

NSF 24-566: National Science Foundation Research Traineeship Institutional Partnership Pilot (NRT-IPP) Program

Program Solicitation

Document Information

Document History

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National Science Foundation

Directorate for STEM Education

Division of Graduate Education

Directorate for Technology, Innovation and Partnerships

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

July 22, 2024



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This National Science Foundation Research Traineeship Institutional Partnership Pilot (NRT-IPP) Program represents a collaboration between the Directorates for STEM Education (EDU) and Technology, Innovation, and Partnerships (TIP). The key goal of this program is to pilot a new partnership approach that will support research and education projects with high industry relevance and that may subsequently be integrated as a separate Track of [the NRT program](#).

Proposals submitted in response to this solicitation must represent an effective partnership among: (a) a non-R1 Institution of Higher Education (IHE) (lead institution), (b) an non-lead IHE (an R1 or non-R1) that has either an ongoing or completed NRT program in at least one of the focus areas defined for this pilot (see below), and (c) two to three industry partners in the same focus area(s). For R1 and non-R1 IHE classifications, please refer to Carnegie Basic Classifications: <https://carnegieclassifications.acenet.edu/carnegie-classification/classification-methodology/basic-classification/> .

The NRT project at the participating non-lead IHE partner should have successfully completed at least three years of work, as demonstrated by three approved annual reports at the time of submission. The lead institution should not have an existing master's degree in the chosen focus area(s). Investigators from a lead institution that has an existing graduate certificate, a track within an existing master's program that is broader than or distinct from the chosen focus area(s), or a Ph.D. program in one or more of the chosen focus areas are encouraged to contact the Program Officers to inquire about eligibility.

Focus Areas:

1. Artificial intelligence, machine learning, autonomy, and related advances.
2. High performance computing, semiconductors, and advanced computer hardware and software.
3. Quantum information science and engineering.
4. Robotics, automation, and advanced manufacturing.
5. Natural and anthropogenic disaster prevention or mitigation.
6. Advanced communications technology and immersive technology.
7. Biotechnology, medical technology, genomics, and synthetic biology.
8. Data storage, data management, distributed ledger technologies, and cybersecurity, including biometrics.
9. Advanced energy and industrial efficiency technologies, such as batteries and advanced nuclear technologies, including but not limited to, for the purposes of electric generation (consistent with section 15 of the National Science Foundation Act of 1950 (42 U.S.C. 1874)).
10. Advanced materials science, including composites 2D materials, other next-generation materials, and related manufacturing technologies.

Please note restrictions on institutional eligibility detailed in Section IV of this solicitation. The number of NRT proposal submissions allowed per lead institution is limited to two (2) submissions total in response to this solicitation. A non-lead IHE NRT project partner can participate in only one (1) proposal in response to this solicitation. The number of NRT proposal submissions per PI or co-PI is limited to one (1) submission total. Eligible non-R1 institutions may submit proposals as either lead institutions, non-lead institutions, or both, with a total institutional limit of three (3) proposals per institution.

Any proposal submitted in response to this solicitation should be submitted in accordance with the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) that is in effect for the relevant due date to which the proposal is being submitted. The NSF PAPPG is regularly revised and it is the responsibility of the proposer to ensure that the proposal meets the requirements specified in this solicitation and the applicable version of the PAPPG. Submitting a proposal prior to a specified deadline does not negate this requirement.

Summary Of Program Requirements

General Information

Program Title:

National Science Foundation Research Traineeship Institutional Partnership Pilot (NRT-IPP) 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 science, technology, engineering, and mathematics (STEM) careers. This solicitation describes a pilot for a potential new track for the existing [NRT Program](#) that will support research and education projects that will result in a new master's degree, certificate, or a track within an existing master's or Ph.D. program with high industry relevance in at least one focus area identified in this pilot. This will be accomplished through an effective partnership among: (a) a non-R1 Institution of Higher Education (IHE) (lead institution), (b) an non-lead IHE (an R1 or non-R1) that has either an ongoing or completed NRT program in at least one of the focus areas defined for this pilot (see below), and (c) two to three industry partners in the same focus area(s). The overall purpose is to train the STEM workforce in focus areas specified in this solicitation by stimulating collaborations among non-R1 institutions, institutions with existing or completed NRT projects, and industry partners.

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
- Daniel R. Marena, telephone: (703) 292-2157, email: dmarena@nsf.gov
- Rebecca Shearman, telephone: (703) 292-7403, email: rshearman@nsf.gov
- Elizabeth A. Webber, telephone: (703) 292-4316, email: ewebber@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 --- STEM Education
- 47.079 --- Office of International Science and Engineering
- 47.083 --- Office of Integrative Activities (OIA)
- 47.084 --- NSF Technology, Innovation and Partnerships

Award Information

Anticipated Type of Award: Continuing Grant

Estimated Number of Awards: 5

NRT-IPP awards (approximately 5 awards each year) are expected to be up to five (5) years in duration with a total budget up to \$4,500,000.

No more than 30% of the total award budget can be provided to the non-lead IHE partner. Collaborative proposals may only be submitted as a single proposal, in which a single award is being requested (with subawards administered by the lead organization). Simultaneous submission of collaborative proposals from different organizations, with each organization requesting a separate award, is not permitted.

Anticipated Funding Amount: \$15,000,000

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:

- Proposals submitted in response to this solicitation must represent a partnership among: (a) a non-R1 Institution of Higher Education (IHE) (lead institution), (b) a non-lead IHE (an R1 or non-R1) that has either an ongoing or completed NRT program in at least one of the focus areas defined for this pilot (see below), and (c) two to three industry partners in the same focus area(s). For R1 and non-R1 IHE classifications, please refer to Carnegie Basic Classifications: <https://carnegieclassifications.acenet.edu/carnegie-classification/classification-methodology/basic-classific>. The NRT project at the participating non-lead IHE partner must have successfully completed at least three years of work, as demonstrated by three approved annual project reports at the time of proposal submission. The lead institution should not have an existing master's degree in the chosen focus area(s). Investigators from a lead institution that has an existing graduate certificate, a track within an existing master's program that is broader than or distinct from the chosen focus area(s), or a Ph.D. program in one or more of the chosen focus areas are encouraged to contact the Program Officers to inquire about eligibility.

Who May Serve as PI:

The PI must hold a tenured faculty appointment at the Associate/Full Professor rank or equivalent at an eligible non-R1 organization.

Limit on Number of Proposals per Organization: 2

Eligible non-R1 IHEs may submit up to two (2) proposals as lead institution.

Eligible R1 and non-R1 IHEs may participate in one (1) proposal as a non-lead partner.

Eligible non-R1 institutions may submit a total of up to three (3) proposals per institution regardless of whether they are a lead or non-lead.

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 this program solicitation.

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

B. Budgetary Information

- **Cost Sharing Requirements:**

Inclusion of voluntary committed cost sharing is prohibited.
- **Indirect Cost (F&A) Limitations:**

Not Applicable
- **Other Budgetary Limitations:**

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

C. Due Dates

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

July 22, 2024

Proposal Review Information Criteria

Merit Review Criteria:

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

Award Administration Information

Award Conditions:

Standard NSF award conditions apply.

Reporting Requirements:

Standard NSF reporting requirements apply.

I. Introduction

Science, technology, engineering, and mathematics (STEM) graduate education is in need of major transformations. There are multiple factors driving the need for change including: (i) recent major national reports on the state of STEM graduate education; (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; (v) the potential to align graduate education practices and models with an understanding of how people learn; and (vi) calls for new models for graduate education at the national and international levels leveraging the high impact educational practices that enhance student engagement and increase student success. [1][2][3][4][5][6][7][8][9][10][11] In addition, there is increasing recognition that addressing the grand challenges in science and engineering requires approaches that are interdisciplinary and [convergent](#), (e.g., where knowledge, theories, methods and data and research communities from multiple disciplines increasingly mingle and where new frameworks, paradigms, and even disciplines may emerge), broader geographic distribution of research and educational opportunities shaping the U.S. STEM workforce including in EPSCoR jurisdictions, as well as broader professional training than is currently characteristic of most graduate programs. [11][12][13]

Employment in STEM occupations has grown 79% since 1990, and the last decade has seen a steady upward trend in the percent of STEM doctoral degree recipients in the United States pursuing careers in industry or business. Industry internships and related experiential learning opportunities provide an important form of professional development for these careers that require interdisciplinary problem solving, team science, and effective communication skills. To recognize the increasing appeal and availability of career paths in industry for today's STEM master's and PhDs, and to build the national STEM workforce needed to lead, innovate and meet national priorities in critical fields, new approaches to STEM graduate education are needed. Accordingly, this pilot for a potential new track for [the NRT Program](#) encourages proposals to test, develop, and implement innovative and effective STEM graduate education models leading to industry-relevant graduate programs (a master's degree, certificate, or track within an existing graduate program) at non-R1 institutions in collaboration with: (i) industry partners, and (ii) partners at institutions of higher education (IHEs) who have successfully implemented/are implementing NRT projects in the chosen focus area(s) identified for this pilot for a new track for NRT. [14][15][16][17][18][19]

[1] *The Path Forward: The Future of Graduate Education*, Commission on the Future of Graduate Education in the United States, 2010

[2] *Advancing Graduate Education in the Chemical Sciences*, American Chemical Society, 2012

[3] *Biomedical Research Workforce Working Group Report*, National Institutes of Health, 2012

[4] *Understanding PhD Career Pathways for Program Improvement*, Council of Graduate Schools, 2014

[5] *Revisiting the STEM Workforce: A Companion to Science and Engineering Indicators 2014*, National Science Board, 2015

[6] *Professional Development: Shaping Effective Programs for STEM Graduate Students*, Council of Graduate Schools, 2017

[7] *Graduate STEM Education for the 21st Century*, The National Academies of Sciences, Engineering and Medicine, 2018

- [8] *The Science of Effective Mentorship in STEM*, The National Academies of Sciences, Engineering and Medicine, 2019
- [9] *Promising Practices for Addressing the Underrepresentation of Women in Science, Engineering, and Medicine: Opening Doors*, The National Academies of Sciences, Engineering and Medicine, 2020
- [10] "PhD training is no longer fit for purpose — it needs reform now", Editorial, *Nature*, 613, 414 (2023).
- [11] *Convergence: Facilitating Transdisciplinary Integration of Life Sciences, Physical Sciences, Engineering, and Beyond*, The National Academies of Sciences, Engineering and Medicine, 2014
- [12] *Enhancing the Effectiveness of Team Science*, The National Academies of Sciences, Engineering and Medicine, 2015
- [13] Kuh, G.D., *High-Impact Educational Practices: What They Are, Who Has Access to Them and Why They Matter. Report from the Association of American Colleges and Universities*, 2008
- [14] *Women and Men in STEM Often at Odds Over Workplace Equity*, Pew Research Center, 2018
- [15] *Survey of Earned Doctorates (SED) 2022*, National Center for Science and Engineering Statistics, National Science Foundation, September 2023
- [16] Juskewitz, E, Heck, K.A., Banono, N.S., 'Why industry internships can be your golden ticket to a prosperous career', *Nature* (2021), March 18, 2021
- [17] Jain, H., Urban, N., Calabrese, G.S., 'PhD training: exposing obstacles to reform', *Nature*, 615, 216 (2023)
- [18] Jain, H., Dierolf, V., Jagota, A., Pan, Z., Urban, N., 'Redesigning US STEM doctoral education to create a national workforce of technical Leaders', *Proc. 2023 Annual Conference of the American Society for Engineering Education. June 25-28, Baltimore, MD*
- [19] Funk, C. and Parker, K. *Diversity in the STEM Workforce Varies Widely Across Jobs*, Pew Research Center, 2018

II. Program Description

A. Focus and Goals

The [NRT Program](#) is dedicated to shaping and supporting effective training of STEM graduate students in high priority interdisciplinary or convergent research areas using 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.

The pilot program described in this solicitation advances these goals with an emphasis on specific focus areas. The overall purpose of the pilot program is to stimulate collaborations among non-R1 institutions, current or former NRT awardee institutions, and industry partners. The program is expected to develop sustainable programmatic capacity at the lead institutions for training members of the STEM workforce in the specific focus areas. The program will also lead to development of successful models of collaboration between non-R1 institutions and institutions with active/successful NRT programs.

B. NRT Traineeships 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. This pilot for a potential new track for the NRT program seeks proposals that focus on providing experiential learning experiences to trainees in addition to their

research and education activities by leveraging experiences of (i) the project leadership team (lead non-R1 IHE institution and R1 or non-R1 non-lead IHE partner) and (ii) 2-3 industry partners identified for the project. Proposed curricula and experiences should prepare trainees to solve interdisciplinary and/or convergent research problems, work in diverse teams, and be able to communicate information about problems and solutions effectively.

The NRT program 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 program's required NRT elements (e.g., courses, workshops, projects, and other training activities specific to the NRT experience). Typically, a successful NRT project includes both funded and non-funded trainees.

To further maximize the number of students benefiting from NRT activities, proposers are expected to make NRT program elements available to other STEM graduate students who are not NRT trainees (within the capacity and budget limitations of the award).

NRT trainees for this pilot should be graduate students with an interest in the focus area(s) chosen for the project. NRT stipends and support for customary costs of education (tuition and required fees) are limited to U.S. citizens, nationals, and permanent residents. However, students who are not eligible for stipend and tuition support can participate as non-stipend-supported NRT trainees or as non-trainees and can receive a lump sum support for research supplies, travel, or other NRT-project-relevant activity within the limitations of the budget.

C. Key Features of NRT Projects

NRT projects demonstrate comprehensive approaches to graduate training, and this pilot for a potential new track for NRT seeks proposals that include the following key features that are central to the [NRT Program](#):

- Development of innovative and potentially transformative interdisciplinary approaches to STEM graduate education (for the purposes of this solicitation, in one or more focus areas identified above);
- Extension of NRT project 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;
- Comprehensive training of STEM graduate students, including the development of technical and professional skills for careers (for this solicitation, in industries related to one or more focus areas);
- 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. Focus Areas

The focus areas for this pilot for a new track for NRT are listed below. The focus area(s) of the proposal and the national workforce need in the chosen focus area(s) should be clearly identified.

1. Artificial intelligence, machine learning, autonomy, and related advances.
2. High performance computing, semiconductors, and advanced computer hardware and software.
3. Quantum information science and engineering.
4. Robotics, automation, and advanced manufacturing.
5. Natural and anthropogenic disaster prevention or mitigation.
6. Advanced communications technology and immersive technology.
7. Biotechnology, medical technology, genomics, and synthetic biology.
8. Data storage, data management, distributed ledger technologies, and cybersecurity, including biometrics.

9. Advanced energy and industrial efficiency technologies, such as batteries and advanced nuclear technologies, including but not limited to for the purposes of electric generation (consistent with section 15 of the National Science Foundation Act of 1950 (42 U.S.C. 1874)).
10. Advanced materials science, including composites 2D materials, other next-generation materials, and related manufacturing technologies.

III. Award Information

Anticipated Type of Award: Continuing Grant

Estimated Number of Awards: 5

NRT IPP awards (approximately 5 awards each year) are expected to be up to five (5) years in duration with a total budget up to \$4,500,000.

No more than 30% of the total award budget can be provided to the non-lead IHE partner. Collaborative proposals may only be submitted as a single proposal, in which a single award is being requested (with subawards administered by the lead organization). Simultaneous submission of collaborative proposals from different organizations, with each organization requesting a separate award, is not permitted.

Anticipated Funding Amount: \$15,000,000

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:

Proposals may only be submitted by the following:

- Proposals submitted in response to this solicitation must represent a partnership among: (a) a non-R1 Institution of Higher Education (IHE) (lead institution), (b) a non-lead IHE (an R1 or non-R1) that has either an ongoing or completed NRT program in at least one of the focus areas defined for this pilot (see below), and (c) two to three industry partners in the same focus area(s). For R1 and non-R1 IHE classifications, please refer to Carnegie Basic Classifications: <https://carnegieclassifications.acenet.edu/carnegie-classification/classification-methodology/basic-classific>. The NRT project at the participating non-lead IHE partner must have successfully completed at least three years of work, as demonstrated by three approved annual project reports at the time of proposal submission. The lead institution should not have an existing master's degree in the chosen focus area(s). Investigators from a lead institution that has an existing graduate certificate, a track within an existing master's program that is broader than or distinct from the chosen focus area(s), or a Ph.D. program in one or more of the chosen focus areas are encouraged to contact the Program Officers to inquire about eligibility.

Who May Serve as PI:

The PI must hold a tenured faculty appointment at the Associate/Full Professor rank or equivalent at an eligible non-R1 organization.

Limit on Number of Proposals per Organization: 2

Eligible non-R1 IHEs may submit up to two (2) proposals as lead institution.

Eligible R1 and non-R1 IHEs may participate in one (1) proposal as a non-lead partner.

Eligible non-R1 institutions may submit a total of up to three (3) proposals per institution regardless of whether they are a lead or non-lead.

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 this program solicitation.

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 proposal.

Additional Eligibility Info:

Collaborative proposals may only be submitted as a single proposal, in which a single award is requested (with subawards administered by the lead organization). Simultaneous submission of collaborative proposals from different organizations, with each organization requesting a separate award, are not permitted.

The lead institution should not have an existing graduate program (master's degree) in the chosen focus area. Investigators from lead institutions that have an existing graduate certificate or a track within an existing graduate program in the chosen focus area are encouraged to contact the Program Officers to inquire about eligibility. The non-lead partner's NRT program must have successfully completed at least three years indicated by three approved annual reports at the time of submission.

Participation includes serving as a lead organization or non-lead partner 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 IHE partner. Only US IHEs are eligible to submit as a lead or non-lead partner. Potential PIs are advised to contact their sponsored research office regarding institutional processes used to select proposals for submission.

V. Proposal Preparation And Submission Instructions

A. Proposal Preparation Instructions

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

- Full Proposals submitted via Research.gov: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal and Award Policies and Procedures Guide* (PAPPG). The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg. Paper copies of the PAPPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov. The Prepare New Proposal setup will prompt you for the program solicitation number.
- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov*. The complete text of the *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide). To obtain copies of the Application

Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov.

See PAPPG Chapter II.D.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 or deviate from the guidance in the PAPPG:

Proposal Set-up: Select "Prepare New Full Proposal" in Research.gov. Search for and select this solicitation title in Step One of the Full Proposal wizard. In the proposal details section, select "Single proposal (with or without subawards)." Separately submitted collaborative proposals are not permitted and will be returned without review.

Project Title: Provide a short informative title that must begin with "NRT-IPP:".

1. **Cover Sheet:** If international activities are proposed, whether or not they will be funded via the NRT award, the international activities box should be checked and the individual countries listed. For planning purposes, use September 15, 2024 for the requested starting date for the FY2024 competition.

2. **Project Summary:** The **Project Summary** must include the following sections: Overview, Intellectual Merit, and Broader Impacts. *Overview:* Provide a summary description, in a section labeled Overview, that addresses the focus area and justification for picking the non-lead IHE partner and how this collaboration with the non-lead partner will help develop research and traineeship activities at the non-R1 lead institution. The selection and engagement of the industry partners should be clearly highlighted. This section should include a succinct statement about regional or national workforce needs in the proposed focus area, and describe why employees with STEM graduate credentials are needed. The 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 total number of graduate students that will participate in project-funded activities at both lead institution and non-lead IHE partner. The number should be disaggregated between the lead institution and non-lead partner. The Overview 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. *Keywords:* The last line of the Overview section must also include 8-10 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 keywords should describe the main scientific/engineering areas explored in the proposal. Keywords should be prefaced with the word "Keywords" followed by a colon and each keyword set should be separated by semicolons. For example, they might appear as, Keywords: semiconductors; biotechnology; robotics; advanced materials; quantum information science and engineering; equity.

3. **Project Description (20-page limit):** The Project Description must contain only Sections 3a through 3o as described below, with the provided headings used and in the order listed. **The Project Description cannot exceed 20 pages, including tables and illustrations.**

3a. **List of Core Participants:** Include a table on page 1 of the Project Description that lists up to 10 core participants, including the PI, co-PIs, and other Senior/Key personnel including other faculty, lead evaluator, and external collaborators. The core participants must be designated as Senior/Key personnel in the proposal and must provide the Senior/Key Personnel Documents required by the PAPPG. At least five (5) core participants should be affiliated with the lead institution. The program will allow one (1) PI and up to four (4) co-PIs, including at least two (2) co-PIs from the lead institution and at least one (1) co-PI from the non-lead IHE partner. Remaining core participants should be listed as Other Senior/Key personnel. Core participants may include one (1) co-PI from an industry partner, but this is not required. Provide each core participant's name, project role, departmental and/or institutional/organizational affiliation, and discipline(s). The lead evaluator (internal or external) must be one of the 10 core participants and should be recruited by the lead institution. It is acceptable to recruit the lead evaluator associated with the ongoing or completed NRT project at the non-lead institutional partner but this is not a requirement.

3b. Focus Area(s) and Brief Description of the Accomplishments of the NRT Program at the non-lead Institutional Partner: Clearly identify the focus area(s) of the project and justify inclusion of the ongoing/completed NRT project in this proposal by highlighting the accomplishments of the chosen NRT project that will be leveraged to accomplish the goals of this project. The non-lead partner must have demonstrated expertise in developing an innovative research and traineeship model that addresses the focus area that the project team has identified for this project. Additionally, the team (lead institution and/or non-lead partner) must demonstrate prior successful collaboration with two to three industry partners who are recruited to participate in the project. Clearly address the experiential learning opportunities that were or are being provided to trainees at the non-lead partner in collaboration with industry partners in the ongoing/completed NRT project and how these opportunities will be leveraged to develop experiential opportunities for the trainees in the planned program at the lead institution. The commitment of the industry partner(s) for the proposed activities in the proposal should be clearly articulated in the Industry Support Letters. Additional details are provided below.

3c. Vision and Goals: Describe the overarching research theme, vision, and goals of the proposed NRT-IPP with a focus on implementing new approaches to training STEM graduate students in the targeted focus area at the lead institution through a comprehensive traineeship model that will lead to developing new graduate-level opportunities (master's program, certificate, or track in an existing master's or PhD program, etc.) in the focus area at the lead institution. Clearly describe how: (i) this NRT-IPP will create graduate-level opportunities (master's degree, certificate, or a track within an existing master's or PhD program) at the lead institution, (ii) experiential learning will be incorporated into the proposed graduate opportunity leveraging the successful experiences of the project team, and (iii) prior industry collaboration of the leadership team (lead and non-lead partner(s)) will be leveraged to recruit industry partners for this project. Proposers should describe how the NRT project would benefit STEM graduate students beyond the NRT trainees at the lead institution and how training innovations from the program will be communicated broadly beyond both the lead institution and non-lead institutional partner. Proposals should also address implications of the proposed NRT project for broadening participation in STEM programs and careers to include students from underrepresented groups.

3d. Organization and Management: Present the plans for the organization and management of the NRT-IPP project, including the responsibilities of key personnel and reporting lines at both the lead institution and non-lead institutional partner. Describe how the leadership team will foster a sense of community among project participants (faculty, trainees, evaluator(s), staff, and collaborators) from the lead institution, non-lead partner, and industry partners. The PI must possess the project management experience necessary to lead and administer the project; core teams should represent relevant expertise in all of the primary fields engaged through the project. Projects should include a full-time Project Coordinator (75%-100%) at the lead institution as a member of the management team. Proposers from the lead institution should clearly identify formal mechanisms for recurring, substantive communication with administrators (e.g., department chairs, college deans, graduate school dean(s), provost, and others) about any institutional barriers in implementing the proposed graduate opportunity at the institution.

3e. 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 non-lead partner's traineeship model and the experiential learning components that will be incorporated, including the justification and rationale for their inclusion. Describe how non-lead partner's experiences will be leveraged to develop the NRT project at the lead institution. Approaches should be innovative, evidence-based, and aligned with the needs of the lead institution in the chosen focus area. Identify what is lacking in the current approaches to STEM graduate education nationally and at the lead institution and how this NRT project will help address those issues. Projects should be aligned with the mission of the lead institution, and proposals should include evidence of alignment to support the expected outcome of developing sustainable programmatic capacity at the lead institution.

The proposal should describe the STEM graduate population that will be served at the lead institution. Accordingly, the proposal should specify the anticipated numbers of NRT trainees at the lead institution 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. Experienced trainees associated with the ongoing or completed NRT project from the non-lead partner can also be funded through the NRT-IPP Program, particularly if these trainees help implement the proposed NRT-IPP project at the lead institution.

Projects must articulate explicit approaches to provide trainees with training and vocational counseling for industry-related careers. Additionally, preparation and structured use of annual updated individual development plans is required and must be certified in annual and final annual project reports. See PAPPG Chapter VII.B.7.

It is expected that the project will result in a sustainable programmatic capacity at the lead institution. Therefore, all proposals should include a plan to institutionalize effective training elements after award expiration and provide appropriate supplementary documentation of institutional support for such efforts. See Section 6a, below.

3f. Required Skills and Competencies: Projects must provide explicit, formal training to project trainees in communication, team science, and ethics. Clearly articulate how the professional development activities developed at the non-lead partner will be adopted/adapted to provide training in these three required skills (and other skills as appropriate) to the trainees from the lead institution. Provide separate sub-headings for: 3f(i) Communication, 3f(ii) Team Science, and 3f(iii) Ethics when discussing these professional development components. Additionally, include another sub-section (3f(iv)) to discuss Additional skills (e.g., interdisciplinary problem solving, project management, leadership, organizational, entrepreneurship, etc.) that are particularly relevant to the proposed career paths of trainees in the chosen focus area.

3g. Industry Partnership Plan: Active engagement of the industry partners is a critical component of the NRT-IPP Program. The project team must demonstrate a proven track record of working with industry to offer experiential learning opportunities for the trainees. Experiences of the team (lead institution and non-lead partner) should be leveraged to develop the traineeship program, including experiential learning opportunities for the trainees. Clearly describe the experiential learning component of the traineeship program that will be implemented at the lead institution. Support letter(s) from the industry partners must be included that will clearly highlight the roles and commitment of these partners in implementing the NRT project in collaboration with the lead institution and non-lead partner. See section 9 for additional details.

3h. Major Research Efforts: Describe examples of the research projects that the NRT will catalyze at the lead institution through the proposed collaboration with the non-lead institutional partner and industry partners. Clearly describe the linkages between these research projects and the research projects of the ongoing or completed NRT project at the non-lead partner. The research projects are expected to meet the requirements for a graduate credential (master's degree, certificate, or a track within an existing graduate program) at the lead institution. Trainees at the lead institution can have mentors from the lead institution, non-lead partner, and industry partners.

3i. Broader Impacts: The Project Description must contain, as a separate section within the narrative labeled 'Broader Impacts', 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 this pilot for a potential new track for NRT include but are not limited to: development of a diverse, globally competitive STEM workforce in the focus area; participation of the full spectrum of diverse talent in STEM; enhanced infrastructure for industry-relevant research and education at the lead institution; increased partnerships and collaborations between academia and industry. Proposers should indicate how the project will impact the training of STEM graduate students beyond the disciplines and lead institution described in the proposal. Further, potential contributions to the development and adoption of evidence-based teaching and learning practices, and research on effective traineeship models for graduate education in the focus areas at non-R1 institutions should be clearly articulated.

3j. Recruitment, Mentoring, and Retention: Experiences of the non-lead partner should be leveraged in developing plans for recruiting, mentoring, and retaining trainees with a particular emphasis on broadening participation of the full spectrum of diverse talent in STEM by engaging members of groups underrepresented in the focus area. Clearly describe how the lessons learned by the non-lead partner in this area will be leveraged to develop effective recruitment, mentoring and retention plans for trainees at the lead institution.

3k. Performance Assessment/Project Evaluation: Projects should include plans to evaluate the success of the research and traineeship activities. Experiences of the non-lead partner should be appropriately leveraged to develop the evaluation plan. Evaluation should be led by an unbiased evaluator recruited by the lead institution. The proposal should identify specific competencies and intended outcomes along with performance measures and an evaluation timetable.

Special attention should be given to evaluate the effectiveness of the partnership (the lead institution and non-lead partner and the industry partners). The evaluation 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 at the lead institution. 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 NRT monitoring systems, contributions at NSF-sponsored PI meetings, and periodic cross-award video conferences to share insights, effective practices, and evaluation findings.

Project evaluator(s) can be from an internal or external assessment unit or consulting entity. If a project chooses to involve an individual from the lead institution or non-lead partner in the evaluation, then the project must provide justification and explain how lack of bias is ensured. The lead program evaluator from the ongoing or completed NRT project at the non-lead partner can be recruited to lead the program evaluation. 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).

3l. Independent Advisory Committee: An independent advisory committee that includes individuals internal to the lead institution and non-lead-partner, external to the institution(s), and representatives of the industry partners is required to provide guidance on a regular basis. The committee must meet regularly (at least twice/year) 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.

3m. Deliverables:

3m(i) Lead Institution: (1) A series of research projects in the focus area(s) that are suitable for trainees pursuing the proposed graduate opportunities at the lead institution, (2) An institution-level graduate-level opportunity (a new certificate or a new track within an existing graduate program, etc.) in the focus area that will be awarded to the trainees participating in the program at the lead institution, (3) A plan demonstrating the demand and feasibility for a new master's program in the focus area at the lead institution at the end of year three, and (4) A detailed plan (a) to develop the new master's program at the lead institution along with a plan for sustaining this master's program beyond the grant period if the outcome of (3) indicates feasibility – or, if the feasibility plan identifies insufficient employer or student demand or other significant barriers, then – (b) to sustain the developed graduate opportunity (2) at the lead institution beyond the grant period.

3m(ii) Non-lead Partner Institution: (1) Inclusion of NRT trainees who actively participate in this partnership for their research and traineeship activities, (2) A plan for sustaining the successful elements of the partnered NRT project and scaling it up at regional and/or national levels, and (3) Articulation of best practices disseminated in the form of a peer-reviewed publication and industry-relevant publication regarding development of a successful NRT collaboration model between an active/successful NRT institution and a non-R1 institution.

3n. 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, particularly emphasizing lessons learned by the non-lead partner implementing NRT program activities at their institution.

3o. Results from Prior 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, including the project's 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.

Additional Proposal Elements

The information that follows provides guidance regarding additional required elements of the proposal package. These elements are not part of the Project Description

4. Budget and Budget Justification: Provide an annual budget for up to five years. The system will automatically generate a cumulative budget. The cumulative proposed budget can be up to \$4,500,000 (maximum). The non-lead IHE partner can request a maximum of 30% of the total request amount. The proposed budget 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. Requests for 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 foreign travel, the proposed destinations must be included in the budget justification.

4a. Trainee Support: Include all trainee support (i.e., stipend, costs of education, travel, materials and supplies needed specifically for trainees) as Participant Support Costs in the budget. The NRT stipend and education costs are intended for those trainees (i.e., graduate students) whose research is aligned with the project's focus area(s). Trainees receiving stipend and cost-of-education support (i.e., NRT-funded trainees) must be full-time students and be United States citizens, nationals, or legal permanent residents. The NSF minimum contribution to NRT stipends is \$37K per year per NRT-funded trainee for a 12-month appointment. Funded trainees are expected to receive at a minimum, the equivalent of one year of \$37K 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 an 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.

4b. 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.

4c. 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 (75%-100% appointment) and an evaluator. The budget should include funds for the PI, one trainee, the Project Coordinator, and an evaluator to attend the annual NRT meetings 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.

5. Facilities, Equipment, and Other Resources: Provide a description of the facilities and major instrumentation that are available for training purposes.

6. Special Information and Supplementary Documentation: Some supplementary documents are required (e.g., institutional support letter, letters of collaboration for certain organizations that appear in the budget, and Data Management and Sharing 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.

6a. Letters of Support and Collaboration: (i) Institutional Letters of Support: Two letters are **required**, each up to two pages in length; one from the appropriate senior university administrator(s) at the lead institution and the second from the appropriate senior university administrator(s) at the non-lead IHE partner. These letters should be submitted as a Supplementary Document 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. The letter from the lead institution must describe institutional support that will be provided to the project team for the development and approval of the graduate opportunities the program creates. Additionally, both Institutional Support letters should describe the support that will be provided to the project team for enhancing the collaborative activities between the lead institution and non-lead institutional partner. (ii) Letters of Support (Other): Up to eight other letters of support, each no more than one page long, may be provided from partner organizations or institutions, including international entities, that would play a significant collaborative role in the project. Each industry partner identified in the proposal must provide a letter. These letters of support should detail specific commitments and contributions (e.g., internships, laboratory access, mentorship, time commitment, etc.) to the NRT project. (iii) Letters of Collaboration: A

letter of collaboration (see the PAPPG) is **required** from each NRT-eligible partner organization that appears in the budget. A letter of collaboration from the non-lead IHE NRT partner is not needed since they will provide an institutional support letter. Each letter of collaboration must include the following appropriate statement at the conclusion of the letter: "We agree to partner on this NRT project as a sub-awardee." No letters should include endorsements or advocacy for the project.

6b. Data Management and Sharing Plan: All proposals are required to include a Data Management and Sharing 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 using the intellectual merit and broader impacts review criteria. 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.

6c. Mentoring Plan: A Mentoring Plan is required for graduate students who receive NRT support and for proposals that request funding to support postdoctoral scholars; the inclusion of postdoctoral scholars is allowed only if they participate in an instructional or other training capacity.

No other items or appendices are to be included. Full proposals containing items, other than those required above or by the PAPPG, will not be accepted or will be returned without review.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Other Budgetary Limitations:

No more than 30% of the total award budget can be provided to the non-lead IHE partner.

C. Due Dates

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

July 22, 2024

D. Research.gov/Grants.gov Requirements

For Proposals Submitted Via Research.gov:

To prepare and submit a proposal via Research.gov, see detailed technical instructions available at:

https://www.research.gov/research-portal/appmanager/base/desktop?_nfpb=true&_pageLabel=research_node_display&_nodePath=/researchGov/Service/Desktop/ProposalPreparation

For Research.gov user support, call the Research.gov Help Desk at 1-800-381-1532 or e-mail rgov@nsf.gov. The Research.gov Help Desk answers general technical questions related to the use of the Research.gov system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

For Proposals Submitted Via Grants.gov:

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: <https://www.grants.gov/web/grants/applicants.html>. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

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

The NSF [Grants.gov Proposal Processing in Research.gov informational page](#) provides submission guidance to applicants and links to helpful resources including the NSF [Grants.gov Application Guide](#), [Grants.gov Proposal Processing in Research.gov how-to guide](#), and [Grants.gov Submitted Proposals Frequently Asked Questions](#). Grants.gov proposals must pass all NSF pre-check and post-check validations in order to be accepted by Research.gov at NSF.

When submitting via Grants.gov, NSF strongly recommends applicants initiate proposal submission at least five business days in advance of a deadline to allow adequate time to address NSF compliance errors and resubmissions by 5:00 p.m. submitting organization's local time on the deadline. Please note that some errors cannot be corrected in Grants.gov. Once a proposal passes pre-checks but fails any post-check, an applicant can only correct and submit the in-progress proposal in Research.gov.

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

VI. NSF Proposal Processing And Review Procedures

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

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

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in [Leading the World in Discovery and Innovation, STEM Talent Development and the Delivery of Benefits from Research - NSF Strategic Plan for Fiscal Years \(FY\) 2022 - 2026](#). 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.D.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.D.2.d(i), prior to the review of a proposal.

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

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

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

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

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

Proposers are reminded that reviewers will also be asked to review the Data Management and Sharing Plan and the 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 related to the proposed project's focus? Are there clear and compelling connections between the training elements and the focus area? Is there a clear plan to offer a graduate credential to participants before a master's degree program is fully

developed and approved? Is there clear integration of research in the focus area with the timeline, requirements, and milestones of the credential-bearing programs, including the planned master's degree? Is there evidence that program activities will persist beyond the duration of the award?

Industry Engagement

What is the quality of the project team's prior engagement with the industry partners identified in the proposal? Do support letters from the industry partners and related proposal content clearly identify their role and commitment for the proposed NRT program? Are plans for continued industry engagement to support sustainability within graduate program(s) at the lead institution included in the proposal that?

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, with an emphasis on industry? Does the project provide the training in communication, team science, collaboration, and ethics? Are the training expectations sufficient, and is the training structured in such a way that they will not hinder trainee research or degree progress?

Integrating Diversity into NSF Programs, Projects, and Activities

Are the recruiting and retention plans likely to broaden participation? Is there evidence of sufficient engagement of key personnel? Are collaborations and/or existing programs appropriately engaged?

Evaluation

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

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 proposers whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new recipients 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 or the Division of Acquisition and Cooperative Support 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 an NSF Grants and Agreements Officer. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process.)

B. Award Conditions

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

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

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

Administrative and National Policy Requirements

Build America, Buy America

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

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

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 annual project report, and a project outcomes report for the general public.

Failure to provide the required annual or final annual 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](https://www.research.gov), for preparation and submission of annual and final annual 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](https://www.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](https://www.research.gov). This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

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

VIII. Agency Contacts

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

General inquiries regarding this program should be made to:

- Daniel Denecke, telephone: (703) 292-8072, email: ddenecke@nsf.gov
- Daniel R. Marenda, telephone: (703) 292-2157, email: dmarenda@nsf.gov
- Rebecca Shearman, telephone: (703) 292-7403, email: rshearman@nsf.gov
- Elizabeth A. Webber, telephone: (703) 292-4316, email: ewebber@nsf.gov

For questions related to the use of NSF systems contact:

- NSF Help Desk: 1-800-381-1532
- [Research.gov](https://www.research.gov) Help Desk e-mail: rgov@nsf.gov

For questions relating to [Grants.gov](https://www.grants.gov) contact:

- [Grants.gov](https://www.grants.gov) Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from [Grants.gov](https://www.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](https://www.nsf.gov). 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](https://www.nsf.gov).

[Grants.gov](https://www.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](https://www.grants.gov) may be obtained at <https://www.grants.gov>.

Related Programs:

[National Science Foundation Research Traineeship \(NRT\) Program](#)

About The National Science Foundation

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

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

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

Facilitation Awards for Scientists and Engineers with Disabilities (FASED) provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See the *NSF Proposal & Award Policies & Procedures Guide* Chapter II.F.7 for instructions regarding preparation of these types of proposals.

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

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

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.

To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at <https://www.nsf.gov>

- **Location:** 2415 Eisenhower Avenue, Alexandria, VA 22314
- **For General Information** (NSF Information Center): (703) 292-5111
- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**
 - Send an e-mail to: nsfpubs@nsf.gov
 - or telephone: (703) 292-8134
- **To Locate NSF Employees:** (703) 292-5111

Privacy Act And Public Burden Statements

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by proposers 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 proposers or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See [System of Record Notices, NSF-50](#), "Principal Investigator/Proposal File and Associated Records," and [NSF-51](#), "Reviewer/Proposal File and Associated Records." Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

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

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

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