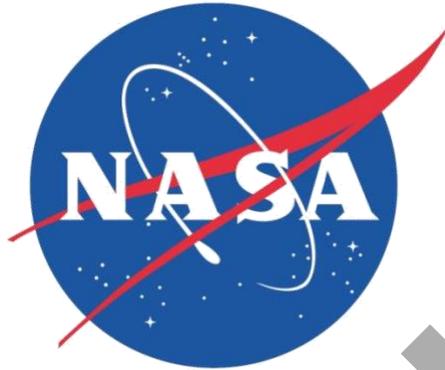


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National Aeronautics and Space Administration
Office of STEM Engagement

**National Space Grant College and Fellowship Program -
Opportunities in NASA STEM FY 2020 – 2024**

Cooperative Agreement Notice (CAN)

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NASA Headquarters
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FINAL

1 INTRODUCTION

The National Aeronautics and Space Administration (NASA or Agency) is committed to defining and implementing a portfolio intended to drive a coherent and coordinated set of activities devoted to engaging students in science, technology, engineering and mathematics (STEM) through NASA’s mission. This portfolio contributes to achieving NASA’s STEM Engagement vision to immerse students in NASA’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, driven by requirements from NASA’s Mission Directorates. This new structure will align appropriated STEM engagement programs, existing and emerging relevant projects, and activities and products from across the Agency, into an overarching framework and strategy. The result will be a more effective and coherent approach and outcomes, see Figure 1.

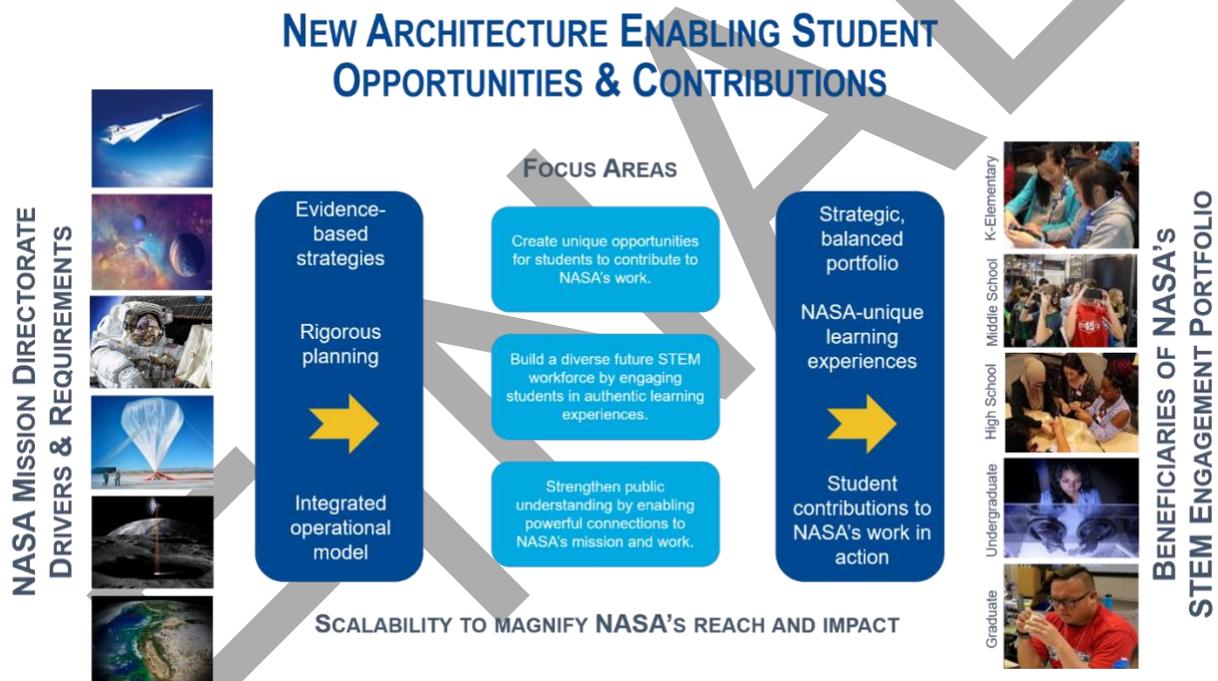


Figure 1 – Office of STEM Engagement (OSTEM) Architecture

Public Law 100-147, passed in 1987, authorized NASA to initiate 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 by interacting with other universities, by broadening joint activities with NASA and aerospace-related industries, and by providing public service functions, such as support to elementary and secondary schools 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 1000 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.

The 52 consortia fund fellowships and scholarships for students pursuing careers in STEM, as well as curriculum enhancement and faculty development. Member colleges and universities also administer pre-college and public service education projects in their states. For more information visit: <https://www.nasa.gov/offices/education/programs/national/spacegrant/about/index.html>

1.1 CONGRESSIONAL FOCUS ON EDUCATION

The America COMPETES Reauthorization Act of 2010 (Public Law. No. 111-358) established a mandate for the development of a federal-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 new strategic plan (<https://www.whitehouse.gov/wp-content/uploads/2018/12/STEM-Education-Strategic-Plan-2018.pdf>) that guides the work of the 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.

Through CoSTEM, NASA's STEM Engagement enterprise focuses on national STEM areas of need and ensures that NASA's STEM engagement investments are unique and non-duplicative. NASA STEM Engagement investments support the CoSTEM federal strategy, which is based on a vision for a future where all Americans will have lifelong access to high-quality STEM education and the United States will be the global leader in STEM literacy, innovation, and employment.

While NASA will not duplicate the efforts of other Federal agencies and partners, NASA will leverage the expertise of STEM Engagement program elements offered through this CAN to contribute to the goals of the Administration.

1.2 NASA STRATEGIC PLAN AND RELEVANCE TO STEM ENGAGEMENT

The NASA 2018 Strategic Plan (https://www.nasa.gov/sites/default/files/atoms/files/nasa_2018_strategic_plan.pdf) focuses on the development of STEM learning opportunities along with the engagement of academic institutions and students toward achieving the vision and mission of NASA. NASA's STEM Engagement efforts contribute toward achieving Strategic Objective 3.3 defined in the strategy plan: "Inspire and Engage the Public in Aeronautics, Space, and Science", and specifically to "inspire, engage, educate, and employ the next generation of explorers through NASA-unique Science, Technology, Engineering and Mathematics learning opportunities".

The Agency contributes to national efforts for achieving excellence in STEM education through a comprehensive STEM Engagement portfolio implemented by the Office of STEM Engagement (OSTEM), the Mission Directorates, and the NASA Centers and facilities located across the country. NASA will continue the Agency's tradition of contributing to the Nation's education ecosystem and supporting the country's educators who play a key role in preparing, inspiring, exciting, encouraging, and nurturing the young minds of today who will manage and lead the Nation's laboratories and research centers of tomorrow.

1.3 STEM ENGAGEMENT PRIORITIES

At the core of NASA's efforts in STEM Engagement are the following cross-cutting design and operational principles. These principles guide the STEM engagement community in the planning and execution of work in direct support of achieving the objectives.

- Mission-driven authentic STEM experiences
- Evidence-based practices
- Diversity and inclusion
- Scalability through partnerships and networks

NASA's STEM engagement function will play a critical role in achieving the Agency's Strategic Objective 3.3 by implementing activities within three focus areas: 1) Create unique opportunities for 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) Strengthen understanding by enabling powerful connections to NASA's mission and work. The goals and objectives for NASA STEM Engagement are:

Goal 1.0: Enabling contributions to NASA's work

Objective 1.1: Students contribute to NASA's endeavors in exploration and discovery.

Objective 1.2: Research and development capacity of educational institutions is enhanced, enabling broad and diverse contributions that directly address NASA priorities.

Goal 2.0: Building a Diverse, Skilled Future STEM Workforce.

Objective 2.1: A broad and diverse set of students are attracted to STEM through NASA opportunities.

Objective 2.2: Students, including those from underrepresented and underserved communities, explore and pursue STEM pathways through authentic learning experiences and research opportunities with NASA's people and work.

Objective 2.3: The portfolio of NASA STEM engagement opportunities meets agency workforce requirements and serves the nation's aerospace and relevant STEM needs.

Objective 2.4: Strategic partnerships with industry, academia, non-profit organizations and educational institutions enhance and extend the impact of NASA's efforts in STEM engagement.

Goal 3.0: Strengthen Understanding of STEM through Powerful Connections to NASA.

Objective 3.1: Youth are introduced to STEM concepts and content through readily available NASA STEM engagement resources and content.

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

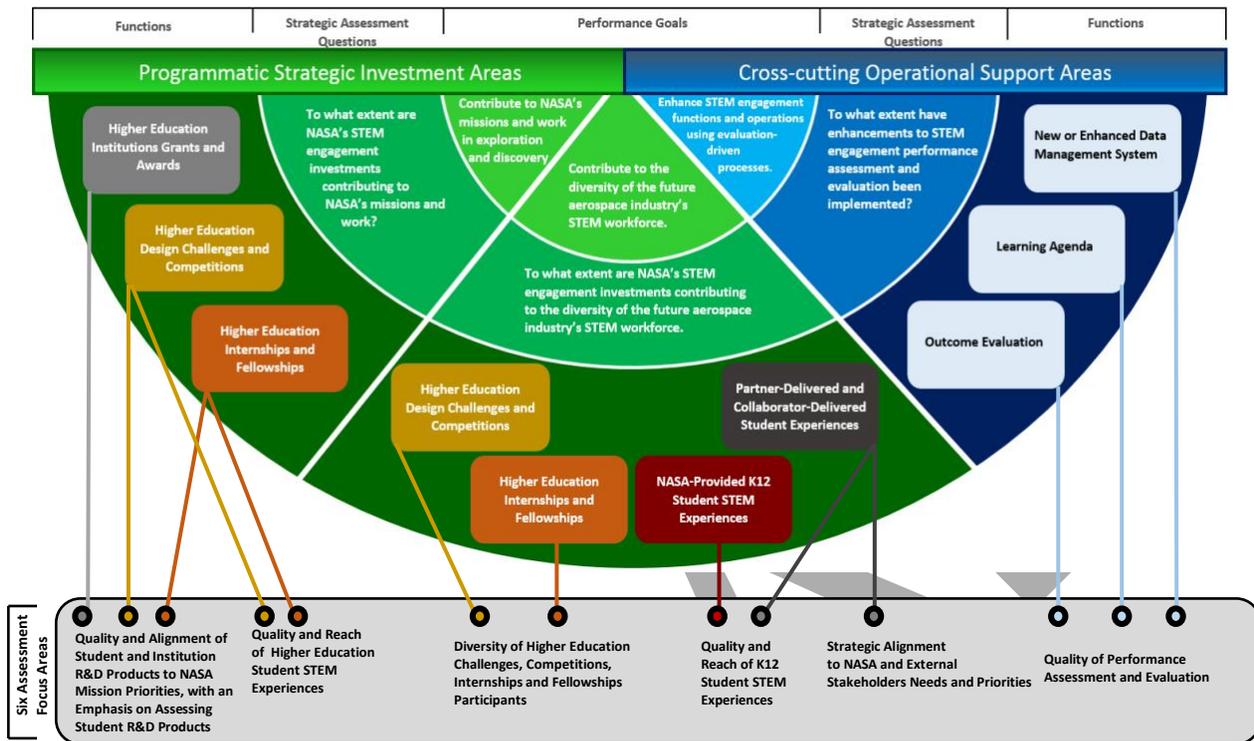
Performance and Evaluation Strategy (Learning Agenda):

In 2018, OSTEM developed a new comprehensive performance and evaluation strategy (learning agenda) in alignment with NASA's 2018 Strategic Plan and in support of the CoSTEM federal strategy for 2018-2022. The performance and evaluation strategy (learning agenda) includes:

- Internal and external performance measures that track progress toward the Agency's strategic objectives and program goals;
- Strategic assessment questions, success criteria and data collection processes, and tools supporting agency evaluation evidence-building capacity; and
- Processes for structuring independent studies conducted by third party vendors and for program-level evidence-based decision-making.

NASA identifies evidence of effective practices in its STEM Engagement investments through program design assessment, program and project evaluation and performance measurement. NASA implements its performance and evaluation strategy (learning agenda) to plan, execute and monitor the performance and effectiveness of its investments. Annually, OSTEM will generate a body of evidence-based data that it generates and data it collects from awardees to assess progress of its investments in achieving performance goals and annual performance indicators in alignment with the model below, to make evidence-based programmatic decisions and to establish future performance measures.

The following FY2019-FY2020 OSTEM Performance and Evaluation Model graphic (Figure 2) depicts the alignment of assessment focus areas with functions, strategic assessment questions and performance goals.



Graves, C. & Strang, T. (2018). *NASA Office of STEM Engagement FY 2019 – FY 2020 learning agenda*. Cleveland, OH: Paragon TEC.

Figure 2 - FY2019 – FY2020 OSTEM Performance and Evaluation Model

2 SCOPE OF PROGRAM ELEMENT

The Space Grant Program is dedicated to building, sustaining, and deploying a skilled, high-performing and diverse workforce that meets the current and emerging needs of NASA and the nation. The program promotes partnerships and cooperation among universities, federal, state, and local governments, and aerospace industries to encourage and facilitate the application of university resources to aerospace and related fields.

The NASA OSTEM solicits proposals for the National Space Grant College and Fellowship Program (Space Grant) *National Space Grant College and Fellowship Program Opportunities in NASA STEM FY 2020 - 2024*. 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. This funding opportunity is intended to provide four years of funding via an educational cooperative agreement.

2.1 OVERVIEW OF OPPORTUNITY

2.1.1 GOALS AND OBJECTIVES

The goal of the Space Grant Program is to contribute to [NASA's mission](#) specifically in the area 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.

To this end, Space Grant consortia shall develop innovative, integrated and comprehensive Projects to meet the following objectives. Proposals shall clearly define the consortia’s efforts and demonstrate how those efforts will meet the following objectives.

The specific objectives of the Space Grant Program are to:

- Create cooperative programs among universities, aerospace industry, and Federal, state, and local governments to foster STEM ecosystems;
- Encourage interdisciplinary training, research, and public service programs related to aerospace;
- Establish and maintain a national network of universities with interests and capabilities in aeronautics, space, and related fields;
- Attract, recruit and train U.S. citizens, especially women, underrepresented minorities, and persons with disabilities, for careers in aerospace science and technology;
- Promote a strong STEM education base from elementary through secondary levels while providing support to teachers in these grade levels toward more effectively improving student academic outcomes;
- Create opportunities that enable student contributions to the development of solutions addressing NASA Mission Directorate challenges; and
- Advance aerospace knowledge and expand related activities.

Space Grant Consortia will support FY2019-2021 Office of STEM Engagement Multi-Year Performance Goals and Annual Performance Indicators (APIs). These are as follows:

- Performance Goal 3.3.3 - 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.
 - Annual Performance Indicator 18-1 (API 18-1): Provide significant, direct student awards in higher education to (1) students across all institutional categories and levels (as defined by the U.S. Department of Education); (2) racially or ethnically underrepresented students, (3) women, and (4) persons with disabilities at percentages that meet or exceed the national percentages for these populations, as determined by the most recent, publicly available data from the U.S. Department of Education’s National Center for Education Statistics for a minimum of two of the four categories.
- Performance Goal 3.3.5 - Provide opportunities for students to contribute to NASA’s aeronautics, space, and science missions and work in exploration and discovery.

- Annual Performance Indicator 18-5 (API 18-5): Space Grant, EPSCoR, and MUREP investments will contribute to American technical capability through at least 1,200 paper presentations and peer-reviewed research publications.

Proposals shall address how the Consortium's project will address performance measurement and assessment per the above, see Section 4.9 & Appendix H.

2.1.2 NASA RELEVANCE

Proposals shall clearly and concisely describe the relevance 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 research priorities of the Mission Directorates and Centers, which are summarized in [Section H.6.8 Research Priorities for NASA Mission Directorates and Centers](#). The current NASA mission directorates are as follows:

- Aeronautics Research (<http://www.aeronautics.nasa.gov/>)
- Human Exploration Operations (<http://www.nasa.gov/directorates/heo/home/index.html>)
- Science (<http://science.nasa.gov/>)
- Space Technology (<http://www.nasa.gov/directorates/spacetech/home/index.html>)

Proposals shall address how the proposed Project and its programmatic elements directly align with the NASA Strategy for STEM Engagement as outlined in Section 1.2. The Consortia will be apprised annually of NASA STEM Engagement priorities and key areas of emphasis. 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. An overview of NASA's STEM Engagement Priorities is provided in Section 1.3.

2.1.3 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.

2.1.4 ELIGIBILITY

Proposals will 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 state-based Space Grant Directors, visit:

http://www.nasa.gov/offices/education/programs/national/spacegrant/home/Space_Grant_Consortium_Websites.html

2.2 FUNDING RESTRICTIONS

In addition to the funding restrictions and requirements included in the *NASA Guidebook for Proposers*, Title 2 CFR 1800, and the *NASA Grant and Cooperative Agreement Manual*, the following restrictions are applicable to this CAN.

- As directed in the *NASA Guidebook for Proposers*, Section 3.18, other than the special cases 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 to the 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).

2.3 INTELLECTUAL PROPERTY RESULTING FROM AWARDS

Award and intellectual property information is available here:

[https://prod.nais.nasa.gov/pub/pub_library/srba/Award and IP Information for Proposers.docx](https://prod.nais.nasa.gov/pub/pub_library/srba/Award_and_IP_Information_for_Proposers.docx)

2.3.1 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 Rights in Data clause within the NASA terms and conditions that 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 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 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 specific proprietary information.

2.3.2 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 supplemental language within the terms and conditions.

2.4 NASA SAFETY POLICY

All proposals shall take into consideration 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.

Proposers shall have a written safety policy. The *NASA Grant and Cooperative Agreement Manual (GCAM)* https://prod.nais.nasa.gov/pub/pub_library/srba/index.html states that grant recipients:

(a) 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 will notify the NASA Grant Officer immediately (within one workday) of any accident involving death, disabling injury or substantial loss of property in performing this award. The recipient will immediately (within one workday) advise NASA of hazards that come to its attention as a result of the work performed.

(b) 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 sub-awardees/subcontractors shall be the responsibility of the recipient.

The following NASA procedural requirement applies to NASA entities and others including recipients of grants and cooperative agreements only to the extent specified or referenced in applicable contracts, grants, or agreements:

NPR 8715.3D: NASA General Safety Program Requirements:

https://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_8715_003D

Responsible Office: Office of Safety and Mission Assurance

For additional information on the NASA Safety and Mission Assurance Program see: <https://sma.nasa.gov/>

3 AWARD INFORMATION

3.1 BASE AWARD DESCRIPTION

Proposers are strongly encouraged to incorporate activities/projects that support the Agency's priorities. The intent of this funding opportunity is to ensure the proposed efforts to NASA's mission by direct alignment of activities to the Mission. The proposal shall clearly convey how the award will support projects that align with Space Grant goals and objectives and the state's STEM needs while at the same time servicing NASA Mission Directorate needs. Per Space Grant regulatory language, making direct student awards via NASA Internships and Fellowships that reflect the Nation's diversity remains a goal of the Space Grant Program. Another goal of the Space Grant Program is to support NASA's missions through programmatic alignment with Mission Directorate challenges and needs. The proposals shall clearly identify all programmatic elements that address both NASA internship and fellowships and alignment with NASA Mission Directorates (e.g., Aeronautics Research Mission Directorate, Human Exploration and Operations Mission Directorate, Science Mission Directorate, and Space Technology Mission Directorate). Submitters are encouraged to create a multi-layered approach for showing how their proposal aligns with the Mission Directorate(s). For instance, a proposer could propose multiple projects that support SMD through new course curriculum and a summer middle school program that focuses on citizen science that targeting middle school students. Successful proposals shall provide opportunities for students to gain hands-on research and engineering experience on authentic flight platforms including high altitude balloons, sounding rockets, aircraft and space satellites. Proposers shall describe how these activities will meet the STEM needs of the state and NASA.

Awardees are required to address diversity of institutions, faculty, and students (gender, underrepresented, and underserved), which addresses API 18-1. Student diversity targets shall align with the National Center for Education Statistics (NCES) enrollment for each state. To see those enrollment levels, please visit - https://nces.ed.gov/programs/digest/d17/tables/dt17_306.60.asp?current=yes. Proposals shall include goals and objectives that are specific, measurable, attainable, realistic, and timely (S.M.A.R.T.) (see [Appendix F](#)). This will be achieved by including a Summary Table of S.M.A.R.T. Goals and Objectives. There shall be demonstrable outcomes, discernable outputs, and/or distinct impacts as a result of the additional NASA investment in the consortium. The S.M.A.R.T. goals should address how each Consortium plans on reaching and maintaining these metrics.

3.2 AWARD TYPE

Awards made under this solicitation will be issued as educational cooperative agreements. The change in award vehicle is necessitated because NASA desires a more collaborative relationship with the awardees, and cooperative agreements will provide for this. The inherent nature of the work does not change from past awards that were administered as grants. Also, 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.

3.3 FUNDING AND COST SHARING

The Government’s obligation to make an award is contingent upon the availability of appropriated funds from which payment can be made. The President’s 2020 Budget requests zero funding for NASA’s OSTEM. In the event that 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.

Table 1 - Award Funding Requirements

	NASA Funding Amount	Minimum Requirement for NASA Internships and Fellowships Allocation	Minimum Cost-Share Requirement *
Year 1	\$700,000	\$182,000	\$518,000
Years 2 - 4	\$685,000	\$178,100	\$506,900

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 are eligible to receive an additional \$150,000 per year for each territory respectively. These supplemental funds for US VI and Guam would be 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 formula:

$$\text{Total Requested NASA Funds} - \text{Required NASA internship and fellowships Allocation} = \text{Cost-share minimum requirement}$$

Please note that cost-share minimum requirements are not flexible. Unrecovered indirect costs on NIF awards can be used as cost-share. Funding above the minimum NASA internship and fellowships allocation amount is allowed; however, proposers shall still meet the minimum cost-share amount included in Table 1. Also, should additional funds become available, OSTEM will encourage proposals for an augmentation of funds. See 2 CFR 200.306, 2 CFR 1800.306 and for more information on Cost Sharing.

3.4 PERIOD OF PERFORMANCE

The period of performance (POP) for awards made under this announcement is four years from the award start date. Proposers shall respond to this solicitation with a 4-year budget and plan. If offered, those proposers requesting a continuation of approved work with additional funding will be required to submit a new budget and budget justification for the additional year. Funded extensions will be dependent on the availability of appropriated funds.

NASA funding beyond the first year is based on the recipient’s satisfactory annual evaluation of documented progress; compliance with data reporting, applicable regulations and laws, and other program requirements; fulfillment of fiduciary responsibilities; and the continued availability of appropriated funds. Continuation of funding may be reduced if cost reporting indicates a

significant level of unexpended funds, or if a recipient's performance is unsatisfactory (as determined by NASA).

3.5 CANCELLATION OF AWARDS

NASA reserves the right not to make any awards under this CAN and/or to cancel this CAN at any time prior to award. If this occurs, NASA assumes no liability (including reimbursement of proposal costs) for canceling the CAN or for any entity's failure to receive actual notice of such cancellation.

3.6 SCHEDULE OF 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). NSPIRES sends a decision notice via email requesting the PI or AOR to log into NSPIRES. This decision notice e-mail 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 that: 1) NASA's review of the proposal is concluded; and 2) no NASA funds are available to support the proposed project, or
- A "selected" or "selectable (pending)" status means that the proposal's review continues and the proposal has NOT received an award. A "selected" or "selectable (pending)" proposal status in NSPIRES is NOT a commitment that a proposal has or will receive an award by NASA nor that any funds have been or will be transferred from NASA Headquarters to a NASA Center.

Proposers are strongly cautioned that only a NASA Grant/Contracting Officer may make commitments, obligations, or awards on behalf of NASA or authorize the expenditure of funds. **A commitment by NASA to fund an award is only made through a grant or cooperative agreement signed by a NASA Grant Officer.** NASA Grant Officers only work at the NASA Shared Services Center (NSSC). 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 its own risk. Please refer to Section 5.4 of the *NASA Guidebook for Proposers* for more information.

3.7 BUDGET GUIDELINES

In addition to the funding guidelines and requirements in the *NASA Guidebook for Proposers*, Title 2 CFR Part 1800, and Section 4.7 of this CAN, the following restrictions govern the use of the federally-provided and the cost-shared portion of funds for this opportunity (referred to collectively as NASA Space Grant funds) and are applicable to this CAN. Proposers shall use NASA funds for support of undergraduate students, graduate students, post-doctoral fellows and their research; for support of faculty and researchers to conduct research, engage in professional development, and redesign, enhance, or develop curriculum; for research-related equipment, travel, and materials; for support of K-12 activities; and to support project management,

administration, and evaluation. For additional budget guidelines, see the *NASA Guidebook for Proposers Responding to a NASA Funding Announcement (revised March 2018)* (<https://www.hq.nasa.gov/office/procurement/nraguidebook/proposer2018.pdf>).

3.8 NASA INTERNSHIPS AND FELLOWSHIP OPPORTUNITIES

Proposers are required to meet the minimum NASA internship and fellowships (NIF) requirement for this announcement. Refer to [Table 1](#) in Section 3.3 for a breakdown of monetary requirements related to NASA Internships and Fellowships. The purpose of this dollar threshold is to ensure that a significant amount of NASA’s investment is applied directly to student awards. Any proposal that does not meet this requirement will be deemed non-compliant and will not be considered for funding. As a reference, [Appendix C](#) provides OSTEM definitions of internship and fellowships for internships and fellowships executed by NASA at NASA Centers and facilities. NASA no longer awards scholarships; however, awardees are not prohibited from offering scholarships from their award. Proposers can make awards to undergraduates, but those awards shall not be called fellowships. Also, proposers can make faculty fellowships that can be used towards meeting the minimum NIF requirement.

All NIF are required to be reported in the NASA approved data management system. Longitudinal tracking is required for a significant student investment. A significant award is a monetary award, or experience which includes one or more of the following: (a) has a value of greater than or equal to \$3,000; (b) participation of greater than or equal to 160 hours; and/or (c) through a cost-benefit analysis proves to have significant impact on the student's academic achievement and employment. Although OSTEM has plans to design and develop a new data management system, awardee performance data shall be reported in the current Office of Education Performance Measurement (OEPM) system (<https://oedc.nasa.gov>). For NASA Center internships, the number of contact hours (time spent on task completion under mentors’ direction) shall meet a minimum threshold of 400 contact hours per internship for college students. For internships at a NASA Center, it is required that Consortia ensure that those awards adhere to the standard NASA internship stipend funding levels. Funds utilized specifically for NASA or industry internships shall not be classified as a fellowship.

Table 2 - NASA Center Internship Student Stipends

Stipend Amounts		
Session	Full-time graduate	Full-time undergraduate
Fall and spring (16 weeks)	\$ 14,400	\$ 11,680
Summer (10 weeks)	\$ 9,000	\$ 7,300

3.9 COOPERATIVE AGREEMENT AWARD REPORTING REQUIREMENTS

The reporting requirements for award recipients under Space Grant will be consistent with the *NASA Grant and Cooperative Agreement Manual (GCAM)* (https://prod.nais.nasa.gov/pub/pub_library/srba/index.html). Unless otherwise noted, the Space Grant PI (Director) shall submit reports via secure transfer and following Personally Identifiable Information (PII) requirements to both the NASA Space Grant Program Office and the Technical Officer for the recipient's award as identified on the award documentation i.e., NF1687, which is issued by the NSSC. For additional information on PII, see *NASA Privacy* (<https://www.nasa.gov/privacy/index.html>) and *NASA Privacy of Information* (<https://www.grc.nasa.gov/its-training/best-practices/privacy-of-information/>).

- Within one month (30 days) after award, using required report formats, recipients shall:
 - Submit a descriptive project abstract for the nasa.gov website.

- Six months before the yearly award anniversary date using required report formats, recipients shall:
 - Summarize Consortium progress as it relates to project milestones
 - Summarize cost expenditures
 - NOTE: A template of the semiannual report will be provided. These reports will not be as comprehensive as the annual performance report.
 - NOTE: Feedback would be provided should edits/corrections be necessary or if there are concerns about performance.
 - NOTE: The frequency of these reports can be modified in the future based upon programmatic requirements.

- On an annual basis, using required report formats, recipients shall:
 - Participate in an annual Site Visit (in-person and virtual) conducted by NASA OSTEM Space Grant Staff. The Space Grant Program Office will determine at the start of each Fiscal Year which Consortia will have an in-person site visit.
 - Submit a pre-site visit Self-Assessment that includes, at a minimum:
 - Project activities completed during the award period of performance;
 - Project accomplishments measured against the proposed goals and objectives;
 - Evidence of how project activities have furthered stakeholder priorities;
 - Extent to which collaborations and/or partnerships have evolved;
 - Plan of activities for the next year; and
 - Financial Report (spreadsheet of side-by-side comparison, cumulative and by year, by category, of budget versus actual with explanation of deviations from plan).
 - Submit performance data into the Office of Education Performance Management (OEPM) OEDC portal by January 31 of the next calendar year. For example, Year 1 data will be due January 31, 2021
 - Submit accurate Student Data Tables and Expenditure Summaries in conjunction with their OEPM data. Student Data Tables will be used to verify Student Award numbers in OEPM as well as longitudinally track students after the conclusion of the award. Awardees will report the status of longitudinal tracking results annually to the NASA Office of Education. The

- template for these reports will be provided to the Consortia each year by the Space Grant Program Office and are essential to verifying OEPM data.
- Proposed activities under the Competitive Projects shall be aligned with the respective Mission Directorate for reporting purposes.
 - NOTE: See Table 3: Example Awardee Metrics Supporting Federal, Agency and OSTEM Priorities
 - NOTE: OSTEM is developing an updated system for award performance. This system should be ready for deployment in time for year 1 reporting, however, in the event that the system is not ready, OSTEM will communicate with awardees about contingency reporting plans.
- Submit annual progress reports, i.e., annual performance report (APR). Consortia will be given guidelines for the submission of the annual progress reports. In addition to the annual progress report, awardees shall:
 - Submit an updated milestone chart along for the next performance year
 - Submit a signed letter from all new partners or collaborators (to include sub-awards) that are established or awarded after the start of Year One
 - Submit a signed Certification of Assurance (see Inside Space Grant for up to date version of this document)
 - NOTE: Every effort will be made to streamline the reporting burden for the consortia while facilitating the compliance with Federal and OSTEM reporting requirements by the National Space Grant Office.
 - Within 90 days of the expiration of the project using required report formats, recipients shall:
 - Submit a final report with summary information from the entire project period of performance. 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.

Table 3 - Awardee Metrics Supporting Federal, Agency and OSTEM Priorities

Strategic Priority	Example Grantee/Awardee Metrics Supporting Federal, Agency and Office of STEM Engagement Priorities
Federal Strategy for STEM Education	<ul style="list-style-type: none"> # of collaborative connections (meetings, engagements, etc.) with the STEM ecosystem # of transdisciplinary research opportunities for undergraduate and graduate students # of teaching materials and resources developed from transdisciplinary research # of STEM educators incorporating or reflecting transdisciplinary approaches in problem-based learning activities in both formal and informal settings, at the K-12, undergraduate, and graduate education levels # of Work-Based Learning and Training opportunities through educator-employer partnerships and collaborations
NASA 2018 Strategic Plan and Office of STEM Engagement (OSTEM) Performance and Evaluation Strategy	<ul style="list-style-type: none"> awardee demographics (race, Ethnicity, sex, disabilities) awardee geographic location awardee academic level awardee institutional categories <i>NOTE: student profile information for students who receive a monetary investment (name, address, email, institution, major, academic level, demographics, military designation, etc.)</i> # of students engaged in project/activity # of educators (informal and formal) engaged in project/activity # of affiliates supporting project/activity # of peer reviewed publications (& Article/Manuscript Title, Authors, Author Type, Publication Title, Publication date) directly resulting from NASA STEM engagement grants and awards # of paper presentations (& Title, Authors, Author Type, Location, Venue (e.g., conference)) directly resulting from NASA STEM engagement grants and awards # of leveraged contracts, cooperative agreements, and grants (& Dollar amount, title, funding source, funding source category) directly resulting from NASA STEM engagement grants and awards # of patents, licenses, and technology transfers (& title, date) directly resulting from NASA STEM engagement grants and awards # and description of research facility enhancements directly resulting from NASA STEM engagement grants and awards # and type of new or enhanced courses developed directly resulting from NASA STEM engagement grants and awards. # of new or enhanced student research experiences directly resulting from NASA STEM engagement grants and awards. # and type of new or enhanced faculty training experiences directly resulting from NASA STEM engagement grants and awards. # R&D products that have increased technology readiness levels (TRL) directly resulting from NASA STEM engagement grants and awards.

The collection and submission of student data is a requirement in order to receive annual funding under the terms of this multi-year award. Types of student data including Names, Dates of Birth, Gender, Ethnicity, Address, and Field of Study, among others, shall be reported into OEPM. Continued funding of this award will be dependent upon complete and accurate reporting during each annual data collection cycle. A summary of reporting requirements for this multi-year award is below:

Type of	Due Date:	Submit to:
Bi-annual Report	6 months after award anniversary	Program Office
Annual Performance Report	60 days prior to award anniversary	Program Office & NSSC
Annual Certification of Assurance	60 days prior to award anniversary	Program Office & NSSC
Annual OEPM Reporting	January 31, 2021-2024	OEPM
Annual Student Data Tables	January 31, 2021-2024	Program Office & Technical Officer
Annual Expenditure Summary	January 31, 2021-2024	Program Office & Technical Officer
Final Close-Out Report	90 days after award end date	Program Office, Technical Officer & NSSC

Recipients shall also complete all required reports as requested by the NSSC as listed on the cooperative agreement required reports and publications document.

3.10 SUMMARY OF SPACE GRANT AWARDEE RESPONSIBILITIES

- Space Grant Lead Institutions (i.e., recipients) shall assume primary responsibility for implementing, operating, and managing the project as described in their original proposal and 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 also shall host an annual on-campus NASA site visit, following the schedule in the Management Guidelines. See additional information regarding reporting under [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*

(https://prod.nais.nasa.gov/pub/pub_library/srba/index.html). 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 PubMed Central system at <https://www.nasa.gov/open/researchaccess/pubspace>. The recipient shall provide a list of publications with annual and final reports.
- NASA reserves the right to impose additional requirements during the Cooperative Agreement's period of performance in order 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 (i.e., OEPM, NASA Internship Application Management System-NIAMS). OSTEM plans to develop a new enhanced data management system that aligns with Federal, Agency and OSTEM performance and evaluation priorities and requirements. Space Grant Management will communicate training and provide data collection tasks for existing and newly developed systems.
- 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 and NASA Community College Aerospace Scholars (NCAS) evaluation efforts.

4 PROPOSAL AND SUBMISSION GUIDANCE

Required Proposal Sections	Page Limit
Proposal Cover Pages	As needed (NSPIRES generated)
Proposal Executive Abstract	4000 characters, including spaces
Data Management Plan	8000 characters, including spaces
Table of Contents	As needed
Consortium Profile	1
Body of Proposal	15
Consortium Management	3
Principal Investigator Curriculum Vitae (CV)	2
Budget Table(s), Details and Narrative	As needed
Affiliate Concurrences	As needed
Letters of Resource Support	As needed
Milestones	As needed
Optional Proposal Sections	Page Limit
NCAS	4 excluding budget table, justification and details

General Format: 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. Proposals shall be uploaded into NSPIRES in PDF format with applicable section bookmarks.

Important note on creating PDF files for upload: 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.

4.1 PROPOSAL EXECUTIVE ABSTRACT

This section shall summarize the larger consortium-wide project. Concisely describe the content and scope of the project, and identify the objective(s), methodology and intended results.

4.2 DATA MANAGEMENT PLAN

Consistent with the NASA Plan for Increasing Access to Results of Federally Funded Research, new terms and conditions about making manuscripts and data publicly accessible may be attached to NASA awards. 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.

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](https://www.nasa.gov/sites/default/files/atoms/files/2069852015nasa_plan-for-web.pdf)

In addition, SMD has posted a Frequently Asked Questions (FAQ) website that addresses questions about DMP requirements at <http://science.nasa.gov/researchers/sara/faqs/dmp-faq->

[roses](#). 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*.

4.3 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.

4.4 BODY OF PROPOSAL

Identify the consortium Project's goals and objectives. [NOTE: goals and objectives are mentioned below in the measurement section, but should be included here.] 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 1.2. In this section, the first time a multi-disciplinary activity is mentioned, the proposer shall identify which Mission Directorates the activity aligns with. 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 should be outlined in alignment 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 (1) Mission Directorate, unless the activity falls under a "Competitive Project".

NASA Internships and Fellowships: Describe in detail proposed internship and fellowship projects and opportunities. Identify the STEM disciplines for graduate and undergraduate support. Student data must be entered into OEPM. Outline how the consortium will collect student information, and get the necessary approvals at the institutional level to fulfill grant reporting requirements. This section should clearly identify the number of projected awards, and a plan to longitudinally track all significant student investments, see Section 3.8. Proposers can categorize funding that is a direct student award under the category called NIF. Proposers shall ensure that the budget table and justification align with this section. See [Appendix C](#) for further descriptions.

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.

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 a**

NASA internship and fellowship award shall be a U.S. National, see [policy concerning citizenship](#). Should a proposal include support for non-U.S. citizens and are not classified as a NIF, then the award recipient must work with the Technical Officer to coordinate 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.

NOTE: Hawaii and South Carolina can provide information on how Guam and U.S. Virgin Islands contribute to their respective Consortium's goals and objectives in a 1-2 page appendix to the proposals.

NOTE: Consortium Strategic Plans are not a required component of the proposal; however, if a proposer makes references to the strategic plan, then include the strategic plan as an appendix to the proposal.

4.5 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. The Consortium's Strategic Plan shall be included as an appendix to the proposal.
- 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.

4.6 BUDGET TABLE, DETAILS AND NARRATIVE

Provide a budget spreadsheet for **each year** (FY2020-2024) of proposed work and a single cumulative budget for the four (4) year award period. A budget narrative/description is also required and shall accompany the spreadsheet. The proposed budget 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. 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. Excel versions of the budget tables will be available upon request from the Space Grant Program Office.

- The budget shall reflect clear alignment with the content and text of the proposal. The budget shall contain sufficient cost detail and supporting information to facilitate a speedy evaluation and award. In order to expedite the evaluation of the proposal, it is highly recommended that the proposal text reference specific and consistent budget categories and vice-versa.
- Significant dollar amounts proposed with no explanation (e.g., Scholarships: \$150,000, Labor: \$80,000, Supplies: \$10,000) may well result in a determination of proposal unacceptability, or cause delays in funding. All costs shall be explained in reasonable detail. Provide the number and amount of projected internships and fellowships. Provide the titles/names and details of workshops, courses, and activities.
- Proposers shall provide a summary table that details all NIF investments
- Subcontracts to an individual or organization: Refer to Appendix C of the *NASA Guidebook for Proposers* (<https://www.hq.nasa.gov/office/procurement/nraguidebook/proposer2018.pdf>). Subcontract awards should include a separate budget, work statement, and/or a breakout of hourly rate for direct labor.
- Cost-Share: Requirements for cost-sharing can be found in **2 CFR §200.306 and 2 CFR 1800.306**. Recipients shall ensure that its organization has written policies/procedures regarding cost-sharing that are allowable and in alignment with those of the sponsoring Agency. Ensure that the proposer has an accounting system that provides for recording of cost-sharing for each project (including budgeted and actual costs). Examples of accounting documentation include signed timesheets for salaries and wages, letters from vendors donating equipment/supplies at fair market value, certified unrecovered indirect costs/rates,

values for non-Federal entity contributions of services and property, and volunteer services furnished by third-party professionals.

- Proposals shall include a table that details expected cost-share amounts by activity per year of the award. For instance, if cost-share is provided via subcontracts, this table will outline the funding each institution/entity is providing as cost-share. Refer to Section 3.4.
- Direct Labor costs shall be separated by titles (e.g. director, program manager, program coordinator, graduate research assistant, clerk, etc.) with estimated hours, 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 the cost-share portion.
- Proposers shall complete the table below for key personnel (Consortium Director, Principal Investigator, Program Manager, etc.). Clearly identify the amount of money (in total) that key personnel is paid by 1) NASA Funds and 2) matching funds, and clearly identify the percentage of time that those dollars translates into based on a 12-month period.

Director/ Other Key Personnel	Dollars	NASA Funding TOTAL dollars for a 12-month period (academic + summertime)	Matching Funding TOTAL dollars for a 12-month period (academic + summertime)
	Time	NASA Funding Percentage of TOTAL time for a 12-month period (academic year + summertime)	Matching Funds Percentage of TOTAL time for a 12- month period (academic year + summertime)

- Other costs (with 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. Proposals may include travel, registration fees, and per diem for national meetings and regional meetings (up to three (3) days). Space Grant funds shall not to be used for expenses (lodging and per diem) on any day(s) at the national/regional meetings in which non-NASA meetings and activities are being conducted.
- Proposers shall include sufficient travel funding for attendance of the biannual OSTEM PI Meeting. The inaugural meeting is being held in the summer of 2019; the next meeting will be held in the summer of 2021. The travel funding should be sufficient to

cover the award PI and a plus one. The locations of the PI Meeting will be communicated to awardees once those details are available. Note: This PI Meeting does not replace the annual site visit that is a requirement of the award.

4.7 BUDGET RESTRICTIONS

Foreign travel shall be related to the goals of Space Grant. Foreign travel requires prior approval from the Space Grant Program 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).

4.8 MILESTONES

Proposers are required to complete a milestone chart. Each year can be represented as a separate milestone chart. The milestones shall be broken down by programmatic element, i.e., Mission Directorate then by activity. The timescale used shall be listed by month. These milestones shall align with the proposed activities, and budget narrative and justification. Upon selection, if an awardee needs to make an update to its milestone chart, an awardee will have up to 30 days after award notification from the NSSC to provide an updated milestone chart. Awardees shall submit an updated milestone chart with their annual performance report for the next performance year.

4.9 PROJECT ASSESSMENT

Each awardee shall establish multi-year goals and objectives with annual indicators of success (performance metrics) across the four (4) year period of performance. Annually, projects shall utilize evidence to implement improvements. The proposer shall describe key metrics to be used for project assessment, including a data collection plan for acquiring and aggregating data to which the pre-award baseline data will be compared. The proposer shall identify quantitative metrics where appropriate, and discuss other means by which the Consortium’s progress will be assessed, including the approach to reporting information required in the annual performance report. Proposals shall document the intended outcomes of proposed project elements and offer metrics to demonstrate progress toward and achievements of these outcomes in alignment with Federal, Agency and OSTEM performance and evaluation priorities and requirements. Proposals shall include a summarized matrix of S.M.A.R.T. Goals, Objectives and Performance Metrics (see [Appendix E](#) Sample S.M.A.R.T. Goals, Objectives and Performance Metrics Matrix). This section can be placed into an appendix to the proposal.

4.10 SUMMARIZED TABLE OF S.M.A.R.T. GOALS, OBJECTIVES AND PERFORMANCE METRICS

The S.M.A.R.T. goals should show alignment with Mission Directorates and have tangible metrics. Refer to [Appendix E](#) for a sample S.M.A.R.T. matrix.

4.11 AFFILIATE CONCURRENCES

Provide a listing of all affiliate members including the institution name and the name of the affiliate member who will provide concurrence. The designated representative from the lead institution (Director) and each affiliate representative must sign this document. This signature represents the affiliate's agreement with the contents of the proposal. Email concurrences are acceptable.

4.12 LETTERS OF RESOURCE SUPPORT

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 identify the sender), and is required even if the Co-I, or Collaborator is from the proposing organization per (Section 3.17 of the [NASA Guidebook for Proposers](#)). Note: If activities and sub-awards are made through competitive means and those awards have not been made prior to the submission of the proposal, letters of support are not required at the time of proposal submission. Letters of resource support are only 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. For collaborations that are not included at the time of proposal submission due to this reason, an update with corresponding letters of resource support shall be provided at the time of annual progress reporting. Further details will be provided to the awardee upon selection.

Additionally, 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.

4.13 NASA AEROSPACE COMMUNITY SCHOLARS (NCAS)

Proposers are invited, but not required, to propose to contribute to NASA Aerospace Community Scholars project. Should a proposer opt to propose to any of the following, the submitted appendix will be evaluated at the same time as the remainder of the proposal. Once the proposal is accepted, the award's scope will encompass proposed work.

Page Limit: Page limit: four (4) pages (not including budget content) per proposing institution

Description: NASA Community College Aerospace Scholars is an Agency wide, Minority University Research and Education Project (MUREP) funded STEM engagement model that encourages community college students to finish a 2-year degree or transfer to a 4-year

university to pursue a NASA-related field or career. Proposers can request MUREP funding to implement the NCAS model at one or more of their minority serving community college campuses. Proposers have the option of including NCAS for a 2, 3, or 4-year period of performance. Up to 16 campuses will be selected.

NCAS consists of a 5-week online learning experience highlighting past, present, and future NASA missions and research. Students complete six quizzes, attend a subject matter expert lecture series, and submit a final project. Students who complete the online learning experience with a minimum grade of 70% are eligible attend a 4-day engineering design workshop on their home campus. Each workshop consists of 40 students who work in teams, learn about NASA careers, tour labs, and learn how to prepare for NASA opportunities for undergraduates.

The intent of this funding opportunity is to make available training and resources for community college campuses to implement the NCAS evidence-based STEM engagement model, on their home campus, for underrepresented 2-year degree seeking students. Evaluation results show students who participate in NCAS strengthen their STEM identity, their understanding of career options, and increase their motivation and persistence in pursuing their academic and professional goals.

Period of Performance and Funding: Proposers have the option of implementing NCAS at one or more qualifying campuses (see eligibility) for a minimum of two consecutive years not to exceed a four-year period of performance beginning in 2020. Funding will be provided by MUREP in the following amounts: Year 1 funding is \$25,000 per campus; Years 2-4 funding is \$12,500 per campus, per year. NASA funding beyond the first year is based on a satisfactory annual evaluation of documented progress; compliance with data reporting, applicable regulations and laws, and other program requirements; fulfillment of fiduciary responsibilities; and the continued availability of appropriated funds. Continuation of funding may be reduced if cost reporting indicates a significant level of unexpended funds, or if an institution's performance is unsatisfactory (as determined by NASA). NOTE: It is the policy of the NCAS Project Office that all NCAS funds not have indirect costs/overhead/F&A costs applied by either the lead institution or subawardee.

Eligibility:

Proposers shall identify one or more campuses within the consortium that meet the following requirements:

1. Accredited community college or 2-year institution
2. Minority serving institution (MSI) as recognized by the US Department of Education
3. Sufficient enrollment of STEM students who meet the eligibility requirements for NCAS. Eligibility requirements for NCAS students are:
 - a. U.S Citizenship;
 - b. High school graduate or equivalent and at least 18 years of age;
 - c. Registered at a US community college during NCAS; and
 - d. Completion of or enrollment in 9 or more semester hours or credits of STEM coursework.
4. Campuses that participated in the NCAS 2019 Pilot are eligible for continuation funding for \$12,500 per campus per year.

Proposers may identify a lead campus to collaborate with multiple campuses within a state to meet requirement three (3). All participating campuses shall satisfy requirements one (1) and two (2) immediately above.

Award Information

Proposals shall clearly convey how the award aligns with Space Grant goals, objectives, and the state's STEM needs. Successful proposals shall illustrate how each campus meets eligibility requirements, has existing or planned quality STEM programs and activities on campus, and institutional support for the inclusion of NCAS as part of those programs and activities. Successful proposals shall also identify faculty responsible for coordinating NCAS on campus, and identify established connections to the aerospace industry or NASA-related university research labs that will be leveraged to produce mentors, judges, and speakers for the NCAS event.

Performance Measurement and Evaluation

Successful proposals shall include a plan for recruiting and retaining 50-80 underrepresented students to complete the 5-week online NCAS course to fill a 40-student on campus. Program level reporting is required and shall address the activity's goals to improve students' STEM identity, student understanding of career options, and student motivation and persistence in pursuing their academic and professional goals. OEPM reporting for each NCAS participant under MUREP is required. Additionally, NCAS may identify one or more campuses to complete participation surveys as part of an external NCAS evaluation.

5 PROPOSAL SUBMISSION INFORMATION

5.1 CERTIFICATIONS OF COMPLIANCE

See the Certifications and Assurances link on the NASA Grant and Cooperative Agreement webpage and Section 3.9 of the *NASA Guidebook for Proposers*. Both can be found at the following site: https://prod.nais.nasa.gov/pub/pub_library/srba/index.html.

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 2 CFR Part 1800, Appendix A.

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 now review and submit financial assistance certifications and representations online. The new process will be required effective January 1, 2020; refer to <https://interact.gsa.gov/blog/certifications-and-representation-improvements-sam>.

For instructions on entering certifications and representations please review the SAM Non-Federal User Guide (Section 4.3.2 Entering Representations and Certifications) at https://www.sam.gov/SAM/SAM_Guide/SAM_Non_Federal_User_Guide/SAM_Non_Fed_User_Guide.html#_Toc4.3.2

Proposers shall submit a new certification of assurances with this proposal as an appendix. Use the link to this document to complete: https://prod.nais.nasa.gov/pub/pub_library/srba/certs.doc. This document must be submitted yearly to the NSSC. Additionally, every awardee should note that the NF1206 (Assurance of Compliance with the National Aeronautics and Space Administration Regulations Pursuant to Nondiscrimination in Federally Assisted Programs) is required every 3 years from the date it is signed. Use the link below to access this file: https://missionstem.nasa.gov/docs/NF_1206.pdf. This form must be submitted to the NSSC as well. Failure to submit these documents, will result in your award being delayed in processing.

Technical Note: NASA's OSTEM has a Task Order with Total Solutions, Inc. (80HQTR18A0003) to support the Space Grant and EPSCoR Programs. To further avoid any possible perception of real or potential conflict of interest, Total Solutions, Inc. is not eligible to serve as a subcontractor, partner, or collaborator to an entity proposing under the Space Grant or EPSCoR Solicitations.

Additionally, to avoid any possible perception of a real or potential conflict of interest, JPL is not eligible to serve as a subcontractor, partner, or collaborator to an entity proposing under NASA TEAM II. However, this restriction does not preclude an applicant from proposing the use of JPL facilities or resources.

5.2 PROPOSAL SUBMISSION

Proposals shall be received by 11:59 ET on the date listed in the [Summary of Key Information](#). All proposals shall be submitted via **NSPIRES** (<http://nspires.nasaprs.com>) or **Grants.gov** (<http://www.grants.gov>). Carefully note the following requirements for submission of an electronic proposal, regardless of the proposer's intent to submit via NSPIRES or Grants.gov.

For those proposals that are rated as "Selectable Pending", a revised proposal and any other supporting documentation must be submitted via NSPIRES. The revised proposal must be resubmitted by the AOR of the proposing institution.

5.3 REGISTRATION IN NSPIRES

- A. Every organization that intends to submit a proposal to NASA in response to this opportunity shall be registered in NSPIRES. This applies to proposals submitted through either NSPIRES or Grants.gov. The organization's electronic business point-of-contact (EBPOC) in SAM, formerly the Central Contractor Registry (CCR), shall perform the registration for either proposal data system.
- B. Each individual team member (e.g., PIs, Co-Investigators, Sci-investigators, etc.) shall be individually registered in NSPIRES. This applies to proposals submitted under Grants.gov and NSPIRES.
- C. 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 in advance and**

to submit the required proposals materials well in advance of the proposal submission deadline.

- D. Note: Respondents without access to the Web or who experience difficulty using NSPIRES 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. (ET), Monday through Friday (except for Federal Government 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 holidays, when Grants.gov support is closed. Proposals received after the due date may be returned without review.
- E. **Proposal Submission Date and Time:** All proposals are due by 11:59 p.m. (ET) on the date listed in the [Summary of Key Information](#). Proposals shall be submitted electronically via NSPIRES (<http://nspires.nasaprs.com>) or Grants.gov (<http://www.grants.gov>)

5.4 PRE-PROPOSAL TELECONFERENCE

A pre-proposal teleconference will be held on Thursday, August 1, 2019 at 1:00 pm Eastern Time. Refer to the Space Grant web page on NSPIRES for connection details. During this time, prospective proposers may verbally ask questions they may have about the opportunity. Proposers may also receive technical assistance from project staff at this time.

Prospective proposers are requested to submit any written questions as instructed on the NSPIRES announcement of this opportunity. Responses to questions submitted will be provided in a list that will be posted on NSPIRES. The list will be updated periodically during the open period of the opportunity.

6 PROPOSAL EVALUATION AND SELECTION

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 proposal 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 funding for that proposal will be reprogrammed by NASA OSTEM.

7 SUMMARY OF KEY INFORMATION

Expected total budget for new awards	\$700,000 = Year 1; \$685,000 = Years 2– 4
Number of new awards pending adequate proposals of merit	52 awards
Maximum duration of awards	4 years
Award Type	Cooperative Agreements
Pre-proposal Conference (Optional)	August 1, 2019 at 1pm EDT Check the NSPIRES website for updates and details.
Due date for proposals	11:59pm ET, September 30, 2019
Page limit for the central Scientific-Educational-Management section of proposal	15 pages; see also Section 3.7 - Overview of Proposal, in the <i>NASA Guidebook for Proposers</i>
Detailed instructions for the preparation and submission of proposals	See the <i>NASA Guidebook for Proposers</i> : http://www.hq.nasa.gov/office/procurement/nraguidebook/proposer2018.pdf
Submission medium	Electronic proposal submission is required via NSPIRES or grants.gov; hard copies will not be accepted. See Chapter 3 of the <i>NASA Guidebook for Proposers</i> .
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspireshelp@nasaprs.com or (202) 479-9376 from 8:00 am to 6:00 pm Eastern Time, excluding Federal Government holidays).
Web site for submission of proposal via grants.gov	http://grants.gov (Contact Center is available by email at support@grants.gov , or by calling 1-800-518-4726 and via website at https://grants-portal.psc.gov .)
Selection Official	Mr. Chad Rowe Space Grant Director (Acting) NASA Headquarters 300 E Street SW Washington, DC 20546 chad.r.rowe@nasa.gov
NASA point of contact concerning this program element	Erica Alston, Ph.D. Space Grant Deputy Project Manager NASA Langley Research Center 5 Langley Blvd. Hampton, VA 23666 erica.j.alston@nasa.gov

Appendix A - NASA Space Grant Program Office Contacts

<p>Chad Rowe Space Grant Program Manager (Acting) chad.r.rowe@nasa.gov</p>	<p>Erica Alston, Ph.D. Space Grant Deputy Project Manager erica.j.alston@nasa.gov</p>
<p>Michael Cherry Senior Program Analyst Valador, Inc. (NASA Support Contractor) michael.r.cherry@nasa.gov</p>	<p>Sonya L. Greene, Ph.D. Senior Program Analyst Valador, Inc. (NASA Support Contractor) sonya.l.greene@nasa.gov</p>
<p>Frank McDonald, Ph.D. Senior Program Analyst Total Solutions, Inc. (NASA Support Contractor) frank.mcdonald@nasa.gov</p>	<p>Andrew Hubbard Resource Analyst andrew.m.hubbard@nasa.gov</p>

Appendix B - NASA Center Space Grant Points of Contact (POCs)

<p><u>Armstrong Flight Research Center</u> Dave Berger Asst. Technical Manager dave.e.berger@nasa.gov</p>	<p><u>Johnson Space Center</u> Misti Moore Education Program Specialist misti.m.moore@nasa.gov</p>
<p><u>Ames Research Center</u> William "Braxton" Toy Specialist william.b.toy@nasa.gov</p>	<p><u>Kennedy Space Center</u> Theresa Martinez Education Specialist theresa.c.martinez@nasa.gov</p>
<p><u>Goddard Space Flight Center</u> James Harrington Computer Scientist james.l.harrington@nasa.gov</p>	<p><u>Langley Research Center</u> Gina Blystone Education Program Specialist gina.r.blystone@nasa.gov</p>
<p><u>Glenn Research Center</u> Dave Kankam, Ph.D. University Affairs Officer mark.d.kankam@nasa.gov</p>	<p><u>Marshall Space Flight Center</u> Frank Six, Ph.D. Education Specialist frank.six@nasa.gov</p>
<p><u>Jet Propulsion Lab</u> Linda Rodgers University Programs Administrator linda.rodgers@jpl.nasa.gov</p>	<p><u>Stennis Space Center</u> Mitch Krell, Ph.D. University Affairs mitch.krell@nasa.gov</p>

Appendix C - OSTEM NASA Internships and Fellowships Definitions

The definitions in this appendix (Appendix C) are only applicable to NASA Center Internships and Fellowships that are managed by NASA. Thus, 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) of mentored, 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.

FINAL

Appendix D - Sample Budget Tables

SAMPLE FY 2020-2021 BUDGET

(Add cells as needed.)

	Fiscal Year 2020 – 2021		
	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			
H. Aeronautics Mission Directorate Projects			
1. Project 1			
2. Project 2			

I. Human Exploration Mission Directorate Projects			
1. Project 1			
2. Project 2			
J. Science Mission Directorate Projects			
1. Project 1			
2. Project 2			
K. Space Technology Mission Directorate Projects			
1. Project 1			
2. Project 2			
L. Competitive Projects			
1. Project 1			
2. Project 2			
M. NASA Community College Aerospace Scholars (NCAS)		No Match Req'd	
Total Direct Project Costs			
N. Subcontracts			
O. Total Direct Costs			
P. Indirect Cost (% rate of item O)			
Q. Total Costs			

SAMPLE FY 2021–2022 BUDGET

(Add cells as needed.)

	Fiscal Year 2021 – 2022		
	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			
H. Aeronautics Mission Directorate Projects			
1. Project 1			
2. Project 2			
I. Human Exploration Mission Directorate Projects			

1. Project 1			
2. Project 2			
J. Science Mission Directorate Projects			
1. Project 1			
2. Project 2			
K. Space Technology Mission Directorate Projects			
1. Project 1			
2. Project 2			
L. Competitive Projects			
1. Project 1			
2. Project 2			
M. NASA Community College Aerospace Scholars (NCAS)		No Match Req'd	
Total Direct Project Costs			
N. Subcontracts			
O. Total Direct Costs			
P. Indirect Cost (% rate of item O)			
Q. Total Costs			

SAMPLE FY 2022–2023 BUDGET

(Add cells as needed.)

	Fiscal Year 2022 – 2023		
	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			
H. Aeronautics Mission Directorate Projects			
1. Project 1			
2. Project 2			
I. Human Exploration Mission Directorate Projects			

1. Project 1			
2. Project 2			
J. Science Mission Directorate Projects			
1. Project 1			
2. Project 2			
K. Space Technology Mission Directorate Projects			
1. Project 1			
2. Project 2			
L. Competitive Projects			
1. Project 1			
2. Project 2			
M. NASA Community College Aerospace Scholars (NCAS)		No Match Req'd	
Total Direct Project Costs			
N. Subcontracts			
O. Total Direct Costs			
P. Indirect Cost (% rate of item O)			
Q. Total Costs			

SAMPLE FY 2023–2024 BUDGET

(Add cells as needed.)

	Fiscal Year 2023 – 2024		
	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			
H. Aeronautics Mission Directorate Projects			
1. Project 1			
2. Project 2			
I. Human Exploration Mission Directorate Projects			

1. Project 1			
2. Project 2			
J. Science Mission Directorate Projects			
1. Project 1			
2. Project 2			
K. Space Technology Mission Directorate Projects			
1. Project 1			
2. Project 2			
L. Competitive Projects			
1. Project 1			
2. Project 2			
M. NASA Community College Aerospace Scholars (NCAS)		No Match Req'd	
Total Direct Project Costs			
N. Subcontracts			
O. Total Direct Costs			
P. Indirect Cost (% rate of item O)			
Q. Total Costs			

SAMPLE CUMULATIVE FY 2020–2024 BUDGET

(Add cells as needed.)

	Cumulative Fiscal Years 2020 – 2024		
	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			
H. Aeronautics Mission Directorate Projects			
1. Project 1			
2. Project 2			
I. Human Exploration Mission Directorate Projects			

1. Project 1			
2. Project 2			
J. Science Mission Directorate Projects			
1. Project 1			
2. Project 2			
K. Space Technology Mission Directorate Projects			
1. Project 1			
2. Project 2			
L. Competitive Projects			
1. Project 1			
2. Project 2			
M. NASA Community College Aerospace Scholars (NCAS)		No Match Req'd	
Total Direct Project Costs			
N. Subcontracts			
O. Total Direct Costs			
P. Indirect Cost (% rate of item O)			
Q. Total Costs			

Appendix E - Sample Cost-Match Table

State Name Cost-Matching Funds for Year 1 (FY2020-2021)

Matching funds from Lead Institution:

\$XX,XXX	Description
\$XX,XXX	Description
Total Funding	Total Lead Institution matching funds

Matching funds from Consortium affiliate institutions:

\$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 Funding	Total affiliate matching funds

\$XXX,XXX	Grand Total Consortium FY2020-2021 Matching Funds
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Appendix F - Sample Table of S.M.A.R.T. Goals, Objectives and Performance Metrics Matrix

Instructions: Show goals, objectives and indicators of success (performance metrics) from the base award.

Strategic Priority Alignment: 1-Alignment to Federal Strategy for STEM Education, 2-NASA 2018, and/or 3-OSTEM Performance and Evaluation Strategy.

Space Grant Objective Alignment: Alignment to the Space Grant Program Objectives (1-7).

1. Promote a strong STEM education base from elementary through secondary levels while preparing teachers in these grade levels to become more effective at improving student academic outcomes.
2. Contribute to the of solving Mission Directorate challenges
3. Establish and maintain a national network of universities with interests and capabilities in aeronautics, space, and related fields.
4. Encourage cooperative programs among universities, aerospace industry, and Federal, state, and local governments to foster STEM Ecosystems.
5. Encourage interdisciplinary training, research, and public service programs related to aerospace.
6. Recruit and train U.S. citizens, especially women, underrepresented minorities, and persons with disabilities, for careers in aerospace science and technology.
7. Space Grant consortia are expected to develop innovative and integrated plans to advance aerospace knowledge and expand related activities.

Goals: Statements about general aims or purposes of the program that are broad, long-range intended outcomes and concepts.

Objectives: Brief, clear statements that describe the desired outcomes of the program.

Metrics: Parameters used to measure progress/success.

Target Number: Quantitative measure if appropriate.

Deadline: Target date for accomplishment/completion.

Consortium _____

Strategic Priority Alignment	Space Grant Objective Alignment	Consortium Year 1 Performance				
		Goal	Objective	Metrics	Target Number	Deadline
Strategic Priority Alignment	Space Grant Objective Alignment	Consortium Year 2 Performance				
		Goal	Objective	Metrics	Target Number	Deadline
Strategic Priority Alignment	Space Grant Objective Alignment	Consortium Year 3 Performance				
		Goal	Objective	Metrics	Target Number	Deadline
Strategic Priority Alignment	Space Grant Objective Alignment	Consortium Year 4 Performance				
		Goal	Objective	Metrics	Target Number	Deadline

Appendix G - Sample Milestone Chart

Guidance: Provide an estimate as to when a proposed activity will occur. The items listed below shall align with the content of the proposal, budget, and budget narrative.

Year:												
Activity	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20
Example: Graduate Student Awards						X						
Example: SMD-High Altitude Balloon Launch							X					

Appendix H - Research Priorities for NASA Mission Directorates and Centers

Note: This information is current as of 6/28/2019.

H.1 Aeronautics Research Mission Directorate Research

Aeronautics Research Missions Directorate (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. Additional information on ARMD can be found at: <http://www.aeronautics.nasa.gov>.

Areas of Interest

Researchers responding to solicitations that address the needs and/or priorities of the ARMD shall propose research that is aligned with one or more of the ARMD programs. Proposers are directed to the following:

- ARMD Programs: <http://www.aeronautics.nasa.gov/programs.htm>
- The National Aeronautics and Space Administration (NASA), Headquarters, Aeronautics Research Mission Directorate (ARMD) Current Year version of the NASA Research Announcement (NRA) entitled, "Research Opportunities in Aeronautics (ROA)" has been posted on the NSPIRES web site at <http://nspires.nasaprs.com> (select "Solicitations" and then "Open Solicitations").

Detailed requirements, including proposal due dates are stated in appendices that address individual thrust areas. These appendices will be posted as amendments to the ROA NRA and will be published as requirements materialize throughout the year.

H.2 Human Exploration and Operations Mission Directorate Research

Human Exploration and Operations Mission Directorate (HEOMD) provides the Agency with leadership and management of NASA space operations related to human exploration in and beyond low-Earth orbit. HEOMD also oversees low-level requirements development, policy, and programmatic oversight. The International Space Station (ISS), currently orbiting the Earth with a crew of six, represents the NASA exploration activities in low-Earth orbit. Exploration activities beyond low Earth orbit include the management of Commercial Space Transportation, Exploration Systems Development, Human Space Flight Capabilities, Advanced Exploration Systems, and Space Life Sciences Research & Applications. The directorate is similarly responsible for Agency leadership and management of NASA space operations related to Launch Services, Space Transportation, and Space Communications in support of both human and robotic exploration programs. Additional information on HEOMD can be found at: (<http://www.nasa.gov/directorates/heo/home/index.html>)

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 in order to enable safe, reliable, and productive human space exploration. The HRP budget enables NASA to resolve health risks in order 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.

Space Biology

The Space Biology research has three primary goals:

- Effectively use microgravity and other characteristics of the space environment to enhance our understanding of fundamental biological processes;
- Develop the scientific and technological foundations for a safe, productive human presence in space for extended periods and in preparation for exploration;
- Apply this knowledge and technology to improve our nation's competitiveness, education, and the quality of life on Earth.

These goals are achieved by sponsoring research studies in five program elements to contribute basic knowledge of biological adaptation to spaceflight to accelerate solutions to biomedical problems affecting human exploration of space as well as human health on Earth: Microbiology; Cell and Molecular Biology; Plant Biology; Animal Biology; and Developmental Biology

Current Space Biology emphases include:

- Using ground-based facilities to characterize the effects of space-like radiation on biological systems. NASA is interested in projects that will characterize how radiation exposure impacts living organisms during a single lifecycle, or over multiple generations.
- Using ground-based simulations to study how spaceflight conditions might impact plant and microbial interactions and growth. Questions of interest to NASA include, but are not limited to, whether spaceflight induces changes in the virulence of plant pathogens and/or whether spaceflight might change benign or commensal microbes on plants into pathogenic ones.
- Using ground-based facilities to simulate a range of gravitational levels on biological specimens to understand and characterize the dose-response curve between 0 and 2 G for various biological systems to determine A) if there are G-level thresholds required to trigger gravity-specific responses in living organisms, and B) the effect that exposure to levels of gravity similar to those encountered on Mars (.38 G) or the moon (0.16 G), and/or hypergravity has on living organisms.

Further details about Space Biology goals, objectives and progress can be found at the [Space Biology Website](#).

Physical Science Research

The Physical Science Research Program, along with its predecessors, has conducted significant fundamental and applied research, both which have led to improved space systems and produced new products offering benefits on Earth. NASA's experiments in various disciplines of physical science reveal how physical systems respond to the near absence of gravity. They also reveal how other forces that on Earth are small compared to gravity, can dominate system behavior in space.

The Physical Science Research Program also benefits from collaborations with several of the International Space Station international partners—Europe, Russia, Japan, and Canada—and foreign governments with space programs, such as France, Germany and Italy. The scale of this research enterprise promises new possibilities in the physical sciences, some of which are already being realized both in the form of innovations for space exploration and in new ways to improve the quality of life on Earth.

Research in physical sciences spans from basic and applied research in the areas of:

- Biophysics: biological macromolecules, biomaterials.
- Combustion science: spacecraft fire safety, droplets, gaseous (premixed and non-premixed), solid fuels, supercritical reacting fluids.
- Complex fluids: colloidal systems, liquid crystals, foams, gels, granular flows.
- Fluid physics: adiabatic two-phase flow, boiling and condensation, capillary flow, interfacial phenomena, cryogenics storage and handling.
- Fundamental physics: space optical/atomic clocks, quantum test of equivalence principle, cold atom physics, critical point phenomena, dusty plasmas.
- Materials science: glasses and ceramics, granular materials, metals, polymers and organics, semiconductors.

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

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 Precursor Near Earth Asteroid (NEA) Missions: Navigation and proximity operations systems; hazard detection; techniques for interacting and anchoring with Near Earth Asteroids; methods of remote and interactive characterization of Near Earth Asteroid (NEA) environments, composition and structural properties; robotics (specifically environmental scouting prior to human arrival and later to assist astronauts with NEA exploration); environmental analysis; radiation protection; spacecraft autonomy, enhanced methods of NEA characterization from earth-based observation.
- 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.
- 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 surface and NEAs. Visualization and data display; interactive data manipulation and sharing; mapping and data layering including coordinate transformations for irregular shaped NEAs; modeling of lighting and thermal environments; simulation of environmental interactions including proximity operations in irregular micro-G gravity fields and physical stability of weakly bound NEAs.
- Research and technology development areas in HEOMD support launch vehicles, space communications, 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))
 - In-helmet Speech Audio Systems and Technologies (Glenn Research Center (GRC))
 - Vehicle Integration and Ground Processing (Kennedy Space Center (KSC))
 - Mission Operations (Ames Research Center (ARC))
 - Portable Life Support Systems (JSC)
 - Pressure Garments and Gloves (JSC)
 - Air Revitalization Technologies (ARC)
 - In-Space Waste Processing Technologies (JSC)
 - Cryogenic Fluids Management Systems (GRC)
 - *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 (Johnson Space Center (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)
 - 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))

H.3 Science Mission Directorate Research

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, 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. At every step we share the journey of scientific exploration with the public and partner with others to substantially improve science, technology, engineering and mathematics (STEM) education nationwide. Additional information on SMD can be found at: (<http://nasascience.nasa.gov>)

Areas of Interest

SMD has developed science objectives and programs to answer fundamental questions in Earth and space sciences in the context of our national science agenda. The knowledge gained by researchers supporting NASA's Earth and space science program helps to unravel mysteries that intrigue us all.

- What drives variations in the Sun, and how do these changes impact the solar system and drive space weather?
- How and why are Earth's climate and environment changing?
- How did our solar system originate and change over time?
- How did the universe begin and evolve, and what will be its destiny?
- How did life originate, and are we alone?

Each of the SMD's four science divisions – Heliophysics, Earth Science, Planetary Science, and Astrophysics – makes important contributions to address national and Agency goals. The NASA 2018 Strategic Plan reflects the direction NASA has received from our government's executive branch and Congress, advice received from the nation's scientific community, the principles and strategies guiding the conduct of our activities, and the challenges SMD faces. Specifically,

Heliophysics Division

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.

The Agency's strategic objective for heliophysics is to **understand the Sun and its interactions with Earth and the solar system, including space weather**. The heliophysics decadal survey conducted by the National Research Council (NRC), *Solar and Space Physics: A Science for a Technological Society* (<http://www.nap.edu/catalog/13060/solar-and-space-physics-a-science-for-a-technological-society>), 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 goals:

- Explore the physical processes in the space environment from the Sun to the Earth and throughout the solar system
- Advance our understanding of the connections that link the Sun, the Earth, planetary space environment, and the outer reaches of our solar system
- 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

Earth Science Division

Our 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 our scientific understanding of Earth as a system and its response to natural and human-induced changes and to improve our 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 our planet. NASA addresses the issues and opportunities of climate change and environmental sensitivity by answering the following key science questions through our 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 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

Two foundational documents guide the overall approach to the Earth science program: the NRC 2007 Earth science decadal survey (<http://www.nap.edu/catalog/11820/earth-science-and-applications-from-space-national-imperatives-for-the>) and NASA's 2010 climate-centric architecture plan (https://smd-prod.s3.amazonaws.com/science-pink/s3fs-public/atoms/files/Climate_Architecture_Final.pdf)

The former articulates the following vision for Earth science research and applications in support of society:

Understanding the complex, changing planet on which we live, how it supports life and how human activities affect its ability to do so in the future is one of the greatest intellectual challenges facing humanity. It is also one of the most challenges for society as it seeks to achieve prosperity, health, and sustainability.

The latter addresses the need for continuity of a comprehensive set of key climate monitoring measurements, which are critical to informing policy and action, and which other agencies and

international partners had not planned to continue. 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.

Planetary Science Division

Planetary science is a grand human enterprise that seeks to understand the history of our solar system and the distribution of life within it. The scientific foundation for this enterprise is described in the NRC planetary science decadal survey, *Vision and Voyages for Planetary Science in the Decade 2013-2022* (<http://www.nap.edu/catalog/13117/vision-and-voyages-for-planetary-science-in-the-decade-2013-2022>). Planetary science missions inform us about our neighborhood and our own origin and evolution; they are necessary precursors to the expansion of humanity beyond Earth. Through five decades of planetary exploration, NASA has developed the capacity to explore all of the objects in our solar system. Future missions will bring back samples from some of these destinations, allowing iterative detailed study and analysis back on Earth. In the future, humans will return to the Moon, go to asteroids, Mars, and ultimately other solar system bodies to explore them, but only after they have been explored and understood using robotic missions.

NASA's strategic objective in planetary science is to **ascertain the content, origin, and evolution of the solar system and the potential for life elsewhere**. We pursue this goal by seeking answers to fundamental science questions that guide NASA's exploration of the solar system:

- How did our solar system form and evolve?
- Is there life beyond Earth?
- What are the hazards to life on Earth?

The Planetary Science Division has translated these important questions into science goals that guide the focus of the division's science and research activities:

- Explore and observe the objects in the solar system to understand how they formed and evolve
- Advance the understanding of how the chemical and physical processes in our solar system operate, interact and evolve
- Explore and find locations where life could have existed or could exist today.
- Improve our understanding of the origin and evolution of life on Earth to guide our search for life elsewhere
- Identify and characterize objects in the solar system that pose threats to Earth, or offer resources for human exploration

In selecting new missions for development, NASA's Planetary Science Division strives for balance across mission destinations, using different mission types and sizes. Achievement of steady scientific progress requires a steady cadence of missions to multiple locations, coupled with a program that allows for a consistent progression of mission types and capabilities, from

small and focused, to large and complex, as our investigations progress. The division also pursues partnerships with international partners to increase mission capabilities and cadence and to accomplish like-minded objectives.

See Section 4.3 of the NASA 2014 Science Plan for specifics, including missions currently in operation, in formulation or development, and planned for the future.

Astrophysics Division

Astrophysics is the study of phenomena occurring in the universe and of the physical principles that govern them. Astrophysics research encompasses a broad range of topics, from the birth of the universe and its evolution and composition, to the processes leading to the development of planets and stars and galaxies, to the physical conditions of matter in extreme gravitational fields, and to the search for life on planets orbiting other stars. In seeking to understand these phenomena, astrophysics science embodies some of the most enduring quests of humankind.

Through its Astrophysics Division, NASA leads the nation on a continuing journey of transformation. From the development of innovative technologies, which benefit other areas of research (e.g., medical, navigation, homeland security, etc.), to inspiring the public worldwide to pursue STEM careers through its stunning images of the cosmos taken with its Great Observatories, NASA's astrophysics programs are vital to the nation.

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

The scientific priorities for astrophysics are outlined in the NRC decadal survey *New Worlds, New Horizons in Astronomy and Astrophysics* (<http://www.nap.edu/catalog/12951/new-worlds-new-horizons-in-astronomy-and-astrophysics>). These priorities include understanding the scientific principles that govern how the universe works; probing cosmic dawn by searching for the first stars, galaxies, and black holes; and seeking and studying nearby habitable planets around other stars.

The multidisciplinary nature of astrophysics makes it imperative to strive for a balanced science and technology portfolio, both in terms of science goals addressed and in missions to address these goals. All the facets of astronomy and astrophysics—from cosmology to planets—are

intertwined, and progress in one area hinges on progress in others. However, in times of fiscal constraints, priorities for investments must be made to optimize the use of available funding. NASA uses the prioritized recommendations and decision rules of the decadal survey to set the priorities for its investments.

NASA's Astrophysics Division has developed several strategies to advance these scientific objectives and respond to the recommendations outlined in the decadal survey on a time horizon of 5-10 years. The successful development of JWST is an Agency priority. Since its re-baseline in 2011, the project has remained on schedule and within budget for an October 2018 launch. JWST and the science it will produce are foundational for many of the astronomical community's goals outlined in the 2010 decadal survey. NASA's highest priority for a new strategic astrophysics mission is the Wide Field Infrared Survey Telescope (WFIRST), the number one priority for large-scale missions of the decadal survey. NASA plans to be prepared to start a new strategic astrophysics mission when funding becomes available. NASA also plans to identify opportunities for international partnerships, to reduce the Agency's cost of the mission concepts identified, and to advance the science objectives of the decadal survey. NASA will also augment the Astrophysics Explorer Program to the extent that the budget allows. Furthermore, NASA will continue to invest in the Astrophysics Research Program to develop the science cases and technologies for new missions and to maximize the scientific return from operating missions.

See Section 4.4 of the NASA 2014 Science Plan for specifics, including missions currently in operation, in formulation or development, and planned for the future.

H.4 Space Technology Mission Directorate Research

Space Technology Mission Directorate (STMD) is responsible for developing the crosscutting, pioneering, new technologies, and capabilities needed by the agency to achieve its current and future missions. 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 take place within NASA Centers, 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 the Space Technology Mission Directorate (STMD) can be found at: (http://www.nasa.gov/directorates/spacetech/about_us/index.html)

Areas of Interest

Space Technology Mission Directorate (STMD) expands the boundaries of the aerospace enterprise by rapidly developing, demonstrating, and infusing revolutionary, high-payoff technologies through collaborative partnerships. STMD employs a merit-based competition model with a portfolio approach, spanning a wide range of space technology discipline areas and technology readiness levels. Research and technology development take place at NASA Centers, academia, and industry, and leverages partnerships with other government agencies and international partners.

STMD executes its mission according to the following tenets:

- Advancing transformative and crosscutting technologies that can be directly infused into future missions;
- Investing in a comprehensive portfolio covering low to high technology readiness levels;
- Competitively selecting research by academia, industry, and NASA Centers based on technical merit;
- Executing with lean structured projects with clear start and end dates, defined budgets and schedules, established milestones, and project level authority and accountability;
- Operating with a sense of urgency and informed risk tolerance to infuse quickly or terminate judiciously;
- Partnering with other NASA Mission Directorates, other government agencies, and the private sector to leverage resources, establish customer advocacy, and support US commercial aerospace interests;
- Delivering new inventions, enabling new capabilities and creating a pipeline of NASA and national innovators

Current space technology topics of particular interest include:

- Advanced manufacturing methods for space and in space
- Autonomous in-space assembly of structures and spacecraft
- Ultra-lightweight materials for space applications
- Materials and structures for extreme environments (high temperature, pressure)
- Extreme environment (including cryogenic) electronics for planetary exploration
- Advanced robotics for extreme environment sensing, mobility, and manipulation
- Deep space optical communication
- Extremely High Frequency microwave technologies for communication, remote sensing, and navigation
- Advanced power generation, storage, and transfer for deep space missions
- Advanced entry, decent, and landing systems for planetary exploration
- Efficient in situ resource utilization to produce items required for long-duration deep space missions including fuels, water, oxygen, food, nutritional supplements, pharmaceuticals, building materials, polymers (plastics), and various other chemicals
- Radiation mitigation for deep space crewed missions
- Biological approaches to environmental control and life support systems
- Autonomous systems for deep space missions
- Advanced telescope technologies for exoplanet imaging

- Low size, weight, and power components for small spacecraft including high-bandwidth communication from space to ground, inter-satellite communication, relative navigation and control for swarms and constellations, precise pointing systems, power generation and energy storage, thermal management, system autonomy, miniaturized instruments and sensors, robotic assembly/manufacturing, and in-space propulsion
- Enabling technologies for low-cost small spacecraft launch vehicles
- Advancements in engineering tools and models supporting Space Technology focus areas

Applicants are strongly encouraged to familiarize themselves with the roadmap document most closely aligned with their space technology interests. The individual roadmap documents may be downloaded at the following link: <http://www.nasa.gov/offices/oct/home/roadmaps/index.html> NASA's 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.

H.5 NASA Centers Areas of Interest

Examples of Center research interest include these specific areas from the following Centers and facilities.

H.5.1 Goddard Space Flight Center (GSFC)

Applied Engineering and Technology Directorate:

Advanced Manufacturing - facilitates the development, evaluation, and deployment of efficient and flexible additive manufacturing technologies.

- **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**
 - 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.

- **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.

Sciences and Exploration Directorate

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.
- 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.
- 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 includes: 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.

- **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 as well as the investigations and space instruments to test them. The researchers participate in planetary and Earth science missions, and collect, interpret, and evaluate measurements.

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

Education efforts in all science divisions seek to develop interest in and understanding of the science at GSFC by K-12 educators and students and the development of future scientist and computer scientists at the undergraduate and graduate level.

Outreach efforts in all four science divisions raise public awareness of the projects and missions in which we are involved, the research we conduct, and the associated benefits to society.

- Quantum computing
- Artificial intelligence and machine learning
- (Big) data analytics

H.5.2 Ames Research Center (ARC)

ARC (or Ames) enables exploration through selected development, innovative technologies, and interdisciplinary scientific discovery. Ames provides leadership in the following areas: astrobiology; small satellites; entry descent and landing systems; supercomputing; robotics and autonomous systems; life Sciences and environmental controls; and air traffic management.

- [Entry systems](#): *Safely delivering spacecraft to Earth & other celestial bodies*
- [Supercomputing](#): *Enabling NASA's advanced modeling and simulation*
- [NextGen air transportation](#): *Transforming the way we fly*
- [Airborne science](#): *Examining our own world & beyond from the sky*
- [Low-cost missions](#): *Enabling high value science to low Earth orbit, the moon and the solar system*
- [Biology & astrobiology](#): *Understanding life on Earth and in space*
- [Exoplanets](#): *Finding worlds beyond our own*
- [Autonomy & robotics](#): *Complementing humans in space*
- [Lunar science](#): *Rediscovering our moon*
- [Human factors](#): *Advancing human-technology interaction for NASA missions*
- [Wind tunnels](#): *Testing on the ground before you take to the sky*

Additional Center core competencies include:

- Space Sciences
- Applied Aerospace and Information Technology
- Biotechnology
- Synthetic biology.
- Biological Sciences
- Earth Sciences
- High Performance Computing,
- Intelligent Systems
- Quantum Computing
- Nanotechnology-electronics and sensors.
- Small Spacecraft and Cubesats
- Airspace Systems
- Augmented Reality
- Digital materials

H.5.3 Glenn Research Center (GRC)

GRC's Research and technology, and engineering engagements include:

- Acoustics
- Advanced Energy (Renewable Wind and Solar, Coal Energy and Alternative Energy)
- Advanced Microwave Communications
- Aeronautical and Space Systems Analysis
- Computer Systems and Networks
- Electric (Ion) Propulsion
- Icing and Cryogenic Systems
- Instrumentation, Controls and Electronics
- Fluids, Computational Fluid Dynamics (CFD) and Turbomachinery
- Materials and Structures, including Mechanical Components and Lubrication
- Microgravity Fluid Physics, Combustion Phenomena and Bioengineering
- Nanotechnology
- Photovoltaics, Electrochemistry-Physics, and Thermal Energy Conversion
- Propulsion System Aerodynamics
- Space Power Generation, Storage, Distribution and Management
- Systems Engineering

The above engagement areas relate to the following key GRC competencies:

- Air-Breathing Propulsion
- Communications Technology and Development
- In-Space Propulsion & Cryogenic Fluids Management

- Power, Energy Storage and Conversion
- Materials and Structures for Extreme Environment
- Physical Sciences and Biomedical Technologies in Space

H.5.4 Armstrong Flight Research Center (AFRC)

AFRC's areas of focus include Autonomy (Collision Avoidance, Separation assurance, formation flight, peak seeking control)

- Adaptive Control
- Hybrid Electric Propulsion
- Control of Flexible Structures using distributed sensor feedback
- Supersonic Research (Boom mitigation and measurement)
- Supersonic Research (Laminar Flow)
- Environmental Responsive Aviation
- Hypersonic Structures & Sensors
- Large Scale Technology Flight Demonstrations (Towed Glider)
- Aerodynamics and Lift Distribution Optimization to Reduce Induced Drag

H.5.5 Marshall Space Flight Center (MSFC)

MSFC's areas of focus include:

Propulsion Systems

- Launch Propulsion Systems, Solid & Liquid
- In Space Propulsion (Cryogenics, Green Propellants, Nuclear, Fuel Elements, Solar-Thermal, Solar Sails, Tethers)
- Propulsion Test beds and Demonstrators (Pressure Systems)
- Combustion Physics
- Cryogenic Fluid Management
- 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
- 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

Space Systems

- 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 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)

Science

- Replicated Optics
- Large Optics (IR, visible, UV, X-Ray)
- High Energy Astrophysics (X-Ray, Gamma Ray, Cosmic Ray)
- Solar, Magnetospheric and Ionospheric Physics
- Radiation Mitigation/Shielding
- Earth Science Applications
- Convective and Severe Storms Research
- Climate Dynamics

- Lightning Research
- Geochronology, Geochemistry, Atmospheres and Interiors of Planetary Bodies
- Physical Science Informatics
- Biophysics (Protein Crystals)

H.5.6 Kennedy Space Center (KSC)

KSC's areas of focus

include:

- TA 4.0 Robotics and Autonomous Systems
 - 4.1 Sensing and Perception
 - 4.1.4 Natural, Man-Made Object, and Event Recognition
 - 4.3 Manipulation
 - 4.3.6 Sample Acquisition and Handling
 - 4.5 System-Level Autonomy
 - 4.5.3 Autonomous Guidance and Control
- TA 6.0 Human Health, Life Support, and Habitation Systems
 - 6.1 Environmental Control and Life Support Systems and Habitation Systems
 - 6.1.1 Air Revitalization
 - 6.1.2 Water Recovery and Management
 - 6.1.3 Waste Management
- TA 7.0 Human Exploration Destination Systems
 - 7.1 In-Situ Resource Utilization
 - 7.1.1 Destination Reconnaissance, Prospecting, and Mapping
 - 7.1.2 Resource Acquisition
 - 7.1.3 Processing and Production
 - 7.1.4 Manufacturing Products and Infrastructure Emplacement
 - 7.2 Sustainability and Supportability
 - 7.2.4 Food Production, Processing, and Preservation
- TA 13.0 Ground and Launch Systems
 - 13.2 Environmental Protection and Green Technologies
 - 13.2.5 Curatorial Facilities, Planetary Protection, and Clean Rooms
 - 13.3 Reliability and Maintainability
 - 13.3.3 On-Site Inspection and Anomaly Detection and Identification
 - 13.3.6 Repair, Mitigation, and Recovery Technologies
- KSC SBIR
 - Standardized Interfaces (a USB port for space)
 - A substantial portion of pre-launch processing involves the integration of spacecraft assemblies to each other or to the ground systems that supply the commodities, power or data. Each stage or payload requires an interface that connects it to the adjacent hardware which includes flight critical seals or connectors and other components. Development and adoption of simplified, standardized interfaces holds the potential of reducing the cost and complexity of future space systems, which increases the funding available for flight hardware and drives down the cost of access to space for everyone.

H.5.7 Jet Propulsion Laboratory (JPL)

JPL is NASA's only Federally Funded Research and Development Center. JPL's areas of focus are:

- Solar System Science
Planetary Atmospheres and Geology; Solar System characteristics and origin of life; Primitive solar systems bodies; Lunar science; Preparing for returned sample investigations
- Earth Science
Atmospheric composition and dynamics; Land and solid earth processes; Water and carbon cycles; Ocean and ice; Earth analogs to planets; Climate Science
- Astronomy and Fundamental Physics
Origin, evolution, and structure of the universe; Gravitational astrophysics and fundamental physics; Extra-solar planets and star and planetary formation; Solar and Space Physics; Formation and evolution of galaxies
- In-Space Propulsion Technologies
Chemical propulsion; Non-chemical propulsion; Advanced propulsion technologies; Supporting technologies
- Space Power and Energy Storage
Power generation; Energy storage; Power management & distribution; Cross-cutting technologies
- Robotics, Tele-Robotics and Autonomous Systems
Sensing; Mobility; Manipulation technology; Human-systems interfaces; Autonomy; Autonomous rendezvous & docking; Systems engineering
- Communication and Navigation
Optical communications & navigation technology; Radio frequency communications; Internetworking; Position, navigation and timing; Integrated technologies; Revolutionary concepts
- 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/sensors; Observatory technology; In-situ instruments/sensor technologies
- Entry, Descent and Landing Systems
Aerobraking, aerocapture and entry systems; Descent; Landing; Vehicle system technology
- Nanotechnology
Engineered materials; Energy generation and storage; Propulsion; Electronics, devices and sensors
- 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

H.5.8 Johnson Space Center (JSC)

JSC's areas of focus include

- In-space propulsion technologies
- Energy Storage Technologies-Batteries, Regenerative Fuel cells
- Robotics and TeleRobotics
- Crew decision support systems
- Immersive Visualization
 - Virtual windows leading to immersive environments and telepresence systems
- Human Robotic interface
- Flight and Ground communication systems
 - Audio
 - Array Microphone Systems and processing
 - Large bandwidth (audio to ultra-sonic) MEMs Microphones
 - Front end audio noise cancellation algorithms implementable in FPGAs- example Independent Component Analysis
 - Audio Compression algorithms implementable in FPGAs.
 - COMSOL Acoustic modeling
 - Sonification Algorithms implementable in DSPs/FPGAs
 - Video
 - Ultra-High Video Compressions
 - H265 Video Compression
 - Rad-Tolerant Imagers
 - Lightweight/low power/radiation tolerant displays
- Advanced habitat systems
- GN&C for descent systems
- Large body GN&C
- Human system performance modeling
- Imaging and information processing
 - Lightweight/Low power Display Technology
 - Scalable software-implementable graphics processing unit
- Simulation and modeling
- Materials and structures
- Lightweight structure
- Human Spaceflight Challenges
 - <http://humanresearchroadmap.nasa.gov/explore/>
- Human System Interfaces
 - OLED Technology Evaluation for Space Applications
 - Far-Field Speech Recognition in Noisy Environments
 - Radiation Hardened Graphics Processing
 - Human Computer Interaction design methods (Multi-modal and Intelligent Interaction) and apparatuses

- Human Systems Integration, Human Factors Engineering: state of the art in Usability and performance assessment methods and apparatus.
- Humans Systems Integration Inclusion in Systems Engineering
- ECLSS
 - Air Revitalization
 - Advanced water, O₂ and CO₂ monitoring and sensors
 - Advance thermally regenerated ionic fluids for CO₂ and Humidity Control
 - Water Recovery and Management
 - Brine water recovery systems and wastewater treatment chemical recover for reuse or repurpose
 - Waste Management
 - Advance wastewater treatment systems (lower toxicity, recoverable)
 - Advanced trace contaminant monitoring and control technology
 - Quiet fan technologies
- Active Thermal Control
 - Lightweight heat exchangers and cold plates
 - Condensing heat exchanger coatings with robust hydrophilic, antimicrobial properties
 - Development and demonstration of wax and water-based phase change material heat exchangers
- EVA
 - Pressure Garment
 - Portable Life Support System
 - Power, Avionics and Software
- Autonomous Rendezvous and Docking
- Crew Exercise
 - Small form Equipment
 - Biomechanics
- EDL (thermal)
- Wireless and Comm Systems
 - Wireless Energy Harvesting Sensor Technologies
 - Robust, Dynamic Ad hoc Wireless Mesh Communication Networks
 - Radiation Hardened EPC Global Radio Frequency Identification (RFID) Readers
 - Computational Electromagnetics (CEM) Fast and Multi-Scale Methods/Algorithms
 - EPC Global-type RFID ICs at frequencies above 2 G
- Radiation and EEE Parts
 - Monitoring
 - Mitigation and Biological countermeasures
 - Protection systems
 - Space weather prediction
 - Risk assessment modeling
- Wearable Tech
 - Wearable Sensors and Controls
 - Wearable Audio Communicator

- Wearable sensing and hands-free control
- Tattooed Electronic Sensors
- In-Situ Resource Utilization
 - Mars atmosphere processing
 - CO₂ collection, dust filtering, Solid Oxide CO₂ electrolysis, Sabatier, reverse water gas shift
 - Lunar/Mars regolith processing
 - Regolith collection and drying
 - Water collection and processing, water electrolysis
 - Methane/Oxygen liquefaction and storage

H.5.9 Stennis Space Center (SSC)

SSC's areas of focus include:

- Active and Passive Nonintrusive Remote Sensing of Propulsion Test Parameters
- Intelligent Integrated System Health Management (ISHM) in Rocket Test-Stands
- Advanced Non-Destructive Evaluation Technologies
- Advanced Propulsion Systems Testing
- Cryogenic Instrumentation and Cryogenic, High Pressure, and Ultrahigh Pressure Fluid Systems
- Ground Test Facilities Technology
- Propulsion System Exhaust Plume Flow Field Definition and Associated Plume Induced Acoustic & Thermal Environments
- Vehicle Health Management/Rocket Exhaust Plume Diagnostics

Propulsion Testing

Active and Passive Nonintrusive Remote Sensing of Propulsion Test Parameters

The vast amount of propulsion system test data is collected via single channel, contact, intrusive sensors and instrumentation. Future propulsion system test techniques could employ passive nonintrusive remote sensors and active nonintrusive remote sensing test measurements over wide areas instead of at a few discrete points. Opportunities exist in temperature, pressure, stress, strain, position, vibration, shock, impact, and many other measured test parameters. The use of thermal infrared, ultraviolet, and multispectral sensors, imagers, and instruments is possible through the SSC sensor laboratory.

Intelligent Integrated System Health Management (ISHM) in Rocket Test-Stands

SHM is a capability to determine the condition of every element of a system continuously. ISHM includes detection of anomalies, diagnosis of causes, and prognosis of future anomalies; as well as making available (to elements of the system and the operator) data, information, and knowledge (DIaK) to achieve optimum operation. In this context, we are interested in methodologies to embed intelligence into the various elements of rocket engine test-stands, e.g., sensors, valves, pumps, tanks, etc. Of particular interest is the extraction of qualitative interpretations from sensor data in order to develop a qualitative assessment of the operation of

the various components and processes in the system. The desired outcomes of the research are: (1) to develop intelligent sensor models that are self-calibrating, self-configuring, self-diagnosing, and self-evolving (2) to develop intelligent components such as valves, tanks, etc., (3) to implement intelligent sensor fusion schemes that allow assessment, at the qualitative level, of the condition of the components and processes, (4) to develop a monitoring and diagnostic system that uses the intelligent sensor models and fusion schemes to predict future events, to document the operation of the system, and to diagnose any malfunction quickly, (5) to develop architectures/taxonomies/ontologies for integrated system health management using distributed intelligent elements, and (6) to develop visualization and operator interfaces to effectively use the ISHM capability.

Advanced Non-Destructive Technologies

Advances in non-destructive evaluation (NDE) technologies are needed for fitness-for-service evaluation of pressure vessels used in rocket propulsion systems and test facilities. NDE of ultra-high-pressure vessels with wall thicknesses exceeding 10 inches require advanced techniques for the detection of flaws that may affect the safe use of the vessels.

Advanced Propulsion Systems Testing

Innovative techniques will be required to test propulsion systems such as advanced chemical engines, single-stage-to-orbit rocket plane components, nuclear thermal, nuclear electric, and hybrids rockets. New and more cost-effective approaches must be developed to test future propulsion systems. The solution may be some combination of computational-analytical technique, advanced sensors and instrumentation, predictive methodologies, and possibly subscale tests of aspects of the proposed technology.

Cryogenic Instrumentation and Cryogenic, High Pressure, and Ultrahigh Pressure Fluid Systems

Over 40 tons of liquefied gases are used annually in the conduct of propulsion system testing at the Center. Instrumentation is needed to precisely measure mass flow of cryogenics starting with very low flow rates and ranging to very high flow rates under pressures up to 15,000 psi. Research, technology, and development opportunities exist in developing instruments to measure fluid properties at cryogenic conditions during ground testing of space propulsion systems. Both intrusive and nonintrusive sensors, but especially nonintrusive sensors, are desired.

Ground Test Facilities Technology

SSC is interested in new, innovative ground-test techniques to conduct a variety of required developmental and certification tests for space systems, stages/vehicles, subsystems, and components. Examples include better coupling and integration of computational fluid dynamics and heat transfer modeling tools focused on cryogenic fluids for extreme conditions of pressure and flow; advanced control strategies for non-linear multi-variable systems; structural modeling tools for ground-test programs; low-cost, variable altitude simulation techniques; and uncertainty analysis modeling of test systems.

Propulsion System Exhaust Plume Flow Field Definition and Associated Plume Induced Acoustic & Thermal Environments

Background: An accurate definition of a propulsion system exhaust plume flow field and its associated plume induced environments (PIE) are required to support the design efforts necessary to safely and optimally accomplish many phases of any space flight mission from sea level or simulated altitude testing of a propulsion system to landing on and returning from the Moon or Mars. Accurately defined PIE result in increased safety, optimized design and minimized costs associated with: 1. propulsion system and/or component testing of both the test article and test facility; 2. any launch vehicle and associated launch facility during liftoff from the Earth, Moon or Mars; 3. any launch vehicle during the ascent portion of flight including staging, effects of separation motors and associated pitch maneuvers; 4. effects of orbital maneuvering systems (including contamination) on associated vehicles and/or payloads and their contribution to space environments; 5. Any vehicle intended to land on and return from the surface of the Moon or Mars; and finally 6. The effects of a vehicle propulsion system on the surfaces of the Moon and Mars including the contaminations of those surfaces by plume constituents and associated propulsion system constituents. Current technology status and requirements to optimally accomplish NASA's mission: In general, the current plume technology used to define a propulsion system exhaust plume flow field and its associated plume induced environments is far superior to that used in support of the original Space Shuttle design. However, further improvements of this technology are required: 1. in an effort to reduce conservatism in the current technology allowing greater optimization of any vehicle and/or payload design keeping in mind crew safety through all mission phases; and 2. to support the efforts to fill current critical technology gaps discussed below. PIE areas of particular interest include: single engine and multi-engine plume flow field definition for all phases of any space flight mission, plume induced acoustic environments, plume induced radiative and convective ascent vehicle base heating, plume contamination, and direct and/or indirect plume impingement effects. Current critical technology gaps in needed PIE capabilities include: 1. An accurate analytical prediction tool to define convective ascent vehicle base heating for both single engine and multi-engine vehicle configurations. 2. An accurate analytical prediction tool to define plume induced environments associated with advanced chemical, electrical and nuclear propulsion systems. 3. A validated, user friendly free molecular flow model for defining plumes and plume induced environments for low density external environments that exist on orbit, as well as interplanetary and other planets.

Vehicle Health Management/Rocket Exhaust Plume Diagnostics

A large body of UV-Visible emission spectrometry experimentation is being performed during the 30 or more tests conducted each year on the Space Shuttle Main Engine at SSC. Research opportunities are available to quantify failure and wear mechanisms, and related plume code validation. Related topics include combustion stability, mixture ratio, and thrust/power level. Exploratory studies have been done with emission/absorption spectroscopy, absorption resonance spectroscopy, and laser induced fluorescence. Only a relatively small portion of the electromagnetic spectrum has been investigated for use in propulsion system testing and exhaust plume diagnostics/vehicle health management.

H.5.10 Langley Research Center (LaRC)

LaRC's areas of focus include:

- Intelligent Flight Systems – Revolutionary Air Vehicles
- Atmospheric Characterization – Active Remote Sensing
- Systems Analysis and Concepts - Air Transportation System Architectures & Vehicle Concepts
- Advanced Materials & Structural System – Advanced Manufacturing
- Aerosciences - Trusted Autonomy
- Entry, Decent & Landing - Robotic Mission Entry Vehicles
- Measurement Systems - Advanced Sensors and Optical Measurement

CONFIDENTIAL

Appendix I - Performance Measurement and Evaluation

GAO-11-646SP Performance Measurement and Evaluation: Definitions and Relationships
<http://www.gao.gov/new.items/d11646sp.pdf>

Program Performance Assessment

Both the executive branch and congressional committees need evaluative information to help them make decisions about the programs they oversee—information that tells them whether, and why, a program is working well or not. In enacting the Government Performance and Results Act of 1993 (GPRA), Congress expressed frustration that executive and congressional decisionmaking was often hampered by the lack of good information on the results of federal program efforts. To promote improved federal management and greater efficiency and effectiveness, GPRA instituted a governmentwide requirement that agencies set goals and report annually on performance.

Many analytic approaches have been employed over the years by the agencies and others to assess the operations and results of federal programs, policies, activities, and organizations. Most federal agencies now use performance measures to track progress towards goals, but few seem to regularly conduct indepth program evaluations to assess their programs' impact or learn how to improve results. Individual evaluation studies are designed to answer specific questions about how well a program is working, and GPRA explicitly encourages a complementary role for these types of program assessment. The GPRA Modernization Act of 2010 aims to improve program performance by requiring agencies to identify priority goals, assign officials responsibility for achieving them, and review progress quarterly. Complete and accurate information on how well programs are working and why will be key to its success.

This glossary describes and explains the relationship between two common types of systematic program assessment: performance measures and program evaluation. Based on GAO publications and program evaluation literature, it was first prepared in 1998. Major contributors were Stephanie Shipman and Joseph Wholey. Please address any questions to Stephanie Shipman at (202) 512-4041 or shipman@gao.gov.



Nancy R. Kingsbury, Managing Director
Applied Research and Methods

United States Government Accountability Office
GAO
Glossary

May 2011

PERFORMANCE MEASUREMENT AND EVALUATION

Definitions and Relationships

GAO-11-646SP

Types of Program Performance Assessment

Performance Measurement Performance measurement is the ongoing monitoring and reporting of program accomplishments, particularly progress toward preestablished goals. It is typically conducted by program or agency management.

Performance measures may address the type or level of program activities conducted (process), the direct products and services delivered by a program (outputs), or the results of those products and services (outcomes).

A "program" may be any activity, project, function, or policy that has an identifiable purpose or set of objectives.

Program Evaluation Program evaluations are individual systematic studies conducted periodically or on an ad hoc basis to assess how well a program is working. They are often conducted by experts external to the program, either inside or outside the agency, as well as by program managers.

A program evaluation typically examines achievement of program objectives in the context of other aspects of program performance or in the context in which it occurs. Four main types can be identified, all of which use measures of program performance, along with other information, to learn the benefits of a program or how to improve it.

Relationship between Performance Measurement and Program Evaluation

Different Focus Performance measurement focuses on whether a program has achieved its objectives, expressed as measurable performance standards. Program evaluations typically examine a broader range of information on program performance and its context than is feasible to monitor on an ongoing basis.

Depending on their focus, evaluations may examine aspects of program operations (such as in a process evaluation) or factors in the program environment that may impede or contribute to its success, to help explain the linkages between program inputs, activities, outputs, and outcomes. Alternatively, evaluations may assess the program's effects beyond its intended objectives, or estimate what would have occurred in the absence of the program, in order to assess the program's net impact. Additionally, program evaluations may systematically compare the effectiveness of alternative programs aimed at the same objective.

Different Use Both forms of assessment aim to support resource allocation and other policy decisions to improve service delivery and program effectiveness. But performance measurement, because of its ongoing nature, can serve as an early warning system to management and as a vehicle for improving accountability to the public.

A program evaluation's typically more in-depth examination of program performance and context allows for an overall assessment of whether the program works and identification of adjustments that may improve its results.

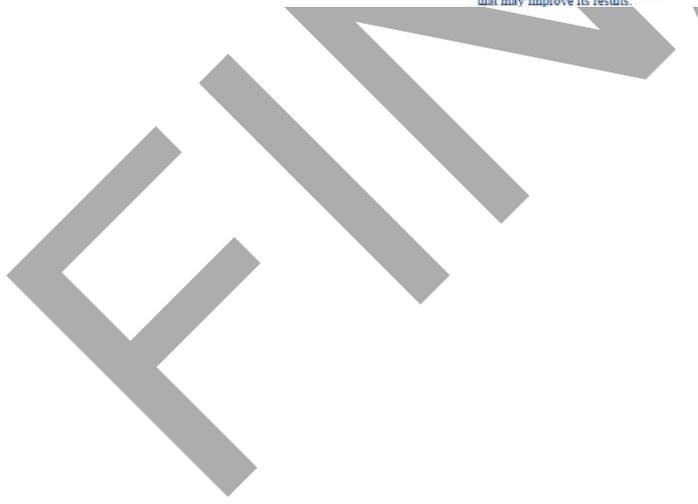
Types of Program Evaluation

Process (or Implementation) Evaluation This form of evaluation assesses the extent to which a program is operating as it was intended. It typically assesses program activities' conformance to statutory and regulatory requirements, program design, and professional standards or customer expectations.

Outcome Evaluation This form of evaluation assesses the extent to which a program achieves its outcome-oriented objectives. It focuses on outputs and outcomes (including unintended effects) to judge program effectiveness but may also assess program processes to understand how outcomes are produced.

Impact Evaluation Impact evaluation is a form of outcome evaluation that assesses the net effect of a program by comparing program outcomes with an estimate of what would have happened in the absence of the program. This form of evaluation is employed when external factors are known to influence the program's outcomes, in order to isolate the program's contribution to achievement of its objectives.

Cost-Benefit and Cost-Effectiveness Analyses These analyses compare a program's outputs or outcomes with the costs (resources expended) to produce them. When applied to existing programs, they are also considered a form of program evaluation. Cost-effectiveness analysis assesses the cost of meeting a single goal or objective and can be used to identify the least costly alternative for meeting that goal. Cost-benefit analysis aims to identify all relevant costs and benefits, usually expressed in dollar terms.



Appendix J - Policy on Late Proposals

NASA does not pre-approve the submission of a late proposal. The decision to submit a late proposal is solely that of the Proposer, and it is then NASA's decision whether to accept it. If NSPIRES is available for submissions, the site automatically captures the time that the system received the proposal. Proposals submitted later than 11:59 PM Eastern time 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

-----Original Message----- 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 of Excerpt-----

Proposers who do not receive a notice similar to the sample above after submission should first check spam filters and junk boxes. If unable to locate the e-mail 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 a proposal was not submitted by the due date and time, the Proposer shall send a detailed explanation via e-mail to NASA's Support Contractor for this CAN:

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. It is entirely possible that a late Proposer may not know whether it was accepted for review until all Proposers are notified approximately nine months from the CAN's proposal due date.

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

Sample Decision Notice E-mail

-----Original Message-----

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.

From the *NASA Guidebook for Proposers*

(<http://www.hq.nasa.gov/office/procurement/nraguidebook>):

Proposers should be aware that neither NASA personnel nor the employees of the support contractor that receives and handles proposals for NASA are able to authorize the submission of a late proposal and, therefore, such permission should not be requested. The decision to submit a late proposal is solely that of the Proposer, and it is then NASA's decision whether to accept it. Late proposals may be considered for review and possible selection only if they appear to offer a distinct benefit to NASA [Ref. Section 5]. In this regard it is important to note that, since almost every CAN receives many more high-quality proposals than can be supported with the available funds, a determination by NASA that a late proposal is of distinct benefit over its competitors is likely to be rare. Additionally, Proposers should note that Grants.gov does not accept late proposals. 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) found at: <https://www.gpo.gov/fdsys/pkg/CFR-2014-title48-vol6/pdf/CFR-2014-title48-vol6-sec1852-235-72.pdf>

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 ubiquitous technical problems with computer systems and with the internet. 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. An example might be 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 failure of the proposing team to complete its proposal prior to the deadline, for whatever reason, does not constitute a technical problem. The failure of the Proposer 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 a proposal would have been received by NASA 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.

Any Changes or Revisions to a Proposal After the Due Date Will Result in a Late Proposal:

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's 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 changes to the proposal's substance under the CAN; 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 decision announcement, there have been changes to the AOR and PI, the Proposer shall immediately notify the above mentioned NSPIRES Support Contractor for this CAN to confirm that the proposing organization will still be able to access NSPIRES.

FINAL

Appendix K - PIV Card Issuance Procedures

In accordance with FAR Clause 52.204-9, Personal Identity Verification of Contractor Personnel (Jan. 2011), the enrollment and processing of NASA identity data and the issuance of credentials to those identities is to 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.

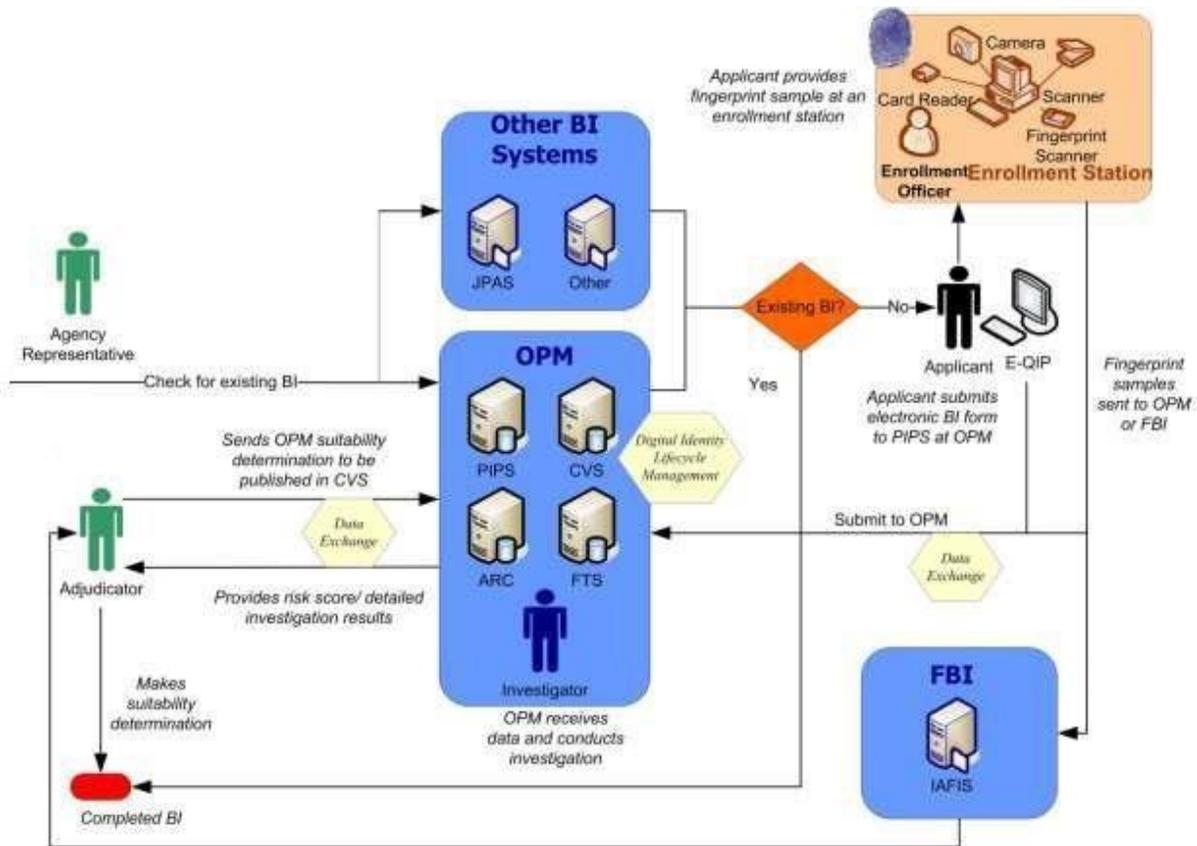


Figure 3 - Review Process

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 Identity Management System (IdMAX) shall be obtained for the visit or assignment before any processing for a PIV or alternate agency credential (collectively referred to as a credential)

can take place. Further, if the foreign national is not under a grant or cooperative agreement where a technical officer has been officially designated, the foreign national will provide the information directly to their 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 finger print, 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.