (Choi *et al.*, 2019; Hateley, *et al*., 2016; Tahimic and Globus, 2017; Nislow et al., 2015), which both regulate and are regulated by mitochondrial function. Furthermore, additional research with the plant model *Arabidopsis thaliana* has shown that exposure to microgravity downregulates the expression of genes encoding proteins associated with the chloroplast (Land *et al*., 2024), thus providing mechanistic data of how space-associated stressors can impact photosynthesis.

While these studies have provided important clues on how the stressors encountered during space exploration dysregulate energy metabolism and homeostasis, a mechanistic understanding of how these stressors, either individually or in combination, contribute to this dysregulation and the impact that such dysregulation has on the overall health of an organism is needed. Therefore, for this research focus area, Space Biology is soliciting ground-based proposals that elucidate the effects of spaceflight related stressors on energy metabolism and/or oxidative stress.

Research Focus: This Space Biology Research Emphasis requests proposals for hypothesis-driven studies that will characterize the impacts that stressors associated with space exploration have on cellular energy metabolism and/or redox responses, and how changes in these processes impact the overall health of an entire organism, or in the case of microbial studies, the health of individual microbes or of communities containing multiple microbes. Such stressors may include, but are not limited to, simulated microgravity or partial gravity, changes in atmospheric pressure or composition (*i.e.*, oxygen and carbon dioxide concentrations), hypoxia, and ionizing radiation (radiation sources that are easily accessible in a laboratory environment, such as X-ray or gamma radiation, can be used).

Such topics of study may include, but are not limited to:

- Characterizing how space-relevant stressors impact mitochondrial integrity and function in eukaryotic organisms, and how changes in these properties impact the overall fitness of the entire organism (within plant/animal/microbial models) or of an entire community (within unicellular models).
- Characterizing how space-associated stressors impact the accumulation of reactive oxygen species cellular redox responses, and how changes in these properties impact the overall fitness of the entire organism (within plant/animal models) or of an entire community (within unicellular models).
- Characterizing how space-associated stressors impact chloroplast integrity and function in plant model systems, and how changes in these properties impact the overall fitness of the entire organism.
- Characterizing the response of prokaryotic organisms to these stressors with the goal of gaining a heuristic understanding of how such stressors impact energy-related metabolic pathways.
- The identification of cross species biosignatures in response to oxidative stress or stressors that impact energy metabolism/homeostasis.

Investigators are also welcome to propose additional types of studies, including those that focus on other cellular components or processes, as long as the overall research focus of the proposed project address the emphasis of this RFA, which is how spaceflight stressors impact energy metabolism/homeostasis and/or oxidative stress/redox responses. Applicants may propose to use any plant or microbial model system for their studies, but animal models will be limited to cell cultures or invertebrates (excluding cephalopods), and applicants will be expected to include their rationale and justification for their choice of model system, and space-relevant variables to be tested in their proposal.

Additional Information: While the Space Biology Program can be contacted at SpaceBiology@nasaprs.com for general questions about this RFA, the program itself is not able to foster collaborations between applicants and NASA scientists or NASA-funded scientists. If potential applicants are seeking to establish such collaborations for their project, then we recommend that they consult the NASA Task Book (at https://taskbook.nasaprs.com) to identify potential collaborators. The NASA Task Book is a database that contains information about all the projects that the NASA Space Biology Program has funded since 2004. Here applicants will also find the names of investigators that have been funded by our program as well as their contact information.

All publications that result from an awarded EPSCOR study shall acknowledge the Space Biology Program within NASA's Biological and Physical Science (BPS) Division. If the NASA GeneLab Data Systems (genelab.nasa.gov) is used, GeneLab shall be referenced in the resulting publication and included in the keyword list. All omics data obtained from this study shall be uploaded to the NASA GeneLab (https://genelab.nasa.gov).

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14.A.4.5.8 The role of genetic diversity in enabling life to thrive in space

POC: Sharmila Bhattacharya SpaceBiology@nasaprs.com

Research Overview: While model systems provide an invaluable tool for helping researchers gain an understanding of how biological systems respond to the harsh environmental factors and stressors that may be encountered during space exploration, much of this research has been conducted using specimens with limited genetic diversity. For example, many animal and plant studies use inbred strains/lines or specific cultivars, respectively, and many microbiology studies use organisms that have the same genetic background, or groups of organisms with limited genetic variability between them. The use of such specimens for initial studies is both appropriate and necessary to reduce variability caused by genetic diversity, which can contribute to "noisy" data when trying to characterize the impacts that multiple space-associated stressors have on biological systems. However, in natural populations, organisms within a single species can be highly genetically diverse and this diversity can translate into vastly different responses to the same stressor among individuals. Therefore, for this research focus area, Space Biology is soliciting proposals that will characterize how genetic diversity impacts the ability of organisms to respond to space-associated stressors as well as how genetic diversity impacts the organism overall fitness under these conditions.

Research Focus: This Space Biology Research Focus Area requests proposals for hypothesis-driven studies that will increase our understanding of how genetic variability or different genetic background modulates an organism's ability to respond to environmental stressors encountered during space exploration. Such stressors may include, but are not limited to, simulated microgravity or partial gravity, changes in atmospheric pressure or composition (*i.e.*, oxygen and carbon dioxide concentrations), hypoxia, and ionizing radiation (radiation sources that are easily accessible in a laboratory environment, such as X-ray or gamma radiation, can be used).

Such topics of study may include, but are not limited to:

- Comparing the responses (and the resulting overall fitness) of multiple genetic backgrounds within a single species to space-associated stressors.
- Following up on previously published observations regarding an organism's response to space-associated stressors and testing how different genetic background/mutations alter that

response.

- Use of forward/and or reverse genetic approaches to identify genes or family/subset of genes that modulate an organism's overall fitness in and response to the presence of space-associated stressors.
- Using synthetic biology approaches to engineer organisms that are better able to tolerate exposure to space-associated stressors.
- Population studies using microbes or plant/animal models with a quick generation time to examine how genetic diversity impacts overall survival, fitness and/or evolution in the presence of space-associated stressors.

Investigators are also welcome to propose additional types of studies as long as the overall research focus of the proposed project address the emphasis of this RFA, which is how genetic diversity enables life to thrive in space. Applicants may propose to use any plant or microbial model system for their studies, but animal models will be limited to cell cultures or invertebrates (excluding cephalopods), and applicants will be expected to include their rationale and justification for their choice of model system, and space-relevant variables to be tested in their proposal.

Additional Information: While the Space Biology Program can be contacted at SpaceBiology@nasaprs.com for general questions about this RFA, the program itself is not able to foster collaborations between applicants and NASA scientists or NASA-funded scientists. If potential applicants are seeking to establish such collaborations for their project, then we recommend that they consult the NASA Task Book (at https://taskbook.nasaprs.com/) to identify potential collaborators. The NASA Task Book is a database that contains information about all the projects that the NASA Space Biology Program has funded since 2004. Here applicants will also find the names of investigators that have been funded by our program as well as their contact information.

All publications that result from an awarded EPSCOR study shall acknowledge the Space Biology Program within NASA's Biological and Physical Science (BPS) Division. If the NASA GeneLab Data Systems (genelab.nasa.gov) is used, GeneLab shall be referenced in the resulting publication and included in the keyword list. All omics data obtained from this study shall be uploaded to the NASA GeneLab (https://genelab.nasa.gov).

14.A.5 Space Technology Mission Directorate (STMD)

POC: Damian Taylor, Damian.Taylor@nasa.gov

The Space Technology Mission Directorate (STMD) is where technology drives exploration and the space economy; and aims to transform future missions while ensuring American leadership in aerospace.

STMD rapidly develops, demonstrates, and infuses revolutionary, high-payoff technologies through transparent, collaborative partnerships, expanding the boundaries of the aerospace enterprise. STMD employs a merit-based competition model with a portfolio approach, spanning a range of discipline areas and technology readiness levels. By investing in bold, broadly applicable, disruptive technology that industry cannot tackle today, STMD seeks to mature the technology required for NASA's future missions in science and exploration while proving the capabilities and lowering the cost for other government agencies and commercial space activities.

Research and technology development takes place within NASA Centers, at JPL, in academia and industry, and leverages partnerships with other government agencies and international partners. STMD engages and inspires thousands of technologists and innovators creating a community of our best and brightest working on the nation's toughest challenges. By pushing the boundaries of technology and innovation, STMD allows NASA and our nation to remain at the cutting edge. Additional information on STMD can be found at: https://www.nasa.gov/directorates/

STMD looks to engage new and diverse partners to garner different perspectives and approaches to our biggest technology challenges. An overarching principle guiding STMD's work is our commitment to inspiring and developing a diverse and powerful US aerospace technology community. As part of our strategic approach, STMD is committed to empowering innovators by expanding our work with and support for underrepresented communities. Furthermore, we are focused on demonstrating engaging practices for underserved and underrepresented communities through the R&D process that strengthens and supports economic growth for a diverse technology community. This is paramount to our ***Lead*** strategic thrust through which ***Go***, ***Land***, ***Live*** and ***Explore*** thrusts are realized.

STMD plans future investments to support our strategic thrusts as follows:

Lead: *Ensuring American global leadership in Space Technology*

- Advance US space technology innovation and competitiveness in a global context: Address national aerospace challenges; Enable rapid and efficient technology development; Take risks; capture and disseminate knowledge.
- Encourage technology driven economic growth with an emphasis on the expanding space economy: Foster the creation and growth of aerospace businesses; Increase the commercialization of NASA-supported technologies; Partner in innovative ways for research and development to expand the aerospace sector; Collaborate with stakeholders in geographic communities across the country.
- Inspire and develop a diverse and powerful US aerospace technology community: Make it easier for all U.S. individuals and organizations to contribute to NASA technology development; Increase representation of diverse and non-traditional groups across STMD's portfolio to leverage creativity and innovation from across America; Cultivate a pipeline of technologists and innovators.

- ***Go***: *Rapid, Safe, & Efficient Space Transportation*
  - Space Nuclear Propulsion: Develop nuclear technologies enabling fast in-space transits.
  - Cryogenic Fluid Management: Develop cryogenic storage, transport, and fluid management technologies for surface and in-space applications.
  - Advance Propulsion: Produce advanced propulsion technologies that enable future science/exploration missions.

- ***Land***: *Expanded Access to Diverse Surface Destinations*
  - Precision Landing and Hazard Avoidance: Develop capabilities to enable lighting-independent precise landing on any terrain.
  - Entry, Descent, and Landing to Enable Science Missions: Develop capabilities enabling small to large missions to efficiently enter any atmospheres and/or land on surfaces within our solar system.
  - 20t and Lunar/Mars Global Access: Develop capabilities to support global access to the moon and Mars including accurate prediction of plume surface interaction.

- ***Live***: *Sustainable Living and Working Farther from Earth*
  - Advanced Habitation Systems (AHS): Keep astronauts healthy and productive while living in space and planetary vehicles.

- In-Situ Resource Utilization: Develop scalable ISRU production/utilization capabilities including sustainable commodities on the lunar and Mars surface.
- Power and Energy Storage Systems: Develop sustainable power sources and other surface utilities to enable continuous in-space and lunar and Mars surface operations.
- Thermal Management Systems: Develop thermal management technologies that enable surviving the extreme in-space and lunar and Mars surface environments.
- Excavation, Construction, and Outfitting (ECO): Develop methodologies for moving regolith for in-situ purposes such as commodities extraction and constructing infrastructure like roads, foundations and structures using in-situ resources.
- Surface Systems: Develop surface support systems to enable long duration surface stays.

- ***Explore***: *Transformative Missions and Discoveries*
  - Advanced Avionics: Develop advanced avionics to meet agency objectives, including radiation-hardened spaceflight computing technologies.
  - Advanced Manufacturing: Develop both terrestrial and in-space manufacturing technologies to make commercial and exploration missions more capable and affordable.
  - Autonomous Systems and Robotics: Develop autonomy and robotics technologies that enable and enhance the full range of science and exploration missions (both with and without crew).
  - Communications and Navigation: Develop communication, navigation, and timing approaches to support diverse asset (human or robotic) needs including establishing asset location in-space.
  - In-space Servicing, Assembly, and Manufacturing (ISAM) and Rendezvous, Proximity Operations, and Capture (RPOC): Develop technologies for in-space creation, maintenance, and evolution of space assets leveraging expanding in-space infrastructure.
  - Small Spacecraft Technologies: Develop technologies for small spacecraft and responsive launch to rapidly expand space capabilities at dramatically lower costs.
  - Sensors, Instruments, and Observatories: Develop technologies for science instrumentation supporting new discoveries.

Furthermore, the above strategic thrusts describe the STMD investment priority strategy and are further detailed in the Strategic Technology Architecture Roundtable (STAR) Process: https://techport.nasa.gov/framework.

STMD's Principal Technologists and System Capability Leads are available for consultation with proposers regarding the state-of-the-art, on-going activities and investments, and strategic needs in their respective areas of expertise. Proposers are encouraged to consult with the appropriate PT or SCLT early in the proposal process.

STMD POC	Technology Area	NASA Email
John Vickers	Advanced Manufacturing	john.h.vickers@nasa.gov
Danette Allen	Autonomous Systems	danette.allen@nasa.gov
Wes Powell	Avionics	wesley.a.powell@nasa.gov
Bernie Edwards	Communications & Navigation	bernard.l.edwards@nasa.gov
Jason Mitchell	Communications & Navigation	jason.w.mitchell@nasa.gov
Arthur Werkheiser	Cryo Fluid Management	arthur.werkheiser@nasa.gov
Kristen John	Dust Mitigation	kristen.k.john@nasa.gov
Michelle Munk	Entry, Descent and Landing (EDL)	michelle.m.munk@nasa.gov
Mike Wright	Entry, Descent and Landing (EDL)	michael.j.wright@nasa.gov
John Carson	EDL Precision Landing	john.m.carson@nasa.gov

Jim Broyan	Environmental Control and Life Support System (ECLSS) Lead	james.l.broyan@nasa.gov
Mark Hilburger	Excavation, Construction and Outfitting (ECO)	mark.w.hilburger@nasa.gov
Julie Kleinhenz	In Situ Resource Utilization	julie.e.kleinhenz@nasa.gov
Jerry Sanders	In Situ Resource Utilization	gerald.b.sanders@nasa.gov
John Dankanich	In Space Transportation	john.dankanich@nasa.gov
Jeremiah McNatt	Power	jmcnatt@nasa.gov
Ron Litchford	Propulsion Systems	ron.litchford@nasa.gov
Bo Naasz	Rendezvous & Capture	bo.j.naasz@nasa.gov
Josh Mehling	Robotics	joshua.s.mehling@nasa.gov
Denise Podolski	Sensors/Radiation/Quantum	denise.a.podolski@nasa.gov
Mark Hilburger	Structures/Materials;	mark.w.hilburger@nasa.gov
Angela Krenn	Surface Systems	angela.g.krenn@nasa.gov
Angela Krenn	Thermal	angela.g.krenn@nasa.gov

In recognition of NASA's leadership in developing advanced technologies for the benefit of all, research topics related to advancing national capabilities in the following climate-related and addressing orbital debris technology areas are of interest:

- Clean Energy and Emissions Technologies: Clean energy and emissions mitigation technology projects focusing on the research and development, demonstration, or deployment of systems, processes, best practices, and sources that reduce the amount of greenhouse gas emitted to, or concentrated in, the atmosphere.

- U.S. Climate Change Research Program: Earth-observing capabilities to support breakthrough science and National efforts to address climate change.
  - Specific topic areas could include:
    - Reductions in greenhouse gas emissions (including CO2, CH4, N2O, HFCs)
      - Fuel Cells
      - Batteries and Energy Storage
      - Carbon Capture, Utilization, and Storage
      - Processes that enhance industrial efficiency and reduce emissions
      - Production of clean energy including solar, hydrogen, nuclear, or other clean energy sources
    - Enabling platforms and early-stage instruments for climate-relevant science observations

- Addressing Orbital Debris: Control the long-term growth of debris population.

- POCs for additional information:
  - Clean energy: Jeremiah Mcnatt (jmcnatt@nasa.gov)
  - Nuclear systems: Anthony Calomino (anthony.m.calomino@nasa.gov)
  - Hydrogen: Jerry Sanders (gerald.b.sanders@nasa.gov)
  - Earth-observing capabilities: Chris Baker (christopher.e.baker@nasa.gov), Justin Treptow (justin.treptow@nasa.gov)

- Carbon capture and utilization: James Broyan (james.l.broyan@nasa.gov)
    - Harnessing data for improved visualization: Lawrence Friedl (SMD) (lfriedl@nasa.gov)
    - Addressing Orbital Debris: Bo Naasz (Bo.j.naasz@nasa.gov)

Applicants are strongly encouraged to familiarize themselves with the 2020 NASA Technology Taxonomy (replaced the 2015 NASA Technology Roadmaps) and the NASA Strategic Technology Framework that most closely aligns with their space technology interests. The 2020 NASA Technology Taxonomy may be downloaded at the following link: https://www.nasa.gov/offices/oct/taxonomy/index.html. The NASA Strategic Technology Framework, including presentations describing the Envisioned Future and strategy for addressing each of the STMD capability areas and outcomes, can be found at: https://techport.nasa.gov/framework.

The National Aeronautics and Space Administration (NASA) Space Technology Mission Directorate (STMD) current year version of the NASA Research Announcement (NRA) entitled, "Space Technology Research, Development, Demonstration, and Infusion" has been posted on the NSPIRES web site at: http://nspires.nasaprs.com (select "Solicitations" and then "Open Solicitations"). The NRA provides detailed information on specific proposals being sought across STMD programs. Specifically, STMD supports research from universities through a number of other solicitations from early stage programs such as NASA's Innovation Corps Pilot, NASA Innovative Advanced Concepts, Space Technology Research Grants, Small Business Technology Transfer, and Lunar Surface Innovation Consortium. Additionally, here's a link to other STMD program opportunities that potentially could benefit from university research ideas.

14.A.6 Areas of Interest for NASA Centers

"Engagement with Center Chief Technologists and the Agency Capability Leadership Teams is critical to value of the research and selection of proposals." Examples of Center research interest areas include these specific areas from the following Centers. If no POC is listed in the Center write-up and contact information is needed, please contact the POC listed in Appendix D for that Center and request contacts for the research area of interest.

14.A.6.1 Ames Research Center (ARC)

POC: Harry Partridge, harry.partridge@nasa.gov

- Entry systems: Safely delivering spacecraft to Earth & other celestial bodies
- Advanced Computing & IT Systems: Enabling NASA's advanced modeling and simulation
    - Supercomputing
    - Quantum computing, quantum sensors and quantum algorithms
    - Applied physics and Computational materials
- **Aero sciences**:
    - Wind Tunnels: Testing on the ground before you take to the sky
- **Air Traffic Management**:
    - NextGen air transportation: Transforming the way we fly
    - Airborne science: Examining our own world & beyond from the sky
    - Airspace Systems, Unmanned aerial Systems
- **Astrobiology and Life Science**: Understanding life on Earth - and in space

- Biology & Astrobiology
- Space radiation health risks
- Biotechnology, Synthetic biology
- Instruments
- Cost-Effective Space Missions: Enabling high value science to low Earth orbit & the moon
  - Small Satellites, Cube satellites
- **Intelligent/Adaptive Systems**: Complementing humans in space
  - Autonomy & Robotics: Enabling complex air and space missions, and complementing humans in space
  - Human Systems Integration: Advancing human-technology interaction for NASA missions
  - Nanotechnology-electronics and sensors, flexible electronics
- **Space and Earth Science:** *Understanding our planet, our solar system and everything beyond*
  - **Exoplanets**: Finding worlds beyond our own
  - **Airborne Science**: Examining our own world & beyond from the sky
  - Lunar Sciences: Rediscovering our moon, searching for water

14.A.6.2 Armstrong Flight Research Center (AFRC)

POC: Timothy Risch, timothy.k.risch@nasa.gov

POC	**Technology Area**	**Email**
Sean Clarke	Hybrid Electric Propulsion	sean.clarke@nasa.gov
Ed Hearing	Supersonic Research (Boom mitigation and measurement)	edward.a.haering@nasa.gov
Dan Banks	Supersonic Research (Laminar Flow)	daniel.w.banks@nasa.gov
Larry Hudson	Hypersonic Structures & Sensors	larry.d.hudson@nasa.gov
Matt Boucher Jeff Ouellette	Control of Flexible Structures, Modeling, System Identification, Advanced Sensors	matthew.j.boucher@nasa.gov jeffrey.a.ouellette@nasa.gov
Nelson Brown	Autonomy (Collision Avoidance, Perception, and Runtime Assurance)	nelson.brown@nasa.gov
Curt Hanson	Urban Air Mobility (UAM) Vehicle Handling and Ride Qualities	curtis.e.hanson@nasa.gov
Shawn McWherter	Urban Air Mobility (UAM) Envelope Protection	shaun.c.mcwherter@nasa.gov
Peter Suh Kurt Kloesel	Aircraft Electrical Powertrain Modeling	peter.m.suh@nasa.gov kurt.j.kloesel@nasa.gov

Bruce Cogan	Un-crewed Aerial Platforms for Earth and Planetary Science Missions	bruce.r.cogan@nasa.gov

14.A.6.3 Glenn Research Center (GRC)

POC: Briggs, Maxwell H. (GRC-T000) maxwell.h.briggs@nasa.gov

- **Power and Energy Storage Systems for Aviation and Space Applications:** sustainable, reduced- and zero-carbon emission approaches, substantial mass and efficiency improvements, and operability in challenging environments
- **Power System Architectures, Networks, and Systems Management and Integration Approaches:** including microgrids and power conversion and management electronics
- **Breakthrough Concepts in Photovoltaics, Electrochemistry, Photocatalysis, Photo/Thermal Energy Conversion:** including enabling manufacturing approaches and integration
- **Electronics for Extreme Temperature Environments:** devices, components, and subsystems
- **Microwave, Optical, and Cognitive Communications Devices, Components, and Systems:** expanded bandwidth and reductions in size and power consumption
- **Quantum Sensors, Communications, and Networks:** devices and simulations
- **Communication Architectures, Networks, and Systems:** integration and simulation
- **Intelligent and Autonomous Systems:** smart sensors, extreme environment instruments
- **Advanced Concepts in Systems Engineering for Aeronautical and Space Systems:** physics-based models, machine learning, and artificial intelligence applications
- **Electrified Aircraft:** architectures, components, systems, and system-level simulations
- **Space-Based Electric Propulsion:** advanced materials, components, and systems
- **Cryogenic Fluid Systems:** components, systems, and cryofluid management simulations
- **Thermal Management Systems:** propulsion and/or power systems for aviation and space
- **Acoustic Emission Mitigation:** aviation and space propulsion applications
- **Aircraft Icing:** prevention, mitigation, and simulation
- **Aviation Safety:** simulation, system concepts, architectures
- **Advanced Computational Fluid Dynamics and Systems Engineering** related to aviation propulsion systems including internal and external aerodynamics, aero-thermochemistry
- **Multi-Functional Materials:** concepts, components, and simulations engaging mechanical, structural, electrical, thermal, energy, communications, or propulsion features, especially including applications enabled by advanced manufacturing processes
- **Shape Memory Alloy Utilization:** actuation, harsh environments, high-strain applications
- **Advanced Metallic Alloy, Ceramic, Macromolecular, and Composite Materials and Coatings:** for extreme environments, especially where enabled by advanced manufacturing processes
- **Nanotechnology Applications:** enhanced mechanical, thermal, electrical, chemical, electrochemical, or catalytic properties
- **Fundamentals of Fluid Physics, Combustion Phenomena, Complex Fluids, and Bioengineering** in reduced- or near-zero gravitational environments
- **Transformational Technologies** such as In-Situ Resource Utilization ((ISRU), in-Space Assembly and Manufacturing (ISAM), and Thermal Management, that are optimized for reduced-gravity environments

14.A.6.4 Goddard Space Flight Center (GSFC)

14.A.6.4.1 Engineering Technology Directorate (ETD)

POC: Denise Cervantes, Ph.D. denise.cervantes@nasa.gov

NASA Goddard Space Flight Center is home to the nation's largest organization of scientists, engineers, and technologists who conceive, design and build new technology to study the solar system and universe.

The Engineering and Technology Directorate (ETD) is the engine that powers Goddard. ETD is the largest organization at Goddard and is home to approximately 1,300 engineers who provide multidisciplinary engineering expertise to NASA's many missions. Goddard has six distinctive facilities & installations. ETD has employees at the Greenbelt main campus in Maryland, Wallops Flight Facility in Virginia, and White Sands Test Facility Ground Stations in New Mexico.

ETD provides multi-disciplinary engineering expertise for the development of cutting-edge science and exploration systems and technologies in the following areas: Earth Science, Astrophysics, Solar System, Heliophysics and Exploration. In addition, ETD acquires and distributes science data worldwide. Goddard encompasses major laboratories and facilities for developing and operating unmanned scientific spacecraft.

GSFC ETD POCS:

- Code 500/GSFC ETD Workforce Development & OSTEM/Higher Education Manager, Dr. Denise Cervantes, denise.cervantes@nasa.gov
- Code 500/GSFC ETD Chief Technologist, Michael Johnson, michael.a.johnson@nasa.gov
    - Code 500/ETD Wallops Flight Facility Engineering Division
        - Associate Chief Technologist, Sarah Wright, sarah.wright@nasa.gov
    - Code 540/ETD Mechanical Systems Division
        - Associate Chief Technologist, Dr. Vivek Dwivedi, vivek.h.dwivedi@nasa.gov
    - Code 550/ETD Instrument Systems and Technology Division
        - Associate Chief Technologist, Renee Reynolds, renee.m.reynolds@nasa.gov
    - Code 560/ETD Electrical Engineering Division
        - Associate Chief Technologist, Chris Green, christopher.m.green-1@nasa.gov
    - Code 580/ETD Software Engineering Division
        - Associate Chief Technologist, Karin Blank, karin.b.blank@nasa.gov
    - Code 590/ETD Mission Engineering and Systems Analysis Division
        - Associate Chief Technologist, Cheryl Gramling, cheryl.j.gramling@nasa.gov
- Code 500/GSFC ETD New Business Leads
    - Code 500/ETD Wallops Flight Facility Engineering Division
        - WFF New Business Lead, Benjamin Cervantes, benjamin.w.cervantes@nasa.gov
    - Code 540/ETD Mechanical Systems Division
        - New Business Lead, Sharon Cooper, sharon.cooper@nasa.gov
    - Code 550/ETD Instrument Systems and Technology Division
        - New Business Lead, Dr. Aprille Ericsson, aprille.j.ericsson@nasa.gov
    - Code 560/ETD Electrical Engineering Division
        - New Business Lead, Marcellus Proctor, marcellus.proctor@nasa.gov
    - Code 580/ETD Software Engineering Division
        - New Business Lead, Steve Tompkins, steven.d.tompkins@nasa.gov
    - Code 590/ETD Mission Engineering and Systems Analysis Division
        - New Business Lead, Peter Knudtson, peter.a.knudtson@nasa.gov

ETD Research Areas:

- Advanced Manufacturing - facilitates the development, evaluation, and deployment of efficient and flexible additive manufacturing technologies. (ref: NAMII.org)
- Advanced Multi-functional Systems and Structures - novel approaches to increase spacecraft systems resource utilization
- Micro - and Nanotechnology - Based Detector Systems - research and application of these technologies to increase the efficiency of detector and optical systems
- Ultra-Miniature Spaceflight Systems and Instruments - miniaturization approaches from multiple disciplines - materials, mechanical, electrical, software, and optical - to achieve substantial resource reductions
- Systems Robust to Extreme Environments - materials and design approaches that will preserve designed system properties and operational parameters (e.g. mechanical, electrical, thermal), and enable reliable systems operations in hostile space environments.
- Spacecraft Navigation Technologies
    - Surface Localization algorithm for autonomous navigation based on sensor observation fusion
    - Spacecraft GNSS receivers, ranging crosslink transceivers, and relative navigation sensors
    - Optical navigation and satellite laser ranging
    - Deep-space autonomous navigation techniques
    - Software tools for spacecraft navigation ground operations and navigation analysis
    - Formation Flying
- Automated Rendezvous and Docking (AR&D) techniques
    - Algorithm development
    - Pose estimation for satellite servicing missions
    - Sensors (e.g., LiDARs, natural feature recognition)
    - Actuation (e.g., micro propulsion, electromagnetic formation flying)
- Mission and Trajectory Design Technologies
    - Mission design tools that will enable new mission classes (e.g., low thrust planetary missions, precision formation flying missions)
    - Mission design tools that reduce the costs and risks of current mission design methodologies
    - Trajectory design techniques that enable integrated optimal designs across multiple orbital dynamic regimes (i.e. earth orbiting, earth-moon libration point, sun-earth libration point, interplanetary)
- Spacecraft Attitude Determination and Control Technologies
    - Modeling, simulation, and advanced estimation algorithms
    - Advanced spacecraft attitude sensor technologies (e.g., MEMS IMU's, precision optical trackers)
    - Advanced spacecraft actuator technologies (e.g. modular and scalable momentum control devices, 'green' propulsion, micropropulsion, low power electric propulsion)
- CubeSats - Participating institutions will develop CubeSat/Smallsat components, technologies and systems to support NASA technology demonstration and risk reduction efforts. Student teams will develop miniature CubeSat/Smallsat systems for: power generation and distribution, navigation, communication, on-board computing, structures (fixed and deployable), orbital stabilization, pointing, and de-orbiting. These components, technologies and systems shall be made available for use by NASA for integration into NASA Cubesat/Smallsats. They may be integrated into complete off-the-shelf "CubeSat/Smallsat bus" systems, with a goal of minimizing "bus" weight/power/volume/cost and maximizing available "payload" weight/power/volume. NASA technologists will then use these components/systems to develop

payloads that demonstrate key technologies to prove concepts and/or reduce risks for future Earth Science, Space Science and Exploration/Robotic Servicing missions.

- On-Orbit Multicore Computing - High performance multicore processing for advanced automation and science data processing on spacecraft. There are multiple multicore processing platforms in development that are being targeted for the next generation of science and exploration missions, but there is little work in the area of software frameworks and architectures to utilize these platforms. It is proposed that research in the areas of efficient inter-core communications, software partitioning, fault detection, isolation & recovery, memory management, core power management, scheduling algorithms, and software frameworks be done to enable a transition to these newer platforms. Participating institutions can select areas to research and work with NASA technologists to develop and prototype the resulting concepts.
- Integrated Photonic Components and Systems - Integrated photonic components and systems for Sensors, Spectrometers, Chemical/biological sensors, Microwave, Sub-millimeter and Long-Wave Infra-Red photonics, Telecom- inter and intra satellite communications.
- Quantum Sensors and Quantum Networking
- Artificial Intelligence and Machine Learning
  - Generative Design- leveraging an artificial intelligence-based iterative design process to optimize the design of systems.
- Radiation Effects and Analysis
  - Flight validation of advanced event rate prediction techniques
  - New approaches for testing and evaluating 3-D integrated microcircuits and other advanced microelectronic devices
  - End-to-end system (e.g., integrated component level or higher) modeling of radiation effects
  - Statistical approaches to tackle radiation hardness assurance (i.e., total dose, displacement damage, and/or single-event effects) for high-risk, low-cost missions.
- Model Based System Engineering (MBSE)

14.A.6.4.2 Sciences and Exploration Directorate

POC: Blanche Meeson, Blanche.W.Meeson@nasa.gov

Dr. Blanche Meeson (she/her/hers)
Chief for Higher Education and GSFC NASA Postdoctoral Program

The Sciences and Exploration Directorate at NASA Goddard Space Flight Center (http://science.gsfc.nasa.gov) is the largest Earth and space science research organization in the world. Its scientists advance understanding of the Earth and its life-sustaining environment, the Sun, the solar system, and the wider universe beyond. All are engaged in the full life cycle of satellite missions and instruments from concept development to implementation, analysis and application of the scientific information, and community access and services.

- The **Earth Sciences Division** plans, organizes, evaluates, and implements a broad program of research on our planet's natural systems and processes. Major focus areas include climate change, severe weather, the atmosphere, the oceans, sea ice and glaciers, and the land surface. To study the planet from the unique perspective of space, the Earth Science Division develops and operates remote-sensing satellites and instruments. We analyze observational data from these spacecraft and make it available to the world's scientists and policy makers. The Division conducts extensive field campaigns to gather data from the surface and airborne platforms. The Division also develops, uses, and assimilates observations into models that simulate planetary processes involving the water, energy, and carbon cycles at multiple scales up to global. Please refer to https://science.gsfc.nasa.gov/earth/ for more information on the Earth Sciences Division at GSFC and the Laboratories that support it, as well as recent research highlights.

POC: Eric Brown de Colstoun (eric.c.browndecolsto@nasa.gov)

- The **Astrophysics Science Division** conducts a broad program of research in astronomy, astrophysics, and fundamental physics. Individual investigations address issues such as the nature of dark matter and dark energy, star formation and evolution, which planets outside our solar system may harbor life, and the nature of space, time, and matter at the edges of black holes. Observing photons, particles, and gravitational waves enables researchers to probe astrophysical objects and processes. Researchers develop theoretical models, design experiments and hardware to test theories, and interpret and evaluate observational data.

  POC: Rita Sam**bru**na (Rita.m.Sambruna@nasa.gov).

- The **Heliophysics Science Division** conducts research on the Sun, its extended solar-system environment (the heliosphere), and interactions of Earth, other planets, small bodies, and interstellar gas with the heliosphere. Division research also encompasses geospace, comprising Earth's magnetosphere and its outer atmosphere, and space weather—the important effects that heliospheric disturbances have on spacecraft and terrestrial systems. Division scientists develop spacecraft missions and instruments, systems to manage and disseminate heliophysical data, and theoretical and computational models to interpret the data. Possible heliophysics-related research topics include: advanced software environments and data-mining strategies (including artificial intelligence and machine learning) to collect, collate and analyze data relevant to the Sun and its effects on the solar system and the Earth; and advanced computational techniques, including but not limited to parallel architectures and the effective use of graphics processing units, for the simulation of magnetized and highly dynamic plasmas and neutral gases in the heliosphere.

  POC: Doug Rabin (*Douglas.Rabin@nasa.gov*).

- The **Solar System Exploration Division** builds science instruments and conducts theoretical and experimental research to explore the solar system and understand the formation and evolution of planetary systems. Laboratories within the division investigate areas as diverse as astrochemistry, planetary atmospheres, extrasolar planetary systems, earth science, planetary geodynamics, space geodesy, and comparative planetary studies. To study how planetary systems form and evolve, division scientists develop theoretical models and experimental research programs, as well as mission investigations and space instruments to test them. The researchers participate in planetary and Earth science missions, and collect, interpret, and evaluate measurements.

  POC: Terry Hurford (Terry.a.Hurford@nasa.gov)

- **Artificial Intelligence, Machine Learning, Big Data Analytics:** The Data Science Group (DSG) supports science through the implementation and applications of artificial intelligence, machine learning, and big data analytics. The DSG supports all science divisions across a wide variety of applications using standard software engineering practices. The DSG is focused on accelerating science and enabling new discoveries through such activities as creation of AI/ML ready data sets, Foundation Models, uncertainty quantification, explainable AI/ML, reproducibility, and open science.

  POC: Dr. Mark Carroll *(mark.carroll@nasa.gov)*

Scientists in all four divisions and our computational and information science organization publish research results in the peer-reviewed literature, participate in the archiving and public dissemination of scientific data, and provide expert user support.

14.A.6.5 Jet Propulsion Laboratory (JPL)
POC: Dr. Tom Cwik, thomas.a.cwik@jpl.nasa.gov

Note: JPL is NASA's only Federally Funded Research and Development Center (FFRDC). As such, JPL is not considered a NASA Center, but is eligible for collaboration within NASA EPSCoR on par with NASA Centers.

• <u>Solar System Science</u> Planetary Atmospheres and Geology Solar System characteristics and origin of life Primitive (1) solar systems bodies Lunar (9) science Preparing for returned sample investigations • <u>Earth Science</u> Atmospheric composition and dynamics (Atmospheric Dynamics Land and solid earth processes (Solid Earth Processes Water and carbon cycles, Carbon Cycles, Water Cycles Ocean and ice Earth analogs to planets, Earth Analog Climate Science • <u>Astronomy and Fundamental Physics</u> Origin, evolution, and structure of the universe, Origin Universe, Evolution Universe, Structure Universe Gravitational astrophysics and fundamental physics Extra-solar planets: Exoplanets; Star formation; Planetary formation Solar and Space Physics Formation and evolution of galaxies; Formation Galaxies; Evolution Galaxies • <u>In-Space Propulsion Technologies</u> Chemical propulsion Non-chemical propulsion Advanced propulsion technologies Supporting technologies Thermal Electric Propulsion	• <u>Human Exploration Destination Systems</u> In situ resource utilization and Cross-cutting systems • <u>Science Instruments, Observatories and Sensor Systems</u> Science Mission Directorate Technology Needs Remote Sensing instruments/Remote Sensing Sensors Observatory technologies In-situ instruments, Sensor technologies Sensors In situ technologies Instrument technologies Precision frequency Precision timing • <u>Entry, Descent and Landing Systems</u> Aerobraking, Aerocapture and entry system; Descent; Engineered materials; Energy generation and storage; Propulsion; Electronics, devices, and sensors Nanotechnology Microtechnology Microelectronics Microdevice Orbital Mechanics Spectroscopy • <u>Modeling, Simulation, Information Technology and Processing</u> Flight and ground computing; Modeling; Simulation; Information processing • <u>Materials, Structures, Mechanical Systems and Manufacturing</u> Materials; Structures; Mechanical systems; Cross cutting

Electric Propulsion • <u>Space Power and Energy Storage</u> Power generation Energy storage Power management & distribution Cross-cutting technologies Solar power, Photovoltaic Tethers Radioisotope Thermoelectric • <u>Robotics, Tele-Robotics, and Autonomous Systems</u> Sensing (Robotic Sensing) Mobility Manipulation technology Human-systems interfaces Autonomy Autonomous rendezvous & docking Systems engineering Vision Virtual reality Telepresence Computer Aided • <u>Communication and Navigation</u> Optical communications & navigation technology Radio frequency communications, Radio Technologies Internetworking Position navigation and timing Integrated technologies Revolutionary concepts Communication technology Antennas Radar Remote Sensing Optoelectronics	• <u>Thermal Management Systems</u> Cryogenic systems; Thermal control systems (near room temperature); Thermal protection systems • <u>Other Research Areas</u> Small Satellite Small Satellite Technologies Balloons Radio Science MEMS Advanced High Temperature Spectroscopy Magnetosphere Plasma Physics Ionospheres Ground Data Systems Laser Drills High Energy Astrophysics Solar physics Interstellar Astrophysics Interstellar Medium Astrobiology Astro bio geochemistry Life Detection Cosmo chemistry Adaptive Optics Artificial Intelligence

14.A.6.6 Johnson Space Center (JSC) / White Sands Test Facility (WSTF)

POCSs
Brian Schwing | brian.m.schwing@nasa.gov
Doug Goodman | doug.goodman@nasa.gov

An overview of JSC/WSTF capabilities and domains of interest can be found at:
https://www.nasa.gov/johnson/frontdoor/capabilities/

JSC/WSTF research areas of interest for this solicitation period include:

- **Active Thermal Control |** Condensing heat exchanger coatings with robust hydrophilic, antimicrobial properties, Wax and water-based phase change material heat exchangers, Lightweight heat exchangers and cold plates
- **Environment Control and Life Support Systems |** Advancements in Carbon Dioxide Reduction, Habitation systems that minimize consumables, Human thermal modeling, Low toxicity hygiene and cleaning products and methods, Odor and Offgas Testing, Oxygen Flammability Testing
- **Extravehicular Activity (EVA) |** Portable Life Support System, Power, Avionics and Software, Pressure Garments
- **Entry, Descent, and Landing |** Spacecraft GN&C Technologies, Deployable Decelerator Technologies, High-Fidelity Parachute Fluid/Structure Interaction, Mechanical Reefing Release Mechanism for Parachutes, Parachute Systems & Modeling, Precision Landing & Hazard Avoidance Technologies, Regolith – Rocket Plume Interaction and Measurement, Embedded Sensors) including those embedded in thermal protection systems and proximity operations and landing), Additive Manufacturing for Thermal Protection Systems, Advanced Materials and Instrumentation for Thermal Protection Systems, Predictive Material Modeling
- **Power Distribution, Control, and Storage |** Lightweight radiation tolerant cables and spools for Lunar/Mars surface power, Dust tolerant electrical connectors, Radiation hard power convertors, Batteries, Regenerative Fuel cells, High energy long-life fuel cell membranes
- **In-Situ Resource Utilization |** Lunar/Mars regolith processing and water-ice mining, Mars atmosphere processing, Methane/Oxygen liquefaction and storage, ISRU regolith processing simulation and modeling
- **Autonomy and Robotics |** Biomechanics, Crew Exercise, Human Robotic interface, Autonomous Vehicle Systems/Management, Data Mining and Fusion, Robotics and TeleRobotics, Simulation and modeling
- **Autonomous Rendezvous and Docking |** Low complexity low mass soft capture systems, Seals and sealing technology, Consumables transfer interfaces (power, data, water, air, fluids), Surface System Docking Interfaces and Environmental Tolerance
- **Human Research |** Behavioral health diagnostic and treatment techniques, Non-invasive diagnostic aides to support communication delay operations
- **Inflatable Structures |** Materials, attachment methods, monitoring, packaging, testing and analysis
- **Spacecraft Glass & Windows |** Light weight and polymer materials windows and pane attachment, Polymer window environmental tolerance and creep testing, Produce accurate loads/stress modeling and correlation techniques of non-linear materials.
- **Computer Human Interfaces (CHI) and Informatics |** Human System Integration, Human Computer Interaction design methods (Multi-modal and Intelligent Interaction), Human-in-the-loop system data acquisition and performance modeling, Trust computing methodology, Crew decision support systems, Advanced Situation Awareness Technologies, Intelligent Displays for Time-Critical Maneuvering of Multi-Axis Vehicles, Intelligent Response and Interaction System, Exploration Space Suit (xEMU) Informatics, Graphic Displays to Facilitate Rapid Discovery, Diagnosis and

Treatment of Medical Emergencies, Machine learning methods and algorithms, Imaging and information processing

- **Spacecraft Voice and Audio Systems |** Array Microphone Systems and processing, Machine-learning front end audio processing, Audio Compression algorithms implementable in FPGAs, COMSOL Acoustic modeling, Front end audio noise cancellation algorithms implementable in FPGAs-example Independent Component Analysis, Large bandwidth (audio to ultra-sonic) MEMs Microphones, Sonification Algorithms implementable in DSPs/FPGAs, Far-Field Speech Recognition in Noisy Environments
- **Imaging and Display Systems |** Lightweight/low power/radiation tolerant displays, OLED Technology Evaluation for Space Applications, Radiation tolerant Graphics Processing Units (GPUs), Scalable complex electronics & software-implementable graphics processing unit, Radiation-Tolerant Imagers, Immersive Imagery capture and display, H265 Video Compression, Ultra High Video Compressions, A Head Mounted Display Without Focus/Fixation Disparity, EVA Heads-Up Display (HUD) Optics
- **Wearable Technology |** Tattooed Electronic Sensors, Wearable Audio Communicator, Wearable sensing and hands-free control, Wearable Sensors and Controls, Wearable digital twin/transformation sensor systems
- **Wireless and Communications Systems |** Computational Electromagnetics (CEM) Fast and Multi-Scale Methods/Algorithms, RFID ICs at frequencies above 2 G, Radiation Hardened Radio Frequency Identification (RFID) Readers, Radiation robust 3GPP network technologies, Robust Dynamic Ad hoc Wireless Mesh Communication Networks, Wireless Energy Harvesting Sensor Technologies, Flight and Ground communication systems
- **Radiation and EEE Parts |** Mitigation and Biological countermeasures, Monitoring, Protection systems, Risk assessment modeling, Space weather prediction
- **In-space Propulsion Technologies |** Human rated in-space propulsion systems (storable and cryogenic), EVA-IVA compatible miniature propulsion systems (including CubeSat), Propellant transfer and refueling, Propellant gauging
- **Pyrotechnic Device Development and Testing |** Miniature pyro valves, Low energy long duration pyrotechnic devices
- **Composite Overwrapped Pressure Vessels (COPV) |** COPV testing and evaluation, COPV life extension protocol development, COPV damage detection course
- **Propulsion System Testing |** Ambient testing at 5000 feet up to 60,000 lb. thrust, Altitude testing >100,000 feet up to 25,000 lb. thrust, Propellants include cryogenic and storable liquids
- **Oxygen Systems Analysis and Testing** | Oxygen Compatibility Assessment, Material and Component Compatibility, Systems Safety Analysis and Failure Investigation, High flow, high pressure particle impact ignition testing, (subsonic and supersonic velocities), Flowing Oxygen Promoted Combustion testing, Friction Ignition testing, Ultra-High Pressure Promoted Combustion Testing, Arc/Spark ignition test systems, Liquid Oxygen (LOX) for pumps, turbopumps, immersion tests, and various other LOX applications
- **Propellants and Aerospace Fluids Testing and Analysis |** Storable propellant analysis, Material testing in propellants, Propellant hazards testing and analysis
- **Hydrogen Testing and Hazard Analysis |** Gaseous and liquid hydrogen testing
- **Micrometeoroid and Orbital Debris (MMOD) Testing |** testing protocols, instrumentation and analysis

14.A.6.7 Kennedy Space Center (KSC)

POC: Tim Griffin (timothy.p.griffin@nasa.gov)

- Storage, Distribution, and Conservation of Cryogenic Fluids and Commodities
- Tools and Techniques for Control, Operation, Inspection, Analysis and Repair
- Environmental and Green Technologies
- Safety Systems for Operations
- Communication and Tracking Technologies
- Robotic, Automated, and Autonomous Systems and Operations
- Operations Support and Advanced Studies Leveraging Primary Center Role Expertise
- Payload Processing and Integration Technologies
- Logistics
- Water/Nutrient Recovery and Management
- Food Production and Waste Management
- Plant Habitats and Flight Systems
- Robotic, Automated and Autonomous Food Production
- ISRU Development Planning/Strategy to Fit Into Architecture
- Resource Acquisition - Regolith/Trash & Gases Liquids
- Consumable Production - Extract/Produce Fuel
- In Situ Construction such as, Landing Pads, Roads, and Berms
- Distribution and Storage of In Situ Resources
- Scientific Instruments
- Resource Assessment/Prospecting

14.A.6.8 Langley Research Center (LaRC)

POC: Neyda Abreu, neyda.m.abreu@nasa.gov

Topics:
(See detailed Description of Topic descriptions below)
Topic 1: Aerosciences: (POC: Alireza Mazaheri - ali.r.mazaheri@nasa.gov)
Topic 2: Intelligent Flight Systems & Trusted Autonomy: (POC: "Mike" Fremaux - c.m.fremaux@nasa.gov)
Topic 3: Advanced Materials, Manufacturing Technologies & Structural Systems: (POC: Chris Wohl - c.j.wohl@nasa.gov)
Topic 4: Measurement Systems - Advanced Sensors and Optical Diagnostics (POC: "Tony" Humphreys - william.m.humphreys@nasa.gov)
Topic 5: Entry, Descent & Landing (POC: Ron Merski – n.r.merski@nasa.gov)
Topic 6: Terrestrial and Planetary Atmospheric Sciences: (POC: Allen Larar - allen.m.larar@nasa.gov)
Topic 7: Innovative Concepts for Earth and Space Science Measurements: (POC: Allen Larar - allen.m.larar@nasa.gov)

Description of Topics – Langley Research Center (LaRC)
Langley Research Center (LaRC), POC: Neyda Abreu, neyda.m.abreu@nasa.gov

Topic 1: Aerosciences: (POC: Alireza Mazaheri - ali.r.mazaheri@nasa.gov)

- Uncertainty quantification for high-fidelity multidisciplinary (e.g., aeroelastic, aeroacoustic) analysis for aircraft flight (POC: Beth Lee-Rauch, e.lee-rausch@nasa.gov)
- Multi-physics high-fidelity approaches for advanced or emerging computer architectures (POC: Beth Lee-Rauch, e.lee-rausch@nasa.gov)
- Machine learning for turbulent or transitional flow modeling (POC: Beth Lee-Rauch, e.lee-rausch@nasa.gov)
- HYBRID turbulent simulation methods and models to simulate highly separated turbulent flows (POC: Luther Jenkins, luther.n.jenkins@nasa.gov)
- Efficient synthetic turbulence generation methods (POC: Luther Jenkins, luther.n.jenkins@nasa.gov)
- Wall models for compressible flows (POC: Luther Jenkins, luther.n.jenkins@nasa.gov)
- High-order unstructured schemes for high-speed flows and aerothermodynamics (POC: Alireza Mazaheri, ali.r.mazaheri@nasa.gov)
- Modular GPU-based chemically reacting solver with stiff integrator (POC: Andrew Norris andrew.t.norris@nasa.gov)
- Uncertainty quantification for stochastic probability density function (PDF) methods (POC: Andrew Norris andrew.t.norris@nasa.gov)
- Gas lattice methods for continuum (high density) flows (POC: Andrew Norris andrew.t.norris@nasa.gov)
- Broadband noise prediction of advanced air mobility aircraft (POC: Mike Doty, michael.j.doty@nasa.gov)
- Novel material concepts to extend the frequency range of acoustic liners (POC: Ran Cabell, randolph.h.cabell@nasa.gov)
- Novel noise reduction concepts for urban air mobility (UAM) propulsors (POC: Ran Cabell, randolph.h.cabell@nasa.gov)

Topic 2: Intelligent Flight Systems & Trusted Autonomy: (POC: "Mike" Fremaux -

c.m.fremaux@nasa.gov)
Research in areas of advanced air mobility, increasingly automated and autonomous systems, robotics, and “smart cities” to enable current and future NASA missions and maintain U.S. aerospace preeminence. Development and validation of new architectures, technologies, and operations for increasingly complex and increasingly autonomous aerospace systems is accomplished by:

- Enabling robust control, vehicle performance, and mission management under nominal conditions, and contingency management under off-nominal conditions.
- Ensuring robust and flexible human-machine integration and teaming.
- Advancing technologies for vehicle and system-autonomy, robotics, and flight vehicle environment awareness.
- Developing new methods and tools for the verification, validation, and safety assurance of complex and autonomous systems.
- Developing, maintaining, and utilizing advanced experimental ground and flight test facilities and labs that enable intelligent flight systems and trusted autonomy.

Topic 3: Advanced Materials, Manufacturing Technologies & Structural Systems: (POC: Chris Wohl - c.j.wohl@nasa.gov)

- Rapid, scalable additive manufacturing
- Materials for extreme environments
- Materials manufacturing and characterization in extreme environments
- Computational modeling of the manufacturing process influence on metallic microscale and bulk properties
- Characterization and evaluation of additive manufactured, multifunctional, and sustainable materials
- Computational modeling of polymer synthesis, processing, and additive manufacturing
- Multifunctional materials supporting electric aircraft
- Composite materials supporting green aviation
- Process monitoring during composites fabrication
- Materials systems supporting Human Landing System (HLS) and Environmental Control and Life Support System (ECLSS) objectives

Topic 4: Measurement Systems - Advanced Sensors and Optical Diagnostics (POC: “Tony” Humphreys - william.m.humphreys@nasa.gov)

- Detectors and focal planes for Low Earth Orbit observing platforms (POC: Alan Little, a.little@nasa.gov)
- Electronics for both flight platforms and ground test facilities (POC: Arthur Bradley, arthur.t.bradley@nasa.gov)
- Optical components including adaptive optics based on phase change materials (POC: Hyun Jung Kim, hyunjung.kim@nasa.gov)
- Microwave, millimeter, and sub-millimeter wave detection systems (POC: Steve Harrah, steve.harrah-1@nasa.gov)
- Weather sensors for Advanced Air Mobility (AAM) applications (POC: Grady Koch, grady.j.koch@nasa.gov)
- Custom laser designs (wavelengths, pulse durations, etc.) for remote sensing and ground facility test applications (POC: Paul Danehy, paul.m.danehy@nasa.gov)

- Flow visualization methods for high-speed ground test facilities (supersonic to hypersonic) (POC: Brett Bathel, brett.f.bathel@nasa.gov)
- High spatial and temporal resolution velocimetry measurements, both seeded and seedless (POC: Paul Danehy, paul.m.danehy@nasa.gov)
- Global surface pressure and temperature measurements (POC: Neal Watkins, anthony.n.watkins@nasa.gov)
- Cryogenic and thermal sensors for ground test facilities (POC: Lisa Le Vie, lisa.r.levie@nasa.gov)
- Non-destructive evaluation (NDE) methods for crewed vehicle structural health (POC: Patti Howell, patricia.a.howell@nasa.gov)
- Automated non-destructive evaluation (NDE) methods and systems utilizing machine learning (POC: Patti Howell, patricia.a.howell@nasa.gov)

Topic 5: Entry, Descent & Landing (POC: Ron Merski – n.r.merski@nasa.gov)
- Advanced EDL architecture approaches
- Advanced EDL vehicle concepts – small spacecraft
- EDL systems analysis (empirical performance assessment tools, packaging)
- Aero-assist technologies -- Aerocapture concepts
- Aero maneuvering technologies – trim tabs, morphing, RCS, magneto-hydrodynamics (MHD)
- Decelerator technologies – ballutes, parachutes, supersonic retro-propulsion, hypersonic inflatable aerodecelerators (HIADs)
- High end computing for EDL modeling -- GPUs
- Flight mechanics and GNC methods
- Atmospheric model development
- Computational fluid dynamics methods and modeling
- Rarefied flow computations -- DSMC
- Complex fluid dynamics characterization -- plume surface interaction, supersonic retro-propulsion, RCS
- Unsteady aerodynamics measurement approaches
- Wind tunnel (subsonic, transonic, supersonic, hypersonic) aero and aeroheating instrumentation, flow characterization methods (MDOE), and testing approaches
- Entry systems structures, composites manufacturing and testing methods
- Landing system concepts
- Ultra-precise velocity and ranging methods -- lidar
- Flight test instrumentation and low-cost data acquisition
- Flight data reconstruction
- Uncertainty quantification

Topic 6: Terrestrial and Planetary Atmospheric Sciences: (POC: Allen Larar - allen.m.larar@nasa.gov)
- Atmospheric science focus areas cover a broad range of measurements and applications, including:
    - Measurements of water vapor, carbon dioxide, ozone, methane, nitrogen oxides, and other important greenhouse gases
    - Aerosol and cloud properties
    - Atmospheric winds
    - Radiation budget

- Atmospheric chemistry and air quality
- Climate change

Topic 7: Innovative Concepts for Earth and Space Science Measurements: (POC: Allen Larar - allen.m.larar@nasa.gov)

- Advanced active and passive remote sensing and in-situ concepts & sensors for new and improved measurements, including:
  - LiDAR
  - Radiometers
  - Spectrometers
  - Interferometers

A.6.9 Marshall Space Flight Center (MSFC)

POC: John Dankanich, john.dankanich@nasa.gov and https://www.nasa.gov/offices/oct/center-chief-technologists

These Principal Technologists and System Capability Leads are available for consultation with proposers regarding the state-of-the-art, on-going activities and investments, and strategic needs in their respective areas of expertise. Proposers are encouraged to consult with the appropriate PT or SCLT early in the proposal process.

POC	Technology Area	NASA Email
Danette Allen	Autonomous Systems	danette.allen@nasa.gov
Shaun Azimi	Robotics	shaun.m.azimi@nasa.gov
Jim Broyan	ECLSS[1] Deputy	james.l.broyan@nasa.gov
John Carson	EDL Precision Landing; HPSC	john.m.carson@nasa.gov
Scott Cryan	Rendezvous & Capture	scott.p.cryan@nasa.gov
John Dankanich	In Space Transportation	john.dankanich@nasa.gov
Terry Fong	Autonomous Systems	terry.fong@nasa.gov
Robyn Gatens	ECLSS Lead	robyn.gatens@nasa.gov
Julie Grantier	In Space Transportation	julie.a.grantier@nasa.gov
Mark Hilburger	Structures/Materials	mark.w.hilburger@nasa.gov
Michael Johansen	Dust Mitigation	michael.r.johansen@nasa.gov
Julie Kleinhenz	In Situ Resource Utilization	julie.e.kleinhenz@nasa.gov
Angela Krenn	Thermal Technologies	angela.g.krenn@nasa.gov
Ron Litchford	Propulsion Systems	ron.litchford@nasa.gov
Jason Mitchell	Communications & Navigation	jason.w.mitchell@nasa.gov
Michelle Munk	Entry, Descent and Landing (EDL)	michelle.m.munk@nasa.gov
Bo Naasz	Rendezvous & Capture	bo.j.naasz@nasa.gov
Denise Podolski	Sensors/Radiation/Comm.	denise.a.podolski@nasa.gov
Wes Powell	Avionics/Communications	wesley.a.powell@nasa.gov
Jerry Sanders	In Situ Resource Utilization	gerald.b.sanders@nasa.gov
John Scott	Space Power & Energy Storage	john.h.scott@nasa.gov

John Vickers	Advanced Manufacturing	john.h.vickers@nasa.gov
Sharada Vitalpur	Communications & Navigation	sharada.v.vitalpur@nasa.gov
Arthur Werkheiser	Cryofluid Management	arthur.wekheiser@nasa.gov
Mike Wright	Entry, Descent and Landing	michael.j.wright@nasa.gov

Propulsion Systems

- Launch Propulsion Systems, Solid & Liquid
- In Space Propulsion (Cryogenics, Green Propellants, Nuclear, Fuel Elements, Solar-Thermal, Solar Sails, Tethers)
- Propulsion Testbeds and Demonstrators (Pressure Systems)
- Combustion Physics
- Cryogenic Fluid Management
- Turbomachinery
- Rotordynamics
- Solid Propellant Chemistry
- Solid Ballistics
- Rapid Affordable Manufacturing of Propulsion Components
- Materials Research (Nano Crystalline Metallics, Diamond Film Coatings)
- Materials Compatibility
- Computational Fluid Dynamics
- Unsteady Flow Environments
- Acoustics and Stability
- Low Leakage Valves

Space Systems

- Surface Habitation
- Surface Construction and Manufacturing
- In Space Habitation (Life Support Systems and Nodes, 3D Printing)
- Mechanical Design & Fabrication
- Small Payloads (For International Space Station, Space Launch System)
- In-Space Asset Management (Automated Rendezvous & Capture, De-Orbit, Orbital Debris Mitigation, Proximity Operations)
- Radiation Shielding
- Thermal Protection
- Electromagnetic Interference
- Advanced Communications
- Small Satellite Systems (CubeSats)
- Structural Modeling and Analysis
- Spacecraft Design (CAD)
- Large Space Structures

- In-Space Manufacturing

Space Transportation

- Mission and Architecture Analysis
- Advanced Manufacturing
- Space Environmental Effects and Space Weather
- Lander Systems and Technologies
- Small Spacecraft and Enabling Technologies (Nanolaunch Systems)
- 3D Printing/Additive Manufacturing/Rapid Prototyping
- Meteoroid Environment
- Friction Stir and Ultrasonic Welding
- Advanced Closed-Loop Life Support Systems
- Composites and Composites Manufacturing
- Wireless Data & Comm. Systems
- Ionic Liquids
- Guidance, Navigation and Control (Autonomous, Small Launch Vehicle)
- Systems Health Management
- Martian Navigation Architecture/Systems
- Planetary Environment Modeling
- Autonomous Systems (reconfiguration, Mission Planning)
- Digital Thread / Product Lifecycle Management (for AM and/or Composites)
- Material Failure Diagnostics

Science

- Replicated Optics
- Large Optics (IR, visible, UV, X-Ray)
- High Energy Astrophysics (X-Ray, Gamma Ray, Cosmic Ray)
- Radiation Mitigation/Shielding
- Regolith (simulants, ISRU applications, extraction)
- Gravitational Waves and their Electromagnetic Counterparts
- Solar, Magnetospheric and Ionospheric Physics
- Planetary Geology and Seismology
- Planetary Dust, Space Physics and Remote Sensing
- Surface, Atmospheres and Interior of Planetary Bodies
- Earth Science Applications
- Convective and Severe Storms Research
- Lightning Research
- Data Informatics
- Disaster Monitoring
- Energy and Water Cycle Research
- Remote Sensing of Precipitation

14.A.6.10 Stennis Space Center (SSC)

POC: Anne Peek anne.h.peek@nasa.gov

Intelligent Integrated System Health Management (ISHM) for Ground and Space Applications

Integrated system health management (ISHM) is a unified approach to assess the current and future state of a system. ISHM incorporates interdependencies with other systems, available resources, concepts of operations, and operational demands. Multiple sources of data are used to analyze the behavior of a system, identify trends, and estimate the remaining useful life of a system. SSC is interested in methodologies to assess the "health" of ground and space systems that enable sustainable lunar exploration and a commercial lunar economy. SSC creates and applies intelligent models of components that constitute systems. EPSCoR research could: (1) develop monitoring and diagnostic capabilities that use, or can be incorporated by, intelligent models to monitor and document the operation of the system; or (2) develop prognostics capabilities to accurately estimate the remaining useful life of a component or a system.

Autonomous Operations for Ground and Space Applications

Unprecedented levels of autonomy will be required by government and industry to enable sustainable space exploration of the Moon and Mars. Trust in these autonomous systems must be established. SSC is interested in creating robust, predictable, intelligent, hierarchical, distributed, autonomous systems to operate ground (Earth) systems, surface (Moon or Mars) systems, and space vehicles. EPSCoR research could: (1) create architectures and/or procedures to design predictable, safe autonomous systems (no black box approaches dependent on sparse training data); or (2) design and demonstrate edge-enabled autonomous operations (no connection to a cloud or off-premises/vehicle server) translatable to radiation-tolerant hardware suitable for Moon or Mars missions.

Advanced Propulsion Test Technology Development

Launch systems continue to undergo a design and manufacturing revolution. Rigorous testing mitigates design and manufacturing issues with these systems. However, as the launch industry grows dramatically, rocket propulsion testing must significantly lower the costs of testing and increase test throughput.

EPSCoR research could: (1) investigate the use of design-of-experiments techniques to optimize test operations to reduce the total number of tests required to accurately estimate the performance of a rocket engine or its components; (2) investigate options to transform the 2 design and manufacture of high-pressure (up to 15,000 psi), LOX-compatible, cryogenic tanks; (3) investigate the use of artificial intelligence and/or quantum computing to rapidly (and cost effectively) evaluate test site locations and optimize test stand configurations to meet customer needs, and generate the essential design information (preliminary design review level) for the best candidates; (4) improve capabilities and methods to accurately predict and model the transient fluid structure interaction between cryogenic fluids and immersed components to predict the dynamic loads and frequency response of facilities; and (5) improve capabilities to predict the behavior of components (valves, check valves, chokes, etc.) during the facility design process are needed. These capabilities are required for modeling components in high pressure (to 12,000 psi), with flow rates up to several thousand lb./sec, in cryogenic environments and must address two-phase flows. Challenges include accurate, efficient, thermodynamic state models; cavitation models for propellant tanks, valve flows, and run lines; reduction in solution time; improved stability; acoustic interactions; and fluid-structure interactions in internal flows

Advanced Rocket Propulsion Test Instrumentation

Rocket propulsion system development is enabled by rigorous ground testing to mitigate the propulsion system risks inherent in spaceflight. Test articles and facilities are highly instrumented to enable a comprehensive analysis of propulsion system performance. Advanced instrumentation has the potential for substantial reduction in time and cost of propulsion systems development, with substantially reduced operational costs and improvements in ground, launch, and flight system operational robustness.

EPSCoR research could design and demonstrate a wireless, highly flexible instrumentation solution capable of multiple types of measurements (e.g., heat flux, temperature, pressure, strain, and/or near-field acoustics). These advanced instruments should function as a modular node in a sensor network, capable of performing some processing, gathering data, and communicating with other nodes in the network. The sensor network must be capable of integration with data from conventional data acquisition systems adhering to strict calibration and timing standards (e.g., Synchronization with Inter-Range Instrumentation Group— Time Code Format B (IRIG-B) and National Institute of Standards and Technology (NIST) traceability is critical to propulsion test data analysis.)

14.B: Contact/Inquiries

For inquiries regarding technical and scientific aspects of NASA's Research Focus Areas in this NOFO, please contact the designated POC.

14.B.1 Mission Directorates : Inquiries/Contacts

Mission Directorates	**POC**
Aeronautics Research Mission Directorate (ARMD)	Dave Berger, dave.e.berger@nasa.gov
Space Operations Mission Directorate (SOMD), Human Research Program • Analog Facilities • Space Radiation • Human-based tissue • Exploration Medical Capability	Kristin Fabre kristin.m.fabre@nasa.gov Alexandra Whitmire: alexandra.m.whitmire@nasa.gov Katherine Rahill: katherine.m.rahill@nasa.gov Janice Zawaski janice.zawaski@nasa.gov Janapriya Saha janapriya.saha@nasa.gov Gregory Nelson gregory.a.nelson@nasa.gov Jay Lemery, MD jay.lemery@nasa.gov
Space Operations Mission Directorate (SOMD) Office of Chief Health and Medical Officer (OCHMO)	Victor Schneider, vschneider@nasa.gov James D. Polk, james.d.polk@nasa.gov
Space Operations Mission Directorate (SOMD) Commercial *Space Capabilities*	Marc Timm, marc.g.timm@nasa.gov Warren Ruemmele, warren.p.ruemmele@nasa.gov
Exploration Systems Development Mission Directorate (ESDMD)	Matt Simon, matthew.a.simon@nasa.gov
Science Mission Directorate (SMD) Heliophysics Division	Patrick Koehn, patrick.koehn@nasa.gov Madhulika Guhathakurta, madhulika.guhathakurta@nasa.gov
Science Mission Directorate (SMD) Earth Science Division	Yaitza Luna-Cruz, yaitza.luna-cruz@nasa.gov Laura Lorenzoni laura.lorenzoni@nasa.gov
Science Mission Directorate (SMD) Planetary Science Division	Erica Montbach (she/her) erica.n.montbach@nasa.gov Michael Lienhard (*he/him*) michael.a.lienhard@nasa.gov
Science Mission Directorate (SMD) Astrophysics Division	Hashima Hasan, hhasan@nasa.gov Mario Perez, mario.perez@nasa.gov
Science Mission Directorate (SMD) Biological and Physical Sciences (BPS)	Francis Chiaramonte francis.p.chiaramonte@nasa.gov
Biological and Physical Sciences (BPS) • Fundamental Physics • Soft Matter/Complex Fluids	Mike Robinson michael.p.robinson@nasa.gov
Biological and Physical Sciences (BPS) • Fluid Physics • Combustion Science • Materials Science	Brad Carpenter bcarpenter@nasa.gov
Biological and Physical Sciences (BPS) • Growth of plants in "deep space-relevant" Earth soils or conditions • The impact of space-associated stressors on energy metabolism and oxidative stress • The role of genetic diversity in enabling life to thrive in space	Sharmila Bhattacharya SpaceBiology@nasaprs.com
Space Technology Mission Directorate (STMD)	Damian Taylor, Damian.Taylor@nasa.gov

STMD, Clean energy	Jeremiah Mcnatt, jmcnatt@nasa.gov
STMD, Nuclear systems	Anthony Calomino, anthony.m.calomino@nasa.gov
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STMD, Earth-observing capabilities	Chris Baker, christopher.e.baker@nasa.gov Justin Treptow, justin.treptow@nasa.gov
STMD, Carbon capture and utilization	James Broyan, james.l.broyan@nasa.gov
SMD, Harnessing data for improved visualization	Lawrence Friedl, lfriedl@nasa.gov
STMD, Addressing Orbital Debris	Bo Naasz, Bo.j.naasz@nasa.gov

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Angela Krenn	Thermal	angela.g.krenn@nasa.gov

14.B.2 NASA Centers: Inquiries/Contacts

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Goddard Space Flight Center (GSFC) Heliophysics Science Division	Doug Rabin (Douglas.Rabin@nasa.gov
Goddard Space Flight Center (GSFC) Solar System Exploration Division	*Terry Hurford (Terry.a.Hurford@nasa.gov*
Goddard Space Flight Center (GSFC) Artificial Intelligence, Machine Learning, Big Data Analytics	Dr. Mark Carroll *(mark.carroll@nasa.gov*
Jet Propulsion Laboratory (JPL)	**Dr. Tom Cwik,** thomas.a.cwik@jpl.nasa.gov
Johnson Space Center (JSC) / White Sands Test Facility (WSTF)	Brian Schwing | brian.m.schwing@nasa.gov Doug Goodman | doug.goodman@nasa.gov
Kennedy Space Center (KSC)	Tim Griffin, timothy.p.griffin@nasa.gov
Langley Research Center (LaRC)	Neyda Abreu, neyda.m.abreu@nasa.gov
Langley Research Center (LaRC) Aerosciences	Alireza Mazaheri, ali.r.mazaheri@nasa.gov

• Uncertainty quantification for high-fidelity multidisciplinary (e.g., aeroelastic, aeroacoustic) analysis for aircraft flight (POC: Beth Lee-Rauch, e.lee-rausch@nasa.gov) • Multi-physics high-fidelity approaches for advanced or emerging computer architectures (POC: Beth Lee-Rauch, e.lee-rausch@nasa.gov) • Machine learning for turbulent or transitional flow modeling (POC: Beth Lee-Rauch, e.lee-rausch@nasa.gov) • HYBRID turbulent simulation methods and models to simulate highly separated turbulent flows (POC: Luther Jenkins, luther.n.jenkins@nasa.gov) • Efficient synthetic turbulence generation methods (POC: Luther Jenkins, luther.n.jenkins@nasa.gov) • Wall models for compressible flows (POC: Luther Jenkins, luther.n.jenkins@nasa.gov) • High-order unstructured schemes for high-speed flows and aerothermodynamics (POC: Alireza Mazaheri, ali.r.mazaheri@nasa.gov) • Modular GPU-based chemically reacting solver with stiff integrator (POC: Andrew Norris andrew.t.norris@nasa.gov) • Uncertainty quantification for stochastic probability density function (PDF) methods (POC: Andrew Norris andrew.t.norris@nasa.gov) • Gas lattice methods for continuum (high density) flows (POC: Andrew Norris andrew.t.norris@nasa.gov) • Broadband noise prediction of advanced air mobility aircraft (POC: Mike Doty, michael.j.doty@nasa.gov) • Novel material concepts to extend the frequency range of acoustic liners (POC: Ran Cabell, randolph.h.cabell@nasa.gov) • Novel noise reduction concepts for urban air mobility (UAM) propulsors (POC: Ran Cabell, randolph.h.cabell@nasa.gov)	
Langley Research Center (LaRC) Intelligent Flight Systems & Trusted Autonomy	"Mike" Fremaux , c.m.fremaux@nasa.gov
Langley Research Center (LaRC) Advanced Materials, Manufacturing Technologies & Structural Systems	Chris Wohl - c.j.wohl@nasa.gov
Langley Research Center (LaRC) Measurement Systems - Advanced Sensors and Optical Diagnostics	"Tony" Humphreys, william.m.humphreys@nasa.gov

- Detectors and focal planes for Low Earth Orbit observing platforms (POC: Alan Little, a.little@nasa.gov)
- Electronics for both flight platforms and ground test facilities (POC: Arthur Bradley, arthur.t.bradley@nasa.gov)
- Optical components including adaptive optics based on phase change materials (POC: Hyun Jung Kim, hyunjung.kim@nasa.gov)
- Microwave, millimeter, and sub-millimeter wave detection systems (POC: Steve Harrah, steve.harrah-1@nasa.gov)
- Weather sensors for Advanced Air Mobility (AAM) applications (POC: Grady Koch, grady.j.koch@nasa.gov)
- Custom laser designs (wavelengths, pulse durations, etc.) for remote sensing and ground facility test applications (POC: Paul Danehy, paul.m.danehy@nasa.gov)
- Flow visualization methods for high-speed ground test facilities (supersonic to hypersonic) (POC: Brett Bathel, brett.f.bathel@nasa.gov)
- High spatial and temporal resolution velocimetry measurements, both seeded and seedless (POC: Paul Danehy, paul.m.danehy@nasa.gov)
- Global surface pressure and temperature measurements (POC: Neal Watkins, anthony.n.watkins@nasa.gov)
- Cryogenic and thermal sensors for ground test facilities (POC: Lisa Le Vie, lisa.r.levie@nasa.gov)
- Non-destructive evaluation (NDE) methods for crewed vehicle structural health (POC: Patti Howell, patricia.a.howell@nasa.gov)
- Automated non-destructive evaluation (NDE) methods and systems utilizing machine learning (POC: Patti Howell, patricia.a.howell@nasa.gov)

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Stennis Space Center (SSC)	Anne Peek anne.h.peek@nasa.gov

14. C: Definitions

- NASA Centers – NASA Centers, located throughout the United States, provide leadership for and execution of NASA's work. There are nine NASA Centers, plus NASA's only Federally Funded Research and Development Center, the Jet Propulsion Laboratory (JPL). JPL is eligible for collaboration within NASA EPSCoR on par with NASA Centers. The nine NASA Centers are:
    - Ames Research Center (ARC)
    - Armstrong Flight Research Center (AFRC)
    - Glenn Research Center (GRC)
    - Goddard Space Flight Center (GSFC)
    - Johnson Space Center (JSC)
    - Kennedy Space Center (KSC)
    - Langley Research Center (LaRC)
    - Marshall Space Flight Center (MSFC)
    - Stennis Space Center (SSC)

- Cooperative Agreement – An award of federal assistance similar to a grant with the exception that NASA will be substantially involved in the recipient's performance of the project. Cooperative agreements are managed pursuant to the policies set forth in 2 CFR § 200, 2 CFR § 1800, and the *NASA Grant and Cooperative Agreement Manual* (GCAM).

- Jurisdiction – A State or Commonwealth that is eligible to submit a proposal in response to this announcement.

- NASA Research Contact – The primary NASA point of contact during the proposal writing stage for the proposed research area. If the proposer has contacted and received permission from a NASA scientific or technical person, that individual may be listed in the proposal as the NASA Research Contact. Otherwise, the NASA Research Contact is the University Affairs Officer at the NASA Center, or the NASA Mission Directorate contact at NASA Headquarters.

- Principal Investigator (PI) – A jurisdiction's EPSCoR Director is considered the Principal Investigator (PI). The PI is responsible for proper conduct of the research, including appropriate use of funds and administrative requirements such as the submission of the scientific progress reports to the Agency. The PI is the administrator of the proposal.

- Science-Investigator (Sc-I) – The Sc-I will serve as the point of contact (POC) with the International Space Station (ISS) Program. The formally stated PI will remain responsible for the overall direction of the effort and the use of funds.

- Research Focus Area (RFA) – An area of research focus aligned with the objectives of NASA.

- Research Assistant – A student (undergraduate, graduate, or postdoctoral) who receives a research appointment in direct support of the NASA EPSCoR research in a research proposal.

- Mission Directorates
    - Aeronautics Research Mission Directorate (ARMD)
    - Exploration Systems Development Mission Directorate (ESDMD)
    - Human Exploration and Operations (HEO) Mission Directorate
    - Science Mission Directorate (SMD)
    - Space Operations Mission Directorate (SOMD)
    - Space Technology Mission Directorate (STMD)

14. D: Certifications

Certification of Compliance, Assurances, and Representations

Awards from this funding announcement that are issued under 2 CFR 1800 are subject to the Federal Research Terms and Conditions (RTC) located at http://www.nsf.gov/awards/managing/rtc.jsp. In addition to the RTC and NASA-specific guidance, three companion resources can also be found on the website: Appendix A— Prior Approval Matrix, Appendix B—Subaward Requirements Matrix, and Appendix C—National Policy Requirements Matrix.

By submitting the proposal identified in the Cover Sheet/Proposal Summary in response to this Research Announcement, the Authorized Organizational Representative (AOR) of the proposing organization (or the individual Proposer if there is no proposing organization) as identified below—

(a) Certifies that the statements made in this proposal are true and complete to the best of his/her knowledge;

(b) Agrees to accept the obligation to comply with NASA award terms and conditions if an award is made as a result of this proposal; and

(c) Confirms compliance with all applicable terms and conditions, rules, and stipulations set forth in the Certifications, Assurances, and Representations contained in this NOFO. Willful inclusion of false information in this proposal and/or its supporting documents, or in reports required under an ensuing award, is a criminal offense (U.S. Code, Title 18, Section 1001).

The AOR’s signature on the Proposal Cover Page automatically certifies that the proposing organization has read and is in compliance with all certifications, assurances, and representations as detailed in the NASA GCAM Appendix A, Standard Format for a NASA Notice of Funding Opportunity (NOFO).

14.E: Useful Web Sites

NASA http://www.nasa.gov

NASA Office of STEM Engagement http://stem.nasa.gov

NASA EPSCoR https://www.nasa.gov/stem/epscor/home/index.html

Vision for Space Exploration
https://www.nasa.gov/pdf/55583main_vision_space_explor
ation2.pdf

NASA Centers & Facilities https://www.nasa.gov/about/sites/index.html

NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES)
http://nspires.nasaprs.com

NASA Grant and Cooperative Agreement Manual (GCAM)

https://www.nasa.gov/offices/procurement/gpc/regulations_and_guidance

NPR 5810.1A, Standard Format for NASA Research Announcement and Other Announcements for Grants and Cooperative Agreements

https://nodis3.gsfc.nasa.gov/displayCA.cfm?Internal_ID=N_PR_5810_001A_&page
_name=mai n

Electronic Code of Federal Regulations (2 CFR 200,
2 CFR 1800)
https://ecfr.federalregister.gov/current/title-2

NASA EPSCoR Director's Contact Information

https://www.nasa.gov/learning-resources/established-program-to-stimulate-
competitive- research/epscor-directors/

Appendix 15: Established Program to Stimulate Competitive Research (EPSCoR) Rapid Response Research (R3), FY 2025

15.0 PROGRAM DESCRIPTION

The NASA Authorization Act for Fiscal Year 1993, Public Law 102-588, and the Established Program to Stimulate Competitive Research (EPSCoR) Reauthorization Act of 2017, Public Law 114-32 authorized the National Aeronautics and Space Administration (NASA) to initiate NASA EPSCoR to strengthen the research capability of jurisdictions that have not historically participated equably in competitive aerospace research activities. The goal of NASA EPSCoR is to provide seed funding that will enable jurisdictions to develop an academic research enterprise directed toward long-term, self-sustaining, nationally competitive capabilities in aerospace and aerospace-related research. This capability will, in turn, contribute to the jurisdiction's economic viability and expand the nation's base for aerospace research and development.

Based on the availability of funding, NASA will continue to help jurisdictions achieve these goals through NASA EPSCoR. Funded jurisdictions' proposals shall be selected through a merit-based, peer-review competition and presented for review to a NASA Headquarters (HQ) Mission Directorate Review Panel.

The following are the specific objectives of NASA EPSCoR:

- Contribute to and promote the development of research capability in NASA EPSCoR jurisdictions in areas of strategic importance to NASA's mission;
- Improve the capabilities of the NASA EPSCoR jurisdictions to gain support from sources outside the NASA EPSCoR programs;
- Develop partnerships among NASA research assets, academic institutions, and industry;
- Contribute to the overall research infrastructure and economic development of the jurisdiction;
  and
- Focus on research of important priority to NASA.

This Notice of Funding Opportunity (NOFO) solicits proposals that are expected to establish research activities that will make significant contributions to NASA's strategic research and technology development priorities and contribute to the overall research infrastructure, science, and technology capabilities of higher education, as well as the economic development of the jurisdiction receiving funding. Each funded NASA EPSCoR proposer shall work closely with a NASA researcher to focus on developing competitive research and technology for the solution of scientific and technical issues of importance to the NASA Mission Directorates and Centers as listed in the Appendix-A, NASA Mission Directorates and Center Alignment. This will allow EPSCoR researchers to work alongside NASA and commercial partners and is intended to strengthen the bonds among NASA EPSCoR jurisdictions, NASA, commercial partners, and other entities.

NASA will designate a Technical Monitor (TM) for every cooperative agreement award. The TM's role will encompass monitoring research progress and ensuring ongoing alignment with the established project objectives. Each recipient of an award is required to furnish an annual report detailing research advancement. These reports will encompass anticipated performance goals, key indicators, target outcomes, baseline data, data collection methods, and other resulting insights. Following evaluation by the TM, these reports will be subject to approval by the NASA EPSCoR Project Manager. Moreover, they will be disseminated among the NASA Mission Directorates, NASA Centers, and NASA's Jet Propulsion Laboratory (JPL) for broader awareness and visibility.

Principal Investigators shall submit electronic progress reports to the NSSC at NSSC-Grant-Report@mail.nasa.gov and the technical officer at agency-epscor@mail.nasa.gov. The reporting requirements for awards made through this NOFO shall be consistent with the NASA Grant and

Cooperative Agreement Manual (GCAM), (https://www.nasa.gov/wp-content/uploads/2024/09/nasa-grant-and-cooperative-agreement-manual-oct-2024.pdf?emrc=c941eb?emrc=c941eb), Appendix D, Award Terms and Conditions (page 76). Recipients also shall comply with performance report requirements (page 55), and Financial Reporting (page 15). Additionally, if the federal share of any award issued under this NOFO is more than $500,000 over the total award's period of performance, additional reporting requirements shall apply. See Title 2 Code of Federal Regulations (CFR) Part 200 (2 CFR 200).

15.1 Overview of the Funding Opportunity

The program parameters are:

- Institutions responding to this NOFO may submit a maximum of three proposals.
- Proposals will be selected from this solicitation for FY 2025 funding.
- The maximum funding request per proposal is $125,000. This amount is to be expended over a one-year period.
- In the proposal title, please include the Research Topic, listed in Section A.
- No cost-sharing by proposers is required. However, cost-sharing can be voluntarily offered, but it will not be a factor in the award decision.
- It is anticipated that 25-30 awards may be made under this NOFO in accordance with the rules and policies set forth in 2 CFR 200, Uniform Administrative Requirements, Cost Principles and Audit Requirements for Federal Awards (https://www.ecfr.gov/current/title-2/subtitle-A/chapter-II/part-200?toc=1), as adopted and supplemented by NASA through Title 2 CFR Part 1800 (2 CFR 1800): Grants and Agreements (https://www.ecfr.gov/current/title-2/subtitle-A/chapter-II/part-200?toc=1), and in the NASA GCAM.
- The Government's obligation to make an award is contingent upon the availability of appropriated funds from which payment can be made.
- This NOFO is available in electronic form through the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) and Grants.gov. However, all proposals shall be submitted through NSPIRES.

To access this NOFO through NSPIRES, go to http://nspires.nasaprs.com and click on Solicitations.

To access this NOFO through Grants.gov, go to https://www.grants.gov/search-grants.html and select the link for NASA under Agency.

15.2 Data Management Plan (DMP)

All proposals submitted under this NOFO are required to submit a Data Management Plan (DMP) in accordance with the *NASA Plan for Increasing Access to the Results of Scientific Research* located at http://www.nasa.gov/sites/default/files/files/NASA_Data_Plan.pdf.

In keeping with the *NASA Plan for Increasing Access to the Results of Scientific Research*, new terms and conditions, consistent with the Rights in Data clause in the award, information about making manuscripts and data publicly accessible may be included in each award document. As a general rule, proposals are required to provide a DMP or proposers shall provide an explanation as to why a DMP is not necessary given the nature of the work proposed. *The DMP shall be submitted by responding to the NSPIRES cover page question about the DMP (limited to 4000 characters)*. Any research project for which a DMP is not necessary shall provide an explanation in the DMP block. Example explanations are as follows:

- *This is a development effort for flight technology that will not generate any data that the proposer/recipient can release, so a DMP is not necessary;*
- *The data that the proposer/recipient will generate will be subject to ITAR; or*
- *The proposer/recipient may explain why its project is not going to generate data.*

- The proposal type that requires a DMP is described in the *NASA Plan for Increasing Access to the Results of Scientific Research* (see above link). The DMP shall contain the following elements, as appropriate to the project:
- A description of data types, volume, formats, and (where relevant) standards;
- A description of the schedule for data archiving and sharing;
- A description of the intended repositories for archived data, including mechanisms for public access and distribution;
- A discussion of how the plan enables long-term preservation of data; and
- A discussion of roles and responsibilities of team members in accomplishing the DMP. (If funds are required for data management activities, these should be included in the budget and budget justification sections of the proposal).

Proposers that include a plan to archive data should allocate suitable time for this task. Unless otherwise stated, this requirement supersedes the data sharing plan mentioned in the *NASA GCAM.*

In addition, researchers submitting NASA-funded articles in peer-reviewed journals or papers from conferences shall make their work accessible to the public through NASA's *PubSpace* at https://sti.nasa.gov/submit-to-pubspace/#.YD5lRJNKhTY.

See NASA's Scientific and Technical Information Program's DMP FAQ at https://sti.nasa.gov/faq/ and the Science Mission Directorate's DMP FAQ at http://science.nasa.gov/researchers/sara/faqs/ for more information.

15.2.1 Unique Entity Identifier (UEI) and System for Award Management (SAM)

Each applicant for NASA funding (unless the applicant is an individual or is excluded per 2 CFR 25.110) is required to:

- Be registered in SAM.gov before submitting a proposal;
- Maintain an active SAM.gov registration with current information, including information on a recipient's immediate and highest-level owner and subsidiaries, as well as on all predecessors that have been awarded a Federal contract or grant within the last three years, if applicable, for all times during which it has an active Federal award or an application or plan under consideration by NASA; and
- Provide its UEI in each application or plan it submits to NASA. An UEI is obtained by registering in SAM.gov.
- Each individual team member (e.g., PI, co-investigators), including all personnel named on the proposal's electronic cover page, shall be individually registered in NSPIRES.

NASA may not issue an award or financial modification to an existing award to an applicant or recipient entity until the entity has complied with the requirements to provide a valid UEI and maintain an active SAM registration with current information. At the time of issuing an award, if the intended recipient has not complied with the UEI or SAM.gov requirements, NASA may determine that the applicant is not qualified to receive an award and use that determination as a basis for making an award to another applicant.

15.2.2 Federal Award Information

Subject to Congressional appropriation of sufficient funds and NASA's receipt of proposals of adequate merit, NASA expects to select up to 25 to 30 proposals for Rapid Response Research (R3) awards. The period of performance for each proposal/resulting award is one year. Successful proposals for this opportunity will be funded as cooperative agreements. As cooperative agreements, substantial involvement between awardees and NASA is to occur. Funding shall be up to $125,000 per award. The period of performance is expected to begin four months from the selection announcement.

15.2.2.1 Award Guidelines

- Available Funding for this NOFO is approximately $4 Million (M).
- Projected Number of Awards: Approximately 25to 30 awards of up to $125,000 each.
- Maximum Award Amount: $125,000
- Anticipated Period of Performance: NASA EPSCoR awards will support cooperative agreements, each with a one-year period of performance (PoP). It is anticipated that this PoP will enable the researchers to achieve the performance task objectives of the proposal and/or as included in any amendments submitted with the recipient's annual progress reports and accepted by the NASA EPSCoR project office.
- Projected PoP Start Date(s): For planning purposes, PIs should assume that the award start date will be approximately six months after the proposal deadline date. The project start date may be negotiated with the NASA Shared Services Center (NSSC) Grant Officer.
- Projected PoP End Date(s): The PoP end date will be one year after the PoP start date.
- Funding Instrument Type(s): Cooperative Agreement
- NASA will assign a Technical Monitor (TM) to each award. Cooperative Agreements have substantial government involvement to support the recipient's performance of the project. Therefore, the TM will monitor the progress of the research and collaborate as required to keep the research aligned with the approved project's objective(s). Each recipient shall provide an annual report on the progress of the research; this report shall be reviewed by the TM and approved in writing by the NASA EPSCoR Project Manager. These reports shall be shared with the NASA Mission Directorates, NASA Centers, and JPL.
- Applicants to this NOFO should be aware that awards made after October 1, 2024, will need to comply with the new Title 2 regulations which are posted here. The regulations posted on ecfr.gov were updated as of October 1.

15.2.2.2 Budget Guidelines and Requirements, Funding Restrictions

All costs charged to awards covered by this NOFO must comply with the Uniform Administrative Requirements in 2 CFR 200 and 2 CFR 1800, unless otherwise indicated in the NOFO, the terms and conditions of the award, and the Grants Policy and Compliance Team - NASA. Additionally, the following restrictions apply:

1. All proposed funds must be allowable, allocable, and reasonable. Funds may only be used for the proposed project. All activities charged under indirect costs must be allowed under 2 CFR 200 cost principles.
2. Grants and cooperative agreements shall not provide for the payment of fee or profit to the recipient.

3. Proposals must not include bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds basis.
4. Any funds used for cost sharing or matching must be allowable under 2 CFR 200.
5. The non-Federal entity must use one of the methods of procurement as prescribed in 2 CFR §200.320, Methods of procurement to be followed (https://www.ecfr.gov/current/title-2/subtitle-A/chapter-II/part-200/subpart-D/subject-group-ECFR45ddd4419ad436d/section-200.320).
6. Funds may not be used to fund research carried out by non-U.S. institutions. However, U.S. research award recipients may directly purchase supplies and/or services that do not constitute research from non-U.S. sources. Subject to export control restrictions, a foreign national may receive payment through a NASA award for the conduct of research while employed either full- or part-time by a U.S. institution. For additional guidance on foreign participation in awards, see the *NASA GCAM* and the NASA FAR Supplement (NFS) part 1835.016-70 (https://www.acquisition.gov/nfs/1835.016-70-foreign-participation-under-broad-agency-announcements-baas).
7. Subject to export control restrictions, a foreign national may receive payment through a NASA award for the conduct of research while employed either full- or part-time by a U.S. institution. For additional guidance on foreign participation, see Appendix A of the *NASA GCAM* and NFS part 1835.016-70.
8. EPSCoR support shall be acknowledged by the EPSCoR research project number in written reports and publications. Note that there is no limit for domestic travel, defined as travel that does not require a U.S. passport, and shall be appropriate and reasonable to conduct the proposed research.
9. NASA EPSCoR funding shall not be used to purchase general purpose equipment, e.g. desktop workstations, office furnishings, reproduction, and printing equipment as a direct charge. However, special purpose equipment purchases (i.e., equipment that is used only for research, scientific, and technical activities directly related to the proposed research activities) are allowed and shall be reflected as a direct charge as per cost principles cited in the GCAM. In addition, proposers shall comply with 2 CFR §200.216: Prohibition on certain telecommunication and video surveillance services or equipment. Equipment and other capital expenditures, special purchase equipment items with a unit cost of $5,000 or more must have the prior written approval of the Federal awarding agency (i.e., the NASA Grant Officer).
10. NASA EPSCoR funding shall not be used to support NASA employees' (full-time equivalent or FTE) participation in a research project unless that funding is provided through a separate funding instrument between the institutions and NASA Center, such as a Space Act Agreement or other reimbursable agreement. NASA EPSCoR will not set aside award funding to send to a NASA Center for FTE support, including travel.
11. NASA EPSCoR funds shall be spent on NASA EPSCoR institutions. If a Research Investigator (PI/Co-I) with NASA EPSCoR award transfers to a non-EPSCoR institution, the EPSCoR funding amount, or the amount that remains unobligated at the time of the PI/Co-I transfer, shall not be transferred to the non-EPSCoR institution, rebudget is required through institution's AOR.
12. This NOFO is not for the renewal or augmentation of existing projects, which are not eligible to compete against proposals submitted in response to this NOFO. Thus, only new proposals will be considered for awards.
13. Procurement contracts shall not be awarded as a result this NOFO.
~~14.~~ Pre-award costs are those incurred prior to the effective date of an award directly pursuant to the negotiation and in anticipation of the award where such costs are necessary for efficient

and timely performance of the scope of work. Once the award is announced, then pre-award costs less than 90 days are allowed.

15. Domestic travel, defined as travel that does not require a U.S. passport, does not have a funding limit and shall be appropriate and reasonable to conduct the proposed research.

15.2.2.3 Direct Costs Limitations

Travel, including foreign travel, is allowed for the meaningful completion of the proposed investigation, as well as for reporting results at appropriate professional meetings. Foreign travel to meetings and conferences in support of the jurisdiction's NASA EPSCoR research project is an acceptable use of NASA EPSCoR funds, with a limit of $3,000 per trip for up to two separate years of a jurisdiction's proposal (i.e., the maximum amount the jurisdiction can request for foreign travel is $3,000 total in any one year and a limit of $6,000 total for each research proposal). NASA EPSCoR support shall be acknowledged by the NASA EPSCoR research project number in written reports and publications.

15.2.2.4 Pre-Award Costs

Pre-award costs are those incurred prior to the effective date of an award that are directly pursuant to the negotiation and in anticipation of the award where such costs are necessary for efficient and timely performance of the scope of work. Per 2 CFR §1800.210, Pre-award costs, NASA waives the requirement for applicants to obtain prior approval for pre-award costs incurred 90 days or less before an award's PoP start date. Pre-award costs more than 90 days prior to an award's PoP start date are not allowable under this NOFO. Any costs that the applicant incurs in anticipation of an award is at the applicant's risk and will be subject to the rules described in 2 CFR §1800.210 and the "Pre-award Costs" section of the GCAM.

15.2.2.5 Indirect Facilities & Administrative (F&A) Costs

Unless otherwise directed in 2 CFR 200, for changes to the negotiated indirect cost rate that occur throughout the project period, the proposer/recipient shall apply the rate negotiated for that year, regardless of whether it is higher or lower than at the time the proposal (including the submitted budget) was awarded.

15.2.2.6 Maximum Funding

The maximum funding that a jurisdiction can request from NASA is $125,000 per proposal. This amount is to be spent in accordance with the budget details and budget narrative in the approved proposal.

15.2.2.7 Other Submission Requirements

Applicants must include a statement detailing their use of undergraduate students, graduate students, and/or postdoctoral fellows' support. The use of NASA EPSCoR funds for support of undergraduate and/or graduate research assistants shall be detailed in the budget justification and described in the narrative and evaluation sections of the proposal.

Letters of Support or Commitment from the NASA EPSCoR Jurisdiction Director are encouraged.

Proposers are encouraged to seek collaboration with NASA subject matter experts, listed in Section A. Proposals budgets may not include civil servant FTE/WYE for research collaboration or advisement. Letters of support or commitment from collaborators are encouraged. NASA civil servants are not allowed to write letter of Endorsement for any particular candidate.

Proposals that include flight activities (not normal passenger travel) such as aircraft or helicopter flight services, including Unmanned Aircraft Systems (UAS)/Drone operations or the acquisition or construction of such flight vehicles, must comply with NASA Policy Directive 7900.4 (https://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPD&c=7900&s=4E). Questions concerning flight compliance requirements may be addressed to Norman Schweizer (norman.s.schweizer@nasa.gov) ACMO or Grant Watson (grant.m.watson@nasa.gov) ISMD, or Richard Schlatter (Richard.schlatter-1@nasa.gov) ISMD.

15.2.2.8 Collection of Demographic Information

NASA is implementing a process to collect demographic data from grant applicants for the purpose of analyzing demographic differences associated with its award processes. Information collected will include name, gender, race, ethnicity, disability status, and citizenship status. Submission of the information is voluntary and is not a precondition of award.

Therefore, NASA requests additional demographic data to ensure its compliance with Title VI of the Civil Rights Act of 1964, 42 United States Code (U.S.C.) §2000d et seq., Title IX of the Education Amendments of 1972, 20 U.S.C. §1681 et seq., Section 504 of the Rehabilitation Act of 1973, 29 U.S.C. §701 et seq. and NASA's implementing regulations at 14 CFR 1250, 1251, and 1253. Submission of the requested information on NASA Form 1839 is purely voluntary and will not affect a proposer's eligibility for award.

15.2.2.9 Statements of Commitment and Letters of Support

Statements of commitment and letters of support are important components of the proposal. However, NASA does not solicit or evaluate letters of endorsement. Review the *NASA GCAM* for the distinctions among statements of commitment, letters of support, and letters of endorsement. Letters of support are only required if there is a facility or resource essential to the implementation of the proposal, and a proposal team member does not have guaranteed access to such facility or resource. By submitting a statement of commitment, the team member confirms that any facilities or resources needed for the proposal are readily available for the proposal team members(s) who require its use.

15.3 Eligibility Information

15.3.1 NASA's Commitment to Diversity and Inclusion

NASA recognizes and supports the benefits of having diverse and inclusive scientific, engineering, and technology communities and fully expects the reflection of such values in the composition of all panels and teams, including peer review panels, proposal teams, science definition teams, and mission and instrument teams. Per Federal statutes and NASA policy, no eligible applicant shall experience exclusion from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from NASA on the grounds of their race, color, religion, age, sex, national origin, or disability. NASA welcomes proposals from all qualified and eligible sources, and strongly encourages proposals from Minority Serving Institutions (MSIs), small-disadvantaged businesses (SDBs), veteran-owned small businesses, service-disabled veteran-owned small businesses (SDVOSB), HUBZone small businesses, and women-owned small businesses (WOSBs), as eligibility requirements apply.

15.3.2 Eligible Applicants

The National Science Foundation (NSF) determines overall jurisdiction eligibility for NASA EPSCoR. The latest available NSF eligibility tables are used to determine overall jurisdiction eligibility for NASA EPSCoR.

The NSF 2023 eligibility table is available at: https://nsf-gov-resources.nsf.gov/2022-06/EPSCoR%20Eligibility%20Table%20Fiscal%20Year%202023.pdf.

The following jurisdictions are eligible to submit a proposal in response to this NOFO: Alabama, Alaska, Arkansas, Delaware, Guam, Hawaii, Idaho, Iowa, Kansas, Kentucky, Louisiana, Maine, Mississippi, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Dakota, Oklahoma, Puerto Rico, Rhode Island, South Carolina, South Dakota, US Virgin Islands, Vermont, West Virginia, and Wyoming.

Only three proposals per Institution within the EPSCoR Jurisdiction shall be accepted. Proposals shall be submitted through the Authorized Organization Representative (or their designee).

All proposals submitted in response to this NOFO shall be submitted electronically via NSPIRES (http://nspires.nasaprs.com). Hard copy proposals will not be accepted. Electronic proposals must be submitted in their entirety by 11:59 p.m., Eastern Time on February 26, 2025.

Proposers without access to the internet or who experience difficulty using the NSPIRES proposal site (http://nspires.nasaprs.com) may contact the **Help Desk at** nspires-help@nasaprs.com **or call 202-479-9376 between 8:00 a.m. and 6:00 p.m. (EDT), Monday through Friday, except on Federal Government holidays.** Proposals received after the due date may be returned without review and not considered for award. If a late proposal is returned, it is entirely at the proposer's discretion whether to resubmit it in response to a subsequent opportunity.

All EPSCoR institutions in eligible jurisdictions shall be made aware of this solicitation. Existing EPSCoR awards that already demonstrate partnerships or cooperative arrangements among academia, government agencies, business and industry, private research foundations, jurisdiction agencies, and local agencies shall not be submitted. No requests for renewals or extensions of previous projects will be accepted in response to this NOFO.

15.3.3 Institutional Eligibility

- EPSCoR jurisdictions that are eligible for the R3 FY2025 competition are listed in the NSF Eligibility table, which can be found here.
- Proposals can only be submitted by institutions eligible to receive EPSCoR funding. These include universities, colleges, non-profit organizations, and state and local governments.
- Institutions of higher education, acting on behalf of their faculty members, that are accredited in and have a campus in the United States, its territories, or possessions.
- Distinct academic campuses (e.g., that award their own degrees, have independent administrative structures, admissions policies, alumni associations, etc.) within multi-campus systems qualify as separate submission-eligible institutions.
- Not-for-profit, non-degree-granting domestic U.S. organizations, acting on behalf of their employees, that include (but are not limited to) independent museums and science centers, observatories, research laboratories, professional societies, and similar organizations that are directly associated with the Nation's research or educational activities.
- Not-for-profit organizations must have an independent, permanent administrative organization (e.g., an Office of Sponsored Projects) located within EPSCoR Jurisdictions and have 501(c)(3) tax status.

15.3.4 Principal Investigators (PIs)/ Co-Investigators (Co-Is) Eligibility

- Proposers (Principal Investigators and Science Investigators) that have an active NASA EPSCoR Research award (Basic Research, ISS and R3, Sub-orbital Flight Opportunity) are not eligible to apply for the R3 program. Proposers that have active Research Infrastructure Development (RID) sub-awards are eligible to apply for this solicitation.

- Previously awarded EPSCoR Research Science Investigators (Research, R3, ISS, SFO), awarded within the last three years, FY22-FY24, are not eligible to apply for the R3 program. RID sub-awards recipients are eligible to apply for this solicitation.
- A PI is typically the lead researcher responsible for the project's overall intellectual direction and administration.
- Co-Is are researchers who collaborate with the PI on the project. They contribute to the project's research and may share administrative responsibilities.
- PIs and Co-Is must have the institutional endorsement to submit proposals.
- Generally, PIs/co-Is are faculty members, researchers, or other individuals with the requisite institutional experience and authority.
- An investigator may serve as either the Principal Investigator (PI) or a Co-Principal Investigator (Co-PI) on only one proposal submitted in response to this solicitation.

The institution must endorse the submission, signifying that it supports the proposed research and that the PI and Co-Is are authorized to undertake the project.

15.3.5 Limit on Number of Proposals per Organization.

- A maximum of three proposals may be submitted in response to this solicitation by any organization in an eligible EPSCoR jurisdiction.
- If more than the maximum allowable proposals are submitted from any single institution, any proposals received after the first three are subject to return without review.
- The authorized organizational representative (AOR) within the university or institution must ensure the above requirements.
- All submissions must be conducted by an AOR within the university or institution. This individual is typically part of the institution's Office of Sponsored Programs or Research Administration.

The AOR ensures that the proposal meets all institutional policies and sponsor requirements before submitting it on behalf of the university.

15.3.6 Inter-University/Jurisdiction Collaboration

Proposers are encouraged to seek collaboration with other institutions within their EPSCoR jurisdiction and/or with institutions located in other EPSCoR jurisdictions. Collaboration allows for leveraging diverse perspectives, potentially leading to more impactful research outcomes.

Potential Benefits of Collaboration:

- **Complementary Strengths:** Universities excel in different areas. Collaboration allows the recipient to address all aspects of the research question effectively.
- **Diverse Perspectives:** Embrace the unique methodologies and viewpoints other universities bring. Shared passion for the research topic fuels collaboration.
- **Enhanced Research Outcomes:** Collaboration fosters diverse perspectives, leading to potentially more impactful research.

Making Collaboration Effective:

- **Identify Partners:** Explicitly highlight how your organization's research aligns with another university's work. Document the planned collaboration in the proposal.

- **Resource Sharing:** Document your organization's plan to share data, equipment, and technical expertise to strengthen the joint proposal.
- **Tackle Complex Challenges:** Explain how your entity's collaborative work is tackling complex research questions beyond the scope of a single university.

Proposers are encouraged to use this opportunity to build long-term research partnerships between and among different institutions.

15.3.7 Ineligibility of Proposals

Proposals involving bilateral participation, collaboration, or coordination in any way with China or any Chinese-owned company, whether funded or performed under a no-exchange-of-funds basis, shall be ineligible for award.

15.4 Application and Submission Information

15.4.1 Address to Request Application Package

All proposals submitted in response to this NOFO shall be submitted electronically via NSPIRES (http://nspires.nasaprs.com). Hard copy proposals will not be accepted.

15.4.2 Content and Form of Application Submission

The Scientific and Technical Plan for all compliant proposals, including detailed information on subawards, must not exceed 5 pages. Additionally, a Budget Justification Narrative and Details for each sub-award must be clearly documented, providing the basis for estimates. This includes the proposed budget, an itemized list detailing expenses within major budget categories, detailed sub-awards, and a summary of personnel. Refer to the NASA GCAM.

Proposal Title: In the Proposal Title, please include the specific Research Identifier, listed in Section A, followed by the proposal title.

Required Proposal Sections (in order of assembly)	**Page / Character Limits**
Proposal Cover Page	NSPIRES proposal cover page that is available at http://nspires.nasaprs.com/
Proposal Summary (abstract)	4,000 characters including spaces
Data Management Plan	4,000 characters, including spaces
Table of Contents	As needed (not included in 5-page limit)
Scientific/Technical Plan	5 pages*
Management Plan	As needed (not included in 5-page limit)
References and Citations	As needed (not included in 5-page limit)
Biographical Sketches for (not included in 5-page limit):	
The Principal Investigator	2 pages(per PI)
the Science Investigator (Sc-I)	2 pages (per Sci-I)

each Co-Investigator (Co-I)	1 page (per Co-I)
Current and Pending Support	As needed (not included in 5-page limit)
Statements of Commitment and Letters of Support	As needed (not included in 5-page limit)
Budget Justification: Narrative and Details • *Includes proposed budget, itemized list detailing expenses within major budget categories,* Facilities and Equipment, *detailed subawards and summary of personnel (NASA GCAM)* • *For grants/cooperative agreements, the table of personnel and work effort shall immediately follow the proposal budget and is not included in the budget.*	As needed (not included in 5-page limit)
Special Notifications and/or Certifications	As needed (not included in 5-page limit)
** includes all illustrations, tables, and figures, where each "n-page" fold-out counts as n-pages and each side of a sheet containing text or an illustration counts as one page.*	

15.4.3 Submission Method, Dates and Times

15.4.3.1 Submission Method

All proposals submitted in response to this NOFO shall be submitted electronically via NSPIRES (http://nspires.nasaprs.com). Hard-copy proposals will not be accepted. Electronic proposals must be submitted in their entirety by 11:59 p.m., Eastern Time on February 26, 2025.
Proposers without access to the Web or who experience difficulty using the NSPIRES proposal site (http://nspires.nasaprs.com) may contact the **Help Desk at** nspires-help@nasaprs.com **or call 202-479-9376 between 8:00 a.m. and 6:00 p.m. (EDT), Monday through Friday, except on Federal Government holidays.** Proposals received after the due date may be returned without review. If a late proposal is returned, it is entirely at the proposer's discretion whether to resubmit it in response to a subsequent appropriate solicitation.

15.4.3.2 Submission Deadline

Proposal Submission Deadline: 02/26/2025 at 11:59 PM ET

All proposals must be received by the established deadline.

NASA will not review proposals that are received after the deadline or consider these late applications for funding. However, NASA may extend the application deadline upon the request of any applicant who can demonstrate good cause exists to justify extending the deadline. Good cause for an extension may include technical problems outside of the applicant's control that prevented submission of the proposal by the deadline or other exigent or emergency circumstances.

Applicants experiencing technical problems outside of their control must notify NASA as soon as possible and before the application deadline. Failure to notify NASA in a timely manner of the issue that prevented the on-time submission of the proposal may prevent the proposal from being considered for award.

While every effort is made to ensure the reliability and accessibility of the NSPIRES site and to maintain a help center via e-mail and telephone, difficulty may arise at any point on the internet, including with the user's own equipment. Prospective proposers are strongly urged to familiarize themselves with the NSPIRES site and to submit the required proposal materials well in advance of the proposal submission deadline. Difficulty in registering with or using NSPIRES is not, in and of itself, a sufficient reason for NASA to consider a proposal that is submitted after the proposal due date.

15.4.4 NASA Contact Information

Program Office Contact
Technical and scientific questions about this NOFO may be directed to:

EPSCoR

Kathleen B. Loftin, Ph.D.
Project Manager, NASA EPSCoR
NASA Kennedy Space Center
Kennedy Space Center, FL 32899-0001
E-mail: kathleen.b.loftin@nasa.gov
Telephone: (321) 603-9971

Inquiries regarding the submission of proposals via NSPIRES may be addressed to:

Althia Harris
NASA Research and Education Support Services (NRESS)
2345 Crystal Drive, Suite 500
Arlington, VA 22202-4816
E-mail: aharris@nasaprs.com
Telephone: (202) 479-9030 x310
Fax: (202) 479-0511

Questions concerning environmental compliance may be addressed to:

NASA EPA Manager
Tina Norwood
E-mail: tina.norwood-1@nasa.gov
Telephone: (202)358-7323

15.4.5 Systems Information

NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES)
NSPIRES is a web-based system that supports the entire lifecycle of NASA research solicitation and selection, from the release of solicitation announcements through proposal submission, the peer review process, and the award decision. Applicants may search for and apply for funding opportunities available at NASA through NSPIRES. For technical assistance with NSPIRES, please contact the NSPIRES Help Desk at nspires-help@nasaprs.com or (202) 479-9376, Monday through Friday, 8:00 AM – 6:00 PM ET, except on Federal Government holidays.

Grants.gov

Grants.gov is the government-wide electronic grants portal and interested parties can search for grant opportunities on this site. For technical assistance with Grants.gov, call the customer support hotline 24 hours per day, seven days per week (except on Federal Government holidays) at (800) 518-4726 or e-mail support@grants.gov.

15.4.6 Collection of Demographic Information

NASA is implementing a process to collect demographic data from grant applicants for the purpose of analyzing demographic differences associated with its award processes. Information collected will include name, gender, race, ethnicity, disability status, and citizenship status. Submission of the information is purely voluntary and is not a precondition of award.

15.4.7 Cancellation of Program Announcement

NASA HQ OSTEM reserves the right to not make any awards under this NOFO and to cancel this NOFO at any time. NASA assumes no liability (including bid and proposal costs) for cancelling this NOFO or for any entity's failure to receive such notice of cancellation.

15.4.8 Intellectual Property

Data Rights: NASA encourages the widest practicable dissemination of research results at any time during the investigation. The award will contain the Rights in Data clause in the GCAM. This clause allows a recipient to assert copyright in any work that is subject to copyright and was developed or for which ownership was acquired under the NASA award.

NASA will reserve a royalty-free, nonexclusive, and irrevocable right to reproduce, publish, or otherwise use the work for Government purposes and to authorize others to do so in any such copyrighted work. Note that the Grant Officer may revise the language under the Rights in Data clause to modify each party's rights based on the circumstances of the program and/or the recipient's need to protect specific proprietary information.

Patent Rights: Recipients will be allowed to elect to retain title to any inventions made under the award. Awards will include the provisions of 37 CFR 401.3(a), which requires use of the standard clause set forth at 37 CFR 401.14 "Patent Rights (Small Business Firms and Nonprofit Organizations)," and the NASA GCAM.

15.4.9 Announcement and Updates/Amendments to Solicitation

This NOFO will be announced via NSPIRES and Grants.gov, but proposals shall be submitted on-time and electronically only via NSPIRES (http://nspires.nasaprs.com). Proposers shall carefully note the information described in the paragraph below for submission of an electronic proposal via NSPIRES. Instructions for submission of proposals are also detailed in the NASA GCAM.

While every effort is made to ensure the reliability and accessibility of the web site and to maintain a help center via e-mail and telephone, difficulty may arise at any point on the internet, including with the user's own equipment. Therefore, proposers are strongly urged to familiarize themselves with the NSPIRES site and to submit the required proposal materials well in advance of the proposal submission deadline. Difficulty in registering with or using NSPIRES is not, in and of itself, a sufficient reason for NASA to consider a proposal that is submitted after the proposal due date. Additional programmatic information for this NOFO may become available before the proposal due date. If so, such information shall be added as a formal amendment to this NOFO and posted on its homepage at http://nspires.nasaprs.com.

It is the proposer's responsibility to regularly check this NOFO's homepage for updates.

15.4.10 Access to NASA Facilities/Systems

Proposers including the use of NASA-unique facilities must include a letter of support from the hosting center. EPSCoR funds may not be used to support civil servant or NASA contractor participation in the research; however, their support can be used for labor associated with testing or use of facilities. Funding for the use of NASA-unique facilities must be explicitly included in the Budget section with the basis of estimate and justification. The funds planned for NASA-unique facilities must be clearly identified in the proposal.

All recipients shall work with NASA project/program staff to ensure proper credentialing for individuals needing access to NASA facilities and/or systems. Such individuals include U.S. citizens, lawful permanent residents (green card holders), and foreign nationals (those who are neither U.S. citizens nor permanent residents). Please note that foreign nationals are normally not allowed access to NASA facilities. Foreign nationals from "designated" countries, i.e., countries designated by the U.S. State Department and listed by NASA as being sponsors of terrorism, cannot be allowed on any NASA facilities unless they are green card holders.

15.4.11 Limited Release of Proposers' Confidential Business Information

- For proposal evaluation and other related administrative processing actions (i.e., funding actions), NASA may find it necessary to release information submitted by the proposer to individuals not employed by NASA (e.g., agency support contractor or subcontractor employees). Business information that would ordinarily be entitled to confidential treatment may be included in the information released to these individuals. Accordingly, by submission of this proposal the proposer hereby consents to a limited release of its confidential business information (CBI).
- Except where otherwise provided by law, NASA will permit the limited release of CBI only pursuant to non-disclosure agreements signed by the support contractor and/or subcontractor, and their individual employees who may require access to the CBI in order to perform the support contract or subcontract.
- Abstracts from proposals selected for award will be posted on NASA's public website (www.nasa.gov).

15.5 Proposal Review Information

Successful research proposals shall provide sound contributions to both immediate and long-term scientific and technical needs of NASA as explicitly expressed in current NASA documents and communications, as well as contribute to the overall research infrastructure, science, and technology capabilities of higher education, and economic development of the jurisdiction.

Successful proposals shall also include pragmatic plans for generating sustained non-EPSCoR support.

Proposals will be evaluated based on the following criteria for the award: Intrinsic Merit, Project Management, and Budget Justification. The bulleted lists after each criterion below should not be construed as any indication of priority or relative weighting. Rather, the bullets are provided for clarity and facilitation of proposal development. **Note:** Each proposer shall provide specific information on how the relevance of the proposed effort to NASA and the jurisdiction was determined.

15.5.1 Proposal Evaluation Criteria

Intrinsic Merit (35% of overall score)

- Proposed research shall have clear goals and objectives, address the expectations described in the announcement, be consistent with the budget, effectively utilize the program management, and demonstrate a high probability for successful implementation.
- Proposals shall provide a narrative of the proposed research activity, including the scientific and/or technical merit of the proposed research, unique and innovative methods, approaches, concepts, or advanced technologies, and the potential impact of the proposed research on its field.

NASA Alignment and Partnerships (35% of overall score)

- Proposals shall discuss the value of the proposed research to NASA.
- Proposals shall describe the use of NASA content, people, or facilities in the execution of the research activities.
- Proposals shall describe current and/or previous interactions, partnerships, and meetings with NASA researchers, engineers, and scientists in the area of the proposed research, and discuss how future partnerships will be fostered between or among the institution's researchers and personnel at the Mission Directorates, NASA Centers, and/or NASA's Jet Propulsion Laboratory (JPL).
- The name(s) and title(s) of NASA researchers with whom the proposers will partner shall be included.
- Proposals shall state how they plan to develop research competitiveness both in the jurisdiction and nationally.

Proposals shall delineate mechanisms for building partnerships with universities, industry, and/or other government agencies to enhance the ability of the jurisdiction to achieve its objectives, to obtain and leverage sources of additional funding, and/or to obtain essential services not otherwise available.

Management and Evaluation (15% of overall score)

NOTE: The following information shall be included in the proposal with page limits as required; the content of this section does not count toward the 15-page limit for the Scientific, Technical, or Management section.

- Personnel: The proposal shall include a list of the personnel participating in this research program, including the Principal Investigator (PI), Science-Investigator (Science-I), and all Co-Investigators (Co-I), Research Associates, Post-Doctoral Fellows, Research Assistants, and other research participants. The credentials of the researchers are important; however, one of the goals of EPSCoR is to encourage and help new researchers.
- Research Project Management: A description shall be included of the Science-I's management structure of the proposed research project, and the extent to which the project's management and research team will lead to a well-coordinated, efficiently managed, and productive effort.
- Multi-Jurisdiction Projects: If the proposed research is a collaboration between or among more than one NASA EPSCoR jurisdiction, one jurisdiction shall be identified as the lead with additional partners identified as sub-awardees. The proposal shall detail the inter-jurisdiction management structure of the proposed research project, including a

list of the participating jurisdictions and the universities and agencies within each jurisdiction. Multi-jurisdictional proposals shall not exceed the $125,000 per award limit.

- Project Evaluation: Each proposal shall document the intended outcomes and offer metrics to demonstrate progress toward and achievements of these outcomes. The proposal shall discuss metrics to be used for tracking and evaluating project progress. Milestones and timetables for achievement of specific objectives during the award period shall be presented. The proposal also shall describe an appropriate evaluation plan/process to document outcomes and demonstrate progress toward achieving the objectives of proposed project elements. The evaluation methodology shall be based upon reputable models and techniques appropriate to the content and scale of the project. Projects shall implement improvements throughout the entire period of performance based on ongoing evaluation evidence.
- Results of Prior NASA EPSCoR Research Support: Examples of accomplishments commensurate with the managerial and administrative expectations of the award shall be provided. The EPSCoR Director will not be assessed on their expertise in the specific proposed research area since the Science-PI is tasked with managing the scientific/technical development progress. However, the following information shall be provided: the NASA EPSCoR award number(s), the title of the projects(s); and period(s) of performance; primary outcomes resulting from the NASA EPSCoR award, including a summary discussion of accomplishments compared to the proposed outcomes from the original proposal; coordination with the research and technical development priorities of NASA, and contribution(s) to the overall research capacity of the jurisdiction.

Budget Justification: Narrative and Details (15% of overall score)

- The proposed budget shall be adequate, appropriate, reasonable, and realistic, and demonstrate the effective use of funds that align with the project as set forth in the proposal. Preparation guidelines for the budget can be found in the *NASA GCAM*.
- A detailed budget, including both NASA-provided and cost-shared funds, is required. This section shall include detailed budgets for each of the one year of the award period and a summary budget for all one year. All sources of cost-sharing shall be thoroughly described and documented.
- The budget will be evaluated based upon the clarity and reasonableness of the funding request. A budget narrative shall be included that discusses relevant budgetary issues such as the extent and level of jurisdiction, industrial, and institutional commitment and financial support, including resources (e.g., staff, facilities, laboratories, indirect support, waiver of indirect costs).
- Proposers including the use of NASA-unique facilities must include a letter of support from the hosting center. EPSCoR funds may not be used to support civil servant or NASA contractor participation in the research. Funding for the use of NASA-unique facilities must be explicitly included in the Budget section with the basis of estimate and justification.
- Investigators are encouraged to prioritize requests for funding of research equipment and instrumentation requests early in the award to maximize its availability for research in the following years.

Section 15.5.2 Review and Selection Process

Review of proposals submitted in response to this NOFO shall be consistent with the general policies and provisions contained in the *NASA GCAM*. However, the evaluation criteria described in this NOFO in Section 15.1, Proposal Evaluation, takes precedence over the evaluation criteria described in the GCAM.

Evaluation by peer review will be used to assess each proposal's overall merit. The evaluation criteria are Intrinsic Merit, NASA Alignment and Partnerships, Management and Evaluation, and Budget Justification: Narrative and Details. See Section 15.1 of this NOFO, Proposal Evaluation Criteria. A NASA Headquarters Mission Directorate panel will use the results of the peer evaluation to make funding recommendations to the Selecting Official. The Selecting Official for Successful research proposals are likely to be those that provide sound contributions to both immediate and long-term scientific and technical needs of NASA as explicitly expressed in current NASA documents and communications. Also, successful proposals are likely to contribute to the overall research infrastructure and economic development of the proposed jurisdiction.

15.5.3 Risk Analysis

NASA Grant Officers will conduct a pre-award review of risk associated with the proposer as required by 2 CFR §200.206, Federal awarding agency review of risk posed by applicants. For all proposals selected for award, the Grant Officer will review the submitting organization's information available through multiple government-wide repositories such as the System for Award Management (SAM.gov), the Contractor Performance and Assessment Reporting System (CPARS), the Federal Audit Clearinghouse (FAC), USAspending.gov, and GrantSolutions Recipient Insight.

Risk Review

For any federal award, if NASA anticipates that the total federal share of funds provided to the recipient will be greater than the simplified acquisition threshold (SAT) (currently $250,000) during the award's PoP:

- Prior to making a federal award with a total amount of Federal share greater than the SAT, NASA is required to review and consider any information about the applicant that is in the designated integrity and performance system accessible through SAM.gov (see 41 U.S.C. §2313);

- An applicant, at its option, may review information in the designated integrity and performance systems accessible through SAM and comment on any information about itself that a Federal awarding agency previously entered and is currently in the designated integrity and performance system accessible through SAM.gov;

- NASA will consider any comments by the applicant, in addition to the other information in the designated integrity and performance system, in making a judgment about the applicant's integrity, business ethics, and record of performance under Federal awards when completing the review of risk posed by applicants as set forth in 2 CFR §200.206.

15.5.4 Anticipated Announcement and Federal Award Dates

Open Solicitation Period:	November 12, 2024, to February 26, 2025
Solicitation Period Closes:	February 26, 2025, 11:59 PM ET
Anticipated Award Announcement date:	September 2025
Federal Award Date:	Prior to September 30, 2025

15.6 Federal Award Administration Information

NASA's stated goal is to announce selections as soon as possible. However, NASA does not usually announce new selections until the funds needed for those awards are approved through the federal budget process. Therefore, a delay in NASA's budget process may result in a delay of the selection date(s). Additional delays may be caused by:

- The need for additional materials from the proposer (e.g., revised budgets and/or budget details) before NASA may legally obligate Federal funds; and
- A delay in NASA receiving its appropriation from Congress for the current fiscal year.

After 180 days past the proposal's submitted date, proposers may contact the NASA EPSCoR Project Manager for a status.

NASA will notify successful grant recipients of funding via a Notice of Award (NASA Form 1687) signed by the Grant Officer. This Notice of Award is the authorizing document and will be sent to the business office of the proposer's institution via email and NSPIRES]. All expenses incurred related to grant activities prior to the PoP start date listed on the Notice of Award are the sole responsibility of the proposer/recipient until the Notice of Award is received and the PoP commences.

NASA's goal is to issue Notices of Award as soon as possible after selections are announced (anticipated in the September 2025 timeframe) to the proposers. However, delays may be caused by:

- The need for additional materials from the proposer (e.g., revised budgets and/or budget details) before NASA may legally obligate federal funds; and/or
- A delay in NASA receiving its appropriation from Congress for the current fiscal year.

A proposer has the right to be informed of the major factor(s) that led to the acceptance or rejection of its proposal. Debriefings will be available upon written request. Again, it is emphasized to proposers that proposals of nominally high intrinsic and programmatic merits may be declined for reasons entirely unrelated to any scientific or technical weaknesses.

15.6.1 Administrative and National Policy Requirements

In addition to the requirements in this section and in this NOFO, NASA may incorporate specific terms and conditions into individual awards in accordance with 2 CFR 200. Specifically, recipients of NASA grant funding shall adhere to requirements set forth in 2 CFR 200, 2 CFR 1800, 2 CFR 170, 2 CFR 175, 2 CFR 182, and 2 CFR 183, and the NASA GCAM. These are available at: https://www.nasa.gov/offices/ocfo/gpc/regulations_and_guidance.

Research Terms and Conditions

Awards from this funding announcement that are issued under 2 CFR 1800 are subject to the Federal Research Terms and Conditions (RTC) located at http://www.nsf.gov/awards/managing/rtc.jsp. In addition to the RTC and NASA-specific guidance, three companion resources can also be found on the website: Appendix A—Prior Approval Matrix, Appendix B—Subaward Requirements Matrix, and Appendix C—National Policy Requirements Matrix.

Environmental Statement

Awards of proposals related to this NOFO must comply with the National Environmental Policy Act (NEPA); thus, proposers are encouraged to plan and budget for any anticipated environmental impacts. While most research awards will not trigger action specific NEPA review, some activities (including international actions) will.

The majority of grant-related activities are categorically excluded as research and development (R&D) projects that do not pose any adverse environmental impact. A blanket NASA Grants Record of Environmental Consideration (REC) provides NEPA coverage for these anticipated activities. The NSPIRES award application cover page includes questions to determine whether a specific proposal falls within the Grants REC and must be completed as part of the proposal submission process. Activities outside of the bounding conditions of the Grants REC will require additional NEPA analysis. Examples of actions that will likely require NEPA analysis include but are not limited to: suborbital-class flights not conducted by a NASA Program Office, activities involving ground-breaking construction/fieldwork, and certain payload activities such as the use of dropsondes.

Questions concerning environmental compliance may be addressed to the NASA NEPA Manager via the NASA program official listed in this NOFO.

15.6.2
Federal Financial Reporting
Recipients of NASA funding must submit quarterly financial reports. Financial reports must be submitted via the Payment Management System (PMS):

• Semi-Annual Federal Financial Reports (FFR) are due within 30 days following the end of each reporting period (October 1 – March 31 and April 1 – September 30).
• Final Financial Status Reports/Final Federal Financial Report (FSR/FFR) are due no later than 120 days after the end of the period of performance

15.6.3 Performance Reporting
Recipients of NASA awards are required to submit both annual and final performance reports. These annual reports should be submitted to NASA no later than 60 days before the award's anniversary date, unless the award is in its final year or if the award's performance period is less than a year. In such cases, only final performance reports need to be submitted for awards in their final year or with a performance period of less than a year. Descriptions of reporting requirements are below:

Annual Performance Report – Used to describe a grant's scientific progress, identify significant changes, report on personnel, and describe plans for the subsequent reporting period.

Due: 60 days prior to the anniversary date of the award (PoP- start date)

Final Performance Report – Used as part of the grant closeout process to submit project outcomes in addition to the information submitted on the annual Performance Report.

Due: within 120 days after the end of the award's PoP (PoP end date)

For all NASA awards, recipients must utilize the Research Performance Progress Report (RPPR) format. The RPPR is not a template or form but rather a set of standard data elements against which award recipients will report. The RPPR is not available as a template or form from NASA. All performance reports must contain the mandatory data elements and reporting category required for RPPRs.

All reports shall include the following data elements on the report's cover page:

- Federal agency (i.e., NASA) and program office to which the report is submitted.
- Award number.

- Project title
- Principal Investigator (PI) name, title, and contact information (e-mail address and phone number).
- Name of submitting official, title, and contact information (e-mail address and phone number), if other than PI.
- Submission date.
- Unique Entity Identifier (UEI) number and Employer Identification Number (EIN) number.
- Recipient organization name and address.
- Recipient identifying number or account number, if any.
- PoP start and end date.
- Reporting period end date.
- Report term or frequency (annual, semi-annual, quarterly, other).
- Final Report? Indicate "Yes" or "No"
- Signature of submitting official (either handwritten or electronic)

In addition to the data elements above, all NASA performance reports shall report on one mandatory reporting category, "accomplishments."

Accomplishments data elements are:

1. What were the major goals and objectives of this project?
2. What was accomplished under these goals?
3. What opportunities for training and professional development has the project provided?
4. How were the results disseminated to communities of interest?
5. What do you plan to do during the next reporting period to accomplish the goals and objectives?

Recipients shall submit a report to the NASA Grant Officer at the NSSC at NSSC-Grant-Report@mail.nasa.gov with copies to the EPSCoR Technical Officer (TO) at agency-epscor@mail.nasa.gov, and to the supported organization on the results pertaining to this award no later than 120 days after the project's end date. The EPSCoR Project Office Program Coordinator shall notify the Jurisdiction PI in advance and in writing when a report is coming due and provide specific formats and data entry forms. The Program Manager shall also provide a Research Project Progress/Performance Reporting Outline, which is a template of the required data. This will be followed by notification from the NSSC that the report is due. The reporting requirements for awards made through this NOFO will be consistent with the reporting requirements outlined in the GCAM.

The NASA Technical Monitor shall evaluate accomplishments toward project goals by reference to indicators such as, but not limited to, the metrics outlined above. NASA may approve no-cost extensions in writing when requested by the recipient and in accordance with the GCAM.

The EPSCoR TO shall review the final report for completeness. A recipient's failure to provide a final report with Invention Disclosures shall delay or preclude the participation of the respective jurisdiction in other funding opportunities related to NASA EPSCoR.

For further details on reporting project performance, please refer to the Post-Award Phase section of the GCAM.

15.6.4 Access to Research

Awards issued under this NOFO must comply with the provision set forth in the NASA Plan for Increasing Access to the Results of Scientific Research (http://www.nasa.gov/sites/default/files/files/NASA_Data_Plan.pdf) including the responsibility for:

- Submitting as-accepted peer-reviewed manuscripts and metadata to a designated repository; and
- Reporting publications with the annual and final performance reports.

15.6.5 Recipient Integrity and Performance Matters

Awards under this solicitation that are $500,000 or more may be subject to post-award reporting requirements reflected in 2 CFR 200 Appendix XII.

15.6.6 FFATA Reporting Requirements

Per 2 CFR 170, Reporting Subaward and Executive Compensation Information, award recipients that issue first-tier subawards above $30,000 shall report those subawards in the Federal Award Accountability and Transparency Act (FFATA) Subaward Reporting System (FSRS). The regulation at 2 CFR 170 provides detailed information regarding what information needs to be reported in these systems and the deadlines for submitting this information. Recipient information that is reported to FSRS is ultimately transferred to USAspending.gov, where such information is publicly available.

15.6.7 Suspension and Debarment Disclosure

This reporting requirement pertains to disclosing information related to government-wide suspension and debarment requirements. Before a recipient enters into a grant award with NASA, the recipient must notify NASA if it knows if it or any of the recipient's principals under the award fall under one or more of the four criteria listed at 2 CFR Part 180.335, What are the causes for debarment?, as follows:

- Are presently excluded or disqualified;
- Have been convicted within the preceding three years of any of the offenses listed in 2 CFR 180.800(a) or had a civil judgment rendered against it or any of the recipient's principals for one of those offenses within that time period;
- Are presently indicted for or otherwise criminally or civilly charged by a governmental entity (federal, state or local) with commission of any of the offenses listed in 2 CFR 180.800(a); or
- Have had one or more public transactions (federal, state, or local) terminated within the preceding three years for cause or default.

At any time after accepting the award, if the recipient learns that it or any of its principalsfalls under one or more of the criteria listed at 2 CFR 180.335, the recipient must provide immediate written notice to NASA in accordance with 2 CFR 180.350.

15.6.8 Additional Reporting Requirements

NASA recipients must conform to all reporting requirements outlined in the Required Publications and Reports section of the GCAM.

15.6.9 Summary of Key Information

Total Estimated annual budget for Rapid Response Research (R3) awards	$4M
Anticipated number of new awards, pending adequate proposals of merit	25-30
Estimated PoP Start Date	August 12, 2025
Duration of awards	one year
Award Type	Cooperative Agreement
Release Date for Rapid Response Research (R3) NOFO	November 12, 2024 Check NSPIRES for details
Pre-proposal Webinar (optional)	December 06, 2024 2:00 PM Eastern Time (Date Subject to Change); Check NSPIRES for details
DUE DATE FOR PROPOSALS	February 26, 2025 11:59 PM Eastern Time Check NSPIRES for details
Page limit for the Narrative Section of proposal	5 pp. See NASA GCAM
Detailed instructions for the preparation and submission of proposals	See NASA GCAM
Submission medium	Electronic proposal submission is required via NSPIRES ONLY. See NASA GCAM
Selection Official	Program Manager: Kathleen B. Loftin, Ph.D. EPSCoR Project Manager NASA Headquarters Washington, DC 20546
NASA Point of Contact for this NOFO	Althia Harris NASA Research and Education Support Services (NRESS) 2345 Crystal Drive, Suite 500 Arlington, VA 22202-4816 Email: aharris@nasaprs.com

15.A FY2025 Research Focus Areas (RFAs)

15.A.1 Electrified Vertical Takeoff and Landing (eVTOL), Electric Powertrain Technologies

Mission Directorate: Aeronautic Research Mission Directorate (ARMD)
NASA Glenn Research Center

Research Overview: With their unique ability to take off and land from any spot, as well as hover in place, vertical lift vehicles are increasingly being contemplated for use in new ways that go far beyond those considered when thinking of traditional helicopters. NASA's Revolutionary Vertical Lift Technology (RVLT) project is working with partners in government, industry, and academia to develop critical technologies that enable revolutionary new air travel options, especially those associated with Advanced Air Mobility (AAM) such as large cargo-carrying vehicles and passenger-carrying air taxis. These new markets are forecast to rapidly grow during the next ten years, and the vertical lift industry's ability to safely develop and certify innovative new technologies, lower operating costs, and meet acceptable community noise standards will be critical in opening these new markets.
NASA is conducting research and investigations in Advanced Air Mobility (AAM) aircraft and operations. AAM missions are characterized by ranges below 300 nm, including rural and urban operations, passenger carrying as well as cargo delivery. Such vehicles will require innovative propulsion systems, likely electric or hybrid-electric, that will need reliable, safe, efficient, and high-power density electro-mechanical powertrain technology.

The target application is eVTOL vehicles sized to carrying four to six passengers with missions as described in References 1-6. Challenges related to insulation of motor windings and the phenomena of partial discharge are discussed in the literature (examples: references 7,8). Challenges related to lubrication of electrified vehicle are also discussed in the literature (examples: references 9,10).

This research opportunity is relevant to aerospace propulsion and is of mutual interest to NASA, FAA, DoD, and the US vertical lift vehicle industry.

Research Focus Area: Research contributing to partial-discharge free motors for aviation propulsion having a continuous power rating in the range 50 – 400 kW.

Focus Area: Of special interest are: (a) techniques for measuring partial discharge and/or other markers of insulation degradation during experiments using twisted-pair wires, motorretes, stators, and/or electric machines; (b) thermo-mechanical aging of stators and/or test units representing material systems for stators; (c) research toward improved understanding of multifactor aging of stators.

Research Identifier: **RFA-001**
POC: Dr. Timothy Krantz, timothy.l.krantz@nasa.gov
Dr. Michael Hurrell, michael.j.hurrell@nasa.gov

Research Focus Area: Lubrication and cooling technologies specifically optimized for long life and highly efficient eVTOL motors, including interest in single-fluid approaches for combined cooling and lubrication of inverters, motors, and gearboxes.
Focus Area: Research to reduce the power losses associated with the lubrication while also meeting requirements for low wear and appropriate cooling.

Research Identifier: **RFA-002**
POC: Dr. Timothy Krantz, timothy.l.krantz@nasa.gov
Dr. Michael Hurrell, michael.j.hurrell@nasa.gov

References:

1) Silva, C.; Johnson, W.; and Solis, E. "Multidisciplinary Conceptual Design for Reduced-Emission Rotorcraft." American Helicopter Society Technical Conference on Aeromechanics Design for Transformative Vertical Flight, San Francisco, CA, January 2018.
2) Johnson, W.; Silva, C.; and Solis, E. "Concept Vehicles for VTOL Air Taxi Operations." American Helicopter Society Technical Conference on Aeromechanics Design for Transformative Vertical Flight, San Francisco, CA, January 2018.
3) Patterson, M.D.; Antcliff, K.R.; and Kohlman, L.W. "A Proposed Approach to Studying Urban Air Mobility Missions Including an Initial Exploration of Mission Requirements." American Helicopter Society 74th Annual Forum, Phoenix, AZ, May 2018.
4) Silva, C.; Johnson, W.; Antcliff, K.R.; and Patterson, M.D. "VTOL Urban Air Mobility Concept Vehicles for Technology Development." AIAA Paper No. 2018-3847, June 2018.
5) Antcliff, K. Whiteside, S., Silva, C. and Kohlman, L. "Baseline Assumptions and Future Research Areas for Urban Air Mobility Vehicles," AIAA Paper No. 2019-0528, January 2019.
6) Silva, C., and Johnson, W. "Practical Conceptual Design of Quieter Urban VTOL Aircraft." Vertical Flight Society 77th Annual Forum, May 2021.
7) Tallerico, T., Salem, J., Krantz, T. and Valco, M., "Urban Air Mobility Electric Motor Winding Insulation Reliability: Challenges in the Design and Qualification of High Reliability Electric Motors and NASA's Research Plan." NASA TM-20220004926, 2022.
8) Petri, T., Keller, M. and Parspour, N. "The Insulation Resilience of inverter-fed Low Voltage Traction Machines: Review, Challenges, Opportunities." IEEE Access (2022).
9) Chen, Yan, Swarn Jha, Ajinkya Raut, Wenyang Zhang, and Hong Liang. "Performance characteristics of lubricants in electric and hybrid vehicles: a review of current and future needs." Frontiers in Mechanical Engineering 6 (2020): 571464.
10) Bustami, Bayazid, Md Mahfuzur Rahman, Mst Jeba Shazida, Mohaiminul Islam, Mahmudul Hasan Rohan, Shakhawat Hossain, Alam SM Nur, and Hammad Younes. "Recent Progress in Electrically Conductive and Thermally Conductive Lubricants: A Critical Review." Lubricants 11, no. 8 (2023): 331.

Research Focus Area: Development of Characterization Techniques to Determine Rate and Temperature Dependent Composite Material Properties for the LS-DYNA MAT213 Model

Research Identifier**:** **RFA-003**

Mission Directorate: Aeronautic Research Mission Directorate (ARMD)

POC: Robert Goldberg robert.goldberg@nasa.gov
Justin Littell justin.d.littell@nasa.gov
Mike Pereira mike.pereira@nasa.gov

Research Overview: Overview of MAT213 - MAT213 is an orthotropic macroscopic three-dimensional material model designed to simulate the impact response of composites which has been implemented in the commercial transient dynamic finite element code LS-DYNA [1-5]. The material model is a combined plasticity, damage and failure model suitable for use with both solid and shell elements. The deformation/plasticity portion of the model utilizes an orthotropic yield function and flow rule. A key feature of the material model is that the evolution of the deformation response is computed based on input tabulated stress-strain curves in the various coordinate directions.

The damage model employs a semi-coupled formulation in which applied plastic strains in one coordinate direction are assumed to lead to stiffness reductions in multiple coordinate directions. The evolution of the damage is also based on tabulated input from a series of load-unload tests. A tabulated failure model has also been implemented in which a failure surface is represented by tabulated single valued functions. While not explicitly part of MAT213, when using the model, interlaminar failure is modeled using either tie-break contacts or cohesive elements.

The MAT213 model has the ability to incorporate both rate dependency and temperature dependency in the material response, which, potentially, could be important aspects of the dynamic and impact response of composites. To date, very little has been done to assess the effectiveness of the rate- and temperature-dependence modeling approaches, or to assess the importance of incorporating these effects in dynamic crush and impact problems. In dynamic crush problems, such as drop weight tests on composite structures, differences in response at different loading rates have been observed [6,7]. In ballistic impact tests of composite panels significant temperature rises have been documented [8]. But a fundamental understanding of the effect of strain rate and temperature is needed.

For this task we are focused on developing techniques and recommended approaches to characterize the rate dependent material parameters required for input into MAT 213 using tests at the coupon scale or similar fundamental types of tests at higher structural scales. In addition, we would like to characterize the effects of temperature changes under dynamic loading to assess the need for incorporating temperature dependence in dynamic models. To carry out this task, we are interested in having NASA-supplied composite materials and structures tested at high loading rates and/or potentially varying temperatures representative of what would exist in crash and impact events. It is expected that the tests will be conducted at the proposer's facility. NASA will attempt to provide a material for which quasi-static room temperature data are available.

A particular additional area of interest is in characterizing the post-peak material response, which can be important in simulating the response of actual structures. Currently, in many cases post peak material parameters are correlated based on the results of structural level tests. A need exists to develop capabilities and methods to characterize material parameters based on lower scale tests that are applicable for the analysis of full structures.

Research Requirements

Coupon Level Testing. Specific tests at a range of strain rates and/or temperatures that are of interest could include the following:

- Tension in the 1-direction
- Compression in the 1-direction
- Tension in the 2-direction
- Compression in the 2-direction
- Shear in the 12-direction
- Shear in the 21-direction
- 45 degrees off axis tension

Note that other tests may be conceived and conducted to develop methods to fully characterize the material of interest and to meet the goals of the project. Within the constraints of time and budget it may be necessary to prioritize tests where rate effects are expected to be more important.

Test Requirements

i. Test coupons will be machined by the grant recipient from flat panels supplied by NASA.
ii. For all tests the full set of test data must be recorded and supplied in electronic tabular format. For the tension, compression and shear tests that are conducted, the tabulated stress-strain curve, all the way to failure, must be provided. Raw data such as loads must also be supplied.
iii. All specimens must be measured and weighed prior to testing
iv. Testing is to be conducted at appropriate and relevant rate and temperature conditions.
v. The test environmental conditions must be recorded and documented
vi. A minimum of three repeats for each loading condition must be conducted
vii. Full Field Digital Image Correlation (DIC) must be used to measure deformations and strains

Deliverables

a. Full tabulated data supplied in electronic tabular format
b. All DIC images and associated calibration files
c. A final report detailing the procedures and results.

References:

1. Khaled, B., Shyamsunder, L., Schmidt, N. Hoffarth, C. and Rajan, S., "Development of a Tabulated Material Model for Composite Material Failure, MAT213. Part 2: Experimental Tests to Characterize the Behavior and Properties of T800-F3900 Toray Composite", DOT/FAA/TC-19/51, Nov. 2018
2. T. Achstetter, "Development of a composite material shell-element model for impact applications", *PhD Dissertation,* George Mason University, 2019
3. Goldberg, R.K.; Carney, K.S.; DuBois, P.; Hoffarth, C.; Harrington, J; Rajan, S.; and Blankenhorn, G.: "Development of an Orthotropic Elasto-Plastic Generalized Composite Material Model Suitable for Impact Problems", *Journal of Aerospace Engineering*, Vol. 29, no. 4, 04015083, 2016.
4. Goldberg, R.K.; Carney, K.S.; DuBois, P.; Hoffarth, C.; Khaled, B.; Rajan, S.; and Blankenhorn, G.: "Analysis and Characterization of Damage Utilizing a Generalized Composite Material Model Suitable for Impact Problems", *Journal of Aerospace Engineering*, Volume 31, Issue 4, 10.1061/(ASCE)AS.1943-5525.0000854, 04018025, 2018.
5. Goldberg, R.K.; Carney, K.S.; DuBois, P.; Hoffarth, C.; Khaled, B.; Shyamsunder, L.; Rajan, S.; and Blankenhorn, G.: "Implementation of a tabulated failure model into a generalized composite material model", *Journal of Composite Materials*, Vol. 52, Issue 25, pp. 3445-3460.
6. Chambe, J.-E., Bouvet, C., Dorival, O., Rivallant, S. and Ferrero, J.-F. "Effects of dynamics and trigger on energy absorption of composite tubes during axial crushing", Int. J. Crashworthiness, 26(5), 2021.

7. Haluza, R., "Measurement and explicit finite element modeling of dynamic crush behavior of carbon fiber reinforced polymer composites", Ph.D. Dissertation, Pennsylvania State University, 2022
8. Johnston, J. P., Pereira, J. M., Ruggeri, C. R., & Roberts, G. D. (2018). High-speed infrared thermal imaging during ballistic impact of triaxially braided composites. *Journal of Composite Materials*, *52*(25), 3549-3562.

Intellectual Property Rights: All data and analysis methods will be publicly available and no intellectual property rights will be assigned to any of the parties involved in this research. See Section 3 of the Terms and Conditions.

Research Focus Area: Multiscale Modeling of Heterogeneous Materials with NASMAT
Research Identifier: **RFA-004**
Mission Directorate: Aeronautic Research Mission Directorate (ARMD)
POC: Trenton M. Ricks, PhD trenton.m.ricks@nasa.gov
Dr. Steven M. Arnold steven.m.arnold@nasa.gov

Research Overview: The NASA Multiscale Analysis Tool (NASMAT) is a versatile platform for performing computationally efficient multiscale analyses of heterogeneous materials. NASMAT offers the user flexibility to define an arbitrary number of length scales (levels) where a variety of micromechanics theories can be implemented at each level [1]. Micromechanics theories can be selected to balance accuracy and computational efficiency and range from analytical (Mori-Tanaka) to several semi-analytical (method of cells) formulations. NASMAT can also be coupled with external software and used to perform multiscale analyses of more complex structures. For example, if NASMAT is coupled with a finite element software, NASMAT effectively acts as an anisotropic, evolving, nonlinear material model which is called at individual integration points within the elements.

Submitters are encouraged to review recent publications from the development team prior to submitting a proposal [1-4]. The selected publications are intended to provide a broad background of current NASMAT activities and should not be interpreted as providing direction on proposed topics. Backends to incorporate user-defined features within NASMAT will be provided by the development team if required. Alternatively, developed models may be incorporated into the open-source MatLab code (https://github.com/nasa/Practical-Micromechanics) accompanying Ref. [5]. Proposed topics should be aligned with one or more Key Elements outlined in the Vision 2040 study [6].

Research Requirements

Submitters are encouraged (but not required) to develop tools, methods, models (e.g., deformation or damage) and software that could be incorporated into NASMAT by the development team in the future. Topics of interest include, damage/failure modeling, multiscale model hand-shaking, evolving microstructures, multi-physics modeling, approaches to enable massively multiscale modeling, and experimental techniques to generate sub-coupon scale validation data. Proposals associated with primarily determining effective elastic properties will not be favorably viewed. Possible material systems include ceramic and polymer matrix composites and metallic systems with applications including unidirectional, woven, nano-reinforced, or short-fiber composites, additive manufacturing, and shape-memory alloys. Proposals demonstrating the need of multiscale modeling for structural problems (e.g., thermos-mechanical loading) are encouraged.

Alternatively, submitters are encouraged to consider submitting proposals involving novel experimental methods that can be utilized to validate existing capabilities within NASMAT. Experimental approaches that can be used to validate mesoscale or microscale modeling are desirable as well as those that aim to validate constituent constitute models under multi-axial and non-proportional loading.

A. Deliverables

1. A final report detailing the models, procedures, and results
2. Model results (if applicable) to be provided in a suitable electronic format
3. Source code for any developed modeling approaches
4. Raw and processed experimental digital data (if applicable)
5. Detailed documentation of new experimental equipment (if applicable)

References:

1. Pineda, E. J., Bednarcyk, B. A., Ricks, T. M., Arnold, S.M., Henson, G. (2021). Efficient multiscale recursive micromechanics of composites for engineering applications. *International Journal for Multiscale Computational Engineering*, 19(4), 77-105.
2. Ricks, T. M., Pineda, E. J., Bednarcyk, B. A., McCorkle, L. S., Miller, S. G., Murthy, P. L., & Segal, K. N. (2022). Multiscale Progressive Failure Analysis of 3D Woven Composites. *Polymers*, *14*(20), 4340.
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4. Gustafson, P. A., Pineda, E. J., Ricks, T. M., Bednarcyk, B. A., Hearley, B. L., & Stuckner, J. (2023). Convolutional Neural Network for Enhancement of Localization in Granular Representative Unit Cells. *AIAA Journal*, 1-13.
5. J. Aboudi, S.M. Arnold, B.A. Bednarcyk (2021). *Practical Micromechanics of Composite Materials Course Textbook,* Elsevier
6. X. Liu, Furrer, D., Kosters, J., & Holmes, J. (2018). Vision 2040: a roadmap for integrated, multiscale modeling and simulation of materials and systems. NASA/CR-2018-219771.

Intellectual Property Rights: All data and analysis methods will be publicly available and no intellectual property rights will be assigned to any of the parties involved in this research. See Section 3 of the Terms and Conditions.

15.A.2 Clean Energy, Climate Change and Orbital Debris
Space Technology Mission Directorate (STMD)

STMD rapidly develops, demonstrates, and infuses revolutionary, high-payoff technologies through transparent, collaborative partnerships, expanding the boundaries of the aerospace enterprise. STMD employs a merit-based competition model with a portfolio approach, spanning a range of discipline areas and technology readiness levels. By investing in bold, broadly applicable, disruptive technology that industry cannot tackle today, STMD seeks to mature the technology required for NASA's future missions in science and exploration while proving the capabilities and lowering the cost for other government agencies and commercial space activities.

Research Focus Area: Earth-observing capabilities to support breakthrough science and National efforts to reduce greenhouse gas emissions (including CO2, CH4, N2O, HFCs).
Research Identifier: **RFA-005**

POC: Sweterlitsch, Jeffrey, Ph.D. jeffrey.j.sweterlitsch@nasa.gov

Research Focus Area: U.S. Climate Change Research Program focusing on carbon capture and Utilization.
Research Identifier: **RFA-006**

POC: Sweterlitsch, Jeffrey, Ph.D. jeffrey.j.sweterlitsch@nasa.gov

Research Focus Area: Addressing Orbital Debris: Control the long-term growth of debris population.
Research Identifier: **RFA-007**
POC: Bo Naasz, Ph.D. Bo.j.naasz@nasa.gov

15.A.3 Space Technology / Aeronautic Research
Space Technology Mission Directorate (STMD)
Aeronautics Research Mission Directorate (ARMD)

NASA Glenn Research Center

Research Focus Area: Development of advanced soft magnetic materials for high-power electronic systems
Research Identifier: **RFA-008**
POC: Dr. Ronald Noebe ronald.d.noebe@nasa.gov

Description: NASA is interested in the development of advanced soft magnetic materials for use in high-efficiency, high-power electrical systems for power conversion, conditioning, and filtering. Such materials will be enabling in future electrical propulsion systems for electrified aircraft and nuclear electric power and propulsion systems. Topic areas of interest include:

- Development and investigation of new materials and processing methods for soft magnetic materials with improved performance at frequencies covering the kHz to MHz range, capable of operating at 200 - 400 °C without cooling. A primary goal for inductors and transformers would be a material capable of operating with switching frequencies in the range of 10 – 100 kHz with an induction field at least 0.8 T, with low losses and can store at least 20 $kW \cdot kg^{-1}$.
- There is significant interest in the development of techniques to measure and characterize magnetostriction in foils and films, especially as a function of temperature and in the fundamental study of magnetostriction in amorphous-nanocrystalline alloys.
- Development of soft magnetic materials optimized to work at cryogenic (77 K and below) temperatures to be used in conjunction with superconducting systems for power filtering/conditioning. Also of interest is the development of characterization techniques for measuring magnetic properties (B-H loops, permeability, loss, magnetostriction) at low temperature.

Research Focus Area: Development of high-temperature structural refractory alloys and silicides and environmental coatings for refractory alloys.
Research Identifier: **RFA-009**
POC: Dr. Ronald Noebe ronald.d.noebe@nasa.gov

Description: NASA is interested in the development of alloys for use at temperatures between 1200 and 2000 °C for structural components in high-speed aircraft, space nuclear power and propulsion applications, surface fission power, high-temperature heat pipes and thermal radiators, and other applications involving extreme temperatures and environments. Topic areas of interest include:

- Development of next generation W-, Mo-, Ta-, or Nb-based alloys
- Fundamental understanding of the effect of interstitial elements on the properties of refractory metal alloys
- Development of refractory metal medium and high entropy alloys, with high strength, ductility, and moderate environmental resistance.
- Development of multi-principal element silicides for structural applications
- Understanding of processing-microstructure-property relationships in refractory alloys and silicides and the effect of alloying on intrinsic deformation and fracture mechanisms.
- Development of powder processing techniques for refractory metal alloys and silicides with an eye towards AM applications

- Development of protective coatings for refractory alloys or development of refractory alloys with inherent environmental resistance
- High-temperature mechanical properties and development of high-temperature test techniques for refractory materials

15.A.4 In Space Manufacturing /On Demand Manufacturing of Electronics (ODME)
Space Operations Mission Directorate (SOMD)
Exploration Systems Development Mission Directorate (ESDMD)
Space Technology Mission Directorate (STMD)

NASA's In Space Manufacturing program is developing new technologies that can support NASA mission architecture and to enable commercialization of the LEO microgravity environment. One such manufacturing technology of primary interest is on-demand printed microelectronics, sensors and semiconductors. NASA ODME project is developing next-generation technologies for deposition of materials to very high feature resolutions and very thin depositions, into the nanometer range. These new systems require new development of materials and processing techniques. ODME works with NASA Flight Opportunities to provide parabolic and suborbital fight testing validation of these processes and materials. Device structures can be, but are not limited to spacecraft health monitoring sensors, environmental monitoring sensors, human health monitoring sensors, energy harvesting devices, energy storage devices and supporting hardware. New semiconductor devices are being enabled with space manufacturing technologies, to eventually enable neuromorphic computing for advanced AI applications and many other exciting next-generation developments.

Research Focus Area: Advanced Manufacturing of Sensors and Electronics
Research Identifier**: RFA-010**

POC: Jessica Koehne, Ph.D. Jessica.E.Koehne@nasa.gov

Research Focus Area: Additive manufacturing and additive manufacturing of electronics
Research Identifier**: RFA-011**

POC: Curtis Hill curtis.w.hill@nasa.gov

Research Focus Area: LEO manufacturing support (additive, advanced materials, thin layer processing)
Research Identifier**: RFA-012**

POC: Curtis Hill curtis.w.hill@nasa.gov

Research Focus Area: Lunar manufacturing of solar cells and sensors
Research Identifier**: RFA-013**

POC: Curtis Hill curtis.w.hill@nasa.gov

Research Focus Area: Materials development for additive manufacturing
Research Identifier**: RFA-014**

POC: Curtis Hill curtis.w.hill@nasa.gov

Research Focus Area: Technology maturation through commercial (sub)orbital flight testing
Research Identifier**: RFA-015**

POC: Curtis Hill
Note: The awardees may have opportunity to seek Flight Opportunity support for flight testing.

A.5 Center for Design and Space Architecture

Mission Directorate: Exploration Systems Development Mission Directorate (ESDMD)
Space Technology Mission Directorate (STMD)

NASA Johnson Space Center
Robert L. Howard, Jr., Ph.D. robert.l.howard@nasa.gov

Research Focus Area: Crew-worn restraints and mobility aids for microgravity spacecraft cabin environments

Research Identifier**: RFA-016**

POC: Robert L. Howard, Jr., Ph.D. robert.l.howard@nasa.gov

Explanation: Traditionally, microgravity spacecraft cabins have included restraints and mobility aids such as handrails and foot restraints to enable crew to navigate the interior of the vehicle in the weightless conditions of orbital spaceflight. This focus area is concerned with alternatives to vehicle-based restraints and mobility aids. Instead, this research area investigates passive (non-powered) restraints and mobility aids that are worn on the crew members' clothing or carried on their person, such that the spacecraft does not need to provide any hardware to enable crew restraint and mobility.

Research Focus Area: Crew quarters internal architectures compatible with both microgravity and fractional gravity domains

Research Identifier**: RFA-017**

POC: Robert L. Howard, Jr., Ph.D. robert.l.howard@nasa.gov

Explanation: NASA and commercial industry are developing plans for human missions to destinations including the Moon, Mars, and deep space. Traditionally, each destination has been viewed in isolation, with spacecraft designed uniquely for that environment. Additionally, there are very few NASA standards that govern the design of crew quarters. This focus area investigates common designs for crew quarters that can be used across lunar habitats, Mars habitats, and deep space habitats, including the definition of functions and capabilities to be included in crew quarters, as well as the design and layout of components needed to implement these functions and capabilities.

Research Focus Area: Repair, Manufacturing, And Fabrication (RMAF) Facility for the Common Habitat Architecture

Research Identifier**: RFA-018**

POC: Robert L. Howard, Jr., Ph.D. robert.l.howard@nasa.gov

Research Overview: Missions beyond LEO are challenging for traditional survivability paradigms such as redundancy management, reliability, sparing, orbital replacement, and mission aborts. Distances, transit durations, crew time limitations, onboard expertise, vehicle capabilities, and other factors significantly limit the ability of human spaceflight crews to respond to in-flight anomalies. There is a need for a Repair, Manufacturing, and Fabrication (RMAF) facility to increase the capability of the crew to recover from spacecraft component failures by combing aspects of machine shop, soft goods lab, and repair shop into an IVA capability for both microgravity and surface spacecraft. An RMAF is responsible for restoring damaged components to working order (repair), keeping components in service or properly functioning (maintenance), and creating new components from raw or scavenged materials (fabrication). This responsibility extends not only to the habitat, but to all other elements sharing the same destination environment (e.g., landers, rovers, robots, power systems, science instruments, etc.). The RMAF serves both the physical operability needs of the architectural systems and contributes in two ways to the psychological well-being of the crew: one the peace of mind from understanding the capacity to respond to failures, and two, the capacity to fabricate items that serve recreational or relaxation purposes. The RMAF has potential applicability to a wide variety of in-space habitation needs.

NASA is exploring space architectures that can serve as next steps to build upon the current Artemis program. The Common Habitat Architecture Study is based on a suite of common spacecraft elements that can be used for long-duration human spaceflight in multiple destinations, including the Moon, Mars, and deep space. NASA is seeking engineering and architectural research to aid in the development of an RMAF facility capable of packaging within mid deck of the Common Habitat, a Skylab-like habitat that uses the Space Launch System (SLS) core stage liquid oxygen tank as the primary structure, with a horizontal orientation. Because most habitats intended for use beyond LEO do not return to Earth, yet may operate for decades, it can be assumed that even low probability failures will eventually occur and there must be a way to recover from them and continue the mission. Thus, the Common Habitat must include the RMAF capability. The RMAF speaks to an overarching gap of inability to mitigate spacecraft component failures. Limited in-space experiments have been conducted with 3D printing, welding, soldering, and other RMAF tools, but they have yet to be integrated into an operable spacecraft facility. The RMAF goes beyond the replacement of failed components with spares and focuses on the capabilities to restore failed components to working order, making them effectively the new spare.

1) Research Focus:

Proposed studies will assess the needs of an RMAF system for long-duration, deep space habitation and create one design solution to increase crew and vehicle survivability. Prior research has identified a list of 53 component-level critical failures that could render a subsystem or element inoperable. Fourteen repair, maintenance, and fabrication functions have been identified as collectively being able to recover a system from any of these failures. This establishes the target capability of the RMAF. Proposers will design a workspace within the volume limitations of the Common Habitat, while still accommodating these fourteen functions and will determine the associated mass impacts.

Critical Failures Requiring RMAF

1. Actuator FOD
2. Actuator overpressure
3. Actuator underpressure
4. Adhesive failure
5. Bad wireless connection
6. Belt break
7. Broken cables
8. Broken electrical connection
9. Broken physical structure
10. Bulb burnout
11. Bulb shatter
12. C&W software failure
13. Connector overtorque
14. Connector pin/connection failure
15. Connector under torque
16. Consumable depletion
17. Cracked housing
18. Cracked screen
19. Debris clog
20. Debris impact damage
21. Debris in motor
22. Diaphragm damage (digital)
23. Electrical lead failure
24. Electrical short
25. Fabric erosion
26. Fabric tear
27. Failed electrical connection
28. Fin breakage / bending/ding
29. Fluid line rupture
30. Fuse blown
31. Kinked line
32. Material abrasion / erosion
33. Material corrosion
34. Material delamination
35. Material stretching
36. Motor failure
37. Physical obstruction
38. Potting failure
39. Power surge
40. Pressure bladder puncture, tear, or rip
41. Spring too weak or too stiff
42. Structural bending
43. Structural buckling
44. Structural burst
45. Structural crack/fracture
46. Structural deformation
47. Structural gouge
48. Structural membrane disjoin
49. Structural rupture / puncture
50. Structural seal failure
51. Structural shear
52. Surface chemical contamination
53. Wire detach, split, tear, rip, or break

Generic RMAF Functions to Repair Critical Failures

1. Soldering
2. Drilling
3. Metal cutting and bending
4. Metallurgical analysis
5. Bonding metal, composite, and other surfaces
6. Electronics analysis and repair
7. Computer/Avionics inspection/testing and repair
8. CAD Modeling / Software Coding / Computer Analysis
9. Material Handling (inclusive of the range from large ORUs and small fasteners)
10. Precision Maintenance (manipulation, inspection, repair of small/delicate components)
11. 3D Printing (metal, plastic, and printed circuit board)
12. Soft goods (including thermoplastics, sewing, cutting, and patching)
13. Dust/Particle/Fume Mitigation
14. Welding

A design solution should include a mass equipment list (MEL), CAD model, and Concept of Operations document. CAD models must be in a format capable of being opened by Rhino 7 and must also be suitable for incorporation in Virtual Reality using the Unreal Engine 5. Physical prototyping and iterative human-in-the-loop (HITL) testing are encouraged but are not required.

2) **References:**

[1] Howard, Robert, "Opportunities and Challenges of a Common Habitat for Transit and Surface Operations," in 2019 IEEE Aerospace, Big Sky, MT, 2019.
[2] Howard, Robert, "Stowage Assessment of the Common Habitat Baseline Variants," in 2020 AIAA ASCEND, Virtual Conference, 2020.
[3] Howard, Robert, "Design Variants of a Common Habitat for Moon and Mars Exploration," 2020 AIAA ASCEND, AIAA, Virtual Conference, 2020.
[4] Howard, Robert, "A Multi-Gravity Docking and Utilities Transfer System for a Common Habitat Architecture," in 2021 AIAA ASCEND, Las Vegas, NV + Virtual, 2021.
[5] Howard, Robert, "A Two-Chamber Multi-Functional Airlock for a Common Habitat Architecture," in 2021 AIAA ASCEND, Las Vegas, NV + Virtual, 2021.
[6] Howard, Robert, "A Common Habitat Base camp for Moon and Mars Surface Operations," in 2021 AIAA ASCEND, Las Vegas, NV + Virtual, 2021.
[7] Howard, Robert, "A Common Habitat Deep Space Exploration Vehicle for Transit and Orbital Operations," in 2021 AIAA ASCEND, Las Vegas, NV + Virtual, 2021.
[8] Howard, Robert. "A Safe Haven Concept for the Common Habitat in Moon, Mars, and Transit Environments." 2021 AIAA ASCEND. Las Vegas, NV + Virtual. November 8-17, 2021.
[9] Howard, Robert, "Down-Selection of Four Common Habitat Variants," in 2022 IEEE Aerospace, Big Sky, MT, 2022.
[10] Howard, Robert, "Internal Architecture of the Common Habitat," in 2022 IEEE Aerospace Conference, Big Sky, Montana, 2022.

3) **Proposer-Coordinated Contributions to Proposed Work:**
Proposer to indicate any contributions to the proposed work that the Proposer has arranged, in the event of a NASA award, and that would be in addition to NASA EPSCoR awarded funding. This may include funding or other in-kind contributions such as materials or services (Proposal should indicate the estimated value of the latter)
    a. **From Jurisdiction or Organization that would partner with the Jurisdiction**
    Encouraged but None are required. Proposer shall indicate if any has been arranged for the proposed work.
4) **Other NASA-Coordinated Contributions to Proposed Work**
The following contributions will be provided to the proposed work that would be in addition to NASA EPSCOR awarded funding, and in the event of an award.
    a. **From NASA organization other than EPSCoR**
    None.
    b. **From Organization partnering with NASA**
    None.
5) **Additional Agreement Clauses applicable to Cooperative Agreements awarded for this Call Area**
Nonadditional.

6) **Intellectual Property Rights:** All technologies developed through this research will be submitted through NASA's New Technology Reporting System prior to any public dissemination. Unless otherwise determined by the NASA New Technology Office, all data and analysis methods will be publicly available and no intellectual property rights will be assigned to any of the parties involved in this research. Proposer to indicate any specific intellectual property considerations in the Proposal. See Section 3 of the Terms and Conditions.

7) **Additional Information:**
NASA will support a telecon with the Proposer prior to the submission of Proposals, to answer Proposer's questions and discuss Proposers anticipated approach towards this Research Request. Contact information is provided in section (5). NASA welcomes opportunities to co-publish results proposed by EPSCoR awardee. NASA goal is for widest possible eventual dissemination of the results from this work when other restrictions allow.

15.A.6 Astrophysics
Science Mission Directorate (SMD)

Research Focus Area: Astrophysics Technology Development

Research Identifier**: RFA-019**

POCs: Dr. Hashima Hasan hhasan@nasa.gov
Dr. Mario Perez mario.perez@nasa.gov

NASA's strategic objective in astrophysics is to discover how the universe works, explore how it began and evolved, and search for life on planets around other stars. Three broad scientific questions flow from this objective:

- How does the universe work?
- How did we get here?
- Are we alone?

Each of these questions is accompanied by a science goal that shapes the Astrophysics Division's efforts towards fulfilling NASA's strategic objective:

- Probe the origin and destiny of our universe, including the nature of black holes, dark energy, dark matter and gravity
- Explore the origin and evolution of the galaxies, stars and planets that make up our universe
- Discover and study planets around other stars, and explore whether they could harbor life

To address these Astrophysics goals, the Astrophysics Research Analysis and Technology Program invites a wide range of astrophysics science investigations from space that can be broadly placed in the following categories.

(i) The development of new technology covering all wavelengths and fundamental particles, that can be applied to future space flight missions. This includes, but is not limited to, detector development, and optical components such as primary or secondary mirrors, coatings, gratings, filters, and spectrographs.

(ii) New technologies and techniques that may be tested by flying them on suborbital platforms such as rockets and balloons that are developed and launched by commercial suborbital flight providers or from NASA's launch range facilities, or by flying them on small and innovative orbital platforms such as CubeSats.

(iii) Studies in laboratory astrophysics. Examples of these studies could include atomic and molecular data and properties of plasmas explored under conditions approximating those of astrophysical environments.

(iv) Theoretical studies and simulations that advance the goals of the astrophysics program

(v) Analysis of data that could lead to original discoveries from space astrophysics missions. This could include the compilations of catalogs, statistical studies, algorithms and pattern recognition, artificial intelligence applications, development of data pipelines, etc.

(vi) Citizen Science programs, which are a form of open collaboration in which individuals or organizations participate voluntarily in the scientific process, are also invited. The current SMD Policy (https://smd-prod.s3.amazonaws.com/science-red/s3fspublic/atoms/files/SPD%2033%20Citizen%20Science.pdf) on citizen science describes standards for evaluating proposed and funded SMD citizen science projects. For more information see the https://science.nasa.gov/citizenscience webpage, that provides information about existing SMD-funded projects.

(vii) Great Observatory Maturation Program (GOMAP): : https://science.nasa.gov/astrophysics/programs/gomap

Proposals should address the goals of the Science Mission Directorate's (SMD) Astrophysics Research Program, defined in SMD's *Science 2020-2024: A Vision for Scientific Excellence* (available at http://science.nasa.gov/about-us/science-strategy). Proposers are encouraged to read this *NASA Science Plan*, the *Astrophysics Roadmap* (available at https://science.nasa.gov/astrophysics/documents/astrophysics-roadmap), and the report of National Academy of Sciences Decadal Survey on Astronomy and Astrophysics 2020, *Pathways to Discovery in Astronomy and Astrophysics for the 2020s*,(available at https://www.nap.edu/catalog/26141/pathways- to-discovery-in-astronomy-and-astrophysics-for-the-2020s)

Investigations submitted to the Astrophysics research program should explicitly support past, present, or future NASA astrophysics missions. These investigations can include theory, simulation, data analysis, and technology development. Information on the Astrophysics research program and missions is available at https://science.nasa.gov/astrophysics.

15.A.7 NASA Biological and Physical Sciences (BPS)
Science Mission Directorate (SMD)
NASA Headquarters Biological and Physical Sciences Division

Research Focus Area: Fundamental Physics
Research Identifier**: RFA-020**
POC: Mike Robinson michael.p.robinson@nasa.gov

Research Overview: Quantum mechanics is one of the most successful theories in physics. The behavior of exotic matter such as superfluids and neutron stars is explained by quantum science, as are everyday phenomena such as the transmission of electricity and heat by metals. The frontline of modern quantum science involves cross-cutting fundamental research. Another frontier encompasses understanding how novel quantum matter—such as high-temperature superconductivity and topological states—emerges from the interactions between many quantum particles. Quantum science is central to the field of precision measurement, which seeks to expand our knowledge of the underlying principles and symmetries of the universe by testing ideas such as the equivalence between gravitational and inertial mass.

Quantum physics is a cornerstone of our understanding of the universe. The importance of quantum mechanics is extraordinarily wide ranging, from explaining emergent phenomena such as superconductivity, to underpinning next-generation technologies such as quantum sensors. Laser-cooled cold atoms are a versatile platform for quantum physics on Earth, and one that can greatly benefit from space-based research. The virtual elimination of gravity in the reference frame of a free-flying space vehicle enables cold atom experiments to achieve longer observation times and colder temperatures than are possible on Earth. The NASA Fundamental Physics program plans to support research in quantum science that will lead to transformational outcomes, such as the discovery of phenomena at the intersection of quantum mechanics and general relativity that inform a unified theory, the direct detection of dark matter via atom interferometry or atomic clocks, the creation of exotic quantum matter than cannot exist on Earth, quantum sensors to search for physics beyond the standard model, and others.

Research Focus: Proposals are sought for ground-based theory and experimental research that may help to develop concepts for future flight experiments in fundamental physics.

Additional Information: All publications that result from an awarded EPSCOR study shall acknowledge NASA Biological and Physical Sciences (BPS). Additional information on BPS can be found at: https://science.nasa.gov/biological-physical

Research Focus Area: Soft Matter Physics
Research Identifier**: RFA-021**
POC: Mike Robinson michael.p.robinson@nasa.gov

Research Overview: Granular material is one of the key focus areas of research in the field of soft matter. The fundamental understanding of physics of granular materials under different gravity condition is of key importance for deep space exploration and long-term habitation to sample collection from asteroids to improving the understanding of granular material handling on earth. Also, fundamental understanding of granular materials can help us understand motions in large bodies on earth (e.g.- landslides) that can help us save lives in case of natural emergencies.

Research Focus: This research topic focuses on developing fundamental knowledge base in the field of-

- Rheology of granular materials (both wet and dry)
    - Impact of anisotropy and structure
    - Impact of electrostatic charging
- In depth understanding of stress distribution in granular materials
- Dynamics of interparticle interaction and short range forces in granular materials

Both experimental and theoretical/numerical work will be in scope.

Additional Information: All publications that result from an awarded EPSCOR study shall acknowledge NASA Biological and Physical Sciences (BPS). Additional information on BPS can be found at: https://science.nasa.gov/biological-physical

Research Focus Area: Fluid Physics
Research Identifier**:** **RFA-022**
POC: Brad Carpenter bcarpenter@nasa.gov

Research Overview: The goal of the microgravity fluid physics program is to understand fluid behavior of physical systems in space, providing a foundation for predicting, controlling, and improving a vast range of technological processes. Specifically, in reduced gravity, the absence of buoyancy and the stronger influence of capillary forces can have a dramatic effect on fluid behavior. For example, capillary flows in space can pump fluids to higher levels than those achieved on Earth. In the case of systems where phase-change heat transfer is required, experimental results demonstrate that bubbles will not rise under pool boiling conditions in microgravity, resulting in a change in the heat transfer rate at the heater surface. The microgravity experimental data can be used to verify computational fluid dynamics models. These improved models can then be utilized by future spacecraft designers to predict the performance of fluid conditions in space exploration systems such as air revitalization, solid waste management, water recovery, thermal control, cryogenic storage and transfer, energy conversion systems, and liquid propulsion systems.

Research Focus: The research area of fluid physics includes the following themes:
Adiabatic two-phase flow
Boiling and condensation
Capillary flow
Interfacial phenomena
Cryogenic propellant storage and transfer

Additional Information: All publications that result from an awarded EPSCOR study shall acknowledge NASA Biological and Physical Sciences (BPS). Additional information on BPS can be found at: https://science.nasa.gov/biological-physical

Research Focus Area: Combustion Science
Research Identifier**:** **RFA-023**
POC: Brad Carpenter bcarpenter@nasa.gov

Research Overview: One of the goals of the microgravity combustion science research program is to improve combustion processes, leading to added benefits to human health, comfort, and safety. NASA's microgravity combustion science research focuses on effects that can be studied in the absence of buoyancy-driven flows caused by Earth's gravity. Research conducted without the interference of buoyant flows can lead to an improvement in combustion efficiency, producing a considerable economic and environmental impact. Combustion science is also relevant to a range of challenges for long-term human exploration of space that involve reacting systems in reduced and low gravity. These challenges include: spacecraft fire prevention; fire detection and suppression; thermal processing of regolith for oxygen and water production; thermal processing of the Martian atmosphere for fuel and oxidizer production; and processing of waste and other organic matter for stabilization and recovery of water, oxygen and carbon. Substantial progress in any of these areas will be accelerated significantly by an active reduced- gravity combustion research program.

Research Focus: The research area of combustion science includes the following themes:
Spacecraft fire safety
Droplets
Gaseous – premixed and non-premixed
High pressure – transcritical combustion and supercritical reacting fluids
Solid fuels

Additional Information: All publications that result from an awarded EPSCOR study shall acknowledge NASA Biological and Physical Sciences (BPS). Additional information on BPS can be found at: https://science.nasa.gov/biological-physical

NASA Biological and Physical Sciences (BPS)
NASA Marshall Space Flight Center (MSFC) / EM41

Research Focus Area: Materials Science
Research Identifier**:** **RFA-024**
POC: Brad Carpenter bcarpenter@nasa.gov

Research Overview: The goal of the microgravity materials science program is to improve the understanding of materials properties that will enable the development of higher-performing materials and processes for use both in space and on Earth. The program takes advantage of the unique features of the microgravity environment, where gravity-driven phenomena, such as sedimentation and thermosolutal convection, are nearly negligible. On Earth, natural convection leads to dendrite deformation and clustering, whereas in microgravity, in the absence of buoyant flow, the dendritic structure is nearly uniform. Major types of research that can be investigated include solidification effects and the resulting morphology, as well as accurate and precise measurement of thermophysical property data. These data can be used to develop computational models. The ability to predict microstructures accurately is a promising computational tool for advancing materials science and manufacturing.

Research Focus: The research area of materials science includes the following themes:

Glasses and ceramics
Granular materials
Metals
Polymers and organics
Semiconductors

Additional Information: All publications that result from an awarded EPSCOR study shall acknowledge NASA Biological and Physical Sciences (BPS). Additional information on BPS can be found at: https://science.nasa.gov/biological-physical

Research Focus Area: Growth of plants in "deep space-relevant" Earth soils or conditions

Research Identifier**:** **RFA-025**
POC: Sharmila Bhattacharya SpaceBiology@nasaprs.com

Research Overview: As human exploration continues to move further out beyond Low Earth Orbit (BLEO), exploration missions will need to become increasingly self-sufficient, and will not be able to rely as heavily on resupply efforts from Earth, as they now do within Low Earth Orbit (LEO). The NASA Space Biology Program is interested in basic research that will ultimately translate into the ability to grow edible plants and crops in deep space environments. Research supported by our program has already demonstrated that 1) edible plants can be grown in the LEO environment of the International Space Station (Massa *et al*., 2017), and that 2) model (non-edible) plant organisms can germinate from seeds planted in lunar regolith obtained from the Apollo 11, 12, and 17 missions (Paul *et al.*, 2022; for a historic perspective refer to Ferl and Paul, 2010). While both these results are very promising, there is still much work that needs to be done to move exploration efforts to the point where astronauts can begin to think about practicing agriculture in harsh deep space environments such as the lunar and Martian surfaces.

While much of Space Biology's funded plant research efforts have focused on experiments conducted in spacecraft, or in the presence of simulated spaceflight/deep-space stressors, the program is interested in exploring other potential niches that exist here on Earth that may provide important insights into how both plants and the surrounding environment can be manipulated to support crop growth under harsh, inhospitable conditions. As early humans spread out across the globe, they have repeatedly encountered extreme environments that were far from being innately supportive of agriculture and settlement. Despite these challenges, humans have often found ways to live and even flourish in such environments, either by finding food sources that were robust enough to grow under such conditions, and/or by altering the terrain through irrigation and natural farming (soil modification with natural composts, crop rotation, etc.) to enable crop growth. Therefore, for this research focus area, Space Biology is soliciting proposals that will provide insights into how plants grow and continue to adapt to Earth's extreme geochemically diverse environments, as well as how these environments can be manipulated to support such growth.

Research Focus: This Space Biology Research Emphasis requests proposals for hypothesis-driven studies that will either provide a better understanding of the mechanisms by which some plants are able to grow and thrive in extreme or geochemically diverse environments on Earth or will identify plants and/or alternative methods that can be used to facilitate plant/crop growth in such extreme environments. Ideally, pilot studies funded from this opportunity will lead to additional future funded research that may translate to improved agricultural methods and tools that can be utilized in extreme environments on earth and eventually in harsh environments of the lunar and Martian surfaces.

Such topics of study may include, but are not limited to:

- Characterizing the molecular and/or biological mechanisms by which plants already known for their agricultural robustness are able to grow in soil types found in Earth's more extreme environments, including volcanic soils and sands (deserts), clay, etc. Particular emphasis may be given to edible plants.
- Identifying new plants that are able to grow in such soil samples and characterizing their growth and vitality.
- Genetic modification of plants to improve growth and robustness in such soils.
- Identifying or engineering microbiomes that will optimize plant growth and vitality in such soils.
- Testing or developing new composting methods or other natural methods to enrich such soils which will enable them to better support plant growth.

If logistics and costs permit, proposed studies may be conducted on location directly in the types of environments mentioned above, however, proposed studies may also use soil samples collected (or purchased) from these environments. It will be up to the proposer to identify the extreme environment/soil samples they will use for their studies, as well as provide justification in their proposal as to why these environments/soils were chosen and have relevance to space exploration.

Additional Information: While the Space Biology Program can be contacted at SpaceBiology@nasaprs.com for general questions about this RFA, the program itself is not able to foster collaborations between applicants and NASA scientists or NASA-funded scientists. If potential applicants are seeking to establish such collaborations for their project, then we recommend that they consult the NASA Task Book (at https://taskbook.nasaprs.com) to identify potential collaborators. The NASA Task Book is a database that contains information about all the projects that the NASA Space Biology Program has funded since 2004. Here applicants will also find the names of investigators that have been funded by our program as well as their contact information.

All publications that result from an awarded EPSCOR study shall acknowledge the Space Biology Program within NASA's Biological and Physical Science (BPS) Division. If the NASA GeneLab Data Systems (genelab.nasa.gov) is used, GeneLab shall be referenced in the resulting publication and included in the keyword list. All omics data obtained from this study shall be uploaded to the NASA GeneLab (https://genelab.nasa.gov).

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Research Focus Area: The impact of space-associated stressors on energy metabolism and oxidative stress.

Research Identifier**: RFA-026**
POC: Sharmila Bhattacharya SpaceBiology@nasaprs.com

Research Overview: The spaceflight environment is known to impose cellular and physiological changes in living systems that are common across species and even across the taxonomic biological kingdoms. These changes can not only adversely impact the well-being of entire organisms, but of entire ecosystems in spacecraft and planetary habitats. In order to help enable life to thrive in space, an understanding of both the effects of these changes, and the mechanisms by which these changes occur, is critical. Recent Space Biology-funded research that employed muti-omics and system biology approaches to profile the transcriptomic, proteomic, metabolomic, and epigenetic responses to spaceflight in tissue samples collected from astronauts, as well as other organisms flown in space, showed that mitochondrial dysfunction is a common consequence of exposure to the spaceflight environment across diverse biological systems (da Silveira *et al*., 2020). These results, however, are not the only findings that indicate that space travel has an impact on biological pathways responsible for cellular and physiological energy metabolism. There are a plethora of studies demonstrating that exposure to space-associated stressors induces oxidative stress and changes within the biological pathways responsible for redox responses in plant, animal, and fungal model systems (Choi *et al.*, 2019; Hateley, *et al*., 2016; Tahimic and Globus, 2017; Nislow et al., 2015), which both regulate and are regulated by mitochondrial function. Furthermore, additional research with the plant model *Arabidopsis thaliana* has shown that exposure to microgravity downregulates the expression of genes encoding proteins associated with the chloroplast (Land *et al*., 2024), thus providing mechanistic data of how space-associated stressors can impact photosynthesis.

While these studies have provided important clues on how the stressors encountered during space exploration dysregulate energy metabolism and homeostasis, a mechanistic understanding of how these stressors, either individually or in combination, contribute to this dysregulation and the impact that such dysregulation has on the overall health of an organism is needed. Therefore, for this research focus area, Space Biology is soliciting ground-based proposals that elucidate the effects of spaceflight related stressors on energy metabolism and/or oxidative stress.

Research Focus: This Space Biology Research Emphasis requests proposals for hypothesis-driven studies that will characterize the impacts that stressors associated with space exploration have on cellular energy metabolism and/or redox responses, and how changes in these processes impact the overall health of an entire organism, or in the case of microbial studies, the health of individual microbes or of communities containing multiple microbes. Such stressors may include, but are not limited to, simulated microgravity or partial gravity, changes in atmospheric pressure or composition (*i.e.*, oxygen and carbon dioxide concentrations), hypoxia, and ionizing radiation (radiation sources that are easily accessible in a laboratory environment, such as X-ray or gamma radiation, can be used).

Such topics of study may include, but are not limited to:

- Characterizing how space-relevant stressors impact mitochondrial integrity and function in eukaryotic organisms, and how changes in these properties impact the overall fitness of the entire organism (within plant/animal/microbial models) or of an entire community (within unicellular models).
- Characterizing how space-associated stressors impact the accumulation of reactive oxygen species cellular redox responses, and how changes in these properties impact the overall fitness of the entire organism (within plant/animal models) or of an entire community (within unicellular models).
- Characterizing how space-associated stressors impact chloroplast integrity and function in plant model systems, and how changes in these properties impact the overall fitness of the entire organism.
- Characterizing the response of prokaryotic organisms to these stressors with the goal of gaining a heuristic understanding of how such stressors impact energy-related metabolic pathways.
- The identification of cross species biosignatures in response to oxidative stress or stressors that impact energy metabolism/homeostasis.

Investigators are also welcome to propose additional types of studies, including those that focus on other cellular components or processes, as long as the overall research focus of the proposed project address the emphasis of this RFA, which is how spaceflight stressors impact energy metabolism/homeostasis and/or oxidative stress/redox responses. Applicants may propose to use any plant or microbial model system for their studies, but animal models will be limited to cell cultures or invertebrates (excluding cephalopods), and applicants will be expected to include their rationale and justification for their choice of model system, and space-relevant variables to be tested in their proposal.

Additional Information: While the Space Biology Program can be contacted at SpaceBiology@nasaprs.com for general questions about this RFA, the program itself is not able to foster collaborations between applicants and NASA scientists or NASA-funded scientists. If potential applicants are seeking to establish such collaborations for their project, then we recommend that they consult the NASA Task Book (at https://taskbook.nasaprs.com) to identify potential collaborators. The NASA Task Book is a database that contains information about all the projects that the NASA Space Biology Program has funded since 2004. Here applicants will also find the names of investigators that have been funded by our program as well as their contact information.

All publications that result from an awarded EPSCOR study shall acknowledge the Space Biology Program within NASA's Biological and Physical Science (BPS) Division. If the NASA GeneLab Data Systems (genelab.nasa.gov) is used, GeneLab shall be referenced in the resulting publication and included in the keyword list. All omics data obtained from this study shall be uploaded to the NASA GeneLab (https://genelab.nasa.gov).

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Choi, W-G, Barker, RJ, Kim S-H, Swanson, SJ, Gilroy, S. Variation in the transcriptome of different ecotypes of Arabidopsis thaliana reveals signatures of oxidative stress in plant responses to spaceflight. Botany. 2019. 106(1): 123-136. DOI: 10.1002/ajb2.1223

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Research Focus Area: The role of genetic diversity in enabling life to thrive in space.

Research Identifier**:** **RFA-027**
POC: Sharmila Bhattacharya SpaceBiology@nasaprs.com

Research Overview: While model systems provide an invaluable tool for helping researchers gain an understanding of how biological systems respond to the harsh environmental factors and stressors that may be encountered during space exploration, much of this research has been conducted using specimens with limited genetic diversity. For example, many animal and plant studies use inbred strains/lines or specific cultivars, respectively, and many microbiology studies use organisms that have the same genetic background, or groups of organisms with limited genetic variability between them. The use of such specimens for initial studies is both appropriate and necessary to reduce variability caused by genetic diversity, which can contribute to "noisy" data when trying to characterize the impacts that multiple space-associated stressors have on biological systems. However, in natural populations, organisms within a single species can be highly genetically diverse and this diversity can translate into vastly different responses to the same stressor among individuals. Therefore, for this research focus area, Space Biology is soliciting proposals that will characterize how genetic diversity impacts the ability of organisms to respond to space-associated stressors as well as how genetic diversity impacts the organism overall fitness under these conditions.

Research Focus: This Space Biology Research Focus Area requests proposals for hypothesis-driven studies that will increase our understanding of how genetic variability or different genetic background modulates an organism's ability to respond to environmental stressors encountered during space exploration. Such stressors may include, but are not limited to, simulated microgravity or partial gravity, changes in atmospheric pressure or composition (*i.e.*, oxygen and carbon dioxide concentrations), hypoxia, and ionizing radiation (radiation sources that are easily accessible in a laboratory environment, such as X-ray or gamma radiation, can be used.

Such topics of study may include, but are not limited to:

- Comparing the responses (and the resulting overall fitness) of multiple genetic backgrounds within a single species to space-associated stressors.
- Following up on previously published observations regarding an organism's response to space-associated stressors and testing how different genetic background/mutations alter that response.
- Use of forward/and or reverse genetic approaches to identify genes or family/subset of genes that modulate an organism's overall fitness in and response to the presence of space-associated stressors.
- Using synthetic biology approaches to engineer organisms that are better able to tolerate exposure to space-associated stressors.
- Population studies using microbes or plant/animal models with a quick generation time to examine how genetic diversity impacts overall survival, fitness and/or evolution in the presence of space-associated stressors.

Investigators are also welcome to propose additional types of studies as long as the overall research focus of the proposed project address the emphasis of this RFA, which is how genetic diversity enables life to thrive in space. Applicants may propose to use any plant or microbial model system for their studies, but animal models will be limited to cell cultures or invertebrates (excluding cephalopods), and applicants will be expected to include their rationale and justification for their choice of model system, and space-relevant variables to be tested in their proposal.

Additional Information: While the Space Biology Program can be contacted at SpaceBiology@nasaprs.com for general questions about this RFA, the program itself is not able to foster collaborations between applicants and NASA scientists or NASA-funded scientists. If potential applicants are seeking to establish such collaborations for their project, then we recommend that they consult the NASA Task Book (at https://taskbook.nasaprs.com/) to identify potential collaborators. The NASA Task Book is a database that contains information about all the projects that the NASA Space Biology Program has funded since 2004. Here applicants will also find the names of investigators that have been funded by our program as well as their contact information.

All publications that result from an awarded EPSCOR study shall acknowledge the Space Biology Program within NASA's Biological and Physical Science (BPS) Division. If the NASA GeneLab Data Systems (genelab.nasa.gov) is used, GeneLab shall be referenced in the resulting publication and included in the keyword list. All omics data obtained from this study shall be uploaded to the NASA GeneLab (https://genelab.nasa.gov).

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Research Focus Area: Commercially Enabled Rapid Space Science Project (CERISS)
Research Identifier**: RFA-028**
POC: Koniges, Ursula M. (HQ-DP000) <ursula.m.koniges@nasa.gov>

Research Overview: The Commercially Enabled Rapid Space Science initiative (CERISS) will develop transformative research capabilities with commercial space industry to dramatically increase the pace of research. Long-range goals include conducting scientist astronaut missions on the International Space Station and commercial low-earth orbit (LEO) destinations and develop automated hardware for experiments beyond low Earth orbit, such as to the lunar surface.

The benefits will include a 10-to-100-fold faster pace of research for a wide range of research sponsored by Biological and Physical Sciences Division, the NASA Human Research Program, other government agencies, and industry. Another benefit will be the increased demand for research and development in low earth orbit, facilitating growth of the commercial space industry.

Research Focus: Advancement of capabilities in the following areas are of particular interest:

Sample preparation; characterization of materials (e.g. differential scanning calorimetry, x-ray diffraction, fourier transform infrared spectroscopy, etc.); and analysis of samples (e.g. fluorescent activated cell sorting, protein and -omics, imaging, etc.)

Additional Information: All publications that result from an awarded EPSCOR study shall acknowledge NASA Biological and Physical Sciences (BPS). Further information on CERISS is available at: https://science.nasa.gov/biological-physical/commercial.

A.8 Commercial Space Capabilities (CSC)

Space Operations Mission Directorate (SOMD)
NASA Johnson Space Center

The Commercial Space Capabilities (CSC) Research Interest area supports the Commercial Low Earth Orbit Development Program of NASA's Space Operations Mission Directorate (SOMD). This area's purpose is to harness the capabilities of the U.S. research community to advance research and perform initial proofs / validations, that improve technologies of interest to the U.S. commercial spaceflight industry. The intent is to address the commercially riskiest portion of implementing new and improved technologies ("Innovation Valley of Death") to advance science and technologies from TRL1 through to TRL3. U.S. commercial spaceflight industry can then assess such technologies and determine implementation.

The overall goal of this area is to encourage and facilitate a robust and competitive U.S. low Earth orbit economy. Efforts that primarily benefit near-Earth commercial activities but that might also be extensible Moon and/or Mars are also in scope.

Research Focus Area: In-Space Welding

Research Identifier: **RFA-029**
POC: Warren Ruemmele warren.p.ruemmele@nasa.gov

Research Overview: Research and initially demonstrate (in 1g) metal welding suitable for being directly exposed to space vacuum/0g. Metals of interest are those typically used for spacecraft structures and plumbing. (Extensibility to being used while exposed to Moon vac/g, and/or Mars atm/g environments could be a secondary interest.) Potential applications include the in-space assembly of very large structures that are too bulky or heavy to launch in one piece, and *in situ* repair or modifications. Consider weld processes suitable for incorporation into a robotic or EVA crew tool. A related secondary interest is for a metal cutting operation suitable for incorporation into a robotic or EVA crew tool. For cutting operations consider debris generation and how to control.

Research Focus Area: Materials and Processes Improvements for Chemical Propulsion State of Art (SoA)

Research Identifier: **RFA-030**
POC: Warren Ruemmele warren.p.ruemmele@nasa.gov

Research Overview: Propose and demonstrate improvements for launch, entry, and/or in-space chemical propulsion (of any type), to improve performance, reduce cost, enable new capabilities, and/or improve/simplify manufacturing. For this topic, when a current SoA exists, identify the shortcoming in the current SoA that the improvement addresses. NASA is specifically interested in proposed work in these subtopics:

Research Focus Area: Materials and Processes Improvements for Electric Propulsion State of Art (SoA)

Research Identifier: **RFA-031**
POC: Warren Ruemmele warren.p.ruemmele@nasa.gov

Research Overview: Propose and demonstrate improvements for solar powered electric propulsion suitable for cislunar application, to improve performance, reduce cost, enable new capabilities, and/or improve/simplify manufacturing. For this topic;

i) Proposer may contact NASA to schedule a pre-proposal telecon to discuss approach and understand details.

ii) ii) Proposer must describe the existing personnel skill and expertise, and facility capabilities to perform the work such as material finishing/processing, testing, inspection, and failure analysis.

NASA is specifically interested in proposed work to any of these three subtopics:

1) Material Properties: An evaluation of the bulk mechanical, thermal, and electrical properties of several common commercially available grades of material in environments relevant to thruster designs.
   a. Specific grades and in some cases samples can be provided by NASA and may include graphite, ceramics, refractories, aluminum, titanium, stainless steel, Inconel, Kovar, and other materials commonly used in thruster designs.
   b. Properties of interest include mechanical strength (flexural and compressive), low cycle fatigue, high cycle fatigue, toughness, slow crack growth, elastic modulus, Poisson's ratio, thermal conductivity, electrical conductivity, emissivity, thermal expansion, and outgas properties.
   c. Environments of interest include ambient temperature, low temperature (-40ºC), thruster temperature (600ºC), and cathode temperature (1100ºC).
   d. This work is intended to help fill gaps in open literature for common properties and materials used by the electric propulsion community to aid in design and analysis.

2) Material Deposition: An evaluation of material deposition resulting from ion beam sputtering of commonly used EP materials onto common spacecraft materials. Data shall include the following:
   a. Phase of the material deposited
   b. Whether the deposits are conductive or insulating
   c. Deposition rate compared to sputter yield based predictions,
   d. When/if spalling of the deposition occur.

3) Krypton Sputter Erosion: An evaluation of the sputter erosion of common thruster, spacecraft, and related materials from Krypton ion bombardment. The materials will be exposed to Krypton ion beams and the following will be determined:
   a. The dependence of the total yield with ion energies in the general range of tens to volts up to 1 kV
   b. Dependence of the total yield with ion incidence angles from normal to near grazing, and/or
   c. Differential yield profiles at various energies and incidence angles.

Materials of interest include graphite, ceramics, coverglass, kapton, composites, and/or anodized coatings. This effort may be combined with the Material Deposition effort as appropriation including possibly measurement of sticking coefficients of the sputtered products

Research Focus Area: Improvements to Space Solar Power State of Art (SoA)

Research Identifier: **RFA-032**
POC: Warren Ruemmele warren.p.ruemmele@nasa.gov

Research Overview: Propose and demonstrate improvements for solar power generation (of any type) suitable for cis-lunar in-space application (e.g. space stations, satellites, power beaming), to improve performance, reduce cost, enable new capabilities, and/or improve/simplify manufacturing. NASA is especially interested in these two subtopics:

1) Improvements for in-space photovoltaics compared to current spaceflight solar array SoA.
2) Engineering trade studies of other solar power production methods (e.g. concentrators, thermodynamic cycles, etc.) compared to current SoA space photovoltaic systems. Considerations would include: Technology readiness and gaps, launch volume and mass with respect to current US launch vehicles, peak/steady state power and characteristics, efficiency, operational considerations, in-space lifetime/performance degradation, energy storage, orbit and distance, and identifying break points and sweet spots.

Research Focus Area: Small Reentry Systems Research Identifier:
Research Identifier: **RFA-033**
POC: Warren Ruemmele warren.p.ruemmele@nasa.gov

Research Overview: Design and demonstrate reentry systems that can be deployed from low Earth orbit to perform a self-guided intact reentry to return small cargo contained inside them intact to Earth. Cargo might include science samples, space-manufactured items, etc. An alternate use is to recover flight data recorders from destructively reentering technology demonstrators to allow retrieving large amounts of telemetry without the use of communications satellites.
Passively guided systems are preferred. Such reentry systems might need to be safely storable inside crewed in-space platforms so preference is to not use hazardous materials. Hazards for people/property on the Earth resulting from reentry must be considered. Landing on ground is preferred to simplify and expedite recovery.

Research Focus Area: Low Consumable Environmental Control and Crew Systems

Research Identifier: **RFA-034**
POC: Warren Ruemmele warren.p.ruemmele@nasa.gov

Research Overview: Design and demonstrate Environmental Control and Crew Systems technologies suitable for use on U.S. commercial Low Earth Orbit (LEO) space stations, and/or for the spacecraft that would transport crew to and from such space stations in LEO. These would be new space stations – **not** the current International Space Station (ISS). This can be end-to-end systems or major subsystems.
The systems areas are:

1) Crew atmosphere (oxygen, carbon dioxide, trace contaminant control, humidity)
2) Crew potable water
3) Crew hygiene (body washing, human waste)
4) Crew clothes cleaning

The overall goals are:

a) To improve current state of art by: notably reducing cost, reducing size/weight/power, minimizing on-orbit maintenance time, and reducing consumables and trash to reduce the need for resupply from/to Earth.
b) Approaches may include recycling and/or repurposing waste products to perform needed space station/space craft functions.

Research Focus Area: Other Commercial Research
Identifier: **RFA-035**
POC: Warren Ruemmele warren.p.ruemmele@nasa.gov

NASA is receptive to topics in this Research Interest Area that it may not have already identified if a strong case can be made for these. The Proposer may therefore propose other topics as follows:
1) The proposed Topic must be consistent with the Intent and goal of this CSC Area.
2) The proposal must include a strong letter of support from a U.S. commercial company that describes the company's need for the work and any arrangements with the Proposer.
3) Before submitting the proposal for such a topic, the Proposer must discuss with NASA per CSC NASA Contact listed in the following page.

Additional Instructions for Proposals in this CSC Interest Area (RFA-029 through RFA-035):

A. Content
1. Proposals should discuss how the effort is anticipated to align with U.S. commercial spaceflight company interest(s). Proposers are encouraged to contact U.S. commercial spaceflight companies to understand current research challenges.
2. Proposals should identify the estimated starting and end point of the currently proposed effort in terms of Technology Readiness Level (TRL) https://www.nasa.gov/pdf/458490main_TRL_Definitions.pdf), and what subsequent work might be anticipated to achieve TRL5.
3. If there is an existing SoA, state how proposed work would address an identified need/shortcoming (not just a "nice to have").
4. Describe proposing Institution's and Co-I/Sci-I's relevant capabilities and prior work. Compare and contrast proposed work against prior and existing work by others. (Weblinks preferred. Does not count against the Technical page limit.)
5. Work must produce a final report and delivery of developed design concept and data (as applicable).
6. Proposers can assume that technically knowledgeable NASA engineers and scientists will be reviewing the Proposal – so Proposer should focus on technical/scientific specifics.
7. NASA anticipates that depending on the specifics of the proposed work, the Proposer *may* need to implement Export Controls (e.g. EAR or ITAR). Proposer should identify in their proposal whether they believe Export Controls would apply, and identify (e.g. weblink) institutional export control methods/policy in the proposal's Data Management Plan. Proposer may contact NASA PoC to discuss prior to submitting proposal.

B. Contributions to Proposed Work other than NASA EPSCoR
Proposer-coordinated contributions from Jurisdiction, or Organizations (especially US commercial entities) that would partner with the Jurisdiction, are welcomed but not required. If there are such contributions then the Proposer must state what has been arranged, include funding or other in-kind contributions such as materials or services and indicate the estimated value of these.

C. Intellectual Property
Proposer to indicate any intellectual property considerations in the Proposal (see terms and conditions).

D. Publishing of Results
NASA welcomes opportunities to co-publish results as proposed by EPSCoR awardee, and its goal is for widest possible eventual dissemination of the results of the Researcher(s) work, to the extent other restrictions (e.g. Export Control) allow. For results that must be controlled, NASA will work with Researcher to present accordingly, and make data available in access controlled databases such as MAPTIS database https://maptis.nasa.gov/.

E. NASA Contact

The CSC NASA Contact will support a telecon with the Proposer prior to the submission of their Proposal, to answer questions and discuss anticipated approach towards this Research Request. NASA Contact will coordinate support from within NASA as needed to provide subject matter expertise/limited consultation in event of award. (If Proposer has already discussed with and NASA or JPL personnel please identify so they might be able to support telecon.)

A.9 NASA Digital Transformation (DT)

Science Mission Directorate (SMD)

Jill Marlow, NASA Digital Transformation Officer
Marlowe, Jill M (HQ-JA000) jill.marlowe@nasa.gov

Patrick Murphy, NASA Digital Transformation – Portfolio Integration
PATRICK MURPHY patrick.murphy@nasa.gov

NASA DIGITAL TRANSFORMATION

NASA Digital Transformation is an agency strategic initiative that aims to accelerate our efforts to modernize and transform NASA using digital advances — by synchronizing DT investments across NASA and catalyzing DT progress by attacking cross-cutting barriers to technology readiness & adoption.

Since 1958, NASA's enduring purpose centers around a mission to discover, explore, innovate, and advance solutions to the problems of flight, within and outside the Earth's atmosphere, for the benefit of humankind. With each new technological revolution, our agency continued to deliver on this mission. Now, the wide-scale adoption of numerous digital advances—cloud computing, data analytics, artificial intelligence, augmented/virtual reality, and others—calls for us to rise to the occasion yet again.

It is vital for us to undergo fundamental digital transformation in order to thrive in a more competitive digital workplace, become more efficient with our resources, and ensure safety from increasing digital threats. In late 2020, NASA established an Enterprise Digital Transformation (DT) agency-level strategic initiative to carry out such an endeavor.
NASA's DT Strategic Framework and Implementation Plan outlines the DT initiative's approach for digitally transforming NASA. By transforming Engineering, Discovery, Operations and Decision Making, we will reach outcomes ensuring continued mission success well into the future. Our world is changing—and so must NASA.

Research Focus Area: Zero Trust, Cybersecurity Mesh Architecture, and Leveraging Artificial Intelligence for Realtime Cyber Defense
Research Identifier**: RFA-036**

NASA Digital Transformation – Zero Trust Foundations; Strategy and Architecture Office (SAO)
NASA Langley Research Center
POC: Mark Stanley, mark.a.stanley-1@nasa.gov

Cybersecurity Engineering Office (CSE)
NASA Headquarters
POC: Dennis daCruz dennis.m.dacruz@nasa.gov

Research Overview: The National Institute of Standards and Technology (NIST), in its Special Publication (SP) 800-207, "Zero Trust Architecture," refers to the increasingly complex enterprise which has "led to the development of a new model for cybersecurity known as "zero trust" (ZT). A ZT approach is primarily focused on data and service protection but can and should be expanded to include all enterprise assets (devices, infrastructure components, applications, virtual and cloud components) and subjects (end users, applications and other nonhuman entities that request information from resources)." While the Zero Trust Framework evolved from its roots in the original Cybersecurity and Infrastructure Security Agency (CISA) Maturity Model to the latest Forrester Research-defined Zero Trust eXtended Framework, another construct emerged; namely, Cybersecurity Mesh Architecture (CSMA). Gartner defines CSMA as "a composable and scalable approach to extending security controls, even to widely distributed assets. Its flexibility is especially suitable for increasingly modular approaches consistent with hybrid multi-cloud architectures. CSMA enables a more composable, flexible and resilient security ecosystem. Rather than every security tool running in a silo, a cybersecurity mesh enables tools to interoperate through several supportive layers, such as consolidated policy management, security intelligence and identity fabric." With a move to an ever more integrated cybersecurity ecosystem, the volume of information, in both mass and speed, that could be leveraged to properly secure and defend the information environment will exceed the human capacity to be effective.

Research Focus: Conduct research on how to optimize a representative Zero Trust information environment to morph into a CSMA and benchmark the potential network operations and cybersecurity telemetry needed to identity, protect, detect, respond, and recover in the event of adversary activity. Then, research the best way in which artificial intelligence, to include machine learning and robotic process automation, could be leveraged to secure and defend the information environment in real time.

Research Focus Area: Applied AI Ethics
Research Identifier**: RFA-037**

NASA Digital Transformation – AI/ML Foundation
NASA Langley Research Center
POC: Ed McLarney, edward.l.mclarney@nasa.gov

Research Overview: There is limited research on trustworthy, responsible, ethical Artificial Intelligence (AI) among a wide variety of government, industry, academic, and international organizations.

Research Focus: Conduct benchmarking research regarding trustworthy, responsible, ethical AI among a wide variety of government, industry, academic, and international organizations. Provide a summary of key AI ethics principles relevant specifically to NASA but also generalizable to other government research, development & scientific organizations. Include the topic of beginning to measure AI ethics characteristics, leveraging existing metrics best practices, and including direct & indirect, subjective and objective measures. Beyond principles and metrics, provide recommendations for behaviors and mechanisms to make application of AI ethics concrete for AI practitioners. NASA will provide documentation of NASA approaches to AI ethics, AI governance, etc. as partial data for this research.

Research Focus Area: Scaled Video ML Object Detection and Alerts
Research Identifier**: RFA-038**

NASA Digital Transformation – AI/ML Foundation
NASA Langley Research Center , JSC, KSC
POC: Ed McLarney edward.l.mclarney@nasa.gov
Martin Garcia martin.garcia@nasa.gov
Mark Page mark.page@nasa.gov

Research Overview: There is limited research in mechanisms for optimizing video stream data flow for ML image analysis, reduction of full-system image recognition latencies to 3-5 seconds or less, training mechanisms to recognize additional conditions / images, robustness against inclement weather, aggregation & visualization of key information, human factors considerations for consuming the outputs, ability to train / correct ML object recognition algorithms, and ability to archive results for post-launch analysis.

Research Focus: Conduct research into mechanisms to scale machine learning object recognition and alerts to hundreds of video streams. Possible use case: monitoring video streams for space launch facilities to warn of people in danger areas or anomalies in countdown sequences. Current practices include human monitoring of key launch video streams, or small numbers of ML-assisted video streams. Research would include mechanisms for optimizing video stream data flow for ML image analysis, reduction of full-system image recognition latencies to 3-5 seconds or less, training mechanisms to recognize additional conditions / images, robustness against inclement weather, aggregation & visualization of key information, human factors considerations for consuming the outputs, ability to train / correct ML object recognition algorithms, and ability to archive results for post-launch analysis. NASA will provide guidance for the research and representative launch videos. Note: this project is not about individual ML video stream object recognition; rather it is about scaling ML video object recognition to hundreds of streams.

Research Focus Area: Verification of AI/ML algorithms for Spacecraft.
Research Identifier**: RFA-039**

NASA Digital Transformation – AI/ML Foundation
NASA MSFC
POC: Scott Tashakkor scott.b.tashakkor@nasa.gov

Research Overview: AI/ML algorithms are non-deterministic by nature, they are statistical algorithms that take inputs and run through multiple nodes for output. Without the determinism and/or guarantee that the algorithm will respond in certain ways, AI/ML will be limited to only supplementary functions in Spacecraft (or aircraft). This is due to the safety of humans and space assets as well as the costs associated with these. Scientists would/could miss significant data or spacecraft can be lost.

Research Focus: Therefore, techniques for V&V of AI/ML algorithms needs to be researched and developed. AI/ML training in space assets suffers similar restrictions, and the hardware that is radiation tolerant (beyond LEO) is not developed yet. Conduct research into techniques for V&V of AI/ML algorithms, training in space assets suffers similar restrictions, and the hardware that is radiation tolerant.

Research Focus Area: Augmenting and Analyzing Requirements with Natural Language Processors.
Research Identifier**: RFA-040**

NASA Digital Transformation – AI/ML Foundation
NASA MSFC

POC: Scott Tashakkor scott.b.tashakkor@nasa.gov

Research Overview: Requirements are the basis to every project; Natural Language Process (NLP) solutions can help remove the ambiguity in requirements or help people identify which requirements need to be focused on. Determining techniques to identify missing requirements needs to be studied as well. Creating higher quality requirements can be augmented with NLP to identify better language to be used and with generative AI methods can write some of the basic requirements.

Research Focus: Conduct research into creation and understanding the quality of requirements augmented with NLP to identify better language to be used and with generative AI methods.

Research Focus Area: AI/ML algorithms to obtain and improve 3-dimentional remote sensing of the Earth's aerosols, clouds, oceans and lands using advanced lidar and polarimeter data.
Research Identifier**: RFA-041**

NASA Digital Transformation – AI/ML Foundation
NASA LaRC
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Research Overview: High-spectral-resolution lidars, such as the NASA High-Spectral-Resolution Lidar (HSRL-1 and HSRL-2 and HALO), and multiangle, multispectral polarimeters, such as the NASA Research Scanning Polarimeter, the PolCube polarimeter, and SPEXone and HARP2 onboard the NASA PACE mission, can provide unprecedented 3-D information about the Earth's aerosols, clouds, oceans and lands.

Research Focus: Conduct research in AI/ML remote sensing algorithms to rapidly and accurately process high-spectral-resolution lidars. AI/ML algorithms are sought that can quantitatively retrieve aerosol/cloud optical and microphysical properties including aerosol/cloud optical depth (AOD), absorbing aerosols (aerosol single-scattering albedo), aerosol/cloud size (effective radius) and size distribution width (effective variance). In addition to aerosol/cloud properties, AI/ML algorithms for cloud detection, ocean and land feature detection, water-leaving radiance, surface reflectance, and albedo are also sought. An emphasis is placed on AI/ML algorithms that can make use of combined lidar and polarimeter data, or combined polarimeter and hyperspectral data. Synergistic analysis of such combined data with AI/ML algorithms can provide additional information that is difficult to retrieve using traditional methods, such as for example aerosol/cloud number concentration or PM2.5. Also, AI/ML techniques can take advantage of combined passive and active sensors to fill observation gaps between the horizontal sparsity of active sensors and the vertical sparsity of passive sensors, to improve real-time 3-D monitoring and modeling of the Earth's surface and atmosphere. AI/ML algorithms that can improve climate models, regional dynamical models, or air quality forecasting models, by learning to optimize location, time and frequency of aerosol and cloud property observations, are also sought.

Research Focus Area: ICAN-C-Obscured Vision Enhancement
Research Identifier**: RFA-042**

NASA Digital Transformation – AI/ML Foundation
NASA MSFC
POC: Kelsey Buckles kelsey.d.buckles@nasa.gov

Research Overview: AI/ML can be used to see through dust and debris, and image processing, providing instantaneous clarity of ambient environment capability.

Research Focus: Conduct research to create a software/hardware capability to reduce visual noise. Primary objective is to reduce visual noise of blowing regolith during lunar landing.

Research Focus Area: Lox Methane HS Video Analysis.
Research Identifier**: RFA-043**

NASA Digital Transformation – AI/ML Foundation
NASA MSFC
POC: Kelsey Buckles kelsey.d.buckles@nasa.gov

Research Overview: There is limited research in utilizing AI/ML software to identifies small scale motion detection in order to analyze a blast and characterize vapor cloud shape/position vs. time in space.

Research Focus: Conduct research to create AI/ML software that identifies small scale motion detection in order to analyze a blast and characterize vapor cloud shape/position vs. time in space. Primary function is to provide verification for Consolidated Operations, Management, Engineering and Test (COMET), Lightning Mapping Array (LMA), and Computational Fluid Dynamics (CFD). Other potential uses include structural health monitoring, foreign objects and debris clearing, and military asset recovery.

Research Focus Area: Motion Mag in the Dark.
Research Identifier**: RFA-044**

NASA Digital Transformation – AI/ML Foundation
NASA MSFC
POC: Kelsey Buckles kelsey.d.buckles@nasa.gov

Research Overview: There is limited research in determining the feasibility of using motion magnification, in place of the Integrated Modal Test (IMT).

Research Focus: Conduct research to determine the feasibility of using motion magnification, in place of the Integrated Modal Test (IMT). Primary objective is the potential replacement of IMT on Artemis II, using custom Long Wave Infrared (LWIR) cameras and lenses to encompass the entire stack.

Research Focus Area: Foreign Object Debris (FOD) Detection Using Computer Vision.
Research Identifier: **RFA-045**

NASA Digital Transformation – AI/ML Foundation
NASA MSFC
POC: Kelsey Buckles kelsey.d.buckles@nasa.gov

Research Overview: There is limited research with software/hardware capabilities to detect and record the location and shape of Foreign Object Debris (FOD).

Research Focus: Conduct research to create a software/hardware capability to detect and record the location and shape of FOD. Primary function would be to use in place of a FOD walk, provide debris location data for analysis, monitor airfields and launch complexes. Using a drone equipped with custom Long Wave Infrared (LWIR) cameras and lenses, with onboard image recognition software.

Research Focus Area: Using Multispectral Neural Radiance Fields (NeRFs) for Ground Detection & Characterization of Lunar Micro Cold Traps
Research Identifier**: RFA-046**

NASA Digital Transformation – AI/ML Foundation
NASA Ames
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Ariel Deutsch ariel.deutsch@nasa.gov

Research Overview: High-resolution, near-real-time modeling is crucial for lunar science and exploration missions, particularly in identifying icy targets. Our proposal aims to generate intricate models of micro-cold-trap topography, temperatures, and water content to streamline target identification in dynamic, low-light polar environments. By applying Neural Radiance Fields (NeRFs) to data acquired from Artemis III and VIPER missions, we plan to enhance 3D mapping techniques, supporting science operations in future NASA expeditions. Micro cold traps, small and cold regions where ice remains thermally stable, are believed to contain approximately 20% of the Moon's water ice. These traps are scattered across the lunar landscape and are safer and more accessible than permanently shadowed regions (PSRs). Despite their importance for lunar exploration, we lack prior knowledge of their locations and compositions due to their minute size.

Research Focus: Conduct research to remedy this by potentially employing custom-built NeRFs on multi-spectral ground-based data during mission operations. This research advancement would revolutionize surface science operations by facilitating the measurement and integration of micro-cold trap topography, temperature, and water content into augmented reality systems, thus assisting in identifying scientific targets.

Unlike traditional methods, NeRFs can maintain the full spectral range and resolution during scene optimization, potentially retaining spectral context throughout the 3D reconstruction process. By utilizing intelligent priors and leveraging knowledge about light sources and sparse point clouds of target regions, the optimization in the NeRF could be constrained. This would result in accurate 3D reconstructions across various wavelengths, especially those diagnostic of water ice. Our proposed NeRFs will be rigorously tested using the SSERVI Lunar Regolith Testbeds at NASA Ames.

Note: NASA Ames is in collaboration with UC Berkeley, with potential NSF funding being directed to Professor Angjoo Kanazawa of the department of Electrical Engineering and Computer Sciences (EECS). Her pioneering research in 3D vision, specifically related to neural volumetric rendering and Neural Radiance Fields, will be instrumental in driving this project forward.

Research Focus Area: High-Resolution 3D Mapping of Lunar Shadowed Regions Using Neural Radiance Fields (NeRFs)
Research Identifier: RFA- **RFA-047**

NASA Digital Transformation – AI/ML Foundation
NASA Ames

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Research Overview: With upcoming missions like Artemis and Commercial Lunar Payload Services (CLPS) aiming to study these lunar polar regions, designing safe traverses into, within, and out of permanently shadowed regions (PSRs) for robots and astronauts poses a primary challenge due to the lack of high-resolution and high signal-to-noise Digital Terrain Models (DTMs) of these areas.

Research Focus: Conduct research to overcome this, and determine if utilizing Neural Radiance Fields (NeRFs) will generate high-resolution 3D models of PSRs for efficient mission planning, safe operations, and maximizing scientific returns.
NeRFs, a novel technique in 3D reconstruction, outperform traditional methods like Multi-View Stereo (MVS) in handling complex lighting conditions typical of lunar polar regions. Recent developments in NeRF pipelines, including Sat-NERF, RAWNeRF, StructNeRF, and DS-NeRF, present promising opportunities for our applications. We intend to leverage these advancements in neural 3D reconstruction as well ray tracing techniques to simulate secondary illumination in PSRs to develop an hybrid MVS/NeRF-based mapping method for PSR reconstruction.

Note: NASA Ames is in collaboration with UC Berkeley, with potential NSF funding being directed to Professor Angjoo Kanazawa of the department of Electrical Engineering and Computer Sciences (EECS). Her pioneering research in 3D vision, specifically related to neural volumetric rendering and Neural Radiance Fields, will be instrumental in driving this project forward.

Research Focus Area: Study the deployment of Large Language Models (LLMs) for Systems Engineering and Project Management at NASA
Research Identifier: RFA- **RFA-048**

NASA Digital Transformation – AI/ML Foundation
NASA Ames

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Ariel Deutsch ariel.deutsch@nasa.gov

Research Overview: As the complexity of projects at NASA increases, more sophisticated tools are required for efficient systems engineering and project management. Large Language Models (LLMs) can offer potential advantages in these domains. However, due to their statistical nature, reliability and transparency concerns may hinder their adoption. Thorough verification and validation processes are vital to ensure their trustworthy and robust implementation in mission-critical planning and execution.

Research Focus: Conduct research on LLMs focuses on: (1) Identifying potential applications and benefits of LLMs in enhancing systems engineering and project management processes. (2) Establishing robust techniques for the verification and validation of LLMs within these contexts. (3) Recognizing and mitigating potential risks and limitations, addressing transparency and bias issues inherent in LLMs. The objective is to enable the integration of LLMs into NASA's operations to improve project management efficiency, reduce planning complexities, and facilitate more effective communication and information processing, paving the way for the next generation of space mission planning and execution.

Research Focus Area: Collaborative platforms for capturing data analytics workflows.
Research Identifier: **RFA-049**

NASA Digital Transformation – AI/ML Foundation
NASA Ames
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Research Overview: Platforms are needed that allow for individuals and groups to perform the many steps needed to transform raw data into domain-relevant insights and publications and capture these steps into workflows that can be shared, revised, and compared. Users must be able to use the tools that they are accustomed to using, such as Jupyter notebooks, MATLAB, Python libraries, various databases, and/or others. However, the various steps that users take need to be captured in a form to where they can be readily re-run, individual steps can be changed, the resulting new workflows can be re-run, and the results compared to the previous workflows. Such workflow capture systems and Machine Learning can be used as the basis for a recommender system for new users to recommend key steps in new workflows that they create. Such systems can also be used to flag publications that may need to be revised because earlier data processing or analytics steps have been revised. Such a system can also serve as an “honest broker” that can instantly make a record of who produced a given result so that others may use that result immediately, without waiting for a publication, and while automatically giving the creator due credit.

Research Focus: Conduct research to properly understand how experts in different domains perform data analytics and develop components of a workflow capture system that will work as described above while using the tools of those domains as much as possible and not impeding the experts' work. Research is also needed to identify interface standards that are general enough to allow the tool interoperability described here and demonstrate whether productivity is improved due to the components and systems developed.

Research Focus Area: Uses of generative AI to dynamically create Photo realistic 3D content in real-time for use in XR applications.
Research Identifier: **RFA-050**

NASA Digital Transformation – AI/ML Foundation
NASA Ames/JSC
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Research Overview: XR environments (virtual reality, augmented reality, and mixed reality) are being used to train crew, support operations, augment collaboration, improve the planning process, support complex data visualization, and support public and education outreach activities. One of the biggest challenges developing these applications is having access to high fidelity, realistic 3D models that are combined to create realistic and immersive applications. An active area of research is to use generative A.I. to, in real-time, create and insert 3D models into a virtual scene dynamically using a simple and intuitive user interface.

Emerging AI generative technologies currently being researched in this field include Neural Radiance Fields (NeRFs) and GANS to support the creation of 3D assets. An investigation into a Language Models (LLM) to generate natural language description of 3D assets can potentially be used in combination with NeRFs to speed up the process of 3D asset generation for XR applications.

Research Focus: Conduct research the feasibility of creating high fidelity 3D models dynamically (using a simple interface to define their properties) and insert them into a live XR session within acceptable timeframes, so that the user does not experience a degradation in frame rate that detracts from the immersive experience? Best validation methods to assure the assets created are representative of what would be expected. Optimum way(s) to interact with the system (voice, keyboard, other)?

Research Focus Area: Use of a Brain Computer Interface (BCI) system as a novel computer interface
Research Identifier: **RFA-051**

NASA Digital Transformation – AI/ML Foundation
NASA Ames/JSC
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Research Overview: The mantel of human to computer interaction for decades has been the keyboard and mouse. Recently technologies such as voice recognition and body/limb/finger tracking have also been used to provide inputs to computers. Of course, the ultimate computer input device would allow a person to interface their mind directly with a computer. The idea that people's thoughts could be read and manipulated has been a theme in science fiction for decades. Conceptually, the brain would be communicating with a computer the same way it communicates with other parts of the body, but instead of using eyes, hands and fingers directly, a person would just have to think what they want the computer to carry out.

Research Focus: Conduct research the feasibility of creating a functional BCI system and the level of interactions/commands that a brain computer interface can provide; What biometric devices are best suited for this type of application. Best methods to incorporate this type of system into an XR environment?

Research Focus Area: Cognitive State Determination System to Support Training, Education, and Real-Time Operations in an XR environment.
Research Identifier**: RFA-052**

NASA Digital Transformation – AI/ML Foundation
NASA Ames/JSC
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Research Overview: There is limited research on how we can use advanced computer science methods to develop correlation algorithms that use autonomic responses in the vision system (pupil dilation), autonomic response related to the conductance of the skin (galvanic skin response), the vascular system (heart rate and heart rate variability), electrochemical patterns in the brain (using EEG), hemoglobin-concentration changes in the brain (using Functional Near-Infrared Spectroscopy - FNIR), Electrical activity in the muscles (EMG), and vocal biomarkers. The system could use all of the biometric modalities mentioned above, or just a subset to carry a determination of a person's mental state. The states of primary interest include: cognitive underload, adequate cognitive workload, high cognitive workload, and cognitive overload. The system should also provide a confidence level for each prediction. A Cognitive State Determination System (CSDS) can significantly improve applications related to education, training, medicine, marketing, aeronautics, transportation, etc. For initial wide range usage, this type of system would require the use of non-intrusive sensors that are easy to use.

Note: An example of a CSDS system for training and education could allow for the educator/trainer to modulate the information being provided based on the trainee's cognitive state. If the trainee is bored, then additional elements to make the tasks more engaging could be added. If the person is getting close to cognitive overload, easier elements could be incorporated. Another example is the usage of a CSDS system to support real-time operations. Providing cognitive state information to support personnel or to the individual themselves would be valuable. This system can be used to support a wide range of activities from operating a spacecraft, flying an airplane, to driving a car. Coupling a cognitive state determination system with an AI/ML system would allow for the creation of an adaptable human interface that can modulate the information being provided to a user based on their cognitive state.

Research Focus: Conduct research on the feasibility to create a system that can accurately determine a person mental state. Specially its' ability to determine when a person is experiencing cognitive underload, adequate cognitive workload, high cognitive workload, and cognitive overload; Variability and performance differences between individuals; Study into the optimum set of biometric sensors needed for this type of system.

Research Focus Area: Automatic XR friendly procedure creation using videos
Research Identifier: **RFA-053**

NASA Digital Transformation – AI/ML Foundation
NASA Ames/JSC
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Research Overview: NASA and many other organizations use procedures to support a wide variety of applications that range from maintaining a simple system, to carrying complex operations in dangerous environments. Depending on the use-case, developing procedures can require significant resource investments by many people with different skill bases. These individuals are scarce and always in demand. The desire is to have the ability to create XR friendly procedures automatically by capturing and analyzing training videos of specific tasks. Additionally, capturing and analyzing context specific to NASA's (or other companies) terms/vocabulary from the video voice or written instructional documentation is a challenging, but necessary component to create accurate and useable procedure content. Finally, in order for the virtual procedure assistance to serve its purpose to its full extent, it must be able to adapt to the user's expertise by presenting the information to them in a user customized manner. Another area of research is how to best incorporate this capability in an immersive XR system.

Research Focus: Conduct research to determine the feasibility of creating a system that can automatically develop accurate procedures using video.; Optimum ways to interact with such a system; Ability for a system to customize procedure content to meet an individual's expertise.

Research Focus Area: Video based mocap system
Research Identifier: **RFA-054**

NASA Digital Transformation – AI/ML Foundation
NASA Ames/JSC

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Research Overview: VR Motion Capture (Mocap) Systems are an important part of an XR system. Technology specific challenges that would be researched include the overall performance and viability of a video based Mocap system. In the near-term, R&D will benefit from automation of analytical workflows for engineering design and contribute toward research and the evaluation of options for in-flight crew data collections on the ISS. Comparing how an astronaut is ambulating over time, when carrying out an activity, can be used to determine changes in the musculoskeletal system that may be caused by fatigue or injury. Identifying and looking for ways to mitigate these types of changes is important to assure that astronauts are always performing in an optimum state.

Furthermore, contactless mocap system can support the development of a personal coach that can instruct a person when they are not performing exercises correctly. This could be done by using a pre-trained A.I. system that knows the positions of a person's limbs, torso and head while exercising and comparing them to optimum positions for the activity. Investigating ways that the system can interact with a person is another research area.

Research Focus: Conduct research to determine the feasibility of creating a system that can automatically determine a person's pose based on video. Performance metrics and limitations of such a system.

Research Focus Area: Retrieval Augmented Dialog LLM
Research Identifier: **RFA-055**

NASA Digital Transformation – AI/ML Foundation
NASA HQ

POCs: David Meza david.meza-1@nasa.gov

Research Overview: NASA policy, strategic documents, SOPs, and other important information are split across many diverse and disparate documents. Currently it is highly time consuming and difficult for NASA employees to determine the correct policy or SOP relevant to their situation. NASA employees lack a simple tool for them to quickly get answers to their questions in a seamless, natural way. Large Language Models (LLMs) provide a potential simple interface for employees to get answers, but current models require NASA questions and information to be provided to a 3rd party as part of the Generative AI process threatening the security of NASA's information. Existing Generative AI tools also suffer from hallucinations where they provide highly convincing, but inaccurate responses.

Research Focus: By deploying an LLM on the NASA network, NASA employees will be able to ask questions in natural language without risking their data leaving NASA systems. This will ensure their privacy and the protection of NASA information. By breaking NASA documents into small chunks of relevant information and storing those documents as semantic embeddings in a vector database, the relevant pieces of NASA policy can be retrieved to answer each question as it is asked. Through prompt engineering and fine-tuning, the LLM can be guided to answer the questions with the additional information "injected" from the NASA official policies and documents. This ensures the models provide true information and do not hallucinate answers to questions not available in their public training data. This project will pilot creating this tool on NASA infrastructure and determine how the tools and interface must be customized for the NASA environment and use cases. This project will explore, document, and propose a technical path forward to scale the pilot system to a production NASA tool. This solution could be replicated at any Agency or organization.

A.10 Earth Science

Science Mission Directorate (SMD)
NASA SMD Earth Science Division (ESD)

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Dr. Kelsey Bisson kelsey.bisson@nasa.gov
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Research Focus Area: Impacts of human activity on coastal physical, geomorphological and ecological variability
Research Identifier: **RFA-056**

Research Focus Area: Sea level rise, coastal erosion/retreat, and salt-water intrusion, and their impacts on ecosystems;
Research Identifier: **RFA-057**

Research Focus Area: Linkages between aquatic dynamics and land subsidence and its impacts on aquatic ecosystems
Research Identifier: **RFA-058**

Research Focus Area: The role of urban development on land subsidence and aquatic ecosystems; biophysical coupling and feedbacks within the aquatic-land interface
Research Identifier: **RFA-059**

Research Focus Area: Impacts of hazards related to climate extremes, such as storms and heat waves, on biogeophysical aspects of the coast; etc.
Research Identifier: **RFA-060**

Research Focus Area: Impacts of upstream activities on coastal communities
Research Identifier: **RFA-061**

Research Focus Area: Integration of existing and upcoming observational and modeling assets into a conceptual or (better) digital aquatic-land framework that enables the dynamical coupling of key processes within the aquatic-land interface.
Research Identifier: **RFA-062**

Research Focus Area: Exposure and vulnerability to geohazards (e.g., infrastructure and flooding, landslides, etc.), land cover/use change and their impacts on water
Research Identifier: **RFA-063**

Research Overview: NASA SMD Earth Science Division (ESD) seeks topics to address coastal and ecosystem resilience, and equity and environmental justice.
This research focus area seeks to expand and build on the recently-established Coastal Resilience program, selected under ROSES22, and the work solicited under ROSES21 equity and environmental justice and ROSES22 IDS environmental and climate justice. Climate change impacts all aspects of the Earth and human systems, and highly populated coastal communities (adjacent to inland water bodies and the ocean) are among those experiencing its most disruptive consequences. Extreme weather events on land (droughts/floods), erosion, loss of marshes and wetlands, rising oceans and other direct human-induced changes threaten coastal communities, ecosystems, national and global economies. Furthermore, land changes from human activities such as groundwater/hydrocarbon extraction/injection, levee construction, river/sediment management, and

urban development can have compounding effects with the naturally occurring land processes such as tectonics, sediment compaction, erosion, etc., with each process modifying the land surface elevation and coastal geomorphology. Combined, these complex and interconnected aquatic-land processes impact biogeochemistry and ecology, affect ecosystem structure and function, and threaten biodiversity.

NASA ESD recognizes a need to develop and learn from relationships with environmental justice (EJ) and climate justice (CJ) and underserved communities, as well as organizations familiar with working alongside these communities. EJ and CJ refer to communities in geographic locations around the globe with significant representation of minoritized populations, low-income persons, and/or indigenous persons or members of Tribal nations, where such individuals experience, or are at risk of experiencing, more adverse human health, environmental, and/or climate change impacts.

NASA Earth Science and satellite-based Earth observations can play an important role in addressing questions at the intersection of Earth observations and EJ/CJ, and are critical to understanding and predicting land/aquatic interface environments that undergo natural and human-induced changes. Understanding both direct and indirect human-induced changes is equally important in informing studies of coastal resilience and addressing high priority EJ/CJ needs.

Proposals seeking to respond to this EPSCoR Research Topic must address research that contributes to furthering support priorities related to coastal resilience and EJ/CJ, and will provide the foundational information and evidence-based knowledge that will help inform solutions to increase resilience of coastal communities and high priority needs as exemplified below. NASA is specifically interested in proposals that make significant use of remote sensing data to advance our understanding of key physical, biological, biogeochemical, geological, and hydrological coastal processes and their interactions within the interface of the aquatic-land-human system, and to enhance our understanding of how these processes will be compounded in rapidly changing coastal environments.
Examples of potential topics suitable for the EPSCoR research on coastal resilience include the exploration of the underlying physical, biological, and/or geological mechanisms within the aquatic-land framework and potential feedback processes and impacts on coastal ecosystems and underserved communities. Examples of coupled coastal processes may include but are not limited to:

1. Impacts of human activity on coastal physical, geomorphological and ecological variability;
2. Sea level rise, coastal erosion/retreat, and salt-water intrusion, and their impacts on ecosystems;
3. Linkages between aquatic dynamics and land subsidence and its impacts on aquatic ecosystems;
4. The role of urban development on land subsidence and aquatic ecosystems; biophysical coupling and feedbacks within the aquatic-land interface;
5. Impacts of hazards related to climate extremes, such as storms and heat waves, on biogeophysical aspects of the coast; etc.
6. Impacts of upstream activities on coastal communities
7. Integration of existing and upcoming observational and modeling assets into a conceptual or (better) digital aquatic-land framework that enables the dynamical coupling of key processes within the aquatic-land interface.
8. Exposure and vulnerability to geohazards (e.g., infrastructure and flooding, landslides, etc.), land cover/use change and their impacts on water

The proposed investigations should be of regional (beyond local, 1,000+ km) focus, preferably in areas of high potential population growth, e.g. U.S. East, West, or Gulf coasts, Island Nations, and other low-lying regions across the globe that are impacted by climate change and/or socio-economic disadvantages. Proposals must provide a rationale for their region of choice. Proposals targeting the EJ/CJ topics are encouraged to integrate socio-economic data in their proposal.

Proposed investigations must utilize remotely sensed observations (e.g., MODIS, Landsat, etc.) for data analysis and as a primary research tool; however, other NASA data products from airborne campaigns, ground-based stations, or model output may be used for the proposed research. Proposers are also encouraged to use data acquired via the NASA Commercial SmallSat Data Acquisition Program (CSDAP). A description of NASA's fleet of Earth observing satellites and sensors can be found at https://science.nasa.gov/missions-page/, with more details about related airborne missions at https://airbornescience.nasa.gov/. Information about data access and discovery can be found at https://earthdata.nasa.gov/.

This research opportunity will not fund the acquisition of new in situ data, but seeks to further leverage the large quantities of remotely sensed and/or in situ data that NASA has already collected over the years.

Research Focus Area: Ocean Worlds Research: observational and modeling synergies between ice, ocean and surficial processes on Earth and other ocean environments in our solar system

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Research Identifier**: RFA-064**

Earth's ocean sustains an extraordinary diversity of life. At the base of the marine food web are phytoplankton, which are unicellular protists that perform photosynthesis at rates equivalent to all plants on land, through the absorption of atmospheric CO2 and sunlight where oxygen and biomass are byproducts for consumption by the wider ecosystem. Phytoplankton use and alter the incoming light field to such a large extent that ecosystem changes are visible from space. On Earth, satellite observations are the only way to observe synoptic change at the time scales relevant for ecosystems, from daily to decadal and from kilometers to the whole globe.

But Earth isn't the only ocean world in our solar system. Water exists in diverse forms on other planets, moons, dwarf planets, and comets. Given the essential role of water as a solvent for "life as we know it," ice, clouds, water vapor in the atmosphere, and oceans on other worlds offer clues in the quest to discover life beyond our home planet. Coordination and collaboration between the Earth ocean sciences and planetary science communities will be critical for next generation studies of ocean world habitability, and – ultimately – building a framework for detecting life. Earth ocean scientists understand how life covaries with environmental conditions and processes, while planetary scientists can translate those underlying concepts to alien environments and present day and future spacecraft measurements. No perfect analog for life on ocean worlds exists on Earth, but there are several environments with similar attributes (e.g., polar ice/ocean interactions, hydrothermal vents) that can be used to generate insights. Extraterrestrial environments may also conceivably present analogs for past terrestrial environments which no longer exist today but which are relevant for understanding the evolution of life on Earth. Synergistic activities concerning how these various planetary layers of ice and atmosphere affect our observations is important because the ice shell and atmosphere are the only window through which we will, for now, observe ocean world systems. This topic seeks projects that further advance the understanding of the workings of ocean worlds, including Earth, by further exploring processes that occur on ocean worlds across the solar system. For example, how do organisms alter ice properties and can these alterations be produced abiotically as well? What surface ice observations indicate underlying ocean processes? Are there places on Earth from which an abiotic baseline (and accompanying observations) can be determined? How do seafloor heating and rotation drive ocean currents, and how do currents distribute biosignatures, heat, salt, nutrients and other components? What are the timescales for equilibrium of volatile organic compounds from different environments? What life forms are found on Earth along the temperature, salinity, pressure spectrum, and can these be used to develop biotic intuitions for other ocean worlds?

Terrestrial and extraterrestrial ocean scientists must work collaboratively to measure and model spatial and temporal dynamics, determine essential parameters that govern interface processes, and evaluate new and existing technologies to access and study dynamics of habitable worlds. Synergy between studies of ice, ocean and geothermal processes on Earth, in targeted ways, and models of how these processes may manifest on ocean worlds benefits both communities. Moreover, the technological needs for exploring, especially at the poles, are often synergistic.

15.A.11 Entry Systems Modeling Project
Space Technology Mission Directorate (STMD)

Entry Systems Modeling Project
Space Technology Mission Directorate (STMD)

Research Focus Area: Deposition of Ablation/Pyrolysis Products on Optical Windows
Research Identifier**: RFA-065**
POC: Aaron Brandis aaron.m.brandis@nasa.gov
Research Overview: Provide experimental data to characterize the deposition of ablation/pyrolysis products on radiometer/spectrometer windows that reduce transmissivity.
Research Focus: Mars 2020 carried a radiometer on the backshell of the entry vehicle as part of the MEDLI2 instrumentation suite. Pyrolysis and ablation products can be deposited on the radiometer window during entry, and reduce the transmissivity. This reduction in transmissivity is a function of spectral wavelength, and can reduce the signal level reaching the radiometer sensing element. Such a test could be conducted in an ArcJet or Plasma torch either with a scaled approximate model of Mars 2020, or a simplified geometry (e.g. a wedge, backward facing step). Relevant materials for testing include PICA, RTV and SLA 561V. After products have been deposited on the window during a test, these products need to be characterized and the transmissivity of the window measured. These post-test results could either be measured as part of the proposal, or the post-test models sent back to NASA for characterization.

Research Focus Area: Plume Surface Interaction Predictive Capability
Research Identifier**: RFA-066**
POC: Aaron Brandis aaron.m.brandis@nasa.gov

Research Overview: Both model improvements and validation data are needed to further develop a multi-physics capability for simulating the interaction of rocket plumes and surface ejecta.
Research Focus: During propulsive spacecraft landings on surfaces with significant surface regolith (or other potential ejecta particles), such as found on the Moon or Mars, improved modeling of the interactions between rocket exhaust plumes and the surface upon which the vehicle is landing is needed. This complicated, multi-physics coupled particle-laden flow produces several phenomena of interest: plume-flow physics, surface erosion, and ejecta dynamics. All of these phenomena can lead to potential risks to a successful mission, including to nearby infrastructure, instrumentation, the vehicle, and in the future, crew. Current models exist for predictive modeling capabilities with varying levels of fidelity. These models largely use computational fluid dynamics (CFD). However, well characterized, relevant data for use in validation or for model inputs is often lacking. Therefore, this topic seeks data utilizing either intrusive or non-intrusive experimental approaches for plume-surface interaction studies that can be used to further the fidelity of predictive models by either improving model input parameters, providing a validation dataset, or informing the design of future ground and flight tests.
Research Focus Area: Computational Methods For Propagating Uncertainty in Hypersonic Flow Simulations
Research Identifier**: RFA-067**
POC: Aaron Brandis aaron.m.brandis@nasa.gov

Research Overview: Develop and implement novel methods to propagate uncertainty distributions for hypersonic computational fluid dynamic simulations.
Research Focus: Hypersonic flow simulations involve many models and database inputs for which each has a large number of either experimentally or fundamentally derived parameters. The impact of uncertainty in these

parameters on quantities of interest has often been dealt with in the past via Monte Carlo style calculations, and frequently using a significantly reduced set of parameters. Therefore, a detailed and robust approach for characterizing the uncertainty on quantities of interest in non-equilibrium real gas hypersonic computational fluid dynamic simulations (CFD) is desired. The method should be able evaluate the sensitivity for defined quantities of interest (e.g. heat flux, or shear stress) to the large number of model and design parameters used as CFD inputs, which can be highly non-linear. An important aspect of the numerical approach detailed is to optimize computational efficiency (time, compute resources) in accurately capturing the sensitivity to this large number of input parameters. The ultimate goal being to use such a methodology to quantitatively assess the reliability of an aeroshell thermal protection system (TPS) during entry.

Research Focus Area: Nitrogen/Methane Plasma Experiments Relevant to Titan Entry
Research Identifier**: RFA-068**

POC: Aaron Brandis aaron.m.brandis@nasa.gov

Research Overview: Provide experimental data to characterize TPS material response under simulated Titan entry conditions.

Research Focus: Research Focus: Data is needed to validate models for the material response of thermal protection system (TPS) materials under simulated Titan entry conditions, with the atmosphere being predominately nitrogen (N2) and a small amount of methane (CH4). The conditions should be traceable to conditions relevant to the upcoming Dragonfly mission. Furthermore, an understanding of how coatings, e.g. NuSil, are impacted (or not) by the presence of methane and in a non-oxidizing environment is of interest. Relevant facilities for such measurements could include ArcJets or Plasma Torches. Data of interest would include thermocouples imbedded in TPS materials (e.g. PICA, SLA) and non-intrusive surface temperature measurements. Characterization of the post-test materials is also of interest. Understanding the material response of NuSil/PICA in a Titan atmosphere is important to maximize the science return for the DrEAM instrumentation suite.

Research Focus Area: Predictive Modeling of Plasma Physics Relevant to High Enthalpy Facilities
Research Identifier**: RFA-069**

POC: Aaron Brandis aaron.m.brandis@nasa.gov

Research Overview: Develop predictive models for arc and plasma processes used in the generation of high enthalpy flows in shock tube and arcjet facilities at NASA.
Research Focus: This proposal seeks predictive modeling of processes occurring in facilities that generate high enthalpy flows at NASA, including Arcs and Plasma Torches. The objectives may differ depending on facilities being modeled. For instance, the Electric Arc Shock tube uses an Arc to produce a high velocity shock waves. Acoustic modes in the arc driver may determine velocity profiles in the tube while ionization processes produce radiating species that may heat driven freestream gases. In plasma torches, studies of recombination of Nitrogen and Air plasma flows have relevance for predicted backshell radiation modeling. Modeling in arc jets may improve estimates of enthalpy profile uniformity and mixing of arc gas with add air.

Research Focus Area: Mechanical Properties of Ablative TPS Materials during Char Formation
Research Identifier**: RFA-070**

POC: Aaron Brandis aaron.m.brandis@nasa.gov

Research Overview: Provide mechanical property data to enable models that couple pyrolysis and char formation with thermostructural analysis for predicting the stress state of ablative TPS materials of interest to Entry Descent and Landing projects and missions at NASA.

Research Focus: This proposal seeks mechanical and/or strength measurements of ablative, porous thermal protection system (TPS) materials. The properties should be determined as a function of char conversion, with the char conversion occurring under controllable, repeatable conditions. Both degree and rate of char formation on the final properties would be desirable. The data would be made available to the TPS materials modeling groups at NASA to improve coupled ablative and thermostructural models.

15.A.12 Office of Chief Health and Medical Officer (OCHMO)

Space Operations Mission Directorate (SOMD)

POC: Dr. Victor Schneider, vschneider@nasa.gov

Dr. James D. Polk, james.d.polk@nasa.gov

Research Focus Area: Development and elaboration of Functional aids and testing paradigms to measure activity for use by parastronauts during spaceflight

Research Identifier**:** **RFA-071**

POC: Victor S. Schneider vschneider@nasa.gov

Research Overview: Development and elaboration of Functional aids and testing paradigms to measure activity for use by parastronauts during spaceflight. This may include egressing and exiting space capsules and donning and doffing spacesuits and other aids for parastronauts. The European Space Agency is establishing a parastronaut feasibility project. Since NASA offers its international partners access to NASA supported spacecraft and the International Space Station, NASA wants to establish appropriate functional testing measures to determine the time it takes fit astronaut-like subjects compared to fit parastronaut subjects to egress and exit simulated space capsules and simulated donning and doffing spacesuit. Research proposals are sought to establish appropriate functional testing.

Research Focus Area: Evaluation space capsule and spacesuit activity in stable and fit lower or upper extremity amputees and compare their responses to non-amputee fit individuals

Research Identifier**:** **RFA-072**

POC: Victor S. Schneider vschneider@nasa.gov

Research Overview: Evaluation space capsule and spacesuit activity in stable and fit lower or upper extremity amputees and compare their responses to non-amputee fit individuals. The European Space Agency is establishing a parastronaut feasibility project. Since NASA offers its international partners access to NASA supported spacecraft and the International Space Station, NASA wants to obtain research data measuring the time it takes fit astronaut-like subjects compared to fit parastronaut subject to egress and exit simulated space capsules and simulated donning and doffing spacesuit. Research proposals are sought to obtain data measuring the functional testing indicated.

15.A.13 Human Research Program
Human Exploration and Operations (HEO) Mission Directorate (HEOMD)

Dr. Kristin Fabre kristin.m.fabre@nasa.gov

Human Research Program

The NASA Human Research Program (HRP) drives advances in scientific and technological research to enable human space exploration. It is a human-focused Program dedicated to providing solutions and mitigation strategies beyond low-earth orbit by reducing the risks to human health & performance through focused translational, applied, and operational research. HRP's primary deliverables include:

- Human health, performance, and habitability standards
- Countermeasures and other risk mitigation solutions
- Advanced habitability and medical support technologies

Recently, HRP has developed a strategy to deliver critical components for an evolvable Crew Health and Performance System by 2032. This will be central to how HRP characterizes spaceflight risks and produces mitigation strategies that enable optimal crew health and performance during exploration missions. HRP will demonstrate and mature this system in ground analogs, in LEO, and on and around the moon to support a 2039 Mars mission. The Human Research Roadmap (https://humanresearchroadmap.nasa.gov) is a web-based version of an HRP Integrated Research Plan that allows users to search HRP risks, gaps, and tasks.

The HRP is organized into several research Elements:

- Human Health Countermeasures
- Human Factors and Behavioral Performance
- Exploration Medical Capability
- Space Radiation

Each of the HRP Elements addresses a subset of the risks. Proposals should address specific gaps listed in the Human Research Roadmap (https://humanresearchroadmap.nasa.gov/Gaps/).

Researchers from proposals selected for this R3 opportunity should consider attending the Human Research Program Investigators' Workshop (HRP IWS) in Galveston, TX (February 2025).

Human Research Program
Human Exploration and Operations (HEO) Mission Directorate (HEOMD)

<u>Precision Health Initiative</u>

Research Focus Area: Pilot studies to adopt terrestrial precision health solutions for astronauts
Research Identifier**: RFA-073**

POC: Corey Theriot corey.theriot@nasa.gov , 281-244-7331

The term "precision health" (similar to precision or personalized medicine in clinical settings) refers to the strategy of collecting and analyzing an individual's unique health status along with environmental and lifestyle data to identify key factors that can ultimately improve the health and performance of each crewmember in an individualized manner.

The Precision Health Initiative seeks to identify innovative methods to maintain an individual astronaut's health and optimal mission performance, requiring in-depth understanding of individual molecular profiles and how they relate to health and performance. The practice of Precision Health encompasses the use of detailed phenotyping of an individual, using both clinical and molecular measures, along with the integrated analyses of those data to draw conclusions about an individual's response to the environment, diet, medications, exercise regimen, etc. This topic seeks proposals for preliminary pilot studies that identify vetted and approved precision health techniques from terrestrial settings that can be applied with little to no modification to crewmembers that will be exposed to the stressors of spaceflight: space radiation, altered gravity, isolation/confinement, distance from Earth, and hostile/closed environments. For this solicitation, the term "technique" encompasses any clinical practice, strategy, test, or process that provides a clinically actionable medical outcome or unique knowledge of an individual's health status.

Research Focus: While most terrestrial precision medicine techniques focus on diagnosis and treatment of disease states, NASA is most interested in preventive measures that maintain crew health and performance during exposure to spaceflight stressors resulting in human health and performance risks as described in the Human Research Roadmap (https://humanresearchroadmap.nasa.gov). Proposed precision health techniques should have compelling evidence of efficacy for the crew population and be approved for terrestrial clinical practice by appropriate governing bodies, and proposals should address incorporation into the existing NASA operations, workflow, and infrastructure. Any proposed precision health techniques using genetic information must comply with the Genetic Information Nondiscrimination Act of 2008 (GINA) rules that preclude use of genetic information in employment decisions, which for NASA means that genetic data cannot be used to inform or influence crew selection or crew mission assignments.

Research Focus Area: Use of human-based tissue engineered models for characterization of space stressor and/or hazard effects.

Research Identifier**:** **RFA-074**

POC: Janapriya Saha janapriya.saha@nasa.gov

Complex *in vitro* models that mimic component of human physiology continue to evolve and show promise for various research. These tissue-engineered models, including organoids and tissue chips, could be ideal in better understanding space flight stressors and hazards such as chronic effects of low-dose radiation exposure to the human, microgravity, etc.. *Research proposals are sought to establish translational value of human-based tissue models for characterization of space flight hazards and/or stressor, and countermeasure studies. Such research should include models relevant to cancer, cardiovascular health, neurocognitive health, bone, immune, retinal etc. (For additional information concerning areas of interest please visit* https://humanresearchroadmap.nasa.gov/Risks/) Selected stressor and or hazard levels should be relevant to space exploration missions.

Respondents can propose the following types of activities:

1. Conduct research on HUMAN tissue models and compare to existing human data on vascular, cancer, cardiovascular health, neurocognitive health, bone, immune, retinal etc.. Structural and functional sturdies should be included, in addition to cell/molecular biomarker readouts. Selected stressor and or hazard levels should be relevant to space exploration missions.

2. Conduct research on ANIMAL tissue models and compare to existing in vivo data on vascular, cancer, cardiovascular health, neurocognitive health, bone, immune, retinal etc.. Structural and functional sturdies should be included, in addition to cell/molecular biomarker readouts. Selected stressor and or hazard levels should be relevant to space exploration missions
3. Obtain relevant preliminary data from either activities 1 or 2 that can be used in a future HRP OMNIBUS or FLAGSHIP grant application

Research Focus Area: Remote-controlled robotic operation

Research Identifier**:** **RFA-075**

POC: Honglu Wu honglu.wu-1@nasa.gov

Research Overview: This research focus area seeks proposals to develop technologies that enable performing tasks with a robot on the Space Station, the Moon or Mars. The robot will be controlled by humans on Earth, and should strive to be able to perform tasks remotely such as surgeries on humans. Other tasks include, but are not limited to, manufacturing new materials in the microgravity environment and preclinical experiments for investigating biological changes and health risks in space, using advanced tissue culture and/or animal models. The intent of such technologies is to allow for highly trained and experienced personnel to remotely perform tasks in space, to not only minimize the involvement of the crew, but also potentially improve the experimental environment and animal welfare with reduced hands-on activities.

Space Radiation

Space radiation exposure is one of numerous hazards astronauts encounter during spaceflight that impact human health. High priority health outcomes associated with space radiation exposure are carcinogenesis, cardiovascular disease (CVD), and central nervous system (CNS) changes that impact astronaut health and performance.

Research Focus Area: Tissue and Data sharing for space radiation risk and mitigation strategies
Research Identifier**:** **RFA-076**
POC: Janice Zawaski janice.zawaski@nasa.gov

Research Overview: Research proposals are sought to accelerate risk characterization for high priority radiation health risks and inform mitigation strategies the NASA Human Research Program (HRP) Space Radiation Element (SRE) by sharing animal tissue samples and data. The proposed work should focus is on translational studies that support priority risk characterization (cancer, CVD, CNS), development of relative biological effectiveness (RBE) values, identification of actionable biomarkers, and evaluation of dose thresholds for relevant radiation-associated disease endpoints. Cross-species comparative analyses of rodent data/samples with higher order species (including human archival data and tissue banks) are highly encouraged.

- Data can include but is not limited to behavioral tasks, tumor data, physiological measurements, imaging, omics', etc. that has already been, or is in the process of being, collected.
- Tissue samples can include, but are not limited to, samples that have already been, or are in the process of, being collected and stored as well as tissues from other external archived banks (e.g., http://janus.northwestern.edu/janus2/index.php).
- Relevant tissue samples and data from other externally funded (e.g., non-NASA) programs and tissue repositories/archives for comparison with high linear energy transfer (LET), medical proton, neutron and other exposures can be proposed.

- A more detailed list of samples and tissues available from SRE can be found at our tissue sharing websites:
  - https://lsda.jsc.nasa.gov/Document/doc_detail/Doc13726
  - https://lsda.jsc.nasa.gov/Document/doc_detail/Doc13766
  - https://lsda.jsc.nasa.gov/Biospecimen by searching "NASA Space Radiation Laboratory (NSRL)" in the payloads field.
  - Instructions for accessing the tissue sharing information are posted at: https://spaceradiation.jsc.nasa.gov/tissue-sharing/.

Research Focus Area: Compound screening techniques to assess efficacy in modulating responses to radiation exposure.
Research Identifier**:** **RFA-077**

POC: Janice Zawaski janice.zawaski@nasa.gov

Research Overview: Research proposals are sought to establish innovative screening techniques for compound-based countermeasures to assess their efficacy in modulating biological responses to radiation exposure relevant to the high priority health risks of cancer, CVD, and/or CNS. Techniques that can be translated into high-throughput screening protocols are highly desired, however high-content protocols will also be considered responsive.

Research Focus Area: Inflammasome role in radiation-associated health impacts
Research Identifier**:** **RFA-078**

POC: Janapriya Saha janapriya.saha@nasa.gov

Research Overview: Research proposals are sought to evaluate the role of the inflammasome in the pathogenesis of radiation-associated cardiovascular disease (CVD), carcinogenesis, and/or central nervous system changes that impact behavioral and cognitive function. Although innate inflammatory immune responses are necessary for survival from infections and injury, dysregulated and persistent inflammation is thought to contribute to the pathogenesis of various acute and chronic conditions in humans, including CVD. A main contributor to the development of inflammatory diseases involves activation of inflammasomes. Recently, inflammasome activation has been increasingly linked to an increased risk and greater severity of CVD. Characterization of the role of inflammasome-mediated pathogenesis of disease after space-like chronic radiation exposure can provide evidence to better quantify space radiation risks as well as identify high value for countermeasure development.

Research Focus Area: Aging related effects of space radiation
Research Identifier**:** **RFA-079**
POC: Gregory Nelson gregory.a.nelson@nasa.gov or Janice Zawaski janice.zawaski@nasa.gov

Normal aging processes have been shown to include many cellular processes that are shared with the pathogenesis of late degenerative diseases. Aging involves a progressive loss of physiological integrity and impaired function and is considered a primary risk factor for cancer, diabetes, cardiovascular disorders, and neurodegenerative diseases. Recently aging processes have been organized into a unified framework called the Hallmarks of Aging (e.g. López-Otin 2013, http://dx.doi.org/10.1016/j.cell.2013.05.039). The nine identified hallmarks of aging are: genomic instability, telomere length reduction, epigenetic changes, altered protein homeostasis, deregulated nutrient sensing, mitochondrial dysfunction, cellular senescence, stem cell depletion, and altered intercellular communication. Many of these processes have been investigated in detail in the context of low LET radiation exposure and "accelerated aging" has been proposed as a conceptual framework for radiation effects. However, much less understood about the effects of high LET space-like radiation exposure, especially at low doses and dose rates. These processes underly impairments to human risk imposed by space radiation exposure and an understanding of their responses is required for astronaut risk estimation, health management and countermeasure development. *Research proposals are sought to explore the pathogenic processes associated with aging and late degenerative diseases that are also elicited by charged particle radiation of composition and dose corresponding to spaceflight exposures. Such research should include models relevant to, but not limited to, cancer, cardiovascular and central nervous system health.*

Respondents can propose the following types of activities:

1. Conduct research on adult animals (sexually and immunologically mature) exposed to space-like radiation that characterize pathogenic processes common to aging and radiation injury. Outcome measures that relate to altered protein homeostasis, mitochondrial dysfunction, cellular senescence, and inflammation are of particular interest as well as those that can be used as predictive biomarkers for translation to humans. Use of both wild type and transgenic animals of both sexes is appropriate. Selected radiation doses, dose rates and sources should be relevant to space exploration missions.
2. Conduct research comparing human and animal tissue models using engineered tissue and organoid models. Structural and functional studies should be included, in addition to cell/molecular biomarker readouts. Selected radiation doses and sources should be relevant to space exploration missions.

Research Focus Area: Effects of space radiation on microvasculature
Research Identifier**: RFA-080**
POC: Gregory Nelson gregory.a.nelson@nasa.gov or Janice Zawaski janice.zawaski@nasa.gov

The microvasculature is responsible for perfusion, nutrient delivery, waste removal and endocrine communication for all cells and tissues and regulates these functions according to real-time tissue demands. It forms the interface between the blood, immune system and parenchyma and plays critical roles in wound healing (e.g., angiogenesis and coagulation). Its structure is adapted to different tissues and organs and can organize to isolate compartments such as blood-brain barrier or portal circulations such as in the liver. Microvascular injury is a prominent feature of normal tissue radiation injury and plays a critical role in both acute (inflammatory) and chronic (fibrotic) radiation responses. It has been hypothesized that damage to vascular endothelium plays the primary role in the development of late radiation-induced tissue injury and many years of investigation using low LET radiation support this idea (e.g. Lyubimova, N. and Hopewell, J.W., 2004 for late CNS effects). However, our knowledge of the effects of high LET space-like radiation on the microvasculature is very incomplete. Limited *in vivo* and *in vitro* experiments have demonstrated altered brain vessel network structure, adhesive properties, blood-brain and blood-retina barrier dysfunction, angiogenesis and other cellular changes. *Research proposals are sought to explore the structural and functional responses of the microvasculature to charged particle radiation of composition and dose corresponding to spaceflight exposures. Such research should include models relevant to, but not limited to, cardiovascular and central nervous system health and may include in vitro and in vivo studies. For purposes of this solicitation, microvasculature or microvessels refers to capillaries and associated small arterioles and venules as well as lymphatics.*

Respondents can propose the following types of activities:

1. Conduct research on adult animals exposed to space-like radiation that characterize functional and structural changes to microvessels in one or more tissue. Biochemical changes, cell signaling,

interactions of endothelial cells with immune system components, measures of perfusion, etc. as they relate to tissue and organ function and overall health are all appropriate. Tumor vasculature models are not of interest. Selected radiation doses and sources should be relevant to space exploration missions. (Computational models of circulation?)

2. Conduct research comparing human and animal tissue models using engineered tissue and organoid models. Structural and functional studies should be included, in addition to cell/molecular biomarker readouts. Selected radiation doses and sources should be relevant to space exploration missions.

Research Focus Area: Use of human-based tissue engineered models for characterization of space stressor and/or hazard effects.

Research Identifier**:** **RFA-081**

POC: Janapriya Saha janapriya.saha@nasa.gov

Complex *in vitro* models that mimic component of human physiology continue to evolve and show promise for various research. These tissue-engineered models, including organoids and tissue chips, could be ideal in better understanding space flight stressors and hazards such as chronic effects of low-dose radiation exposure to the human, microgravity, etc.. *Research proposals are sought to establish translational value of human-based tissue models for characterization of space flight hazards and/or stressor, and countermeasure studies. Such research should include models relevant to cancer, cardiovascular health, neurocognitive health, bone, immune, retinal etc. (For additional information concerning areas of interest please visit* https://humanresearchroadmap.nasa.gov/Risks/) Selected stressor and or hazard levels should be relevant to space exploration missions.

Respondents can propose the following types of activities:

4. Conduct research on HUMAN tissue models and compare to existing human data on vascular, cancer, cardiovascular health, neurocognitive health, bone, immune, retinal etc.. Structural and functional sturdies should be included, in addition to cell/molecular biomarker readouts. Selected stressor and or hazard levels should be relevant to space exploration missions.
5. Conduct research on ANIMAL tissue models and compare to existing in vivo data on vascular, cancer, cardiovascular health, neurocognitive health, bone, immune, retinal etc.. Structural and functional sturdies should be included, in addition to cell/molecular biomarker readouts. Selected stressor and or hazard levels should be relevant to space exploration missions
6. Obtain relevant preliminary data from either activities 1 or 2 that can be used in a future HRP OMNIBUS or FLAGSHIP grant application

15.A.14 Planetary Division
Science Mission Directorate (SMD)

SMD requests that EPSCoR includes research opportunities in the area of Extreme Environments applicable to Venus, Io, Earth volcanoes. and deep-sea vents.

Venus has important scientific relevance to understanding Earth, the Solar System formation, and Exoplanets. For EPSCoR technology projects, Venus' highly acidic surface conditions are also a unique extreme environment with temperatures (~900F or 500C at the surface) and pressures (90 earth atmospheres or equivalent to pressures at a depth of 1 km in Earth's oceans). Furthermore, information on Venus' challenging environmental needs for its exploration can be found on the Venus Exploration Analysis Group (VEXAG) website: https://www.lpi.usra.edu/vexag/.

In particular, the technology requirements and challenges related to Venus exploration are discussed in the Venus Technology Roadmap at:

https://www.lpi.usra.edu/vexag/documents/reports/VEXAG_Venus_Techplan_2019.pdf

Research Focus Area: In-situ Astrobiology Instruments
Research Identifier**: RFA-082**

POC: Montbach, Erica N. (GRC-MA00) erica.n.montbach@nasa.gov
Michael Lienhard michael.a.lienhard@nasa.gov

Research Overview: The determination of whether other bodies in our solar system are, or were habitable, are important science questions identified in "An Astrobiology Strategy for the Search for Life in the Universe" at https://nap.nationalacademies.org/catalog/25252/. Additional information on promising destination in the solar system towards the search for conditions suitable for life can be found in "Origins, Worlds, and Life: A Decadal Strategy for Planetary Science and Astrobiology 2023-2032 (2022)" at https://nap.nationalacademies.org/catalog/26522/.

NASA may employ instruments similar to those used on Earth to detect biomarkers and/or to determine evidence of habitability in the solar system. The concentration of organic material at destinations of interest may be very low, necessitating innovative sample handling and processing techniques to perform sample analysis. Maintaining positive and negative controls, ensuring that samples are not destroyed or contaminated, and reading highly dilute and/or small samples are also technology challenges in this area. This topic seeks the development of innovative technologies that significantly improve instrument measurement capabilities for future planetary science missions that will look for bio habitability in the search for life.

Research Focus Area: Advanced Mobility for Subsurface Access
Research Identifier**: RFA-083**

POC: Montbach, Erica N. (GRC-MA00) erica.n.montbach@nasa.gov,
Michael Lienhard michael.a.lienhard@nasa.gov

Research Overview: Subsurface access and drilling have applications in several priority future Planetary Science missions to locations including; the Moon, Mars, small bodies, and ocean worlds. Exploration of these locations requires access to pristine/unmodified materials and have scientific relevance to understanding the Earth, the Solar System formation, support in the search for life and could be key for in situ resource utilization. Technologies include drills, melt probes, tethers, submersibles, emplaced communication nodes, telemetry from the probe/drill tip, and materials capable of meeting stringent planetary protection requirements.

As highlighted in the Origins, Worlds and Life (OWL) Decadal Survey and community documents, certain high-priority science objectives, including subsurface ice composition, detailed organics characterization to search for modern biosignatures, and in situ stable and radiogenic isotopic measurements of rocks will benefit from further technology development. In situ laboratories on rovers at carefully selected sites, and measurements of a dynamic surface and atmosphere that link the past and the present and inform investigation of a planetary body's subsurface.

For EPSCoR technology projects, subsurface access technology has important scientific relevance to understanding how the interiors of planetary bodies evolve, and how this evolution is recorded in a body's physical and chemical properties, also how solid surfaces are shaped by subsurface, surface, and external processes. In addition, supporting the search for life by enabling new observations and measurements to understand the evolution of the planetary body surfaces, interiors, atmosphere, and transport of volatiles from surface to subsurface, and of the potential for past life, or potentially still extant subsurface life. Strong geophysical evidence exists for subsurface water oceans in the Jovian satellites Europa, Ganymede and Callisto and the Saturnian satellites Enceladus and Titan, therefore, the ability to drill into the icy layer on these icy worlds is also highly needed.

Drill systems with capability on the locations identified would be of great interest.

15.A.15 Planetary Protection

Science Mission Directorate (SMD)
Exploration Systems Development Mission Directorate (ESDMD)

Office of Safety & Mission Assurance

Research Focus Area: Addressing Knowledge Gaps in Planetary Protection for Crewed Mars Mission Concepts - Microbial and Human Health Monitoring

Research Identifier**:** **RFA-084**

POC: J Nick Benardini James.N.Benardini@nasa.gov

Research Overview: Planetary Protection is the practice of protecting solar system bodies from contamination by Earth life and protecting Earth from possible life forms that may be returned from other solar system bodies. NASA's Office of Planetary Protection (OPP) promotes the responsible exploration of the solar system by implementing and developing efforts that protect the integrity of scientific discovery, the explored environments, and the Earth.

As NASA expands its exploration portfolio to include crewed missions beyond low Earth orbit, including planning for the first crewed Mars mission, a new paradigm for planetary protection is needed. Together with COSPAR, the Committee on Space Research, NASA has been working with the scientific and engineering communities to identify gaps in knowledge that need to be addressed before an end-to-end planetary protection implementation can be developed for a future crewed Mars mission[1].

For this EPSCoR Rapid Research Response Topic, NASA is interested in proposals that will address identified knowledge gaps in planetary protection for crewed Mars mission concepts, facilitating a knowledge-based transition from current robotic exploration-focused planetary protection practice to a new paradigm for crewed missions.

Research Focus: The capability to detect, monitor and then (if needed) mitigate the effects of adverse microbial-based events, whether terrestrial or Martian in origin, is critical in the ability to safely complete a crewed return mission to and from the red planet.

OPP is interested in proposals that would be the first steps on a path to develop -omics based approaches (including downstream bioinformatic analyses) for planetary protection decision making, with a particular emphasis on assessing perturbations in the spacecraft microbiome as indicators of key events such as exposure to the Mars environment, or changes in crew or spacecraft health.

Additionally, OPP is interested in technologies and approaches for mitigation of microbial growth in space exploration settings. This includes remediation of microbial contamination (removal, disinfection, sterilization) in spacecraft environments in partial or microgravity as well as on planetary surfaces.

Research Focus Area: Addressing Knowledge Gaps in Planetary Protection for Crewed Mars Mission Concepts - Natural Transport of Contamination on Mars

Research Identifier**:** **RFA-085**

POC: J Nick Benardini James.N.Benardini@nasa.gov

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[1] Further information on the COSPAR meeting series on planetary protection knowledge gaps for crewed Mars missions can be found in the Conference Documents section of the OSMA Planetary Protection web site, in particular the report of the 2018 meeting at: https://sma.nasa.gov/docs/default-source/sma-disciplines-and-programs/planetary-protection/cospar-2019-2nd-workshop-on-refining-planetary-protection-requirements-for-human-missions-and-work-meeting-on-developing-payload-requirements-for-addressing-planetary-protection-gaps-on-nat.pdf?sfvrsn=507ff8f8_8

Research Overview: The threat of harmful biological contamination at Mars is a balance between the release and spread of terrestrial biota resulting from the spacecraft surface operations, and the lethality of the Martian environment to these organisms. To understand and manage the risk of such contamination, the OPP is interested in studies of the following:

- Modeling and experimentation to describe the surface/atmospheric transport of terrestrial microorganisms as they would be released from spacecraft hardware at the Martian surface.
- Modeling and experimentation to describe the subsurface transport of terrestrial microorganisms as they would be released from spacecraft hardware onto the Martian surface.
- Modeling and experimentation to describe the lethality of the Mars environment to terrestrial organisms as they would be released from spacecraft hardware at the Martian surface.

Proposed research could focus in individual (indicator) organisms or populations of organisms. Of particular interest is the resistance of terrestrial organisms to the Martian UV environment under conditions relevant to release from crewed spacecraft (in clumps, attached to dust particles, or as part of a biofilm matrix).

Additional Information: All publications that result from an awarded EPSCoR study shall acknowledge NASA OSMA. If the NASA GeneLab Data Systems (genelab.nasa.gov) is used, GeneLab shall be referenced in the resulting publication and included in the keyword list. All -omics data obtained from these studies shall be uploaded to the NASA GeneLab.

15.A.16 Space Geodesy Program
Science Mission Directorate (SMD)
NASA Goddard Space Flight Center

Research Focus Area: Space Geodesy, Earth Science
Research Identifier**: RFA-086**
POC: Stephen Merkowitz stephen.m.merkowitz@nasa.gov

NASA develops and operates a global ground network of Space Geodesy systems, including Satellite Laser Ranging, Very Long Baseline Interferometry, and Global Navigation Satellite System stations. Data from these stations are used for the realizations of the Terrestrial and Celestial Reference Frames, measurements of the Earth Orientation Parameters, and satellite Precision Orbit Determination. The data also supports a wide variety of important scientific investigations, including studies of the Earth's surface and interior and fundamental tests of gravity. See https://space-geodesy.nasa.gov for more details.

Proposal research opportunities include science applications of the space geodesy, technology development for the next generation NASA systems, geodetic data analysis, and development of algorithms for geodetic analysis tools.

Research Focus Area: Lunar Laser Ranging, Planetary Science
Research Identifier**: RFA-087**
POC: Stephen Merkowitz stephen.m.merkowitz@nasa.gov

Data from NASA's and the other international Lunar Laser Ranging stations are used to support a wide variety of important scientific investigations, including studies of the Moon's interior structure and fundamental tests of gravity. The measurements also contribute to the realizations of lunar reference frames, interplanetary spacecraft navigation, and positioning and navigation on and around the Moon. NASA is preparing to deploy several new lunar retroreflectors on the lunar surface that will improve the geometric coverage and enable better measurements of the lunar orientation.

Proposal research opportunities include science applications of Lunar Laser Ranging, technology development for improved Lunar Laser Ranging capabilities, Lunar Laser Ranging data analysis, and development of algorithms for Lunar Laser Ranging analysis tools.

15.B Contacts/Inquiries

For inquiries regarding technical and scientific aspects of NASA's Research Focus Areas in this NOFO, please contact:

Research Focus Area/Point of Contact (POC)		
Electrified Vertical Takeoff and Landing (eVTOL), Material Characterization and Modeling Aeronautic Research Mission Directorate (ARMD) Timothy Krantz, timothy.l.krantz@nasa.gov NASA Glenn Research Center (GRC) Michael Hurrell, michael.j.hurrell@nasa.gov NASA GRC Robert Goldberg robert.goldberg@nasa.gov NASA GRC Justin Littell justin.d.littell@nasa.gov NASA Langley Research Center (LaRC) Mike Pereira mike.pereira@nasa.gov NASA GRC Trenton M. Ricks, PhD trenton.m.ricks@nasa.gov NASA GRC Steven M. Arnold steven.m.arnold@nasa.gov NASA GRC		
Research Focus Area	**Point of Contact**	**Id**
Research contributing to partial-discharge free motors for aviation propulsion having a continuous power rating in the range 50 – 400 kW.	Timothy Krantz, timothy.l.krantz@nasa.gov Michael Hurrell michael.j.hurrell@nasa.gov	**RFA-001**
Lubrication and cooling technologies specifically optimized for long life and highly efficient eVTOL motors, including interest in single-fluid approaches for combined cooling and lubrication of inverters, motors, and gearboxes.	Timothy Krantz, timothy.l.krantz@nasa.gov Michael Hurrell michael.j.hurrell@nasa.gov	**RFA-002**
Development of Characterization Techniques to Determine Rate and Temperature Dependent Composite Material Properties for the LS-DYNA MAT213 Model	Robert Goldberg robert.goldberg@nasa.gov Justin Littell justin.d.littell@nasa.gov Mike Pereira mike.pereira@nasa.gov	**RFA-003**
Multiscale Modeling of Heterogeneous Materials with NASMAT	Trenton M. Ricks trenton.m.ricks@nasa.gov Steven M. Arnold steven.m.arnold@nasa.gov	**RFA-004**
Clean Energy, Climate Change and Orbital Debris Space Technology Mission Directorate (STMD) Jeffrey Sweterlitsch, PhD jeffrey.j.sweterlitsch@nasa.gov NASA JSC Bo Naasz, PhD Bo.j.naasz@nasa.gov NASA Goddard Space Flight Center (GSFC)		

Research Focus Area/Point of Contact (POC)		
Research Focus Area	**Point of Contact**	**Id**
Earth-observing capabilities to support breakthrough science and National efforts to reduce greenhouse gas emissions (including CO2, CH4, N2O, HFCs).	Sweterlitsch, Jeffrey, Ph.D. jeffrey.j.sweterlitsch@nasa.gov	**RFA-005**
U.S. Climate Change Research Program focusing on carbon capture and Utilization.	Sweterlitsch, Jeffrey, Ph.D. jeffrey.j.sweterlitsch@nasa.gov	**RFA-006**
Addressing Orbital Debris: Control the long-term growth of debris population	Bo Naasz, PhD. Bo.j.naasz@nasa.gov	**RFA-007**
Space Technology / Aeronautic Research Space Technology Mission Directorate (STMD) Aeronautics Research Mission Directorate (ARMD) Dr. Ronald Noebe ronald.d.noebe@nasa.gov NASA Glenn Research Center (GRC)		
Research Focus Area	**Point of Contact**	**Id**
Development of advanced soft magnetic materials for high-power electronic systems.	Dr. Ronald Noebe ronald.d.noebe@nasa.gov	**RFA-008**
Development of high-temperature structural refractory alloys and silicides and environmental coatings for refractory alloys.	Dr. Ronald Noebe ronald.d.noebe@nasa.gov	**RFA-009**
In Space Manufacturing /On Demand Manufacturing of Electronics (ODME) Space Operations Mission Directorate (SOMD) Exploration Systems Development Mission Directorate (ESDMD) Space Technology Mission Directorate (STMD) Jessica Koehne, Ph.D. Jessica.E.Koehne@nasa.gov NASA Ames Research Center (ARC) Curtis Hill curtis.w.hill@nasa.gov NASA Marshall Space Flight Center (MSFC)		
Research Focus Area	**Point of Contact**	**Id**
Advanced Manufacturing of Sensors and Electronics	Jessica Koehne, Ph.D. Jessica.E.Koehne@nasa.gov	**RFA-010**
Additive manufacturing and additive manufacturing of electronics	Curtis Hill curtis.w.hill@nasa.gov	**RFA-011**
LEO manufacturing support (additive, advanced materials, thin layer processing)	Curtis Hill curtis.w.hill@nasa.gov	**RFA-012**
Lunar manufacturing of solar cells and sensors	Curtis Hill curtis.w.hill@nasa.gov	**RFA-013**
Materials development for additive manufacturing	Curtis Hill curtis.w.hill@nasa.gov	**RFA-014**
Technology maturation through commercial (sub)orbital flight testing	Curtis Hill curtis.w.hill@nasa.gov	**RFA-015**

Research Focus Area/Point of Contact (POC)		
Center for Design and Space Architecture Exploration Systems Development Mission Directorate (ESDMD) Space Technology Mission Directorate (STMD) Robert L. Howard, Jr., Ph.D. robert.l.howard@nasa.gov NASA Johnson Space Center (JSC)		
Research Focus Area	**Point of Contact**	**Id**
Crew-worn restraints and mobility aids for microgravity spacecraft cabin environments	Robert L. Howard, Jr., Ph.D. robert.l.howard@nasa.gov	**RFA-016**
Crew quarters internal architectures compatible with both microgravity and fractional gravity domains	Robert L. Howard, Jr., Ph.D. robert.l.howard@nasa.gov	**RFA-017**
Repair, Manufacturing, And Fabrication (RMAF) Facility for the Common Habitat Architecture	Robert L. Howard, Jr., Ph.D. robert.l.howard@nasa.gov	**RFA-018**
Astrophysics Science Mission Directorate (SMD) Dr. Hashima Hasan, hhasan@nasa.gov NASA Headquarters (HQ) Dr. Mario Perez, mario.perez@nasa.gov NASA HQ		
Research Focus Area	**Point of Contact**	**Id**
Astrophysics Technology Development	Dr. Hashima Hasan hhasan@nasa.gov Dr. Mario Perez mario.perez@nasa.gov	**RFA-019**
NASA Biological and Physical Sciences (BPS) Science Mission Directorate (SMD) NASA Headquarters Biological and Physical Sciences Division NASA Marshall Space Flight Center (MSFC) / EM41 Diane Malarik Diane.C.Malarik@nasa.gov NASA Headquarters (HQ) Brad Carpenter bcarpenter@nasa.gov NASA HQ Mike Robinson michael.p.robinson@nasa.gov NASA HQ Sharmila Bhattacharya SpaceBiology@nasaprs.com NASA HQ Dr. Lisa Carnell; lisa.a.scottcarnell@nasa.gov NASA HQ		
Fundamental Physics	Mike Robinson; michael.p.robinson@nasa.gov	**RFA-020**
Soft Matter Physics	Mike Robinson; michael.p.robinson@nasa.gov	**RFA-021**
Fluid Physics	Brad Carpenter bcarpenter@nasa.gov	**RFA-022**
Combustion Science	Brad Carpenter bcarpenter@nasa.gov	**RFA-023**

Research Focus Area/Point of Contact (POC)		
Materials Science	Brad Carpenter bcarpenter@nasa.gov	**RFA-024**
Growth of plants in inhospitable "deep space-relevant" Earth soils or conditions	Sharmila Bhattacharya SpaceBiology@nasaprs.com	**RFA-025**
The impact of space-associated stressors on energy metabolism and oxidative stress.	Sharmila Bhattacharya SpaceBiology@nasaprs.com	**RFA-026**
The role of genetic diversity in enabling life to thrive in space.	Sharmila Bhattacharya SpaceBiology@nasaprs.com	**RFA-027**
Commercially Enabled Rapid Space Science Project (CERISS)	Ursula M. Koniges ursula.m.koniges@nasa.gov	**RFA-028**
Commercial Space Capabilities (CSC) Space Operations Mission Directorate (SOMD) Marc Timm, Program Executive marc.g.timm@nasa.gov NASA Headquarters (HQ) Warren Ruemmele, Project Executive warren.p.ruemmele@nasa.gov NASA Johnson Space Center (JSC)		
Research Focus Area	**Point of Contact**	**Id**
In-Space Welding	Warren Ruemmele warren.p.ruemmele@nasa.gov	**RFA-029**
Materials and Processes Improvements for Chemical Propulsion State of Art (SoA)	Warren Ruemmele warren.p.ruemmele@nasa.gov	**RFA-030**
Materials and Processes Improvements for Electric Propulsion State of Art (SoA)	Warren Ruemmele warren.p.ruemmele@nasa.gov	**RFA-031**
Improvements to Space Solar Power State of Art (SoA)	Warren Ruemmele warren.p.ruemmele@nasa.gov	**RFA-032**
Small Reentry Systems	Warren Ruemmele warren.p.ruemmele@nasa.gov	**RFA-033**
Low Consumable Environmental Control and Crew Systems	Warren Ruemmele warren.p.ruemmele@nasa.gov	**RFA-034**
Other Commercial Space Topic	Warren Ruemmele warren.p.ruemmele@nasa.gov	**RFA-035**

Research Focus Area/Point of Contact (POC)
ASA Digital Transformation (DT) Science Mission Directorate (SMD) **NASA Digital Transformation Officer** **Jill Marlowe** jill.marlowe@nasa.gov NASA Headquarters (HQ) **NASA Digital Transformation – Portfolio Integration** **Patrick Murphy** patrick.murphy@nasa.gov NASA HQ NASA Digital Transformation – Zero Trust Foundations; Strategy and Architecture Office (SAO) Mark Stanley mark.a.stanley-1@nasa.gov NASA Langley Research Center (LaRC) Cybersecurity Engineering Office (CSE) Dennis daCruz dennis.m.dacruz@nasa.gov NASA HQ NASA Digital Transformation – AI/ML Foundation Ed McLarney edward.l.mclarney@nasa.gov NASA LaRC Martin Garcia martin.garcia@nasa.gov NASA Johnson Space Center (JSC) Mark Page mark.page@nasa.gov NASA Kennedy Space Center (KSC) Scott Tashakkor scott.b.tashakkor@nasa.gov NASA Marshall Space Flight Center (MSFC) Snorre Stamnes snorre.a.stamnes@nasa.gov NASA LaRC Shan Zeng shan.zeng@nasa.gov NASA LaRC Yongxiang Hu yongxiang.hu-1@nasa.gov NASA LaRC Kelsey Buckles kelsey.d.buckles@nasa.gov NASA MSFC Ignacio López-Francos ignacio.lopez-francos@nasa.gov NASA Ames Caleb Adams caleb.a.adams@nasa.gov NASA Ames Research Center (ARC) Ariel Deutsch ariel.deutsch@nasa.gov NASA ARC Nikunj Oza nikunj.c.oza@nasa.gov NASA ARC Jules Casuga jules.casuga@nasa.gov NASA ARC Frank Delgado francisco.j.delgado@nasa.gov NASA JSC David Meza david.meza-1@nasa.gov NASA HQ

Research Focus Area	Point of Contact	Id
Zero Trust, Cybersecurity Mesh Architecture, and Leveraging Artificial Intelligence for Realtime Cyber Defense	Mark Stanley mark.a.stanley-1@nasa.gov	**RFA-036**
Applied AI Ethics	Ed McLarney edward.l.mclarney@nasa.gov	**RFA-037**
Scaled Video ML Object Detection and Alerts	Ed McLarney edward.l.mclarney@nasa.gov Martin Garcia martin.garcia@nasa.gov Mark Page mark.page@nasa.gov	**RFA-038**

Research Focus Area/Point of Contact (POC)		
Verification of AI/ML algorithms for Spacecraft	Scott Tashakkor scott.b.tashakkor@nasa.gov	**RFA-039**
Augmenting and Analyzing Requirements with Natural Language Processors	Scott Tashakkor scott.b.tashakkor@nasa.gov	**RFA-040**
AI/ML algorithms to obtain and improve 3-dimentional remote sensing of the Earth's aerosols, clouds, oceans and lands using advanced lidar and polarimeter data	Snorre Stamnes snorre.a.stamnes@nasa.gov Shan Zeng shan.zeng@nasa.gov Yongxiang Hu yongxiang.hu-1@nasa.gov	**RFA-041**
ICAN-C-Obscured Vision Enhancement	Kelsey Buckles kelsey.d.buckles@nasa.gov	**RFA-042**
Lox Methane HS Video Analysis	Kelsey Buckles kelsey.d.buckles@nasa.gov	**RFA-043**
Motion Mag in the Dark	Kelsey Buckles kelsey.d.buckles@nasa.gov	**RFA-044**
Foreign Object Debris (FOD) Detection Using Computer Vision	Kelsey Buckles kelsey.d.buckles@nasa.gov	**RFA-045**
Using Multispectral Neural Radiance Fields (NeRFs) for Ground Detection & Characterization of Lunar Micro Cold Traps	Ignacio López-Francos ignacio.lopez-francos@nasa.gov Caleb Adams caleb.a.adams@nasa.gov Ariel Deutsch ariel.deutsch@nasa.gov	**RFA-046**
High-Resolution 3D Mapping of Lunar Shadowed Regions Using Neural Radiance Fields (NeRFs)	Ignacio López-Francos ignacio.lopez-francos@nasa.gov Caleb Adams caleb.a.adams@nasa.gov Ariel Deutsch ariel.deutsch@nasa.gov	**RFA-047**
Study the deployment of Large Language Models (LLMs) for Systems Engineering and Project Management at NASA	Ignacio López-Francos ignacio.lopez-francos@nasa.gov Caleb Adams caleb.a.adams@nasa.gov Ariel Deutsch ariel.deutsch@nasa.gov	**RFA-048**
Collaborative platforms for capturing data analytics workflows	Nikunj Oza nikunj.c.oza@nasa.gov	**RFA-049**
Uses of generative AI to dynamically create Photo realistic 3D content in real-time for use in XR applications	Jules Casuga jules.casuga@nasa.gov Frank Delgado francisco.j.delgado@nasa.gov	**RFA-050**

Research Focus Area/Point of Contact (POC)		
Use of a Brain Computer Interface (BCI) system as a novel computer interface	Jules Casuga jules.casuga@nasa.gov Frank Delgado francisco.j.delgado@nasa.gov	**RFA-051**
Cognitive State Determination System to Support Training, Education, and Real-Time Operations in an XR environment	Jules Casuga jules.casuga@nasa.gov Frank Delgado francisco.j.delgado@nasa.gov	**RFA-052**
Automatic XR friendly procedure creation using videos	Jules Casuga jules.casuga@nasa.gov Frank Delgado francisco.j.delgado@nasa.gov	**RFA-053**
Video based mocap system	Jules Casuga jules.casuga@nasa.gov Frank Delgado francisco.j.delgado@nasa.gov	**RFA-054**
Retrieval Augmented Dialog LLM	David Meza david.meza-1@nasa.gov	**RFA-055**
Earth Science Science Mission Directorate (SMD) NASA SMD Earth Science Division (ESD) Earth Science Remote Sensing Dr. Laura Lorenzoni, laura.lorenzoni@nasa.gov Dr. Kelsey Bisson kelsey.bisson@nasa.gov Dr. David Grinspoon david.grinspoon@nasa.gov		
Research Focus Area	**Point of Contact**	**Id**
Impacts of human activity on coastal physical, geomorphological and ecological variability	Dr. Laura Lorenzoni, laura.lorenzoni@nasa.gov Dr. Kelsey Bisson kelsey.bisson@nasa.gov Dr. David Grinspoon david.grinspoon@nasa.gov	**RFA-056**
Sea level rise, coastal erosion/retreat, and salt-water intrusion, and their impacts on ecosystems	Dr. Laura Lorenzoni, laura.lorenzoni@nasa.gov Dr. Kelsey Bisson kelsey.bisson@nasa.gov Dr. David Grinspoon david.grinspoon@nasa.gov	**RFA-057**
Linkages between aquatic dynamics and land subsidence and its impacts on aquatic ecosystems	Dr. Laura Lorenzoni, laura.lorenzoni@nasa.gov Dr. Kelsey Bisson kelsey.bisson@nasa.gov Dr. David Grinspoon david.grinspoon@nasa.gov	**RFA-058**

Research Focus Area/Point of Contact (POC)		
The role of urban development on land subsidence and aquatic ecosystems; biophysical coupling and feedbacks within the aquatic-land interface	Dr. Laura Lorenzoni, laura.lorenzoni@nasa.gov Dr. Kelsey Bisson kelsey.bisson@nasa.gov Dr. David Grinspoon david.grinspoon@nasa.gov	**RFA-059**
Impacts of hazards related to climate extremes, such as storms and heat waves, on biogeophysical aspects of the coast	Dr. Laura Lorenzoni, laura.lorenzoni@nasa.gov Dr. Kelsey Bisson kelsey.bisson@nasa.gov Dr. David Grinspoon david.grinspoon@nasa.gov	**RFA-060**
Impacts of upstream activities on coastal communities	Dr. Laura Lorenzoni, laura.lorenzoni@nasa.gov Dr. Kelsey Bisson kelsey.bisson@nasa.gov Dr. David Grinspoon david.grinspoon@nasa.gov	**RFA-061**
Integration of existing and upcoming observational and modeling assets into a conceptual or (better) digital aquatic-land framework that enables the dynamical coupling of key processes within the aquatic-land interface	Dr. Laura Lorenzoni, laura.lorenzoni@nasa.gov Dr. Kelsey Bisson kelsey.bisson@nasa.gov Dr. David Grinspoon david.grinspoon@nasa.gov	**RFA-062**
Exposure and vulnerability to geohazards (e.g., infrastructure and flooding, landslides, etc.), land cover/use change and their impacts on water	Dr. Laura Lorenzoni, laura.lorenzoni@nasa.gov Dr. Kelsey Bisson kelsey.bisson@nasa.gov Dr. David Grinspoon david.grinspoon@nasa.gov	**RFA-063**
Ocean Worlds Research: observational and modeling synergies between ice, ocean and surficial processes on Earth and other ocean environments in our solar system	Dr. Laura Lorenzoni, laura.lorenzoni@nasa.gov Dr. Kelsey Bisson kelsey.bisson@nasa.gov Dr. David Grinspoon david.grinspoon@nasa.gov	**RFA-064**
Entry Systems Modeling Project Space Technology Mission Directorate (STMD) Aaron Brandis aaron.m.brandis@nasa.gov NASA Ames Research Center (ARC)		
Research Focus Area	**Point of Contact**	**Id**
Deposition of Ablation/Pyrolysis Products on Optical Windows	Aaron Brandis aaron.m.brandis@nasa.gov	**RFA-065**
Plume Surface Interaction Predictive Capability	Aaron Brandis aaron.m.brandis@nasa.gov	**RFA-066**

Research Focus Area/Point of Contact (POC)		
Computational Methods For Propagating Uncertainty in Hypersonic Flow Simulations	Aaron Brandis aaron.m.brandis@nasa.gov	**RFA-067**
Nitrogen/Methane Plasma Experiments Relevant to Titan Entry	Aaron Brandis aaron.m.brandis@nasa.gov	**RFA-068**
Predictive Modeling of Plasma Physics Relevant to High Enthalpy Facilities	Aaron Brandis aaron.m.brandis@nasa.gov	**RFA-069**
Mechanical Properties of Ablative TPS Materials during Char Formation	Aaron Brandis aaron.m.brandis@nasa.gov	**RFA-070**
Office of Chief Health and Medical Officer (OCHMO) Space Operations Mission Directorate (SOMD) Victor S. Schneider vschneider@nasa.gov NASA Headquarters (HQ)		
Research Focus Area	**Point of Contact**	**Id**
Development and elaboration of Functional aids and testing paradigms to measure activity for use by parastronauts during spaceflight	Victor S. Schneider vschneider@nasa.gov	**RFA-071**
Evaluation space capsule and spacesuit activity in stable and fit lower or upper extremity amputees and compare their responses to non-amputee fit individuals	Victor S. Schneider vschneider@nasa.gov	**RFA-072**
Human Research Program Human Exploration and Operations (HEO) Mission Directorate (HEOMD) **Space Radiation** **Precision Health Initiative** **Systems Biology Translation** Dr. Kristin Fabre kristin.m.fabre@nasa.gov Corey Theriot corey.theriot@nasa.gov NASA Johnson Space Center (JSC) Robin Elgart shona.elgart@nasa.gov NASA JSC Janice Zawaski janice.zawaski@nasa.gov NASA JSC		
Pilot studies to adopt terrestrial precision health solutions for astronauts	Corey Theriot corey.theriot@nasa.gov	**RFA-073**
Use of human-based tissue engineered models for characterization of space stressor and/or hazard effects.	Janapriya Saha janapriya.saha@nasa.gov	**RFA-074**
Remote-controlled robotic operation	Honglu Wu honglu.wu-1@nasa.gov	**RFA-075**
Tissue and Data sharing for space radiation risk and mitigation strategies	Janice Zawaski janice.zawaski@nasa.gov	**RFA-076**

Research Focus Area/Point of Contact (POC)		
Compound screening techniques to assess efficacy in modulating responses to radiation exposure	Janice Zawaski janice.zawaski@nasa.gov	**RFA-077**
Inflammasome role in radiation-associated health impacts	Janapriya Saha janapriya.saha@nasa.gov	**RFA-078**
Aging related effects of space radiation	Gregory Nelson gregory.a.nelson@nasa.gov Janice Zawaski janice.zawaski@nasa.gov	**RFA-079**
Effects of space radiation on microvasculature	Gregory Nelson gregory.a.nelson@nasa.gov Janice Zawaski janice.zawaski@nasa.gov	**RFA-080**
Use of human-based tissue engineered models for characterization of space stressor and/or hazard effects	Janapriya Saha janapriya.saha@nasa.gov	**RFA-081**

Planetary Science
Science Mission Directorate (SMD)

Glenn Research Center (GRC)

Erica Montbach, PhD (*she/her*)
Manager, Planetary Exploration Science Technology Office (PESTO)
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Planetary Science Division michael.a.lienhard@nasa.gov

Research Focus Area	**Point of Contact**	**Id**
In-situ Astrobiology Instruments	Erica Montbach erica.n.montbach@nasa.gov Michael Lienhard michael.a.lienhard@nasa.gov	**RFA-082**
Advanced Mobility for Subsurface Access	Erica Montbach erica.n.montbach@nasa.gov Michael Lienhard michael.a.lienhard@nasa.gov	**RFA-083**

Research Focus Area/Point of Contact (POC)		
Planetary Protection **Office of Safety & Mission Assurance** Science Mission Directorate (SMD) Exploration Systems Development Mission Directorate (ESDMD) J Nick Benardini James.N.Benardini@nasa.gov NASA Headquarters (HQ)		
Research Focus Area	**Point of Contact**	**Id**
Addressing Knowledge Gaps in Planetary Protection for Crewed Mars Mission Concepts	J Nick Benardini James.N.Benardini@nasa.gov	**RFA-084**
Natural Transport of Contamination on Mars	J Nick Benardini James.N.Benardini@nasa.gov	**RFA-085**
Space Geodesy Program Science Mission Directorate (SMD) NASA Goddard Space Flight Center Stephen Merkowitz stephen.m.merkowitz@nasa.gov		
Research Focus Area	**Point of Contact**	**Id**
Space Geodesy, Earth Science	Stephen Merkowitz stephen.m.merkowitz@nasa.gov	**RFA-086**
Lunar Laser Ranging, Planetary Science	Stephen Merkowitz stephen.m.merkowitz@nasa.gov	**RFA-087**

15.C Definitions

- NASA Centers – NASA Centers, located throughout the United States, provide leadership for and execution of NASA's work. There are nine NASA Centers, plus NASA's only Federally Funded Research and Development Center, the Jet Propulsion Laboratory (JPL). JPL is eligible for collaboration within NASA EPSCoR on par with NASA Centers. The nine NASA Centers are:
    - Ames Research Center (ARC)
    - Armstrong Flight Research Center (AFRC)
    - Glenn Research Center (GRC)
    - Goddard Space Flight Center (GSFC)
    - Johnson Space Center (JSC)
    - Kennedy Space Center (KSC)
    - Langley Research Center (LaRC)
    - Marshall Space Flight Center (MSFC)
    - Stennis Space Center (SSC)

- Cooperative Agreement – An award of federal assistance similar to a grant with the exception that NASA will be substantially involved in the recipient's performance of the project. Cooperative agreements are managed pursuant to the policies set forth in 2 CFR 200, 2 CFR 1800, and the *NASA Grant and Cooperative Agreement Manual* (GCAM).
- Jurisdiction – A State or Commonwealth that is eligible to submit a proposal in response to this announcement.
- NASA Research Contact – The primary NASA point of contact during the proposal writing stage for the proposed research area. If the proposer has contacted and received permission from a NASA scientific or technical person, that individual may be listed in the proposal as the NASA Research Contact. Otherwise, the NASA Research Contact is the University Affairs Officer at the NASA Center, or the NASA Mission Directorate contact at NASA Headquarters.
- Principal Investigator (PI) – A jurisdiction's EPSCoR Director is considered the Principal Investigator (PI). The PI is responsible for proper conduct of the research, including appropriate use of funds and administrative requirements such as the submission of the scientific progress reports to the Agency. The PI is the administrator of the proposal.
- Science-Investigator (Sc-I) – The Sc-I will serve as the point of contact (POC) with the International Space Station (ISS) Program. The formally stated PI will remain responsible for the overall direction of the effort and the use of funds.
- Research Focus Area (RFA) – An area of research focus aligned with the objectives of NASA.
- Research Assistant – A student (undergraduate, graduate, or postdoctoral) who receives a research appointment in direct support of the NASA EPSCoR research in a research proposal.
- Mission Directorates
    - Aeronautics Research Mission Directorate (ARMD)
    - Exploration Systems Development Mission Directorate (ESDMD)
    - Human Exploration and Operations (HEO) Mission Directorate
    - Science Mission Directorate (SMD)
    - Space Operations Mission Directorate (SOMD)
    - Space Technology Mission Directorate (STMD)

15.D Certifications

Certification of Compliance, Assurances, and Representations

Awards from this funding announcement that are issued under 2 CFR 1800 are subject to the Federal Research Terms and Conditions (RTC) located at http://www.nsf.gov/awards/managing/rtc.jsp. In addition to the RTC and NASA-specific guidance, three companion resources can also be found on the website: Appendix A— Prior Approval Matrix, Appendix B—Subaward Requirements Matrix, and Appendix C—National Policy Requirements Matrix.

By submitting the proposal identified in the Cover Sheet/Proposal Summary in response to this Research Announcement, the Authorized Organizational Representative (AOR) of the proposing organization (or the individual Proposer if there is no proposing organization) as identified below—

(a) Certifies that the statements made in this proposal are true and complete to the best of his/her knowledge;

(b) Agrees to accept the obligation to comply with NASA award terms and conditions if an award is made as a result of this proposal; and

(c) Confirms compliance with all applicable terms and conditions, rules, and stipulations set forth in the Certifications, Assurances, and Representations contained in this NRA or CAN. Willful inclusion of false information in this proposal and/or its supporting documents, or in reports required under an ensuing award, is a criminal offense (U.S. Code, Title 18, Section 1001).

The AOR's signature on the Proposal Cover Page automatically certifies that the proposing organization has read and is in compliance with all certifications, assurances, and representations as detailed in the NASA GCAM.

15.E Useful Web Sites

NASA http://www.nasa.gov

NASA Office of STEM Engagement http://stem.nasa.gov

NASA EPSCoR https://www.nasa.gov/stem/epscor/home/index.html

Vision for Space Exploration https://www.nasa.gov/pdf/55583main_vision_space_exploration2.pdf

NASA Centers & Facilities https://www.nasa.gov/about/sites/index.html

NASA Solicitation and Proposal Integrated Review and Evaluation System(NSPIRES) http://nspires.nasaprs.com

NASA Grant and Cooperative Agreement Manual (GCAM)

https://www.nasa.gov/wp-content/uploads/2024/09/nasa-grant-and-cooperative-agreement-manual-oct-2024.pdf

NASA Grant and Cooperative Agreement Terms and Conditions

https://www.nasa.gov/wp-content/uploads/2024/09/nasa-grant-and-cooperative-agreement-terms-and-conditions.pdf?emrc=7735d3

NPR 5810.1A, Standard Format for NASA Research Announcement and Other Announcements for Grants and Cooperative Agreements

https://nodis3.gsfc.nasa.gov/displayCA.cfm?Internal_ID=N_PR_5810_001A_&page_name=main

Electronic Code of Federal Regulations (2 CFR 200, 2 CFR 1800) https://ecfr.federalregister.gov/current/title-2

NASA EPSCoR Director's Contact Information https://www.nasa.gov/stem/epscor/home/EPSCoR_Directors.html