NSF 24-553: Improving Undergraduate STEM Education: Computing in Undergraduate Education

Program Solicitation

Document Information

Document History

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National Science Foundation
Directorate for Computer and Information Science and Engineering
Division of Computer and Network Systems
Division of Computing and Communication Foundations
Division of Information and Intelligent Systems
Office of Advanced Cyberinfrastructure
Directorate for STEM Education
Division of Undergraduate Education

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

May 30, 2024

April 29, 2025

Last Tuesday in April, Annually Thereafter

Table Of Contents

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:

Improving Undergraduate STEM Education: Computing in Undergraduate Education (IUSE: CUE)

Synopsis of Program:

The Improving Undergraduate STEM Education: Computing in Undergraduate Education (IUSE: CUE) program aims to better prepare a wider, more diverse range of students to collaboratively use computation across a range of contexts and challenging problems. With this solicitation, the National Science Foundation focuses on re-envisioning how to teach computing effectively to a broad group of students, in a scalable manner, with an emphasis on broadening participation of groups who are underrepresented and underserved by traditional computing courses and careers.

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.

- Jeffrey Forbes, Program Director, CISE/CNS, telephone: (703) 292-5301, email: jforbes@nsf.gov
- Allyson Kennedy, Program Director, CISE/CNS, telephone: (703) 292-8905, email: aykenned@nsf.gov

- Paul Tymann, Program Director, EHR/DUE, telephone: (703) 292-2832, email: ptymann@nsf.gov

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

- 47.070 --- Computer and Information Science and Engineering
- 47.076 --- STEM Education

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 3 to 6

Grants may be awarded in a variety of sizes and durations. Larger budget requests have a higher expectation for the breadth of impact. The estimated program budget, number of awards, and average award size/duration are subject to the availability of funds and the quality of proposals received.

Anticipated Funding Amount: $7,500,000

NSF anticipates that approximately $7.5 million will be available for new awards in this program.

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.
- State and Local Governments: State educational offices or organizations and local school districts.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

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

There are no restrictions or limits.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not required
- **Preliminary Proposal Submission:** Not required
- **Full Proposals:**
    - Full Proposals submitted via 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):

  May 30, 2024

  April 29, 2025

  Last Tuesday in April, Annually Thereafter

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:

Additional award conditions apply. Please see the full text of this solicitation for further information.

Reporting Requirements:

Additional reporting requirements apply. Please see the full text of this solicitation for further information.

I. Introduction

As noted in a report by the National Academies of Sciences, Engineering, and Medicine, *Assessing and Responding to the Growth of Computer Science Undergraduate Enrollments* [Washington, DC: The National Academies Press, 2018 (

https://doi.org/10.17226/24926)]:

It is a time for institutions to consider their missions and the constituencies they serve, and to determine what role computing should play in the experience, knowledge, and skills of its graduates of 2025 and beyond.

Computing is increasingly central to innovation across a wide range of disciplinary and interdisciplinary problem domains, resulting in undergraduate computer science, computer engineering, and information science programs being called upon to prepare larger and more diverse student populations. However, standard computing course sequences do not always serve these student populations well. Among other factors, a dearth of innovative, culturally relevant curricula and student support in undergraduate computing pathways have contributed to low participation of students from groups underrepresented in computing, leaving a huge swath of diverse talent untapped. In addition, valuable curricular reforms undertaken by a single institution often have limited impact on the larger academic community and do not account for the myriad of pathways students may take to arrive in computing courses. In addition, given the role of two-year colleges in equipping students for both computing workforce needs and continued post-secondary education, it is also vital to understand and support the many ways in which students experience and learn about computing in these institutions throughout their education.

With this solicitation, the National Science Foundation seeks a holistic restructuring of computing degree pathways. Specifically, organizations should collaborate to re-envision how to teach computing effectively to a broad group of students, in a scalable manner, with an emphasis on broadening participation of groups who are underrepresented and underserved by traditional computing courses and careers.

IUSE: CUE builds on past investments by NSF's Directorates for Computer and Information Science and Engineering (CISE) and STEM Education (EDU). The previous IUSE: CUE solicitation (NSF 19-546) supported the initial formation of teams to work together across disciplines and institutions of higher education (IHEs) to consider how Computer Science (CS) education can better support the ubiquitous role of computation across disciplines. In 2019-2020, NSF supported CUE.NEXT workshops to initiate a national dialogue on the role of computing in undergraduate education. Given its focus on undergraduate education, the IUSE: CUE program is aligned with NSF's Improving Undergraduate STEM Education (IUSE) framework, which is a comprehensive effort to accelerate improvements in the quality and effectiveness of undergraduate education in STEM fields.

II. Program Description

Overview:

With this solicitation, IUSE: CUE invites proposals for partnerships to re-envision how to teach computing effectively in a scalable manner focusing on those undergraduate students from groups underserved by traditional computing courses and careers.

Proposals will be funded across three tracks that focus on evidence-based transformative efforts to modernize computing courses and accelerate student success in the knowledge, skills, and dispositions of current and emerging industries, and/or explore effective pathways to computing degrees and careers that involve two-year colleges and industry partnerships.

- The **Transformation** track focuses on addressing one or more key challenges in transforming undergraduate computing education through innovative programs.
- The **Pathways** track considers the multiple entry and exit points through two-year colleges as part of effective pathways to computing degrees and/or careers.
- The **Mobilizing** track aims to develop a shared national vision around innovation and inclusion in undergraduate computing education.

All proposal tracks prioritize the creation of environments that are inclusive, equitable, and supportive of students – to include those from groups typically underrepresented in computing. In addition, innovative programs often offer an opportunity to recruit, welcome, and retain a much broader group of students, thereby benefiting all computing students

and, more widely, the computing disciplines. With this in mind, proposals must include specific plans to broaden participation in computing (BPC).

Transformation

Transformation proposals should focus on one or more key challenges to re-envision undergraduate computing education. Specific challenges include but are not limited to:

1. **The intersection of computing and other disciplines** – Increasing numbers of undergraduate students are enrolling in computing courses, in many cases not because they are interested in a career in computing but because they are interested in applying sophisticated computational skills and methods to a range of disciplines from biology to linguistics to art. This challenge seeks innovative approaches to address the growing demand being placed on CISE departments across all types of institutions of higher education.
2. **Undergraduate computing courses for 2025 and beyond** – Computing is rapidly evolving with new innovations and emerging technologies developing at a rate too great for many CISE departments to accommodate given their limited resources. As such, there is a growing gap between the topics addressed by some undergraduate computing coursework and current problems in computing research and industry practice. This challenge seeks innovative ways to update computing pathways to better provide students with the fundamental skills and understandings for the ever-changing landscape of computing careers.
3. **Holistic support toward computing degrees and certifications** – This challenge seeks innovative strategies that support students in their path to computing careers, to include increasing access to computing education for those traditionally underrepresented in computing. These strategies may include, but are not limited to developing non-traditional programs, practices, or certification tracks designed to support underserved students via effective practices that build student capacity.
4. **Effective, inclusive, and equitable online teaching for computing** – Online courses are become increasingly more common among students pursuing an undergraduate degree while working full-time, and they have been essential during the COVID-19 pandemic. As remote education becomes more common at IHEs, it is critical that online curricula foster effective, inclusive, and equitable learning environments for a diverse student body. This challenge seeks new and innovative ways to promote inclusive online teaching and learning for computing undergraduate education.

Teams are not expected to address all parts of computing education but rather to make a substantial regional or national impact on some aspect of computing pathways. This solicitation invites innovative ideas in computing education that involve new approaches and action; produce fundamental, structural change; and go outside of or beyond existing norms and principles. Teams with the necessary knowledge and skill set to execute such projects should include faculty across a range of domains, including education researchers. Teams must have an impact across multiple institutions and include a multi-institutional partnership, with a lead IHE and at least two other IHEs or other organizations.

Transformation proposals may request up to $2 million. The maximum duration of an award is five years.

Pathways

Pathways proposals should **support and explore effective pathways to computing degrees and careers involving two-year colleges.** Specifically, proposers should consider the multiple entry and exit points through two-year colleges:

- **Entry points into two-year colleges:** Many school districts have made progress in implementing equitable and rigorous computing courses at the high school level but need to coordinate efforts addressing articulation into college degree programs. Proposals may explore strategies that support students in the transition from high school into a two-year college, e.g., through bridge programs, short courses, etc. At the same time, two-year colleges also serve adult learners looking to upskill or reskill to meet the demands and gain economic advancement in a growing technological workforce. Proposals could also examine programs that support these students, collaborating with local or national industry partners to align with pressing workforce needs.

- **The two-year college to four-year college transition:** Students often face a range of barriers while pursuing a pathway into a baccalaureate program including enrollment caps, poorly defined transfer criteria, and the cultural differences between two-year and four-year institutions. Proposals might address any of these or other issues in an effort to better support students as they prepare for entry into four-year computing programs.

Teams must include a two-year college as part of the partnership. Teams must have an impact across multiple institutions and include a multi-institutional partnership, with a lead IHE and at least two other IHEs or other organizations.

Pathways proposals should include synergistic academic-industry partnerships that establish pathways for computing students transitioning from high school to a two-year institution or from a two-year to a four-year intuition. Academic-industry partnerships are intended to remove barriers and facilitate innovative paths to competitive careers in computing. Letters of commitment from industry partners must be provided at the time of submission of the proposal.

Pathways proposals may request up to $2 million. The maximum duration of an award is five years.

Mobilizing

The Mobilizing track invites proposals to convene diverse sets of CISE stakeholders through a series of workshops modeled after Biology's *Vision and Change* movement to develop a shared national vision around innovation and inclusion in undergraduate computing education. Mobilizing CUE workshops might address curricular supports in key thematic areas such as revitalizing core courses (data structures, algorithms, systems, etc.); integration of privacy, security, and society; modernizing curricula to incorporate emerging technologies (AI, Quantum); and robust programs at the intersection of computing and other disciplines. Mobilizing CUE workshops could also consider working with industry partners to support the development of a common, scalable educational infrastructure that would ensure equitable access to curricular supports across educational institution types.

Proposals can consider virtual, hybrid, or in-person approaches but must provide a rationale for the expected success of the convenings. Mobilizing CUE proposals can request up to $1 million. The maximum duration of an award is 18 months.

https://www.carnegiefoundation.org/blog/improvement-discipline-in-practice

III. Award Information

Anticipated Type of Award: Continuing Grant or Standard Grant

Estimated Number of Awards: 3 to 6

Grants may be awarded in a variety of sizes and durations. Larger budget requests have a higher expectation for the breadth of impact. The estimated program budget, number of awards, and average award size/duration are subject to the availability of funds and the quality of proposals received.

Anticipated Funding Amount: $7,500,000

NSF anticipates that approximately $7.5 million will be available for new awards in this program.

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.
- 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.
- State and Local Governments: State educational offices or organizations and local school districts.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

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

There are no restrictions or limits.

Additional Eligibility Info:

Transformation and Pathways proposals must be comprised of a multi-institutional partnership, with a lead IHE and at least two other IHEs or other organizations. Pathways proposals must include a two-year college as part of the partnership. Proposals that do not meet this requirement will be returned without review.

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.

COVER SHEET:

By their very nature, proposals responding to this solicitation may well be working with Human Subjects (looking at outcomes for faculty, students or both). Please refer to the guidance on proposals involving Human Subjects in PAPPG Chapter II.E.5.

PROPOSAL TITLES:

Proposal titles should contain the acronym "CUE-" at the beginning of the title, followed by either "T," "P," or "M" to indicate that they are being submitted to the Transformation, Pathways, or Mobilizing track, respectively. For example, "CUE-T: ⟨**Title**⟩.

Titles of proposals submitted in response to the EducateAI DCL (NSF 24-025) should begin with "EducateAI:".

If you submit a proposal as part of a set of collaborative proposals, the title of the proposal should begin with "Collaborative Research" followed by a colon, then the CUE track, and then the title. For example, **Collaborative Research: CUE-T: ⟨Title⟩**. Please note that if submitting via Research.gov, the system will automatically insert the prepended title "Collaborative Research" when the collaborative set of proposals is created.

PROJECT DESCRIPTION:

This program solicitation is particularly interested in BPC to support the full spectrum of diverse computing talent, including groups that have been traditionally underrepresented or underserved in computing.

All proposals must explicitly address broadening participation with respect to the two Additional Solicitation Specific Review Criteria:

1. Does the proposal identify the characteristics and needs of the intended population(s) to be served?
2. Does the proposal include specific plans or strategies for addressing or accommodating the particular needs of participants of the intended population(s)?

Reviewers will be asked to specifically evaluate the proposal on these two criteria as well as the two standard NSF Merit Review Criteria (Intellectual Merit and Broader Impacts). Proposals that do not adequately address these additional criteria will be declined.

Successful proposals are likely to include the following elements:

1. **Knowledge base for the project**: Successful proposals are expected to delineate the knowledge base from which the project is built. This grounding may be accomplished through a survey of relevant literature and summaries of findings of prior work. In particular, if the proposed project is building from previous work funded by NSF, a summary of the work, relevant findings, and lessons learned is an important component of the proposal.
2. **Project evaluation plan**: For all proposals, an appropriate evaluation plan should be included for all projects, along with project personnel dedicated to evaluation of project activities. Evaluation activities may be conducted

by an independent evaluator, by qualified members of the project team, or guided by a project advisory board. The external critical review should be sufficiently independent and rigorous to influence the project's activities and improve the quality of its findings. Evaluation activities should be aligned with proposed activities and expected outcomes. A successful proposal will (1) describe the expertise of the external reviewer(s); (2) explain how that expertise relates to the goals and objectives of the proposal; and (3) specify how the PI will report and use results of the project's external, critical review process.

3. **Relevant research questions**: For projects that include a research component, the research questions should be aligned with the research plan, project activities, and expected outcomes, and be answerable through data generated by or related to the proposed project activities.
4. **Dissemination plan**: All projects should contain a plan for dissemination of project efforts through appropriate channels. These channels may include study registration, presentation of results in public forums including conferences and workshops, publication of research findings and materials in appropriate venues, and/or engagement in virtual and face-to-face communities. The IUSE: CUE program requires the use of Creative Commons licensing for new materials and release of computer code under an intellectual property license allowing others to use and build on the work.
5. **Sustainability**: All projects should consider sustainability of efforts after the completion of funding. Sustainability should also be considered in the design of hardware and software to enable project efforts to be continued following system upgrades.
6. **Collaboration plan**: All projects should contain a plan for coordinating the various participants of the project. The collaboration plan should include
    - a description of the partnership among IHEs, the relevant characteristics of its members, and the specific roles of the project participants in all organizations involved;
    - an initial statement of common goals and examples of possible common metrics;
    - plans for communication and convenings of members;
    - descriptions of any management and administrative structures that will be put in place initially;
    - methods that will be used in assessing/evaluating the success of the collaboration; and
    - specific references to the budget line items that support collaboration and coordination mechanisms.

Supplementary Documents:

In the Supplementary Documents section, upload the following information where relevant:

A list of Project Personnel and Partner Organizations (required) (Note: In collaborative proposals, the lead organization should provide this information for all participants):

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, Senior Personnel, funded/unfunded Consultants or Collaborators, Subawardees, Postdocs, and project-level advisory committee members. 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:

- Mary Smith; XYZ University; PI
- John Jones; University of PQR; Senior Personnel
- Jane Brown; XYZ University; Postdoctoral Researcher
- Bob Adams; ABC Community College; Paid Consultant
- Susan White; DEF Corporation; Unfunded Collaborator
- Tim Green; ZZZ University; Subawardee

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

C. Due Dates

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

  May 30, 2024

  April 29, 2025

  Last Tuesday in April, Annually Thereafter

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/ProposalPreparationanc 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

This program solicitation is particularly interested in BPC to support the full spectrum of diverse computing talent, including groups that have been traditionally underrepresented or underserved in computing. In addition to considering the two general NSF Merit Review Criteria, reviewers will also be asked to evaluate the following:

1. Does the proposal identify the characteristics and needs of the intended population(s) to be served?
2. Does the proposal include specific plans or strategies for addressing or accommodating the particular needs of participants of the intended population(s)?

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.

Special Award Conditions:

Projects will be required to maintain a project website and attend annual PI and community meetings.

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.

Recipients must participate in CUE program-level evaluation by which NSF can assess quantitative gains in relevant measures for students from the underrepresented communities, supplying data that is disaggregated by race, ethnicity, gender, disability status, and discipline (but **not** further disaggregated to the individual level; NSF does not seek data on individuals). Recipients will be required to make qualitative assessments of the process of change. CUE projects are expected to have the capability of collecting and analyzing data for these program evaluation activities.

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:

- Jeffrey Forbes, Program Director, CISE/CNS, telephone: (703) 292-5301, email: jforbes@nsf.gov
- Allyson Kennedy, Program Director, CISE/CNS, telephone: (703) 292-8905, email: aykenned@nsf.gov
- Paul Tymann, Program Director, EHR/DUE, telephone: (703) 292-2832, email: ptymann@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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