Improving Undergraduate STEM Education (IUSE) Program
focus on K-12 STEM Teacher Preparation

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GREETINGS

The **National Science Foundation's Division of Undergraduate Education (DUE)**, housed within the **Directorate for STEM Education (EDU),** funds projects that strengthen STEM education at two- and four-year colleges and universities by improving curricula, instruction, laboratories, infrastructure, assessment, diversity of students and faculty, and collaborations.

DUE is home to ***five core programs:***

- Advanced Technological Education Program (ATE)
- Improving Undergraduate STEM Education Program (IUSE:EDU)
- Improving Undergraduate STEM Education: Hispanic Serving Institutions Program (IUSE:HSI)
- Robert Noyce Teacher Scholarship Program (Noyce)
- NSF Scholarships in STEM (S-STEM)

Improving Undergraduate STEM Education
NSF 23-510

Next IUSE deadline: **January 15, 2025**

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

July 24, 2024 for ICT (Level 2) and ESL (Level 2 or 3)

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

Also, new PAPPG 24-1 for proposals due on or after May 20, 2024!

Many proposal preparation questions can be answered by checking the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG).

Webinar topics:

- What do you want to do?
- Introduction to IUSE: EDU Program
- Description of IUSE: EDU (including tracks & levels)
- Additional Program Details
- Tips for Success
- Resources

Are YOU Interested in…

- ❑Making changes at your institution to improve students' STEM learning and engagement?
- ❑Using assessment to enhance what is known about effective STEM teaching and learning practices?
- ❑Considering the implications of the aforementioned factors for pre-service STEM teacher preparation?

From Idea to Proposal

First Step: Write down or brainstorm 1-2 ideas for improving pre-service STEM teacher education that require financial resources.

What Next???:

- Has a similar project already provided results? Check through literature search, NSF award search, your communities/organizations
- Do you need collaborators, and if so, can you find them?
- Is IUSE the right fit? Two ways to check: read the solicitation and talk to a Program Director!

More on IUSE…

Improving Undergraduate STEM Education (IUSE) Program Overview

Program Solicitation NSF 23-510

What is IUSE: EDU?

- IUSE: EDU is a core STEM education program that seeks to promote novel, creative, and transformative approaches to improve STEM education for all undergraduates.
- 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.
- 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.

IUSE: EDU Program Goals

To build knowledge about STEM teaching and learning at the undergraduate level	To incorporate evidence-based practices in undergraduate STEM teaching and learning	To build and understand systemic change in undergraduate STEM education
Develop novel, creative, and transformative approaches to undergraduate STEM teaching and learning	Adapt, improve, replicate, and include evidence-based practices in STEM teaching and learning for all undergraduates	Lay the groundwork for sustained departmental, institutional, or community transformation and improvement

What does IUSE: EDU expect?

- 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 <u>OR</u> through evaluation of project activities, impacts, or outcomes.
- Dissemination of findings is expected. Creative dissemination efforts are encouraged.

IUSE: EDU Tracks and Levels

Engaged Student Learning (ESL)

- Increasing engagement and learning through new tools, resources and models
- Generating knowledge about student learning

Level 1: ≤ $400k, up to 3 years
Level 2: $400k - $750k, up to 3 years
Level 3: $750k - $2M, up to 5 years

New to IUSE DCL: NSF 23-043

Institutional and Community Transformation (ICT)

- Spreading and scaling up evidence-based practices using a “theory of change”
- Generating knowledge about the organizational change process

Capacity-Building: $200k for single institution or $400k for multiple institutions, up to 2 years
Level 1: ≤ $400k, up to 3 years
Level 2: $400k - $2M, up to 5 years

Program Deadlines

- ESL and ICT Level 1 and ICT Capacity-Building proposals:
  - **Third Wednesday in January**
  - This is a good place to start for institutions new to NSF or new to IUSE support
- ESL and ICT Level 2 & Level 3 proposals:
  - **Third Wednesday in July**
- Check the program website and program solicitation for updates

IUSE program website

Sample Engaged Student Learning Project Themes

- Assessment/metrics of learning and practice (in STEM or pedagogy courses for teachers)
- Educational Research (of best practices in STEM teacher preparation)
- Conducting undergraduate disciplinary research (for preservice teachers)
- Developing the STEM and STEM-related workforce (including teachers; *not scholarships*)
- Educating a STEM-literate population (**including STEM teachers**)
- Broadening participation in STEM (including STEM teachers)
- Exploring co-curricular activities to increase student motivation and persistence (in STEM teaching)
- STEM faculty professional development (including PD for STEM faculty teaching preservice STEM teachers)
- Building capacity in higher education (including STEM teacher preparation programs or curricula)

Sample Institutional CT Project Themes

- Technology and distance education methods (in STEM or pedagogy courses for teachers)
- Institutional STEM planning efforts and investigation of evidence-based practices in institutional strategic planning and faculty rewards
- STEM faculty professional development (including PD for STEM faculty teaching pre-service STEM teachers)
- Development of instruments and metrics to assess institutional shifts towards evidence-based teaching practices (in STEM or pedagogy courses for teachers)
- Research studies on approaches for advancing change in the STEM undergraduate community (including STEM teacher preparation programs)

Note: While these are some examples of ICT project themes, other themes are appropriate and many other applications to preservice STEM teacher preparation are possible.

Q & A — Session #1

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More IUSE Specifics

Collaborations are encouraged among:

- STEM disciplinary instructors
- Departmental and institutional administrators
- Education researchers

Project/Proposal Elements: (Section II. Program Description. C.)

1) Knowledge base for the project
2) Project evaluation plan (except ICT Capacity-Building)
3) Relevant research questions
4) Dissemination plan
5) Sustainability

More IUSE Specifics

"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.**"

- Two possible ways to generating knowledge
  - Research questions
  - Evaluation of project activities, impacts, or outcomes
- Evaluation activities should be aligned with proposed activities and expected outcomes. Evaluation may be conducted by an independent external evaluator, by qualified members of the project team, or guided by a project advisory board.

Engaged Student Learning (ESL) Projects

- ❑ Focuses on improving student learning
- ❑ Supports development of improved instructional materials and/or methods
- ❑ Aims to engage students, improve learning, and increase retention in STEM
- ❑ Range of approaches including (but not limited to):
  - Development and implementation of novel instructional methods and technologies
  - Design and assessment of metrics to measure STEM teaching and learning or student outcomes
  - Faculty learning through professional development
  - Discipline-based or interdisciplinary educational research

Institutional & Community Transformation (ICT)

- ❑Focuses on improving evidence-based instruction by academic departments, institutions, & other organizations/communities
- ❑Supports efforts to build and understand systemic change in undergraduate STEM education
- ❑Aims to use appropriate theories of change to transform institutions
- ❑Range of approaches including (but not limited to):
  - Transformation of high-enrollment, lower-division courses within a discipline or across disciplines to include evidence-based teaching practices
  - 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
  - Identification of common elements across disciplines, programs, institutions, or systems that support students from underrepresented groups to be successful in STEM

ICT Proposals

- **Systemic change** at the departmental, institutional, or multi-institutional level, or across communities of STEM educators and/or educational researchers.
- Describe **theory of change.**
- Include **research literature and theoretical perspectives** concerning change.
- Recognize STEM higher education as a **complex system;** achieving goals involves analyzing and addressing organizational factors, such as institutional policies and practices or opportunities for professional growth.

Levels: Scope, Scale & Funding

Scale = number of students, faculty, departments, institutions, or other groups that the work engages

Scope = 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.

Levels: Scope, Scale & Funding (cont.)

ESL

- **Level 1**, up to $400K & 3 yrs., early stage or exploratory research projects, or adaptation of existing pedagogies and methodologies in novel environment s on a small scale.

ICT

- **Capacity Building**, $200K single institution, $400K multi-institution, 2 yrs., early-stage exploratory projects or small to mid-scale projects that build on prior work
- **Level 1**, $400K, 3 yrs., early stage exploratory or small to mid-scale projects that build on prior work.

ICT Capacity Building

ICT

- enable institutions that have not served as the lead institution on a prior ICT award to identify a project of interest.
- 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.

Key Things to Keep in Mind

- New deadlines
  - 2 submission deadlines per fiscal year (July and January)
  - Only Capacity Building (for ICT) and Level 1 for January deadline
  - Only Level 2 or 3 for July deadline
- Replication studies are supported
  - “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”
- For resubmissions or multiple proposals from the same institution/PIs, make sure substantive changes have been made.
  - It is usually not ideal to change levels in a resubmission so that you can meet a closer deadline.
  - It is also not ideal to replicate or build on a funded project that is still in its early stages.

IUSE Fact Check (*True or False*)

- Q1: All proposals must have a research component.
    - False, but all proposals must generate new knowledge; this may be through a research component or through a robust evaluation.
- Q2: Funds for STEM curriculum development, programmatic pathways, learning resources, assessment instruments, and faculty development may receive funding.
    - True
- Q3: Proposals may focus on both STEM and non-STEM majors.
    - True, efforts to improve STEM undergraduate education for either or for both are welcome.
- Q4: Proposals may focus solely on STEM teacher preparation.
    - True, as well as any area of STEM undergraduate education.
- Q4: Proposals should demonstrate a solid grounding in relevant literature on STEM teaching and learning.
    - True, all proposals should be evidence-based.
- Q5: Proposals should increase knowledge about effective STEM education through posing one or more research questions or through evaluation of project activities, impacts, or outcomes.
    - True
- Q6: Proposal writers only need reference the solicitation in their preparation.
    - False, all NSF proposals must follow PAPPG guidelines

IUSE Fact Check (*cont.*)

Which of the following may receive IUSE funding?

- ❑ 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

Answer—ALL of the above

Q & A — Session #2

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IUSE: EDU Research Projects

- Projects that are predominantly research studies may be submitted to either track (ESL or ICT). You may also want to consider the ECR Core Research program for fundamental education research.

- Research studies may explore (among other possibilities):
  - Creation, exploration, or implementation of tools, resources, and models
  - Enhancement of student learning and attitudes through teaching strategies and effective curricula
  - Diffusion of widespread practices through the community
  - Effective professional development

Workshops and Conferences

- Proposals for workshops and conferences addressing critical challenges in undergraduate STEM education may be **submitted at any time**.
- Typically these proposals include budgets between $50,000 and $100,000.
- Proposers must consult an NSF Program Officer (in the IUSE: EDU program) before submission to determine appropriateness of proposed workshop or conference for IUSE: EDU.

ESL and ICT Proposals Must…

- Be transportable and propagatable --- and include
  - plans for making project transportable.
  - plans for encouraging, enabling, and facilitating use of findings or developments by others.
- Be evidence-based --- and include
  - evidence-based justification of the proposed topic and approach.
  - substantial discussion from research literature.
- Be knowledge-generating --- and include
  - plans for collecting, analyzing, and sharing data.
  - goals and objectives (intended outcomes).
  - evaluation plan to determine the effect of the intervention.
  - description of how the evaluation results will be a basis for publication.
- Include objective feedback (formative and summative)

Basic Perspectives for IUSE: EDU Projects

- Projects should be both "evidence-based" and "knowledge-generating"
  - *<u>Evidence-based</u>: Is the project building on prior work?*
  - *<u>Knowledge-generating</u>: What will be learned from the planned conduct of the project?*

- <u>Perspective</u>: It is okay for IUSE: EDU projects to serve the PI's institution, but they should also serve all of us by providing useful knowledge for broad constituencies of educators

Q & A – Session #3

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Tips for Success

Successful IUSE proposals will…

- Build on what is known, summarizing published literature and defining a starting point that extends the prior work
- Include a well-designed plan to gather data
- Specify methods of analysis that will be employed to answer the questions posed
- Include mechanisms to evaluate the success of the project
- Explain how findings and materials will be shared
- Address the sustainability of project efforts
- Collaborate as needed with other investigators, institutions, or communities
- Make the Intellectual Merit and Broader Impacts obvious

Merit Review Considerations

The following elements should be considered in the review for both **Intellectual Merit** and **Broader Impacts**:

- What is the potential for the proposed activity to:
  - Advance knowledge and understanding within its own field or across different fields (*Intellectual Merit, i.e. what will we learn?*)

    AND

  - Benefit society or advance desired societal outcomes (*Broader Impacts, i.e. who will be affected?*)
- To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts?

Intellectual Merit: Examples

- Give **context** for your research. Is it part of a larger program?
- What are you building on? What are you building towards?
- Would it lead to new questions, techniques, or insights?
- What's the new idea? Why is now the right time? Why are you the right person?
- Are there applications or connections to other fields (crypto, medicine, etc.)?

Broader Impacts: Examples

- **Mentoring:** undergrad or grad students, postdocs, etc.
- **Education:** advising research, developing new courses, writing textbooks
- **Outreach activities:** math circles, work in prisons, public talks, popular writing
- **Broadening participation:** with organizations or on your own
- **Professional service:** organizing conferences, editorial boards, professional societies

Important: Educationally-focused projects often have a hard time disentangling Intellectual Merit and Broader Impacts, but you need to separate them out in your proposal.

Proposal & Award Policies & Procedures Guide (PAPPG)

NSF 24-1: Effective for proposals submitted or due on or after May 20, 2024

Know Proposal Sections

2. Sections of the Proposal

The sections described below represent the body of a research proposal submitted to NSF. Failure to submit the required sections will result in the proposal not being accepted[10], or being returned without review. See Chapter IV.B for additional information.

A full research proposal must contain the following sections[11]. Note that the *NSF Grants.gov Application Guide* may use different naming conventions, and sections may appear in a different order than in Research.gov, however, the content is the same:

a. Cover Sheet

b. Project Summary

c. Table of Contents

d. Project Description

e. References Cited

f. Budget and Budget Justification

g. Facilities, Equipment and Other Resources

h. Senior/Key Personnel Documents
- (i) Biographical Sketch(es)
- (ii) Current and Pending (Other) Support
- (iii) Collaborators and Other Affiliations (see also Chapter II.D.1 for additional information on submission of single copy documents
- (iv) Synergistic Activities

i. Special Information and Supplementary Documentation[12]
- (i) Mentoring Plan (if applicable)
- (ii) Data Management and Sharing Plan

Documentation of Collaboration

Documentation of collaborative efforts are made through letters of collaboration.

- Letters of collaboration should be limited to stating the intent to collaborate and should not contain endorsements or evaluation of the proposed project.
- The *recommended* (but not *required*) format for letters of collaboration is spelled out in the PAPPG

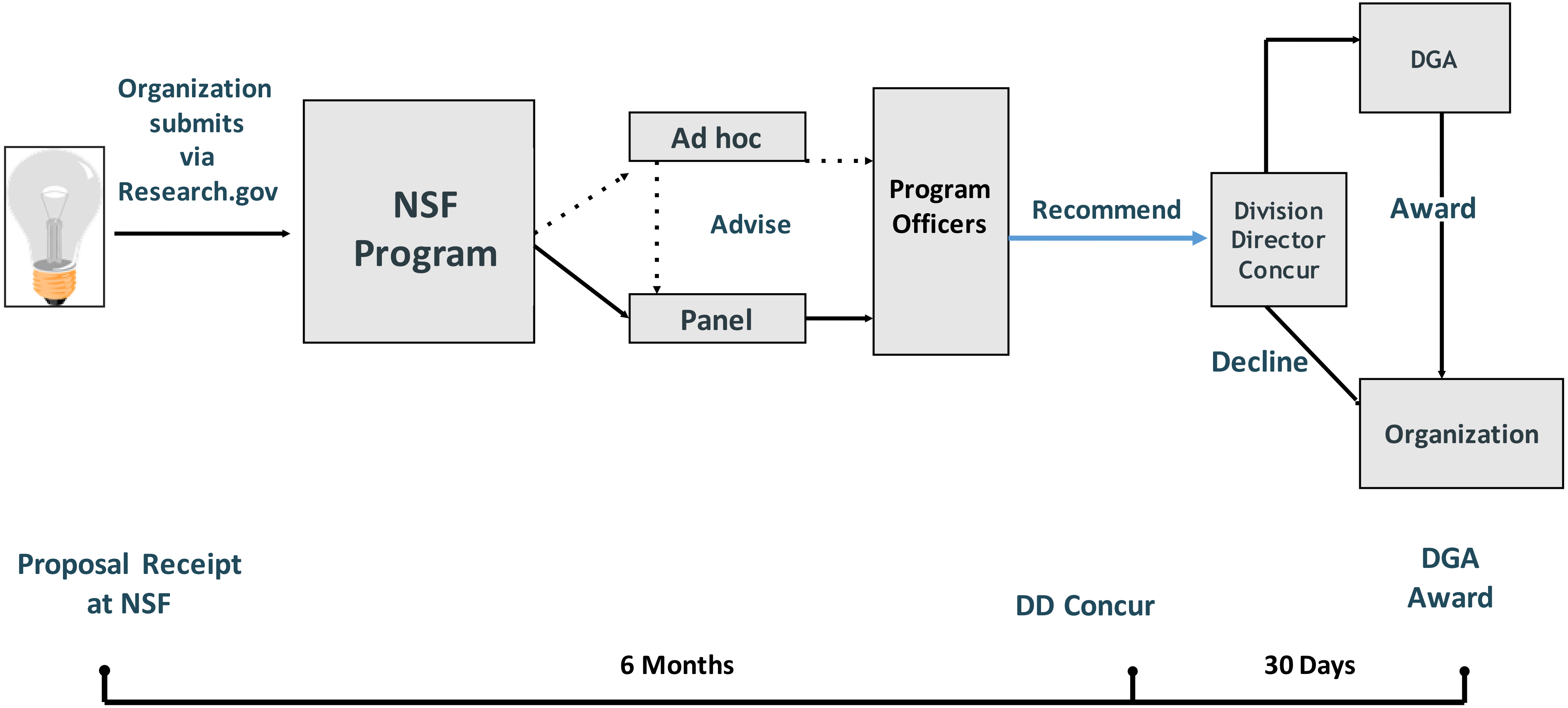
Submitting a Proposal

- **Write your proposal & make your budget**
  - Follow the Proposal and Award Policies & Procedures Guide (PAPPG) carefully
- **Work with your Sponsored Research Office (SRO) to submit it**
  - NSF funds institutions, not individuals (except for the MSPRF), so the institution submits the proposal
- **If at first you don't succeed…**
  - Success rates are low, and competition is stiff. Don't get discouraged. Read the reviews, find things to improve, connect with a program officer, and try again. (And again. And again.)

Tips for Success

- Consult the program solicitation and NSF Proposal & Award Policies & Procedures Guide (PAPPG) (NSF 24-1)
- Test drive Research.gov (Please do not submit in Grants.gov)
- Alert the Sponsored Research Office
- Follow page and font size limits
- Be aware of other projects and advances in the field
- Cite the literature
- Provide details
- Discuss prior results
- Include evaluation plan with timelines and benchmarks

Proposal Review Process and Timeline



Merit review criteria for all NSF proposals: Intellectual Merit and Broader Impacts

Intellectual Merit: the potential to advance knowledge

Broader Impacts: the potential to benefit society and contribute to the achievements of specific, desired societal outcomes

Clarity

Coherence

Compliance

After review, you will receive

* Rating
* Intellectual Merit
* Broader Impacts
* Summary

Individual reviews (anonymous)

* Ranking bin
* Intellectual Merit
* Broader Impacts
* Summary

Panel summary (anonymous)

Dear PI,
A panel of experts reviewed your proposal, and …

Sincerely,
Program Officer

Program officer comments (declines only)

Dear PI,
The National Science Foundation hereby awards a grant of …

Dear PI,
I regret to inform you that the National Science Foundation is unable to support your proposal…

Award or decline letter
and process statement

It's ok to email your program officer afterwards about your proposal and reviews, especially if your proposal was declined and you'd like to revise it.

Program Resources

Some Helpful Resources

- NSF Proposal and Award Policies & Procedures Guide
  - https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papp
- Solicitation, FAQs, and Webinar resources
  - Improving Undergraduate STEM Education: Education and Human Resources (IUSE: EHR) | Beta site for NSF - National Science Foundation
  - Frequently Asked Questions (FAQs) for Improving Undergraduate STEM Education: Education and Human Resources (IUSE: EHR) (nsf21082) | NSF - National Science Foundation
- NSF Merit Review Overview
  - Merit Review | NSF - National Science Foundation
- Common Guidelines for Education Research and Development
  - https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf13126

Complementary EDU Programs
(with a teacher preparation focus)

- Robert Noyce Teacher Scholarship Program (Noyce) Track 4: Noyce Research: NSF 23-586
- EDU Core Research (ECR): NSF 21-588
- Advanced Technological Education (ATE): NSF 21-598
- Discovery Research PreK-12 (DRK12): NSF 23-596

Upcoming Noyce Webinars

- April 24 @ 3:00 pm ET: Track 4 Research
- April 25 @ 2:00 pm ET: Noyce Track 1: Scholarships & Stipends and Capacity Building
- April 26 @ 2:00 pm ET: Track 2 Teaching Fellowships & Track 3 Master Teaching Fellowships
- May 1 @ 3:00 pm ET: Research Experiences in STEM Settings (RESS)

- Visit the Noyce Program webpage and www.nsfnoyce.org for additional updates and upcoming events

We Want You!

- Consider serving as a reviewer! Fill out the IUSE reviewer survey on the IUSE website or…
- Contact an IUSE Program Officer via email with a copy of your 2-page vita attached.
  - ❖ NSF IUSE Teacher Prep Program Directors:

    Jennifer Ellis, jtellis@nsf.gov

    Patrice Waller, pwaller@nsf.gov

    Leah McAlister-Shields, lmcalist@nsf.gov

THANK YOU for your interest in improving undergraduate STEM education, *particularly related to* Pre-Service STEM Teacher Preparation!

IUSE program website

Questions?

IUSE@nsf.gov