# NSF 22-578: Geobiology and Low-Temperature Geochemistry (GG)

## Program Solicitation

### Document Information

**Document History**

- **Posted:** March 17, 2022
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**National Science Foundation**
Directorate for Geosciences
Division of Earth Sciences

**Full Proposal Deadline(s)**:

Proposals Accepted Anytime

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## Important Information And Revision Notes

**Revision Notes**

This solicitation updates the program description.

This solicitation clarifies data management requirements and reminds PIs the Broader Impact activities should be specifically addressed in annual and final reports.

This solicitation clarifies requirements for proposals to work in foreign countries, or on native/tribal/indigenous lands.

This solicitation allows for the inclusion of Student Mentoring Plans in the Supplementary Documents.

**Important Information**

Innovating and migrating proposal preparation and submission capabilities from FastLane to Research.gov is part of the ongoing NSF information technology modernization efforts, as described in Important Notice No. 147. In support of these efforts, research proposals submitted in response to this program solicitation must be prepared and submitted via Research.gov or via Grants.gov, and may not be prepared or submitted via FastLane.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG).

## Summary Of Program Requirements

**General Information**

**Program Title:**

Geobiology and Low-Temperature Geochemistry (GG)

**Synopsis of Program:**

The Geobiology and Low-Temperature Geochemistry Program supports research on geochemical processes in terrestrial Earth's surface systems, as well as the interaction of geochemical and biological processes. Proposals may address field, laboratory, theoretical, or modeling studies of these processes and related mechanisms at all spatial and temporal scales. The Geobiology and Low-Temperature Geochemistry Program is interested in supporting transformational and cutting-edge research. The Program also supports the development of geochemical proxies and analytical techniques. The Program is highly interdisciplinary and interfaces with other programs within the Geosciences Directorate, and with programs across NSF, including in biology, chemistry, and engineering.

**Cognizant Program Officer(s):**

*Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.*

- Alberto Perez-Huerta, telephone: (703) 292-8550, email: eargg@nsf.gov
- Yurena Yanes, telephone: (703) 292-2649, email: eargg@nsf.gov
- Jonathan G. Wynn, telephone: (703) 292-4725, email: eargg@nsf.gov

**Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):**

- 47.050 --- Geosciences

**Award Information**

**Anticipated Type of Award:** Standard Grant or Continuing Grant

**Estimated Number of Awards:** 25 to 30 annually

**Anticipated Funding Amount:** $9,000,000 annually, pending availability of funds

**Eligibility Information**

**Who May Submit Proposals:**

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.

**Who May Serve as PI:**

There are no restrictions or limits.

**Limit on Number of Proposals per Organization:**

There are no restrictions or limits.

**Limit on Number of Proposals per PI or co-PI:**

According to the Division of Earth Sciences (EAR) policy (https://www.nsf.gov/geo/ear/resubmission_policy.jsp), proposals that have been declined are not eligible for resubmission for one year from the original date of submission and must be substantially revised to be considered. Exceptions to this policy require prior approval by an EAR Program Officer.

**Proposal Preparation and Submission Instructions**

**A. Proposal Preparation Instructions**

- **Letters of Intent:** Not required
- **Preliminary Proposal Submission:** Not required

- **Full Proposals:**
    - Full Proposals submitted via Research.gov: *NSF Proposal and Award Policies and Procedures Guide* (PAPPG) guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.
    - Full Proposals submitted via Grants.gov: *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov* guidelines apply (Note: The *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide).

**B. Budgetary Information**

- **Cost Sharing Requirements:**

  Inclusion of voluntary committed cost sharing is prohibited.

- **Indirect Cost (F&A) Limitations:**

  Not Applicable

- **Other Budgetary Limitations:**

  Other budgetary limitations apply. Please see the full text of this solicitation for further information.

**C. Due Dates**

- **Full Proposal Deadline(s)**:

  Proposals Accepted Anytime

**Proposal Review Information Criteria**

**Merit Review Criteria:**

National Science Board approved criteria apply.

**Award Administration Information**

**Award Conditions:**

Additional award conditions apply. Please see the full text of this solicitation for further information.

**Reporting Requirements:**

Additional reporting requirements apply. Please see the full text of this solicitation for further information.

## I. Introduction

The Geobiology and Low-Temperature Geochemistry Program is a program of the Division of Earth Sciences (EAR). EAR supports investigations of the Earth's structure, composition, evolution, and the interaction of the lithosphere with the Earth's biosphere, atmosphere, and hydrosphere. In addition, EAR provides support for instrumental and observational infrastructure, cyber infrastructure, and innovative educational and outreach activities. Projects may employ any combination of field, laboratory, and computational studies with observational, theoretical, or experimental approaches. Support is available for research and research infrastructure through awards made in response to investigator-initiated proposals from U.S. universities and other eligible organizations. EAR will consider co-funding of projects with other agencies and supports international activities and collaboration with international partners.

## II. Program Description

The Geobiology and Low-Temperature Geochemistry Program supports research on geochemical processes in terrestrial Earth surface systems, as well as the interaction of geochemical and biological processes. Proposals may address field, laboratory, theoretical, or modeling studies of these processes and related mechanisms at all spatial and temporal scales. The program is interested in supporting transformational and cutting-edge research.

Studies may address:

1. Geochemical and biogeochemical processes occurring at or near the Earth's surface in terrestrial or near-shore settings, now and in the past, and across the broad spectrum of interfaces ranging from planetary and regional to mineral-surface and aqueous solutions;
2. Low-temperature geochemical and biogeochemical systems and cycles, including their feedbacks and responses to climate change, other environmental change, and human activities;
3. The geobiology and geochemistry of the sources, sinks and sequestration of greenhouse gases;
4. The role of life in the transformation and evolution of Earth's geochemical cycles;
5. The geochemistry of critical Earth minerals and materials, including identifying new sources of critical minerals on the Earth's surface, understanding their pathways in the natural environment, and understanding their concentration by Earth surface and geobiological processes;
6. Mineralogy and chemistry of earth materials (soil, sediments, and rocks) and their interaction with solutions, gases, and biota;
7. Geomicrobiology, including microbial geochemistry, biomining, and biomineralization;
8. The intersection of earth materials and human health, with the focus on geochemistry;
9. The development of proxies, tools, methods and models for low-temperature geochemistry and geobiological research - including major and trace element geochemistry, stable and radiogenic isotope geochemistry and geochronology, "omics" approaches (genomics, transcriptomics, and proteomics), and models for low-temperature geochemistry and geobiological research, from molecular to global scale.
10. Interdisciplinary geobiological and (bio)geochemical research in the Critical Zone.

The Geobiology and Low-Temperature Geochemistry program is committed to supporting interdisciplinary and multidisciplinary research, as well as research involving international collaboration. The program is especially interested in proposals in emerging fields. The program commonly co-reviews proposals with other NSF programs. Within the Division of Earth Sciences, common co-review partners include Hydrological Sciences, Geomorphology and Land-Use Dynamics, Petrology and Geochemistry, Sedimentary Geology and Paleobiology, and Instrumentation and Facilities. Within the Geosciences Directorate, common co-review partners include Marine Geology and Geophysics, Chemical Oceanography and the Office of Polar Programs. Proposals on basic science research with environmental and industrial applications are commonly co-reviewed with Environmental Engineering, Nanoscale Interactions, and Environmental Chemical Sciences. The program also co-reviews with programs in the Division of Environmental Biology. Where appropriate, proposals may be considered for joint support or transferred to other programs (not exclusive to the list above) at the National Science Foundation when it is deemed appropriate by Program Officers from the respective programs or divisions. Principal Investigators are encouraged to contact the cognizant program directors regarding proposals that may cross disciplinary boundaries before submission.

The Geobiology and Low-Temperature Geochemistry program encourages proposals for large projects that will contribute to transformative methodologies and cross disciplinary research within its portfolio. Interdisciplinary teams considering submitting such proposals are strongly encouraged to contact the cognizant program director with an expression of interest and to communicate their anticipated needs before proceeding with proposal development. The review and funding of such activities would normally be coordinated with other programs in EAR and/or other Divisions or Directorates. Interdisciplinary projects that have a significantly larger scientific scope and budget than those considered for funding by this program are encouraged under the Frontiers in Earth Sciences Research program (FRES).

A wide range of Broader Impacts activities are supported by the program, as described below in Section VI.A. Successful projects will include creative, well-integrated, and effective broader impact activities developed within the context of the

mission, goals, and resources of the organizations and people involved. The expertise of collaborators, the proposal budget, and budget justification should reflect this integration. Example activities might include but are not limited to those that create effective methods of engagement with local communities or the public at large; develop infrastructure in the lab or the field; translate research to benefit broader societal needs; involve early career researchers and students with diverse experiences and backgrounds; and/or foster new partnerships (e.g., with Minority Serving Institutions, two-year colleges, or internationally). Plans for undergraduate and graduate student mentoring should include evidence-based strategies for effective recruitment, retention and/or training to be provided. We welcome innovative efforts that advance belonging, accessibility, justice, equity, diversity, and inclusion or identify and remove barriers that have historically excluded some groups from the geosciences.

The Geobiology and Low-Temperature Geochemistry Program is committed to supporting the most meritorious research in any relevant area, including interdisciplinary and multidisciplinary research, as well as studies that involve international collaborations and partnerships. The Program is specially interested in proposals in emerging fields, and those that are responsive to recent reports from the community. Proposals for community workshops that can guide the program on new research topics and grand challenge questions are encouraged. All proposals for workshops, conferences, research coordination networks (RCN), RAPID, and EAGER awards, as described in the PAPPG, must be discussed with one of the program directors before submission.

Examples of projects supported by the program can be found using the NSF Award Search (Program Information) engine by entering Element Code 7295.

## III. Award Information

**Anticipated Type of Award:** Standard Grant or Continuing Grant.

**Estimated Number of Awards:** 25 to 30 annually.

**Anticipated Funding amount:** is $9,000,000, annually, pending availability of funds.

## IV. Eligibility Information

**Who May Submit Proposals:**

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.

**Who May Serve as PI:**

There are no restrictions or limits.

**Limit on Number of Proposals per Organization:**

There are no restrictions or limits.

**Limit on Number of Proposals per PI or co-PI:**

According to the Division of Earth Sciences (EAR) policy (https://www.nsf.gov/geo/ear/resubmission_policy.jsp), proposals that have been declined are not eligible for resubmission for one year from the original date of submission and must be substantially revised to be considered. Exceptions to this policy require prior approval by an EAR Program Officer.

## V. Proposal Preparation And Submission Instructions

### A. Proposal Preparation Instructions

**Full Proposal Preparation Instructions**: Proposers may opt to submit proposals in response to this Program Solicitation via Research.gov or Grants.gov.

- Full Proposals submitted via Research.gov: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal and Award Policies and Procedures Guide* (PAPPG). The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg. Paper copies of the PAPPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov. The Prepare New Proposal setup will prompt you for the program solicitation number.
- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov*. The complete text of the *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov.

In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via Research.gov. PAPPG Chapter II.D.3 provides additional information on collaborative proposals.

See PAPPG Chapter II.C.2 for guidance on the required sections of a full research proposal submitted to NSF. Please note that the proposal preparation instructions provided in this program solicitation may deviate from the PAPPG instructions.

**The following information supplements the PAPPG and NSF Grants.gov Application Guide**

**Project Description:**

**Projects involving work in foreign countries:** For studies in countries other than the United States, the box for International Activities should be checked on the Cover Sheet and the country/countries should be identified. The Project Description should discuss, where appropriate, collaborations with scientists and students from the host country, and how these individuals will be involved in the project. Collaborations should be well justified, in that they represent true intellectual collaboration and utilize the expertise and specialized skills, facilities, and/or resources of the foreign collaborator. Principal investigators are encouraged to provide U.S. students and junior researchers with international research experiences. Arrangements to allocate samples and data between host country organization(s) or institution(s) and U.S. organization(s) or institution(s) should be discussed in the proposal or in the Data Management plan. Investigators are encouraged to include any permits (including legally required collecting, import, and export permits for samples, instrumentation, and data), authorizations, and agreements, in the Other Supplementary Documents section of the proposal. Failure to obtain the appropriate permits for all aspects of the research effort may jeopardize not only the proposed research, but also the well-being of the personnel.

**Field projects:** For field-based projects, PIs are encouraged to include information on the protocols that will be undertaken to ensure the mental and physical safety of the field party, especially students and others who are inexperienced in working under conditions that can be, at times, uncomfortable, unfamiliar, or threatening. Field protocols are particularly important for projects that involve hazardous conditions, such as working on active volcanoes, post-disaster reconnaissance or in some international settings (as identified by a U.S. State Department Travel Advisory).

**Environmental Review and Compliance:** Prior to making a funding decision, additional steps may be required as part of NSF's compliance with applicable federal environmental authorities such as the National Environmental Policy Act (NEPA), the National Historic Preservation Act (NHPA), and the Endangered Species Act (ESA). In order to support NSF's federal environmental review and compliance obligations, proposals should indicate whether activities are anticipated to impact the natural or cultural environment, especially activities involving renovation, construction, or major fixed equipment installation. Additional information may be requested from the PI. More information can be found in the PAPPG, and the Organization Environmental Impacts Checklist (referenced in PAPPG Chapter II.D.2.j) may be helpful in evaluating impacts.

**Letters of Collaboration:**

According to PAPPG, letters of collaboration should be limited to stating the intent to collaborate and should not contain endorsements or evaluation of the proposed project. The recommended format for letters of collaboration is as follows:

"If the proposal submitted by Dr. [insert the full name of the Principal Investigator] entitled [insert the proposal title] is selected for funding by NSF, it is my intent to collaborate and/or commit resources as detailed in the Project Description or the Facilities, Equipment and Other Resources section of the proposal."

In addition: **Projects involving work in foreign countries:** For studies in countries other than the United States, letters of collaboration from foreign institutions must include a statement on how any data used in the collaboration will be shared with the broader scientific community.

**Projects with support from NSF-funded facilities:** Letters of collaboration from any NSF-funded facilities, must conform with guidelines established by NSF and the Facility. Proposals to this solicitation can submit letters of collaboration from facilities that detail equipment, support and costs associated with the proposed activities and include those letters as a Supplementary Document.

**Projects involving work on sovereign Native/Tribal/Indigenous lands:** Proposals that include research in Native/Tribal communities or on Tribal lands must include a letter of collaboration that confirms community collaboration, or at a minimum community awareness, and permission to work on associated lands from the relevant community organizations or tribal leadership (see the U.S. Department of Housing and Urban Development Tribal Directory Assessment tool or the National Congress of American Indians tribal directo ) as a Supplementary Document. Collaborations should be well justified, in that they represent true intellectual collaboration and utilize the expertise and specialized skills, facilities, and/or resources of the community. Where relevant, plans should be articulated for sharing data with indigenous communities following CARE (Collective benefit, Authority to control, Responsibility, and Ethics) Principles for Indigenous Data Governance. Investigators should request sufficient funding to support the time and travel of Native community members and treat their collaborators as members of their research team, including acknowledging collaborators in publications and including them as co-authors and in research presentations, as appropriate.

**Data Management Plan:** Principal investigators are required to adhere to the EAR Division Data Policy available on the NSF website. With the goal of making EAR-supported data products findable, accessible, interoperable, and reusable (FAIR), key considerations for compliance with the EAR Division Data Sharing Policy include the following:

- EAR's definition of "data" is expansive and includes (but is not limited to) the following: full data sets, derived data products (e.g., model results, output, and workflows), software, and physical collections.
- The proposal Data Management Plan (DMP) should clearly describe what data will be collected, what analyses will be done, when data collection is considered "final," and how and when the project will provide open and timely access to data running and after the project.

- PIs are strongly encouraged to identify long-lived disciplinary repositories most appropriate for the data type to be collected.

The Geobiology and Low-Temperature Geochemistry program recommends investigators read the following report generated by the community on data management recommendations: Brantley, S. L., Wen, T., Agarwal, D. A., Catalano, J.G., Schroeder, P. A., Lehnert, K., ...& Pierce, E. M., (2021). The future low-temperature geochemical data-scape as envisioned by the U.S. geochemical community. Computers & Geosciences, 157, 104933. https://doi.org/10.1016/j.cageo.2021.104933.

**Student Mentoring Plans**: Proposals that request funding to support undergraduate and/or graduate students at any participating institution may include a mentoring plan that describes any recruitment, training and/or other activities to be provided to the students and the mentors. Student mentoring plans should be uploaded as Other Supplementary Documents.

**B. Budgetary Information**

**Cost Sharing:**

Inclusion of voluntary committed cost sharing is prohibited.

**Other Budgetary Limitations:**

Equipment needs that can be demonstrably linked to the conduct of a specific research project being proposed to EAR may be included within the budget of the related research proposal. In general, equipment requests on proposals submitted to EAR research programs should not exceed a total of $50,000. Equipment requests in excess of $50,000 usually require a separate proposal directly to the Instrumentation and Facilities Program. However, equipment requests of less than $50,000 that are unassociated with specific research proposals may be submitted to the Instrumentation and Facilities Program. Investigators planning on submitting an EAR research proposal with a significant equipment budget are encouraged to discuss these plans with the relevant research program officer prior to submission.

**C. Due Dates**

- **Full Proposal Deadline(s)**:

  Proposals Accepted Anytime

**D. Research.gov/Grants.gov Requirements**

**For Proposals Submitted Via Research.gov:**

To prepare and submit a proposal via Research.gov, see detailed technical instructions available at: https://www.research.gov/research-portal/appmanager/base/desktop?_nfpb=true&_pageLabel=research_node_display&_nodePath=/researchGov/Service/Desktop/ProposalPreparationa For Research.gov user support, call the Research.gov Help Desk at 1-800-673-6188 or e-mail rgov@nsf.gov. The Research.gov Help Desk answers general technical questions related to the use of the Research.gov system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

**For Proposals Submitted Via Grants.gov:**

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: https://www.grants.gov/web/grants/applicants.html. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact

Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

***Submitting the Proposal:*** Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to the NSF FastLane system for further processing.

Proposers that submitted via Research.gov may use Research.gov to verify the status of their submission to NSF. For proposers that submitted via Grants.gov, until an application has been received and validated by NSF, the Authorized Organizational Representative may check the status of an application on Grants.gov. After proposers have received an e-mail notification from NSF, Research.gov should be used to check the status of an application.

## VI. NSF Proposal Processing And Review Procedures

Proposals received by NSF are assigned to the appropriate NSF program for acknowledgement and, if they meet NSF requirements, for review. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF either as *ad hoc* reviewers, panelists, or both, who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal. In addition, Program Officers may obtain comments from site visits before recommending final action on proposals. Senior NSF staff further review recommendations for awards. A flowchart that depicts the entire NSF proposal and award process (and associated timeline) is included in PAPPG Exhibit III-1.

A comprehensive description of the Foundation's merit review process is available on the NSF website at: https://www.nsf.gov/bfa/dias/policy/merit_review/.

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in *Building the Future: Investing in Discovery and Innovation - NSF Strategic Plan for Fiscal Years (FY) 2018 – 2022*. These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

One of the strategic objectives in support of NSF's mission is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions must recruit, train, and prepare a diverse STEM workforce to advance the frontiers of science and participate in the U.S. technology-based economy. NSF's contribution to the national innovation ecosystem is to provide cutting-edge research under the guidance of the Nation's most creative scientists and engineers. NSF also supports development of a strong science, technology, engineering, and mathematics (STEM) workforce by investing in building the knowledge that informs improvements in STEM teaching and learning.

NSF's mission calls for the broadening of opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

### A. Merit Review Principles and Criteria

The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To

identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects.

**1. Merit Review Principles**

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.
- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

**2. Merit Review Criteria**

All NSF proposals are evaluated through use of the two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. **Both** criteria are to be given **full consideration** during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. (PAPPG Chapter II.C.2.d(i). contains additional information for use by proposers in development of the Project Description section of the proposal). Reviewers are strongly encouraged to review the criteria, including PAPPG Chapter II.C.2.d(i), prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- **Intellectual Merit:** The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- **Broader Impacts:** The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to
    a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
    b. Benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. NSF values the advancement of scientific knowledge and activities that contribute to achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and other underrepresented groups in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

Proposers are reminded that reviewers will also be asked to review the Data Management Plan and the Postdoctoral Researcher Mentoring Plan, as appropriate.

**B. Review and Selection Process**

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review.

Reviewers will be asked to evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will generally be completed and submitted by each reviewer and/or panel. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF strives to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new awardees may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

After programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications. After an administrative review has occurred, Grants and Agreements Officers perform the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

Once an award or declination decision has been made, Principal Investigators are provided feedback about their proposals. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers or any reviewer-identifying information, are sent to the Principal Investigator/Project Director by the Program Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

## VII. Award Administration Information

### A. Notification of the Award

Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process.)

### B. Award Conditions

An NSF award consists of: (1) the award notice, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award notice; (4) the applicable award conditions, such as Grant General Conditions (GC-1)*; or Research Terms and Conditions* and (5) any announcement or other NSF issuance that may be incorporated by reference in the award notice. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

*These documents may be accessed electronically on NSF's Website at https://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the NSF *Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

**Administrative and National Policy Requirements**

**Build America, Buy America**

As expressed in Executive Order 14005, Ensuring the Future is Made in All of America by All of America's Workers (86 FR 7475), it is the policy of the executive branch to use terms and conditions of Federal financial assistance awards to maximize, consistent with law, the use of goods, products, and materials produced in, and services offered in, the United States.

Consistent with the requirements of the Build America, Buy America Act (Pub. L. 117-58, Division G, Title IX, Subtitle A, November 15, 2021), no funding made available through this funding opportunity may be obligated for an award unless all iron, steel, manufactured products, and construction materials used in the project are produced in the United States. For additional information, visit NSF's Build America, Buy America webpage.

**Special Award Conditions:**

**EAR Data Policy:** Principal investigators are required to adhere to the EAR Data Policy available on the NSF website. Final Reports for all awards should include a statement describing how the data policy requirements have been met, in the section titled "Products," under Other Products, Other Publications, or Website or Other Internet Sites.

### C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer no later than 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). No later than 120 days following expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report, will delay NSF review and processing of any future funding increments as well as any pending proposals for all identified PIs and co-PIs on a given award. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through Research.gov, for preparation and submission of annual and final project reports. Such reports provide information on accomplishments, project participants (individual and organizational), publications, and other specific products and impacts of the project. Submission of the report via Research.gov constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

More comprehensive information on NSF Reporting Requirements and other important information on the administration of NSF awards is contained in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

**Broader Impacts:** Investigators are expected to specifically address progress on activities related to the proposed Broader Impacts and Data Management in annual and final reports in the Impacts section of the report.

**Data Reporting Requirements:** PIs are required to provide updates on the status of data sharing and archiving in Annual and Final reports, in the section titled "Products," under Other Products, Other Publications, or Website or Other Internet Sites.

## VIII. Agency Contacts

*Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.*

General inquiries regarding this program should be made to:

- Alberto Perez-Huerta, telephone: (703) 292-8550, email: eargg@nsf.gov
- Yurena Yanes, telephone: (703) 292-2649 email: eargg@nsf.gov
- Jonathan G. Wynn, telephone: (703) 292-4725, email: eargg@nsf.gov

For questions related to the use of FastLane or Research.gov, contact:

- FastLane and Research.gov Help Desk: 1-800-673-6188
- FastLane Help Desk e-mail: fastlane@nsf.gov.
- Research.gov Help Desk e-mail: rgov@nsf.gov

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: support@grants.gov.

## IX. Other Information

The NSF website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this website by potential proposers is strongly encouraged. In

addition, "NSF Update" is an information-delivery system designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF Grants Conferences. Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. "NSF Update" also is available on NSF's website.

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this mechanism. Further information on Grants.gov may be obtained at https://www.grants.gov.

**Related Programs:**

In addition to the other programs in the Division of Earth Sciences Disciplinary Section, closely related programs include:

- Earth Sciences: Instrumentation and Facilities
- Frontier Research in Earth Sciences (FRES)
- Chemical Oceanography
- Marine Geology and Geophysics
- Ecosystem Science Cluster
- Environmental Chemistry
- Environmental Engineering
- Faculty Early Career Development Program (CAREER)
- Research Coordination Networks (RCN)
- Critical Zone Collaborative Network

## About The National Science Foundation

The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

NSF receives approximately 55,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Arctic and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

*Facilitation Awards for Scientists and Engineers with Disabilities* (FASED) provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See the *NSF Proposal & Award Policies & Procedures Guide* Chapter II.E.6 for instructions regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.
To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at https://www.nsf.gov

- **Location:** 2415 Eisenhower Avenue, Alexandria, VA 22314
- **For General Information** (NSF Information Center): (703) 292-5111
- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**

  Send an e-mail to: nsfpubs@nsf.gov

  or telephone: (703) 292-8134
- **To Locate NSF Employees:** (703) 292-5111

## Privacy Act And Public Burden Statements

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See System of Record Notices, NSF-50, "Principal Investigator/Proposal File and Associated Records," and NSF-51, "Reviewer/Proposal File and Associated Records." Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton
Reports Clearance Officer
Policy Office, Division of Institution and Award Support
Office of Budget, Finance, and Award Management
National Science Foundation
Alexandria, VA 22314


National Science Foundation, 2415 Eisenhower Ave Alexandria, VA 22314
Tel: (703) 292-5111,