Human Exploration Research Opportunities (HERO)

National Aeronautics and Space Administration

NASA Research Announcement

Catalog of Federal Domestic Assistance (CFDA) Number: 43.003

80JSC018N0001
NRA Issued: July 31, 2018

OVERVIEW

Proposals Due
Starting no earlier than September 5, 2018
Through no later than September 5, 2019

REFER TO APPENDICES FOR EXACT DUE DATES
# Human Exploration Research Opportunities

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A. Executive Summary

This National Aeronautics and Space Administration (NASA) Research Announcement (NRA), entitled “Human Exploration Research Opportunities (HERO)—2018”, solicits applied research in support of NASA’s Human Research Program (HRP). The research will fall into one or more categories corresponding to HRP’s five Elements: Space Radiation, Human Health Countermeasures, Exploration Medical Capability, Human Factors and Behavioral Performance, and International Space Station Medical Projects. This NRA covers all aspects of research to provide human health and performance countermeasures, knowledge, technologies, and tools to enable safe, reliable, and productive human space exploration.

Awards generally range from under $100K per year for focused, limited efforts (e.g., data analysis) to $1M per year for extensive activities (e.g., development of scientific hardware) and will be made as grants. The funds available for awards in each research opportunity offered in this NRA range from less than one million to several million dollars. This range of available funds allows a range in the number of proposals accepted, depending on the research opportunity’s objectives and the submission of meritorious proposals. The period of performance for an award can range from one to five years. All categories of United States (U.S.) institutions are eligible to submit proposals in response to this NRA. Any changes or modifications to any of these guidelines will be specified in the descriptions of the relevant research opportunities in the solicited research response area appendices (i.e., HERO appendices) of this solicitation.

Details of the solicited research opportunities are given in the HERO appendices of this NRA, and it is anticipated that several response area appendices will be issued throughout the year as needed. All appendices will use a two-step solicitation process requiring that a compliant and relevant Step-1 proposal be submitted in order to be considered to be invited to submit a Step-2 proposal. Proposals that do not conform to the standards outlined in this solicitation may be declared noncompliant and will be handled in accordance with NASA Federal Acquisition Regulation Supplement 1815.305-70 (https://www.hq.nasa.gov/office/procurement/regs/NFS.pdf). Proposal due dates are given in appendices to this NRA, which will be posted at http://nspires.nasaprs.com/. Interested proposers should monitor the Web site or subscribe to the Human Exploration and Operations Mission Directorate electronic notifications system through their NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) account for new research opportunities or amendments to this NRA through July 2019 at which time release of a subsequent HERO NRA is planned. Proposers should monitor Frequently Asked Questions (FAQs), posted alongside this solicitation in NSPIRES, that will be updated periodically with questions posed by potential investigators and corresponding answers.
B. Human Research Program

1. Background

NASA’s HRP investigates and mitigates the highest risks to astronaut health and performance in exploration missions. The goal of the HRP is to provide human health and performance countermeasures, knowledge, technologies, and tools to enable safe, reliable, and productive human space exploration. The scope of this goal includes both the successful completion of exploration missions and the preservation of health over the astronaut’s lifetime. The HRP contains five Elements: Space Radiation, Human Health Countermeasures, Exploration Medical Capability, Human Factors and Behavioral Performance, and International Space Station Medical Projects.

Two foundational documents of the HRP are the Human Research Program Requirements Document (PRD, Revision G, Page Change Notice 1) and the Human Research Program Integrated Research Plan (IRP, Revision J). The PRD lists the crew health and performance risks that the HRP must understand and mitigate. The IRP describes the plan to understand and reduce the risks. Proposers should note that the IRP is more recently updated and should be considered correct when differences are seen between the documents.

The PRD (https://www.nasa.gov/sites/default/files/atoms/files/human_research_program_requirements_document.pdf) describes the high-level requirements that the HRP must meet. The requirements in the PRD are divided into the following three categories: (1) human system standards (PRD section 4), (2) human health and performance risks (PRD section 5) and (3) provisions of enabling capabilities (PRD section 6). Table 3 of the PRD contains HRP risks. All of the risks in the table are dynamic. New risks will likely be identified with further spaceflight experience. Other risks may be retired if they are successfully mitigated, or if increased understanding lessens their severity. The research topic areas described in the appendices of this NRA derive from the need to address crew health and performance risks articulated in Table 3 of the PRD.

The IRP describes HRP’s research activities that are intended to address the needs of human space exploration and serve HRP customers. The IRP illustrates the HRP’s research plan through 2030. The Human Research Roadmap (http://humanresearchroadmap.nasa.gov) is a Web-based version of the IRP that allows users to search HRP risks, gaps, and tasks.

The National Space Biomedical Research Institute (NSBRI, http://nsbri.org/) was a nonprofit organization competitively selected by NASA that used an integrated team approach to advance biomedical research and countermeasure development. The NSBRI worked in close partnership with HRP through a cooperative agreement which ended in September 2017.

The Translational Research Institute for Space Health (TRISH, https://www.bcm.edu/centers/space-medicine/translational-research-institute) seeks innovative and disruptive technologies, techniques, and countermeasures that will enable and enhance human exploration of deep space. The Institute’s goal is to fund innovative approaches that will
reduce multiple risks to human health on missions beyond low Earth orbit. The TRISH was founded in 2016 and works in partnership with HRP through a cooperative agreement.

In the past, NASA has conducted its spaceflight research on six-month missions on the International Space Station (ISS). However, starting in the near future, there will be a series of one-year missions on the ISS in addition to the six-month missions. The one-year missions will be supplemented with shorter two-month missions. When appropriate, the proposed research should consider these different mission durations on the ISS.

2. Goal and Specific Objectives

The goal of the HRP is to provide human health and performance countermeasures, knowledge, technologies, and tools to enable safe, reliable, and productive human space exploration. The scope of this goal includes both the successful completion of exploration missions and the preservation of astronaut health over the life of the astronaut. The following specific objectives support this goal:

1. Quantification of the crew health and performance risks associated with human spaceflight for the various exploration missions.
2. Development of countermeasures to provide mission planners and system developers with strategies for mitigating crew health and performance risks.
3. Development of technologies to provide mission planners and system developers with strategies for monitoring and mitigating crew health and performance risks.

This NRA solicits research that addresses at least one of these specific objectives.

C. Solicitation

It is critical for investigators to carefully read ALL of the instructions in this NRA. Proposals submitted in response to this NRA should be submitted to the most relevant research opportunity described in the solicited research response area appendices (see also the Table of Contents that prefaces this NRA). Many of the research topic area emphases are different from those that have appeared in previous NRAs. All proposals will ultimately undergo a scientific merit peer review using similar processes and procedures, but procedures and forms for proposal submission differ for each solicited research response area appendix. The eventual funding of selected proposals will vary for the different types of awards. Do not submit the same research proposal to more than one opportunity within this solicitation.

1. Proposal Solicitation Process

Details of the solicited topics are given in the solicited research response area appendices of the NRA. All appendices will require a Step-1 proposal in order to be considered to be invited to submit a Step-2 proposal. In this two-step process, Step-1 proposals submitted in response to this NRA will be evaluated by NASA to determine how well they match one of the stated areas of emphasis identified in the solicited research response area appendices. Only the proposals that NASA considers responsive to their respective areas of emphasis will be invited to submit Step-2
proposals. NASA reserves the right to act in the best interests of the Federal Government in the matter of acceptance and evaluation of all proposals. The HRP and NASA Space Biology (https://www.nasa.gov/sites/default/files/atoms/files/16-05-11_sb_plan_2.pdf) may share information with each other about Step-1 and Step-2 proposals submitted in response to this solicitation. Investigators of Step-1 proposals submitted in response to one opportunity described in this solicitation may be invited to submit a Step-2 proposal to a different opportunity described in appendices of this solicitation. In order to leverage resources, it is possible that HRP may jointly fund awards in conjunction with NASA Space Biology when there are topics of mutual interest.

2. Solicited Research Opportunities

This NRA solicits proposals in response to the topic areas described in the following research opportunity appendices:

- **Appendix A**: NASA Research and Technology Development to Support Crew Health and Performance in Space Exploration Missions – Flagship proposals are solicited that address specific research emphases of the Space Radiation Element. These projects are expected to be multi-year efforts.
- **Appendix B**: NASA Human Research Program Omnibus Opportunity - Proposals are solicited that address any of the risks listed in the IRP. In addition, basic investigations are solicited from new proposers that have not received HRP funding in the past. Omnibus projects are expected to last no more than one year.

Additional solicited research proposal opportunity appendices may be issued throughout the year as needed. Investigators may submit more than one proposal in response to this NRA; however, identical proposals may NOT be submitted to more than one solicited research response area appendix. If an identical proposal is submitted it will be returned without review.

3. Education and Public Outreach

Research projects funded by NASA present an opportunity for NASA to enhance and broaden public knowledge, understanding of, and appreciation for biological and biomedical research, and the value of this research in space environments. Individuals participating in NASA research projects have a responsibility to foster the development of a scientifically informed public. Therefore, all participants in this NRA are strongly encouraged to promote general scientific literacy and public understanding of biological and biomedical sciences, space environments, and NASA projects through formal and informal education opportunities.

4. Vertebrate Animal Scientific Review

NASA requires that any and all research proposals that request funding for vertebrate animal research shall be reviewed as described in the Vertebrate Animal Scientific Review (VASR) section posted alongside each applicable solicited research response area. Each response that requires vertebrate animals must address the five points outlined in the VASR. The VASR requirements are in addition to Institutional Animal Care and Use Committee (IACUC)
requirements, if appropriate.

5. Sample Size Specification Guidelines for HRP Research Studies

Statistical planning plays an important role in virtually all scientific research. It plays a particularly valuable role in the design of experiments, including specification of sample size(s), and also in the analysis of outcomes that address primary aims and hypotheses. As a result, Principal Investigators (PIs) are highly encouraged to recruit statisticians as Co-Investigators (Co-Is), so that they can apply their skills to help produce high-quality research proposals.

The Sample Size Specification Guidelines document posted alongside this NRA gives particular emphasis to the problem of how to arrive at and justify experiment sample size(s). The recommendations are necessarily general, and may not be universally applicable. Nevertheless, these guidelines are intended to clarify an understanding among PIs, grant reviewers, and NASA pertaining to sample-size issues for HRP research studies. The peer review panels will include a statistician.

It is the responsibility of the PI to propose a study that has a reasonable likelihood of detecting an effect with some clinical, operational, or scientific meaning. If applicable, the study description should include a range of possible sample sizes and their associated power. If a study is selected as a candidate for funding, the PI may be asked to explain or modify assumptions and calculations pertaining to sample size prior to funding determination.

6. NASA Safety Policy

Safety is NASA’s highest priority. 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 instruments), and 4) high-value equipment and property. All research conducted under NASA auspices shall conform to this philosophy.

It is the intent of NASA to implement the results of its funded research as rapidly as possible if it can have an impact on crew health and safety. To that end, NASA requests that PIs with such findings bring them to the attention of the appropriate party within the NASA Human Health and Performance Directorate as soon as possible after discovery. An example of such a finding is one in which an immediate danger to crew health is discovered, or which identifies a potentially harmful situation which could be alleviated by rapid modification of crew operations. The appropriate person to contact will depend on the perceived severity of the finding:

Immediate danger to crew health and safety:

Catherine Koerner
Director, Human Health and Performance Directorate
Telephone: 281-483-2617
Email: catherine.a.koerner@nasa.gov
Terry Taddeo, M.D.  
Supervisory Medical Officer  
Telephone: 281-483-7041  
Email: terrance.a.taddeo@nasa.gov

Serious but not imminent concern about crew health and safety:

Jennifer Fogarty, Ph.D.  
Chief Scientist, Human Research Program  
Telephone: 281-483-9753  
Email: jennifer.fogarty-1@nasa.gov

In some cases, the PI may be requested to come to NASA JSC and make a presentation on the findings to the Human System Risk Board (HSRB), which assesses the status of the major risks to crew health and performance on a continuing basis. Nothing in this procedure is intended to interfere with rights to intellectual property such as publication and presentation at scientific conferences as per 2 CFR 1800.909 and 2 CFR 1800.930. Questions about this safety policy can be directed to Dr. Jennifer Fogarty.

7. Human Genetic Research

The HRP requires that genetic research on human volunteers must be in compliance with NASA Policy Directive 7170.1, which can be found at https://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PD_7170_0001&page_name=main&search_term=7170%2E1. The purpose of these regulations is to protect the privacy and personal medical information of the individuals on whom the genetic information is obtained for research purposes. Note that this directive requires investigators to offer genetic counseling to research subjects, both before and after obtaining genetic information.

8. Consideration of Sex as a Biological Variable

NASA expects that sex as a biological variable will be factored into research designs, analyses, and reporting in vertebrate animal and human studies. Proposers should note that achieving an equal ratio of male to female participants for spaceflight studies may be difficult due to crew scheduling constraints and that it may be challenging to determine differences between sexes for in-flight studies due to small sample sizes. Ground-based studies should attempt to reach a more even distribution of sexes in the subjects. For both in-flight and ground-based studies, strong justification from the scientific literature, preliminary data, or other relevant considerations must be provided for applications proposing to study only one sex.

9. Availability of Funds for Award

Funds are not currently available for awards under this NRA. The Government’s obligation to make award(s) is contingent upon the availability of the appropriated funds from which payment can be made, and the receipt of proposals that are determined acceptable for NASA award under this NRA.
10. Additional Funding Restrictions

The construction of facilities is not an allowed activity, unless specifically stated so in the HERO appendices. For further information on allowed costs, refer to the cost principles cited in the NASA Federal Acquisition Regulations Supplement (NFS) and the 2018 NASA Guidebook for Proposers (http://www.hq.nasa.gov/office/procurement/nraguidebook/). Travel, including foreign travel, is allowed as may be necessary for the meaningful completion of the proposed investigation, as well as for publicizing its results at an appropriate professional meeting.

Regardless of whether they are functioning as a team lead or as a team member, personnel from NASA Centers must propose budgets based on Full Cost Accounting (FCA). Non-NASA U.S. Government organizations should propose based on FCA unless no such standards are in effect; in that case such proposers should follow the Managerial Cost Accounting Standards for the Federal Government as recommended by the Federal Accounting Standards Advisory Board. For further information, see http://www.hq.nasa.gov/fullcost/.

11. Award Information

The mechanism for funding each selected proposal will be the funding vehicle best suited for the project and proposing organization; the funding allocations for participating investigators will be based on the submitted budget, available funds, programmatic relevancy review, and peer review. Awards will be made as grants. Profit to commercial organizations under grants is not allowed. The order of precedence, in case of any conflict, is first, provisions of law; second, the NASA FAR Supplement (for procurement solicitations) or 2 Code of Federal Regulations (CFR) 1800 and the Grant and Cooperative Agreement Manual (https://prod.nais.nasa.gov/pub/pub_library/Grant_and_CooperativeAgreementManual.doc); third, the specific requirements contained herein; and lastly the direction provided in the NASA Guidebook for Proposers.

The selected proposal is expected to be funded as a grant in one-year increments for activities lasting one to five years as stipulated for each solicited research response area. The funding duration will depend on proposal requirements, peer review panel recommendations, and continuing progress of the activity. Proposals will be evaluated as described under each solicited research response area. Proposals to continue or supplement existing grants, if selected, will result in award of an appropriate grant.

Anticipated award amounts are listed in each solicited research response area appendix. NASA does not provide separate funding for direct and indirect costs; thus, the amount of the award requested is the total of all costs submitted in the proposed budget.

12. Diversity and Inclusion

NASA recognizes and supports the benefits of having diverse and inclusive scientific, engineering, and technology communities and fully expects that such values will be reflected in
the composition of all panels and teams including peer review panels (science, engineering, and technology), proposal teams, science definition teams, and mission and instrument teams.

D. Eligibility Information

1. Eligibility of Applicants

All categories of United States (U.S.) institutions are eligible to submit proposals in response to this NRA. Principal Investigators may collaborate with universities, Federal Government laboratories, the private sector, and state and local government laboratories. In all such arrangements, the applying entity is expected to be responsible for administering the project according to the management approach presented in the proposal.

The applying entity must have in place a documented base of ongoing high-quality research in science and technology, or in those areas of science and engineering clearly relevant to the specific programmatic objectives and research emphases indicated in this NRA. Present or previous NASA support of research or training in any institution or for any investigator is not a prerequisite to submission of a proposal.

2. Guidelines for International Participation

a. Guidelines for International Team Members on U.S. Proposals

The HRP welcomes international team members on U.S. proposals. International collaborations that demonstrate clear scientific benefits or cost savings are particularly encouraged. **Step-2 proposals with international participation that do not include an endorsement from a respective government agency or sponsoring institution in the foreign country will be declined without further review.**

Services and direct purchases provided by international team members are allowable as subcontracts on U.S. proposals. Additional information on international participation can be referenced at [https://www.hq.nasa.gov/office/procurement/regs/NFS.pdf](https://www.hq.nasa.gov/office/procurement/regs/NFS.pdf).

b. Guidelines for International Proposals

NASA welcomes proposals from outside the U.S. However, foreign entities are generally not eligible for funding from NASA. Therefore, unless otherwise noted in the NRA, proposals from foreign entities should not include a cost plan unless the proposal involves collaboration with a U.S. institution, in which case a cost plan for only the participation of the U.S. entity must be included. Proposals from foreign entities and proposals from U.S. entities that include foreign participation must be endorsed by the respective government agency or sponsoring institution in the country from which the foreign entity is proposing. Such endorsement should indicate that the proposal merits careful consideration by NASA, and if the proposal is selected, sufficient funds will be made available to undertake the activity as proposed.

All foreign proposals must be printed in English and comply with all other submission
requirements stated in the NRA. All foreign proposals will undergo the same evaluation and selection process as those originating in the U.S. All proposals must be received before the established closing date. Those received after the closing date will be treated in accordance with NASA FAR Supplement 1852.235-72, paragraph (g) (https://www.hq.nasa.gov/office/procurement/regs/NFS.pdf). Sponsoring foreign government agencies or funding institutions may, in exceptional situations, forward a proposal without endorsement if endorsement is not possible before the announced closing date. In such cases, the NASA sponsoring office should be advised when a decision on endorsement can be expected.

Successful and unsuccessful foreign entities will be contacted directly by the NASA sponsoring office. Copies of these letters will be sent to the foreign sponsor. Should a foreign proposal or a U.S. proposal with foreign participation be selected, NASA’s Office of External Relations will arrange with the foreign sponsor for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency or funding institution will each bear the cost of discharging their respective responsibilities.

Depending on the nature and extent of the proposed cooperation, these arrangements may entail

(i) An exchange of letters between NASA and the foreign sponsor; or

(ii) A formal Agency-to-Agency Memorandum of Understanding (MOU).

NASA’s policy is to conduct research with non-U.S. organizations on a cooperative, no-exchange-of-funds basis. Although Co-Investigators or collaborators employed by non-U.S. organizations may be identified as part of a proposal submitted by a U.S. organization, NASA funding through this NRA may not be used to support research efforts by non-U.S. organizations at any level; however, the direct purchase of supplies and/or services that do not constitute research from non-U.S. sources by U.S. award recipients is permitted. See NASA FAR Supplement Part 1835.016-70 for additional information on international participation, which can be referenced at https://www.hq.nasa.gov/office/procurement/regs/NFS.pdf.

Also see NASA Policy Directive 1360.2B Initiation and Development of International Cooperation in Space and Aeronautics Programs, which is located at http://nodi3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PD_1360_002B&page_name=main

c. Assurance of Compliance – China Funding Restriction

All proposals submitted to this NRA must comply with the following: Assurance of Compliance with the Department of Defense and Full-Year Appropriation Act, Public Law 112-10 Section 1340(a); The Consolidated and Further Continuing Appropriation Act of 2012, Public Law 112-55, Section 539; and future-year appropriations. These are hereinafter referred to as “the Acts.”

a) NASA is restricted from using funds appropriated in the Acts to enter into or fund any grant or cooperative agreement of any kind to participate, collaborate, or coordinate bilaterally with China or any Chinese-owned company, at the prime recipient level and at all sub-recipient levels, whether the bilateral involvement is funded or performed under a no-exchange-of-funds arrangement.
b) Definition: “China or Chinese-owned Company” means the People’s Republic of China, any company owned by the People’s Republic of China, or any company incorporated under the laws of the People’s Republic of China.

c) The restrictions in the Acts do not apply to commercial items of supply needed to perform a grant or cooperative agreement.

d) By submission of its proposal, the proposer represents that the proposer is not China or a Chinese-owned company, and that the proposer will not participate, collaborate, or coordinate bilaterally with China or any Chinese-owned company, at the prime recipient level or at any sub-recipient level, whether the bilateral involvement is funded or performed under a no-exchange-of-funds arrangement.

d. Export Control Guidelines Applicable to Proposals Including Foreign Participation

Proposals including foreign participation must include a section discussing compliance with U.S. export laws and regulations, e.g., 22 CFR Parts 120-130 and 15 CFR Parts 730-774, as applicable to the circumstances surrounding the particular foreign participation. The discussion must describe in detail the proposed foreign participation and is to include, but not be limited to, whether or not the foreign participation may require the prospective investigator to obtain the prior approval of the Department of State or the Department of Commerce via a technical assistance agreement or an export license, or whether a license exemption/exception may apply. If prior approvals via licenses are necessary, discuss whether the license has been applied for or, if not, the projected timing of the application and any implications for the schedule. Information regarding U.S. export regulations is available at http://www.bis.doc.gov/licensing/exportingbasics.htm

3. Cost Sharing or Matching

If an institution of higher education, hospital, or other nonprofit organization wants to receive a grant from NASA, cost sharing is not required. However, NASA can accept cost sharing if it is voluntarily offered. If a commercial organization wants to receive a grant, cost sharing is required unless the commercial organization can demonstrate that they are unlikely to receive substantial compensating benefits for performance of the work. If no substantial compensating benefits are likely to be received, then cost sharing is not required, but can be accepted. Acceptable forms of cost sharing are discussed in NFS 1816.303-70: https://www.hq.nasa.gov/office/procurement/regs/NFS.pdf.

4. Data Management Plan

Each proposal must include a Data Management Plan (DMP) that describes how data generated by the proposed research will be shared and preserved and how data collected will be made available to the public on completion of flight and ground-control experiments. If there is a valid reason why data sharing and/or preservation is not possible or scientifically appropriate, some justification must be provided. The DMP must describe how data sharing and preservation will enable validation of results, or how results could be validated if data are not shared or preserved. DMPs must provide a plan for making all research data underlying results and findings in publications digitally accessible at the time of publication. The DMP should be a
separate section in the proposal. NASA will review DMPs during the second-tier review of the research proposal described in Section G.3.a below.

**Open Access Requirement:** According to the NASA Public Access Policy, all NASA-funded authors and coauthors (both civil servants and non-civil servants) will be required to deposit copies of their peer-reviewed scientific publications and associated data into NASA’s publication repository, called NASA PubSpace, which is part of PubMed Central and managed by the National Institutes of Health. This policy excludes patents, publications that contain material governed by personal privacy, export control, proprietary restrictions, or national security law or regulations. For more information on this policy and how to submit publications to NASA PubSpace, please see [https://www.nasa.gov/open/researchaccess/pubspace](https://www.nasa.gov/open/researchaccess/pubspace).

5. Data Sharing

Investigators should have an expectation of data sharing with other efforts where projects are synergistic or use the same spaceflight or analog facility. Proposers should include a cost estimate to account for any anticipated data sharing. The adequacy of the data sharing plan will be considered by NASA when making recommendations about funding applications as appropriate. In making such considerations, NASA may negotiate modifications of data sharing plans with the PI. Any data sharing plans represent a commitment by the institution (and its subcontractors as applicable) to support and abide by the plan.

For NASA-funded projects that necessitate overlap and/or coordination of methods and measures in a shared sample, investigators must specify that a shared sample will be used and define the data-sharing measures in their Institutional Review Board (IRB) protocols and in the associated informed consents. Investigators must use any data-sharing processes and forms mandated by the IRB. Investigators are expected to share flight and ground-based data with other PIs consistent with the approved protocols, upon request from a PI, and with the approval of the request by HRP. Timing of such between-investigator data sharing will happen as soon as possible after the data collection, and investigators will be responsible for planning the timing and logistics of such sharing jointly, and will inform HRP of these plans before transferring data. IRB protocols must include language in informed consent forms notifying subjects of the potential for data sharing, language indicating the possibility of data sharing to the IRB, and any measures being requested via data sharing from other investigators. Once the investigation is complete, the full data set should be submitted to NASA’s Life Sciences Data Archive (LSDA, [https://lsda.jsc.nasa.gov/](https://lsda.jsc.nasa.gov/)) and may be released to other investigators for alternate uses.

6. Study Archive

The Federal Government exercises its license rights to all data collected through research programs sponsored by NASA. See 2 C.F.R. 1800.909. Therefore, all research data resulting from NASA-funded studies must be submitted to NASA. These data are then archived in the NASA LSDA for the benefit of the greater research and operational spaceflight community. Archival data products may include but are not limited to low-level (raw) data, high-level (processed) data, and data products such as calibration data, documentation, related software, and other tools or parameters that are necessary to interpret the data. Plans for archiving should be
detailed in the DMP section of the Step-2 proposal. Once a grant is awarded, the PI and the supporting NASA Element shall work with LSDA to outline specific archiving requirements in an LSDA Data Submission Agreement (DSA). These requirements shall include which data are to be included, the format of the data, and the timeframe in which the data are expected to be submitted for archiving.

NASA requires investigators to return residual samples of human biospecimens from astronauts and select analog venues, and environmental samples in the pre-, in-, and post-mission phases, to enable further risk(s) mitigation and discovery research.

NASA recognizes the importance of the right of first publication in demonstrating and maintaining the scientific credentials of its funded investigators. In general, NASA intends to continue its discretionary policy of allowing the funded PIs a period of one year after final data collection from subjects or acquisition of final specimen in spaceflight or ground-based investigations, before making the data available to other investigators through release from the LSDA. The details and any exceptions or special circumstances of this policy will be documented in each investigation’s Data Submission Agreement. However, the HRP Chief Scientist has the prerogative, at any time, to include all extant results, whether published or unpublished, in HRP’s internal analyses as needed for decisions pertaining to astronaut safety, health, and performance and programmatic scope and direction. These analyses will not be published within the one-year period described above unless required by law or NASA policy.

7. Individual Researcher Reporting

a. Annual Reporting

The PI shall provide an annual written report to NASA. This report is due 60 days prior to the anniversary of the start of funding. Receipt of the annual report is a prerequisite for continued funding installments. This information will be used to assess the degree of progress of the project. A component of this annual report will be used for the NASA Space Life & Physical Sciences Research & Applications Division Task Book (https://taskbook.nasaprs.com/Publication/welcome.cfm). The Task Book includes descriptions of all peer-reviewed activities funded by the Human Exploration and Operations Mission Directorate (HEOMD). The Task Book is an invaluable source of information for NASA biological and biomedical researchers as well as the external scientific and technical communities. This information will consist primarily of

- an abstract;
- a bibliographic list of publications;
- invention disclosures;
- a statement of progress, including a comparison with the originally proposed work schedule; and
- results of periodic data reviews.

Additional reporting requirements may be added to ensure timely integration of the research or technology development into NASA.
b. Intellectual Property Reporting

The PI’s institution must report each invention resulting from the grant to NASA within 60 days after the inventor discloses it in writing to PI institution’s personnel responsible for patent matters. The Recipient may use whatever format is convenient to disclose subject invention. NASA prefers that the Recipient use either the electronic or paper version of NASA Form 1679, Disclosure of Invention and New Technology (Including Software), to disclose subject inventions. Both the electronic and paper version of the NASA Form 1679 may be accessed at the electronic New Technology Reporting web site at https://invention.nasa.gov. See 2 CFR 1800.908 and 14 CFR 401.14 for additional information.

c. Final Report

A final report must be provided to the NASA Grants Office at the end of the award funding period, including a detailed listing of all peer-reviewed publications. The final report is a requirement for eligibility for future NASA solicitations. The information in this report will consist primarily of

- statement of the specific objectives;
- significance of the work;
- background;
- overall progress during the performance period;
- narrative discussion of technical approaches including problems encountered;
- accomplishments related to approach; and
- an appendix with bibliography, copies of all publications and reports, and intellectual property disclosures. Any publications or other public materials containing data are particularly important to include in this section.

8. Software Sharing Policy

A software dissemination plan, with appropriate timelines, is expected in the application only if software development is a part of the application. There is no prescribed single-use license for software produced through grants responding to this announcement. In accordance with federal law, NASA will protect the privacy and ownership rights of software developers. However, HRP does have goals for software dissemination, and reviewers will be instructed to evaluate the dissemination plan relative to these goals:

1. The software should be freely available to biomedical researchers and educators in the nonprofit sector, such as institutions of education, research institutions, and government laboratories.
2. The terms of software availability should permit the dissemination and commercialization of enhanced or customized versions of the software, or incorporation of the software or pieces of it into other software packages.
3. To preserve utility to the community, the software should be transferable such that another individual or team can continue development in the event that the original investigators are unwilling or unable to do so.
4. The terms of software availability should include the ability of researchers to modify the source code and to share modifications with other colleagues. An applicant should take responsibility for creating the original and subsequent “official” versions of a piece of software.

5. To further enhance the potential impact of their software, applicants are expected to propose a plan to manage and disseminate the improvements or customizations of their tools and resources by others. This proposal may include a plan to incorporate the enhancements into the “official” core software, may involve the creation of an infrastructure for plug-ins, or may describe some other solution.

The Software Sharing Plan should be included in the DMP, if applicable. The plan for software sharing will be evaluated during peer review together with any other resource sharing plans.

The adequacy of the software sharing plans will be considered by NASA when it makes recommendations about funding applications as appropriate. In making such considerations, NASA may negotiate modifications of software sharing plans with the PI. Any software dissemination plans represent a commitment by the institution (and its subcontractors as applicable) to support and abide by the plan.

Software and any related documentation developed as part of your project must be turned over to NASA upon request and include any information necessary to transition the software to NASA information systems, servers, networks, etc. for use in the operations environment. The documentation must include source code and any information necessary to operate (e.g., user’s guide). It is expected that the PI will work with NASA to make sure that the software can be used on the platforms available.

9. Computational Models

Any model developed as part of your project must be quantitatively verified and validated according to NASA's Standard for Models and Simulations (NASA-STD-7009A) (https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20160011121.pdf) or equivalent. Furthermore, documentation must be provided that clearly captures the modeling approaches used and model operations guide. Finally, the investigation team must also be willing to provide all model code for NASA to make available as an open-source product.

10. Publications

Award grantees are obligated to attempt to publish results of HRP-funded research so they can be available to the broader scientific community. All publications (including Web sites, presentations, or other electronic products) of any material based on or developed under NASA-sponsored projects should conclude or begin with the following acknowledgment:

“This material is based upon work supported by the National Aeronautics and Space Administration under Grant/Contract/Agreement No. <xxxxxx>”. Except for articles or papers published in peer-reviewed scientific, technical, or professional journals, the exposition of results from NASA-supported research should also include the following disclaimer:
"Any opinions, findings, and conclusions or recommendations expressed in this article <or report, material, etc.> are those of the author(s) and do not necessarily reflect the views of the National Aeronautics and Space Administration."

As a courtesy, any releases of NASA photographic or illustrative data products should list NASA first on the credit line followed by the name of the PI institution; for example,

"Photograph <or illustration, figure, etc.> courtesy of NASA <or NASA Center managing the mission or program> and the <Principal Investigator institution>.",

Please note that any research publications or presentations utilizing research data from the LSDA or crew medical data from the Lifetime Surveillance of Astronaut Health (LSAH) must be submitted for review to ensure that no personally identifiable information data are included. All draft and final versions of abstracts, presentations, and manuscripts must be reviewed by LSDA and/or LSAH before they are submitted to a conference, journal, or other entities outside the PI laboratory (including the NASA Export Control Document Availability Authorization system). After each revision (e.g., per recommendations of editors and/or reviewers), the new version must also be reviewed by LSDA/LSAH before it is resubmitted to the journal. In addition, recognition of either or both of these data sources must be included in the publication’s or presentation’s acknowledgments section if not otherwise included in the document.

The HRP requires public disclosure of the results of its sponsored research within one year of the grant’s completion and, therefore, expects significant findings from supported research to be promptly submitted for peer-reviewed publication with authorship(s) that accurately reflects the contributions of those involved. For all funded projects, HRP requests but does not require that scientific manuscripts prepared under HRP support be sent to the office of the HRP Chief Scientist before they are submitted for publication. This is to determine whether there may be inadvertent release of identifiable crew information, to identify synergies between projects, and to track program status. It will not be used to otherwise control the content of such manuscripts. In addition, any published manuscript funded by HRP should be submitted to the HRP Chief Scientist or her designee within one month of publication.

11. Other Considerations

Required Travel
The proposal must include travel costs for the following: Annual NASA Human Research Program Investigators’ Workshop. All NASA HRP PIs are required to attend this workshop, which is usually scheduled for January or February of each year in the vicinity of Houston, TX.

Optional Travel
Visits to NASA JSC to discuss research methods and results with NASA personnel. Presentation at a professional society meeting (highly desirable).
E. Proposal Information

1. Types of Research Platforms

Ground-Based, Analog Definition, Flight Definition

Proposals selected for support through this NRA will be designated as either 1) ground-based, 2) analog definition, or 3) flight definition. Commitment by NASA to proceed from analog definition or flight definition to the execution phase will be made only after additional engineering and feasibility assessments have been performed.

Proposals that use appropriate non-human experimental models will be considered for solicitations, if the proposer can demonstrate that the approach will accelerate the achievement of one or more of the three HRP specific objectives enumerated in section B.2 or if it will enable the achievement of one of the objectives entirely without the use of human subjects.

Proposers who wish to use a facility (except for a NASA-provided facility) that is not under their direct control must submit with their proposal application a letter from the respective facility manager or organization manager that states the following:
1. The PI has permission to use the particular facility.
2. The PI will pay the respective organization for the use of the facility. The cost of the facility should be included in the letter as well as in the proposal budget. If the PI has free use of the facility, that should be stated.

a. Ground-Based

Investigations that do not propose to use analog facilities or to conduct flight studies are referred to as “ground-based” proposals in this solicitation. Investigators who are offered support for a ground-based study addressing topics in Section II or Section III of this solicitation will normally be expected to provide results useful to NASA after no more than three years for NASA awards. If additional research is necessary to obtain results, the investigator will be required to submit a new proposal for competitive renewal after no more than three years of support from a NASA award. Such follow-on proposals may be ground-based (with or without use of analog facilities) or flight-based.

b. Analog Definition

Proposals that propose to use spaceflight analog facilities, but not flight resources, are referred to as “analog definition” proposals in this solicitation. Analog definition investigations must represent mature studies strongly anchored in previous ground-based research or previous analog research and must be thoroughly justified.

Additional information for analog definition proposals will be collected through an Analog Study Resource Worksheet (available at [http://nspires.nasaprs.com/external/](http://nspires.nasaprs.com/external/)) as part of the proposal upload. This worksheet is required for a complete Step-2 proposal. It is very important that this
information be clear and accurate as it will be used to determine the feasibility of implementing the experiment. Examples of such information are: number of subjects required from an appropriate power analysis, age and sex of subjects, composition of sample, and physical characteristics of subjects.

Selected proposals will enter a definition period usually lasting from three to twelve months, depending on the complexity of the experiment. During this definition period the detailed experiment requirements of the proposal and implementation approaches and options are prepared in cooperation with an assigned representative from the HRP. In addition, where appropriate, NASA reserves the right to form teams of investigators whose experiments have compatible requirements for human subjects, specimens, operations, data, and treatment and sharing of biological samples. A selected investigator who becomes a member of a research team will be required to work with other team members to develop an integrated set of objectives that can be met within fiscal and analog resource constraints. Development of this integrated approach may result in modification, transfer, or deletion of some objectives put forth in an individual proposal. Specifics associated with the definition period will be addressed with the investigator at the time of selection.

Selection for definition assures an investigation of neither assignment to an analog study nor continued funding beyond the definition period. Investigations selected for analog experiment definition must successfully complete subsequent development steps to be considered for an analog assignment. NASA does not guarantee that any investigation selected for definition will advance to analog experiment status. Commitment by NASA to proceed from analog definition to the execution phase of an analog experiment will be made only after several additional engineering and scientific reviews and project milestones have established the feasibility and continued relevance of the proposed experiment.

Analog experiments will also be reviewed periodically for continued relevance, availability of analog opportunities, and implementation feasibility. These reviews may result in a decision by the Selection Official to discontinue an analog experiment before its implementation or completion.

**c. Flight Definition**

Any selected proposal that proposes to use NASA flight resources is referred to as a “flight definition” proposal in this solicitation. Flight definition investigations must represent mature studies strongly anchored in previous ground-based research or previous flight research and must be thoroughly justified. Two types of flight experiments are germane for this solicitation:

1. Research performed on human subjects exposed to long-duration spaceflight; and
2. On-orbit experiments that can be implemented on the ISS.

Additional information for flight definition proposals will be collected through a Flight Experiment Resource Worksheet as part of the proposal upload. This worksheet is required for a complete Step-2 proposal. The information requested includes number of subjects, pre/in/post-flight testing and crew time requirements, flight hardware requirements, cold stowage.
requirements, etc. It is very important that this information be clear and accurate, as it will be used to determine the feasibility of implementing the experiment.

Selected flight definition proposals will enter a definition period usually lasting six to twelve months. During this definition period the detailed experiment requirements of the proposal and implementation approaches and options are prepared in cooperation with an assigned representative from the HRP. In addition, where appropriate, NASA reserves the right to form teams of investigators whose experiments have compatible requirements for human subjects, specimens, operations, data, and treatment and sharing of biological samples. A selected investigator who becomes a member of a research team will be required to work with other team members to develop an integrated set of objectives that can be met within fiscal and flight resource constraints. Development of this integrated approach may result in modification, transfer, or deletion of some objectives put forth in an individual proposal. Specifics associated with the definition period will be addressed with the investigator at the time of selection.

Selection for definition assures an investigation of neither a flight opportunity nor continued funding beyond the definition period. Investigations selected for flight experiment definition must successfully complete subsequent development steps to be considered for a flight assignment. NASA does not guarantee that any investigation selected for definition will advance to flight experiment status. Commitment by NASA to proceed from flight definition to the execution phase of a flight experiment will be made only after several additional engineering and scientific reviews and project milestones have established the feasibility of the proposed experiment.

Once an experiment is selected for flight implementation, it will also be reviewed periodically for availability of flight opportunities and implementation feasibility. These reviews may result in a decision by the Selection Official to discontinue a flight experiment before its implementation or completion.

Flight definition proposals must be compatible with the operational constraints and capabilities of the spaceflight environment, as well as the Soyuz landings. The HRP Flight Experiment Information Package posted alongside this NRA (http://nspires.nasaprs.com/external/) provides detailed information on these constraints as well as a description of the unique aspects of the evaluation and selection process for flight experiments. Proposals that require spaceflight equipment, facilities, or other resources not identified in this NRA or in the accompanying HRP Flight Experiment Information Package will have a lower priority for selection. Please note that NASA will pay for magnetic resonance imaging (MRI) costs associated with a flight study if done locally in the Houston area.

There are certain human life sciences experimental requirements that, while not impossible to perform, are difficult to implement. Investigators should consider these limitations when developing their experiment protocols, knowing that technical feasibility is an important part of the overall assessment. The Flight Experiment Resources Worksheet posted alongside this NRA (http://nspires.nasaprs.com/external/) specifically addresses several of these requirements, and investigators should fill this out carefully and thoroughly in order for technical reviewers to better understand the experiment’s requirements.
Requirements that may be difficult to accommodate include these:

1. Any new flight hardware. The extent of how difficult this development will be depends on how much design and development is required for custom-made equipment and how extensively off-the-shelf equipment will have to be modified.
2. Return of hardware for refurbishment or data retrieval. Down mass resources will be protected for critical science samples; data should be planned to be downlinked and hardware will likely be discarded.
3. Requirements for cold stowage that exceed the capabilities of the equipment identified on the cold stowage Web site (http://www.nasa.gov/mission_pages/station/research/experiments/facilities_hardware.html#Multipurpose under Multipurpose: Refrigerator or Freezer section). Experiment-unique refrigerators or freezers will not be developed.
4. Software that requires a dedicated computer or operating system. This includes a dedicated virtual machine on existing hardware.
5. Software that uses a ClickOnce installation model.
7. Overly invasive or complicated procedures that may hinder crew consent.
8. Total preflight Baseline Data Collection (BDC) requirements of more than ten hours per subject.
9. Single BDC sessions requiring more than two hours per subject.
10. More than two hours of BDC per subject required within three months of launch.
11. BDC testing requirements within two months of launch.
12. In-flight procedures that require a high degree of proficiency and training before crewmember launch (e.g., requires more than three two-hour sessions for one unique procedure or skill; requires refresher session within 60 days of launch).
13. Two or more hours of testing per subject within the first three days after landing.
14. More than three hours of total testing per subject in the first week after landing.
15. Strenuous or provocative sessions on Return Day (R+0) or R+1. Any activity that could be considered strenuous or provocative for a healthy normal subject may not be feasible for crewmembers in this time frame.
16. Complicated in-flight sessions before the second week of flight (e.g., requires setup of multiple pieces of equipment, followed by a testing session of more than an hour; sessions that require privatized voice or video).
17. More than five complicated in-flight sessions involving multiple pieces of equipment. (e.g., requires setup of multiple pieces of equipment, followed by testing of more than two to three hours; requires extensive privatized resources).
18. A single session with one crewmember requiring four hours in one day.
19. Crew activity that must be performed daily or more than once a week.
20. Very precise or inflexible timing requirements for sessions (e.g., +/- window for testing of less than one week, multiple timed blood draws, sessions that are linked to other crew activities such as eating and extravehicular activity [EVA]). Note that occasional fasting data collections upon crew wake up are not difficult to implement.

21. Extended, continuous activities over multiple days that could interfere with other operations.

2. Types of Research Products

The three types of specific objectives listed in section B.2 of this document give rise to three types of research products. If applicable for the specific research topic, proposers will identify, through answers to questions prompted by NSPIRES, which of the three types of research products best characterizes the proposed research:

1. For the quantification of a crew health and performance risk objective, the research product should define the likelihood or the consequence of a risk more completely. Such proposals must specify how much the uncertainty in the likelihood or the consequence of the risk is anticipated to be reduced by the proposed research.

2. For the countermeasure development objective, the research product should be a countermeasure to be developed to mitigate a risk, or reduce the impact of a risk factor, or reduce the resources required to mitigate a risk. Such proposals must specify the Countermeasure Readiness Level (CRL) at the beginning of the proposed work and the anticipated CRL at the conclusion of the proposed work.

3. For the technology development objective, the research product should be a technology to be developed to mitigate a risk, reduce the impact of a risk factor, or better define a risk or risk factor. Such proposals must specify the Technology Readiness Level (TRL) at the beginning of the proposed work and the anticipated TRL at the completion of the proposed work.

a. Countermeasure Readiness Level

A countermeasure is any means or procedural strategy that prevents or reduces the negative effects on crew health or performance or facilitates recovery upon return to Earth. The astronaut corps is diverse, comprising men and women 30-60 years of age and of various ethnic backgrounds. Countermeasures should be robust enough to be efficacious across this population, but also be flexible enough to be tailored for individual specificity.
NASA has developed a scale to allow it to define, assess, and quantify the level of “countermeasure readiness”. The use of this scale allows program managers to determine and describe how each funded research project fits into the countermeasure development “pipeline” and to monitor progress in countermeasure development. Each investigator must examine and understand the CRL scale and specify in the proposal the CRL that will result from the funding and conduct of their proposed research. Figure 1 illustrates the CRL scale, which describes the level of scientific maturity of research ranging from the fundamental studies that suggest potential countermeasures to studies that allow the systematic evaluation and validation of countermeasures they are implemented in flight operations.

**b. Technology Readiness Level**

Within NASA strategy, nine TRLs have been defined, ranging from the basic physical principles to a “flight-proven” system. Figure 2 below provides these definitions in a scale that describes the levels of technology research, development, testing, and operations. Typically, the goal is to take technology to TRL 6, after which it can be picked up and used in an exploration mission. Each investigator must examine and understand the TRL scale and specify in the proposal the TRL that will result from the funding and conduct of their proposed research.
**Figure 2. Technology Readiness Levels**

**F. Submission Information**

1. **Source of Application Materials**

All information needed to submit an electronic proposal in response to this NRA is contained in the HERO appendices, this document, and in the 2018 version of the companion document entitled “Guidebook for Proposers Responding to a NASA Research Announcement (NRA)” (hereinafter referred to as the *Guidebook for Proposers*) that is located at [http://www.hq.nasa.gov/office/procurement/nraguidebook/](http://www.hq.nasa.gov/office/procurement/nraguidebook/).

Additionally, applicants shall prepare proposals in accordance with the “Instructions for Responding to NASA Research Announcements,” NASA Federal Acquisition Regulations (FAR) Supplement (NFS), Part 1852.235-72, hereinafter referred to as the *NASA FAR Supplement*, which is located at [https://www.hq.nasa.gov/office/procurement/regs/NFS.pdf](https://www.hq.nasa.gov/office/procurement/regs/NFS.pdf).

The information in this HERO overview document supersedes and provides additional direction to that found in the *Guidebook for Proposers* and provides additional direction consistent with the *NASA FAR Supplement*. Proposals that do not conform to the solicitation requirements may...
be declared noncompliant and declined without review.

Proposal submission questions received will be answered and published in a FAQ document. This FAQ document will be posted on the NSPIRES solicitation download site alongside this document. Other FAQs specific to particular opportunities may be posted alongside the appropriate HERO appendix. All FAQs will be updated periodically between submission release and the Step-2 proposal due date. Any supplemental information will also be posted alongside this document or the appropriate HERO appendix.

2. Content and Form of Proposal Submission

a. Registration in NASA Proposal Data System

HERO appendices released under this HERO overview document require that the proposer register key data concerning their intended submission with the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) located at http://nspires.nasaprs.com. Potential applicants are urged to access this site well in advance of the proposal due date(s) of interest to familiarize themselves with its structure and enter the requested identifier information. It is especially important to note that every individual named on the proposal’s Cover Page (see further below) must be registered in NSPIRES and that such individuals must perform this registration themselves. Team members will be asked to confirm their organization affiliation when added to a proposal. No one may register a second party, even the PI of a proposal in which that person is committed to participate. This data site is secure and all information entered is strictly for NASA’s use only.

Every organization that intends to submit a proposal to NASA in response to a HERO appendix, including educational institutions, industry, nonprofit institutions, NASA Centers, the Jet Propulsion Laboratory, and other U.S. Government agencies, must be registered in NSPIRES, regardless of the electronic system used to submit proposals. Such registration must be performed by an organization’s electronic business point-of-contact (EBPOC) in System for Award Management (SAM).

Proposers from new organizations that have not applied for NASA grants or contracts are recommended to begin at least 15 business days before the deadline in order to complete organization registration in SAM (which is a prerequisite to registering the organization in NSPIRES) and then complete organization registration and proposer affiliation in NSPIRES. The SAM Web site is https://www.sam.gov.

b. Electronic Submission

Proposals must be submitted electronically. Step-1 and Step-2 proposals must be submitted electronically by one of the officials at the PI’s organization who is authorized to make such a submission. All team members must be registered in NSPIRES and confirm their organizational affiliation when added to a proposal before the PI organization official can submit. It is strongly recommended that the PI work closely with his/her team members and organization official to ensure the proposal is submitted by the due date and time listed in this
solicitation. Proposals submitted after the listed due dates and times in the appendix being responded to may be declared noncompliant and will be handled in accordance with the NFS.

NSPIRES accepts fully electronic proposals through a combination of data-based information (e.g., the electronic Cover Page and its associated forms) and uploaded portable document format (PDF) file(s) that contain the body of the proposal. The Web site will provide a list of all elements that make up an electronic proposal, and the system will conduct an element check to identify any item(s) that is (are) apparently missing or incomplete. Proposers are particularly encouraged to begin their submission process early.

Requests for assistance in accessing and/or using this Web site may be directed by email to nspires-help@nasaprs.com or by telephone to 202-479-9376 Monday through Friday, 8:00 AM – 5:00 PM Eastern Time. FAQs may be accessed through the Proposal Online Help site at https://nspires.nasaprs.com/external/help.do. Tutorials of NSPIRES are available at https://nspires.nasaprs.com/tutorials/index.html.

3. Intent to Propose and Step-1 Proposals

Proposals solicited through HERO solicited research response area appendices will use a two-step proposal process.

The NSPIRES system will guide proposers through submission of all required proposal information. Please note that the Proposal Summary, Business Data, Program Specific Data, and Proposal Team are required Cover Page Elements for a Step-1 proposal. The proposal summary should be between 100 and 300 words (4000 characters maximum) and understandable by the layman reader. Budgets should not be included with the Step-1 proposal. The project team is not considered binding for Step-1 proposals and can be adjusted in an invited Step-2 proposal. As per the FAR, failure to include any of the key components may result in return of your Step-1 proposal without review.

To initiate a Step-1 proposal:

- Log in using your NSPIRES user name and password.
- Click on Proposals under the NSPIRES Options.
- Click on the Create Proposal button.
- Select “Solicitation” to prepare a new proposal.
- Click the button for the appendix being responded to.
- Follow the step-by-step instructions provided in NSPIRES to complete your Step-1 proposal.

Step-1 proposals submitted to HERO appendices will include a synopsis of the intended research, with the total length of the Step-1 proposal not to exceed the number of 8 ½ by 11-inch pages specified in the appendix being responded to using a standard 12-point font and one-inch margins. This synopsis will be provided as a PDF proposal document upload, and must not be password protected or locked in any way. Required elements of the Step-1 application include
(1) A clear description of the research product(s).
(2) The type of investigation (ground-based, analog definition, or flight definition).
(3) The specific aims of the proposal.
(4) An outline of the plan to accomplish the specific aims.

**No additional documents should be uploaded with the Step-1 proposal.** Budget and detailed program data should not be included with the Step-1 proposal. Project personnel are not considered binding for Step-1 and can be adjusted in an invited Step-2 proposal. References, forms, and letters of support (e.g., letter of support from foreign space agency) are not required for the Step-1 proposal, and if included, count toward the page limit.

**If your proposal is a resubmission, you should identify it as such in your Step-1 submission; you are not, however, required to address prior reviews unless invited to submit a full proposal.** Please be aware that submission of a Step-1 proposal to reintroduce a proposal invited during a previous review cycle to be submitted as a Step-2 proposal, but not funded (i.e., a resubmission from a previous round of review), does not guarantee that this newly submitted Step-1 proposal will be judged responsive to the areas of focus in the current NRA and therefore invited to be submitted as a Step-2 proposal.

Step-1 proposals are prepared by the PI or a designated representative of the PI. **Step-1 proposals are submitted by an official of the PI’s organization after the PI has released the prepared proposal to the institution official.** It is strongly recommended that the PI work closely with his/her organization official to ensure the proposal is submitted by the due date and time listed in this solicitation. Proposals will not be accepted after the listed due dates except as provided in the *NASA FAR Supplement 1852.235-72(g).*

Step-1 proposers can use either NSPIRES ([http://nspires.nasaprs.com](http://nspires.nasaprs.com)) or Grants.gov ([http://www.grants.gov/](http://www.grants.gov/)) for proposal submission. Proposers intending to use Grants.gov should contact Benjamin Goodman ([bgoodman@nasaprs.com](mailto:bgoodman@nasaprs.com)), Senior Scientist, NASA Research and Education Support Services (NRESS), to ensure that the Grants.gov system is available for Step-1 proposal submission for a given appendix. All proposers, team members, and agency officials must be registered before proposal submission with NSPIRES regardless of the electronic system used to submit proposals. NSPIRES remains the only system through which a Step-1 proposal can be continued as a Step-2 proposal. Proposers submitting a Step-1 proposal who receive an invitation to submit a Step-2 proposal will have the option of building on a stored Step-1 proposal within the NSPIRES database. Grants.gov will not be available for invited Step-2 submissions. All invited proposers must use NSPIRES for Step-2 proposal submission. Instructions for submitting proposals to NASA via Grants.gov may be found on the Grants.gov portal at [http://www.grants.gov/](http://www.grants.gov/).

Step-1 proposals must be submitted within the window of opportunity and by the deadline listed in a given HERO appendix.

All submitters of Step-1 proposals must log in to NSPIRES on or after the Step-1 notification date listed in the HERO appendix being responded to in order to receive their Step-2 full proposal invitation status. A courtesy email will be generated by NSPIRES as a reminder to
check full proposal invitation status; however, it is the responsibility of the submitter to log in to NSPIRES to receive their full proposal invitation status.

Decision information can be accessed in two ways:

1) After logging in, the PI 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.
2) After logging in, the Authorized Organization Representative selects “Organization Mgmt” link and, from within the submitting organization, selects the “Organization Proposals” link, then 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.

4. Instructions for Preparation of Invited Step-2 Proposals

Step-2 proposals will only be accepted from invited proposers using NSPIRES by the deadline listed in a given HERO appendix.

The NSPIRES system will guide proposers through submission of all required proposal information. Select prior-phase proposal when creating an invited Step-2 proposal. Please note that the Proposal Summary, Business Data, Budget, and Proposal Team and Program Specific Questions are required Cover Page Elements for all Step-2 proposals. The proposal summary should be between 100 and 300 words (4000 characters maximum) and understandable by the layman reader. In addition to the Cover Page online budget forms, proposers are encouraged to provide expanded budgets as needed (e.g., for subcontracts) as part of their Proposal Budget (see number 16 below and the Guidebook for Proposers). For proposals with NASA civil servant team members only: Proposers are required to enter the NASA civil servant team member name and fraction of full-time equivalent (FTE) involvement in the same field under the Item column in section F “Other Direct Costs” of the online budget. The funds requested should be entered as the Total Requested Funds for the NASA civil servant, including salary, fringe, materials, travel, etc. (see the FAQ posted alongside this document for additional budget instruction). This budget entry should be made for each year of NASA civil servant involvement, and is in addition to the agency identification under the team member section and the NASA civil servant FTE designation under the business data section.

To ensure proper Step-2 proposal transmission, please provide only one PDF attachment upload ordered as below. For proposal sections 3 through 8 and sections 10-11, 14-15, and 18, specific instructions are given in this HERO overview document (see section F.4.a though F.4.k). These specific instructions supersede those found in the NASA Guidebook for Proposers. Proposals that do not conform to these requirements may be declared noncompliant and declined without review. For sections 1-2, 9, 12-13, and sections 16-17, proposers are encouraged to reference the NASA Guidebook for Proposers; however, there are no specific submission compliance requirements for these sections (such as format, structure, or
Each section of the proposal listed below should begin on a new page (no single page of the proposal should include parts of more than one proposal section).

1. Table of Contents
2. If applicable, inclusion of the Flight Experiment Resource Worksheet, Analog Study Resource Worksheet, or Retrospective Data Request Study Feasibility Assessment Form (posted on NSPIRES alongside this document).
4. Animal Care or Human Subjects certifications, if applicable (see F.4.b below).
5. Response to prior review, if applicable (see F.4.c below).
6. Productivity of currently funded research, if applicable (see F.4.d below).
7. Vertebrate Animal Scientific Review, if applicable (see F.4.e below and VASR posted on NSPIRES solicitation site).
8. Project Description (see section F.4.f below).
9. References and Citations
10. Statistical Approach (see section F.4.g below).
11. Management Approach (see F.4.h below).
12. Personnel Biosketches (see Guidebook for Proposers).
13. Current and Pending Support (see Guidebook for Proposers).
14. Facilities and Equipment (See F.4.i below).
15. Data Management Plan (including Software Sharing Plan, if applicable, See F.4.j below).
16. Proposal Budget with Budget Narrative and Budget Details (see Guidebook for Proposers).
17. Statements of Commitment and Letters of Resource Support (see Guidebook for Proposers).
18. Reprints, Preprints, and Appendices (See F.4.k below).

While the NSPIRES system allows the upload of supporting documents as separate uploads, please provide the information above in only one PDF proposal document upload. It is essential that all PDF files generated and submitted meet NASA requirements. At a minimum, it is the responsibility of the proposer 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 comply with NSPIRES.

There is a recommended 10 MB size limit for proposals. Large file sizes can affect the performance of the NSPIRES system. Most electronically submitted proposals will be less than 2 MB in size.
NSPIRES accepts electronic proposals through a combination of data-based information (e.g., the electronic Cover Page) and the uploaded PDF file that contains the proposal as outlined above. The NSPIRES proposal submission process ensures that a minimum set of required proposal cover page fields are completed. Provision of the proposal summary and business data elements of the cover page will be necessary for the Authorized Organizational Representative (AOR) to submit the proposal to NASA. If either of these two proposal elements is incomplete, the "View Proposal/ Check Elements" function of NSPIRES will display red "error" flags and messages to alert the user to the information that is required but missing, and the "Submit Proposal" button will not be available. Although the PI will be able to release the proposal to the AOR, the proposal cannot be submitted by the AOR to NASA until these required fields are complete. Any additional information that is missing will be identified by yellow "warning" flags. Proposers are reminded to check the solicitation instructions to ensure compliance with all instructions, as adherence to these two element validation checks alone is insufficient to guarantee a compliant proposal. Additionally, in cases where instruction in the NRA contradicts an NSPIRES warning, the NSPIRES yellow “warning” may be ignored. Proposers should follow the NRA instructions closely to help ensure submission of a compliant proposal.

The NSPIRES system is limited in the character sets that can be used in filling out online forms. Please refer to the online tutorials when using special characters. Alternatively, spell out special characters where possible (such as micro rather than the Greek symbol). Applicants are encouraged to preview their proposal before releasing it to their designated Organization by clicking the “Generate” button at the bottom of the View Proposal Screen in NSPIRES. The “Generate” feature allows applicants to preview their entire proposal in a single PDF file before submitting it, but previewing is not a required step in the submission process. Please contact the NSPIRES Help Desk for assistance with this feature (Email: nspires-help@nasaprs.com or telephone: 202-479-9376).

a) Human Research Roadmap
The investigator must examine and understand the research emphases outlined in the HERO appendix being responded to and the risks identified in the HRR (http://humanresearchroadmap.nasa.gov). Proposers must include, as part of their proposal, a description of how their research aims map to the identified IRP risks, gaps, and deliverables. This description is limited to two pages and does not count toward the page limit of the project description.

b) Special Matters
For proposals using human subjects and/or animals, assurance of compliance with human subjects and/or animal care and use provisions is required.


Animal use and care requirements are described in 14 CFR 1232 (http://www.ecfr.gov/cgi-bin/text-
NASA utilizes a just-in-time practice for approval of the use of human subjects or animals. If the IRB/IACUC certification is already approved at proposal submission, attach a copy of the certification as part of the proposal.

After an award is made, a statement must be provided from the Applicant institution which identifies the selected proposal by name and which certifies that the proposed work will meet all Federal and local requirements for human subjects and/or animal care and use. This statement includes relevant documentation of IRB approval and/or approval by the IACUC. NASA will require current IRB and IACUC certification prior to each year’s award.

For delivery of any certifications received after the proposal due date, please contact Benjamin Goodman, Senior Scientist, NASA Research and Education Support Services, at bgoodman@nasaprs.com.

c) Revised Proposals
Investigators submitting a proposal in response to this solicitation, and whose most recent submission that included specific aims similar to those of any NASA-, NSBRI-, or TRI-sponsored research announcement was not accepted, are required to submit an explanation of how the current proposal addresses criticisms from previous review cycles. This explanation shall be presented preceding the research description as part of the main proposal upload and is limited to two pages. This explanation should include changes made to the current proposal as a result of review comments and/or an explanation of why previous review comments are not applicable to the current proposal. **Responses to prior reviews that exceed two pages will be redacted to include only the first two pages of the section and the PI will be notified.**

Investigators resubmitting a proposal in response to this solicitation may only submit a proposal with similar hypothesis(es) and aims a total of three times (original submission plus two resubmissions). Significant changes must be made to the proposal hypothesis(es) and specific aims for consideration after the third attempt or the proposal will be declined without further review.

These two pages are not considered part of the project description. Proposal reviewers will be provided with the evaluations of previous submissions. Proposers must respond to previous criticisms relevant to any portion of the new proposal under consideration. Proposers who have questions concerning their response to a previous review are encouraged to contact Benjamin Goodman, Senior Scientist, NASA Research and Education Support Services, at bgoodman@nasaprs.com.

d) Productivity of NASA-, NSBRI-, and TRISH-Funded Research
Proposers (only the PI) currently funded by or who have received funding within the last four years from any NASA funding source must provide specifics about the productivity of the supported research, including progress in experiments, research publications, and new findings. This explanation should be presented preceding the research description as part of the main proposal upload and is limited to two pages. These two pages are not considered part of the
project description. Related impacts, if any, on the proposed research plan should be highlighted in the body of the project description. Prior productivity refers to any role in a previously funded project, including but not limited to Principal Investigator. Proposals that request continued support but do not include this productivity section may not be considered for funding.

e) Vertebrate Animal Scientific Review (if applicable)
Each response to this solicitation that requires vertebrate animals must address the five points outlined in the VASR instructional document posted alongside this document. This response should be presented as part of the main proposal upload and is limited to two pages. These two pages are not considered part of the page project description. A sample VASR is provided in the VASR instructional document posted alongside this document on the NSPIRES solicitation page. VASRs that exceed two pages will be redacted to include only the first two pages of the section and the PI will be notified.

f) Project Description
The length of the project description of the proposal shall not exceed the number of pages specified in the appendix being responded to using standard (12-point) type. Text shall have one-inch margins. Referenced figures and tables must be included in the pages of the project description; however, figure captions can use a 10-point font. The proposal shall contain sufficient detail to enable reviewers to make informed judgments about the overall merit of the proposed research and about the probability that the investigators will be able to accomplish their stated objectives with current resources and the resources requested. The hypotheses (if appropriate) and specific aims of the proposed research shall be clearly stated. Proposals that exceed the maximum page length will be redacted such that the limit is not exceeded and the PI will be notified. In these cases, the proposer will be given the choice of either accepting redaction or being declined. Cited literature and all other proposal sections are not considered part of the project description. Reviewers are not required to consider information presented as appendices or to view and/or consider Web links in their evaluation of the proposal. In some cases, the Step-1 invitation letter may contain information concerning redirection of a study, and the proposer should incorporate this information when drafting the Step-2 proposal.

g) Statistical Approach
A statistical section with proper justification should be included. If a statistical section is not applicable, a brief statement saying why it is not should be included. The Sample Size Specification Guidelines document posted alongside this NRA gives particular emphasis to the problem of how to arrive at and justify experiment sample size(s). The recommendations are necessarily general, and may not be universally applicable. Nevertheless, these guidelines are intended to clarify an understanding among PIs, grant reviewers, and NASA pertaining to sample-size issues for NASA research studies. The statistical approach section of the proposal is limited to one page and will be evaluated by a statistician serving on the peer review panel. Statistical sections that exceed one page will be redacted to include only the first page of the section and the PI will be notified.
h) Management Approach
The management structure for the proposal personnel should be provided. In particular, plans for
distribution of responsibilities and arrangements for ensuring a coordinated effort should be
described.

i) Facilities and Equipment
The proposal must describe any required facilities and equipment. This section must describe any
existing facilities and equipment that are required for the proposed investigation and whether or
not the team already has access to them in good working order or if they need to be repaired,
upgraded or acquired.

Proposers who wish to use a facility that is not under their direct control must submit with their
proposal application a letter from the respective facility manager or organization manager that
states the following:
1. That the PI has permission to use the particular facility.
2. If the PI will pay the respective organization for the use of the facility. The cost of the facility
should be included in the letter as well as in the proposal budget. If the PI has free use of the
facility, that should be stated.

j) Data Management Plan
Each proposal must include a DMP that describes how data generated by the proposed research
will be shared and preserved, and how data collected will be made available to the public on
completion of flight and ground-control experiments. If there is a valid reason why data-sharing
and/or preservation is not possible or scientifically appropriate, some justification must be
provided. The DMP must describe how data sharing and preservation will enable validation of
results, or how results could be validated if data are not shared or preserved. DMPs must provide
a plan for making all research data underlying results and findings in publications digitally
accessible at the time of publication. The DMP should be a separate section in the proposal. As
described in this document, the Data Management Plan should include the Software Sharing
Plan, if applicable, and take into account NASA’s open-access policy. The DMP section of the
proposal must not exceed one page. Data Management Plans that exceed one page will be
redacted to include only the first page of the section and the PI will be notified.

k) Reprints, Preprints, and Appendices
Reprints, preprints (refereed and unrefereed), and appendices, if any, do not count toward the
project description page limit, and are to be included following all other sections of the proposal
(reviewers are not required to consider information presented in proposal appendices).

G. Proposal Review Information

1. Review Processes

Review of proposals submitted to this NRA will be consistent with the general policies and
provisions given in Section 5 of the NASA Guidebook for Proposers. See below for specific
process details.
2. Step-1 Proposal Relevancy Review

Each Step-1 proposal submitted to HERO solicited research response area appendices will be reviewed by a minimum of three members of a Step-1 HRP Evaluation Panel unless otherwise specified in the HERO appendix describing the opportunity. The HRP Chief Scientist will assign the reviewers for each Step-1 proposal.

Each reviewer will assign an evaluation of “invite” or “decline” based on whether the study addresses one or more of the risks and gaps in the HRP Human Research Roadmap (http://humanresearchroadmap.nasa.gov) and the perceived value of the study’s deliverables to NASA’s need to fill HRR gap(s) and meet the goals of the solicited research topics. Additionally, the Step-1 reviewers will consider the innovative nature of the proposed study and the potential for results to deliver new tools, techniques, or knowledge that could lead to novel breakthroughs addressing one or more of the risks and gaps in the HRR as well as feasibility of the study. The HRP Chief Scientist will review the individual evaluations and approve a final composite recommendation for each Step-1 proposal. Only those Step-1 proposals having a final evaluation of “invite” will be invited to submit a full Step-2 proposal.


a. Evaluation Process Summary

Evaluation by an independent peer review panel will be used to assess each Step-2 proposal’s intrinsic scientific and technical merit, its relevance to NASA’s stated objectives, its statistical plan, and its cost realism. See Section 5 of the NASA Guidebook for Proposers for further discussion of these criteria and their relative weights. The evaluation criteria include factors evaluated by peer reviewers, as well as programmatic factors evaluated by NASA program personnel. Note the following specific points:

- The solicited research response areas may give specific factors, based on the solicited research objectives, which will be considered when evaluating a proposal’s science and/or technical merits and/or its relevance to program objectives.

- Relevance will be judged in part by the proposal’s focus on specific strategic and science objectives for that HERO solicited research response area, as given in the NRA. This focus on relevance to the solicitation topic rather than NASA’s broader goals, supersedes any instructions in the Guidebook for Proposers.

- Cost data for U.S. proposals will be evaluated both by peer review (for cost realism and cost reasonableness) and by NASA program personnel (for total cost and comparison to available funds). Proposers must follow the budget requirements in Section 3.18 of the NASA Guidebook for Proposers. In evaluating the cost reasonableness of the proposals, reviewers will assess whether the proposed level of effort (i.e., FTE) and the proposed other direct costs (i.e., supplies, equipment, travel) are commensurate with those required to accomplish the goals of the investigation.

- Neither the existence of proposed voluntary cost sharing nor the lack thereof, nor the magnitude of such cost sharing will be used as evaluation criteria or as a precondition for
award. If voluntary cost sharing is proposed, the proposer should describe, in detail, any proposed cost-sharing arrangements.

The overall evaluation process for Step-2 proposals submitted to HERO appendices will include a compliance review followed by a First-Tier Merit Review and a Second-Tier Program Alignment Review. The **First-Tier Review** will be a merit peer review by a panel of scientific or technical subject matter experts. The number and diversity of experts required will be determined by the response to HERO appendices and by the variety of disciplines represented in the proposals relevant to the research emphases described in the appendix being responded to. The merit review panel will **assign a score from 0-100, or assign a Not Recommended for Further Consideration (NRFC)** based on the intrinsic scientific or technical merit of the proposal. The final score or NRFC designation will reflect the consensus of the peer-review panel. After the merit review is complete the panel will be asked to include in their critique of each proposal any comments they may have concerning the proposal’s budget and/or DMP. In general, proposals that are highly rated in the merit review process will undergo a second-tier review for program alignment; however, at the HRP Chief Scientist’s discretion, proposals with lower scores may also undergo a second-tier review if they can be rescoped and meet specific programmatic needs.

For research requiring vertebrate animals, the first-tier review will also include a Vertebrate Animal Science Review (VASR) as outlined in the VASR posted on the NSPIRES solicitation download site alongside this NRA.

**b. Compliance Matrix Review**

All proposals must comply with the general requirements of the NRA as described in this solicitation, the **Guidebook for Proposers**, and the **NASA FAR Supplement**. Upon receipt, proposals will be reviewed for compliance with these requirements, including:

1) Proposals will not be accepted after the due dates and times listed in the appendix being responded to except as provided in the **NASA FAR Supplement**.

2) The proposal project description must be no greater in length than the limit in the corresponding appendix. Proposals that exceed the page length will be redacted such that the limit is not exceeded. In these cases, the proposer will be given the choice of either accepting redaction or being declined.

3) Submission of appropriate IRB or IACUC certification for all proposals using human or animal test subjects, if available, or declaration of pending status if unavailable.

4) Submission of an appropriate and justified budget for a funding period not exceeding that described in the corresponding appendix.

5) Investigators submitting a proposal in response to a HERO appendix, and whose most recent submission that included specific aims similar to those of any NASA-, NSBRI-, and TRI-sponsored research announcement was not accepted, are required to submit an explanation of how the current proposal addresses criticisms from previous review cycles. This explanation should be presented in a separate form of no more than two pages. Related changes in the research plan should be highlighted in the body of the project.

6) For proposals that are continuations of currently funded research, a description that provides
specifics about the productivity of the supported research, including progress in experiments, research publications, and new findings.

7) Proposals that require vertebrate animals must include a VASR component, not to exceed two pages.

8) For flight proposals, submission of the Flight Experiment Resource Worksheet.

9) For flight analog proposals, inclusion of the Analog Study Resource Worksheet.

10) Submission of all other appropriate information as required by this NRA.

Note: At NASA’s discretion, noncompliant proposals may be withdrawn from the review process and declined without further review. Compliant proposals submitted in response to this NRA will undergo an intrinsic scientific or technical merit review. In general, only those proposals most highly rated in the merit review process will undergo additional reviews for program balance and cost; however, at the HRP Chief Scientist’s discretion, proposals with lower scores may also undergo additional reviews if they can be rescoped and meet specific programmatic needs.

c. First-Tier Intrinsic Scientific and/or Technical Merit Review
To be responsive to this research solicitation, proposed studies should produce research product(s) that address the research emphases stated in the corresponding HERO appendix, and lead to new knowledge or deliverables within accepted scientific and technology standards.

All of the following criteria will be used in determining the merit score. Specific appendices may modify these criteria or add additional criteria as necessary.

Significance:
Does this study address a research emphasis stated in this solicitation? Does the study test a significant hypothesis or produce data that would enable a significant hypothesis to be generated? If the study is non-hypothesis driven, are the data produced needed to understand or reduce the risk addressed by the research emphasis? If the task will produce a software model or tool, how will it serve to better quantify or mitigate a risk? If the aims of the application are achieved, how well will the product(s) address the research emphases? If the aims of the application are achieved, how will scientific knowledge or technology advance?

Approach:
Are the conceptual framework, design, methods, and analyses adequately developed, well integrated, and appropriate to the aims of the project? Is the proposed approach likely to yield the desired results? Does the applicant acknowledge potential problem areas and consider alternative tactics?

Statistical Plan:
If applicable, has the applicant included a range of reasonable sample sizes for a proposed study with proper justification? Does the study provide adequate justification for sample size? For example, is the choice of primary outcome relevant for the stated Aims? Are assumed effect magnitudes reasonable? Are assumed variability estimates reasonable? Are they estimated properly? Are they relevant for the proposed experimental design and data analysis
methodology? What type I and type II errors are assumed? Is there room for a tradeoff here to accommodate sample size constraints and still provide useful information from the study? Do the investigators provide a reasonable data analysis plan? For example, is it appropriate for the proposed experimental design (e.g., repeated measures)? Does it address research hypotheses or aims? Is it robust to the sampling and other constraints associated with the research venue?

**Mitigation of Risks to Crew Health:**
For a study quantifying risks to crew health or performance, does the study adequately improve the understanding of the adverse consequences, the probability of their occurrence, or the timeframe in which the risk must be addressed? For a study developing countermeasures, will the proposed countermeasure reduce a risk to crew health or performance, reduce the impact of the risk, or reduce the resources required to mitigate it? For a study developing technology, will the research product reduce a risk to crew health or performance, or reduce its impact or better define it, and is the technology feasible within the confines of the operational environment?

**Investigators:**
Are the investigators appropriately trained and well suited to carry out this work? Is the proposed work appropriate to the experience level of the principal investigator and any co-investigators? Is the evidence of the investigators’ productivity satisfactory?

**Environment:**
Does the scientific environment in which the work will be performed contribute to the probability of success? Do the proposed experiments take advantage of unique features of the scientific environment or employ useful collaborative arrangements? Is there evidence of institutional support?

**d. Second-Tier Programmatic Review**

The **Second-Tier Review** will evaluate the programmatic balance, feasibility, and cost of proposals. This review will be conducted by the HRP Chief Scientist, the HRP Element Scientists, and HRP Element Managers. All applications will be reviewed with respect to

- How relevant is the proposed work to the HRP Goals and Objectives? Does the proposed project provide clear added value to the HRP Integrated Research Plan? Does inclusion of the proposed work enhance the balance of the research portfolio?
- Does the proposed work clearly address a specific Gap in the HRP Integrated Research Plan? Does the project have unequivocal value to the HRP?
- Does the plan have a high likelihood of progress and end-user adoption that will fill the HRP IRP Gap or make a major contribution to filling it?
- How does the value of the proposed work toward answering critical questions and achieving HRP Goals and Objectives compare to the cost?
- For proposals requiring vertebrate animals, is the coding of the VASR rated as Acceptable? NASA staff will work with the applicant to resolve concerns before any funds are awarded. Coding of the VASR as Acceptable is required before an award is made.

Note that neither a high merit score alone nor a high relevance score alone will obligate NASA
to select any proposal. NASA retains the option to select proposals outside of the traditional fundable range if, in its judgment, their weaknesses in either merit or relevance can be resolved or mitigated and if it is in the best interests of the Government to do so.

In addition, analog definition proposals and flight definition proposals will undergo reviews for feasibility as described below.

i. Analog Definition Proposals
Only those analog definition proposals that are most highly rated in the merit review process will undergo additional reviews for analog feasibility. A panel of technical experts from NASA will evaluate the feasibility of carrying out the analog experiment and the potential for establishing teams of investigators to optimize utilization of human subjects, samples, data, and analog resources. This review will be conducted by technical experts familiar with the development and conduct of analog studies.

ii. Flight Definition Proposals
Only those flight definition proposals most highly rated in the merit review process will undergo additional reviews for flight feasibility. A panel of technical experts from NASA will evaluate the feasibility of carrying out the flight experiment and the potential for establishing teams of investigators to optimize utilization of human subjects, samples, data, and flight resources. This review will be conducted by technical experts familiar with the development of spaceflight experiment hardware, ground and flight operations, crew training, and vehicle resources (such as power, volume, or mass).

4. Selection Processes

Selection processes will be consistent with the provisions of the NASA Guidebook for Proposers. For some solicited research response areas, the desire to achieve a balance of efforts across the solicited program objectives may play a role in the selections, taking into account not only the new proposals of merit that are suitable for selection, but also those that seek an extension of activities initiated through previous but now concluded selections, i.e., “successor” proposals.

Unless otherwise specified, the HRP Director (or his designee) is the Selection Official for proposals that have been submitted in response to the research topics that are solicited in the NASA HERO Appendices.

The information resulting from these two levels of review, as described above, will be used to prepare selection recommendations developed by the NASA HRP Chief Scientist. Selection for funding will be made by the NASA HRP Program Director or his designee.

To optimize resources, NASA pursues the intentional formation of investigator partnerships between individual investigators whose experiments will use resources to maximum advantage by addressing different facets of the same questions. NASA anticipates that such intentional teaming arrangements will result in better utilization of available resources to resolve specific critical questions. NASA strongly encourages investigators submitting applications in response to HERO appendices to consider identifying collaborations between individual investigators as
part of the development of their individual proposals and to identify this pre-coordination in their management plan. Additional information can be referenced in the NASA FAR Supplement. Finally, NASA may integrate proposals if, in their judgment, the goals, objectives, or products of the proposals are similar.

For some NASA research topics, NASA is considering utilizing individual research proposals to form a Virtual NASA Specialized Center Of Research (VNSCOR) where NASA aligns a set of individual awards into an NSCOR-like team project. Individual proposals may be selected to become Elements of a VNSCOR. Elements of the VNSCOR will also join a working group organized by NASA on the specific research topic. VNSCORs will be composed of four to six individual research elements, each with its own specific aims.

Where appropriate for analog definition or flight definition studies, NASA reserves the right to form teams of investigators whose experiments have compatible requirements for human subjects, specimens, operations, data, and treatment and sharing of biological samples. A selected investigator who becomes a member of a research team will be required to work with other team members to develop an integrated set of objectives that can be met within fiscal and analog or flight resource constraints. Development of this integrated approach may result in modification, transfer, addition, or deletion of some objectives put forth in an individual proposal. Specifics associated with the definition period will be addressed with the investigator at the time of selection.

Additionally, proposals submitted in response to HERO appendices that are found to have strong programmatic relevance and scientific merit, but that cannot be funded due to limited resources, may be forwarded to partner programs (e.g., Space Biology) or agencies (e.g., NSF) for consideration.

5. Selection Announcement and Award Dates

NASA’s goal is to announce selections within 150 days of the final proposal due date. In order to announce selection decisions as soon as is practical, even in the presence of budget uncertainties, the Selection Official may decide to defer selection decisions on some proposals while making selection decisions on others. If the Selection Official uses this option, then proposals will be designates as "selected", "not selected", "or not selected at this time". Proposals that are not selected at this time will be considered for a supplemental selection when circumstances allow (e.g., in the event funds become available). All proposers whose proposals are not selected at this time will eventually be notified whether their proposal is selected through a supplemental selection or is no longer being considered for a supplemental selection. Proposers will be notified via NSPIRES and offered a debriefing consistent with the policy in Appendix D of the NASA Guidebook for Proposers.

6. Ombudsman

A NASA ombudsman has been appointed to hear and facilitate the resolution of concerns from proposers during the pre-award and post-award phases of this solicitation. When requested, the ombudsman will maintain strict confidentiality as to the source of the concern. The existence of
the ombudsman is not to diminish the authority of the Selecting Official. Further, the ombudsman does not participate in the evaluation of the proposals, the source selection process, or the adjudication of formal disputes. Therefore, before consulting with an ombudsman, interested parties must first address their concerns, issues, disagreements, and/or recommendations to the contracting officer for resolution.

If resolution cannot be made by the contracting officer, interested parties may contact the installation ombudsman, Jose Garcia, 2101 NASA Parkway, Houston, TX, 77058, 281-483-4117, Email: jose.c.garcia@nasa.gov. Concerns, issues, disagreements, and recommendations that cannot be resolved at the installation level may be referred to the NASA ombudsman, Monica Manning, Assistant Administrator for Procurement, at 202-358-1050, Email: agency-procurementombudsman@nasa.gov. Please do not contact the ombudsman to request copies of the solicitation, verify due date, or clarify technical requirements. Such inquiries shall be directed to the contacting officer as specified in Section H of this document.

H. Research Resources

1. Current Research Portfolio for NASA

Investigators are encouraged to review summaries of currently funded NASA research by accessing the NASA Task Book at http://taskbook.nasaprs.com/peer_review/index.cfm. In order to achieve programmatic balance, specific topics that are currently well represented in the scope of NASA research may be de-emphasized.

2. Biomedical and Biological Data Archives

Access to NASA’s life sciences data can assist the research community in providing a better understanding of the appropriate strategies required to mitigate spaceflight-related health risks. These archives include data collected on the astronauts as part of medical evaluations and research studies and research data collected on ground test subjects, animal subjects, and plants.

Researchers who are awarded a grant may submit more detailed data requests for retrospective data. These requests are evaluated on a case-by-case basis. Astronaut data are preferentially provided in grouped or de-identified format; however, not all types of data can be de-identified. Identifiable (attributable) human medical and research data are only available with the informed consent of the astronaut. Please refer to the 2018 HRP Retrospective Data Request Guidelines for additional information and complete the 2018 HRP Retrospective Data Request Feasibility Assessment Form, both of which are included with this solicitation.

Research Data: Life Sciences Data Archive
The LSDA (https://lsda.jsc.nasa.gov/) is a publicly accessible archive of data from NASA-funded spaceflight, flight analog, and ground-based life sciences research experiments. This searchable database includes human (astronaut and ground test subject), animal, and plant studies conducted from 1958 to the present. It contains over 2,400 experiment descriptions, and non-attributable data for many investigations that can be downloaded directly from the Web site.
Additional information on and inquiries about the LSDA data can be made online at https://lsda.jsc.nasa.gov/Request/dataRequestFAQ or by email at jsc-lsda@mail.nasa.gov.

**Medical Data: Lifetime Surveillance of Astronaut Health**

The LSAH ([https://lsda.jsc.nasa.gov/LSAH/LSAH_Home](https://lsda.jsc.nasa.gov/LSAH/LSAH_Home)) is a proactive occupational surveillance program for the astronaut corps to screen and monitor astronauts for occupation-related injury or disease. The LSAH program examines the incidence of acute and chronic morbidity and mortality of astronauts, and defines the risks of morbidity and mortality associated with the occupational exposures encountered by astronauts. Data associated with the LSAH project includes clinical, mission, and occupational health information recorded throughout each astronaut’s career as a NASA astronaut or payload specialist and LSAH physical examinations of former astronauts after their retirement from the astronaut corps.

Limitations of the Data: The primary goal for collecting these data is for clinical purposes, rather than for a research study. The data content is driven by crew surgeon need for care of a patient. Therefore the data may contain numerous gaps, in contrast to a research data set. For example, the data may list outcome (e.g., “normal”) rather than a specific value; the data may not always be collected for each crewmember or at an expected time point, or the data may be taken under different circumstances (e.g., an astronaut returning on a Soyuz may have different types of tests or test dates than an astronaut returning on a Shuttle). Several types of clinical data (e.g., ultrasonography, WinSCAT, vision testing, MRI) require special qualifications to interpret, and thus research teams should include personnel with the requisite expertise before data can be released.

Information about the medical requirements (MR) for both short-duration and long-duration human spaceflight is available online at [https://lsda.jsc.nasa.gov/MRID](https://lsda.jsc.nasa.gov/MRID).

Additional information on the LSAH data and inquiries about the data can be made online at [https://lsda.jsc.nasa.gov/Request/dataRequestFAQ](https://lsda.jsc.nasa.gov/Request/dataRequestFAQ) or by email at jsc-lsda@mail.nasa.gov.

**GeneLab Database**

Omics experiments result in large data sets requiring special tools to interpret them. NASA has launched a data repository of omics data, derived from either spaceflight experiments or ground experiments, to tease out factors influencing life in space (e.g., ionizing radiation, acceleration, microgravity simulation). GeneLab is an open-science, collaborative project with the mission to maximize the science return from spaceflight and associated ground experiments. The heart of GeneLab open science is the GeneLab Data System (GLDS), which provides a publicly available bioinformatics platform to store, process, and gain new knowledge from omics data sets derived from these investigations. The GeneLab platform is critical for: storing and interpreting multi-omics data, providing omics processing pipelines, navigating through metadata describing experiments and flight conditions, and letting the community at large mine processed data to gain new knowledge about the impact of space on life.

As scientists use GeneLab workbench to visualize in silico biological changes in space, they can start articulating potential hypotheses and investigating them further by requesting access to the corresponding tissue archived at the LSDA for additional assay (e.g., histopathology, polymerase
chain reaction of specific genes, Western blot). To facilitate such investigations, GeneLab and LSDA have been collaborating closely to provide reciprocal links between metadata and corresponding archived tissues on their respective Web sites. For more information, please contact GeneLab at http://genelab.nasa.gov/.

3. Animal Biospecimen Sharing Program

Animal biospecimen sharing provides the scientific community with access to NASA’s inventory of biological materials from organisms that have flown in space and from related ground-control studies. For inquiries or questions visit the User’s Guide for Requesting NASA Data at https://lsda.jsc.nasa.gov/Request/dataRequestFAQ. Visit the LSDA Web site at https://lsda.jsc.nasa.gov/cf/scripts/biospecimens/bio_search_start_adv.cfm for specific information regarding which samples are still available, characteristics of each mission from which the samples were obtained, experimental conditions used to obtain and preserve the samples, and protocols (e.g., diet, light/dark cycle, housing, fixation of samples, storage).

4. Spaceflight Microbial Isolates

NASA scientists have continuously performed routine environmental monitoring of the air, surfaces, and water systems of the ISS. Surface sample collection began in 2000 (Expedition 1), air sample collection began in 2001 (Expedition 2), and water monitoring of the U.S. water potable system has occurred since the installation of the potable water dispenser in 2009. Samples are collected and enumerated during spaceflight operations. Identification of these isolates occurs on samples returned to the ground-based laboratory. For the purposes of this NRA, the NASA Microbiology Laboratory has several isolates, collected and identified during the microbial monitoring efforts, which are available for research evaluation. The organisms have been identified as either being collected from Air and Surface or the Potable Water Dispenser. Several types of microorganisms have been identified multiple times during sampling and are available for evaluation on a time course indicated as early, middle, and late in the life of the ISS. The complete list may be found at https://lsda.jsc.nasa.gov/scripts/experiment/exper.aspx?exp_index=13823.

5. Flight Capabilities

The HRP Flight Experiment Information Package (http://nspires.nasaprs.com/external/) provides detailed information on flight capabilities and constraints as well as a description of the unique aspects of the evaluation and selection process for flight experiments.

A comprehensive list of research facilities on board the ISS may be found at (http://www.nasa.gov/mission_pages/station/research/facilities_category.html).

Proposals that require spaceflight equipment, facilities, or other resources that are not identified in this NRA or in the accompanying HRP Flight Experiment Information Package will have a lower priority for selection.
6. Radiation Capabilities

The NASA Space Radiation Laboratory (NSRL) is an irradiation facility capable of supplying particles from protons to gold with primary energies in the range of 50-2500 MeV for protons and 50-1100 MeV/n for high-mass, high-energy (HZE) particles. NASA plans to operate the NSRL for approximately 900 hours per year; selection of beam species and energies for experimental periods will be made by NASA officials in consultation with scientists proposing experiments for these beams. Activities at the NSRL are a joint effort of Brookhaven National Laboratory’s Collider-Accelerator Department, providing accelerated particle beams, and the Biosciences Department, providing experimental area support, animal care, and cell and biology laboratories. The NSRL includes irradiation stations, beam controls, and laboratory facilities required for most radiobiological investigations. Additional information about NSRL may be found at http://www.bnl.gov/medical/nasa/nsrl_description.asp.

Investigators wishing to utilize other facilities besides NSRL must provide a detailed justification for their use and must include certification that use of those facilities will be at no cost to NASA. An exception to this, is the utilization of the Colorado State University low dose rate neutron facility where additional costs may be incurred. Additional information about the low dose rate neutron facility may found at https://three.jsc.nasa.gov under “IN THE NEWS – JULY 2018.” Gamma-rays (Cs or Co) should be used as the reference radiation for studies. Significant justification needs to be provided to use X-rays with energies below 300 peak kilovoltage (kVp) as a reference radiation. Gamma controls must be completed at BNL for comparison with heavy charged particles, in particular for the calculation of relative biological effectiveness (RBE).

7. Behavioral Health and Performance Laboratory

Mission and Expertise

The Behavioral Health & Performance (BHP) Laboratory at JSC serves three main functions: (1) Conduct original multidisciplinary research on individual and team behavioral health, performance, and biopsychosocial adaptation over time in isolated, confined, and extreme operational environments, (2) Contribute behavioral science and operational research expertise on projects relevant to NASA’s mission, and (3) Provide contract services for on-site technical support of projects conducted at JSC or other NASA and International Partner facilities.

The BHP Lab team has a broad range of expertise within the behavioral sciences including experimental psychology, industrial/organizational psychology, health psychology, clinical psychology, behavioral and cognitive neuroscience, comparative psychology, psychiatry, psychometrics, and operational performance assessment. The BHP Lab’s members have extensive experience conducting applied research in laboratory, field, and operational settings, including Isolated, Confined, and Controlled (ICC) habitats, Isolated, Confined, and Extreme (ICE) environments, and in spaceflight itself.
Resources

The BHP Laboratory is housed within JSC’s Human Health and Performance Laboratory (Building 21) as part of the Biomedical Research and Environment Sciences Division, with full access to the facility’s 118,000 square feet of laboratory, bioanalytical, human performance testing, flexible high-bay space, and biological sample storage resources.

The BHP Lab maintains a core set of equipment and technical capabilities, including laptop and desktop computers (Windows, Mac, and Linux available by request), iPad tablets, actigraphy watches (sleep/wake/activity monitoring), physiological monitors (cardiovascular, proximity, and speech intensity), audio and high definition video recording, a dedicated -80°C freezer, Qualtrics subscription (for secure online survey administration), telecommunications tools, and various software packages for data management/analysis and document preparation.

The BHP Laboratory also maintains a set of BHP Standard Measures, including objective tasks, wearable devices, and self-reports quantifying a wide range of individual and team behavioral health and performance outcomes. BHP Standard Measures protocols are being implemented on the ISS, JSC’s Human Exploration Research Analog (HERA) facility, the Scientific International Research In a Unique terrestrial Station (SIRIUS) habitat in Moscow, and Neumayer Station in Antarctica. Investigators proposing to use ISS, HERA, or SIRIUS for their studies may obtain concurrently collected BHP Standard Measures data via a data sharing agreement with the BHP Lab at no additional cost. The BHP Standard Measures suite also may be made available to Investigators for data collection in other laboratory, field, and operational settings within or outside of NASA.

The full NASA Behavioral Health and Performance Standard Measures suite currently includes the following:

- Cognition
  - Computerized battery of 10 cognitive, neurobehavioral, and sensorimotor tests
- Robotics Onboard Trainer-Research (ROBoT-R)
  - Computerized research adaptation of the ROBoT-R as performance assessment with ISS robotic arm grapple/capture operational task
- Actigraphy
  - Philips Actiwatch wrist-worn device measuring sleep-wake patterns, light exposure, and physical activity/workload
- Sociometric Badges
  - Lanyard-worn device, behavioral ecology measure of interpersonal proximity, frequency/duration of dyadic interactions, and speech intensity
- Self-Report Measures
  - Beck Depression Inventory II
  - Profile of Mood States—Short Form
  - IPIP-NEO-120 Personality
  - Social Desirability Scale (SDS-17)
  - Demographics
- Age, gender, education/field, years of expertise, military experience, other analog/ICE/spaceflight experience, team work experience, exercise habits, relationship status
  - Caffeine and Medication Usage
  - Sleep Diary
    - Self-report ratings of sleep quantity, quality, and disruption
  - Visual Analog Scales (VAS)
    - Self-report ratings of workload, stress, fatigue, and conflict
  - Team Cohesion
    - Perceived team task and social cohesion
  - Team Performance
    - Perceived team performance effectiveness
  - Team Processes
    - Perceived team effectiveness in Mission Analysis, Goal Specification, Strategy and Planning, Monitor Progress, Monitor Resources, Cooperation (backup behavior), Communication, Coordination, Conflict Management, Encouragement, Emotional Balance
  - Team Climate
    - Seven-item Psychological Safety subscale
  - Social Support
    - Six-item Enhancing Recovery in Coronary Heart Disease (ENRICHD) Social Support
  - Group Living
    - Rating of self and crew mates: Appropriate use of humor; appreciate others’ knowledge, skills, and abilities; clean and tidy with personal items; clean and tidy with work items; considerate of others’ preferences; willingness to do another mission with them. Includes free-form text entry.

**Working With the NASA Behavioral Health & Performance Laboratory**

Investigators who wish to include BHP Laboratory resources in a project are encouraged to contact the BHP Lab early in the planning process to assess project needs, BHP Lab availability, and adequacy of resources. The BHP Lab supports data-sharing agreements of BHP Standard Measures data with Investigators conducting protocols concurrently run with BHP Standard Measures. This service and related letters of commitment for proposals may be provided at no additional cost to the recipient Investigator. Participation in active scientific collaborations or contracted technical services agreements is subject to fully burdened labor rates through JSC as the participating organization. For additional information or to coordinate the inclusion of the BHP Lab resources into a project, please contact BHP Lab Director, Dr. Pete Roma (pete.roma@nasa.gov).

**8. Analog Capabilities**

Proposers who require the use of any of the analogs listed below (a-e) should fill out the Analog Study Resource Worksheet ([http://nspires.nasaprs.com/external/](http://nspires.nasaprs.com/external/)) and include the
worksheet as part of their proposal upload.

**a. Human Exploration Research Analog**

The NASA Analogs Web site ([https://www.nasa.gov/analogs/hera/about](https://www.nasa.gov/analogs/hera/about)) provides detailed information on the capabilities of the Human Exploration Research Analog (HERA). This habitat is located on site at JSC and is housed in building 220. The HERA is a two-story, four-port habitat unit. It is cylindrical with a vertical axis, and connects to a simulated airlock and hygiene module. Currently, the HERA represents an analog for simulation of isolation, confinement, and remote conditions of mission exploration scenarios. Studies suitable for this analog may include, but are not limited to, behavioral health and performance assessments, communication and autonomy studies, human factors evaluations, and exploration medical capabilities assessments and operations. Proposals that require resources beyond those described on the Web site (i.e., experiment-unique resources) should include adequate budget for those resources. All Step-2 proposers wishing to use the HERA should fill out the Analog Study Resource Worksheet posted alongside this NRA ([http://nspires.nasaprs.com/external/](http://nspires.nasaprs.com/external/)).

**b. Exercise Countermeasures Laboratory**

The Exercise Countermeasures Laboratory (ECL, [https://hrp.grc.nasa.gov/explore/human-health-countermeasures/exercise-countermeasures/](https://hrp.grc.nasa.gov/explore/human-health-countermeasures/exercise-countermeasures/)) at NASA Glenn Research Center (GRC) is a ground-based test bed that provides high-fidelity weightlessness, lunar (1/6g), and Martian (1/3g) human-in-the-loop exercise simulations for developing exercise countermeasure devices, equipment, and exercise protocols for spaceflight, and quantifying the physiological demands of performing exercise in a shirtsleeve environment. The enhanced Zero-g Locomotion Simulator (eZLS) exercise platform orients human test subjects horizontally, such that they exercise in simulated zero-g (oriented 90 degrees relative to the gravity vector) against a three-degree-of-freedom air-bearing exercise simulator that allows frictionless translation and rotation. The test subjects are suspended in this supine orientation from a motorized system of bungees for weightlessness locomotion or exercise simulation, or at the appropriate pitch angle for whole-body partial gravity simulations. Kick load assessments, sensorimotor challenges, and lower and upper body kinematics can all be assessed in this way in simulated zero-g, without the time limitations of parabolas on parabolic flight. A subject load device (SLD) interface provides gravity-replacement loads via Series Bungee System bungees, or a near-constant force pneumatic SLD whereby load is proportional to system pressure. Both are used to provide gravity-replacement loads at the desired levels, similar to the ISS T2 Treadmill. The current data acquisition user interface is programmed in LabVIEW and is set up to continuously monitor foot forces under treadmill belt, in-line SLD force, accelerations, displacements, heart rate, and treadmill speed. The laboratory uses a BTS Bioengineering motion capture system (SMART-DX500) to analyze human movement, either while in the eZLS or on the ground. Wireless electromyography data, wearable accelerometry, and force plates are available for a full suite of biomechanical analysis and operational volume capability. Test protocols are conducted under approval of the JSC IRB, and the PI’s host institution IRB. Medical monitoring is provided at Level 3 ([http://irb.nasa.gov](http://irb.nasa.gov)). Recent human-in-the-loop test protocols include medical station analysis for a habitat design, operational volume analysis and imparted loads characterization for compact exploration exercise devices, development of the ISS T2 Treadmill harness and
evaluation of the T2 treadmill vibration isolation system with NASA JSC and Boeing; a kinematic and electromyographic study comparing gait parameters and muscle-activation patterns during treadmill running in the eZLS, 1g upright, and in parabolic flight; lunar-gravity locomotion studies and Daily Load Stimulus characterizations during various lunar tasks; evaluations of compact advanced exercise equipment, compact subject load devices, sensorimotor balance challenge countermeasures; and development of wireless biometric sensors that have also been evaluated in parabolic flight.

The ECL boasts a cadre of talented and dedicated engineers and scientists who bring knowledge of spaceflight payloads, flight analog and ground research, and technology development, and are truly collaborative.

More detailed information is available by contacting the GRC ECL Manager, Scott Bleisath, Email: scott.a.bleisath@nasa.gov.

c. Human Exploration Spacecraft Testbed for Integration Advancement

The 20-Foot Chamber at JSC is a ground-based space habitat analog capable of providing a fully closed environment for human testing. It can establish, maintain, and control internal temperature, atmospheric pressure, oxygen concentration, carbon dioxide concentration, and trace gas contaminants for extended periods (days to weeks to months, 24/7). The facility is man-rated for long-duration human testing and is staffed with a qualified and highly experienced team of test directors, engineers, and technicians. Manned (or unmanned) test processes are well established and supported for continuous improvement.

The testbed is a 6.1-m-diameter by 8.4-m-high altitude chamber with three interior levels and two airlocks for controlled access during test. Total volume is 229 m³. Data collection and archiving are available, as are high-speed fiber-optic lines for linkage to other local and remote facilities.

More detailed information is available by contacting the JSC, Crew and Thermal Systems Division Chief Technologist, Donald L. Henninger, Ph.D., Email: donald.l.henninger@nasa.gov.

d. Parabolic Aircraft Flight

For experiments that require use of parabolic flight, NASA will identify and fund an appropriate parabolic flight platform. Investigators should plan on coordinating flights with a commercial provider with assistance from a liaison at NASA if an award is issued. Proposers should budget for travel and experiment support at the testing site.

e. Suborbital Capabilities

The payloads to be flown on suborbital reusable launch vehicle (sRLV) flights must be either automated or remotely operated. Remote operation capability should be confirmed with the flight operator. Suborbital spaceflight opportunities are expected to be available during the lifetime of selected proposals from this solicitation. They may provide longer—but still brief—exposure to
weightlessness and other spaceflight conditions than parabolic aircraft flights. Suborbital flight opportunities are described at:
https://www.nasa.gov/directorates/spacetech/flightopportunities/index.html

Suborbital reusable launch vehicle flights make possible a new generation of research by providing frequent access to a new region of space heretofore unexplored, with user-friendly gravitational loads in a pressurized, temperature-controlled environment and payload accommodation from 1 to 100 kg, soda-can-sized to human-sized. Short-duration flights will permit researchers to access payloads both before and after flight.

For a typical suborbital flight, the vehicle will accelerate briefly using rocket propulsion to achieve high vertical velocity. When the vehicle is above the sensible atmosphere, it will follow a typical ballistic arc, providing reduced gravity for about four minutes, then will decelerate on reentry into the atmosphere. Landing on Earth may use some or all of winged flight, parachutes, and rocket propulsion. Proposals to employ suborbital flights must make a strong case that the use of that modality is necessary to meet NASA’s objectives of reducing the human risks of space exploration.

I. Bibliography

The Human Research Program Requirements Document is available online at: https://www.nasa.gov/hrp/research/announcements

The Human Research Program Human Research Roadmap is available online at: http://humanresearchroadmap.nasa.gov

The Human Research Program Evidence Book is available online at: http://humanresearchroadmap.nasa.gov/evidence/

The Human Research Program Task Book is available online at: http://taskbook.nasaprs.com/peer_review/index.cfm

NASA Life Sciences Data Archive (LSDA) is an online database containing descriptions and results of completed NASA-sponsored flight experiments. Descriptions are included of experiments, missions, procedures, hardware, bio-specimens collected, personnel, and documents. The LSDA is available online at: https://lsda.jsc.nasa.gov/

Medical Requirements Integration Document (MRID) defines integration activities to support the medical requirements (MR) for both short-duration and long-duration human spaceflight for the Space Shuttle and International Space Station (ISS) programs. The MRID is available online at: https://lsda.jsc.nasa.gov/MRID

Guidebook for Proposers Responding to a NASA Research Announcement (NRA) is available online at: http://www.hq.nasa.gov/office/procurement/nraguidebook/
NASA Federal Acquisition Regulations Supplement Instructions for Responding to NASA Research Announcements is available online at the following address: https://www.hq.nasa.gov/office/procurement/regs/NFS.pdf

Standard Format for NASA Research Announcements (NRAs) and other Announcements for Grants and Cooperative Agreements are available online at: https://nods3.gsfc.nasa.gov/npg_img/N_PR_5810_001A_/N_PR_5810_001A_.pdf

NASA Grant and Cooperative Agreement Manual is available online at: https://prod.nais.nasa.gov/pub/pub_library/Grant_and_CooperativeAgreementManual.doc

HRP Flight Experiment Information Package is available online at: http://nspires.nasaprs.com/external/

Safe Passage, Astronaut Care for Exploration. Institute of Medicine, National Academy Press, 2101 Constitution Avenue NW, Washington DC 20418 (2001). This document is available online at: https://www.nap.edu/catalog/10218/safe-passage-astronaut-care-for-exploration-missions


J. NASA Contact

NASA Selecting Official: HRP Program Director or his designee

Additional technical information for the NASA programs is available from:
  Jennifer Fogarty, Ph.D.
  Chief Scientist, Human Research Program
  NASA Johnson Space Center (Mail Code SA2)
  Houston, TX 77058
  Telephone: 281-483-9753
  Fax: 281-483-6089
  Email: jennifer.fogarty-1@nasa.gov

JSC Procurement Point of Contact:
  Sophia Mo
  Contracting Officer
  NASA Johnson Space Center (Mail Code BH4)
  Houston, TX 77058
  Telephone: 281-792-7877
  Fax: 281-483-7890
  Email: sophia.mo@nasa.gov
K. List of Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tr>
<td>AOR</td>
<td>Authorized Organizational Representative</td>
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<td>kVp</td>
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<tr>
<td>TRISH</td>
<td>Translational Research Institute for Space Health</td>
</tr>
<tr>
<td>U.S.</td>
<td>United States</td>
</tr>
<tr>
<td>VAS</td>
<td>Visual Analog Scales</td>
</tr>
<tr>
<td>VASR</td>
<td>Vertebrate Animal Scientific Review</td>
</tr>
<tr>
<td>VNSCOR</td>
<td>Virtual NASA Specialized Center of Research</td>
</tr>
<tr>
<td>WinSCAT</td>
<td>Spaceflight Cognitive Assessment Tool for Windows</td>
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