

EHR Core Research (ECR): Building Capacity in STEM Education Research (ECR: BCSER)

PROGRAM SOLICITATION

NSF 20-521

REPLACES DOCUMENT(S):

NSF 19-565



National Science Foundation

Directorate for Education and Human Resources
Division of Graduate Education
Division of Human Resource Development
Research on Learning in Formal and Informal Settings
Division of Undergraduate Education

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

February 28, 2020

Fourth Friday in February, Annually Thereafter

IMPORTANT INFORMATION AND REVISION NOTES

Proposal titles should begin with BCSER.

The Project Summary should specify the proposed project activity: Individual Investigator Development, Institutes in Research Methods, or conferences and workshops.

Proposals for the ECR Data Resource Hub have been deleted.

Proposals for Individual Investigator Development projects must include a letter of collaboration from the research mentor(s) as Supplementary Documentation.

Co-Principal Investigators are not allowed on Individual Investigator Development proposals.

The Data Management Plan requirements for proposals submitted to the Directorate for Education and Human Resources (EHR) have been revised.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) ([NSF 19-1](#)), which is effective for proposals submitted, or due, on or after February 25, 2019.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

EHR Core Research (ECR): Building Capacity in STEM Education Research

Synopsis of Program:

ECR's Building Capacity for STEM Education Research (ECR: BCSER) solicitation supports projects that build individuals' capacity to carry out high quality STEM education research that will enhance the nation's STEM education enterprise and broaden the pool of researchers that can conduct fundamental research in STEM learning and learning environments, broadening participation in STEM fields, and STEM workforce development.

Specifically, ECR: BCSER supports activities that enable early and mid-career researchers to acquire the requisite expertise and skills to conduct rigorous fundamental research in STEM education. ECR: BCSER seeks to fund research career development activities on topics that are relevant to qualitative and quantitative research methods and design, including the collection and analysis of new qualitative or quantitative data, secondary analyses using extant datasets, or meta-analyses.

This career development may be accomplished through investigator-initiated projects or through professional development institutes that enable researchers to integrate methodological strategies with theoretical and practical substantive issues in STEM education. Early and mid-career faculty new to STEM education research, particularly underrepresented minority faculty and faculty at minority-serving and two-year institutions, are encouraged to submit proposals.

ECR: BCSER especially welcomes proposals that pair well with the efforts of NSF INCLUDES (https://www.nsf.gov/news/special_reports/nsfincludes/index.jsp) to develop STEM talent from all sectors and groups in our society. Proposers are encouraged to identify topics that support the thrust of NSF 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.

- Please direct inquiries to:, telephone: (703) 292-8112, email: ECRBCSER@nsf.gov

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

- 47.076 --- Education and Human Resources

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 26

NSF expects to make 26 standard or continuing grant awards. The ECR: BCSER competition anticipates having approximately \$12,000,000 for new awards in FY 2020, subject to availability of funds, as follows:

Individual Investigator Development in STEM Education Research: Up to 16 awards. The maximum award amount is \$350,000 for two years.

Institutes in Research Methods: Up to five awards. The maximum award amount for is \$1,000,000 for three years.

The typical award amount for Conferences is \$25,000 to \$100,000.

Anticipated Funding Amount: \$12,000,000

Anticipated funding amount is approximately \$12,000,000 subject to availability of funding.

Eligibility Information

Who May Submit Proposals:

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

Who May Serve as PI:

Co-PIs are not allowed on Individual Investigator Development proposals.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

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

There are no restrictions or limits.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not required
- **Preliminary Proposal Submission:** Not required
- **Full Proposals:**
 - Full Proposals submitted via FastLane: *NSF Proposal and Award Policies and Procedures Guide* (PAPPG) guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.
 - Full Proposals submitted via Research.gov: *NSF Proposal and Award Policies and Procedures Guide* (PAPPG) guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.
 - 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 28, 2020

Fourth Friday in February, Annually Thereafter

Proposal Review Information Criteria

Merit Review Criteria:

National Science Board approved criteria apply.

Award Administration Information

Award Conditions:

Standard NSF award conditions apply.

Reporting Requirements:

Standard NSF reporting requirements apply.

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I. INTRODUCTION

Insights from fundamental STEM education research inform the development of theories that explain phenomena of importance to the mission of NSF's Directorate for Education and Human Resources (EHR). Examples include theories to explain what factors impede or promote individuals' learning in various contexts; what factors contribute to persistent underrepresentation of individuals from various groups in STEM courses of study and careers; and what skills, experiences, and affective characteristics prepare individuals for the current and emerging STEM professional workforce.

Advances in fundamental STEM education research also are essential to foster new and/or more effective interventions and innovations in STEM education, broadening participation, and workforce development. Fundamental STEM education research studies generate (whether by design or more indirectly^[1]) the knowledge, theories, and understandings on which viable strategies for enhancing performance or addressing gaps in STEM learning, broadening participation in STEM, and STEM professional workforce development are based. Through the EHR Core Research (ECR) and other programs, EHR supports advances in fundamental knowledge in each of these areas.

Recognizing the value of skills, expertise, and experiences that support fundamental contributions to the knowledge base, the ECR Building Capacity for STEM Education Research (ECR: BCSER) competition seeks to support projects that build individuals' competencies to carry out high quality fundamental education research in STEM fields, particularly early career researchers and researchers seeking to shift their work, for example, from education research or STEM disciplinary research to STEM education research. STEM education research capacity building may be accomplished through investigator-initiated projects and professional development institutes that enable researchers to integrate methodological strategies with theoretical and practical substantive issues in STEM education. Proposals may be submitted that also seek support to conduct well-focused conferences or workshops related to ECR: BCSER goals.

Through these initiatives, ECR: BCSER will invest in the field, helping to broaden the pool of researchers with the skills, experiences, and expertise required to successfully conceptualize, design, and conduct studies capable of expanding fundamental understandings critical to enhancing STEM learning, broadening participation in STEM fields, and developing the STEM professional workforce.

[1] Stokes (1997: 73) used the terms 'pure basic research' to designate investigations with a quest for fundamental understanding inspired with no consideration for use, and 'use-inspired basic research' to designate investigations with a quest for fundamental understanding inspired by considerations of use.

II. PROGRAM DESCRIPTION

NSF's Directorate for Education and Human Resources (EHR) seeks, through the EHR Core Research (ECR) and other programs, to support fundamental research that advances progress toward the strategic goals of (a) the Directorate with respect to STEM learning and learning environments, broadening participation in STEM, and STEM workforce development and (b) the Foundation as outlined in the NSF Strategic Plan, [Building the Future: Investing in Discovery and Innovation - NSF Strategic Plan for Fiscal Years \(FY\) 2018 - 2022](#). As described in the joint U.S. Department of Education Institute of Education Sciences (IES) and NSF *Common Guidelines for Education Research and Development* (NSF 13-126, p. 9), two genres of research in particular contribute to this fundamental, core knowledge in education:

- *foundational research*, which typically "seek[s] to test, develop, or refine theories...and may develop innovations in methodologies and/or technologies that will influence and inform research and development in different contexts", and
- *early-stage or exploratory research*, which "examines relationships among important constructs...to establish logical connections that may form the basis for future interventions or strategies to improve education outcomes."

ECR: BCSER supports three types of projects designed to build individuals' capacity to carry out high quality fundamental (foundational and early-stage or exploratory) education research in science, technology, engineering, and mathematics. **Individual Investigator Development in STEM Education Research** (ECR: BCSER: IID) invites submission of proposals from early-career and mid-career investigators. Awards will support individual investigators who have (a) articulated a fundamental research project appropriate for the ECR program, (b) identified specific capabilities the investigator needs to more fully develop in order to conduct the research project, and (c) detailed a professional development plan that will enable the investigator to complete a pilot project within the specified time period. **Institutes in Research Methods** (ECR: BCSER: IRM) awards support institutes that provide participants with training in up-to-date applications of computational, quantitative, qualitative, and evaluative research methods useful to STEM education researchers. Eligible participants may include investigators at any stage in their career development. Proposals that seek support to conduct well-focused **conferences and workshops** (ECR: BCSER: CONF) relevant to the competition goals also are invited.

Relevant Capacity Building Foci

To successfully conceptualize, design, and execute studies capable of making contributions to fundamental knowledge in STEM education and learning, broadening participation, and workforce development, investigators and their teams typically require a wide range of knowledge, skills, expertise, and experiences, including:

- Deep knowledge of subject-matter literature: Domain expertise (mastery of theories and findings) is critical to investigators' ability to identify important scientific questions and articulate a compelling, theoretically derived and framed rationale for the project.
- Multidisciplinary perspectives: Theories, methodologies, analytical techniques, and findings that can have a catalytic effect when explored in the context of multiple fields. Moreover, interdisciplinary endeavors also increase the human capacity of the nation to address problems, broadening the range and diversity of scholars working toward their solution (Porter & Rafols, 2009).
- Skill operationalizing research questions and articulating theories of change: Investigators should be able to operationalize the conceptual framework that organizes the responses to the research questions before collecting data, i.e., defining variables into measurable factors.
- Expertise in study design, research methods, and data analysis techniques and familiarity with advances in computational, quantitative, qualitative and evaluative research methodologies. Expertise in these areas is essential in arguing the feasibility and appropriateness of the proposed research to generate sufficiently robust evidence on the topic(s) of interest and in executing the study as planned. Depending upon the nature of the research proposed, experience may be required identifying appropriate measures, devising appropriate sampling strategies, developing and establishing the psychometric properties of research instruments, and aligning analytic methods with the study design.
- Expertise that could advance educational innovation: Investigators should be able to incorporate new methods and techniques in their research that will improve education quality. For example, they may consider how artificial intelligence tools or large data sets could be used or mined to enhance traditional teaching and learning methods. Areas where this research may be applicable could include intelligent tutoring systems, personalized learning, computer-adapted assessments, or in automating of teaching tasks.

- Skill synthesizing study findings through meta-analysis, meta-synthesis, and other systematic review methodologies.
- Experience collecting, managing, documenting, and archiving data (e.g., to facilitate replication and reproducibility studies^[2] and secondary analyses).
- Experience building teams, establishing partnerships, leading collaborations, and mentoring junior collaborators.

Targeted Audience

With its focus on early-career investigators, ECR: BCSER complements the Faculty Early Career Development (CAREER) Program's mission and focus. However, ECR: BCSER welcomes proposals also from mid-career faculty and investigators from academic as well as non-academic organizations. Individual researchers who have received a doctoral degree in a disciplinary STEM field outside of education and wish to pursue research in STEM education, or who have received a doctoral degree from an education research program and wish to complement their expertise with training in a disciplinary STEM field outside of education may apply for Individual Investigator Development in STEM Education Research (IID) awards.^[3] ECR: BCSER: IID awards to early career investigators are intended to recognize beginning STEM education researchers with significant potential and to provide them with research experiences that will develop their competencies and establish their research careers within the scientific community. Early and mid-career faculty new to STEM education research, particularly underrepresented minority faculty and faculty at minority-serving and two-year institutions, are particularly encouraged to submit IID proposals.

ECR: BCSER encourages proposals also from other acknowledged experts in the research capacity areas described above to organize and offer Institutes in Research Methods (IRM). The target audiences for the training that IRM awards provide should include the early- and mid-career investigators eligible for IID awards.

Proposal and award types

Individual Investigator Development in STEM Education Research (ECR: BCSER: IID)

ECR: BCSER supports individual investigators in pursuing investigator-designed programs of developmental activities that will build capacity to pursue fundamental research projects while advancing their STEM education research skills and competencies more generally. The primary goal of ECR: BCSER Individual Investigator Development in STEM Education Research (ECR: BCSER: IID) awards is to facilitate the acquisition of education research expertise that will position the investigator to successfully conceive and execute fundamental STEM education research with the potential to meaningfully advance current knowledge about STEM learning and learning environments, broadening participation in STEM, and STEM workforce development. IID submissions may propose to develop multiple capacities (including experience in building teams, establishing partnerships, leading collaborations, and mentoring junior collaborators), but these proposals must focus primarily on developing the Principal Investigator's (PI's) skills and experience in study design, research methods, data analysis, synthesis, and/or subject-matter expertise in STEM education. IID submissions also may request support that would enable the PI to access facilities and other resources necessary to complete the proposed fundamental research project.

Given ECR: BCSER's emphasis on building capacity to conduct fundamental STEM education research, it is expected that some applicants for IID awards may have little previous experience in leading foundational or early-stage/exploratory STEM education research studies. Nevertheless, IID awards are intended to recognize and support beginning STEM education research investigators with significant potential, provide them with research experiences that will build their capacity to make meaningful contributions to fundamental understanding, and support them in establishing their research careers within the STEM education research community. Accordingly, it is expected that the investigator will have sufficient grounding in STEM research or education research that the investigator will be able, independently or with the assistance of a mentor, to:

- Identify a fundamental STEM education research topic **and** articulate an appropriately scoped project related to that topic that can be completed within the project period of performance. The first step in developing an ECR: BCSER: IID proposal is to identify a core, theoretically derived and framed question that, if answered, could contribute to fundamental understanding in the areas of interest to NSF's Directorate for Education and Human Resources. An appropriately scoped project may be a single, discrete element of a larger fundamental STEM education research study. The IID research activity could be framed as part of a larger fundamental STEM education research agenda that, if pursued, would enable the PI to contribute to theory-building on this topic. Importantly, the PI must design the research activity to be conducted as part of the IID project such that it can be completed in its entirety during the period of the award.
- Assess her/his experience and expertise and identify specific capability(ies) that will be advanced to complete the project. IID awards are designed to support individual investigators in developing their skills, experience, and expertise. It is expected that PIs submitting proposals to IID will be able—**independently and/or with assistance from colleagues or mentors**—to identify specific gaps in their study design, research methods, data analysis, synthesis, and/or STEM education subject-matter expertise relevant to the successful pursue of fundamental STEM education research with significant potential for advancement. As part of their IID proposals, PIs are expected to provide an assessment of these gaps and to indicate how, through completing a specified program of professional development activities and the appropriately scoped research activity(ies) (see above), the PI will be better positioned to pursue a fundamental STEM education research agenda and contribute to foundational knowledge.
- Prepare a detailed professional development plan that will build the investigator's capacity(ies) to complete the pilot project within the specified period and that will contribute to the investigator's broader career trajectory. The third key component of an IID proposal is a detailed plan for developing the specific study design, research methods, data analysis, synthesis, and/or STEM education subject-matter skills, knowledge, experience, and expertise the PI has identified. The plan should provide detailed information on the goals of the professional development plan (PD); the professional development activities that will be undertaken during the project aligned with the overall PD goal each activity addresses; and the timeline for completing activities. Suitable activities might include attending short-courses, workshops, or other training; convening and consulting regularly with an advisory group; identifying and securing a commitment from an individual willing to serve as a mentor to the PI throughout the project period; and specifying a mentoring plan. Institutes in Research Methods funded through the ECR: BCSER competition also offer viable professional development options. The overall project timeline should indicate the rationale for the timing of the PD activities relative to the research activities. The plan also should incorporate a mechanism to assess success. PIs are strongly encouraged to identify a mentor and/or an advisory board to provide external feedback on the outcomes and impacts of the planned PD activities on the investigator's capacity to complete the IID research activities, and the PI's fundamental STEM education research skills and experience more generally.

2. Institutes in Research Methods

Institutes in Research Methods (ECR: BCSER: IRM) awards support field-initiated institutes that provide participants with training in up-to-date applications of computational, quantitative, qualitative, and evaluative research methods that advance the participants' skills and competencies in STEM education research. Institute activities must be relevant to the specific methodology focus proposed. Participants are expected to receive practical experience in developing and refining a research topic that could be investigated further. Eligible participants may include investigators at any stage in their career development.

Participants may include investigators at any stage in their career development, and IRM proposals must provide evidence of the demand for the training proposed for the targeted participants. Proposals to conduct Institutes in Research Methods may present a comprehensive array of courses, summer sessions, seminars, or short topics or more focused modules. Proposals should describe successful prior experience in conducting similar institutes and discuss how the institute will evaluate its success. Proposals should include plans to involve faculty and postdoctoral researchers from underrepresented groups and minority serving institutions. Eligible Institute topics include, but are not be limited to, advances in the following research methodologies:

Computational: Learning analytics for textual, speech and video data; neural-nets; artificial intelligence and methods for the analysis of large data sets.

Quantitative: Research design in clustered settings; quasi-experimental designs; measurement: classical, item response theory, & cognitive diagnostic measurement; modern validity arguments in measurement; task design for assessment; survey design and survey sampling to include sampling weights and their uses; meta-analysis; single study designs, multilevel data structures, structural equation modeling, network analysis. Other relevant topics include research data management and multi-method research designs for causal inferences.

Qualitative: Case studies, longitudinal case study designs; discourse analysis of STEM learning, design- based research, meta-synthesis, grounded theory.

Evaluative: Formative and summative **evaluation designs.**

Conference and Workshop Proposals

Proposals seeking support to conduct well-focused conferences and workshops related to the ECR: BCSER goals may also be submitted. Proposals should include a conceptual framework for the conference or workshop, draft agenda, possible participant list, the outcomes or products that will result from the conference, and how these products serve the goals of the ECR capacity building competition. Proposals focused on transition from discipline-based research to STEM education research and building skills for the future of STEM education research are of particular interest. Proposals focused on components of the national network of NSF INCLUDES also are welcomed. Investigators are encouraged to contact a cognizant EHR Program Officer prior to submission. Typical award size is \$25,000 to \$100,000. (Please refer to Chapter II.E.7 in the PAPPG for guidance about conference and workshop proposals.) The specialized items requested must be included within the 15-page project description.

References of Potential Interest

National Science Board. (2018). *Our Nation's Future Competitiveness Relies on Building a STEM-Capable U.S. Workforce: A Policy Companion Statement to Science and Engineering Indicators 2018*. Arlington, VA: National Science Foundation.

National Science Board. (2018) *Science and Engineering Indicators*. Arlington, VA: National Science Foundation

National Academies of Sciences, Engineering, and Medicine. 2018. *Indicators for Monitoring Undergraduate STEM Education*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/24943>.

National Academies of Sciences, Engineering, and Medicine. 2017. *Supporting Students' College Success: The Role of Assessment of Intrapersonal and Interpersonal Competencies*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/24697>.

National Academies of Sciences, Engineering, and Medicine. 2016. *Barriers and Opportunities for 2-Year and 4-Year STEM Degrees: Systemic Change to Support Students' Diverse Pathways*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/21739>.

Porter, A. L., & Rafols, I. (2009). Is Science Becoming More Interdisciplinary? Measuring and Mapping Six Research Fields over Time. *Scientometrics* 81(3), 719-745.

U.S. Department of Education and the National Science Foundation. (2013). *Common Guidelines for Education Research and Development: A Report from the Institute of Education Sciences, U.S. Department of Education and the National Science Foundation*, NSF 13-127. Arlington, VA: National Science Foundation.

[2] For guidelines on designing studies with reproducibility and replicability in mind and reporting findings to facilitate replication and reproducibility studies, see the joint IES/NSF *Companion Guidelines on Replication & Reproducibility in Education Research (NSF 19-022)*.

[3] For the purposes of this solicitation, ECR defines STEM fields outside of education as those communities largely represented by the NSF directorates of Biological Sciences (BIO), Computer and Information Sciences and Engineering (CISE), Engineering (ENG), Geosciences (GEO), Mathematics and Physical Sciences (MPS), or Social, Behavioral and Economic Sciences (SBE).

III. AWARD INFORMATION

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

NSF expects to make 26 standard or continuing grant awards. The ECR: BCSER competition anticipates having approximately \$12,000,000 for new awards in FY 2020, subject to availability of funds, as follows:

Individual Investigator Development in STEM Education Research: Up to 16 awards. The maximum award amount is \$350,000 for two years.

Institutes in Research Methods: Up to five awards. The maximum award amount for is \$1,000,000 for three years.

The typical award amount for Conferences is \$25,000 to \$100,000.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

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

Who May Serve as PI:

Co-PIs are not allowed on Individual Investigator Development proposals.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

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

There are no restrictions or limits.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

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

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG). The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg. Paper copies of the PAPPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov. Proposers are reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.
- Full Proposals submitted via Research.gov: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal and Award Policies and Procedures Guide* (PAPPG). The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg. Paper copies of the PAPPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov. The Prepare New Proposal setup will prompt you for the program solicitation number.
- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov*. The complete text of the *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov.

In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via the NSF FastLane system. PAPPG Chapter II.D.3 provides additional information on collaborative proposals.

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

The following instructions supplement guidelines in the PAPPG and NSF *Grants.gov Application Guide*:

The Cover Sheet

- Select the **ECR: BCSER solicitation number**.
- Add **BCSER** as a prefix to the proposal title.
- **The box for Human Subjects must be checked**; this box should not be left blank. The Human Subjects box should be marked as pending if an Institutional Review Board (IRB) is either (1) reviewing the project plan and has not yet determined a ruling of "approved" or "exempt", or (2) the project plan has not yet been submitted to an IRB for review. If human subjects activities are exempt from IRB review, enter appropriate exemption number in the space provided.

To avoid delays in processing award recommendations, **it is strongly recommended that PIs begin the process of obtaining appropriate IRB approvals or exemptions** as needed for projects involving human subjects. No awards will be made without such approvals or exemptions.

Project Summary. The Project Summary should specify the project activity (i.e., Individual Investigator Development in STEM Education Research, Institutes in Research Methods, ECR Data Resource Hub, conference or workshop).

1. Individual Investigator Development in STEM Education Research Projects

In addition to the guidance in the PAPPG, the Project Description section should include a cohesive and well-articulated STEM education research professional development plan with clearly defined goals, objectives, and metrics. The proposed activities should advance the investigator's career goals and aspirations while demonstrating the potential to conduct fundamental STEM education research. Thus, the proposed activities should describe the specific expertise that will be used to contribute to the STEM education research knowledge base. The Project Description may not exceed 15 pages.

Proposals **must** address the following elements:

- o A fundamental STEM education research topic and appropriately scoped project that can be completed within the project period.
- o A STEM education research professional development plan that includes an assessment of the investigator's experience, expertise, and specific competencies to be developed to complete the project. Describe the specific gaps in the study design, research methods, data analysis, synthesis, and/or subject-matter expertise that hinder the pursuit of fundamental STEM education research agendas that are of particular interest. Provide detailed goals of the professional development plan, description and rationale for the professional development activities that will be undertaken, and timeline for completing that activities. Describe how the professional development supports the investigator's broader career trajectory.
- o Rationale for selection of the mentor/collaborator or advisory board and description of his/her role in the research professional development plan.

Proposals must include a letter of collaboration from the research mentor (s) describing the assistance that will be provided. Submit the letter as Supplementary Documentation.

2. Institutes in Research Methods

In addition to the guidance in the PAPPG, the project description should articulate the following:

Scope and Significance

- o The scope and significance of the stated mission and goals of the institute;
- o A detailed description of the curriculum, training plan, schedule of activities that are relevant to the focus of the institute, and expected outcomes;
- o Evidence of the likelihood that the proposed activities will be effective in meeting the ECR: BCSEER program goals;
- o The likely overall impact of the proposed activities in building STEM educational research capacity.

Project Management

- o Description of the organization's (investigator's) capacity to support the training, including evidence of prior success;
- o Description of roles, responsibilities, and capabilities of the project team;
- o Description of the anticipated number and demographics of desired participants;
- o Evidence of demand for the proposed training for the targeted participants; and
- o A detailed strategy to attract and support participants from underrepresented groups and minority-serving institutions.

Assessment and Evaluation

The third review element considered with respect to both NSF's intellectual merit and broader impacts merit review criteria asks whether the plan proposed is well-reasoned and incorporates a mechanism to assess success. In developing and describing their mechanisms to assess success, proposers are encouraged to consider: including plans to monitor and assess institute activities; specifying criteria that will be used to evaluate the quality and outcomes of the Institute's activities; and detailing any processes that will be employed to collect and analyze (quantitative and/or qualitative) data in support of evaluation.

Budget and Budget Justification. Budgets should be in NSF format and include up to five pages of budget justification. The budget justification should be in narrative form and include detailed explanations for each line item with budget resources listed in the budget. Information about what may or may not be included in the budget or budget justification is outlined in the NSF PAPPG. For proposals with subawards, each subaward must include a separate budget and budget justification of no more than five pages.

Funds should be budgeted for the principal investigator or a project member to attend a two-day grantees' meeting in the Washington, D.C. area each award year.

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 28, 2020

Fourth Friday in February, 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.

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review.

Reviewers will be asked to evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will generally be completed and submitted by each reviewer and/or panel. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF strives to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new awardees may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

After programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications. After an administrative review has occurred, Grants and Agreements Officers perform the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

Once an award or declination decision has been made, Principal Investigators are provided feedback about their proposals. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers or any reviewer-identifying information, are sent to the Principal Investigator/Project Director by the Program Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process.)

B. Award Conditions

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

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

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

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer no later than 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). No later than 120 days following expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report, will delay NSF review and processing of any future funding increments as well as any pending proposals for all identified PIs and co-PIs on a given award. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through Research.gov, for preparation and submission of annual and final project reports. Such reports provide information on accomplishments, project participants (individual and organizational), publications, and other specific products and impacts of the project. Submission of the report via Research.gov constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

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

VIII. AGENCY CONTACTS

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

General inquiries regarding this program should be made to:

- Please direct inquiries to:, telephone: (703) 292-8112, email: ECRBCSER@nsf.gov

For questions related to the use of FastLane or Research.gov, contact:

- FastLane and Research.gov Help Desk: 1-800-673-6188
FastLane Help Desk e-mail: fastlane@nsf.gov.
Research.gov Help Desk e-mail: rgov@nsf.gov

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: support@grants.gov.

IX. OTHER INFORMATION

The NSF website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this website by potential proposers is strongly encouraged. In addition, "NSF Update" is an information-delivery system designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF [Grants Conferences](#). Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. "NSF Update" also is available on [NSF's website](#).

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this mechanism. Further information on Grants.gov may be obtained at <https://www.grants.gov>.

ABOUT THE NATIONAL SCIENCE FOUNDATION

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

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

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

Facilitation Awards for Scientists and Engineers with Disabilities (FASSED) provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See the *NSF Proposal & Award Policies & Procedures Guide* Chapter II.E.6 for instructions regarding preparation of these types of proposals.

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

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

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

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

- **Location:** 2415 Eisenhower Avenue, Alexandria, VA 22314

- **For General Information** (NSF Information Center): (703) 292-5111
- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**
 - Send an e-mail to: nsfpubs@nsf.gov
 - or telephone: (703) 292-7827
- **To Locate NSF Employees:** (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

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

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

Suzanne H. Plimpton
 Reports Clearance Officer
 Office of the General Counsel
 National Science Foundation
 Alexandria, VA 22314

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