

# NSF 23-510: Improving Undergraduate STEM Education: Directorate for STEM Education (IUSE: EDU)

## Program Solicitation

### Document Information

#### Document History

- **Posted:** October 20, 2022
- **Replaces:** [NSF 21-579](#)

[View the program page](#)



**National Science Foundation**  
Directorate for STEM Education  
Division of Undergraduate Education

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

January 18, 2023

Third Wednesday in January, Annually Thereafter

Institutional and Community Transformation (Capacity-Building and Level 1) proposals and Engaged Student Learning (Level 1) proposals

July 19, 2023

Third Wednesday in July, Annually Thereafter

Institutional and Community Transformation (Level 2) proposals and Engaged Student Learning (Level 2 and Level 3) proposals



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### **Important Information And Revision Notes**

**Update:** The Micron Foundation has been added as a collaborating partner in this program. For additional information, please refer to Dear Colleague Letter: Equitable and Transformative Approaches to Educating the Semiconductor Workforce ([NSF 23-118](#)).

This solicitation contains the following revisions:

1. Program due dates have been revised.
2. Funding amounts and estimated numbers of awards have been revised.
3. [NSF 20-034, Dear Colleague Letter: Stimulating Participation from Institutions New to the Improving Undergraduate STEM Education: Education and Human Resources Program](#) has been referenced to provide guidance for institutions new to the IUSE program.
4. A requirement for a supplementary document containing a list of project participants has been added.

The IUSE: EDU program team will host webinars in which key features and expectations of the IUSE: EDU program will be discussed. Information about the webinars will be posted to the IUSE: EDU program webpage: <https://beta.nsf.gov/funding/opportunities/improving-undergraduate-stem-education-education>.

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: Directorate for STEM Education (IUSE: EDU)

**Synopsis of Program:****Synopsis of Program:**

The fields of science, technology, engineering, and mathematics (STEM) hold much promise as sectors of the economy where we can expect to see continuous vigorous growth in the coming decades. STEM job creation is expected to outpace non-STEM job creation significantly, according to the Commerce Department, reflecting the importance of STEM knowledge to the US economy.

The National Science Foundation (NSF) plays a leadership role in developing and implementing efforts to enhance and improve STEM education in the United States. Through the NSF *Improving Undergraduate STEM Education* (IUSE) initiative, the agency continues to make a substantial commitment to the highest caliber undergraduate STEM education through a Foundation-wide framework of investments. The IUSE: EDU is a core NSF STEM education program that seeks to promote novel, creative, and transformative approaches to generating and using new knowledge about STEM teaching and learning to improve STEM education for undergraduate students. The program is open to application from all institutions of higher education and associated organizations. NSF places high value on educating students to be leaders and innovators in emerging and rapidly changing STEM fields as well as educating a scientifically literate public. In pursuit of this goal, IUSE: EDU supports projects that seek to bring recent advances in STEM knowledge into undergraduate education, that adapt, improve, and incorporate evidence-based practices into STEM teaching and learning, and that lay the groundwork for institutional improvement in STEM education. In addition to innovative work at the frontier of STEM education, this program also encourages replication of research studies at different types of institutions and with different student bodies to produce deeper knowledge about the effectiveness and transferability of findings.

IUSE: EDU also seeks to support projects that have high potential for broader societal impacts, including improved diversity of students and instructors participating in STEM education, professional development for instructors to ensure adoption of new and effective pedagogical techniques that meet the changing needs of students, and projects that promote institutional partnerships for collaborative research and development. IUSE: EDU especially welcomes proposals that will pair well with the efforts of NSF INCLUDES ([https://www.nsf.gov/news/special\\_reports/nsfincludes/index.jsp](https://www.nsf.gov/news/special_reports/nsfincludes/index.jsp)) to develop STEM talent from all sectors and groups in our society.

For all the above objectives, the National Science Foundation invests primarily in evidence-based and knowledge-generating approaches to understand and improve STEM learning and learning environments, improve the diversity of STEM students and majors, and prepare STEM majors for the workforce. In addition to contributing to STEM education in the host institution(s), proposals should have the promise of adding more broadly to our understanding of effective teaching and learning practices.

The IUSE: EDU program features two tracks: (1) Engaged Student Learning and (2) Institutional and Community Transformation.

**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.*

- General inquiries may be addressed to:, telephone: (703) 292-8670, email: [iuse@nsf.gov](mailto:iuse@nsf.gov)

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

- 47.076 --- STEM Education

## Award Information

**Anticipated Type of Award:** Standard Grant or Continuing Grant

**Estimated Number of Awards:** 135

The program estimates making awards for 50 Level 1 projects, 30 Level 2 and 3 projects, 15 Capacity-Building projects, and 40 conferences and workshops.

**Anticipated Funding Amount:** \$61,000,000

The program estimates that approximately \$61,000,000 will be available for new awards per fiscal year. See section III below for further information about the anticipated number of awards in the program's two tracks and the average size and duration of awards. The estimated program budget, number of awards, and average award size/duration are subject to the availability of funds.

## Eligibility Information

### Who May Submit Proposals:

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

### Who May Serve as PI:

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: 3

An individual may serve as PI or co-PI on no more than three IUSE: EDU proposals submitted during the period of October 1 through September 30. This eligibility constraint will be strictly enforced. In the event that an individual exceeds this limit, proposals will be accepted based on earliest date and time of proposal submission (i.e., the first three proposals will be accepted and the remainder will be returned without review). No exceptions will be made.

## Proposal Preparation and Submission Instructions

### A. Proposal Preparation Instructions

- **Letters of Intent:** Not required
- **Preliminary Proposal Submission:** Not required
- **Full Proposals:**
  - Full Proposals submitted via Research.gov: *NSF Proposal and Award Policies and Procedures Guide* (PAPPG) guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: [https://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=pappg](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](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:**

Other budgetary limitations apply. Please see the full text of this solicitation for further information.

### **C. Due Dates**

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

January 18, 2023

Third Wednesday in January, Annually Thereafter

Institutional and Community Transformation (Capacity-Building and Level 1) proposals and Engaged Student Learning (Level 1) proposals

July 19, 2023

Third Wednesday in July, Annually Thereafter

Institutional and Community Transformation (Level 2) proposals and Engaged Student Learning (Level 2 and Level 3) proposals

### **Proposal Review Information Criteria**

#### **Merit Review Criteria:**

National Science Board approved criteria apply.

#### **Award Administration Information**

#### **Award Conditions:**

Standard NSF award conditions apply.

#### **Reporting Requirements:**

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

## **I. Introduction**

The National Science Foundation's (NSF's) Improving Undergraduate STEM Education (IUSE) Initiative is a Foundation-wide effort to accelerate improvements in the quality and effectiveness of undergraduate education in all STEM fields<sup>1</sup>. Undergraduate STEM education is critical for preparing both a diverse STEM workforce and a STEM-literate public that is ready to support and benefit from the progress of science<sup>2</sup>. The IUSE initiative provides a Foundation-wide framework of investments to support the agency's commitment to the highest caliber undergraduate STEM education. By improving the quality and effectiveness of undergraduate education in all STEM fields, IUSE investments enable NSF to lead national progress toward a diverse and innovative workforce and a STEM-literate public.

Through the IUSE framework, NSF coordinates its investments in undergraduate programs and undergraduate STEM education to maximize impact, and to use shared metrics and appropriate program evaluation approaches. These investments are made across all directorates and address both STEM education in general and specific disciplinary needs.

IUSE investments support a variety of activities including the inclusion of inquiry-based and active learning approaches in undergraduate STEM instruction, efforts to increase undergraduate STEM research experiences and courses, and research on the persistence and graduation of students in STEM programs. In addition, specific emerging cross-disciplinary needs include data science preparation for students in all majors, recruitment and retention of women and of students from groups underrepresented in STEM degree programs, incorporation of undergraduate research in STEM fields for STEM majors and non-majors, and re-envisioning of introductory courses in light of new research findings and theories. IUSE also seeks to broaden participation in STEM fields from all sectors and groups in society and proposers are encouraged to establish linkages, as appropriate, with components of the national network of NSF INCLUDES projects<sup>3</sup>.

The IUSE: Directorate for STEM Education (IUSE: EDU) program seeks to promote novel, creative, and transformative approaches to generating and using new knowledge about STEM teaching and learning to improve STEM education for all undergraduates. Through its investments, the program seeks to support development, and implementation, and research efforts that (1) bring recent advances in STEM disciplinary and interdisciplinary knowledge into undergraduate education, (2) adapt, improve, and incorporate evidence-based practices into STEM teaching and learning, and (3) lay the groundwork for institutional improvement. Investments made by the IUSE: EDU program seek to contribute to the educational and capacity-building goals of the NSF Directorate for STEM Education and to the strategic goals and objectives of the NSF<sup>4</sup>.

## II. Program Description

### A. Program overview:

The IUSE: EDU program supports projects designed to contribute to a future in which all undergraduate students are fully engaged in their STEM learning. The IUSE: EDU program promotes (1) Engaged Student Learning: the development, testing, and use of teaching practices and curricular innovations that will engage students and improve learning, persistence, and retention in STEM, and (2) Institutional and Community Transformation: the transformation of colleges and universities to implement and sustain highly effective STEM teaching and learning.

All projects supported by IUSE: EDU must:

- Demonstrate a strong rationale for project objectives or incorporate and build on educational practices that are demonstrably effective
- Contribute to the development of exemplary undergraduate STEM education
- Add to the body of knowledge about what works in undergraduate STEM education and the conditions that lead to improved STEM teaching and learning
- Measure project progress and achievement of project goals

To accomplish these goals, IUSE: EDU projects may focus their activities at any level, including the student, faculty, institutional or community<sup>5</sup> levels. Development, propagation, adaptation, and transferability of evidence-based practices are also important considerations. Projects should consider designing materials and practices for use in a wide variety of institutions or institutional types. Topics of interest to the IUSE: EDU program include, but are not limited to, the following:

- Development and study of the efficacy of innovative teaching and learning practices and resources
- Development, testing, and dissemination of instruments for measuring student outcomes
- Efforts to increase the diversity of the STEM workforce including K-12 teachers and/or the faculty and institutions engaged in work to improve undergraduate STEM education
- Faculty professional development to increase the use of evidence-based teaching practices
- Implementation of and research on sustained change processes involved in adopting evidence-based and effective instruction within or across departments, disciplines, or institutions
- Efforts to achieve STEM educational goals through innovative partnerships, for example with community organizations, local, regional, or national industries, centers for teaching and learning, professional societies, or

libraries,

- Propagating and sustaining transformative and effective STEM teaching and learning through institutional practices or involvement of professional societies

IUSE: EDU also welcomes proposals to conduct workshops and conferences aimed at improving undergraduate STEM education, developing implementation practices, and/or assembling research partnerships and agendas.

All IUSE: EDU projects are expected to increase knowledge about effective STEM education. **This may be achieved through posing one or more research questions that will be answered through the course of the study or through evaluation of project activities, impacts, or outcomes**<sup>6</sup>. Projects should include a well-designed plan to gather data and should specify methods of analysis that will be employed to answer the questions posed and mechanisms to evaluate success of the project. Projects should also specify strategies for generating and using formative and summative assessment of project processes, outputs, and/or outcomes.

The IUSE: EDU program strongly encourages collaboration among disciplinary instructors, departmental and institutional administrators, and educational researchers in the design and implementation of a project. Transferability and propagation are important aspects for IUSE: EDU-supported efforts and should be addressed throughout a project's lifetime. Dissemination plans should ensure that resources and findings from the project are accessible for multiple audiences, such as researchers and educators. Ultimately, results and findings from IUSE: EDU projects are expected to contribute to EDU's larger themes focusing on STEM learning and learning environments, broadening participation and institutional capacity in STEM, and/or STEM professional workforce development.

The IUSE: EDU program recognizes that putting existing research-based practices into place may be the most important local need for improving undergraduate STEM education. Consequently, conceptual replication or adaptation studies are encouraged to foster propagation of evidence-based STEM teaching and learning approaches in new environments. The 2018 Companion Guidelines on Replication & Reproducibility in Education Research describes conceptual replication as studies that "seek to determine whether similar results are found when certain aspects of a previous study's method and/or procedures are systematically varied."<sup>7</sup> Conceptual replication or adaptation projects may study the impact of an intervention in a new population of students, faculty, or institutional types. These projects might also modify components of an intervention to better meet local needs, implement an intervention in a new environment, improve or adapt assessment instruments, or re-envision the analytic approach to measuring impact. For the purposes of the IUSE: EDU Program, replication studies are intended to broaden or deepen our understanding of the efficacy and applicability of evidence-based practices. As a result, replication or adaptation studies should be designed to enable universities and two- and four-year colleges to adopt, adapt, or improve curricular materials, curriculum design, practices, policies, faculty capacity, organizational culture, or climate in ways that improve the learning and learning environments of undergraduate STEM students.

Researchers interested in conducting fundamental research are also encouraged to consult EHR's Core Research (ECR) Program<sup>8</sup>.

B. Program tracks and levels:

The IUSE: EDU program features two tracks: (1) **Engaged Student Learning** and (2) **Institutional and Community Transformation**. Several levels of scope, scale, and funding are available within each track, as detailed below.

### **Track 1: Engaged Student Learning**

The Engaged Student Learning (ESL) track focuses on design, development, and research projects that involve the creation, exploration, or implementation of tools, resources, and models. Projects must show high potential to increase student engagement and learning in STEM. Projects may focus directly on students or indirectly serve students through faculty professional development or research on teaching and learning. Whatever the focus, all projects should be both evidence-based and knowledge-generating, with well-developed plans to study student experiences and evaluate student outcomes. NSF's investment in research and development for Engaged Student Learning in undergraduate STEM education encompasses a range of approaches including:

- Development and implementation of novel instructional methods or adaptation of existing evidence-based pedagogies in STEM disciplines or in multi-disciplinary or interdisciplinary courses or programs
- Design and assessment of metrics aiming to measure STEM teaching and learning or student outcomes
- Local, regional, or national efforts to develop and disseminate tools, resources, or models designed to improve STEM teaching and learning
- Discipline-based educational research or research that spans multiple disciplinary domains
- Faculty learning through professional development
- Re-envisioning or adaptation of learning environments
- Co-curricular activities that increase student motivation and persistence in STEM
- Investigation of novel instructional tools or learning systems, including cyber-learning or learning technologies
- Synthesis or meta-analysis of prior work to examine differences in findings across studies and variations in the types of interventions, for whom, and under what conditions
- Collaborations between two-year and four-year institutions to develop innovative pathways for student transfers and success

In keeping with the mission of the NSF's Directorate for STEM Education, ESL projects can contribute to developing the STEM and STEM-related workforce, advancing a disciplinary STEM field, broadening participation in STEM, educating a STEM-literate public, improving K-12 STEM education through undergraduate pre-service STEM teacher preparation, encouraging life-long learning, and/or building STEM capacity in higher education.

Three levels of funding are available for ESL projects. These funding levels should align with the scale and scope of the effort and the capacity of the team to conduct the proposed study. The scale of the work refers to the number of students, faculty, departments, institutions, or other groups that the work engages while the scope of the work refers to the range of project components involved. Inclusion of investigators and/or institutions new to NSF as project team members or collaborative partners is encouraged as a mechanism for expanding project impact and for building capacity in STEM disciplinary, interdisciplinary, or multi-disciplinary engaged student learning.

#### ESL Level 1

ESL Level 1 projects have a maximum award of \$400,000 and a maximum duration of three years. Awards at this level will support early-stage or exploratory research projects<sup>6</sup>, as well as projects that propose adaptation of existing pedagogies and methodologies in novel environments on a small scale. Proposals from a single institution involving one or more faculty members in a single discipline or across several disciplines are appropriate for this level, as are partnerships across disciplines, institutions, or communities focused on a unifying thematic approach or problem. Pilot data illustrating initial efforts may be helpful in assessing the viability of the project, but projects with a strong grounding in the relevant literature are also appropriate for this level. Investigators from institutions new to the IUSE program are encouraged to consult [NSF 20-034](#), Dear Colleague Letter: Stimulating Participation from Institutions New to the Improving Undergraduate STEM Education: Education and Human Resources Program.

The annual deadline for ESL Level 1 submissions is the third Wednesday in January.

#### ESL Level 2

ESL Level 2 project awards range from \$400,001 to \$750,000 and have a maximum duration of three years. ESL Level 2 projects should have a scale and scope beyond what would be expected for ESL Level 1 projects. ESL Level 2 projects are intended to support design and development efforts or impact studies<sup>6</sup> to improve student learning, including department-wide reform efforts, interdisciplinary or multi-disciplinary collaborations, or partnerships across institutions. ESL level 2 projects may be from a single institution or involve multi-institutional collaborations. Partnerships with professional societies, industries, or community partners are also appropriate for this level.

The annual deadline for ESL Level 2 submissions is the third Wednesday in July.



### ESL Level 3

ESL Level 3 project awards range from \$750,001 to \$2 million and have a maximum duration of five years. Projects at this scale and scope are expected to benefit large numbers of students or broad communities of faculty and instructors through large-scale design and development studies or impact research<sup>6</sup>. ESL Level 3 projects are expected to demonstrate sufficient scale and scope to warrant this level of support. ESL Level 3 projects are expected to contain highly developed research plans including significant research questions or large-scale evaluation efforts. Budgetary requests should be commensurate with the scope and scale of the proposed project. Collaborations among disciplinary instructors, departmental and institutional administrators, and educational researchers are likely to strengthen ESL Level 3 proposals. In addition, ESL Level 3 proposals are likely to involve two or more institutions, although submissions from single entities will be considered if the scale and scope of the project is appropriate.

To determine suitability of a project for consideration as an ESL Level 3 effort, or for assistance in distinguishing between ESL Level 3 and ICT Level 2 projects (see below), proposers are encouraged to contact an NSF program officer prior to preparation and submission of a full proposal.

The annual deadline for ESL Level 3 submissions is the third Wednesday in July.

### **Track 2: Institutional and Community Transformation**

The Institutional and Community Transformation (ICT) track funds innovative work applying evidence-based practices that improve undergraduate STEM education and research on the organizational change processes involved in implementing evidence-based practices. The emphasis of this track is on systemic change that may be measured at the departmental, institutional, or multi-institutional level, or across communities of STEM educators and/or educational researchers.

Institutional and Community Transformation projects are expected to include one or more **theories of change** to guide the proposed work<sup>9</sup>. A theory of change functions to identify and organize the dimensions of the proposed work and is a critical component of ICT projects. Competitive proposals will examine the impact of deliberate interventions in undergraduate STEM education. While proposed projects will vary in approach and the underlying theory/theories of change identified, promising proposals will recognize that STEM higher education is a complex system and that achieving goals involves analyzing and addressing organizational factors, such as institutional policies and practices or opportunities for professional growth.

ICT projects may focus on departments or colleges within institutions, entire institutions, on groups of institutions, or on STEM communities of educators, practitioners, and/or educational researchers. NSF's investment in research and development in institutional and community transformation encompasses a range of approaches, such as:

- Transformation of high-enrollment, lower-division courses within a discipline or across disciplines to include evidence-based teaching practices
- Developing disciplinary or interdisciplinary teaching evaluation rubrics that are rooted in a common research-based framework
- Development and propagation of faculty communities of practice to support efforts to improve accessibility or sustainability of evidence-based educational approaches
- Examination of change processes in colleges, universities, or academic communities and developing metrics and identifying best practices to guide the process of institutional transformation
- Re-envisioning of learning environments or support networks for faculty and students
- Inclusion of non-tenure-track faculty or instructors through policy or professional development
- Identification of common elements across disciplines, programs, institutions, or systems that support students from groups underrepresented in STEM to be successful.

Three levels of funding are available for Institutional and Community Transformation projects.

These funding levels align with the scale and scope of the empirical effort and the capacity of the team to conduct the proposed research. The scale of the work refers to the number of students, faculty, departments, institutions, or other groups that the work engages while scope refers to the range of project components involved. Inclusion of investigators and/or institutions new to NSF as project team members or collaborative partners is encouraged as a mechanism for expanding project impact and for building capacity in institutional and community transformation.

#### ICT Capacity-Building

ICT Capacity-Building proposals may be submitted as individual or collaborative projects. The maximum award size is \$200,000 for a single institution proposal or \$400,000 for a multi-institution proposal. The maximum duration of both single and multi-institutional proposals is two years.

Capacity-Building proposals are expected to enable institutions that have not served as the lead institution on a prior ICT award to identify a project of interest. Funding for these projects is intended to support efforts to assess institutional needs, formulate departmental and/or institutional commitments, develop necessary campus partnerships, audit prior institutional efforts, gather data, learn about relevant theories of change, identify relevant institutional practices and policies, and/or formulate plans for advancing institutional or community transformation. Proposers are encouraged to include a variety of participants such as disciplinary or educational researchers, assessment and evaluation experts and advisors, and institutional leaders. Funds awarded for ICT Capacity-Building proposals are intended to defray costs such as coordinating among project participants, sharing data, and attending relevant meetings including IUSE: EDU PI meetings. The project timeframe is intended to allow institutions to host one or more working meetings at which stakeholders and potential research partners might ultimately develop an ICT Level 1 or Level 2 proposal.

The annual deadline for ICT Capacity-Building submissions is the third Wednesday in January.

#### ICT Level 1

ICT Level 1 proposals have a maximum award size of \$400,000 and a maximum duration of three years. Awards at this level are intended for early-stage exploratory projects<sup>6</sup> or small to mid-scale projects that build on prior work.

The annual deadline for ICT Level 1 submissions is the third Wednesday in January.

#### ICT Level 2

ICT Level 2 project awards range from \$400,001 to \$2 million and a maximum duration of five years. ICT Level 2 awards are intended to support design and development work or impact research<sup>6</sup>. Projects at this scale and scope may be disciplinary, interdisciplinary or multi-disciplinary in nature and are intended to examine and/or incorporate broad communities of institutions, departments, or faculty. ICT Level 2 projects are expected to demonstrate sufficient scale and scope to warrant support at this level. Prior work need not have been funded through the IUSE: EDU Program but should provide data and document expertise of the project team in support of project objectives. ICT Level 2 work is expected to contain robust research plans including either significant research questions or large-scale evaluation efforts, along with appropriate assessment efforts.

To determine suitability of a project for consideration as an ICT Level 2 effort, or for assistance in distinguishing between ICT Level 2 and ESL Level 3 projects (see above), proposers are encouraged to contact an NSF program officer prior to preparation and submission of a full proposal.

The annual deadline for ICT Level 2 submissions is the third Wednesday in July.

#### Conferences

Proposals for conferences addressing important challenges in undergraduate STEM education may be submitted at any time following consultation with a program officer. Conference proposals that address diversity in STEM teaching and learning, and those involving collaborations of educational researchers and disciplinary scientists to ensure that STEM teaching reflects cutting-edge STEM disciplinary research are especially encouraged. Information about preparing Conference Proposals is contained in PAPPG Chapter II.E.

### C. Project elements

Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the NSF Proposal & Award Policies & Procedures Guide (PAPPG)<sup>10</sup>. 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 except ICT Capacity-Building, 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 external evaluator, by qualified members of the project team, or guided by a project advisory board<sup>11</sup>. Evaluation activities should be aligned with proposed activities and expected outcomes.
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<sup>12</sup>, 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: EDU 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<sup>13</sup>.
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.

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### References and Notes:

<sup>1</sup> All the STEM fields supported by NSF are supported by the IUSE program including the learning, social, behavioral, and economic sciences.

<sup>2</sup> *Building the Future Investing in Innovation and Discovery: NSF Strategic Plan 2018-2022*.  
[https://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=nsf18045](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf18045)

<sup>3</sup> [https://www.nsf.gov/funding/pgm\\_summ.jsp?pims\\_id=505289](https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505289)


<sup>4</sup> <https://www.nsf.gov/edu/about.jsp>; [https://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=nsf18045](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf18045)

<sup>5</sup> Here community refers to academic communities associated with disciplinary or professional societies of faculty and other academic professionals.

<sup>6</sup> U.S. Department of Education and the National Science Foundation. (2013). *Common Guidelines for Education Research and Development: A Report from the Institute of Education Sciences, U.S. Department of Education and the National Science Foundation, NSF 13-126*. Arlington, VA: National Science Foundation.


<sup>7</sup> [https://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=nsf19022](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf19022)

<sup>8</sup> [https://www.nsf.gov/funding/pgm\\_summ.jsp?pims\\_id=504924](https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504924) (ECR solicitation)

<sup>9</sup> Connolly, M. R., and Seymour, E. (2015) Why theories of change matter (WCER Working Paper No. 2105-2). Retrieved from the University of Wisconsin-Madison, Wisconsin Center for Education Research website: <https://wcer.wisc.edu/publications/working-papers> 

<sup>10</sup> [https://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=pappg](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg).

<sup>11</sup> 2010 User-Friendly Handbook for Project Evaluation. <http://www.evaluate.org/resources/doc-2010-nsfhandbook/> 

<sup>12</sup> Please see registration sites such as the Open Science Framework (<https://osf.io> ) or Prospero (<https://www.crd.york.ac.uk/prospero/> )

<sup>13</sup> <https://creativecommons.org/licenses/> 

### III. Award Information

NSF anticipates that approximately \$61 million will be available for new awards in this program per fiscal year. Grants may be awarded in a variety of sizes and durations, with approximately 40% of available funds allocated for ICT: Capacity-Building projects, IUSE Level 1 projects, and conferences and workshops and 60% of available funds allocated for IUSE Level 2 and 3 projects. 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 Type of Award:** Standard Grant or Continuing Grant

**Estimated Number of Awards:** 135

### IV. Eligibility Information

#### Who May Submit Proposals:

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

#### Who May Serve as PI:

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: 3

An individual may serve as PI or co-PI on no more than three IUSE: EDU proposals submitted during the period of October 1 through September 30. This eligibility constraint will be strictly enforced. In the event that an individual exceeds this limit, proposals will be accepted based on earliest date and time of proposal submission (i.e., the first three proposals will be accepted and the remainder will be returned without review). No exceptions will be made.

### 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](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](mailto: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](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](mailto: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.D.3 provides additional information on collaborative proposals.

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

**Project Data Form:** A Project Data Form must be submitted as part of all proposals. The information on this form is used to direct proposals to appropriate reviewers and to determine the characteristics of projects supported by the NSF Division of Undergraduate Education (DUE). In Research.gov, this form will appear as a required section of the proposal only after the IUSE: EDU Program solicitation number has been selected in Step 1 of the Proposal Creation Wizard. Grants.gov users should refer to Section VI.5.2. of the NSF Grants.gov Application Guide for specific instructions on how to submit the DUE Project Data Form.

**List of project participants:** Each IUSE proposal must include, as a supplementary document, a list of the name, institutional affiliation, and role of all project personnel outside of the PI, co-PI(s), and senior personnel. This includes project staff, advisory board members, project evaluators, consultants, collaborators, and any other individuals participating in the project. The list should not include graduate or undergraduate students, or individuals yet to be named.

## **B. Budgetary Information**

### **Cost Sharing:**

Inclusion of voluntary committed cost sharing is prohibited.

### **Other Budgetary Limitations:**

Scholarships for students are not supported by the IUSE: EDU program.

## **C. Due Dates**

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

January 18, 2023

Third Wednesday in January, Annually Thereafter

Institutional and Community Transformation (Capacity-Building and Level 1) proposals and Engaged Student Learning (Level 1) proposals

July 19, 2023

Third Wednesday in July, Annually Thereafter

Institutional and Community Transformation (Level 2) proposals and Engaged Student Learning (Level 2 and Level 3) proposals

#### **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](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 1-800-673-6188 or e-mail [rgov@nsf.gov](mailto: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](mailto:support@grants.gov). The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

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

Proposers that submitted via 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/](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.C.2.d(i). contains additional information for use by proposers in development of the Project Description section of the proposal). Reviewers are strongly encouraged to review the criteria, including PAPPG Chapter II.C.2.d(i), prior to the review of a proposal.

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

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

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

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

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



increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

Proposers are reminded that reviewers will also be asked to review the Data Management Plan and the Postdoctoral Researcher Mentoring Plan, as appropriate.

## **B. Review and Selection Process**

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

Proposals submitted in response to the IUSE: EDU solicitation are reviewed by merit review panels, ad hoc reviewers, or both. All proposals will be reviewed approximately 8-10 weeks after the deadline date. Proposals will be reviewed using the NSF Merit Review Criteria of Intellectual Merit and Broader Impacts.

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

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

After programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements 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](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](mailto: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](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](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg).

Developers of new materials are required to license all work (except for computer software source code, discussed below) created with the support of the grant under either the 3.0 Unported or 3.0 United States version of the Creative Commons Attribution (CC BY), Attribution-ShareAlike (CC BY-SA), or Attribution-NonCommercial-ShareAlike (CC BY-NC-SA) license.

These licenses allow subsequent users to copy, distribute, transmit, and adapt the copyrighted work and requires such users to attribute the work in the manner specified by the grantee. Notice of the specific license used would be affixed to the work, and displayed clearly when the work is made available online. For general information on these Creative Commons licenses, please visit <http://creativecommons.org/licenses/> .

It is expected that computer software source code developed or created with IUSE grant funds be released under an intellectual property license that allows others to use and build upon the work. The grantee may release all new source code developed or created with IUSE grant funds under an open license acceptable to the Free Software Foundation (<http://gnu.org/licenses/> ) and/or the Open Source Initiative (<https://opensource.org/licenses/> .

Annual reports should detail the project's progress in achieving the expected goals and outcomes for that year. If the expected goals or outcomes were not achieved, the report should describe how the project will implement any revisions or address any delays.

## 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:

- General inquiries may be addressed to:, telephone: (703) 292-8670, email: [iuse@nsf.gov](mailto:iuse@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](mailto: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](mailto:support@grants.gov).

**For general inquiries, please contact [IUSE@nsf.gov](mailto:IUSE@nsf.gov)**

**For specific disciplinary questions, proposers are encouraged to contact a Program Officer in their discipline.**

### Biological Sciences

- Celeste Carter, telephone: (703) 292-4651, email: [vcarter@nsf.gov](mailto:vcarter@nsf.gov)
- Olivia Long, telephone: (703) 292-7897, email: [olong@nsg.gov](mailto:olong@nsg.gov)
- Josephine Rodriguez, email: [jrodrigu@nsf.gov](mailto:jrodrigu@nsf.gov)
- Gordon Uno, telephone: (703) 292-2574, email: [geuno@nsf.gov](mailto:geuno@nsf.gov)

### Chemistry

- Tom Kim, telephone: (703) 292-4458, email: [tkim@nsf.gov](mailto:tkim@nsf.gov)
- Jennifer Lewis, telephone: (703) 292-7340, email: [jenlewis@nsf.gov](mailto:jenlewis@nsf.gov)
- Kalyn Owens, telephone: (703) 292-4615, email: [kowens@nsf.gov](mailto:kowens@nsf.gov)
- Dawn Rickey, telephone: (703) 292-4674, email: [drickey@nsf.gov](mailto:drickey@nsf.gov)

### Computer Science

- Paul Tymann, telephone: (703) 292-2832, email: [ptymann@nsf.gov](mailto:ptymann@nsf.gov)

- Monisha Pulimood, telephone: (703) 292-4257, email: [spulimoo@nsf.gov](mailto:spulimoo@nsf.gov)

#### **Data Science**

- Nasser Alaraje, telephone: (703) 292-8063, email: [nalaraje@nsf.gov](mailto:nalaraje@nsf.gov)
- Mike Ferrara, telephone (703) 292-2635, email: [mferrara@nsf.gov](mailto:mferrara@nsf.gov)

#### **Engineering**

- Nasser Alaraje, telephone: (703) 292-8063, email: [nalaraje@nsf.gov](mailto:nalaraje@nsf.gov)
- Karen Crosby, telephone (703) 292-2124, email: [kcrosby@nsf.gov](mailto:kcrosby@nsf.gov)
- Christine Delahanty, telephone (703) 292-8492, email: [cdehahan@nsf.gov](mailto:cdehahan@nsf.gov)
- Jennifer Ellis, telephone (703) 292-2125, email: [jtellis@nsf.gov](mailto:jtellis@nsf.gov)
- Abby Ilumoka, telephone: (703) 292-2703, email: [ailumoka@nsf.gov](mailto:ailumoka@nsf.gov)
- Olga Pierrakos, telephone: (703) 292-7253, email: [olpierra@nsf.gov](mailto:olpierra@nsf.gov)
- Lulu Sun, telephone: (703) 292-7260, email: [lsun@nsf.gov](mailto:lsun@nsf.gov)
- Lynnette Madsen, telephone: (703) 292-4936, email: [lmadsen@nsf.gov](mailto:lmadsen@nsf.gov)

#### **ENG: Division of Engineering Education & Centers ( [IUSE:PFE/RED](#) )**

- Alice L. Pawley, telephone: (703) 292-7286, email: [apawley@nsf.gov](mailto:apawley@nsf.gov)

#### **Geological Sciences**

- Keith Sverdrup, telephone: (703) 292-4671, email: [ksverdru@nsf.gov](mailto:ksverdru@nsf.gov)

#### **GEO: Division of Ocean Sciences (OCE)**

- Elizabeth L. Rom, telephone: (703) 292-7709, email: [elrom@nsf.gov](mailto:elrom@nsf.gov)

#### **Institutional and Community Transformation**

- Connie Della-Piana, telephone: (703) 292-5309, email: [cdellapi@nsf.gov](mailto:cdellapi@nsf.gov)
- Tom Kim, telephone: (703) 292-4458, email: [tkim@nsf.gov](mailto:tkim@nsf.gov)
- Jennifer Lewis, telephone: (703) 292-7340, email: [jenlewis@nsf.gov](mailto:jenlewis@nsf.gov)
- Lynnette Madsen, telephone: (703) 292-4936, email: [lmadsen@nsf.gov](mailto:lmadsen@nsf.gov)

#### **Interdisciplinary**

- Corby Hovis, telephone: (703) 292-4625, email: [chovis@nsf.gov](mailto:chovis@nsf.gov)
- Tom Kim, telephone: (703) 292-4458, email: [tkim@nsf.gov](mailto:tkim@nsf.gov)
- Keith Sverdrup, telephone: (703) 292-4671, email: [ksverdru@nsf.gov](mailto:ksverdru@nsf.gov)
- Lynnette Madsen, telephone: (703) 292-4936, email: [lmadsen@nsf.gov](mailto:lmadsen@nsf.gov)

#### **Mathematics**

- Mike Ferrara, telephone: (703) 292-2635, email: [mferrara@nsf.gov](mailto:mferrara@nsf.gov)
- Patrice Waller, telephone: (703) 292-4944, email: [pwaller@nsf.gov](mailto:pwaller@nsf.gov)

#### **Physics / Astronomy**

- Corby Hovis, telephone: (703) 292-4625, email [chovis@nsf.gov](mailto:chovis@nsf.gov)
- Bud Talbot, telephone: (703) 292-7165, email: [rtalbot@nsf.gov](mailto:rtalbot@nsf.gov)

### **Pre-service STEM Education**

- Jennifer Ellis, telephone (703) 292-2125, email: [jtellis@nsf.gov](mailto:jtellis@nsf.gov)
- Leah McAlister-Shields, telephone: (703) 292-8712, email: [lmcalist@nsf.gov](mailto:lmcalist@nsf.gov)
- Patrice Waller, telephone: (703) 292-4944, email: [pwaller@nsf.gov](mailto:pwaller@nsf.gov)

### **Research/Evaluation/Assessment**

- Connie Della-Piana, telephone: (703) 292-5309, email: [cdellapi@nsf.gov](mailto:cdellapi@nsf.gov)
- Dawn Rickey, telephone: (703) 292-4674, email: [drickey@nsf.gov](mailto:drickey@nsf.gov)

### **Social Sciences and Behavioral Sciences**

- Connie Della-Piana, telephone: (703) 292-5309, email: [cdellapi@nsf.gov](mailto:cdellapi@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.

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