Ideas Lab: Personalized Engineering Learning (PEL)

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:

    Ideas Lab: Personalized Engineering Learning (PEL)

Synopsis of Program:

An Ideas Lab is an intensive meeting that brings together multiple diverse perspectives to focus on finding innovative cross-disciplinary solutions to a grand challenge problem (see below and PAPPG Chapter II.F.6. for more information about this type of proposal). The goal of the Personalized Engineering Learning Ideas Lab is to extend engineering education research to enable advanced personalization in pedagogy and assessment in a K-12 or higher education context. The following broad areas have been identified as possible avenues to advance knowledge: personalized engineering education, multimodal sensing for personalized learning systems and team-based personalized learning. This Ideas Lab aims to bring together experts from diverse scientific, engineering and education backgrounds to develop innovative technologies and solutions to achieve personalized learning for engineering education.

This Ideas Lab is organized by the Office of Emerging Frontiers and Multidisciplinary Activities (EFMA), the Division of Engineering Education and Centers (EEC), and the Division of Civil, Mechanical and Manufacturing Innovation (CMMI) in the Directorate for Engineering (ENG); the Division of Information and Intelligent Systems (IIS) in the Directorate for Computer and Information Science and Engineering (CISE); the Division of Behavioral and Cognitive Sciences (BCS) in the Directorate for Social, Behavioral

and Economic Sciences (SBE); the Division of Graduate Education (DGE), , the Division of Research on Learning in Formal and Informal Settings (DRL), and the Division of Undergraduate Education (DUE) in the Directorate for STEM Education (EDU); and the Division of Translational Impacts (TI) in the Directorate for Technology, Innovation and Partnerships (TIP).

INFORMATIONAL WEBINAR: The Emerging Frontiers and Multidisciplinary Activities (EFMA) Office will host an informational webinar in October 2023 to discuss the *Ideas Lab: Personalized Engineering Learning* solicitation and to answer questions. Details on how to join this webinar will be posted on the EFMA Website.

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.

- Matthew A. Verleger, Lead Program Director, ENG/EEC, telephone: (703) 292-2961, email: mverlege@nsf.gov

- Alexandra Medina-Borja, Program Director, ENG/CMMI, telephone: (703) 292-7557, email: amedinab@nsf.gov

- Thomas Martin, Program Director, CISE/IIS, telephone: (703) 292-2170, email: tmartin@nsf.gov

- Amy A. Wilson-Lopez, Program Director, EDU/DRL, telephone: (703) 292-2606, email: awilsonl@nsf.gov

- Margret Hjalmarson, Program Director, EDU/DRL, telephone: (703) 292-5186, email: mhjalmar@nsf.gov

- Dorian Davis, Program Director, EDU/DGE, telephone: (703) 292-7181, email: ddavis@nsf.gov

- Christine Delahanty, Program Director, EDU/DUE, telephone: (703) 292-8492, email: cdelahan@nsf.gov

- Soo-Siang Lim, Program Director, SBE/BCS, telephone: (703) 292-7878, email: slim@nsf.gov

- Lindsay Portnoy, Program Director, TIP/TI, telephone: (703) 292-8848, email: lportnoy@nsf.gov

- Louise R. Howe, Program Director, ENG/EFMA, telephone: (703) 292-2548, email: lhowe@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
- 47.084 --- NSF Technology, Innovation and Partnerships

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 3

Up to three awards are anticipated depending upon availability of funds and the type, scale, and variety of project ideas developed at the Ideas Lab. The budget for proposals is up to $1,000,000 for a duration of up to 2 years.

Anticipated Funding Amount: $3,000,000

The total funding available for this Ideas Lab is $3,000,000 over 2 years. Up to three awards are anticipated. Estimated program budget, number of awards and average award size/duration are subject to the availability of funds and compelling proposals.

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.
- For-profit organizations: U.S.-based commercial organizations, including small businesses, with strong capabilities in scientific or engineering research or education and a passion for innovation.
- 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 or co-PI on only one proposal submitted to this solicitation. There is no limit on the number of proposals for which an individual may participate as Other Senior Personnel.

If an individual is listed as PI or co-PI on more than one proposal to this solicitation, all proposals in excess of the limit for any person will be returned without review in the reverse order received.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not required

- **Preliminary Proposals:** Submission of Preliminary Proposals is required. Please see the full text of this solicitation for further information.

- **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

- **Preliminary Proposal Due Date(s)** *(required)* (due by 5 p.m. submitter's local time):

  November 29, 2023

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

  May 08, 2024

Proposal Review Information Criteria

Merit Review Criteria:

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

Award Administration Information

Award Conditions:

Standard NSF award conditions apply.

Reporting Requirements:

Standard NSF reporting requirements apply.

TABLE OF CONTENTS

I. INTRODUCTION

In 2008, the National Academy of Engineering (NAE) announced as one of 14 Grand Challenges for Engineering in the 21st Century "*Advance Personalized Learning*" with the goal of creating individualized instruction to make learning more reliable for the learner. More recently, in 2020, an NSF STEM Education Directorate report highlighted a vision in which "STEM Education of the Future brings together our advanced understanding of how people learn with modern technology to create more personalized learning experiences, to inspire learning, and to foster creativity from an early age." This "will unleash and harness the curiosity of young people and adult learners across the United States, cultivating a culture of innovation and inquiry, and ensuring our nation remains the global leader in science and technology discovery and competitiveness" [1]. Since individual learning preferences can affect what is learned, when it is learned and how it is learned, personalized learning approaches must be designed to be intuitive and efficient for all students. **Therefore, researchers must address the gap that exists between people and technology by designing universal technology that will improve human learning performance for every individual.** Recent advances in science, engineering, and education research as well as technology provide an opportunity to address this gap.

As personalization continues to gain traction and technology advances, personalized learning is becoming a corner stone and a defining part of a new era in education [1]. The future of personalized teaching and learning in engineering will be driven by learners themselves, and by integrative use of sensing, tools, resources, and feedback. Learning is envisioned to be enabled through individual and group curricular or co-curricular interactions, among novices and experts, and rooted in appropriate cultural contexts and ethical considerations. The learning opportunities and domains of learning are flexible and will be responsive to potential needs to nudge learners in new directions in fields that are rapidly changing. Learning environments will take advantage of opportunities to gather additional data from learners by integrating physiological, physical, and cognitive cues with knowledge management and retrieval processes. Our understanding of cognition will be increased through rapid quantitative and qualitative data analysis, assessing mastery of both open- and closed-ended mental and physical tasks.

The goal of this Ideas Lab is to extend Engineering Education Research (EER) to enable advanced personalization in pedagogy and assessment in a

K-12 or higher education context. Personalization could address traditional engineering skills, professional skills, psycho-social constructs, and/or other aspects of engineering education. Approaches may be informed by the study of engineers as individual learners or as members of engineering teams. Multimodal sensing could enable improved understanding of cognitive and learning processes to enhance teaching or learning. Personalization could also come in the form of changes to institutional structures or processes. Regardless of the specific focus, the results should advance engineering learning in a way that is personal to the individual and considers personalized learning in an ethical, responsible, and effective way. These studies will advance our understanding of how people learn to become engineers, explore diverse pathways to and through degree programs, and develop ethical solutions for learning in formal and informal settings to achieve desired learning outcomes. Projects are expected to focus on learning engineering in K-12 and/or higher education contexts. NSF strongly encourages proposals that will broaden and sustain participation in engineering education by diverse groups. The goal of this program aligns with NSF Strategic Plan for Fiscal Years 2022-2026 (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf22068). Specifically, it aligns with the first and third strategic goals – "Empower STEM talent to fully participate in science and engineering" and "Benefit society by translating knowledge into solutions".

[1] Subcommittee of the Advisory Committee of the Education and Human Resources Directorate. *STEM Education for the Future. A Visioning Report.* 2020. https://www.nsf.gov/edu/Materials/STEM%20Education%20for%20the%20Future%20-%202020%20Visioning%20Report.pdf

II. PROGRAM DESCRIPTION

1. Problems to be solved and objectives

This Ideas Lab (see below for more information about this format) is intended to revisit the concept of personalized learning to understand and address the effects of individual learning differences and to develop new research projects that will advance the design of, and technology for, personalized learning solutions for engineering education. It requires a thoughtful strategy around the identification, integration, and implementation of tools, resources and practices that are responsive to learners' interests and cognitive, physical, emotional, and educational needs. NSF investments have contributed through challenging the research community to identify major advances in AI-driven learning and digital platforms for formal and informal settings and integrating support for individuals with disabilities. Personalized learning for engineering education will build on these investments to break new ground toward the next frontier for engineering education and learning.

The following broad areas have been identified as possible avenues to advance knowledge in personalized learning:

1. Personalized Engineering Education: EER has increased our knowledge about learning in engineering classrooms, co-curricular (informal) settings and at work. Much of that research has been focused on discipline-level outcomes. This theme provides an opportunity to explore how to take those discipline-level outcomes and integrate them into more personalized learning experiences across multiple learning contexts and to increase our understanding of the engineering education system. This theme will draw upon research in science, mathematics, computer science, and technology education and the learning sciences; but also requires an understanding of how engineering learning is distinct from non-engineering disciplines. Studies addressing this theme should represent a broad spectrum of stakeholders. Each project developed through the Ideas Lab will be expected to include a researcher with expertise in EER or educational systems.

2. Multimodal Sensing for Personalized Learning Systems (PLS): Much of the recent focus of PLS development has been on computing and AI systems for learning. This theme extends this work to develop and integrate multimodal sensors to better understand and model the physical and/or mental and cognitive cues and tasks that occur in engineering. Multimodal data collection could involve physiological sensors, facial and speech recognition, and computer vision, with consideration for hardware and software needs for real-time data collection and analysis at scale. Projects developed through the Ideas Lab should integrate consideration of societal impact and ethics.

3. Team-based Personalized Learning: Engineering is a team-based activity and the need for collaboration increases as projects become more complex. This theme provides an opportunity to investigate team-based design and the potential for human-machine co-design or co-learning. Expertise and developments in human factors, ergonomics, cognitive sciences, and learning sciences will enable the study of cognitive, social, and affective factors in design. Projects developed through the Ideas Lab should integrate consideration of societal impact and ethics.

Projects may extend beyond pre-K-12 or college student learning to consider teachers, faculty, institutions, or community.

An Ideas Lab in-person workshop is planned to facilitate formation of unique, cross disciplinary teams that explore novel approaches relevant to these areas and develop ideas for full proposal submission by May 8, 2024. Virtual meetings before and after the workshop will also be used to facilitate team formation and idea exchange.

2. Expertise Needed from Different Areas

Multiple NSF Directorates, Divisions, and Offices have partnered in recognition of the need for interdisciplinary teams and collaborations to address the challenges outlined in this solicitation.

Successful full proposals are expected to incorporate a broad base of expertise; it is anticipated that these multidimensional teams will be assembled during the Ideas Lab. Participating Directorates, Divisions, and Offices encourage submission of preliminary proposal applications from individuals from each of their communities, to draw on their unique expertise and experience with personalized learning or engineering education and to develop potential solutions. Programmatic areas of interest specific to the solicitation are described below to provide guidance on potential

expertise relevant to the Ideas Lab workshop.

Important Note: Prospective PIs are strongly encouraged to consult with Cognizant Program Officers in the relevant research area(s) prior to submitting a preliminary proposal.

The Directorate for Engineering (ENG):

The *Office of Emerging Frontiers and Multidisciplinary Activities (EFMA)* strategically supports projects in important emerging areas in a timely manner. Established in fiscal year 2015, the office also provides support to multidisciplinary education programs and facilities. The signature activity of EFMA is the Emerging Frontiers in Research and Innovation program (EFRI). EFRI investigators pursue cutting-edge, interdisciplinary research with the potential for transformative impacts on national needs and grand challenges. The EFMA GERMINATION program supports the design of pedagogical frameworks, platforms, and/or environments that enable academic researchers in STEM (Science, Technology, Engineering, and Mathematics) fields to conceive research ideas and questions with potentially transformative outcomes.

The *Division of Engineering Education and Centers (EEC)* invests in the creation of 21st century engineers and discovery of technologies through transformational center-based research, research in education and inclusion, and research opportunities for students and teachers. EEC programs encompass the professional formation of engineers (including engineering technology) and broadening participation of engineers, including the ethical responsibility of practicing engineers. EEC encourages submissions providing expertise and contributions in pedagogy, the assessment of individual learning and within groups, sociocognitive and affective constructs related to learning, technology-mediated learning, engineering education research methods, engineering ethics, broadening participation in engineering, transitions between education levels or career, and learning topics in areas of national priority.

The *Division of Civil, Mechanical and Manufacturing Innovation (CMMI)* invests in potentially transformative research in manufacturing and building technologies; efficient, economical, and sustainable transformation and utilization of engineering materials; promoting resilient and sustainable infrastructure systems, including distributed networks; data-driven decision-making in manufacturing and service enterprises and design, control, and optimization of engineered systems. In all these programs and funding opportunities, CMMI supports the integration of research and education and strives to support interdisciplinary research collaborations that drive innovation in civil, mechanical, industrial, and manufacturing engineering fields, including how those disciplines are taught to the next generation of engineers. Related to this solicitation, efforts that leverage knowledge of biological, cognitive, and physical signals to model human interaction with engineered learning support systems are of interest. Emerging research on the intelligent use of data and human-technology coordination in the context of learning are also welcome. Ideas exploring and enhancing our understanding of human cognitive, behavioral, and social processes in the context of personalized education of futuristic civil, mechanical, materials, industrial, or manufacturing engineering topics are encouraged.

The Directorate for Computer and Information Science and Engineering (CISE):

The *Division of Information and Intelligent Systems (IIS)* studies the inter-related roles of people, computers, and information. The division supports research in human-computer interaction (including human-technology interfaces; computer graphics; computing for creativity; computer-mediated communication and collaboration; assistive and adaptive technology; social impacts of computing; and design), data science (including general methods for data acquisition, exploration, analysis, and explanation; advanced analytics; data management; and knowledge bases), and artificial intelligence (including artificial intelligence; machine learning; computer vision; human language technologies; and computational neuroscience). IIS encourages submissions providing expertise in any of these areas as they relate to personalized learning.

The Directorate for STEM Education (EDU):

The *Division of Graduate Education (DGE)* advocates for innovative, inclusive, high quality graduate education in the STEM fields. DGE manages innovative cross-Foundation programs that directly or indirectly support U.S. citizens and permanent residents in their quest to become the leading scientists and engineers of the future. To better inform its programs, DGE supports research and other activities that will generate exciting new ideas for the graduate education of the future. The Division supports proposals that will generate knowledge around development and implementation of bold, new, and potentially transformative approaches to STEM graduate education training. DGE encourages submissions that address personalized learning in graduate STEM education.

The *Division of Research on Learning in Formal and Informal Settings (DRL)* invests in projects to improve the effectiveness of STEM learning for people of all ages. Its mission includes promoting innovative research, development, and evaluation of learning and teaching across all STEM disciplines by advancing cutting-edge knowledge and practices in both formal and informal learning settings. DRL also promotes the broadening and deepening of capacity and impact in the educational sciences by encouraging the participation of scientists, engineers, and educators from the range of disciplines represented at NSF. Therefore, DRL's role in the larger context of Federal support for education research and evaluation is to be a catalyst for change—advancing theory, method, measurement, development, and application in STEM education. The Division seeks to advance both early, promising innovations as well as larger-scale adoptions of proven educational innovations. In doing so, it challenges the field to create the ideas, resources, and human capacity to bring about the needed transformation of STEM education for the 21st century. DRL encourages submissions providing expertise in research on STEM learning in formal or informal settings among pre-K-12th grade learners, their families, and their educators.

The *Division of Undergraduate Education (DUE)* promotes excellence in undergraduate STEM education for all students. DUE accomplishes this

mission through its four goals of providing leadership, supporting curriculum development, preparing the workforce, and fostering connections. DUE's current programs constitute a comprehensive approach to strengthening STEM education at two- and four-year colleges and universities by improving curricula, instruction, laboratories, infrastructure, assessment, diversity of students and faculty, and collaborations. DUE encourages submissions around personalized learning in undergraduate STEM education.

The Directorate for Social, Behavioral and Economic Sciences (SBE):

The *Division of Behavioral and Cognitive Sciences (BCS)* supports basic research in the psychological, linguistic, anthropological, and geographical sciences. Core programs relevant to the topic of personalized learning include but are not limited to: Cognitive Neuroscience; Developmental Sciences; Linguistics; Perception, Action and Cognition; Science of Learning and Augmented Intelligence; and Social Psychology. Collectively, these programs support research that probes human learning in individuals and in groups, to include a wide-range of topics including attention, memory, social-emotional influences on learning, development of learning across the life-span, and human interactions with technology that enhance learning. These investigations cut across multiple levels of analyses using a variety of methods including computational modeling, behavioral studies, brain imaging, neural recording, and other bio-sensors. BCS encourages submissions providing expertise in any of these areas as they relate to personalized learning.

The Directorate for Technology, Innovation and Partnerships (TIP):

The *Division of Translational Impacts (TI)* accelerates the translation of research results to practical use through its Lab-to-Market Platform. The SBIR program (America's Seed Fund) invests in hundreds of early-stage startups annually, transforming scientific discovery into products and services with commercial and societal impact. America's Seed Fund, powered by NSF, supports startups and small businesses working across almost all areas of science and technology. The SBIR Learning and Cognition Technologies topic (LC) aims to cover all learning and cognitive innovations that require research and development to advance the field of STEM education from "pre-K to gray." This topic supports the development of prototypes or proofs-of-concept but does not support curriculum development or incremental work on existing technologies. The Human-Computer Interaction (HC) topic aims to support the early-stage development and prototyping of unproven technologies that increase the usability of high-intensity human-computer interactive tasks. Intradisciplinary approaches to sustainable products in this topic are encouraged as HC is an intersection of multiple disciplines, including computer science, behavioral sciences, human-centered design, media studies and several other fields of study. The Augmented and Virtual Reality topic aims to support the early-stage development of technological innovations in hardware, software, photonics, displays, communication processes and other augmented and virtual reality technologies. It also supports innovations that bring evidence-based academic discoveries to the public sphere via augmented and virtual reality technologies. Since augmented and virtual reality technology is applicable to multiple industries, proposals should clearly identify target markets, potential paths to commercialization success and competitive analysis demonstrating the need for the proposed solution in advancing the entire field.

3. Award Selection Process

This program will consist of the following stages:

1) *Preliminary Proposal*: Any individual interested in participating in the Ideas Lab should respond to this solicitation by submitting a preliminary proposal (see Section V). The preliminary proposals will be reviewed by NSF and by external reviewers. A subset of experts will be invited to participate in the Ideas Lab Workshop. Participants will be selected on the basis of the interests, expertise, and other characteristics described in their submitted preliminary proposals. Submission of the preliminary proposal will be considered an indication of availability to attend and participate through the full course of the Ideas Lab Workshop described below.

2) *Ideas Lab Workshop*: This professionally facilitated workshop will be held to allow the invited experts to exchange ideas and form collaborative teams.

3) *Full proposal*: Selected collaborative teams from the Ideas Lab will be invited to submit full proposals to NSF by the full proposal deadline. These full proposals must reflect the outline developed at the meeting. The full proposals will undergo NSF merit review, and a subset of proposals will be selected for awards.

4. The Ideas Lab Workshop

The Ideas Lab Workshop is an interactive gathering on a focused problem and involves up to 35 participants from diverse backgrounds who have not had significant prior interaction. The workshop aims to stimulate and facilitate creative thinking around conceptualizing and formulating promising new techniques and technologies for personalized learning for engineering education.

Participants will be expected to engage constructively in dialogue with one another, the facilitators, and the Director(s) and Mentors to develop collaborative research proposals. Collaboration is an integral aspect of the Ideas Lab.

4.1 How will the Ideas Lab Work?

The Ideas Lab is an intensive, interactive, and free-thinking environment, where a diverse group of participants from a range of disciplines and backgrounds gets together - away from their daily routines - to immerse themselves in collaborative thinking processes in order to construct innovative solutions and approaches for identifying and tackling challenging problems. The Ideas Lab in-person meeting will run over three days.

The in-person meeting will be followed by a set of virtual meetings to allow the teams to further exchange and develop their ideas. In the event that an in-person meeting is not possible (for example due to a pandemic), the entire Ideas Lab workshop will be conducted virtually.

The participants will work collaboratively to identify and define the scope of the scientific, engineering, educational, and technology challenges relating to the design, development, and implementation of novel dynamic personalized learning systems. As the Ideas Lab progresses, participants will dynamically develop and hone novel ideas about how the identified challenges may be addressed, and then use these ideas and approaches to develop research projects, which should contain genuinely innovative and potentially risk-taking investigations.

The nature of the Ideas Lab requires a high degree of trust between participants in order to make the required breakthroughs in scientific thinking. This trust extends to allowing the free and frank exchange of scientific ideas, some being in the very early stages of development. The aim of the Ideas Lab is not to discuss ideas that are already well-developed but not yet published. Rather, the goal is to bring individuals from different disciplines together to interact and engage in free thinking on first principles, to learn from one another and create an integrated vision for future research projects. It is expected that the sharing of these ideas will be encouraged within the Ideas Lab, but their confidentiality will be respected outside the Ideas Lab.

The Ideas Lab will be led by Workshop Director(s) whose role will be to assist in defining the topics and to help facilitate discussions at the event. The Director(s) will be joined by a small number of mentors and a team of professional facilitators. The mentors will be selected by NSF based on their intellectual standing, their impartiality and objectivity, and their broad understanding of, and enthusiasm for, the subject area. The Workshop Director(s) and mentors will take full part in the Ideas Lab but will not be eligible to receive research funding under this collaborative activity. They will, therefore, act as impartial peer reviewers in the process, providing a function analogous to that of an NSF review panel.

The Ideas Lab workshop can be broken down into several stages:

- Defining the scope of the challenges
- Evolving common languages and terminologies amongst people from a diverse range of backgrounds and disciplines
- Sharing perspectives and understanding of the scientific challenges, as well as the diverse expertise brought by the participants to the Ideas Lab
- Taking part in break-out sessions focused on the challenges, using creative thinking techniques
- Capturing the outputs in the form of highly innovative research projects
- Using "real-time" peer review to develop projects at the Ideas Lab

The Ideas Lab will be an intensive event. However, there will be opportunities for networking and other activities as a break from the intensive technical discussions.

4.2 Who Should Apply to Participate?

The ability to develop and pursue new approaches will be crucial. Expertise is required from a very broad range of disciplines, and applicants should not feel limited by conventional perceptions: the Ideas Lab approach is about bringing people together who would not normally interact.

Having the right mix of participants influences the success or failure of such an activity. Applications are encouraged from individuals representing diverse research areas across a range of disciplines. Contributions to these current educational and technical challenges could be made by researchers working in a variety of disciplines or research areas such as engineering education research, learning sciences, human-computer interaction, sensing technologies, or artificial intelligence.

This program seeks broad and diverse representation of participants who reflect the Nation's demography and geography. The program welcomes submission of proposals to this funding opportunity that include the participation of the full spectrum of diverse talent in STEM, including PIs from a diverse set of institutions (including predominantly undergraduate institutions, non-R1 schools, those in EPSCoR jurisdictions, and others).

4.3 Location and Date

This hybrid Ideas Lab workshop is planned to take place in 2024, with a three-day in-person event tentatively scheduled for the week of February 26, 2024 and virtual activities the following week. The environment will encourage free and open-minded thinking, vital for the purposes of this event. Additional information about the venue and meeting logistics will be provided to the selected participants. Travel to the Ideas Lab workshop, accommodation, refreshments, breakfast, lunch, and dinner costs will be covered. However, all incidental costs incurred while at the event will be borne by the participants.

III. AWARD INFORMATION

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 3

Up to three awards are anticipated depending upon availability of funds and the type, scale, and variety of project ideas developed at the Ideas

Lab. The budget for proposals is up to $1,000,000 for a duration of up to 2 years.

Anticipated Funding Amount: $3,000,000

The total funding available for this Ideas Lab is $3,000,000 over 2 years. Up to three awards are anticipated. Estimated program budget, number of awards and average award size/duration are subject to the availability of funds and compelling proposals.

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.
- For-profit organizations: U.S.-based commercial organizations, including small businesses, with strong capabilities in scientific or engineering research or education and a passion for innovation.
- 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 or co-PI on only one proposal submitted to this solicitation. There is no limit on the number of proposals for which an individual may participate as Other Senior Personnel.

If an individual is listed as PI or co-PI on more than one proposal to this solicitation, all proposals in excess of the limit for any person will be returned without review in the reverse order received.

Additional Eligibility Info:

Inclusion of appropriate engineering education expertise in the leadership team is highly recommended.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Preliminary Proposals *(required)*: Preliminary proposals are required and must be submitted via Research.gov, even if full proposals will be submitted via Grants.gov.

Please note, the preliminary proposal must come from one individual and cannot include co-PIs or collaborators. Participants in the Idea Lab will be selected on the basis of information submitted in the preliminary proposal.

Preliminary Proposal Set-Up: Select "Prepare New Preliminary Proposal" in Research.gov. Search for and select this solicitation title in Step 1 of the Preliminary Proposal wizard. The information in Step 2 is pre-populated by the system.

Title: The title format is "Ideas Lab: PEL Preliminary Proposal:" followed by a descriptive title. Please note that Research.gov will automatically prepend the title with "Ideas Lab:".

As described in PAPPG Chapter II.F.6., the **Project Description** section of the preliminary proposal is limited to two pages and should conform to

the following guidelines:

Page One:

Q1. Please provide a brief summary of your professional background, describing any relevant experience with pedagogical platforms, problem-solving, engineering design, motivation, self-efficacy, multimodal sensing, learning technologies, and pathways to new investigations in personalized learning. (limit: 200 words)

Please note that if you are selected as a participant, information provided in response to this question will be made available to the other participants to facilitate networking at the Ideas Lab meeting.

Q2. How do you see your expertise and interests contributing to realizing the goal of this Ideas Lab solicitation? Please frame your answer to explain your interests to an audience with different expertise to your own. (limit: 250 words)

Page Two:

Please spend some time considering your answers to the following questions. Your responses (of no more than 100 words each) will help us assess your suitability (independent of your research track record) for the innovative and collaborative setting of the Ideas Lab.

Q3. Collaborative teamwork where everyone is regarded and respected as equal is essential to an innovation lab of this kind. What do you regard as your strengths here? (100 words)

Q4. The setting requires ease and ability to communicate with those from different disciplines and with different expertise to your own. How do you see yourself suited to this setting? (100 words)

Q5. How do you deal with potential conflict when adapting your ideas to fit into something that is strongly community-driven? (100 words)

Q6. The innovation lab is especially suited to individuals who can step outside their own area of expertise or interest, are positively driven, enjoy creative activity and can think innovatively. It is an intensive setting requiring you to develop novel approaches over several days with individuals you may not know. How do you consider yourself suited to this environment? (100 words)

Q7. What do you hope to gain from participating? (100 words)

Applicants must include a **Biographical Sketch** and a **Current and Pending Support** document (prepared in accordance with standard NSF formatting guidelines, available at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg).

No appendices or supplementary documents may be submitted.

Submission of the preliminary proposal will be considered an indication of availability to attend and participate through the full course of the three-day residential Ideas Lab workshop and the follow-up virtual meetings. Selected participants will be notified, and logistics arranged for travel to, and participation in, the Ideas Lab. Following the conclusion of the Ideas Lab, NSF program staff will invite the submission of full proposals related to one or more of the ideas developed during the Ideas Lab.

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.

Full proposals based on project ideas developed through interactions at the Ideas lab should conform to the project outline developed at the conclusion of the meeting. If substantive changes are contemplated, an NSF Program Director should be contacted for guidance.

Proposal Set-Up: Select "Prepare New Full Proposal" in Research.gov. Search for and select this solicitation title in Step One of the Full Proposal wizard. The information in Steps 2 and 3 are pre-populated by the system.

Title: The title format is "Ideas Lab: PEL" followed by a descriptive title. Please note that if submitting via Research.gov, the system will automatically prepend the title with "Ideas Lab:".

Other Supplementary Documents: The following special information must be provided as a Supplementary Document. This information is not considered part of the 15-page project description limitation but should not exceed a total of 5 pages.

A management plan including 1) a list of project personnel, including their affiliations, expertise, and project roles; 2) a plan for team coordination and project management; 3) a detailed project schedule.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Budget Preparation Instructions:

Each full proposal budget must include funding for travel to Washington, DC, for a PI or Co-PI and up to one other project participant to attend annual two-day PI meetings in the Washington, DC, area during the award period.

C. Due Dates

- **Preliminary Proposal Due Date(s)** *(required)* (due by 5 p.m. submitter's local time):

  November 29, 2023

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

  May 08, 2024

D. Research.gov/Grants.gov Requirements

For Proposals Submitted Via Research.gov:

To prepare and submit a proposal via Research.gov, see detailed technical instructions available at: https://www.research.gov/research-portal/appmanager/base/desktop?_nfpb=true&_pageLabel=research_node_display&_nodePath=/researchGov/Service/Desktop/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.

Additional Solicitation Specific Review Criteria

Full proposals derived from the Ideas Lab will be evaluated to determine:

- whether the scientific themes/objectives in the proposal are congruent with the ideas presented at the Ideas Lab, and

whether any significant changes in project scope or resources from those presented at the Ideas Lab have been justified.

Full proposals submitted in response to this program solicitation will be reviewed internally by the cognizant NSF Program Officers, the Ideas Lab mentors, and other external reviewers, 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, Internal NSF Review, or Ideas Lab Mentors.

The Ideas Lab review and selection process is outlined in PAPPG Chapter II.F.6.

Preliminary Proposal Review:

Preliminary proposals will be reviewed by a Selection Panel via a panel managed by the PDs. Up to 35 applicants will be selected for participation in the Ideas Lab based on scientific expertise aligned with the goals of the Ideas Lab and willingness to work in teams. Additional considerations will include diversity and potential for broader impact in education and on society. The recommendations of the Selection Panel will be advisory to the PDs. The PDs will recommend invite/do not invite decisions to participate, considering the input provided by the Selection Panel.

Full Proposal Review

Invited full proposals will be reviewed by the Ideas Lab Director(s) and the Mentors Panel, and other external reviewers as appropriate. Recommendations are advisory to the NSF. In addition to evaluation of intellectual merit and broader impacts, the review will include a determination of whether the themes and objectives contained in the Ideas Lab project are consistent with those in the full proposal, and whether significant changes in project scope or resources from those described in the Ideas Lab project are justified.

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:

- Matthew A. Verleger, Lead Program Director, ENG/EEC, telephone: (703) 292-2961, email: mverlege@nsf.gov

- Alexandra Medina-Borja, Program Director, ENG/CMMI, telephone: (703) 292-7557, email: amedinab@nsf.gov

- Thomas Martin, Program Director, CISE/IIS, telephone: (703) 292-2170, email: tmartin@nsf.gov

- Amy A. Wilson-Lopez, Program Director, EDU/DRL, telephone: (703) 292-2606, email: awilsonl@nsf.gov

- Margret Hjalmarson, Program Director, EDU/DRL, telephone: (703) 292-5186, email: mhjalmar@nsf.gov

- Dorian Davis, Program Director, EDU/DGE, telephone: (703) 292-7181, email: ddavis@nsf.gov

- Christine Delahanty, Program Director, EDU/DUE, telephone: (703) 292-8492, email: cdelahan@nsf.gov

- Soo-Siang Lim, Program Director, SBE/BCS, telephone: (703) 292-7878, email: slim@nsf.gov

- Lindsay Portnoy, Program Director, TIP/TI, telephone: (703) 292-8848, email: lportnoy@nsf.gov

- Louise R. Howe, Program Director, ENG/EFMA, telephone: (703) 292-2548, email: lhowe@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.

For questions related to environmental compliance, please contact Holly E. Smith, Office of the General Counsel, phone (703) 292-7713, email hesmith@nsf.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**   (703) 292-5111
  (NSF Information Center)**:**

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

- **To Order Publications or Forms:**

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

       or telephone: (703) 292-8134

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

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

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

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

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

Policies and Important Links | Privacy | FOIA | Help | Contact NSF | Contact Web Master | SiteMap

National Science Foundation, 2415 Eisenhower Avenue, Alexandria, Virginia 22314, USA
Tel: (703) 292-5111, FIRS: (800) 877-8339 | TDD: (703) 292-5090 or (800) 281-8749

Text Only