

C.23 INTERDISCIPLINARY CONSORTIA FOR ASTROBIOLOGY RESEARCH

NOTICE: Amended on March 30, 2020. This amendment delays the Step-2 proposal due date for this program element to May 15, 2020

~~Amended on March 17, 2020. This amendment delays the Step-2 proposal due date for this program element to April 17, 2020~~

Amended November 25, 2019. This amendment releases final text for this program element.

This program element uses a two-step proposal submission process, described in Section 2 of C.1 The Planetary Science Division Research Program Overview.

Participants on awards selected via this program element will become members of the newly established Astrobiology Program Research Coordination Networks that are relevant to their selected research. For more information about these networks, see Section 2.12 of this program element.

This program element differs from the default in ROSES and/or [C.1 The Planetary Science Research Program Overview](#) in a number of ways. Please See Section 2 for a list of program specific requirements.

1. Introduction and Scope of Program

The goal of the NASA's Astrobiology program is the study of the origins, evolution, and distribution of life in the Universe. It is central to NASA's continued exploration of our Solar System and beyond. Research is centered on the origin and early evolution of life, the potential of life to adapt to different environments, and the implications for life elsewhere. NASA, together with the science community, has developed the 2015 Astrobiology Strategy that describes the scientific goals and objectives of NASA's Astrobiology Program (see <https://astrobiology.nasa.gov/research/astrobiology-at-nasa/astrobiology-strategy/>).

A wide array of NASA Science Mission Directorate (SMD) flight missions incorporate astrobiology goals and objectives. For this reason, with this program element NASA is seeking proposals responding to both the long-term goals and objectives identified in the Astrobiology Strategy and focused on ensuring that the NASA Astrobiology community is prepared to respond to the challenge of planning and implementing these missions. Accordingly, proposals that place emphasis on research that will help prepare for current or future flight programs directed at astrobiological targets are encouraged.

Proposals for Interdisciplinary Consortia for Astrobiology Research (ICAR) must describe an interdisciplinary approach to a single compelling question in astrobiology, and address at least one aspect of the 2015 Science Strategy. Team size and resources requested should be appropriate to the scale of the proposed research. There is no ideal size of an ICAR Team. Because this is an opportunity for larger teams and for five years of support, the scope of the research, and subsequently the resources needed, should exceed those typically considered in a Research Opportunities in Space and Earth Sciences (ROSES) program element (e.g., Exobiology, Habitable Worlds).

NASA's Astrobiology Program (see <http://astrobiology.nasa.gov/>) is managed within the Science Mission Directorate (SMD) at NASA Headquarters (HQ) and supports awards for individual investigator research, instrument and technology development and testing. More information on the strategic priorities and research/technology investments of the SMD can be found in the 2014 Science Plan for NASA's Science Mission Directorate, available at <http://science.nasa.gov/about-us/science-strategy/>.

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. Critical steps must be taken to broaden the participation of underrepresented groups and institutions serving minority students in NASA activities. The following web page from the Office of Civil Rights, U.S. Department of Education links to lists of institutions of higher education enrolling populations with significant percentages of undergraduate minority students, or that serve certain populations of minority students:

<https://www2.ed.gov/about/offices/list/ocr/edlite-minorityinst.html>

The Astrobiology Program is committed to increasing the participation of underrepresented groups in its activities, and it strongly encourages their participation as Lead or Co-Institutions.

1.1 Research Coordination Networks

The areas of research emphasis in this program element are linked to three of the five astrobiology research coordination networks (RCN) and are as follows:

- **Habitability and Detection of Life on Exoplanets**

Research in this area seeks to accelerate the discovery and characterization of other potentially life-bearing worlds in the galaxy, using a systems science approach. Topics of interest include the investigation of the diversity of exoplanets including how their history, geology, dynamical processes, stellar radiation, and climate interact to create the conditions for life. Investigations that study Earth and/or other planetary bodies in our Solar System as coupled atmosphere-hydrosphere-cryosphere-geosphere-biosphere (Earth) systems, that study the properties of the Sun (and other stars) and how they interact with the magnetic fields, affect atmospheric chemistry and climates of their orbiting planets, or that seek to understand the underlining planetary processes that are responsible for the fidelity, resilience or detectability of biosignatures are encouraged. Research aimed exclusively at collecting data that reveals the diversity of planets in the galaxy and the properties of their host stars should be submitted to the Exoplanet Research Program (E.3). Proposals aimed exclusively at the identification and characterization of radio signals from extrasolar planets that may harbor intelligent life are not solicited at this time. Research focused on defining, understanding or characterizing "technosignatures" as specific types of biosignatures indicative of intelligent life are included in this area; however, proposals to search for technosignatures are not included.

- Prebiotic Chemistry in Early Earth Environments

Research in this area seeks to delineate the planetary and molecular processes that set the physical and chemical conditions within which living systems may have arisen. Topics of interest include the formation of complex organic molecules in space and their delivery to planetary surfaces; models of early environments in which organic chemical synthesis could occur; the forms in which prebiotic organic matter has been preserved in planetary materials; determining what chemical systems could have served as precursors of metabolic and replicating systems on Earth and elsewhere, including alternatives to the current DNA-RNA-protein basis for life; and the range of planetary environments amenable to life. Emphasis is placed on studies that constrain or extend concepts of possible chemical evolution relevant to the origin, evolution, and distribution of life. Studies of sites thought to be analogues to the early Earth or other planetary environments that might potentially harbor life will be considered as part of NASA's broader interest in the search for life in the Universe. Laboratory and theoretical studies, as well as related data-analysis, will be considered.

- Primitive Cells to Multicellularity

The goal of research into the early evolution of life is to determine the nature of the most primitive organisms, the environment in which they evolved, evolution of the earliest metabolism, and the origin of advanced life. Target investigations include but are not limited to: i) determining when and in what setting life first appeared and the characteristics of the first successful living organisms; ii) understanding the phylogeny and physiology of microorganisms, including extremophiles, whose characteristics may reflect the nature of primitive environments; iii) determining the original nature of biological energy transduction, membrane function, and information processing, including the construction of artificial chemical systems to test hypotheses regarding the original nature of key biological processes; iv) investigating the development of key biological processes and their environmental impact; v) examining the response of Earth's biosphere to extraterrestrial events; vi) investigating the evolution of genes, pathways, and microbial species subject to long-term environmental change relevant to the origin of life on Earth and the search for life elsewhere; vii) studying the coevolution of microbial communities, and the interactions within such communities, that drive major geochemical cycles, including the processes through which new species are added to extant communities; and viii) studying the origin and early evolution of those biological factors that are essential to multicellular life, such as developmental programs, intercellular signaling, programmed cell death, the cytoskeleton, and cellular adhesion control and differentiation, in the context of the origin of advanced life.

Acknowledging the potential overlap between the topics listed above and those in other program elements (e.g. XRP, or Exobiology), it is necessary that proposers use the relevance statement (see Section 2.5) to explain why the topic and/or scope would not be appropriate for any other ROSES element.

2. Programmatic Information

Proposals are sought for new projects within the scope of the Astrobiology program. Proposals submitted in response to this program element must be for work that is not currently supported or for investigations that would extend to their next logical phase

those tasks that have been funded in the Astrobiology program, but with periods of performance that expired in the last year or are expiring in the next half-year.

Although there is a place in the program for exploration of novel and relevant environments, selection preference will be given to hypothesis-driven research projects.

This program element differs from the default in ROSES and or [C.1 The Planetary Science Research Program Overview](#) in a number of ways. Proposers should be aware that:

- There is a required Relevance Statement collected on the NSPIRES cover page (see Section 2.5)
- The ban on adding team members between Step-1 and Step-2 is more restrictive than the default rules in C.1 (see Sections 4.1 & 4.3)
- The constituent parts of the proposal and their page limits differ from the ROSES default (see Table 1 in Section 4.3) and
- The evaluation criteria differ from the default (see Section 5).

2.1 Program Exclusions

The following restrictions apply to proposals submitted to this program element:

- Research aimed exclusively at collecting data that reveals the diversity of planets in the galaxy and the properties of their host stars should be submitted to the Exoplanet Research Program (E.3).
- Proposals aimed exclusively at the identification and characterization of radio signals from extrasolar planets that may harbor intelligent life are not solicited at this time.
- This program does not accept proposals for work in Antarctica.
- This program element does not request proposals for the development of advanced instrument concepts and technologies as precursors to astrobiology flight instruments. Such proposals should be submitted to the Planetary Instrument Concepts for the Advancement of Solar System Observations (PICASSO; see program element C.12) Program (for technology readiness levels [TRLs] 1-3+) or the Maturation of Instruments for Solar System Exploration (MatISSE; see program element C.13) Program (for TRLs 4-6).
- Proposals for science-driven field campaigns that are expected to produce new science results, as well as new operational or technological capabilities, should be submitted to the Planetary Science and Technology from Analog Research (PSTAR) program (see program element C.14).
- The ICAR program does not accept proposals for topical conferences, workshops, or symposia; such proposals may be submitted in response to program element E.2 Topical Workshops, Symposia, and Conferences. Proposers should specifically identify the ICAR program as the relevant SMD program element and refer to the goals and objectives of the ICAR program in demonstrating relevance.

2.2 Additional Funding for Relevant Instrumentation Construction or Upgrade

Proposers to ICAR are eligible to request funds for major equipment under the Planetary Major Equipment and Facilities (PMEF) program. See program element C.17

for information on how to append a PMEF request to a regular ICAR research proposal or submit a stand-alone PMEF proposal to supplement an existing ICAR award.

2.3 NASA Postdoctoral Program Fellows

PIs and Co-Is on awards from this program are eligible to serve as mentors to NASA Postdoctoral Program (NPP) Fellows. The tenure of a Fellow must begin no later than two years before the end of the ICAR award but may extend beyond it. Proposals from potential Fellows must be submitted through the standard NPP process. The Astrobiology Program expects to select no more than three Fellows associated with ICAR research this year. More information about the NASA Postdoctoral Program may be found at <http://npp.usra.edu/>.

2.4 Planetary Science Division Early Career Award Program

Details of the new Planetary Science Early Career Award (ECA) program are given in program element C.19. The aim of this program is to support research and professional development of outstanding early-career scientists, and to help stimulate research careers in areas supported by the Planetary Sciences Division. This program is an ECA-participating ROSES program element. Proposals from eligible PIs, or Science PIs if applicable, selected from this program in 2020 may become the 'parent award' for future ECA proposals (i.e., in 2021 or later).

2.5 Relevance Statement Requirement

Proposals must discuss relevance to this program element in a (4000-character max) text box on the cover pages via the NSPIRES web interface for this program element. This statement is outside of the 25-page Research Plan and the relocation of the relevance discussion does not decrease that 25-page limit. This requirement supersedes the *NASA Guidebook for Proposers* and the *ROSES Summary of Solicitation*, and the omission of this statement is sufficient reason for a proposal to be returned without review.

The relevance discussion must explicitly refer to the section of this program element to which the proposal is responsive. The relevance discussion must identify the RCN(s) to which the proposed research is most closely related and include how the proposed research will contribute to the goals of that RCN. If the proposed work is close in scope to research covered by any other program element, this discussion must also justify why it is more relevant to this program element than that other program element. This discussion may not be used to address the proposal's intrinsic merit, budget justification, or any other factor that remains in the 25-page main body, or any other section, of the proposal.

2.6 Research Coordination Networks (RCNs)

PIs of proposals selected for funding from this program element that cover a research topic related to the newly established Research Coordination Networks will become members of the Steering Committees of these RCNs (For more information, see: <https://astrobiology.nasa.gov/news/astrobiology-program-faqs/>). Relevance to an RCN is an evaluation criterion for proposals to this program element, and eligibility for participation in an RCN does not indicate that additional research funding will be provided. However, PIs will be expected to attend one in person steering committee

meeting a year and a PI meeting for all RCN PIs. The proposal should include a request for funding to cover this travel. The currently active RCNs are:

- NExSS (Nexus for Exoplanet System Science): a research coordination network that brings together scientists from many disciplines to investigate the diversity of exoplanets and to learn how their history, geology, and climate interact to create the conditions for life. (For more information see <https://nexss.info/>.)
- PCE3 (Prebiotic Chemistry and Early Earth Environments): a research coordination network that brings together those interested in how to investigate the delivery, synthesis, and fate of small molecules under the conditions of the Early Earth, and the subsequent formation of proto-biological molecules and pathways that lead to systems harboring the potential for life. (For more information see <http://prebioticchem.info/>)
- FECM (From Early Cells to Multicellularity): members of this RCN will investigate the earliest biological processes and the evolution of life on Earth into more complex organisms up to the advent of multicellularity.

Information about the additional RCNs that are being established can be found here: <https://astrobiology.nasa.gov/news/how-many-astrobiology-research-coordination-networks-will-be-established/>

2.7 Award Type and Funding Information

Proposals to ICAR will have a nominal five-year period of performance and are expected to start in the third quarter of calendar year 2020. It is anticipated that \$5-7M will be available for this selection in the first award year, leading to five to ten awards, each of five years duration. If the appropriated funds available are less than anticipated, then fewer awards may be made. It is also anticipated that the same amount of funding as the first year will be available in the subsequent award years. Annual funding allotments after the first award year will be provided only after the submission of an acceptable progress report (see Section 6.3). Note that all funding awards are contingent upon the availability of appropriated funds.

3. Resources: Information, Data, and Facilities

3.1 Limits on Use of Mission Data

Proposals to this program element must follow the rules for use of mission data given in section 3.4 of C.1, the Planetary Science Research Program Overview. If the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome.

3.2 Facilities and Data Sources Available to Proposers

Refer to section 4 of C.1, the Planetary Science Research Program Overview, for a detailed list of the data and astromaterials resources, and facilities available to proposers to this program element, and how to use them. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

3.3 Data Management Plans (DMPs)

Proposals submitted to this program element must include a Data Management Plan (see C.1, Section 3.6), and since samples are an important component of ICAR Research, please discuss both data and sample management as part of the Data Management Plan. This must be placed in a special section, not to exceed two pages in length, immediately following the References and Citations section for the Scientific/Technical/Management portion of the proposal. These two pages are not considered part of the 25-page limit for the Research Plan portion of the proposal.

3.3.1 Other research material sharing, registration and curation

Sharing of valuable sample material is highly encouraged. Investigators are expected to share with other researchers, at no more than incidental cost and within a reasonable time, samples, physical collections, and other supporting materials created or gathered in the course of work under NASA agreements. Teams are expected to encourage and facilitate such sharing.

Nonbiological samples collected during the conduct of research funded by NASA will be registered in SESAR, the System for Earth Sample Registration, as a first step towards sample curation and sharing.

SESAR operates the registry that distributes the International Geo Sample Number IGSN. SESAR catalogs and preserves sample metadata profiles, and provides access to the sample catalog via the Global Sample Search. For more information see <http://www.geosamples.org/>.

3.3.2 Biological Samples

Academic, private, and community facilities have traditionally been sites where biological materials are curated. Not all material can (or should) be accommodated in these facilities. PIs should archive voucher and type specimens as dictated by community standards and practices, as required by journals for publication, and as appropriate to support research results.

3.4 Geologic Maps

Proposers who plan investigations involving geologic mapping should consult C.1, Section 3.8, for guidance on submission and requirements for publication of U.S. Geological Survey (USGS) maps. The scientific goal of such a geologic map product should be clearly explained and justified.

4. Proposal Submission and Content

4.1 Two-Step Submission Process

This program element will use a two-step proposal submission process. A 5-page Step-1 proposal is required and must be submitted electronically by the Step-1 due date in Tables [2](#) and [3](#). The Step-1 proposal must be submitted by the organization's Authorized Organizational Representative (AOR). Only proposers who submit a Step-1 proposal are eligible to submit a full Step-2 proposal. 25-page Step-2 proposals must contain the same title, scientific goals and Principal Investigator as those in the Step-1 proposal. No team members may be added between Step-1 and Step-2. Format and

compliance evaluation criteria are described below. Submission of the Step-1 proposal does not obligate the offerors to submit a Step-2 proposal.

4.2 Step-1 Proposal Content

The content of Step-1 proposal must be uploaded as a PDF file in NSPIRES. In addition to the Principal Investigator, proposers are reminded that they must have the team assembled with the proposal at Step-1 (if you are not familiar with this process in NSPIRES please refer to [the walkthrough from the SARA web page](#)). The Step-1 proposal shall contain a scientific and technical section, not to exceed 5 pages, that begins with the title of the proposed investigation and describes:

- a. A compelling question in astrobiology that will be the focus of the proposed research program;
- b. A description of the importance of the research program and its relevance to the goals of the Astrobiology Program as contained in the 2015 Astrobiology Strategy <https://astrobiology.nasa.gov/research/astrobiology-at-nasa/astrobiology-strategy/>;
- c. A description of the research approach, including a discussion of how each investigation in the proposed research is necessary and how it will be integrated into an interdisciplinary investigation; and
- d. A description of how the proposed research complements the research goals covered by one or more of the RCNs described in Section 2.6.

Please note that the NSPIRES system for proposal submission requires a very brief summary to be entered into the Proposal Summary field and a Proposal Attachment, which should be a single PDF file of the science and technical section of the Step-1 proposal. Evaluation criteria for Step-1 proposals can be found in Section 5.1.

4.3 Step-2 Proposal Submission and Content

A budget and other specified information is required. The Step-2 proposal title, scientific goals and Principal Investigator must be the same as those in the Step-1 proposal. No team members may be added between Step-1 and Step-2.

All Step-2 proposals must include the following materials in the following order and using the titles as given. Details for each item are given in Section 7.

Content for Step-2 (full) proposals are specified in this document and supercede default instructions in the *ROSES Summary of Solicitation* and the [Planetary Science Research Program Overview](#).

Table 1 Constituent Parts of the Proposal

	<u>PAGE LIMITS</u>
Step-2 Proposal <i>Cover Page/Proposal Summary</i>	As per NSPIRES
Step-2 Proposal Title Page (optional)	1
Table of Contents	1
Executive Summary	3
Summary of Personnel and Commitments	As needed
Research Plan	25*
Science Management Plan	4

Data Management Plan	2
References	As needed
Facilities and Equipment (as appropriate)	5
Curriculum Vitae	For the PI: 3
	For each Co-I: 1
Current and Pending Support	As needed
Statement(s) of Commitment from Co-Is and/or Collaborators	As needed
Budget Summary and Details	As needed
Total Budget File (separate PDF)	As needed
HEC request form (optional separate PDF)	As per RMS system

* Including illustrations, tables, figures, and foldouts.

5. Evaluation Criteria

5.1 Step-1 Evaluation Process and Criteria

Step-1 proposals will not be peer reviewed. They will be evaluated by the Astrobiology Senior Scientist, the Astrobiology Deputy Program Scientist, and the Lead of the Planetary Science Research and Analysis Program. Feedback will be provided to the proposers via NSPIRES.

The four criteria for evaluation of Step-1 proposals are:

1. The compelling nature of the focus of the proposed research program and the appropriateness of its scope.
2. The relevance of the proposed research program to the goals of the Astrobiology Program, as contained in the 2015 Astrobiology Strategy.
3. The degree of interdisciplinarity of the proposed research program.
4. The extent to which the proposed research program addresses the research goals of the RCNs identified above.

Based on evaluations of the Step-1 proposals, Step-2 proposals will be categorized as either Encouraged or Discouraged and the proposer will be notified electronically via NSPIRES. Step-2 proposals may still be submitted even if Discouraged.

5.2 Step-2 Evaluation Process and Criteria

Step-2 proposals shall be evaluated by a peer review panel.

The five criteria for evaluation of Step-2 proposals are:

1. Merit of the Research Plan
2. Merit of the Science Management Plan
3. Merit of the Data and Sample Management Plan
4. Relevance to ICAR
5. Cost Reasonableness

Successful proposals must score highly on the first four evaluation criteria to be a high priority for Selection. Selection is expected to be highly competitive.

5.2.1 *Scientific/Technical Merit of the Proposed Research*

This criterion addresses the scientific and technical merit of the proposed astrobiology research program with respect to the goals and objectives in the 2015 Astrobiology Strategy. Particular emphasis will be placed upon innovative and interdisciplinary approaches to fulfilling research objectives.

Specifically, this criterion addresses the:

- Expected significance of the proposed research – its potential impact to astrobiology and the broader scientific community,
- Extent to which the research is innovative, asking new questions and proposing new ways to answer them,
- Extent to which the entire proposal is integrated towards answering a unifying and compelling question in astrobiology,
- Degree to which the proposal is interdisciplinary – that is, the degree to which it includes and credibly applies the perspectives, skills, tools, and approaches of multiple disciplines toward addressing the question,
- Detail and soundness of the technical approach and methodology to be employed in conducting the proposed research, and
- Quality of scientific staff.

Prior relevant accomplishments will be considered positive evidence of the likelihood that the proposed research plan can be carried out successfully.

To score highly on Merit of the Research Plan, proposals should include interdisciplinary investigations of the highest quality, on a focused, compelling question that addresses at least one aspect of the 2015 Astrobiology Strategy. A proposal will be considered responsive to this program element whether its compelling question addresses a single Strategy goal or multiple Strategy goals, provided that the proposal provides an interdisciplinary approach to conducting the research.

5.2.2 *Merit of the Science Management Plan*

Each proposal must include a separate plan that describes how the staff, facilities, and other resources identified in the proposal will be managed to achieve the research objectives.

This plan must include:

- A structure for administering personnel, with particular emphasis on how the activities of researchers from different science disciplines will be integrated in implementing the proposed research program,
- A definition of the roles and responsibilities of each participant, noting the proportion of each individual's time to be devoted to the proposed research activity,
- A specific plan, when multiple institutions are involved in the proposal, for bringing separate elements together into a well-functioning and interdisciplinary unit. (If a consortium of institutions is proposed, letters verifying cooperation, coordination, and commitments of resources from administrative officials of the consortium members must be included as an appendix to the proposal.),

- An outline of the general plan of work, including anticipated key milestones for accomplishments, and
- A plan for maintaining communication among team members (e.g., weekly tag-ups, videoconferencing, annual meetings).

5.2.3 *Merit of the Data and Sample Management Plan*

The data management plan should ensure that results are fit for contemporary use and available for discovery and reuse.

Management plans must include:

- Types and volume of data, samples, and other materials to be produced in the course of the project.
- Standards to be used for data and metadata format and content.
- Policies for providing access and enabling sharing.
- Provisions for reuse, redistribution, and the production of derivatives.
- Plans for archiving and preserving access to data and materials.

Data should be made openly available as soon as possible, but no later than two (2) years after the data were collected. This period may be extended under exceptional circumstances, but only by agreement between the Principal Investigator and NASA.

5.2.4 *Relevance to ICAR*

Proposals will be evaluated on their relevance to the astrobiology program goals and relevance to an RCN. To be of high relevance, proposals must articulate and demonstrate an understanding of how the proposed research relates to and will influence the field of astrobiology as well as ongoing and planned research activities and flight missions of NASA, if applicable. Proposals will also be evaluated on how well they draw specific connections to, and describe how the results of the work will have strategic impact on, NASA's space flight programs, its broader science activities (e.g., in astronomy, astrophysics and Earth sciences), and/or its role as one of a suite of a Federal Research and Development (R&D) agencies supporting scientific research.

Relevance would be demonstrated by, but is not limited to, the following:

- Support of current or future space missions directed at astrobiological targets,
- Technology or instrument development related to the astrobiological exploration of these targets,
- Fundamental research having clear and critical but longer-term implications for acquiring or interpreting data from these targets,
- Synergistic collaboration with other funding agencies, or between the Astrobiology Program and other NASA science programs, for example, the Earth Science, Heliophysics, and Astrophysics Programs.

5.2.5 *Cost Reasonableness*

The resources requested must be appropriate and well justified for the period of performance. An assessment of cost, in the context of the proposed scope of work, will be performed by peer review, but not factored into the evaluation score. NASA

Astrobiology Program personnel will evaluate cost compared to funds available through this program element.

6. Summary of Key Information

Expected program budget for first year of new awards	~\$5-7M
Number of new awards pending adequate proposals of merit	~5-10
Maximum duration of awards	5 years.
Due date for Step-1 proposals	See Tables 2 and 3 of this ROSES NRA.
Due date for Step-2 proposals	See Tables 2 and 3 of this ROSES NRA.
Planning date for start of investigation	6 months after proposal due date.
Page limit for the Research Plan section of proposal	25 pp; see below.
Relevance	This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the <i>ROSES Summary of Solicitation</i> .
Detailed instructions for the preparation and submission of proposals	Please see <i>ROSES Summary of Solicitation</i> Section I(g) Order of Precedence and the NASA Guidebook for Proposers .
Submission medium	Electronic proposal submission is required; no hard copy is permitted.
Web site for submission of Step-1 and -2 proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of Step-1 and -2 proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH19ZDA001N-ICAR
Point of contact concerning this program	Mary Voytek Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: 202-358-1577 Email: Mary.A.Voytek@nasa.gov

7. Details of Proposal Contents

Proposals to ICAR have the same basic requirements as submissions to other ROSES calls, with a few notable exceptions. Veteran ROSES proposers may refer to Section 2, above for a bullet list of the ways in which this program element differs from the default. However, in the interest of facilitating proposals from a broad community, including many who may be unfamiliar with ROSES, we include below thorough guidelines, repeating some things that appear in the [ROSES-2019 Summary of Solicitation](#).

All Step-2 proposals in response to this element should include the following parts in the order listed (note that some are optional). Proposals that omit any required parts will be returned without review.

- NSPIRES Proposal Cover Page/Proposal Summary

The NSPIRES Proposal Cover Page contains the following:

Proposal Information: PI information, proposal title, proposed start and end dates, submitting institution information, certification and authorization.

Certifications, Assurances, and Representations: The Authorized Organizational Representative's (AOR) signature on the Proposal Cover Page automatically certifies that the proposing organization has read and is in compliance with these certifications. No additional form is necessary. Go to NSPIRES for the updated list.

Team Members: Names, institution and contact information. All team members must register themselves in NSPIRES and provide all required data. Each team member must establish an organizational relationship, i.e., identify the organization or other auspices through which the person is participating in the proposal. A proposal cannot be submitted if an organizational relationship within NSPIRES is missing from any team member. The online confirmation for team members satisfies the requirement for a "statement of commitment" unless contributions are provided. In such a case, a "letter" validating the contribution is additionally required.

Proposal Summary: (max. 4000 characters, Section 2.3.3 of the *NASA Guidebook for Proposers*): Brief description of the project, including objectives, targeted audience, partners, method of approach, relevance to NASA themes, use of NASA content, and outcomes. For Step-2 proposals, NSPIRES will initially populate this section with the proposal summary input for Step-1, which can be edited as necessary. Please note that if your proposal is selected this summary will be released so it should not contain any propriety information and must not contain any ITAR information.

NSPIRES Budget: Include figures for all years (up to 5 years for this program element) of the proposed project in the spaces provided, describing total budget, including any subawards. All labor costs, including civil servant labor, shall be provided in this part of the cover page; labor figures will automatically be redacted by NSPIRES for presentation to the peer reviewers (see Section IV(b)iii of the *ROSES Summary of Solicitation* and the SARA web page the [walkthrough on this subject](#) for more information on labor redaction).

Program Specific Data: Proposers should answer all questions asked in this section of the cover page.

Note: To improve proposal reviewability, only one PDF file for the full proposal can be submitted through NSPIRES. This file begins with the Proposal Title Page (the Table of Contents if no Title Page is used) and includes all of the contents described below. An advantage of submitting the proposal as one PDF document is that it is easier for the offeror to create a table of contents that will be correct. See below for further instructions on creation and submission of an additional PDF file – the "total budget" file.

- Proposal Title Page

The Proposal Title Page is optional, and its design is at the discretion of the proposer. If one is included, at a minimum it must include the full title of the proposal, the name of the Principal Investigator, the name and address of the proposing institution, and a list of any other institutions participating in the proposed investigation. The ITAR notice, if there is one, should be included on this page.

- Table of Contents

A *Table of Contents* shall identify each of the key parts of the proposal, including subsections of the proposal's central Research Plan. To facilitate developing and assembling the proposal, a proposer may individually number each principal section.

- Executive Summary

The Executive Summary should clearly describe the proposed program: its rationale, innovations, distinguishing features, unifying intellectual focus, proposed research, and training plans; and its approach to management of its participating personnel and institutions. In addition, this Summary should briefly address the commitment to implementing the collaborative and networking concepts of the NASA Astrobiology RCNs.

- Summary of Personnel and Commitments

The proposal must contain a one page summary list, in simple tabular form of the proposer's own choosing, that gives the names and/or titles of all personnel (including postdoctoral fellows and graduate students) and intended work commitment (both compensated and uncompensated) for the proposed investigation in time (rounded to the nearest 0.01 of a Work Year) for each year of the proposed period of performance.

- Research Plan

The proposal should contain sufficient detail to fully describe the proposed effort in order to enable a reviewer 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. In addition, the proposal should indicate clearly the interdisciplinary nature of the research, and what innovative approaches are being applied to achieve the objectives.

This section is the main body of a proposal and should cover the following topics in the order given, all within the specified limit of 25 pages:

- The objectives and expected significance of the proposed research, including a complete description of any instruments or hardware proposed to be built in order to carry out the research (Note: see also the Facilities and Equipment section below for the description of critical equipment needed for carrying out the proposed research).
- How the proposed work is expected to build on and otherwise extend the state of knowledge in the field.
- The technical approach and methodology to be employed in conducting the proposed research, including any special facilities of the proposing institution(s) and/or capabilities of the proposer(s) for carrying out the work.

- Science Management Plan

The Science Management Plan should include each of those items indicated in Section 5 in sufficient detail to allow the reviewer to assess the likelihood of success of the proposed objectives.

- Data and Sample Management Plan

The Data and Sample Management Plan should demonstrate appropriate standards for data, metadata, and sample sharing and provide adequate details for reviewers to assess feasibility and accessibility of data and sample sharing with respect to the criteria listed in section 5.2.3.

The costs required to implement the proposed Data and Sample Management Plan must be included within the overall proposed budget.

Other research material sharing, registration and curation:

Sharing of valuable sample material is highly encouraged. Investigators are expected to share with other researchers, at no more than incidental cost and within a reasonable time, samples, physical collections, and other supporting materials created or gathered in the course of work under NASA agreements. Teams are expected to encourage and facilitate such sharing.

Nonbiological Samples collected during the conduct of research funded by NASA will be registered in SESAR, the System for Earth Sample Registration, as a first step towards sample curation and sharing.

SESAR operates the registry that distributes the [International Geo Sample Number IGSN](#). SESAR catalogs and preserves sample metadata profiles, and provides access to the sample catalog via the [Global Sample Search](#). For more information see <http://www.geosamples.org/>.

Biological Samples

Academic, private, and community facilities have traditionally been sites where biological materials are curated. Not all material can (or should) be accommodated in these facilities. PIs should archive voucher and type specimens as dictated by community standards and practices, as required by journals for publication, and as appropriate to support research results.

- References

All citations given in the *Research Plan* must be included in full in a list of references, without page limits. It is highly desirable that references use the full title of the paper or article being referenced. In all cases, standard and easily understood abbreviations for journals must be used.

- Relevance

Proposals must discuss relevance to this program element in a (4000-character max) text box on the cover pages via the NSPIRES web interface for this program element. Proposers are asked to explicitly address the relevance of their program to ICAR (see Sections 2.5 and 5.2.4). Proposals must demonstrate specific relevance. For example, relevance to missions should, when possible, describe specific missions and how the proposed work will contribute. Relevance to other NASA science programs should describe the specific program and the resulting synergy that is expected. Collaborations with other funding partners should describe the individual organizations and the nature of the partnership. Major impact to astrobiological science objectives should describe the particular significance of the work and its impact on the field.

- Facilities and Equipment

As appropriate, this section should describe any facilities (including any U.S. Government owned facilities) and/or major equipment critical for carrying out the proposed project that are already available or would need to be purchased in order to carry out the proposed investigation. In the latter case, these costs should be entered in the required proposal Budget Summary and described in accompanying budget details.

- Curriculum Vitae

The PI must submit a *Curriculum Vitae* (not to exceed three pages) that includes a history of his/her professional training and positions and a bibliography of publications relevant to the proposal. The proposal must also include a one page *Vitae* for each Co-I. A Co-I who serves as an Institutional PI may submit a *Vitae* using the same page limit as for the PI.

- Current and Pending Support

Information must be provided for all ongoing and pending projects and proposals that involve the proposing PI and any Co-Is who are expected to perform a significant share of the proposed work (e.g., an Institutional PI), whether or not their contributions are specific costs in the proposal's budget. Information is required for each of two categories of support awards that exist at the time of the proposal submission deadline, namely:

- a) Current Support (for any of the period that overlaps with the proposal being submitted to this program element), and
- b) Pending Support (including the proposal to this program element).

For each of these categories, provide the following information for each such key individual on the proposal team as noted above:

- Title of award or project;
- Program name (if appropriate) and sponsoring agency or institution (including point of contact with telephone number);
- Proposed period of performance and budget; and
- Commitment in fractions of a full time Work Year (WY = 2080 hours).

In addition, provide the name of any other institution, including an individual point of contact with their telephone number, to which the proposal submitted to this program element, or any part thereof, has been or will be submitted for consideration of funding. For such pending research, the PI must notify the Program Officer immediately of any successful proposals that are awarded any time after the proposal submission date until the time of selections.

- **Statement(s) of Commitment from Co-I's and/or Collaborators**
Every PI, Co-I, and Collaborator identified as a participant on the proposal's cover page and/or in the proposal's Research Plan must acknowledge his/her intended participation in the proposed effort. The NSPIRES proposal management system allows for participants named on the Proposal Cover Page to acknowledge a statement of commitment electronically.
- *Budget Summary and Details*

The required NSPIRES *Proposal Cover Page* contains a section in tabular form for the submission of budget figures, including all labor, for each year of the proposed effort, as well as for the total period of performance.

In addition to the budget summary information provided in the NSPIRES Cover Page forms, all proposers are required to include more detailed budgets including total FTE commitment for a task whether or not compensation is requested. NASA also requires budget justifications, including detailed subcontract/subaward budgets in the Budget Justification. For this program element, this additional budget must be divided into three parts, the "Budget Justification: Narrative" and the "Budget Justification: Details", both as described in the *NASA Guidebook for Proposers*, and the separately uploaded "Total Budget" a requirement specific to this solicitation. Proposers to this solicitation must provide the Total Budget in a file called "totalbudget.pdf" uploaded as a separate attachment in NSPIRES.

The first two parts the "Budget Justification: Narrative" and the "Budget Justification: Details" are within the proposal and available for peer review. The Budget Justification: Narrative includes the rationale and basis of estimate for all components of cost including procurements, travel, publication costs, and all subawards/subcontracts. The Budget Justification: Details must include the detailed proposed budget including all of the Other Direct Costs (see list below) and Other Applicable Costs as specified in the *NASA Guidebook for Proposers*. For this solicitation, the Budget Justification: Narrative and the Budget Justification: Details must not specify the Total Estimated Cost, or the cost of Labor, fringe or overhead for any personnel.

The Total Budget file which is not seen by the peer reviewers must specify the complete set of cost components including all costs discussed in the Budget Narrative and Budget Details, as well as the Total Estimated Cost, cost of Direct Labor (including civil servant labor), and Administrative Costs (overhead). The Total Budget document will

not be provided to the peer review, but will be used by NASA in the evaluation of total cost and comparison of the proposed cost to available funds.

The required Budget Justification: Narrative and Details sections of the proposal must be incorporated into the single PDF proposal document as these will be provided to the peer review.

Note that failure to provide sufficient budget justification and data in the Budget Narrative (including the Table of Personnel and Work Effort) and the Budget Details, recognizing that the peer review will not have access to the Total Estimated Cost, the cost of Direct Labor, and Administrative Costs (e.g., overhead), will prevent the peer review from appropriately evaluating the cost reasonableness of the proposed effort. A finding by the peer review of “insufficient information to properly evaluate cost reasonableness” will be considered a weakness of the proposal. Inconsistent budget information between these budget descriptions will also be considered a weakness of the proposal.

Instructions for presenting the proposed budget are provided below. Note that the discussion below references items that should be in the “*total budget*” file; proposers should follow the guidance provided above for determining where each item described below should be presented.

- 1) Provide a complete Budget Summary for the total, as well as each individual year of the, proposed period of performance. The proposed costs are to be summarized according to the following general categories, which are consistent with the budget section of the *Proposal Cover Page*:
 - Direct Labor (salaries, wages, and fringe benefits)
 - Other Direct Costs:
 - Subcontracts
 - Consultant Services
 - Equipment
 - Materials and Supplies
 - Travel
 - Other
 - Indirect Costs (Facilities and Administrative Costs)
 - Total Estimated Costs

- 2) Provide detailed computations of all estimates in each cost category with narratives as required to fully explain each proposed cost as follows.
 - Direct Labor (salaries, wages, and fringe benefits): list the number and titles of personnel, amounts of time to be devoted to the grant, and rates of pay.
 - Other Direct Costs:
 - a. Subcontracts: describe the work to be subcontracted, estimated amount, recipient (if known), and the reason for subcontracting.
 - b. Consultants: identify consultants to be used, why they are necessary, the time they will spend on the project, and rates of pay (not to exceed the equivalent of the daily rate for Level IV of the Executive Schedule, exclusive of expenses and indirect costs).

- c. Equipment: list separately. Explain the need for items costing more than \$5,000.
Describe basis for estimated cost. General purpose equipment is not allowable as a direct cost unless specifically approved by the NASA Grant Officer. Any equipment purchase requested to be made as a direct charge under this award must include the equipment description, how it will be used in the conduct of the basic research proposed, and why it cannot be purchased with indirect funds.
 - d. Supplies: provide general categories of needed supplies, the method of acquisition, and the estimated cost.
 - e. Travel: describe the purpose of the proposed travel in relation to the grant and provide the basis of estimate, including information on destination and number of travelers, where known.
 - f. Other: enter the total of direct costs not covered by above. Include an itemized list explaining the need for each item and the basis for the estimate.
 - g. Proposed Cost Sharing (if any): Any proposed cost sharing should be reflected within the amounts entered in the *Budget Summary* forms and the value of such cost sharing and the nature of it should be described in the narrative. There is no ability to demonstrate cost sharing as a negative number within the *Budget Summary* forms.
- Facilities and Administrative (F&A) Costs: Identify F&A cost rate(s) and base(s) as approved by the cognizant Federal agency, including the effective period of the rate. Provide the name, address, and telephone number of the Federal agency official having cognizance.
 - Subtotal-Estimated Costs: Enter the sum of all items listed above.
 - Other Applicable Costs: Enter total explaining the need for each item.
 - Total Estimated Costs: Note that this amount must match the amount presented on the *Proposal Cover Page*.
- Note also the following important considerations when completing the proposed budget:
 - (i) If a proposal is selected for award, failure to adequately address the provisions of the Instructions for Equipment will require that NASA contact the proposing institution for the required information. Such activity may delay the award until the purchase is either justified as a direct charge for general-purpose equipment or budgeted as an indirect expense.
 - (ii) If a PI from a non-Government institution proposes to team with a Co-I from a U.S. Government institution (for this purpose, JPL is considered a NASA Center), then the institutional budget for that Government Co-I is to be included in the proposal's budget details, and the cost for this Government Co-I is to be listed under Other Applicable Costs of the Budget Summary and no institutional overhead should be applied to these costs. If the proposal is selected, NASA will execute an inter- or

intra-agency funds transfer, as appropriate, to cover the cost of the Government Co-I. Conversely, if a Government PI institution teams with a private sector Co-I institution, that Government institution is expected to cover such Co-I costs through a subcontract that they execute. Therefore, such private sector Co-I costs should be entered under Subcontracts on the Budget Summary.

- (iii) The proposing (PI) institution must subcontract the funding of all proposal Co-I's who reside at other institutions (except for a Government Co-I for a private sector PI as noted above); that is, NASA will not separately make awards to Co-I's at distributed institutions regardless of the cost impact to the PI proposal for the management of such subcontracts. (Note: Under exceptional circumstances, this provision can be waived)
- (iv) 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>).

Electronic Submission through the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES)

All proposals submitted in response to this solicitation must be submitted in electronic form. Hard copies will not be accepted. Electronic proposals must be submitted by the Authorized Organization Representative (AOR) at the proposer's institution. Electronic submission by the AOR serves as the required original signature by an authorized official of the proposing institution.

Proposers may opt to submit their Step-1 proposals in response to this solicitation via either of two different electronic proposal submission systems: either via the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com> or via Grants.gov at <http://www.grants.gov>.

Step-2 proposals must be submitted via NSPIRES, regardless of which system was used for Step-1. NASA plans to use the NSPIRES system to facilitate the review process.

Note carefully the following requirements for submission of an electronic proposal to NSPIRES:

- Every organization that intends to submit a proposal to NASA electronically must be registered in NSPIRES. (this requirement applies even for Step-1 proposals submitted via Grants.gov)

- Organizations must obtain a Data Universal Numbering System (DUNS) number. Note that an organization must also be registered in the System for Award Management (SAM) and obtain a CAGE Code before receipt of any Federal award. The SAM approval process can take several days (at minimum). SAM registration should be performed by an organization's electronic business primary point-of-contact. Organizations new to NSPIRES or any offeror new to the NASA process should visit and register in the SAM system (sam.gov) early in the proposal preparation process.
- Any partner institution requesting NASA funds through the proposed project must be listed on the Proposal Cover Page. NASA will not fund institutions that do not appear on the Proposal Cover Page.
- In addition, every individual named on the proposal's electronic Proposal Cover Page form as a proposing team member in any role, including Co-Is and collaborators, must be registered in NSPIRES, even if the Step-1 proposal is submitted via Grants.gov. Such individuals must perform this registration themselves; 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.
- Each individual team member named on the proposal's cover page must specify an institutional relationship. The institutional relationship specified must be the institution through which the team member is participating in the proposed project. A proposal cannot be submitted if an organizational relationship is missing for any team member. If the individual has multiple institutional relationships, then this institution may be different from the individual's primary employer or preferred mailing address.

Submission of electronic proposals via NSPIRES requires several coordinated actions within the proposing institution. In particular, when the PI has completed entry of the data requested in the required electronic forms and attachment of the allowed PDF attachments, including the project description section, an official at the PI's institution who is authorized to make such a submission (referred to as the AOR) must submit the electronic proposal (forms plus attachments). Coordination between the PI and his/her AOR on the final editing and submission of the proposal materials is facilitated through their respective accounts in NSPIRES. Note that if one individual is acting in both the PI and AOR roles, he/she must ensure that all steps in the process are taken, including submitting the proposal from the institution.

Only appendices/attachments that are specifically requested in either this program element or in the *NASA Guidebook for Proposers* will be permitted. Proposals containing additional appendices/attachments may be declared noncompliant and returned without peer review. In the event the information in this program element is different from or contradicts the information in the *NASA Guidebook for Proposers*, the information in this program element takes precedence.

Important note on creating PDF files for upload: It is essential that all PDF files generated and submitted meet the NASA requirements below. This will ensure that the

submitted files can be transferred into NSPIRES. At a minimum, it is the responsibility of the offeror to: (1) ensure that all PDF files are unlocked and searchable and that edit permission is enabled, to ensure that all submitted files can be ingested by NSPIRES; 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 offeror 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/index.html> for more information on submitting PDF documents into NSPIRES. PDF files that do not meet the NASA requirements cannot be transferred into the NSPIRES system; such files may be declared noncompliant and not submitted to peer review for evaluation.

NSPIRES 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. The element check may produce warnings and/or identify errors. Warnings can be ignored if the proposer has verified that the apparently incomplete information is not inconsistent with the requirements of the solicitation. Warnings do not preclude proposal submission; however, an error in the element check will preclude submission.

Offerors are encouraged to begin their submission process early. Tutorials and other NSPIRES help topics may be accessed through the NSPIRES online help site at <http://nspires.nasaprs.com/external/help.do>. For any questions that cannot be resolved with the available on-line help menus, requests for assistance may be directed by E-mail to nspires_help@nasaprs.com or by telephone to (202) 479-9376, Monday through Friday, 8:00 a.m. to 6:00 p.m. Eastern Time (excluding Federal holidays).
