

Human Networks and Data Science (HNDS)

PROGRAM SOLICITATION NSF 21-514

REPLACES DOCUMENT(S): NSF 19-608



National Science Foundation

Directorate for Social, Behavioral and Economic Sciences
Division of Behavioral and Cognitive Sciences
Division of Social and Economic Sciences

Full Proposal Deadline(s) (due by 5 p.m. submitter's local time):

February 04, 2021

First Thursday in February, Annually Thereafter

Deadline for HNDS-I proposals only. HNDS-R proposals will be submitted to the relevant primary program using that program's deadline.

IMPORTANT INFORMATION AND REVISION NOTES

This Human Networks and Data Science (HNDS) solicitation replaces the previous Human Networks and Data Science - Infrastructure (HNDS-I) solicitation. It updates the synopsis and description of the Human Networks and Data Science - Core Research (HNDS-R) track and clarifies that HNDS-R proposals will be submitted to and co-review with other programs.

Restrictions on the number of HNDS-I proposals per PI or co-PI have been added.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) (NSF 20-1), which is effective for proposals submitted, or due, on or after June 1, 2020.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Human Networks and Data Science (HNDS)

Synopsis of Program:

The Human Networks and Data Science program (HNDS) supports research that enhances understanding of human behavior and how humans interact with and are influenced by their environments by leveraging data science and network science research across a broad range of topics. HNDS research will identify ways in which dynamic, distributed, and heterogeneous data can provide novel answers to fundamental questions about individual and group behavior. HNDS is especially interested in proposals that provide data-rich insights about human networks to support improved health, prosperity, and security.

HNDS has two tracks:

1. **Human Networks and Data Science – Infrastructure (HNDS-I).** Infrastructure proposals will address the development of data resources and relevant analytic techniques that support fundamental Social, Behavioral and Economic (SBE) research. Successful proposals will, within the financial resources provided by the award, construct user-friendly large-scale next-generation data resources and relevant analytic techniques and produce a finished product that will enable new types of data-intensive research. The databases or techniques should have significant impacts, either across multiple fields or within broad disciplinary areas, by enabling new types of data-intensive research in the SBE sciences.
2. **Human Networks and Data Science – Core Research (HNDS-R).** Core research proposals will address theoretically motivated questions about the nature, causes, and/or consequences of human behavior (broadly defined) that occurs within contexts defined by the networks that determine the human experience, from the biological networks in the human body to the sociocultural, economic and geospatial networks that comprise human societies. HNDS-R proposals should be submitted through any primary disciplinary program within SBE and not to this solicitation. HNDS-R is interested in leveraging multi-scale, multi-level network data and techniques of network analysis to further theory development across the social sciences. Proposals that address human behavior

within complex hierarchical network structures and/or that address problems involving nonlinear dynamics and network heterogeneity are particularly encouraged. Supported projects are expected to yield results that will enhance, expand, and transform theory and methods, and that generate novel understandings of human networks – particularly understandings that can improve the outcomes of significant societal opportunities and challenges. HNDS-R encourages core research proposals that make innovative use of NSF-supported data networks, data bases, centers, and other forms of scientific infrastructure including those developed by HNDS-I (formerly RIDIR) projects.

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.

- Trisha Van Zandt, telephone: (703) 292-7437, email: pvanzand@nsf.gov
- Tyler S. Kendall, W13149, telephone: (703) 292-2434, email: tkendall@nsf.gov
- Don Rimón-Program Specialist, telephone: (703) 292-2960, email: drimon@nsf.gov

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

- 47.075 --- Social Behavioral and Economic Sciences

Award Information

Anticipated Type of Award: Standard Grant

Estimated Number of Awards: 5 to 25

The HNDS-I track anticipates funding approximately 4 infrastructure projects; HNDS-R anticipates co-funding from 5 to 20 core research projects. HNDS-R proposals will be co-reviewed with other SBE programs.

Anticipated Funding Amount: \$8,000,000

amount for all awards per year: \$8 million. Estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

Eligibility Information

Who May Submit Proposals:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), Chapter I.E. Unaffiliated individuals are not eligible to submit proposals in response to this solicitation.

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:

An individual may be listed as a PI or co-PI on only one HNDS-I proposal per year.

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 FastLane: *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=papppg.
 - 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=papppg.
 - 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:**

Not Applicable

C. Due Dates

- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):

February 04, 2021

First Thursday in February, Annually Thereafter

Deadline for HNDS-I proposals only. HNDS-R proposals will be submitted to the relevant primary program using that program's deadline.

Proposal Review Information Criteria

Merit Review Criteria:

National Science Board approved criteria apply.

Award Administration Information

Award Conditions:

Standard NSF award conditions apply.

Reporting Requirements:

Standard NSF reporting requirements apply.

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I. INTRODUCTION

The systems of networks in which humans are embedded are massively complex. They range from the ever-changing connections between neurons in the human brain to the climates and political structures in which human societies are embedded. Modeling these networks must take into account the many layers within or dimensions along which nodes are defined, the different time and measurement scales used to characterize behavior at each level, the heterogeneity of nodes and edges within and across layers, and the non-stationarity of network topologies due to the influence of latent events occurring outside the model

structure. In addition, networks of connections between nodes may emerge as a function of self-organization in response to changes in network topology at higher or lower levels of the system.

The Human Networks and Data Science (HNDS) program is dedicated to supporting research that furthers understanding of human behavior as a function of the networks that define both individuals and the environment in which that behavior takes place. HNDS advances research in the Social, Behavioral, and Economic Sciences (SBE) in two ways. First, infrastructure projects under HNDS-I aim to develop user-friendly large-scale next-generation data resources and relevant analytic techniques to advance fundamental research in SBE areas of study. Second, core research projects under HNDS-R make theoretical contributions to SBE disciplines by constructing models of human processes in which networks emerge, or by constructing models of networks at all levels of human experience, with the goal of explaining human behavior in the context of human environments.

II. PROGRAM DESCRIPTION

The HNDS program offers two tracks: one for infrastructure projects and one for core research activities. Infrastructure projects (HNDS-I) will develop user-friendly large-scale next-generation data resources and relevant analytic techniques to advance fundamental research in SBE areas of study. Successful infrastructure proposals will construct, within the financial resources provided by the award, databases and/or relevant analytic techniques and produce a finished product that will enable impactful, previously impossible data-intensive research. The databases or techniques should have significant impacts, either across multiple fields or within broad disciplinary areas, by enabling new types of data-intensive research in the SBE sciences.

Core research projects (HNDS-R) will address theoretically motivated questions about the nature, causes, and/or consequences of human behavior (broadly defined) that occurs within the multidimensional contexts defined by the networks that determine the human experience, from the biological networks in the human body to the sociocultural, economic and geospatial networks that comprise human societies. HNDS-R is interested in leveraging multi-scale, multi-level network data and techniques of network analysis to further theory development across the social sciences. Proposals that address human behavior within complex hierarchical network structures and/or that address problems involving nonlinear network dynamics and network heterogeneity are particularly encouraged. Supported projects are expected to yield results that will enhance, expand, and transform theory, and that will have positive broader impacts that benefit society.

HNDS-Infrastructure

HNDS-I seeks to build upon the past successes of the previous Resource Implementations for Data Intensive Research in the Social, Behavioral and Economic Sciences (RIDIR) and HNDS-I competitions. The goal of this competition is to produce one or both of two types of finished products:

- Databases, which may consist of a new large-scale database, a substantial expansion or revision of an extant database, or the merging of extant databases. Databases might include traditional relational data in digital form, collections of historical data, images, video and audio recordings, administrative data/records or any other form of structured sets of data. The database must be accompanied by a usable interface that allows for the application of extant analytic tools or analytical tools that are developed as part of the project. Within this competition, the justification for the database rests on the potential it provides for enabling “data intensive SBE research”, which is amenable to utilization by substantial numbers of investigators. Central to the evaluation of proposals are the types, scope and potential significance of the research such a database would afford. For this competition, data-intensive research is defined as research involving data resources that extend well beyond the storage requirements, computational intensiveness or complexity that is currently typical in SBE areas of research. **HNDS-I proposals should make clear how the proposed activities will enable promising SBE research that would not otherwise be possible.** The investigations enabled by such data intensive research may be within or between any new or existing SBE field or fields. It may involve linkages between SBE science and other fields of science, although this is not required.
- Analytic tool(s) which would serve to enhance database use to address significant research questions within the SBE sciences. While a strong proposal would produce a tool of general utility it is required that the applicant link and discuss the tool within the context of a specific database or set of databases. The tool must be made readily available to a broad research community at no more cost than is necessary to cover the expenses of its provision.

Successful HNDS-I proposals will describe products that will have significant impacts by enabling new types of data-intensive research. These products should be fundamental and generalizable rather than narrow and specific. Database proposals should define/identify a resource that can be used to answer scientific questions that could not otherwise be addressed. Analytic tool development proposals should be directed towards the same goal of enabling researchers to address new and significant SBE science questions. Investigators are encouraged to think broadly and to create a vision that extends intellectually to more than one SBE area of research potentially linking to other fields of science as well. Proposals should describe the bodies of data and other significant attributes regarding data structures, metadata, analytics, or tools needed to facilitate research. Investigators are encouraged to think creatively about data and consider new data collections, repurposed existing data, and new approaches to data as appropriate for the research questions of interest. Novel approaches are encouraged. Proposals should have a well-defined work plan with steps sufficiently detailed to enable a clear understanding of specific work activities and milestones.

An explicit goal of the HNDS-I competition is to establish broad and large-scale databases with relevant analytic tools which will be utilized by a large number and wide range of researchers. It is anticipated that successful proposals may extend well beyond a single discipline. The relevance of the proposed work should be of interest to a broad intellectual community by virtue of its potential or actual generalizability or extendibility.

HNDS-I proposers should examine the following questions in an integrated manner in their proposals, to the extent that they are relevant to their own projects:

- Science:
 - What broad, important, fundamental research questions will be addressed?
 - What research communities would be interested in exploring these questions?
- Information technology:
 - What kinds of data are to be involved, including the metadata and the broader infrastructure in which data are embedded? How will the data be collected? If the database structures are novel (e.g., not a relational database), what would be their design? What analytic or statistical approaches will be provided to analyze the data?
 - What infrastructure and financial support is required to ensure access to and long-term maintenance of these large-scale data?
- Governance:
 - How will the research communities involved in the project address governance as they relate to issues such as sustainability, access and ethical use of data relating to privacy and data confidentiality?
 - How will issues such as interoperability and potential integration with existing resources be addressed?

Proposers are strongly encouraged to include, as part of the project description, a discussion of any social and public policy issues that relate to the type, use, and acquisition of data associated with the large-scale database envisioned. Topics bearing on these issues could include the ethical uses of these data, the protection of human-subject privacy and data confidentiality, and how the broader social impacts of the enabled research can enhance the well-being of society and its members. Proposers should make clear the relationship between any new large-scale databases and existing large-scale databases in related areas.

The protection of human subjects is of paramount importance; if the proposed project will involve the use of human data or data related to human activities, PIs should consult with their local institutional review board (IRB) to obtain either IRB approval or official letters of exemption. Proposals will not be recommended for award until and unless appropriate IRB approval or exemption documents have been submitted to NSF. See PAPPG, Chapter II.D.5 for NSF policies on proposals involving human subjects.

For proposals involving the use of vertebrate animals, sufficient information must be provided in the project description to enable reviewers to evaluate the choice of species, number of animals to be used, and any necessary exposure of animals to discomfort, pain, or injury. Consistent with the requirements of the Animal Welfare Act [7 U.S.C. 2131 et seq] and the regulations promulgated by the Secretary of Agriculture [9 CFR, 1.1-4.11], NSF requires that proposed projects involving use of any vertebrate animal for research or education be approved by the submitting organization's Institutional Animal Care and Use Committee (IACUC) before an award can be made. See PAPPG, Chapter II.D.4 for NSF policies on proposals involving vertebrate animals.

Proposers should also be aware of the federal government's long-term policy regarding "Increasing Access to the Results of Federally Funded Scientific Research." This [memorandum](#) from the Office of Science and Technology Policy, announced on February 22, 2013 can be viewed on the OSTP web site. See PAPPG, Chapter XI.D.2.c for NSF policy on public access to copyrighted material.

Supplementary Documents for HNDS-I Proposals

In addition to the supplementary documents required in the [NSF Proposal & Award Policies & Procedures Guide](#), HNDS-I proposals must include two additional documents uploaded under Other Supplementary Documents. Although, at the Principal Investigator's discretion these issues may also be discussed in the proposal's Project Description, they must be directly addressed in the supplementary documents.

- **Technical Plan:** A specific and detailed plan and technical details must be presented for how the project goals will be achieved. For example: (1) Technicians, either by name or by competence/job qualifications should be identified; (2) If students are involved, how will they be trained? (3) How will the broader research community be informed of the product and trained in its use? A detailed schedule with milestones should be included. (This list is not intended to be complete.) (page limit: 2 pages)
- **Sustainability Plan:** How will the product be sustained after the expiry of the award? How will it be maintained and made accessible to the research community? Every project must include an estimate of its annual operational cost if it were to become fully operational. (page limit: 1 page)

HNDS- Core Research

HNDS-R seeks proposals that advance theory across the SBE sciences through the analysis of human network data and the construction of models of human behavior in the context of the networks that influence human life. **HNDS-R proposals should address theoretical, disciplinary-specific questions from a modeling approach that moves away from simplifying assumptions and toward more complex, realistic network structures.** Such structures include multidimensional hierarchical networks with nonstationary topology, and dynamic systems from which networks emerge. Proposals that leverage NSF-supported data networks, databases, centers, and other forms of scientific infrastructure or infrastructure and/or databases established with HNDS-I or RIDIR awards are particularly encouraged. HNDS-R proposals should not focus on the development of new network analyses or statistical methods but rather on the novel application of these methods to advance theory in relevant disciplines.

HNDS-R proposals should not be submitted to this solicitation, but to another core program in the SBE directorate. The HNDS-R program will co-review and co-fund projects with other SBE programs. A HNDS-R project should focus on a clearly articulated problem relevant to its core program.

Additional requirements for HNDS-R proposals

HNDS-R proposals should follow the guidance in this solicitation and the guidelines of the core program to which they are submitted. To guarantee consideration by the HNDS program, the Unit of Consideration (UOC) on the proposal cover sheet should indicate this core program and HNDS should be selected as a second UOC.

For information about SBE fields to which proposals might be relevant, investigators should consult the SBE research organization home pages ([SBE Office of Multidisciplinary Activities - SMA](#); [Behavioral and Cognitive Sciences - BCS](#); [Social and Economic Sciences - SES](#)).

III. AWARD INFORMATION

HNDS will make 4-5 larger infrastructure awards per year and co-fund up to approximately 20 core research awards per year. Total maximum amount for all awards per year: \$8 million. Estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), Chapter I.E. Unaffiliated individuals are not eligible to submit proposals in response to this solicitation.

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:

An individual may be listed as a PI or co-PI on only one HNDS-I proposal per year.

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 FastLane, Research.gov, or Grants.gov.

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal & Award Policies & 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. Proposers are reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.
- 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 FastLane or 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.

All proposal titles should begin with the prefix "HNDS-I:" or "HNDS-R". See Program Description section for special proposal preparation information and required Supplementary Documents.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

C. Due Dates

- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):

February 04, 2021

First Thursday in February, Annually Thereafter

Deadline for HNDS-I proposals only. HNDS-R proposals will be submitted to the relevant primary program using that program's deadline.

D. FastLane/Research.gov/Grants.gov Requirements

For Proposals Submitted Via FastLane or Research.gov:

To prepare and submit a proposal via FastLane, see detailed technical instructions available at: <https://www.fastlane.nsf.gov/a1/newstan.htm>.

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/ProposalPreparationandSubmission.html. For FastLane or Research.gov user support, call the FastLane and Research.gov Help Desk at 1-800-673-6188 or e-mail fastlane@nsf.gov or rgov@nsf.gov. The FastLane and Research.gov Help Desk answers general technical questions related to the use of the FastLane and Research.gov systems. 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 FastLane or 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 underrepresented minorities 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.

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.

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:

- Trisha Van Zandt, telephone: (703) 292-7437, email: pvanzand@nsf.gov
- Tyler S. Kendall, W13149, telephone: (703) 292-2434, email: tkendall@nsf.gov
- Don Rimón-Program Specialist, telephone: (703) 292-2960, email: drimon@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>.

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 (FASSED) 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

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