EHR Core Research (ECR)

Fundamental Research in Science, Technology, Engineering and Mathematics (STEM) Education

PROGRAM ANNOUNCEMENT

NSF 15-509

REPLACES DOCUMENT(S):

NSF 13-555, NSF 13-604

National Science Foundation

Directorate for Education & Human Resources

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

February 03, 2015

September 10, 2015

Second Thursday in September, Annually Thereafter

IMPORTANT INFORMATION AND REVISION NOTES

Any proposal submitted in response to this announcement should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) (NSF 15-1). The PAPPG is consistent with, and, implements the new Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards (Uniform Guidance) (2 CFR § 200). NSF anticipates release of the PAPPG in the Fall of 2014 and it will be effective for proposals submitted, or due, on or after December 26, 2014. Please be advised that proposers who opt to submit prior to December 26, 2014, must also follow the guidelines contained in NSF 15-1.

The REAL program is now incorporated into the EHR Core Research (ECR): Fundamental Research in STEM Education.

The first sentence of the Project Summary should indicate the focal area(s) for the project and the proposal types: type I, type II, type III; synthesis; or conference or workshop.

In Part II, under Program Description, Elements of ECR Proposals; the announcement provides additional detail on expectations for the theoretical grounding, research design, data management, methodology, communication strategies and external feedback for all proposals to ECR.

The *Guidelines* publication can be found on the NSF website with the number NSF 13-126 (http://www.nsf.gov/pubs/2013/nsf13126/nsf13126.pdf). A set of FAQs regarding the *Guidelines* are available with the number NSF 13-127 (http://www.nsf.gov/pubs/2013/nsf13127/nsf13127.pdf). Grant proposal writers and PIs are encouraged to familiarize themselves with both documents and use the information therein to help in the preparation of proposals to NSF.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

EHR Core Research (ECR)
Fundamental Research in Science, Technology, Engineering and Mathematics (STEM) Education

Synopsis of Program:

The EHR Core Research (ECR) program of fundamental research in STEM education provides funding in critical research areas that are essential, broad and enduring. EHR seeks proposals that will help synthesize, build and/or expand research foundations in the following focal areas: STEM learning, STEM learning environments, STEM workforce development, and broadening participation in STEM.

The ECR program is distinguished by its emphasis on the accumulation of robust evidence to inform efforts to (a) understand, (b) build theory to explain, and (c) suggest interventions (and innovations) to address persistent challenges in STEM interest, education, learning, and participation. The program supports advances in fundamental research on STEM learning and education by fostering efforts to develop foundational knowledge in STEM learning and learning contexts, both formal and informal, from childhood through adulthood, for all groups, and from the earliest developmental stages of life through participation in the workforce, resulting in increased public understanding of science and engineering. The ECR program will fund fundamental research on: human learning in STEM; learning in STEM learning environments, STEM workforce development, and research on

broadening participation in STEM.

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.

- Address questions to the program, telephone: (703) 292-2333, email: ECR@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: 64

Pending availability of funds.

Anticipated Funding Amount: $61,500,000

Eligibility Information

Who May Submit Proposals:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the Grant Proposal Guide, Chapter I, Section E.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

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

There are no restrictions or limits.

Proposal Preparation and Submission Instructions

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, Part I: Grant Proposal Guide (GPG) Guidelines apply. The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg.
  - Full Proposals submitted via Grants.gov: NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov Guidelines apply (Note: The NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide).

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. proposer's local time):

  February 03, 2015

  September 10, 2015

  Second Thursday in September, 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

The nation faces extraordinary opportunities and considerable challenges in aspiring to lead the world in science, technology, engineering and mathematics (STEM). Unprecedented diversity in human capital, rapid and exciting scientific advances leading to new approaches to solving critical societal problems, and a national emphasis on the importance of innovation all point to unparalleled opportunities for the future. At the same time, challenges exist in preparing a workforce with adequate competencies and foundational knowledge to advance STEM and understand how it can affect daily life.

The National Science Foundation (NSF) is committed to investing in the best ideas in science, engineering and in education across its very broad portfolio. In order to make those investments strategically, and to have confidence in their potential impact, it is essential to build and expand a coherent and deep scientific research base that informs and guides efforts to meet STEM education and learning challenges now, and into the future.

The mission of EHR is to achieve excellence in U.S. science, technology, engineering and mathematics (STEM) education at all levels and in all settings (both formal and informal) in order to support the development of a diverse and well-prepared workforce of scientists, technicians, engineers, mathematicians and educators and a well-informed citizenry that have access to the ideas and tools of science and engineering. The purpose of these activities is to enhance the quality of life of all citizens and the health, prosperity, welfare and security of the nation.

To achieve these goals, it is critical to develop and accumulate foundational knowledge based on fundamental research (basic or use inspired – see Stokes, 1997) on STEM learning and learning environments, STEM professional workforce development, and broadening participation in STEM. The EHR Core (ECR) fundamental research program addresses these needs. Specifically, the research portfolio ECR will provide a coherent foundation of theory and research evidence to guide and improve STEM learning and the design of learning environments for all citizens, along with the research evidence needed to support STEM workforce development and to guide increases in the participation of those underrepresented in STEM. Such a foundation is essential for strategically focusing the broader set of investments by the Federal government and other funders on the science of learning and the importance of broadening participation in STEM education and the STEM workforce.

II. PROGRAM DESCRIPTION

The fundamental research that ECR supports advances the frontiers of understanding about how more people learn, and use more STEM knowledge, more effectively. To do this, ECR projects are grounded in theory, ask well formulated research questions, employ relevant data and analytic techniques, and contribute to the growing body of literature on STEM education research. ECR projects bring together the expertise, literatures, methods and learning priorities of the entire range of scientific communities represented by the NSF research directorates as well as EHR. ECR supports researchers who use large scale, next generation data resources and relevant big data analytic techniques to advance fundamental research in STEM learning, STEM learning environments, STEM workforce development, and broadening participation research where appropriate. ECR also supports research on efforts to make that knowledge available to other researchers, education developers, leaders and practitioners so that research is

used broadly to improve STEM education and the development of a flexible, knowledgeable and diverse STEM workforce. The specific strands of research ECR seeks to support include STEM learning and learning environments, workforce development, and broadening participation in STEM.

STEM learning and learning environments: EHR encourages the creative use of formal and informal STEM learning environments —including the full array of available and emerging materials, platforms, and learning opportunities—to ensure that all students have access to high-quality, inspiring STEM learning and teaching to better prepare tomorrow's scientists and engineers, as well as engage the public and youth living in an increasingly science-rich and technological world. EHR investments in this area seek to amplify the most promising developments and build a coherent, cumulative knowledge base, focusing on high-leverage topics.

In this context, ECR seeks to provide the foundational knowledge necessary to improve and to advance STEM learning and education for all populations (including students, parents, and teachers), in all settings (formal, informal and technological) across the life course. To this end ECR supports ***fundamental research on learning in STEM*** that combines theory, techniques, and perspectives from a wide range of disciplines and contexts. Proposals may address topics including, but not limited to: the neural bases of STEM learning, the cognitive bases of such learning (how people learn in and across STEM disciplines and settings, e.g., the skills, knowledge and cognitive models needed to support data science); the affective dimensions of learning (what motivates and sustains learner interest in STEM and what fosters engagement and persistence); education policy and policy-relevant research grounded in the cognitive and social conditions of STEM learning, along with the development of methods, models and measures including those used in the data sciences; and the use of new and existing datasets (including large-scale datasets).

ECR also supports fundamental ***research on STEM learning environments***. Such research attends to the interfaces between teaching and learning and the mediation of STEM learning (see e.g., National Research Council, 2012d). To this end ECR supports fundamental research investigating: how learning in organizations (schools, classrooms, museums, systems, work places), and technologies of any type can make critical and far-reaching improvements in a range of learning outcomes; the alignment of curriculum, instruction and assessment; and the development of diagnostic and performance assessments. ECR also supports design-based iterative research on foundational knowledge for the implementation of new models of teaching and learning (including, for example, cyberlearning).

STEM professional workforce development: The need to prepare a diverse, highly skilled and motivated workforce, including teachers who can meet the demands of a dynamic and complex global economy is a widely recognized national challenge. EHR investments respond to that challenge by providing the evidence on how to best support and prepare a STEM professional workforce that is ready to capitalize on unprecedented advances in technology and science, and to address current and future global, social, and economic challenges. Key time frames of importance relative to workforce development occur as early as middle school, and may continue through technical training in community colleges or career preparation in undergraduate, graduate, or postgraduate programs and then into lifelong, personalized learning as the competencies and knowledge needed for STEM careers shift.

In this context, ECR supports fundamental ***research on STEM professional workforce development*** and invites proposals for studies that will strengthen the research base that informs investments in STEM workforce preparation and development at all levels of education from K-12 to postdoctoral training. Evidence-based understanding of STEM education and training is needed with respect to STEM career pathways and transitions; academic and non-academic STEM careers; emerging practices and changing contexts of the STEM workforce; and the changing higher education climate and capacity for reforming STEM workforce development efforts.

Proposals may address topics including, but not limited to the: impact of different funding models at the undergraduate and graduate levels (e.g., teaching assistantship, fellowship, traineeship, research assistantship, work-for-pay, loans) on the preparation of 21st century STEM workers with advanced and flexible skills needed for the STEM job market; impact of technology, demographics, and social media for professional networking on the STEM labor market and education and training; persistence in STEM majors and careers; influence of public/private partnerships on workforce preparation; and use of big data for interpreting the implications of labor market trends on STEM education and training. Mapping backward from workplace expectations for knowledge and competencies to the design of educational interventions might yield more effective interventions. Proposers are encouraged to leverage current NSF investments (e.g., interdisciplinary research centers, large facilities, funded workforce development projects) as research bases.

Broadening participation in STEM: EHR supports the investigation of issues underlying the learning and participation of members of groups underrepresented in STEM fields. Underrepresented groups may include (but are not necessarily limited to): women and girls, people with disabilities, underrepresented minorities (e.g., African Americans, Hispanics, Native Americans, Alaska Natives, Native Hawaiians, and Pacific Islanders), English-language learners, veterans and students from rural or lower socio-economic backgrounds. ECR seeks to catalyze the foundational knowledge building through research that informs the development of interventions and models to impact learning, persistence, and success in STEM for members of various groups under specific conditions and in specific contexts. Proposers must document the STEM disciplinary underrepresentation of the groups they wish to study and place the proposed work in the broader context of STEM education and workforce participation in the U.S. This effort is in collaboration with and complements similar research tracks in the various programs in the Division of Human Resource Development (HRD) in EHR and the Directorate for Social, Behavioral and Economic Science (SBE) as outlined in the Dear Colleague Letter "Stimulating Research Related to the Science of Broadening Participation" (NSF 13-020) (http://www.nsf.gov/pubs/2013/nsf13020/nsf13020.pdf).

In this context ECR supports fundamental ***research on broadening participation in STEM*** and invites proposals that will pursue fundamental research about what it takes to diversify and increase participation in STEM effectively, including research improves our understanding of how to build institutional capacity and informal learning environments that foster the untapped potential of underrepresented minority groups in STEM fields. Proposals may address topics including, but not limited to, better understanding of what leads to: retention and degree attainment; development of measures, processes and metrics to assess impacts and outcomes of broadening participation and institutional capacity initiatives and programs; studies that examine the impact of diversity (or the lack thereof) of various kinds on innovation and productivity in STEM education and in the STEM workforce (including in-depth studies on practices that have proved effective in reducing stumbling blocks across multiple sites). Current technologies and cyberlearning options have provided new opportunities to further enhance STEM research and education; however, issues of accessibility for and impacts on underrepresented groups are not yet fully understood. Broadening participation research areas of special interest include research in disabilities education and research on gender in science and engineering. ECR ***research in disabilities education*** includes fundamental research about learners (of all ages) with disabilities in STEM, with a particular focus on efforts to understand and address disability-based differences in STEM education and workforce participation. Fundamental research projects typically address areas such as stereotype threat, an individual's identity (e.g. STEM and disability identity), underlying attention and physical barriers that impact STEM learning, and the societal and organizational characteristics that influence learning and educational pathways. Projects must employ evidence-based educational exemplars, have a strong theoretical base, and be justified by relevant educational, disability, and social science research. ECR ***research on gender in science and engineering*** seeks to understand and address gender-based differences in STEM education and workforce participation through education and implementation research that will lead to a larger and more diverse domestic STEM workforce. Typical projects will contribute to the knowledge base addressing gender-related differences in learning and in the educational experiences that affect student interest, performance, and choice of careers; how pedagogical approaches and teaching styles, curriculum, student services, and institutional culture contribute

to causing or closing gender gaps that persist in certain scientific fields.

Eligible Proposal Types

ECR supports a wide range of research activities. ECR seeks to fund fundamental research that involves the collection of new data, and secondary analyses that leverage extant state, national, international or other databases. Substantively, these research projects may fall within or cut across any of the Research Areas described above. In addition, ECR supports research to develop innovative research methods, metrics, and conceptual models to measure existing and emerging phenomena, and test theory that informs core scientific questions about STEM education and learning. Three levels of funding and durations are available to support these investigations (up to $500,000; up to $1,500,000; and up to $2,500,000). The three levels of funding should align with the maturity of the proposed work, the size and scope of the empirical effort, as well as the capacity of the interdisciplinary team to conduct the proposed research: (1) **Level I proposals**: have a maximum award size of $500,000 and a maximum duration of 3 years; (2) **Level II proposals** have a maximum total award size of $1,500,000 and a maximum duration of 3 years; (3) **Level III proposals** have a maximum award size of $2,500,000 and a maximum duration of 5 years.

ECR also supports a small number of capacity building proposals through synthesis projects and conferences and workshops related to the goals of the program. **Synthesis** proposals seek support for the synthesis and/or meta-analysis of existing knowledge on a topic of critical importance to STEM learning and/or education, or for the diffusion of research-based knowledge. Investigators are permitted to propose workshops and other meetings as one of the means of completing the syntheses and diffusing the research-based knowledge that is developed. Additional emphasis will be placed on the proposed dissemination plan. Maximum award size for Synthesis proposals is $300,000 (total) for duration of up to two years. **Conference and Workshop** proposals seek support to conduct well-focused conferences or workshops related to the goals of the program. Budgets are expected to be commensurate with the duration of the event and the number of participants. Proposals should include a conceptual framework for the conference, draft agenda, possible participant list, the outcomes or products that will result from the conference/workshop, and how these products serve the fundamental research goals of the ECR program. Conference and workshop proposals are evaluated on an ad hoc basis and so may be submitted at any time (not only to the competition deadline), generally at least one year in advance of when the event would be held. Investigators are encouraged to contact a Program Officer prior to submission. Typical costs are $25,000 to $100,000.

Elements of ECR Proposals

High quality ECR proposals should address the following elements:

Linkages to theory and extant research in the field: All research proposals should be located in a body of literature to which a contribution would be made. The proposal should make the case for why the proposed line of inquiry is fundamental in nature. The PI's should include a discussion of the theory or theories grounding the research and how the proposed research will add to this theoretical grounding. The program will allow descriptive studies of phenomena that could lead to the development of a theory or model or that contribute to theory.

Research plan: Proposals should include well-focused research questions and/or testable hypotheses that reflect the current state of knowledge in the area and the theory or conceptual framework being used. The proposal should discuss in detail the methods used to answer the research questions and/or test the hypotheses posed, along with the types of data to be collected and methods for data collection. Methods should directly link to the theory or theories being used. If a population sample is used, this should be described along with the rationale for sample selection, and the investigator's access to the sample. The proposal should address whether the design is premised on special needs and interests due to educational level, gender, race, ethnicity, economic status, or disability, and to what extent data will be disaggregated for multiple characteristics.

Contributions to implementation (where applicable): Proposals to conduct fundamental research should highlight implications for subsequent enactments of the intervention paying particular attention to subjects, measures, application of the treatment and settings.

Contributions to foundational knowledge and theory: Proposals should include a coherent and persuasive chain of reasoning that shows how the research claims will be warranted and how the results have the potential to add new evidence based insights to theory, and where appropriate practice.

Communication strategy: Proposals should include a strategy for reaching a broad audience for the findings of the project including, where appropriate, researchers in education and other fields, practitioners, and public audiences. The potential results of the proposed research are expected to be of sufficient significance to merit peer-review and broader publication. (For additional information on dissemination and communication see the resources available from the American Association for the Advancement of Science's Center for Public Engagement with Science & Technology; and the Dissemination and Communication Resources available from the Center for Advancing Research & Communication.)

Objective external feedback: Proposals should include a strategy for ongoing objective external feedback using benchmarks, indicators, logic models, roadmaps or other evaluative methods to document progress toward goals, objectives and outcomes defined in the proposal. All projects are expected to track and report their accomplishment of proposal targets for broader impacts and intellectual merit. This objective external feedback can be provided through a number of vehicles: the advisory board, or through a formal evaluation. A plan for such soliciting objective external feedback should be documented in the proposal.

References

Carnevale, Anthony P., Nicole Smith, and Michelle Melton. (2011) *STEM*. Washington, DC: Georgetown University Center on Education and the Workforce.

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Committee on a Conceptual Framework for New K-12 Science Education Standards. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

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President's Council of Advisors. *(2012) Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics*. Washington, DC: Executive Office of the White House.

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III. AWARD INFORMATION

NSF expects to make standard or continuing grant awards. Pending the availability of funds, the estimated number of awards will be 64 new awards in FY 2015. Approximately 14 Level I studies, 24 Level II studies, 6 Level III studies, 10 Synthesis, and 10 Conference and Workshop awards will be funded. The anticipated funding available for new awards in FY 2014 for ECR is $62,000,000. The maximum award amount Level I research proposals is $500,000, with duration of up to three years. The maximum award amount for Level II research proposals is $1,500,000, with duration of up to three years. The maximum award amount for Level III research proposals is $2,500,000, with duration of up to five years. The maximum award amount for Synthesis projects is $300,000, with duration of up to two years. The typical award amount for Conferences and Workshops 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 Grant Proposal Guide, Chapter I, Section E.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

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

There are no restrictions or limits.

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 Announcement via Grants.gov or via the NSF FastLane system.

- Full proposals submitted via FastLane: Proposals submitted in response to this program announcement should be prepared and submitted in accordance with the general guidelines contained in the NSF Grant Proposal Guide (GPG). The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov. Proposers are reminded to identify this program announcement number in the program announcement block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

- Full proposals submitted via Grants.gov: Proposals submitted in response to this program announcement via Grants.gov should be prepared and submitted in accordance with the NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov. The complete text of the NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: (http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide). 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 announcement 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) 292-7827 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. Chapter II, Section D.4 of the Grant Proposal Guide provides additional information on collaborative proposals.

See Chapter II.C.2 of the GPG for guidance on the required sections of a full research proposal submitted to NSF.

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. proposer's local time):

  February 03, 2015

  September 10, 2015

  Second Thursday in September, Annually Thereafter

D. FastLane / Grants.gov Requirements

For Proposals Submitted Via FastLane:

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

For Proposals Submitted Via Grants.gov:

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

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

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

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

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 the GPG as Exhibit III-1.

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

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in *Investing in Science, Engineering, and Education for the Nation's Future: NSF Strategic Plan for 2014-2018*. These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and

activities.

One of the strategic objectives in support of NSF's mission is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions must recruit, train, and prepare a diverse STEM workforce to advance the frontiers of science and participate in the U.S. technology-based economy. NSF's contribution to the national innovation ecosystem is to provide cutting-edge research under the guidance of the Nation's most creative scientists and engineers. NSF also supports development of a strong science, technology, engineering, and mathematics (STEM) workforce by investing in building the knowledge that informs improvements in STEM teaching and learning.

NSF's mission calls for the broadening of opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

A. Merit Review Principles and Criteria

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. (GPG 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 GPG 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 announcement 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 be completed and submitted by each reviewer. 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 http://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the NSF *Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

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 at least 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). Within 90 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 *Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

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:

- Address questions to the program, telephone: (703) 292-2333, email: ECR@nsf.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: fastlane@nsf.gov.

For questions relating to Grants.gov contact:

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

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 at https://public.govdelivery.com/accounts/USNSF/subscriber/new?topic_id=USNSF_179.

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

ABOUT THE NATIONAL SCIENCE FOUNDATION

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 provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See Grant Proposal Guide Chapter II, Section D.2 for instructions regarding preparation of these types of proposals.

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

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

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

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

- **Location:** 4201 Wilson Blvd. Arlington, VA 22230

- **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 Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004), and NSF-51, "Reviewer/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

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

Suzanne H. Plimpton
Reports Clearance Officer
Office of the General Counsel
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