

# Enriched Doctoral Training in the Mathematical Sciences (EDT)

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## PROGRAM SOLICITATION

NSF 14-589



National Science Foundation

Directorate for Mathematical & Physical Sciences  
Division of Mathematical Sciences

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

November 12, 2014

July 08, 2015

Second Wednesday in July, Annually Thereafter

## IMPORTANT INFORMATION AND REVISION NOTES

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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

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### General Information

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**Program Title:**

Enriched Doctoral Training in the Mathematical Sciences (EDT)

**Synopsis of Program:**

The long-range goal of the Enriched Doctoral Training in the Mathematical Sciences (EDT) program is to strengthen the nation's scientific competitiveness by increasing the number of well-prepared U.S. citizens, nationals, and permanent residents who pursue careers in the mathematical sciences and in other professions in which expertise in the mathematical sciences plays an increasingly important role. The EDT program will achieve this by supporting efforts to enrich research training in the mathematical sciences at the doctoral level by preparing Ph.D. students to recognize and find solutions to mathematical challenges arising in other fields and in areas outside today's academic setting. Graduate research training activities supported by EDT will prepare participants for a broader range of mathematical opportunities and career paths than has been traditional in U.S. mathematics doctoral training.

**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.*

- Jennifer S. Pearl, telephone: (703) 292-4492, email: [jslimowi@nsf.gov](mailto:jslimowi@nsf.gov)
- Nandini Kannan, telephone: (703) 292-8104, email: [nakannan@nsf.gov](mailto:nakannan@nsf.gov)
- J. Matthew Douglass, telephone: (703) 292-2467, email: [mdouglass@nsf.gov](mailto:mdouglass@nsf.gov)
- Swatee Naik, telephone: (703) 292-4876, email: [snaik@nsf.gov](mailto:snaik@nsf.gov)

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

- 47.049 --- Mathematical and Physical Sciences

### Award Information

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

**Estimated Number of Awards:** 5 to 10

In determining the number and size of awards, NSF considers the advice of reviewers and availability of funds. It is projected that award recommendations will be made annually in January, with the exception of FY15 when awards will be made in March. Estimated program budget, number of awards, and average award size/duration are as follows but are subject to the availability of

funds.

**Anticipated Funding Amount:** \$4,000,000

We anticipate that the total amount of money to be spent on this program annually will be approximately \$4,000,000. We anticipate that individual award sizes will vary depending on the scope of the project, but that the maximum award size will be \$600,000 in total for a three-year award.

## Eligibility Information

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**Who May Submit Proposals:**

Proposals may only be submitted by the following:

- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.
- Academic institutions accredited in, and having a campus located in, the United States that grant doctoral degrees in the mathematical sciences.

**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:**

There are no restrictions or limits.

## Proposal Preparation and Submission Instructions

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**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=papp](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papp).
  - 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: [http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=grantsgovguide](http://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):

November 12, 2014

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## Proposal Review Information Criteria

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**Merit Review Criteria:**

National Science Board approved criteria apply.

## Award Administration Information

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**Award Conditions:**

Standard NSF award conditions apply.

#### Reporting Requirements:

Standard NSF reporting requirements apply.

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## I. INTRODUCTION

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Mathematical sciences graduate research training at the doctoral level in the United States is a many-faceted, vibrant enterprise. The Enriched Doctoral Training in the Mathematical Sciences (EDT) program supports efforts to enhance research training by moving beyond the common paradigm of training in a single, tightly-focused topical area to include a broader range of graduate research experiences that prepare doctoral students for a spectrum of career paths, including both academic and non-academic employment. The EDT program supports efforts to improve research training by involving doctoral students in research activities supplementary to the dissertation research theme, in order to (1) more appropriately prepare students for a broader range of careers, as well as to (2) advance research in the mathematical sciences through inspiration from problems in other disciplines. The EDT program encourages connections between mathematical sciences academic departments and other units within and outside of the university, including those in the business, industry, government, or non-profit realms.

The desirability of broadening U.S. graduate training in the mathematical sciences, as well as aligning it more strongly with careers many students choose, has been indicated in several recent reports and documents, including:

- *The Mathematical Sciences in 2025* (2013) <sup>1</sup>
- *INGenIOuS Project Report* (2013) <sup>2</sup>
- *Universities and the Future of America Research* (2012) <sup>3</sup>
- *Pathways Through Graduate School and Into Careers* (2012) <sup>4</sup>
- *Science and Technology Priorities for the FY 2015 Budget*, Office of Science and Technology Policy / Office of Management and Budget (2013) <sup>5</sup>

Several of these references reaffirm that mathematics and statistics are central to science and engineering and reiterate the increasing importance of the mathematical sciences in business and industry. They also emphasize that advances in the mathematical sciences facilitate progress in other fields, and that, conversely, problems in fields outside of mathematics have given rise to completely new areas of mathematical sciences research. Consequently, progress in many areas of national priority, as well as the health of the mathematical sciences as a discipline, will be significantly strengthened by further nurturing this symbiotic relationship.

Furthermore, although traditional doctoral training in mathematics has been aimed at an academic career path, recent American Mathematical Society survey data demonstrate that a substantial portion of doctoral recipients are taking positions outside of academia. <sup>6</sup>

To address the challenge of enriching graduate training in the mathematical sciences, the EDT program will support efforts by academic institutions or other qualified organizations that meet the **objective** of preparing doctoral students who:

- will be well-equipped to recognize opportunities for the development of mathematics and statistics in problems from other disciplines, especially in challenges arising in business, industry, and government; and

- can effectively apply advanced mathematics and statistics to solve problems originating outside the traditional academic mathematical sciences setting.

The enriched research training encouraged through the EDT program is expected to have significant benefits for several groups of stakeholders, including:

- For all participating graduate students: Enhanced understanding of their research areas in a broader context.
- For graduate students who pursue academic careers: Preparation to take mathematical inspiration from problems in disciplines outside of the mathematical sciences, allowing them to initiate development of new areas of mathematics; preparation to serve as links in their future faculty appointments between academics and the business/industry/government/non-profit realm; and preparation to advise their future students on the full range of possible career paths that exist with training in the mathematical sciences.
- For graduate students who pursue careers outside academics: Better preparation for, and knowledge of, a wide range of career paths in areas of business, industry, government, and non-profits where the mathematical sciences play increasingly important roles.
- For faculty: Ph.D. trainees with enhanced understanding of the research area in a broader context; easier placement of graduating students.
- For academic departments: Enhanced ties to other disciplinary units within the university and to non-academic partners; enhanced recruitment and placement of students.
- For the mathematical sciences community: A suite of pilot projects that can be used as models and adapted by graduate programs around the country.

In the long term, advances in the mathematical sciences inspired by problems arising in other fields will be brought about by graduates who have thorough understanding of both mathematics and another domain, and advanced mathematical techniques will increasingly be used to solve problems of national priority across a wide spectrum of fields and economic sectors.

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1. [http://www.nap.edu/catalog.php?record\\_id=15269](http://www.nap.edu/catalog.php?record_id=15269)

2. <http://www.ingeniousmathstat.org/pdfs/INGenIOuS-report.pdf>

3. [http://www.nap.edu/catalog.php?record\\_id=13396](http://www.nap.edu/catalog.php?record_id=13396)

4. <http://pathwaysreport.org>

5. <http://www.whitehouse.gov/sites/default/files/omb/memoranda/2013/m-13-16.pdf>

6. The number of tenure-track hires each year is much smaller than the number of doctorates granted. For example, data from the Report on New Doctoral Recipients (2012) (<http://www.ams.org/profession/data/annual-survey/2012Survey-NewDoctorates-Supp-TableE1.pdf>) shows that 1798 individuals received a doctorate in the mathematical sciences in the 2011-2012 year. In this same year, 680 tenure-track positions were filled in all mathematics departments, and 86 tenure-track positions filled in doctoral statistics and biostatistics departments combined (<http://www.ams.org/profession/data/annual-survey/2012Survey-RecruitmentHiring-Supp-TableR2.pdf>). The ratio of doctoral graduates to tenure track jobs filled is thus approximately 2.3. In addition, of the 1511 employed new doctoral recipients in 2012 whose employer was reported, 494 or 33% were employed outside of the academic sector (in the business, industry, government, or non-profit realm) for the first position after the Ph.D.

## II. PROGRAM DESCRIPTION

The long-range goal of the Enriched Doctoral Training in the Mathematical Sciences (EDT) program is to strengthen the nation's scientific competitiveness by increasing the number of well-prepared U.S. citizens, nationals, and permanent residents who pursue careers in the mathematical sciences and in other professions in which expertise in the mathematical sciences plays an increasingly important role. As indicated in the introduction, the EDT program will serve this long-range goal by supporting efforts by academic institutions or other qualified organizations to meet the **objective** of preparing doctoral students in the mathematical sciences who:

- will be well-equipped to recognize opportunities for the development of mathematics and statistics in problems from other disciplines, especially in challenges arising in business, industry, and government; and
- can effectively apply advanced mathematics and statistics to solve problems originating outside the traditional academic mathematical sciences setting.

The EDT program will support projects that include training in areas supplementary to the dissertation research theme and that are instrumental for connections with business, industry, government, and the non-profit sector. Supplementary training may for example include internships, research projects, consulting, and participation in complementary courses or summer schools. Projects are expected to train students to work in teams to refine, attack, and solve problems that are open-ended, not initially sharply formulated, and originate outside the academic mathematical realm. Projects should also provide opportunities that allow the students to develop strong oral and written communication skills in an interdisciplinary setting. While the solicitation allows requests for projects that vary in scope, the intention of this program is to support awards that will each benefit a cohort of students. The Division of Mathematical Sciences intends that the collection of projects funded will benefit students whose dissertation topics lie in all sub-fields of the mathematical sciences.

As a rule, EDT funding will not support entirely new doctoral student lines for departments, but rather will provide support for activities involving Ph.D. students that supplement their traditional training. Proposals should describe, and plans should attempt to minimize, any potential increase in the students' time to degree. EDT is not intended to support activities for students who might already be receiving this type of enriched training through a regular course of study. Instead, EDT projects should augment the experience of students who would not generally have the type of experience described.

The EDT program encourages collaborations that bring together investigators from different disciplines or from different sectors: academia, private industry, government laboratories, and non-profit organizations. In addition to proposals from institutions of higher education, the EDT program encourages the submission of proposals from professional organizations for activities that aim to enhance connections at the graduate level. Multiple models of implementation are possible, and the community is encouraged to be creative in this regard. EDT aims to develop a suite of pilot projects that will eventually be adapted more widely and grow into mainstream activities.

### III. AWARD INFORMATION

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

**Estimated Number of Awards:** 5 to 10

In determining the number and size of awards, NSF considers the advice of reviewers and availability of funds. It is projected that award recommendations will be made annually in January, with the exception of FY15 when awards will be made in March. Estimated program budget, number of awards, and average award size/duration are as follows but are subject to the availability of funds.

**Anticipated Funding Amount:** \$4,000,000

We anticipate that the total amount of money to be spent on this program annually will be approximately \$4,000,000. We anticipate that individual award sizes will vary depending on the scope of the project, but that the maximum award size will be \$600,000 in total for a three-year award.

### IV. ELIGIBILITY INFORMATION

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#### Who May Submit Proposals:

Proposals may only be submitted by the following:

- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.
- Academic institutions accredited in, and having a campus located in, the United States that grant doctoral degrees in the mathematical sciences.

#### 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:

There are no restrictions or limits.

#### Additional Eligibility Info:

**Participating graduate students supported with EDT funds must be citizens, nationals, or permanent residents of the United States and its territories and possessions.**

No citizenship requirement applies to Principal Investigators.

### V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

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#### A. Proposal Preparation Instructions

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

- 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=papp](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papp). Paper copies of the PAPPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from [nsfpubs@nsf.gov](mailto: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 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: ([http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=grantsgovguide](http://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

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 the NSF FastLane system. PAPPG Chapter II.D.3 provides additional information on collaborative proposals.

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

The following instructions **supplement** the GPG or NSF Grants.gov Application Guide guidelines.

1. **Cover Sheet.** The title of the project should begin "EDT: ...."
2. **Project Summary.** The project summary must clearly state the goals of the proposed EDT project.
3. **Project Description.** The project description is not to exceed 15 pages in length and must contain the following items:
  - a. **Results from Prior NSF Support** (if applicable), adhering to the specific guidelines set out in the GPG.
  - b. **Key Activities.** Provide a detailed plan for the EDT activities that support the **objective** described in the program description. Give examples of research areas and potential problems to be pursued with sufficient detail and references so that the intellectual merit can be evaluated. Describe how the proposed activities will better prepare graduates to recognize opportunities for contributions of mathematics and statistics in other disciplines and to apply advanced mathematics and statistics effectively. Include plans for partnerships, opportunities for students to develop communication and team-work skills, and mechanisms to educate students about the range of careers available to them. Describe the relationship of the proposed activities to any currently existing efforts.
  - c. **Recruitment.** Describe in detail the recruitment plan for all participants. The NSF is particularly interested in increasing the participation in the STEM disciplines of women, underrepresented minorities (African Americans, Hispanics, Native Americans, and Native Pacific Islanders), veterans, and persons with disabilities. In EDT awards, only those graduate students who are citizens or permanent residents of the United States or its possessions can be supported directly with EDT funds.
  - d. **Project Assessment, Evaluation, and Reporting.** The objective of the EDT program is to develop mechanisms for significantly increasing the number of U.S. Ph.D. degree holders in the mathematical sciences who
    - will be well-equipped to recognize opportunities for the application of mathematics and statistics in other disciplines, especially in challenges arising in business, industry, and government; and
    - can apply advanced mathematics and statistics to solve problems of interest originating outside the traditional academic mathematical sciences setting.

It is expected that individual proposers will refine this objective to create goals that are specific to their proposed projects. Grantees are responsible for determining if their EDT projects have met the goals that they define in their proposals. This includes obtaining baseline data from which to measure changes and reporting this baseline data in the proposal.

In particular, proposals must clearly identify the following: the goals to be achieved; the specific new activities to be conducted; the way in which these activities address the goals and the way in which these activities significantly differ from or enhance common practice; measurable proposed outcomes for the project; and specific methods for evaluation of the success of the activity and for assessment of progress toward the goals.

All projects should include an evaluation plan that describes both a strategy for continuous monitoring of the project to provide feedback for improvement (formative evaluation) and a strategy for evaluating the effectiveness of the project in achieving its goals and identifying positive and negative findings upon completion (summative evaluation). The principal investigator(s) may wish to engage educational research specialists in planning and implementing the project evaluation. Additionally, it is highly desirable to have a mechanism for tracking participating students beyond graduation in order to assess the impact of the project. Finally, grantees will be asked to help inform and participate in a coordinated assessment in order to ensure that NSF can understand the impact of the EDT-funded projects in the aggregate.

e. **Dissemination / Community-Building.** Proposals should clearly address dissemination of information about project outcomes. Investigators of EDT projects are expected to share the knowledge and experience gained in developing and assessing their graduate training innovations with the mathematics and statistics community. EDT aims to fund pilot projects that will enrich doctoral training in the mathematical sciences: dissemination to the mathematics and statistics community is therefore critical to the success of the program. This may be achieved in a number of ways, including websites, publications, publicly accessible databases, presentations, and workshops.

4. **Project Budget.** The proposal should include a detailed project budget and budget justification, as described in the GPG or NSF Grants.gov Application Guide. The budget justification should explain and justify major cost items and any unusual situations/inclusions. The budget may include items such as partial student stipends for U.S. citizens, nationals, and permanent residents, limited faculty salaries, support for coordination activities, equipment, and other direct costs (e.g., materials, publication costs). It should not include full funding for new graduate student trainee positions. Note that support of graduate trainees is in the form of stipends and should be entered as Participant Costs in Section F of the budget page. Proposers should request funds for up to two faculty members to travel to an annual PI meeting (US location to be determined) held to coordinate assessment and dissemination efforts and share information on effective practices.
5. **Supplementary Documentation (10-page limit).** Investigators must provide the baseline data against which they will measure the effectiveness of their EDT projects as a supplementary document. While all material relevant to determining the quality of the proposed work must be included within the 15-page Project Description or as part of the budget justification, proposers may, as a part of the Supplementary Documentation, include letters showing collaborator commitments and organizational commitments. Such letters are essential if the proposed activities include business, industry, government, or non-profit partners. Competitive proposals will have letters that demonstrate real commitment by partners to furthering the training of students. Letters of general endorsement are not permitted.

## B. Budgetary Information

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### Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

## C. Due Dates

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

November 12, 2014

July 08, 2015

Second Wednesday in July, Annually Thereafter

## D. FastLane/Grants.gov Requirements

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### For Proposals Submitted Via FastLane:

To prepare and submit a proposal via FastLane, see detailed technical instructions available at: <https://www.fastlane.nsf.gov/a1/newstan.htm>. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or e-mail [fastlane@nsf.gov](mailto:fastlane@nsf.gov). The FastLane Help Desk answers general technical questions related to the use of the FastLane system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

### For Proposals Submitted Via Grants.gov:

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: <http://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](mailto: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 are strongly encouraged to use FastLane 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

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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: [http://www.nsf.gov/bfa/dias/policy/merit\\_review/](http://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 *Investing in Science, Engineering, and Education for the Nation's Future: NSF Strategic Plan for 2014-2018*. 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

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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

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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

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### A. Notification of the Award

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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

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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 [http://www.nsf.gov/awards/managing/award\\_conditions.jsp?org=NSF](http://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF). Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from [nsfpubs@nsf.gov](mailto: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=papp](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papp).

### C. Reporting Requirements

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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=papp](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papp).

## VIII. AGENCY CONTACTS

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*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:

- Jennifer S. Pearl, telephone: (703) 292-4492, email: [jslimowi@nsf.gov](mailto:jslimowi@nsf.gov)
- Nandini Kannan, telephone: (703) 292-8104, email: [nakannan@nsf.gov](mailto:nakannan@nsf.gov)
- J. Matthew Douglass, telephone: (703) 292-2467, email: [mdouglas@nsf.gov](mailto:mdouglas@nsf.gov)
- Swatee Naik, telephone: (703) 292-4876, email: [snaik@nsf.gov](mailto:snaik@nsf.gov)

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: [fastlane@nsf.gov](mailto:fastlane@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](mailto:support@grants.gov).

## IX. OTHER INFORMATION

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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 <http://www.grants.gov>.

## ABOUT THE NATIONAL SCIENCE FOUNDATION

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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 <http://www.nsf.gov>

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|---|---------------------------------------|
| • <b>Location:</b>  | 4201 Wilson Blvd. Arlington, VA 22230 |
| • <b>For General Information</b><br>(NSF Information Center): | (703) 292-5111                        |
| • <b>TDD (for the hearing-impaired):</b>                      | (703) 292-5090                        |

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## 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 Systems of Records, [NSF-50](#), "Principal Investigator/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004), and [NSF-51](#), "Reviewer/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004). 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  
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