Research on Innovative Technologies for Enhanced Learning (RITEL)

PROGRAM SOLICITATION
NSF 23-624

REPLACES DOCUMENT(S):
NSF 20-612

National Science Foundation
Directorate for STEM Education
Research on Learning in Formal and Informal Settings
Division of Undergraduate Education
Directorate for Computer and Information Science and Engineering
Division of Information and Intelligent Systems
Division of Computer and Network Systems
Directorate for Engineering
Engineering Education and Centers
Directorate for Social, Behavioral and Economic Sciences
Division of Behavioral and Cognitive Sciences

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

January 24, 2024

November 05, 2024

November 04, 2025

IMPORTANT INFORMATION AND REVISION NOTES

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

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Research on Innovative Technologies for Enhanced Learning (RITEL)

Synopsis of Program:

The purpose of the ***Research on Innovative Technologies for Enhanced Learning (RITEL)*** program is to support early-stage research in emerging technologies for teaching and learning that respond to pressing needs in authentic (real-world) educational environments. RITEL supports future-oriented exploratory and synergistic research in emerging technologies (including, but not limited to, artificial intelligence (AI), robotics, and immersive or augmenting technologies) for teaching and learning. The program accepts proposals that focus on learning, teaching, or a combination of both. The scope of the program is broad and includes teaching and learning in science, technology, engineering, and mathematics (STEM) and in foundational areas that enable STEM (e.g., self-regulation, literacy, communication, collaboration, creativity, and socio-emotional skills). RITEL supports research in all learning contexts (e.g., formal, informal, workplace) and for all learner populations. RITEL has a special interest in diverse learner/educator populations and in developing new educational technologies that are cost-effective for budget-limited school districts, colleges and universities. Research in this program should be informed by the convergence (synthesis) of multiple disciplines: e.g., learning sciences; discipline-based education research; computer and information science and engineering; design; and cognitive, behavioral, and social sciences. RITEL is unique in its requirement that projects must advance research in

both learning (and/or teaching) and technology.

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.

- Amy L. Baylor, co-lead EDU, EDU/DRL, telephone: (703) 292-5126, email: abaylor@nsf.gov
- Tatiana Korelsky, co-lead CISE, CISE/IIS, telephone: (703) 292-8930, email: tkorelsk@nsf.gov

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

- 47.041 --- Engineering
- 47.070 --- Computer and Information Science and Engineering
- 47.075 --- Social Behavioral and Economic Sciences
- 47.076 --- STEM Education

Award Information

Anticipated Type of Award: Standard Grant

Estimated Number of Awards: 20 to 25

Contingent upon availability of funds.

Anticipated Funding Amount: $25,000,000

Each project will be funded for a duration of 3 years and up to $900,000.

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

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.
- Non-profit, non-academic organizations: Independent museums, observatories, research laboratories, professional societies and similar organizations located in the U.S. that are directly associated with educational or research activities.
- Tribal Governments: The governing body of any Indian or Alaska Native tribe, band, nation, pueblo, village, or community that the Secretary of the Interior acknowledges to exist as an Indian tribe under the Federally Recognized Indian Tribe List Act of 1994 (25 U.S.C. 479a, et seq.)

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: 1

An individual may participate as **PI, co-PI, or other Senior Personnel in no more than one (1)** proposal in response to this solicitation for each submission date. In the event that an individual exceeds the limit, the first proposal received (based on the date and time stamp of proposal submission) will be accepted and the remainder will be returned without review. **No exceptions will be made.**

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

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

B. Budgetary Information

- **Cost Sharing Requirements:**

  Inclusion of voluntary committed cost sharing is prohibited.

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

  Not Applicable

- **Other Budgetary Limitations:**

  Not Applicable

C. Due Dates

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

  January 24, 2024

  November 05, 2024

  November 04, 2025

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

Technologies are rapidly emerging and it is critical to research their impact for teaching and learning. The general public must be prepared to excel in highly technological, interactive and AI-driven education and work environments. Emerging technologies are transforming teaching and learning, in formal (K-12, higher education), informal and other settings, particularly in support of STEM learning.

The COVID-19 pandemic led to new, unprecedented, and unexpected reliance on remote learning and work, which led to new and changing roles of teachers/educators, parents, families, workers, and other collaborators. Looking to the future, finding new ways to learn and teach is of great importance, and there is much interest in the role of emerging technologies to reimagine learning.

Further, many people have experienced first-hand the power and possibilities of technologies such as generative AI. Now more than ever, while emerging technologies can lead to exciting new innovations in teaching and learning, issues of equity, ethics, bias, privacy, and security are of extreme importance. Educational technologies must be integrated in an ethical, equitable, responsible, and effective way. Projects should engage a wide range of stakeholders (e.g., students, teachers, mentors, workers, and families) as partners in the co-design process to address these issues intentionally.

While some technologies are becoming more accessible, others are still out of reach for many communities. Research is needed that considers how to employ emerging technologies in authentic (real-world) environments such as under-resourced schools and institutions. It is important to consider diverse learner/educator populations and develop new educational technologies that are cost-effective for budget-limited school districts, colleges, and universities.

New technologies need to be investigated through innovative teaching, educating, and mentoring practices in a variety of settings, to include formal settings such as physical and virtual classrooms, as well as informal settings (e.g., museums, nature centers, libraries, public participation in scientific research, and other online experiences). Further, given the rapidly changing landscape of work, research in emerging technologies for learning can support just-in-time learning, upskilling, reskilling, and pervasive and lifelong learning. Emerging technologies must be grounded in the experiences of educators and students, particularly with respect to cognitive, social, and behavioral aspects.

Given the complexities surrounding the design of technology and learning environments, high-impact research requires interdisciplinary teams, with expertise across disciplines, including but not limited to the learning sciences, discipline-based education research, computer science, engineering, human-computer interaction, design, the social and behavioral sciences, together with ethics, policy, and privacy. This program envisions diverse cross-disciplinary teams that approach teaching and learning technologies with complementary perspectives and scientific rigor.

II. PROGRAM DESCRIPTION

The purpose of the ***Research on Innovative Technologies for Enhanced Learning (RITEL)*** program is to support early-stage research in emerging technologies for teaching and learning that respond to pressing needs in authentic (real-world) educational environments. RITEL supports future-oriented exploratory and synergistic research in emerging technologies (including, but not limited to, artificial intelligence (AI), robotics, and immersive or augmenting technologies) for teaching and learning. The program accepts proposals that focus on learning, teaching, or a combination of both. The scope of the program is broad and includes teaching and learning in science, technology, engineering, and mathematics (STEM) and in foundational areas that enable STEM (e.g., self-regulation, literacy, communication, collaboration, creativity, and socio-emotional skills). RITEL supports research in all learning contexts (e.g., formal, informal, workplace) and for all learner populations. RITEL has a special interest in diverse learner/educator populations and in developing new educational technologies that are cost-effective for budget-limited school districts, colleges, and universities.

Research in this program should be informed by the convergence (synthesis) of multiple disciplines: e.g., learning sciences; discipline-based education research; computer and information science and engineering; design; and cognitive, behavioral, and social sciences. These interdisciplinary areas of research could include (but are not limited to) affective computing, human-centered AI, learning analytics, social/educational robotics, intelligent conversational agents/assistants, and virtual/embodied agents.

RITEL is an exploratory research program that serves as an incubator to support cutting-edge research in advanced learning and teaching

technologies. Research should be theory-driven and apply human-centered design methods to explore proof-of-concept or feasibility of innovative learning technologies in support of new learning and/or teaching experiences. Emerging and innovative technologies have the potential to reshape teaching and learning processes, which in turn can influence new technology designs. RITEL encourages projects that explore new ideas and involve risk.

RITEL is unique in its requirement that projects must advance fundamental research in *both* learning (and/or teaching) and technology.

Projects that broaden participation, expand STEM pathways, ensure educational equity, or otherwise promote diversity, inclusion, and access in STEM education and careers are strongly encouraged. RITEL encourages proposals from Minority-Serving Institutions (MSIs).

All projects must be framed in terms of a pressing need in an authentic educational environment. The research should address a meaningful and practical teaching and/or learning problem identified by educators and/or other stakeholders who have expertise in the specific context.

This program supports a broad range of projects across:

- *Content areas:* STEM and other foundational areas supported by NSF that enable STEM learning and teaching (e.g., self-regulation, literacy, communication, collaboration, creativity, curiosity, and social skills).
- *Populations and contexts*: learners, teachers, mentors, educators, and other workers in formal (e.g., K12, higher education) or informal settings; and individual, collective, and collaborative learning and teaching across the lifespan.

The primary goal should be investigating a new technology in the context of advancing teaching and/or learning. RITEL will not fund projects that are primarily about development of a technology.

All projects must have clear research objectives that integrate teaching and/or learning and technology research to *advance* the respective fields (e.g., learning sciences, discipline-based education research, computer and information sciences, engineering, and/or social, cognitive, and behavioral sciences) as described below:

Teaching and/or learning research

- For teaching, this includes researching new teaching processes and approaches (e.g., andragogy and pedagogy).
- For learning, this includes researching new learning processes, principles, and theories (e.g., cognitive, behavioral, affective, socio-cultural, social, epistemological, problem-based, project-based, developmental, and other perspectives).

Technology research

- Examples of emerging technology research include (but are not limited to): AI-driven technologies; virtual, immersive, embodied, interactive, or augmented environments; multimodal modeling/sensing of cognitive or affective states; language and speech processing; learning analytics and dashboards; and robotics.
- The technology research must *advance* fields involving computer science, information science, and/or engineering.
- It is insufficient to simply implement or test an existing technology, even if innovative. Incremental advances in existing technologies or deployment/implementation of existing technologies in novel learning contexts will not be funded through this program.

Project ideas that do not align with this solicitation may fit with other NSF programs. Please see programs such as: "Education Core Research (ECR)," "Innovative Technology Experiences for Students and Teachers (ITEST)," "Improving Undergraduate STEM Education (IUSE)," "Human-Centered Computing (HCC)," and the "Science of Learning and Augmented Intelligence," as well as cross-cutting opportunities such as "Smart and Connected Communities (S&CC)".

III. AWARD INFORMATION

$25 million is anticipated to fund proposals for durations of 3 years and up to a total funding amount of $900,000 per project.

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

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must

explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.
- Non-profit, non-academic organizations: Independent museums, observatories, research laboratories, professional societies and similar organizations located in the U.S. that are directly associated with educational or research activities.
- Tribal Governments: The governing body of any Indian or Alaska Native tribe, band, nation, pueblo, village, or community that the Secretary of the Interior acknowledges to exist as an Indian tribe under the Federally Recognized Indian Tribe List Act of 1994 (25 U.S.C. 479a, et seq.)

Who May Serve as PI:

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Limit on Number of Proposals per Organization:

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V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

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

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

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 Research.gov. PAPPG Chapter II.E.3 provides additional information on collaborative proposals.

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

Other Required Supplementary Documents:

The following supplementary documents should be uploaded into the Supplementary Documentation Section. **No other supplementary materials are allowed.**

(1) List of Project Personnel and Partner Organizations (required):
Provide current, accurate information for all personnel and organizations involved in the project. NSF staff will use this information in the merit review process to manage reviewer selection. The list **must** include all PIs, co-PIs, other Senior Personnel, paid/unpaid Consultants or Collaborators, Subawardees, and Postdoctoral Researchers. This list should be numbered and include (in this order) Full name, Organization(s), and Role in the project, with each item separated by a semi-colon. Each person listed should start a new numbered line. For example:

- Mei Lin; XYZ University; PI

- Jak Jabes; University of PQR; Senior Personnel
- Jane Brown; XYZ University; Postdoctoral Researcher
- Rakel Adeamas; ABC Community College; Paid Consultant
- Maria Wan; Welldone Institution; Unpaid Collaborator
- Rimone Greene; ZZZ University; Subawardee

For conflict-of-interest purposes, **potential advisory board members should not be approached or identified in the proposal**.

(2) Letters of Collaboration. Letters should document collaborative arrangements of significance to the proposal and must stay within the PAPPG requirement to state only the intent to collaborate. They should not contain endorsements or evaluation of the proposed project. Note that letters of collaboration are not necessary for subawardee organizations, whose commitment is explicit in the proposal. Letters of Support are not permitted. Consult the PAPPG for instructions on the appropriate content for a letter of collaboration.

(3) Collaboration and Management Plan: A Collaboration and Management Plan is required for all proposals**.** Up to 1 page is allowed for this plan. The plan must describe the interdisciplinary project team that reflects the convergent disciplines represented in the project. This may include paid or unpaid consultants or collaborators. For proposals that address learning within the work context, we encourage including a relevant industry participant or consultant. Information should include:

1. The collaborators, their expertise, and the specific roles of each in the proposed project; and
2. Coordination mechanisms that will enable scientific integration across the multi-disciplinary project team.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Budget Preparation Instructions:

Budgets must include funding for the PI to attend a two-day PI meeting every year during the lifetime of the award in the Washington, DC, area.

C. Due Dates

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

  January 24, 2024

  November 05, 2024

  November 04, 2025

D. Research.gov/Grants.gov Requirements

For Proposals Submitted Via Research.gov:

To prepare and submit a proposal via Research.gov, see detailed technical instructions available at: https://www.research.gov/research-portal/appmanager/base/desktop?_nfpb=true&_pageLabel=research_node_display&_nodePath=/researchGov/Service/Desktop/ProposalPreparationandSubmission.html. For Research.gov user support, call the Research.gov Help Desk at 1-800-381-1532 or e-mail rgov@nsf.gov. The Research.gov Help Desk answers general technical questions related to the use of the Research.gov system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

For Proposals Submitted Via Grants.gov:

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

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

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

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

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

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

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

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

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in *Leading the World in Discovery and Innovation, STEM Talent Development and the Delivery of Benefits from Research - NSF Strategic Plan for Fiscal Years (FY) 2022 - 2026*. These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

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

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

A. Merit Review Principles and Criteria

The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects.

1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.
- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

2. Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. **Both** criteria are to be given **full consideration** during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. (PAPPG Chapter II.D.2.d(i). contains additional information for use by proposers in development of the Project Description section of the proposal). Reviewers are strongly encouraged to review the criteria, including PAPPG Chapter II.D.2.d(i), prior to the review of a proposal.

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

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

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

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

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

Proposers are reminded that reviewers will also be asked to review the Data Management 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 proposers whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new recipients may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

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

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

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

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

B. Award Conditions

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

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

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

Administrative and National Policy Requirements

Build America, Buy America

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

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

C. Reporting Requirements

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

- Amy L. Baylor, co-lead EDU, EDU/DRL, telephone: (703) 292-5126, email: abaylor@nsf.gov
- Tatiana Korelsky, co-lead CISE, CISE/IIS, telephone: (703) 292-8930, email: tkorelsk@nsf.gov

For questions related to the use of NSF systems contact:

- NSF Help Desk: 1-800-381-1532
- 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 (FASED) provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See the *NSF Proposal & Award Policies & Procedures Guide* Chapter II.F.7 for instructions regarding preparation of these types of proposals.

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

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

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

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

- **Location:** 2415 Eisenhower Avenue, Alexandria, VA 22314
- **For General Information** (NSF Information Center)**:** (703) 292-5111
- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**

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

  or telephone: (703) 292-8134
- **To Locate NSF Employees:** (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

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

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

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Policy Office, Division of Institution and Award Support
Office of Budget, Finance, and Award Management
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