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Innovations in Graduate Education (IGE) Program

PROGRAM SOLICITATION

NSF 17-585



National Science Foundation

Directorate for Education & Human Resources
Division of Graduate Education

Directorate for Biological Sciences

Directorate for Computer & Information Science & Engineering

Directorate for Engineering

Directorate for Geosciences

Directorate for Mathematical & Physical Sciences

Directorate for Social, Behavioral & Economic Sciences

Office of Integrative Activities

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

October 25, 2017

September 27, 2018

September 27, 2019

IMPORTANT INFORMATION AND REVISION NOTES

A letter of intent is no longer required for full IGE proposal submission. FY2015-FY2017 IGE submissions required a LOI when IGE was a track under the NSF Research Traineeship Program (Solicitation [NSF 16-503](#)).

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) ([NSF 17-1](#)), which is effective for proposals submitted, or due, on or after January 30, 2017.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Innovations in Graduate Education (IGE) Program

Synopsis of Program:

The Innovations in Graduate Education (IGE) program is designed to encourage the development and implementation of bold, new, and potentially transformative approaches to STEM graduate education training. The program seeks proposals that explore ways for graduate students in research-based master's and doctoral degree programs to develop the skills, knowledge, and competencies needed to pursue a range of STEM careers.

IGE focuses on projects aimed at piloting, testing, and validating innovative and potentially transformative approaches to graduate education. IGE projects are intended to generate the knowledge required for their customization, implementation, and broader adoption. The program supports testing of novel models or activities with high potential to enrich and extend the knowledge base on effective graduate education approaches.

The program addresses both workforce development, emphasizing broad participation, and institutional capacity building needs in graduate education. Strategic collaborations with the private sector, non-governmental organizations (NGOs), government agencies, national laboratories, field stations, teaching and learning centers, informal science centers, and academic partners are encouraged.

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.

- John Weishampel, telephone: (703) 292-2162, email: jweisham@nsf.gov
- Daniel Denecke, telephone: (703) 292-8072, email: ddenecke@nsf.gov
- Vinod K. Lohani, telephone: (703) 292-2330, email: vlohani@nsf.gov

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

- 47.041 --- Engineering
- 47.049 --- Mathematical and Physical Sciences
- 47.050 --- Geosciences
- 47.070 --- Computer and Information Science and Engineering
- 47.074 --- Biological Sciences
- 47.075 --- Social Behavioral and Economic Sciences
- 47.076 --- Education and Human Resources
- 47.079 --- Office of International Science and Engineering
- 47.083 --- Office of Integrative Activities (OIA)

Award Information

Anticipated Type of Award: Standard Grant

Estimated Number of Awards: 6 to 10

IGE Awards (6 to 10 anticipated in FY 2018) are expected to be up to three (3) years in duration with a total budget between \$300,000 and \$500,000.

Anticipated Funding Amount: \$4,000,000

The estimated number of awards and the anticipated funding amount listed above are for FY 2018. The number of awards and funding level in FY 2019 and FY 2020 are anticipated to be similar to FY 2018. Funding amounts depend on 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: 2

An eligible organization may participate in two Innovations in Graduate Education proposals per competition. **Participation includes serving as a lead organization on a non-collaborative proposal or as a lead organization, non-lead organization, or subawardee on a collaborative proposal.** Organizations participating solely as evaluators on projects are excluded from this limitation. Proposals that exceed the institutional eligibility limit (beyond the first two submissions based on timestamp) will be returned without review regardless of the institution's role (lead, non-lead, subawardee) in the returned proposal.

Limit on Number of Proposals per PI or Co-PI: 1

An individual may serve as Lead Principal Investigator (PI) or Co-PI on only one proposal submitted to the IGE program per annual competition. Proposals that exceed the PI/Co-PI eligibility limit (beyond the first submission based on timestamp) will be returned without review regardless of the individual's role (PI or co-PI) in the returned proposal.

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=pappg.
 - 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.

- o 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):

October 25, 2017

September 27, 2018

September 27, 2019

Proposal Review Information Criteria

Merit Review Criteria:

National Science Board approved criteria. Additional merit review criteria apply. Please see the full text of this solicitation for further information.

Award Administration Information

Award Conditions:

Standard NSF award conditions apply.

Reporting Requirements:

Standard NSF reporting requirements apply.

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I. INTRODUCTION

Science, technology, engineering, and mathematics (STEM) graduate education is poised to undergo a major transformation. There are multiple drivers for change including: (i) recent major national reports on the state of STEM graduate education [1], (ii) the accelerating pace of science and engineering discoveries and technological innovations, (iii) national STEM workforce trends, (iv) the growing globalization of science and engineering, and (v) the potential to align graduate education practices and models with an increasing understanding of how people learn. In addition, there is increasing recognition that addressing the grand challenges in science and engineering requires interdisciplinary and broader professional training that is atypical for most graduate programs. These realities and the increasing calls for new approaches to STEM graduate education represent an extraordinary opportunity. Accordingly, this solicitation encourages proposals in **Innovations in Graduate Education (IGE)** to test, develop, and implement innovative and effective STEM graduate education approaches.

[1] *The Path Forward: The Future of Graduate Education*, Commission on the Future of Graduate Education in the United States, 2010; *Advancing Graduate Education in the Chemical Sciences*, American Chemical Society, 2012; Biomedical Research Workforce Working Group Report, National Institutes of Health, 2012; *Understanding PhD Career Pathways for Program Improvement*, Council of Graduate Schools, 2014; *Revisiting the STEM Workforce: A Companion to Science and Engineering Indicators 2014*, National Science Board, 2015; *Professional Development: Shaping Effective Programs for STEM Graduate Students*, Council of Graduate Schools, 2017.

II. PROGRAM DESCRIPTION

IGE projects will generate potentially transformative models for improvements in graduate education that prepare the next generation of scientists and engineers for the full range of possible STEM career paths to advance the nation's STEM enterprise. IGE is dedicated solely to piloting, testing, and validating innovative approaches to graduate education and to generating the knowledge required for the customization and implementation of the most successful, transformative ones. The primary target population for IGE projects must be master's and/or doctoral STEM students in a research-based degree program that requires a thesis or dissertation.

The IGE program will not focus on comprehensive training (see NSF Research Traineeship Solicitation 16-503) or foundational research examining how graduate students learn (see EHR Core Research Solicitation 15-509), but rather will promote targeted test-bed efforts that are informed by evidence, including findings from research on learning.

Activities proposed as part of the research project may include, but are not limited to, student professional skill development, career preparation and vocational counseling, faculty training, inventive partnerships, international experiences, internships, outreach, virtual networks, and mentoring. In addition, projects should utilize evidence-based strategies to broaden participation of students from diverse backgrounds.

Goals of the IGE Program are to:

- Catalyze rapid advances in STEM graduate education broadly as well as those responsive to the needs of particular disciplinary and interdisciplinary STEM fields, and
- Generate the knowledge base needed to inform the development of models as well as their implementation and adaptability.

The IGE Program calls for proposals to:

- Design, pilot, and test new, innovative and transformative approaches for inclusive STEM graduate education;
- Examine the potential to extend a successful approach developed in one discipline or context to other disciplines, or transfer an evidence-based approach to a new context; and
- Develop projects that are informed by learning science and the existing body of knowledge about STEM graduate education.

Leadership teams (PI/Co-PIs) comprising professional expertise in the learning sciences and pedagogy, as well as in the principal science domain(s), are strongly encouraged.

III. AWARD INFORMATION

IGE Awards (6 to 10 anticipated in FY 2018) are expected to be up to three (3) years in duration with a total budget between \$300,000 and \$500,000.

The estimated number of awards and the anticipated funding amount listed above are for FY 2018. The number of awards and funding level in FY 2019 and FY 2020 are anticipated to be similar to FY 2018. Funding amounts depend on 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:

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Limit on Number of Proposals per PI or Co-PI: 1

An individual may serve as Lead Principal Investigator (PI) or Co-PI on only one proposal submitted to the IGE program per annual competition. Proposals that exceed the PI/Co-PI eligibility limit (beyond the first submission based on timestamp) will be returned without review regardless of the individual's role (PI or co-PI) in the returned proposal.

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.

FULL PROPOSAL CONTENT

The full proposal must include only the main and supplementary documents described in Sections 1-10 below. The page limit for the Project Description is 15 pages. Proposals that are missing required sections and/or exceed the 15-page limit for the Project Description will be returned without review.

1. **Cover Sheet:** A short informative title that begins with "IGE:" is recommended. If international activities are proposed, whether or not they will be funded via the IGE award, the international cooperative activities box should be checked and the individual countries listed. For planning purposes, use July 1, 2018 (or 2019 or 2020) as the award start date for proposals submitted to the FY2018 (or FY2019 or FY2020) competitions.
2. **Project Summary** (1-page limit): Summarize the graduate education model or approaches that will be piloted and tested, or the existing pilot that will be adopted or expanded, as part of the IGE project. Describe the disciplinary field(s) involved, the knowledge that will be generated to inform implementation and adaptability of transformative approaches to STEM graduate education, and how the project is responsive to a need and/or opportunity. Each NSF merit review criterion (Intellectual Merit and Broader Impacts) must be addressed in a separate statement (see Chapter II.C.2.b of the PAPPG for additional instructions). The summary should be written in a manner that will be informative to STEM professionals working in the same or related fields, and understandable to a scientifically literate lay reader.
3. **Table of Contents:** A table of contents is automatically generated for the proposal by FastLane or Grants.gov and cannot be edited.
4. **Project Description** (15-page limit): The Project Description cannot exceed 15 pages, including tables and illustrations. The Project Description must contain only **Sections 4a through 4d described below with the suggested headings and in the order listed.**

4a. Innovation(s) in Graduate Education: Describe the overarching goals of the proposed IGE with a focus on piloting and testing potentially transformative improvements in graduate education. All innovations should be grounded in the appropriate literature. Specify the approaches or models to be piloted and tested as well as the targeted graduate student population and the justification for their inclusion. Identify the potential of the IGE project to provide appreciable and meaningful added value to the current degree programs at the institution(s) or in the discipline(s).

Discuss the potential for extending the approaches and activities nationally and how they could advance the modernization of graduate education across STEM disciplines.

The proposal should describe institutional plans that address facilitation of the pilot and, equally importantly, how successful approaches, practices, and models will be shared across the institution and nationally.

If a collaborative proposal is proposed, describe the role of the non-lead institution(s) and the participating personnel roles, and the mechanisms for project communication. A collaborative proposal should be submitted only if the partner institution(s) has (have) a significant role and will substantially enhance the education model or components tested.

4b. Broader Impacts: The Project Description must contain, as a separate section within the narrative, a discussion of the broader impacts of the education model and activities. For further information see Chapter II.C.2.d of the PAPPG.

4c. Performance Assessment/Project Evaluation: Assessment of the project is a high priority for the IGE program. Projects should include plans to evaluate the outcomes of the approach tested to provide transformative improvements in graduate education. Assessments should be both formative and summative, and the plan should describe how and when formative assessments would be shared with the project participants and institutional administration. Proposals should include plans for communicating assessment results, both within the IGE community and more broadly through publications and professional meetings.

Projects are not required to have an external evaluator. However, leadership teams should have the expertise in the learning sciences, education research, or evaluation to implement robust data collection methods appropriate to the targeted outcomes or model tested. Multiple iterations of data collection over the duration of the award are strongly encouraged, when appropriate.

4d. Results from Prior NSF Support: The PI and Co-PIs who have received NSF funding (including any current funding) in the past five years must provide information on the prior award(s), major achievements, and relevance to the proposed IGE project. Individuals who have received more than one prior award (excluding amendments) should report on the award(s) most closely related to the proposal. Complete bibliographic citation for each publication resulting from an NSF award must be included in either the Results from Prior NSF Support section or in the References Cited section of the proposal. For further information see Chapter II.C.2.d(III) of the PAPPG.

5. References Cited

6. Biographical Sketches: Biographical sketches should be provided for only the PI, Co-PIs, and other senior personnel.

7. Budget and Budget Justification: Provide an annual budget for up to three years total duration. FastLane or Grants.gov will automatically generate a cumulative budget. The proposed budget can range between \$300,000-\$500,000 and should be consistent with the costs to develop, implement, and evaluate the pilot. The budget should include funds for the PI and a co-PI or evaluator to attend an annual IGE meeting in Washington, DC during each year of the project. For further information on allowable costs see Chapter II.C.2.g of the PAPPG.

7a. Graduate Student Support: IGE projects will not support graduate student stipends or salary or cost of education, including tuition and fees.

7b. Faculty/Senior Personnel Salaries: Salary support must be consistent with contributions to the project. Support for postdoctoral fellows is not allowed unless they explicitly have an instructional or other training role.

7c. Other Budget Items: Direct costs for explicit participant support and programmatic elements must be commensurate with the goals specified in the proposal. Other budget requests (e.g., travel, equipment, and research support) must be integral to goals specified in the proposal.

Budget Justification (3-page limit): The Budget Justification must clearly explain how funds will be used in the proposed project. For proposals with any subawards, each subaward must include a separate budget justification of no more than three pages.

8. Current and Pending Support: This should be provided for the PI and other senior personnel.

9. Facilities, Equipment, and Other Resources: Provide a description of the facilities and major instrumentation that are available to support the project.

10. Supplementary Documentation:

Letters of Collaboration and Support: One support letter, up to two pages in length and submitted as a Supplementary Document, may be provided from a senior institutional administrator describing institutional support for the pilot or proof-of-concept to be tested. Additionally, up to eight other letters of collaboration, using the standard NSF format (see PAPPG Chapter II.C.d(iv)), may be provided from partner organizations, including international ones, that play a significant collaborative role in the project.

Collaborators/Individuals with Conflicts of Interest: Collaborators & Other Affiliations (COA) information specified in the PAPPG should be submitted using the instructions and spreadsheet template found at <https://nsf.gov/bfa/dias/policy/coa.jsp>. The PI, co-PIs, and other senior project personnel are required to upload this information as a Single Copy Document.

Data Management Plan: All proposals are required to include a Data Management Plan of up to two pages; it should be included as a separate Supplementary Document with Data Management Plan as the heading. The Data Management Plan should describe how the project would conform to the NSF policy on dissemination and sharing of research results as well as any educational products (e.g., curricular materials). This plan will be reviewed as part of the intellectual merit and broader impacts of the proposal. Data management requirements and plans relevant to the Directorate for Education and Human Resources are available on the NSF website at <https://www.nsf.gov/bfa/dias/policy/dmp.jsp>. For more information see Chapter II.C.2.j of the PAPPG.

Postdoctoral Mentoring Plan: A Postdoctoral Mentoring Plan is required if postdoctoral fellows receive IGE support, which is allowed only if they participate in an instructional or other training capacity.

No other items or appendices are to be included. **Full proposals containing items other than those required above or by the Proposal and Award Policies and Procedures Guide (PAPPG) will not be reviewed.**

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):

October 25, 2017

September 27, 2018

September 27, 2019

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.

Additional Solicitation Specific Review Criteria

- **Evaluation and Assessment**

Is there a well-conceived plan, including tangible metrics aligned with the goals and pilot timeline, to evaluate the outcomes of the proposed project? The assessment should be aimed at gathering the student-based data needed to test the hypothesis.

- **STEM education, disciplinary, interdisciplinary, and workforce needs**

Does the proposal adequately identify the intended contribution(s) of the IGE project to STEM education, disciplinary/interdisciplinary and/or workforce needs? For example, is it aimed at a need in a single discipline or is it targeting skillsets in response to interdisciplinary research? Does the proposal ground the identified need in the literature?

- **Knowledge generation to inform improvements in graduate education**

To what extent would the project generate the knowledge needed to inform implementation and adaptability of potentially transformative improvements to graduate education?

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:

- John Weishampel, telephone: (703) 292-2162, email: jweisham@nsf.gov
- Daniel Denecke, telephone: (703) 292-8072, email: ddenecke@nsf.gov
- Vinod K. Lohani, telephone: (703) 292-2330, email: vlohani@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) 292-7827
- **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
Office of the General Counsel
National Science Foundation
Alexandria, VA 22314

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