National Science Foundation Research Traineeship (NRT) Program

PROGRAM SOLICITATION
NSF 21-536

REPLACES DOCUMENT(S):
NSF 19-522

National Science Foundation

Directorate for Education and Human Resources
   Division of Graduate Education

Directorate for Biological Sciences

Directorate for Computer and Information Science and Engineering

Directorate for Engineering

Directorate for Geosciences

Directorate for Mathematical and Physical Sciences

Directorate for Social, Behavioral and Economic Sciences

Office of Integrative Activities

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

   February 25, 2021

   September 06, 2021

   September 6, Annually Thereafter

IMPORTANT INFORMATION AND REVISION NOTES

A letter of intent is no longer required for this program.

For FY2021, Artificial Intelligence (AI) and Quantum Information Science and Engineering (QISE) have been added to the national priority areas in which the NRT Program encourages proposals. We seek proposals on any interdisciplinary research theme of national priority, with special emphasis on AI and QISE and the six research areas within NSF's 10 Big Ideas. The NSF research Big Ideas are Harnessing the Data Revolution (HDR), The Future of Work at the Human-Technology Frontier (FW-HTF), Navigating the New Arctic (NNA), Windows on the Universe: The Era of Multi-Messenger Astrophysics (WoU), The Quantum Leap: Leading the Next Quantum Revolution (QL), and Understanding the Rules of Life: Predicting Phenotype (URoL). Proposals that align with one of these designated priority areas should contain a title to reflect that alignment, as described in the program solicitation (e.g., NRT-AI: title, NRT-HDR: title, NRT-QL: title).

Proposals may be submitted under two tracks (i.e., Track 1 and Track 2). Track 1 proposals may request a total budget (up to five years in duration) up to $3 million for projects with a focus on STEM graduate students in research-based PhD and/or master's degree programs. Track 2 proposals may request a total budget (up to five years in duration) up to $2 million; NSF requires that Track 2 proposals focus on programs from institutions not classified as Doctoral Universities: Very High Research Activity (R1). Requirements for Track 1 and Track 2 are identical.

Please note restrictions on institutional eligibility. The number of NRT proposal submissions allowed per institution remains limited to two (2) submissions total. The number of NRT proposal submissions per PI or co-PI remains limited to one (1) submission total.

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

June 1, 2020.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

National Science Foundation Research Traineeship (NRT) Program

Synopsis of Program:

The NSF Research Traineeship (NRT) 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. The program is dedicated to effective training of STEM graduate students in high priority interdisciplinary or convergent research areas, through a comprehensive traineeship model that is innovative, evidence-based, and aligned with changing workforce and research needs. Proposals are requested that address any interdisciplinary or convergent research theme of national priority, as noted above.

The NRT program addresses workforce development, emphasizing broad participation, and institutional capacity building needs in graduate education. The program encourages proposals that involve 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. NRT especially welcomes proposals that include partnership with NSF Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (INCLUDES) and leverage INCLUDES project efforts to develop STEM talent from all sectors and groups in our society (https://www.nsf.gov/news/special_reports/big_ideas/includes.jsp). Collaborations between NRT proposals and existing NSF INCLUDES projects should strengthen both NRT and INCLUDES projects.

Cognizant Program Officer(s):

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

- Daniel Denecke, telephone: (703) 292-8072, email: ddenecke@nsf.gov
- Vinod K. Lohani, telephone: (703) 292-2330, email: vlohani@nsf.gov
- John Weishampel, telephone: (703) 292-2162, email: jweisham@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: 18 to 20

NRT Track 1 Awards (14-16 awards each year) are expected to be up to five (5) years in duration with a total budget up to $3,000,000.

NRT Track 2 Awards (4-6 awards each year) are expected to be up to five (5) years in duration with a total budget up to $2,000,000.

Anticipated Funding Amount: $55,000,000

Estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.

Who May Serve as PI:

The PI must be on the faculty of the submitting institution.

Limit on Number of Proposals per Organization: 2

An eligible organization may participate in only two (2) proposals per NRT competition as lead or collaborative non-lead. All Track 1 and/or Track 2 NRT proposals will be counted toward this total limit of two proposals per organization.

Participation includes serving as a lead organization or non-lead organization on any proposal. Organizations participating only as evaluators on projects are excluded from this limitation. Proposals that exceed the organizational eligibility limit will be returned without review regardless of whether the organization on such a proposal serves as lead or non-lead collaborative organization. Only US IHEs are eligible to submit as a lead or non-lead organization. Potential PIs are advised to contact their institutional office of research regarding processes used to select proposals for submission.

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

An individual may serve as Principal Investigator (PI) or co-PI on only one (1) proposal submitted to the NRT 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 Grants.gov: *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov* guidelines apply (Note: The *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide).

B. Budgetary Information

- **Cost Sharing Requirements:**

  Inclusion of voluntary committed cost sharing is prohibited.

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

  Not Applicable

- **Other Budgetary Limitations:**

  Not Applicable

C. Due Dates

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

  February 25, 2021

  September 06, 2021

  September 6, Annually Thereafter

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:

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

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IX. **Other Information**

I. INTRODUCTION

Science, technology, engineering, and mathematics (STEM) graduate education is poised to undergo major transformations. There are multiple drivers for such 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 and demographic 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 convergent approaches, as well as broader professional training that is not characteristic of most graduate programs.[2] These realities and the increasing calls for new approaches to STEM graduate education represent an extraordinary opportunity. Accordingly, this NRT solicitation encourages proposals to test, develop, and implement innovative and effective STEM graduate education models, promote interdisciplinary and broad professional training of graduate students, broaden participation in the STEM workforce, and foster fundamental research advances in support of national priorities.

[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; Graduate STEM Education for the 21st Century, The National Academies of Sciences, Engineering and Medicine, 2018.; The Science of Effective Mentorship in STEMM, The National Academies of Sciences, Engineering and Medicine, 2019; Promising Practices for Addressing the Underrepresentation of Women in Science, Engineering, and Medicine: Opening Doors, The National Academies of Sciences, Engineering and Medicine, 2020.*

[2] *Convergence: Facilitating Transdisciplinary Integration of Life Sciences, Physical Sciences, Engineering, and Beyond , The National Academies of Sciences, Engineering and Medicine, 2014; Enhancing the Effectiveness of Team Science, The National Academies of Sciences, Engineering and Medicine, 2015.*

II. PROGRAM DESCRIPTION

A. Focus and Goals

The NRT Program is dedicated to shaping and supporting highly effective training of STEM graduate students in high priority interdisciplinary or convergent research areas through the use of comprehensive traineeship models that are innovative, evidence-based, and aligned with changing workforce and research needs. The goals of the program are to:

- Catalyze and advance cutting-edge interdisciplinary or convergent research in high priority areas;
- Increase the capacity of U.S. graduate programs to produce diverse cohorts of interdisciplinary STEM professionals with technical and transferable professional skills for a range of research and research-related careers within and outside academia; and
- Develop innovative approaches and knowledge that will promote transformative improvements in graduate education.

Creation of sustainable programmatic capacity at institutions is an expected outcome. Consequently, all proposals should describe mechanisms to institutionalize effective training elements after award expiration and provide appropriate documentation of institutional support for such efforts (see Full Proposal Content, section 8).

B. NRT Traineeship and Trainees

NRT traineeships are dedicated to the comprehensive development of graduate students as versatile STEM professionals for a range of research and research-related careers within and outside academia. Accordingly, proposals should focus on and demonstrate strong commitment to technical and professional training of STEM graduate students that emphasizes research training and extends beyond into other aspects of students' professional development. Specifically, NRT projects are expected to develop trainees' technical skills broadly, including facility and/or familiarity with the techniques, languages, and cultures of fields integral to the interdisciplinary or convergent research theme; foster the development of transferable professional skills; and provide trainees with mentoring and vocational counseling from professionals who have the

backgrounds, experience, and skills to advise trainees on how to prepare for a variety of STEM career pathways.

NRT is intended to benefit a population of STEM graduate students beyond those who receive an NRT stipend. An NRT trainee is thus defined as a STEM graduate student, irrespective of funding source, who is accepted into an institution's NRT program and completes the required NRT elements (e.g., courses, workshops, projects, and other training activities specific to the NRT experience) set by the program. To further maximize the number of students benefiting from NRT activities, proposers are expected to make available (within the capacity and budget limitations of the award) NRT program elements to other STEM graduate students who are not NRT trainees.

NRT trainees must be master's and/or doctoral STEM students in a research-based degree program that requires a thesis or dissertation. If an NRT proposal from an institution includes both master's and doctoral students, the proposal should identify any differences in NRT program requirements, as well as mechanisms to foster the development of a collective NRT graduate student community. NRT stipends and support for customary costs of education (tuition and required fees) are limited to U.S. citizens, nationals and permanent residents. However, international students can participate as non-stipend-supported NRT trainees or as non-trainees.

C. Key Features of NRT Projects

NRT projects demonstrate comprehensive approaches to graduate training and should include the following key features that are central to the NRT Program:

- Development of innovative and potentially transformative interdisciplinary approaches to STEM graduate education;
- Extension of NRT program elements to non-stipend-supported NRT trainees and to non-trainees to benefit a larger population of STEM graduate students across an institution;
- Dissemination of insights gained and results from NRT training approaches;
- Facilitation and advancement of novel, potentially transformative interdisciplinary or convergent research in areas of high priority to the nation; Comprehensive training of STEM graduate students, including the development of technical and professional skills for both research and research-related careers within and outside academia;
- Incorporation of evidence-based strategies to broaden participation of students from diverse backgrounds; and
- Implementation of robust program assessment and evaluation that is central to the traineeship and routinely informs and improves practice.

D. Priority Research Areas

The NRT Program accepts proposals in any interdisciplinary or convergent research theme of national importance, and encourages specific priority research areas that change periodically. All interdisciplinary or convergent research themes should align with NSF or other national STEM research priority areas and have high potential to develop novel, innovative practices in graduate education. Proposers should describe the importance of the NRT project's thematic focus to the nation and the particular need to train students for a variety of careers in that thematic area.

For FY2021 and FY2022, proposals are encouraged in the research areas of Artificial Intelligence (AI), Quantum Information Science and Engineering (QISE) and the six research areas in NSF's 10 Big Ideas. The NSF research Big Ideas are Harnessing the Data Revolution (HDR), The Future of Work at the Human-Technology Frontier (FW-HTF), Navigating the New Arctic (NNA), Windows on the Universe: The Era of Multi-Messenger Astrophysics (WoU), The Quantum Leap: Leading the Next Quantum Revolution (QL), and Understanding the Rules of Life: Predicting Phenotype (URoL). The FY2021 Budget Request to Congress includes an additional $15 million to include a special focus on artificial intelligence and artificial intelligence engineering.

All proposals, regardless of research area, must clearly describe an overarching interdisciplinary or convergent research focus and outline how the research theme will foster high-return, interdisciplinary synergies. Proposals should also describe how the training and research elements will be integrated and justify the need for bold and innovative approaches to train graduate students in the thematic area. In keeping with the broader goals of the NRT program, proposals should demonstrate significant impact on the design and testing of new curricula and career-focused training approaches specific to the research focus area. Proposals should also discuss the project's potential to have impact beyond the institution, including the possible broad adoption of approaches, curricula, and instructional material within the relevant disciplines.

E. Program Tracks

Proposals may be submitted under two tracks (i.e., Track 1 and Track 2).

Track 1 proposals may request a total budget (up to five years in duration) up to $3 million for projects with a focus on STEM graduate students in research-based PhD and/or master's degree programs. All Institutions of Higher Education (IHEs) accredited in, and having a campus located in the US, acting on behalf of their faculty members and that award a research-based master's degree and/or a doctoral degree in STEM disciplines supported by the National Science

Foundation are eligible to apply to Track 1.

Track 2 proposals may request a total budget (up to five years in duration) of up to $2 million. Eligibility to apply to Track 2 is limited to non-R1 Institutions of Higher Education (IHEs) accredited in, and having a campus located in the US, acting on behalf of their faculty members, that award a research-based master's degree and/or a research-based doctoral degree in STEM disciplines supported by the National Science Foundation. Such institutions include Master's Colleges and Universities that award fewer than 20 research/scholarship doctoral degrees per year, Doctoral/Professional Universities (D/PU) that award fewer than 20 research/scholarship doctoral degrees per year, and Doctoral Universities: High Research Activity (R2, as defined in the Carnegie classification of higher education institutions). **Doctoral Universities: Very High Research Activity (R1) are not eligible for Track 2 consideration.**

Other requirements for Track 1 and Track 2 are identical.

III. AWARD INFORMATION

Anticipated Type of Award: Standard Grant

Estimated Number of Awards: 18 to 20

NRT Track 1 Awards (14-16 awards each year) are expected to be up to five (5) years in duration with a total budget up to $3,000,000.

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Anticipated Funding Amount: $55,000,000

Estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

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Who May Serve as PI:

The PI must be on the faculty of the submitting institution.

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An eligible organization may participate in only two (2) proposals per NRT competition as lead or collaborative non-lead. All Track 1 and/or Track 2 NRT proposals will be counted toward this total limit of two proposals per organization.

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An individual may serve as Principal Investigator (PI) or co-PI on only one (1) proposal submitted to the NRT 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.

Additional Eligibility Info:

Proposals may only be submitted by the following:

- Track 1: All Institutions of Higher Education (IHEs) accredited in, and having a campus located in the US, acting on behalf of their faculty members and that award a research-based master's degree and/or a doctoral degree in STEM disciplines supported by the National Science Foundation.

- Track 2: Institutions of Higher Education (IHEs) accredited in, and having a campus located in the US, acting on behalf of their faculty members that award a research-based master's degree and/or a doctoral degree in STEM disciplines supported by the National Science Foundation including: Master's Colleges and Universities and D/PU Doctoral/Professional Universities that award fewer than 20 research/scholarship doctoral degrees and Doctoral Universities: High Research Activity (R2, as defined in the Carnegie classification of higher education institutions). Doctoral Universities: Very High Research Activity (R1) are not eligible for Track 2 consideration.

- Track 1 and Track 2: The NRT program encourages proposals from designated Minority Serving Institutions (Historically Black Colleges and Universities, Hispanic Serving Institutions, Tribal Colleges and Universities, Alaskan Native or Native Hawaiian-Serving Institutions, Asian American- and Native American Pacific Islander-Serving Institutions).

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 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 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. 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 documents described in Sections 1-11 below. The page limit for the Project Description is 20 pages. Required sections and subsections are indicated with a line preceding the section number to be used as a checkbox when reviewing final proposals for completion. Proposals that are missing required sections and/or exceed the 20-page limit for the Project Description will be returned without review.

_____**1. Cover Sheet:** Provide a short informative title that begins with the appropriate prefix. Titles for projects addressing a theme outside of the eight priority areas must begin with "NRT:". For projects targeting a specific priority area, use the following format: "NRT-priority area:" (e.g. NRT-AI; NRT-QISE; NRT-HDR; NRT-FW-HTF:, NRT-NNA:, NRT-QL:, NRT-URoL:, NRT:WoU:). If international activities are proposed, whether or not they will be funded via the NRT award, the international cooperative activities box should be checked and the individual countries listed. For planning purposes, use October 1, 2021 for the requested starting date for FY2021 competition and March 1 for FY2022 and subsequent competitions.

_____ **2. Project Summary** (1-page limit): Provide a summary description, in a section labeled Overview, that addresses the research area and theme, the training plan, and the research-education integration. The project summary Overview must include the expected number of NRT trainees who will receive an NRT stipend, the number of additional NRT trainees who will not receive an NRT stipend, and the estimated grand total number of graduate students that will participate in project-funded activities. The number should be disaggregated to make clear the estimated number of master's students, doctoral students, or both that the program will serve. 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. All project summaries must also include 5-10 keywords that describe the project's research and/or education focus area(s). This information is intended to assist in identifying reviewers with the knowledge and expertise needed to review the proposal. The list of keywords should be the last paragraph of the Overview section of the Project Summary. The keywords should describe the main scientific/engineering areas explored in the proposal. Indicate the Track (Track 1 or Track 2) for which the proposal should be considered. Keywords should be prefaced with "Keywords" followed by a colon and each keyword set should be separated by semicolons. Keywords should be of the type used to describe research in a journal submission and may include technical areas of expertise necessary to review the proposal. For example, they might appear as, Keywords: sustainability; nanotechnology; water resources; renewable energy; equity; Track1. Each NSF merit review criterion (Intellectual Merit and Broader Impacts) must be addressed in a separate labeled statement (see Chapter II.C.2.b of the PAPPG for additional instructions).

_____ **3. Project Description** (20-page limit): The Project Description must contain only Sections 3a through 3l as described below, with the provided headings used in the order listed. The Project Description cannot exceed 20 pages, including tables and illustrations. The relative attention given in the proposal narrative to the research and training elements should reflect the principal goal of the NRT program: highly effective training of STEM graduate students in an interdisciplinary or convergent research area through a comprehensive traineeship approach that comprises elements that are innovative, evidence-based, and aligned with changing workforce and research needs.

_____ **3a. List of Core Participants**: Specify, in tabular form, up to 10 core participants, including the PI, co-PIs, other faculty and senior personnel, lead evaluator, and external collaborators. Provide each individual's name, project role, departmental and/or institutional/organizational affiliation, and discipline(s). The lead evaluator must be one of the 10 core participants. These core participants must be the same ones for whom Biographical Sketches and Current and Pending Support information are included.

_____ **3b. Theme, Vision, and Goals:** Describe the overarching research theme, vision, and goals of the proposed NRT with a focus on implementing new approaches to training STEM graduate students in the targeted interdisciplinary or convergent (see Convergence Research at NSF) research area, through a comprehensive traineeship. Identify the potential of the NRT project to provide added value to the current degree programs and methods of graduate training at the institution(s). Emphasize the graduate training needs in the project's thematic research field, both at the host institution(s) and nationally. In addition, describe the need for professionals with master's and/or doctoral degrees in the project's thematic research area. Articulate how the proposed NRT project will foster interdisciplinary synergisms emerging from ongoing research activities and/or via NRT-funded initiatives. Describe how the proposed NRT complements and builds on other ongoing or prior institutional efforts to improve STEM graduate education. Proposers should describe how the NRT project would benefit STEM graduate students beyond NRT trainees and how training innovations from the program will be communicated broadly beyond the institution. Address implications of the proposed NRT project for broadening participation in STEM programs and STEM careers to students from underrepresented groups.

_____ **3c. Organization and Management:** Present the plans for the organization and management of the NRT project, including the responsibilities of key personnel and reporting lines. Describe how the leadership team will foster a sense of community among project participants (faculty, trainees, evaluator(s), staff, and collaborators) and convergence among the

disciplines through activities and practices. The PI must possess the scientific, teaching, and mentoring expertise and the project management experience necessary to lead and administer the NRT; core teams should represent research expertise in all of the primary fields engaged through the project. Projects should include an NRT Project Coordinator (50%-100%) as a member of the management team. Proposers should identify formal mechanisms for recurring, substantive communication with administrators (e.g., department chairs, college deans, graduate school dean(s), provost(s), and others) about the NRT's progress and any institutional barriers.

If a collaborative project is proposed, describe the role of the non-lead institution(s) and its (their) participating personnel, the organizational structure(s), and the mechanisms for project communication. A collaborative proposal should be submitted only if the partner institution(s) has (have) a significant role and substantially enhance(s) the training program. Collaborative projects involving trainees at more than a single lead institution should describe practices to ensure that trainees at the participating institution(s) are equal partners, with strong mentorship and comparable access to training activities.

_____ **3d. Education and Training:** The NRT program focuses on creating innovations in STEM graduate education within a traineeship environment to prepare the scientists and engineers of the future. Describe the adopted traineeship model and its components, including the justification and rationale for their inclusion, and how they are integrated with NRT research activities. The approaches should be innovative, evidence-based, aligned with changing workforce and research needs, transferable, and dedicated to developing versatile STEM professionals. Identify what is lacking in the current approaches to STEM graduate education institutionally and nationally and how the NRT will help meet those needs, both within the participating departments and across the institution(s). Projects should be aligned with institutional missions, and proposals should include evidence of that alignment to support the expected outcome of developing sustainable programmatic capacity at an institution.

The proposal should describe the STEM graduate population that will be served. Accordingly, the proposal should specify the anticipated numbers of NRT trainees supported with NRT stipends and NRT trainees not supported with NRT stipends. An estimate of the number of other STEM graduate students expected to take one or more of the NRT project's elements should also be provided. These numbers should distinguish doctoral and master's degree students.

NRT training is expected to span the duration of a student's master's or doctoral program. Thus, proposals should include a timeline of logically phased, progressive training elements over the entire degree program(s). Training should be integrated with degree program requirements so that the anticipated time-to-degree is not extended.

Projects must articulate explicit approaches to provide trainees with training and vocational counseling for both research and research-related careers, within and outside academia; preparation and structured use of individual development plans for trainees is highly recommended.

_____ **3e. Required skills and competencies**: Projects must provide explicit, formal training in:

_____ **3e(i). Communication**. Improved communication skills is an expected outcome of the NRT program and communication training should include minimum competencies. The communication training should prepare trainees to identify and explain the potential benefits and broader impacts of their research discoveries to a range of stakeholders, including policy makers and the general public.

_____ **3e(ii). Teamwork.** Improved skills in teamwork, team science, or collaboration is another expected outcome; projects should clarify how these skills will be developed, their relevance to the proposed interdisciplinary or convergent research.

_____ **3e(iii). Ethics.** Improved skills in ethical deliberation, ethical decision-making and/or competencies related to research ethics and social responsibility is another expected outcome of the NRT program. Projects should address: how the training will prepare trainees to conduct responsible research in a range of career environments, relevance of the training to the proposed interdisciplinary or convergent research, how students will develop competencies.

Appropriate rubrics to measure the above skills and mechanisms for regular, structured feedback to trainees should be described in the Performance Assessment/Project Evaluation section (3i, below).

_____ **3e(iv). Additional skills**: Additionally, projects should include plans to provide trainees with other transferable professional skills (e.g., project management, leadership, teaching, entrepreneurship, conflict resolution, mentorship, and outreach) that are relevant to the proposed research projects and potential trainee career paths.

Collaborations with non-academic partners (e.g., industry, national/government laboratories, non-government organizations, government agencies, independent laboratories, and research, education, outreach, and informal science centers) are encouraged to promote the trainees' professional development. Internships and international experiences are encouraged if they provide marked added value, including authentic mentorship by hosts. If internships are included, proposers should describe pre-internship orientation for trainees and hosts, duration, and expected outcomes. Letters of

support from internship host organizations are strongly encouraged (see section 11a, below). The NRT program encourages projects that foster development of a global perspective, through experiences abroad and/or activities at the home institution(s).

____ **3f. Major Research Efforts:** Describe examples of the novel, potentially transformative research that the NRT will catalyze through interdisciplinary synergies emerging from currently funded activities at the institution(s) and/or via separate NRT-funded interdisciplinary or convergent initiatives. Explain the need for the proposed NRT research and how it would substantially advance, inform, and transform research beyond funded initiatives already underway at the institution(s). NRT funding should be used to complement rather than supplant other research funding.

____ **3g. Broader Impacts:** The Project Description must contain, as a separate section labeled 'Broader Impacts' within the narrative, a discussion of how both the training components and the major research efforts will contribute more broadly to the achievement of societally relevant outcomes. Such outcomes in the context of NRT include, but are not limited to: development of a diverse, globally competitive STEM workforce; full participation of women, veterans, persons with disabilities, and underrepresented minorities in STEM; improved STEM education and educator/faculty development; enhanced infrastructure for research and education; increased partnerships and collaborations (both domestic and international) between academia, industry, and others. Proposers should indicate how the project will impact the training of STEM graduate students beyond the disciplines and institutions described in the proposal, contribute to the development and adoption of evidence-based teaching and learning practices, and advance research on effective models for graduate education. For further information see Chapter II.C.2.d of the PAPPG. *Please note that, as specified in the PAPPG, a separate section labeled "Intellectual Merit" is **not required** within the Project Description for proposals submitted to this solicitation.*

____ **3h. Recruitment, Mentoring, and Retention:** Describe plans for recruitment, mentoring, and retention of trainees with a particular emphasis on broadening participation of underrepresented groups, including but not limited to American Indians/Alaska natives, African Americans, Hispanics, Pacific Islanders (natives of Hawaii, Guam, Samoa), persons with disabilities, veterans, and/or women.

____ **3h(i). Demographic Table**. All proposals must include a TABLE with quantitative data showing recruitment (enrollment), retention, and graduation outcomes of graduate students from underrepresented groups and, separately, for majority students in participating departments for the five years preceding the submission date, including time-to-degree completion. Tables should include data on students from groups that will be the focus of project diversity efforts. Comparisons with national-level data are strongly encouraged. Proposals that do not include the required table will be returned without review.

____ **3h(ii). Diversification Strategy**. Proposals should describe in detail: the evidence base for the recruiting, mentoring, retention, and broadening participation strategies; the rationale for strategies that will be used to pursue diversity goals; and successes of any existing recruiting or retention programs that will be leveraged through the project. Proposers must explain how their processes for admission to the NRT program and their actions to broaden participation will be coordinated with the admissions policies and procedures of the department(s) and university. Proposers are especially encouraged to establish linkages, as appropriate, with the components of the national network of NSF INCLUDES projects (see https://www.nsf.gov/news/special_reports/big_ideas/includes.jsp).

____ **3i. Performance Assessment/Project Evaluation:** Projects should include plans to evaluate the success of the research and traineeship activities. In particular, the proposal should identify specific competencies and outcomes along with performance measures and an evaluation timetable. Although the focus should be on trainees, the evaluation plan should also assess how the NRT project affects faculty teaching and research, academic programs, and institutional policies regarding interdisciplinary collaboration in STEM graduate education. The assessment plan should describe how and when assessment outcomes would be shared with the project participants, including trainees and institutional administration. Describe mechanisms for regular feedback from the evaluator(s) and the trainees to the leadership team and how that feedback will inform the project implementation practices. Proposals should include plans for communicating assessment results both within the NRT community and more broadly through publications and professional meetings. Awardees should be prepared to contribute to NRT program evaluation, including participation in systematic data collection via NSF monitoring systems, contributions at NSF-sponsored PI meetings, and periodic cross-award, joint video conferences to share insights, effective practices, and evaluation findings.

The project team should ensure that the project benefits from an unbiased and external perspective in project assessment/evaluation activities. Project evaluator(s) can be from an internal or external assessment unit or consulting entity. If a project chooses to involve an individual or team from the lead or collaborating institution(s) in the evaluation, then the project must provide justification and explain how lack of bias is ensured. This section should also describe project evaluation sustainability plans including the efforts that will be made so that the assessment/evaluation tools that are developed/implemented during the project period are available to the academic community at the participating institution/s beyond the award period. The lead evaluator must be listed as one of the 10 core participants. This requirement does not

impact institutional eligibility, as organizations participating solely as project evaluators are excluded from the eligibility limit (see Section IV).

_____ **3j. Independent Advisory Committee**. An independent advisory committee composed of individuals external to the institution(s) is required to provide guidance on a regular basis. The committee should meet regularly to provide advice to the leadership team based on the evaluator's findings and other formal and informal information obtained from the leadership team, other participants, trainees, and administrators.

_____ **3k. Recent Student Training Experiences:** Describe the experience of the PI and co-PIs/senior personnel with leading or participating in STEM education and training over the past five years. Describe any overlap and/or complementarity between the training and the proposed NRT program.

_____ **3l. Results from Prior NSF Support:** The PI and co-PIs who have received NSF funding (including any current funding) from an award with an end date in the past five years must provide information on the prior award, major achievements, and relevance to the proposed NRT project. Individuals who have received more than one prior award must report on the award most closely related to the proposal. A 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.

_____ **4. References Cited:** For further information see Chapter II.C.2.e of the PAPPG.

_____ **5. Biographical Sketches:** Biographical sketches must be provided for the core participants (up to 10), including the lead evaluator, identified in Section 3a (see above); no additional biographical sketches are permitted. For new NSF requirements for Biographical Sketches, see: https://www.nsf.gov/bfa/dias/policy/biosketch.jsp.

_____ **6. Budget and Allowable Costs:** Provide an annual budget for up to five years. FastLane or Grants.gov will automatically generate a cumulative budget. The proposed budget for Track 1 proposals can be up to $3,000,000 (maximum). The proposed budget for Track 2 proposals can be up to $2,000,000 (maximum). Proposal budgets for both tracks should be consistent with the costs to develop, offer, administer, and evaluate the program elements (e.g., courses, workshops, internships) and the number of trainees supported financially with NRT stipends or from other sources. Indirect costs should be included on all subawards. Direct costs for explicit trainee support and programmatic elements must be commensurate with the goals specified in the proposal. All travel (both domestic and foreign) must be justified. For further information on allowable costs see Chapter II.C.2.g of the PAPPG.

_____ **6a. Trainee Support:** Include all trainee support (e.g., stipend, costs of education, travel) as **Participant Support Costs** in the budget. NRT stipend and education costs are intended for those trainees (i.e., research-based master's and/or doctoral students) whose research is aligned with the project's research theme. Trainees receiving stipend and cost-of-education support (i.e., NRT-funded trainees) must be full-time students and hold United States citizenship or national or permanent resident status. The NSF **minimum contribution** to NRT stipends is $34,000 per year per NRT-funded trainee for a 12-month appointment. Funded trainees are expected to minimally receive the equivalent of one year of $34K stipend support that may be distributed over their traineeship tenure. NRT-funded trainees cannot be charged tuition or any other required costs of education while they are receiving a NRT stipend. Thus, the budget should include customary costs of education (i.e., tuition and required fees) for NRT-funded trainees. Additional costs for all trainees (NRT-funded and non-NRT-funded) to participate in programmatic and training elements should be designated as Travel, Subsistence, or Other Participant Support Costs in the budget.

_____ **6b. Faculty/Senior Personnel Salaries:** Salary support must be consistent with contributions to the traineeship. Support for postdoctoral fellows is not allowed unless they explicitly have an instructional or other training role.

_____ **6c. Other Budget Items:** Other budget requests (e.g., non-trainee travel, equipment, and research support) must reflect the training focus of the program, including programmatic elements and non-NRT-stipend-supported trainee support. Projects should budget for an NRT Project Coordinator (50%-100% appointment) and an evaluator. The budget should include funds for the PI, one trainee, the Project Coordinator, and an evaluator to attend an annual NRT meeting in Washington, DC, plus funds for the PI to attend a one-day orientation meeting for new PIs in Washington, DC during the first year of the project.

Budget Justification: The Budget Justification must clearly explain how funds will be used in direct support of trainees and the traineeship program. For proposals with any subawards, each subaward must include a separate budget justification. See PAPPG Chapter II.C.2.g.

_____ **7. Current and Pending Support:** This must be provided for all core participants listed in section 3a. For new NSF requirements for Current and Pending Support, see: https://www.nsf.gov/bfa/dias/policy/cps.jsp.

_____ **8. Facilities, Equipment, and Other Resources**: Provide a description of the facilities and major instrumentation that

are available for training purposes. Inclusion of voluntary committed cost sharing is prohibited for NRT proposals. For further information see Chapter II.C.2.i of the PAPPG.

_____ **9. Supplementary Documentation:** Some supplementary documents are required (e.g., institutional support letter [maximum two pages], letters of collaboration for certain organizations that appear in the budget, and data management plan), while others are optional (e.g., partner letters of support [maximum one page]). Letters of collaboration have mandatory eligibility language that must be added. Proposals that lack required supplementary documents or that exceed the page limitations described below will be returned without review.

_____ **9a. Letters of Collaboration and Support:** One support letter, up to two pages in length and submitted as a Supplementary Document, is **required** from the appropriate senior university administrator at the lead institution and should describe institutional support for the traineeship program and how successful programmatic elements and any associated institutional policies and infrastructure will be sustained after award closure. A letter of collaboration (see PAPPG Chapter II.C.2.d(iv) and II.C.2.j) is **required** from each NRT-eligible partner organization (see Section IV) that appears in the budget. Each letter of collaboration must include the following appropriate statement at the conclusion of the letter: "*We agree to partner on this NRT project, understanding that serving as a non-lead organization on a proposal will count toward our organizational eligibility limit of two NRT proposals per annual competition.*" OR "*We agree to partner on this NRT project as a subawardee.*" Additionally, up to eight other letters of support, each no more than one page long, may be provided from partner organizations or institutions, including international ones, that play a significant collaborative role in the project. These letters of support should detail specific contributions (e.g., internships, laboratory access, mentorship) to the traineeship and would be submitted as Supplementary Documents. No letters should include endorsements or advocacy for the project.

_____ **9b. Data Management Plan:** All proposals are required to include a Data Management Plan of up to two pages as a separate Supplementary Document. 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 Directorates, Offices, Divisions, Programs or other NSF units are available on the NSF website at https://www.nsf.gov/bfa/dias/policy/dmp.jsp. The PI should follow the data management requirements and plans for the Directorate, Office, Division, Program, or other NSF unit most closely aligned with the research theme of the NRT traineeship. For more information see Chapter II.C.2.j of the PAPPG.

_____ **9c. Postdoctoral Mentoring Plan:** A Postdoctoral Mentoring Plan is required if postdoctoral fellows receive NRT support, which is allowed only if they participate in an instructional or other training capacity. Chapter II.C.2.j of the PAPPG should be consulted for additional information.

Single Copy Documents:

Collaborators & Other Affiliations: Information regarding collaborators and other affiliations must be separately provided for each individual identified among the 10 core participants, including the PI, co-PIs, other faculty and senior personnel, lead evaluator, and external collaborators. 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.

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):

    February 25, 2021

    September 06, 2021

    September 6, Annually Thereafter

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

- **Integration of Research and Education**

Does the proposal address training needs that are not currently available at the institution(s) and/or in disciplines? Are there clear and compelling connections between the training elements and the interdisciplinary research theme? If this is a new program, is the degree path clear or, if trainees are drawn from existing degree programs, is there clear integration of research and with the timeline, requirements, and milestones of those programs? Is there indication that program activities will persist beyond the duration of the award?

- **Interdisciplinarity or Convergence**

What is the degree of interdisciplinarity or convergence and the potential for high impact synergies among the disciplines? Does the core team include appropriate expertise in the relevant fields? Does the interdisciplinary plan engage multiple disciplines appropriately to solve the research problems identified? Will the proposed convergent research and training integrate knowledge, methods, and expertise from different disciplines to potentially form novel frameworks to catalyze scientific discovery and innovation?

- **Professional Development**

What is the breadth and quality of the plan to provide NRT trainees with professional development training for a range of research and research-related career pathways, both within and outside academia? Does the project provide the required communications and teamwork, team science or collaboration training and ethics training? Are the training expectations sufficient, and are they structured in such a way that they will not hinder trainee research or degree progress?

- **Integrating Diversity into NSF Programs, Projects, and Activities**

What is the quality of the recruiting and retention plans to broaden participation? Does the plan represent a realistic path given the baseline data reflected in the Demographic Table? Is there evidence of sufficient engagement of key personnel? Are collaborations and/or existing programs appropriately engaged?

- **Evaluation**

Does the evaluation plan include outcomes, performance measures, benchmarks, and an evaluation timetable, as well as a description of how formative evaluation will improve practice? Are research and educational activities addressed? Is there a plan to share insights, practices, and findings broadly? Will the evaluation generate evidence to inform and document program sustainability?

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.

PIs will be required to submit annual and final project reports that differ from the standard reporting format contained in Research.gov. Instructions for preparing and submitting such reports will be provided to the PI.

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:

- Daniel Denecke, telephone: (703) 292-8072, email: ddenecke@nsf.gov

- Vinod K. Lohani, telephone: (703) 292-2330, email: vlohani@nsf.gov

- John Weishampel, telephone: (703) 292-2162, email: jweisham@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.

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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**   (703) 292-5111
  (NSF Information Center)**:**

- **TDD (for the hearing-impaired):** (703) 292-5090

- **To Order Publications or Forms:**

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

  or telephone: (703) 292-8134

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

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

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

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Suzanne H. Plimpton
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