National Science Foundation
Division of Undergraduate Education (DUE)

Funding Opportunities in the NSF Division of Undergraduate Education

Workshop for New Physics and Astronomy Faculty
November 17, 2019

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Division of Undergraduate Education (DUE)
Directorate for Education and Human Resources (EHR)

Outline

- Brief overview of the National Science Foundation
- Division of Undergraduate Education Programs
- Writing Successful DUE Proposals
- Questions and Answers

NSF's Mission:

"…to promote the progress of science;
to advance the national health, prosperity, and welfare;
to secure the national defense..."

NSF Support:

- *Is a primary driver of the U.S. economy.*
- *Enhances the nation's security.*
- *Advances knowledge to sustain global leadership.*

$7.8 billion FY 2018 estimation

94% funds research, education and related activities

48,300 proposals

11,700 awards funded

1,800 NSF-funded Institutions

386,000 NSF-supported researchers

All S&E disciplines funded

Funds research into STEM education

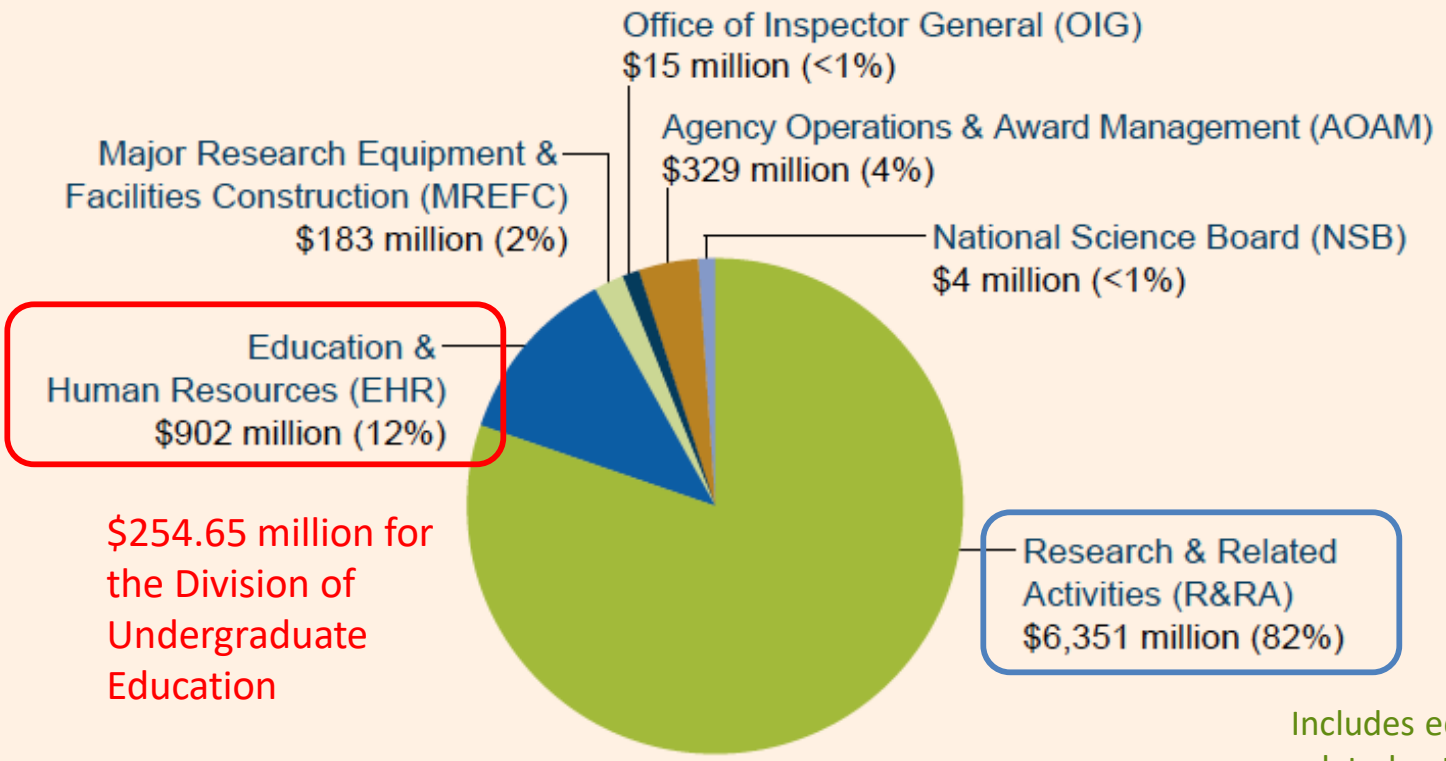
236 Nobel Prize winners

NSF by the numbers

Numbers shown are based on FY 2018 activities.

Where It Comes From

FY 2018 Appropriations by Account—$7,784 million



$254.65 million for the Division of Undergraduate Education

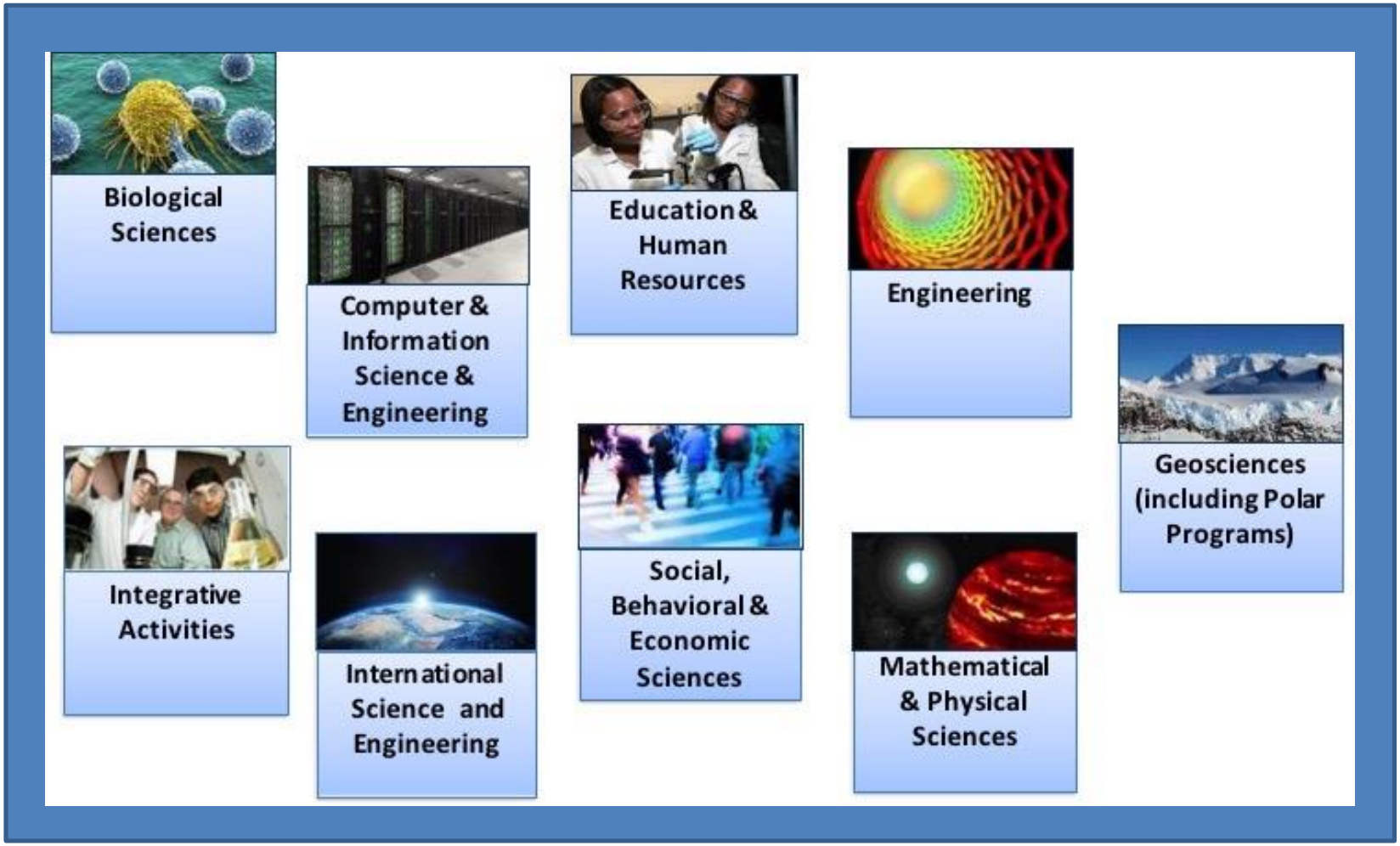
Includes education-related activities in research directorates (CAREER, REU sites)

Note: R&RA includes Additional Supplemental Appropriation for Disaster Relief Requirements of $16.3 million from P.L. 115-123.

Totals may not add due to rounding.

https://www.nsf.gov/pubs/2019/nsf19003/nsf19003.pdf

NSF Funds All Fields of Science and Engineering



Ten Big Ideas for Future NSF Investments

RESEARCH IDEAS

Harnessing Data for 21st Century Science and Engineering

Work at the Human-Technology Frontier: Shaping the Future

Navigating the New Arctic

Windows on the Universe: The Era of Multi-messenger Astrophysics

The Quantum Leap: Leading the Next Quantum Revolution

Understanding the Rules of Life: Predicting Phenotype

PROCESS IDEAS

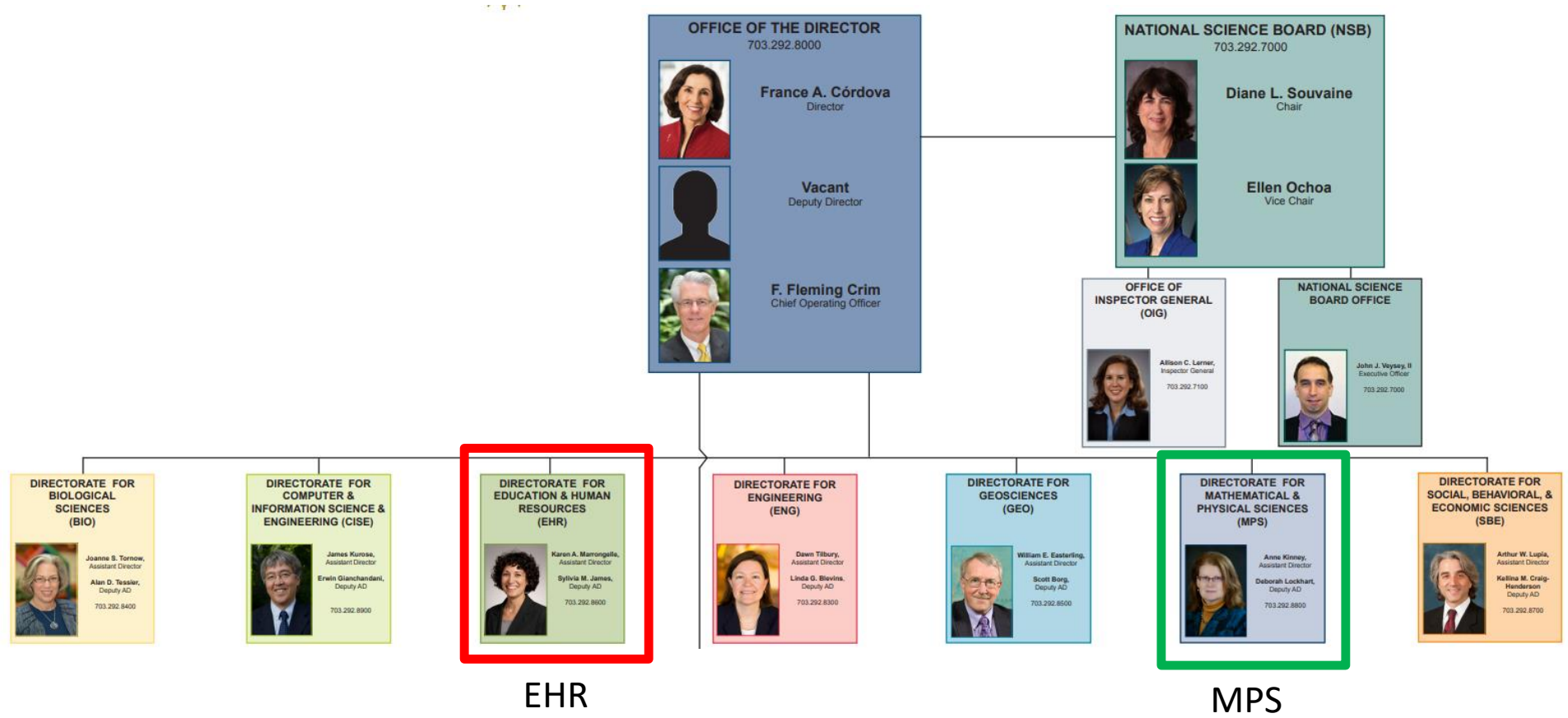
Mid-scale Research Infrastructure

NSF 2026

Growing Convergent Research at NSF

NSF INCLUDES: Enhancing STEM through Diversity and Inclusion

NSF's Organizational Structure



Directorate for Education and Human Resources (EHR) Goals

- ✓ Prepare the next generation of STEM professionals and attract/retain more Americans to STEM careers
- ✓ Develop a robust research community that can conduct rigorous research and evaluation to support excellence in STEM education
- ✓ Increase the technological, scientific and quantitative literacy of all Americans
- ✓ Broaden participation and close achievement gaps in all STEM fields.

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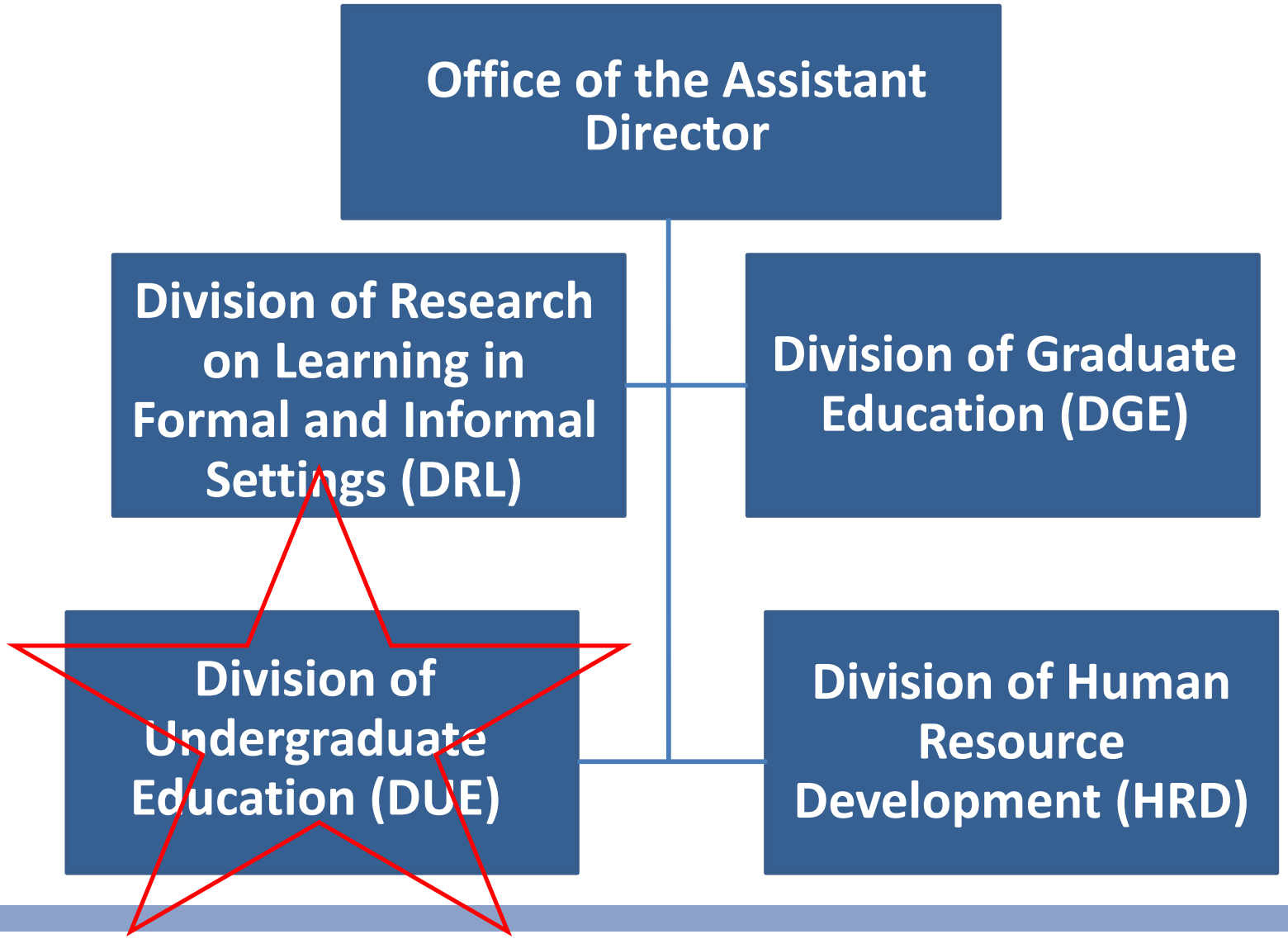
EHR's Organizational Structure



DUE's Mission:

To promote excellence in undergraduate science, technology, engineering, and mathematics (STEM) education for all students.

Potentially Transformative Education R&D

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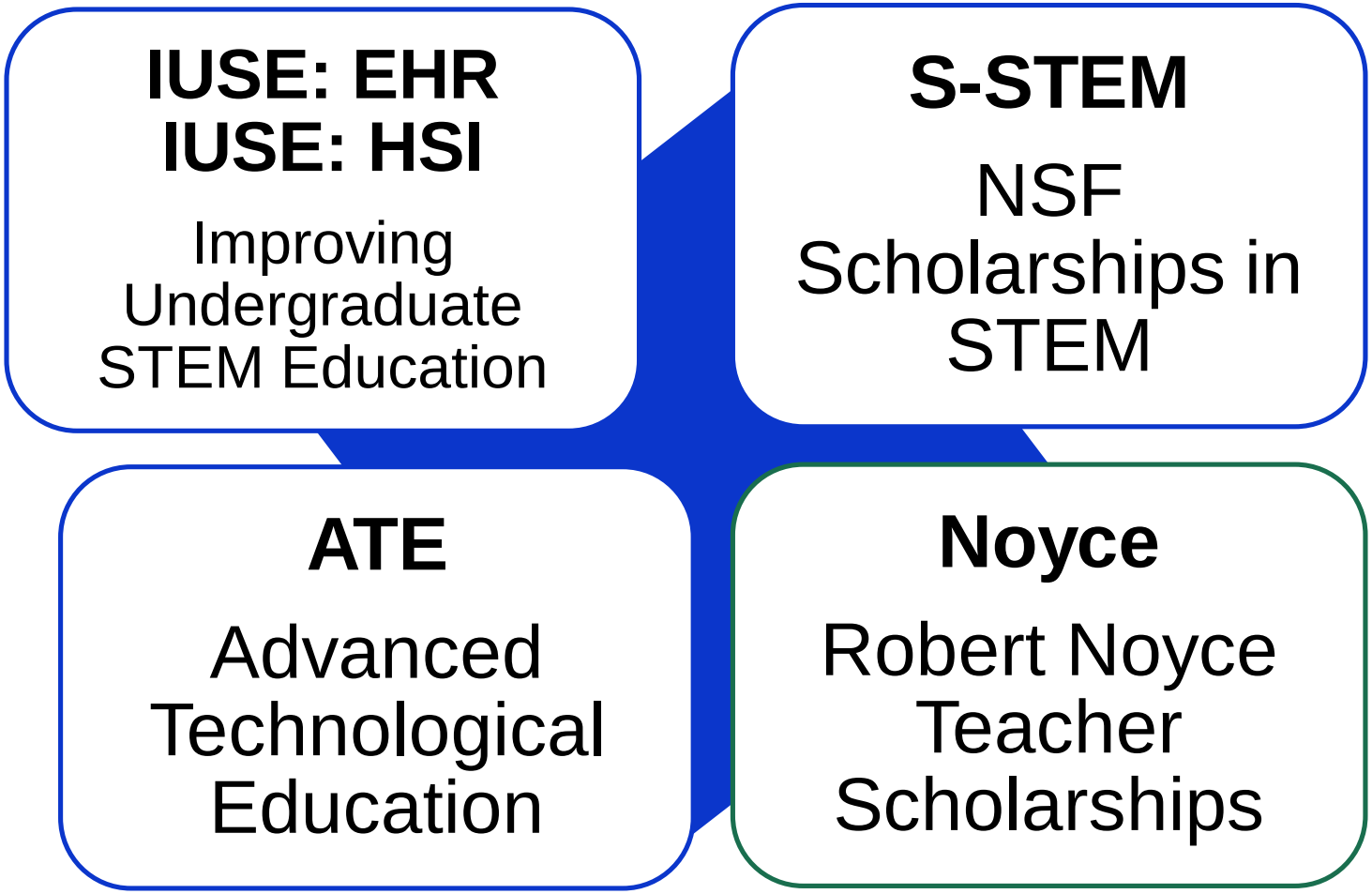
Division of Undergraduate Education (DUE)

Division of Undergraduate Education (DUE)



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ATE

Advanced Technological Education

SOLICITATION: NSF 18-571

ATE Program Overview

1) ATE Focuses on the education of technicians to meet workforce demands in existing and emerging advanced technological fields.
2) Colleges that award two-year degrees and their faculty must play leadership role on all projects.
3) Requires partnerships between two-year colleges and business and industry, along with secondary schools, four-year colleges and universities, and government, as appropriate.
4) Must respond to the hiring needs of for highly-skills technical workforce in the service area of the proposing institution(s).
5) Must address sustainability.
6) Read the program solicitation for more detailed information.

S-STEM

NSF Scholarships in STEM

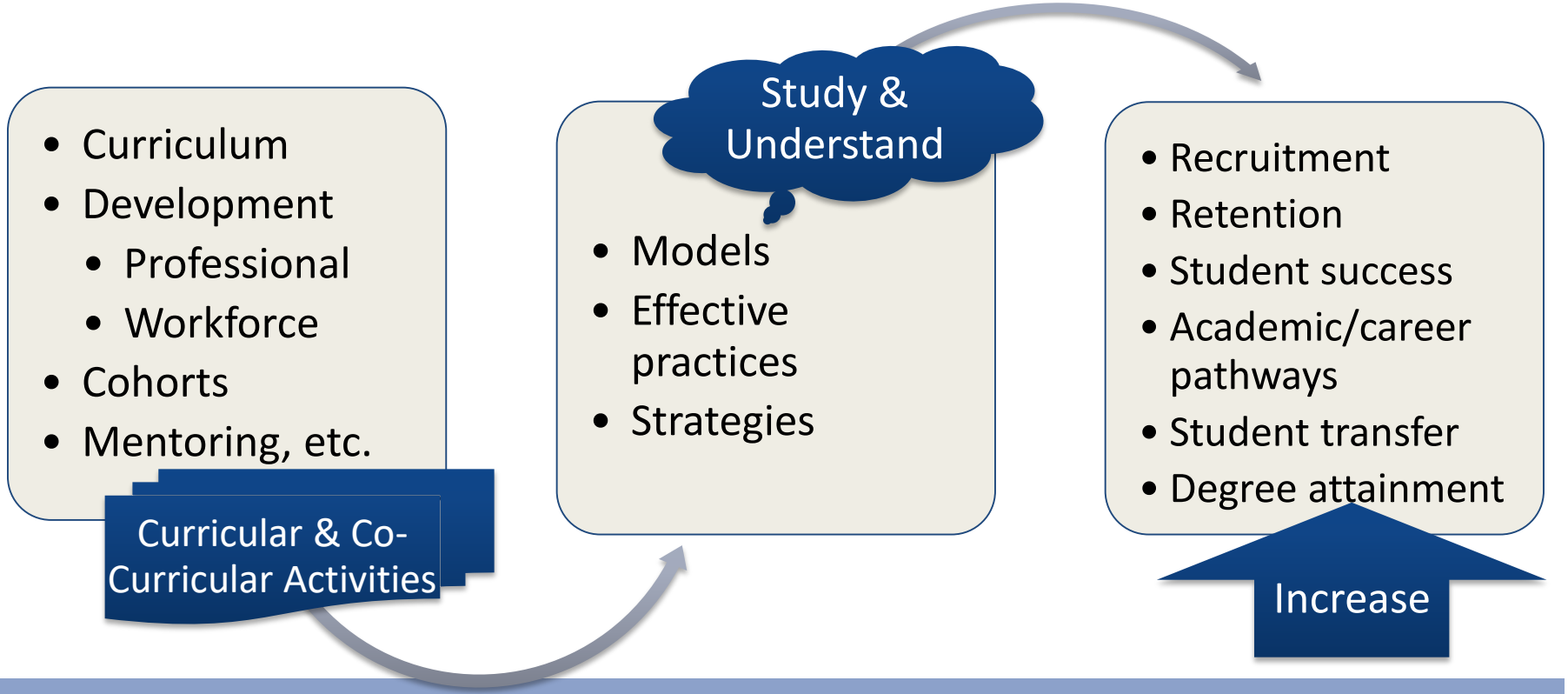
SOLICITATION: NSF 17-527

National Science Foundation
Division of Undergraduate Education (DUE)

NSF Scholarships in STEM (S-STEM) Program

Supports institutional scholarship programs for full-time, academically-talented STEM students with demonstrated financial need.

- Scholarship Amount: Up to $10,000 per student per year (depending on **financial need**)
- 60% of Budget to Scholarships – 40% to Student Support, Admin., Research, Evaluation



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S-STEM Program

Three Program Tracks

Track 1: Institutional Capacity Building → **Up to $650K, Up to 5 yrs**

For institutions without prior funding from S-STEM or STEP programs

Track 2: Design and Development: Single Institution → **Up to $1M, Up to 5 yrs**

Tracks 2 & 3 seek to leverage S-STEM funds with institutional efforts and infrastructure to increase and understand impacts

Track 3: Design and Development: Multi-Institution Consortia → **Up to $5M, Up to 5 yrs**

Deadline (All Strands and Types):
25 March 2020
Last Wednesday in March, Annually Thereafter

Management Team

Project teams composed of:

1) Faculty member currently teaching in one of the S-STEM disciplines
   - STEM disciplinary expertise

2) STEM Administrator
   - Communicate across functional units of institution

3) A researcher with experience in institutional, educational, discipline-based educational, or social science investigation at the institution or from another institution or research organization
   - Education, DBER, social science, change expertise

National Science Foundation
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IUSE: HSI

Improving Undergraduate STEM Education: Hispanic-serving Institutions Program

SOLICITATION: NSF 19-540

IUSE: Hispanic-Serving Institutions Program (HSI Program, 19-540)

- Requirements set by Congress in the Consolidated Appropriations Act, 2017 and the American Innovation and Competitiveness Act
  - Build capacity at HSIs
  - Increase graduation rates
  - Support associates and bachelors degrees in STEM at HSIs.
- https://nsf.gov/ehr/HSIProgramPlan.jsp

HSI Program-Eligible Institutions

- Accredited
- Offer undergraduate educational programs in STEM
- Satisfy the HSI definition
  - At least 25% Hispanic enrollment
  - Needy students
  - Low budget for institution
- Eligibility certification required with proposal

HSI Program

19-540

Track 1: Building Capacity

- Up to $2.5M for up to 5 years
  - Critical Transitions
  - Innovative Cross-Sector Partnerships
  - Teaching and Learning in STEM

Track 2: New to NSF

- Up to $300K for up to 3 years

Deadline:
Third Wednesday in September
(September 16, 2020)

Noyce

Robert Noyce Teacher Scholarship Program

SOLICITATION: NSF 17-541

National Science Foundation
Division of Undergraduate Education (DUE)

Noyce Teacher Scholarships

Act of Congress (2002)

GOAL: to encourage talented STEM majors and STEM professionals to become K-12 STEM teachers

Scholarship, stipend, and fellowship recipients must teach in a high-need school district for a specified number of years

Track 1 (S&S) Scholarships & Stipends	Undergraduate STEM majors and/or STEM career changers
Track 2 (TF) NSF Teaching Fellowships	STEM career changers
Track 3 (MTF) NSF Master Teaching Fellowships	Exemplary, experienced STEM teachers

Track 4 (Noyce Research) Research on the Preparation, Recruitment, and Retention of K-12 STEM Teachers

Deadline (All Tracks):
Last Tuesday in August, Annually Thereafter

IUSE: EHR

Improving Undergraduate STEM Education

SOLICITATION: NSF 19-601

IUSE: EHR Program Goals

To build knowledge about STEM teaching and learning at the undergraduate level	To incorporate evidence-based practices in STEM teaching and learning for all undergraduates	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	Lay the groundwork for sustained departmental, institutional, or community transformation and improvement

IUSE: EHR Tracks and Levels

Engaged Student Learning	Institutional and Community Transformation
• Increasing engagement and learning through new tools, resources and models • Generating knowledge about student learning	• Spreading and scaling up evidence-based practices using a "theory of change" • Generating knowledge about the organizational change process
Level 1: ≤ $300k, up to 3 years **Level 2: $300k - $600k, up to 3 years** **Level 3: $600k - $2M, up to 5 years**	**Capacity-Building: $150k for single institution or $300k for multiple institutions, up to 2 years** **Level 1: ≤ $300k, up to 3 years** **Level 2: $300k - $2M for single institution or $3M for multiple institutions, up to 5 years**

IUSE Program Deadlines

- Level 1 and Capacity-Building proposals:
  - **February 4, 2020** (and the first Tuesday in February thereafter)
  - **August 4, 2020** (and the first Tuesday in August thereafter)

- Level 2 and Level 3 proposals:
  - **December 4, 2019** (and the first Tuesday in December thereafter)

National Science Foundation
Division of Undergraduate Education (DUE)

#1505086

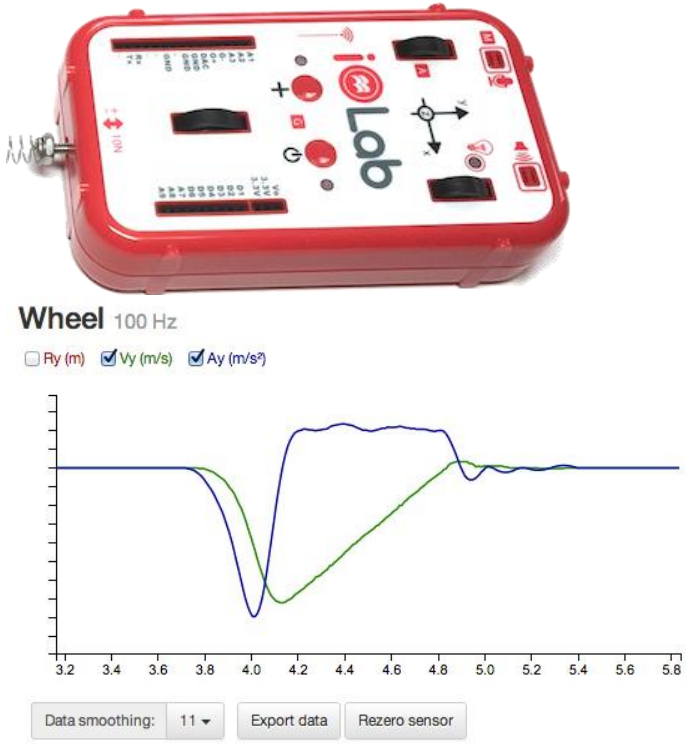
Distance Learning Labs for Introductory Physics

Problem

Physics lags behind other scientific fields in the development of cost-effective, research-validated hands-on labs for distance education.

Solution

Develop mechanics labs combining proven pedagogy of *RealTime Physics* with the *IOLab*, a versatile and inexpensive lab tool.



Validation

Use the Force and Motion Conceptual Evaluation (FMCE) and the Colorado Learning Attitudes about Science Survey (CLASS) for Experimental Physics

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National Science Foundation
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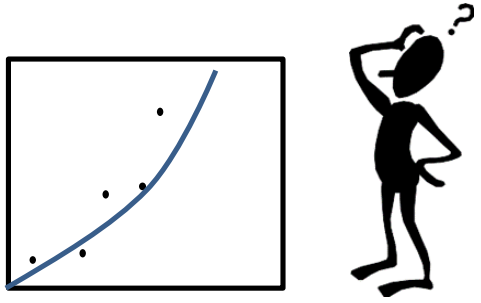
#1611482

The Physics Lab Inventory of Critical thinking (PLIC)



Goal: Develop and validate an efficient assessment instrument to evaluate students' critical thinking skills as related to experimental data and models

- Year 1: Development & preliminary validation
- Year 2: Statistical validation & reliability analysis
- Year 3: Implementation & testing

- A tool for pre- and post-tests of students' ability to evaluate experimental methods and data, improve data quality, and draw conclusions from data and models
- Preliminary research on:
  - Student understanding & difficulties about experimental data and uncertainty
  - Effects of lab pedagogies on student performance
  - Characterizing performance of various populations of students

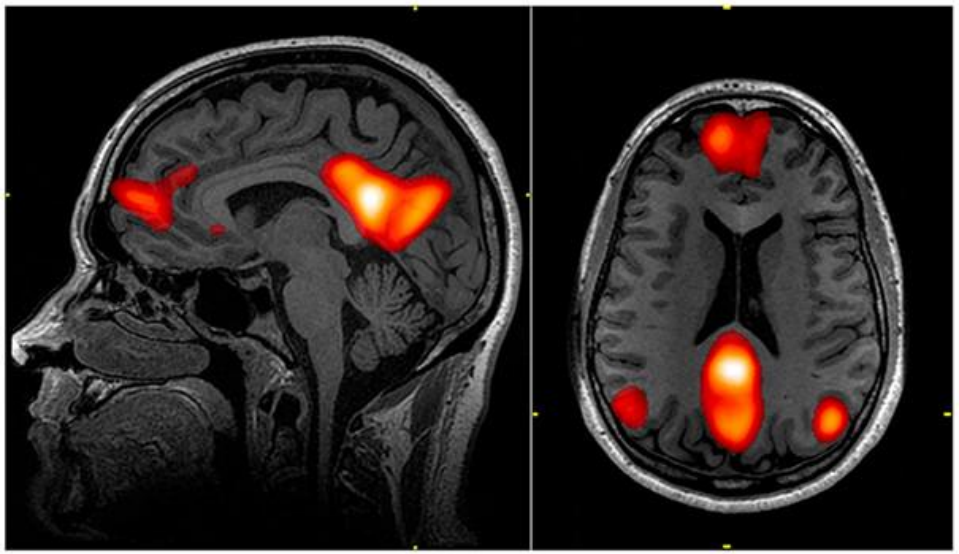
Carl Weiman, Stanford University
Natasha Holmes, Cornell University

National Science Foundation
Division of Undergraduate Education (DUE)

#1933984

Improving Introductory Physics for Life-Science Students through a Biomedically Relevant Multimedia Curriculum

Problem: Physics courses are foundational for life science and pre-health students, but curricular materials and instructional approaches don't connect well with the students' chosen majors



Proposed Solution: To develop modular, multimedia, biomedically relevant educational material for use in introductory physics courses

Desired Outcomes:

- To validate the importance of physics as a basic science integral to medicine
- To provide faculty with a coherent physics education curriculum that can be implemented in a variety of environments

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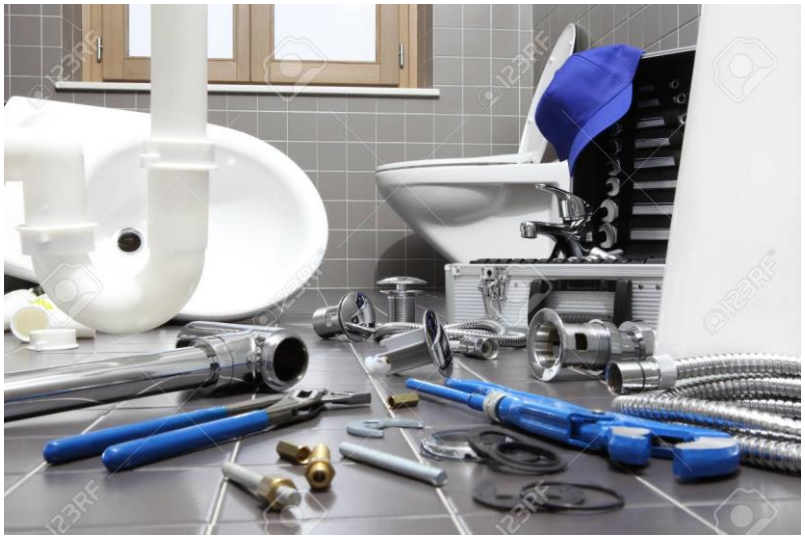
#1914603

Research and Curriculum Development to Leverage Student Conceptual Resources for Understanding Physics

Problem: Current physics instructional materials use a deficit theory of learning, which views student ideas as incorrect and in need of fixing.

Proposed Solution: To develop instructional models based on Resource Theory, to build students' current ideas into sophisticated physics concepts.



Desired Outcomes:

- To identify productive student ideas in specific physics topic areas
- To develop and test instructional materials that will build on these ideas
- To document the instructional contexts in which specific student ideas are elicited
- To disseminate products and findings to university faculty to support them in implementing effective instruction

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Paula Heron pheron@phys.washington.edu, University of Washington

Common Guidelines

- The publication Common Guidelines for Education Research and Development offers guidance on building the evidence base in STEM learning. Research and development efforts that increase understanding of effective undergraduate STEM teaching and learning provide the foundation for building the STEM workforce of tomorrow and improving scientific literacy.

Cross-Directorate STEM Education Programs

- Research Experiences for Undergraduates (REU: EHR; NSF 19-582)
- Faculty Early Career Development Program (CAREER: EHR; NSF 17-537)
- EHR Core Research (ECR; NSF 19-508)

ECR

EHR Core Research

SOLICITATION: NSF 19-508

ECR Core Research

- fundamental research in STEM education
  - essential,
  - broad
  - Enduring
- Focal areas:
  - STEM learning, STEM learning environments,
  - STEM workforce development, and
  - broadening participation in STEM
- robust evidence to inform efforts to
  - understand,
  - build theory to explain, and
  - suggest interventions (and innovations) to address persistent challenges

ECR Funding Levels

Funding should align with the maturity of the proposed work, the size and scope of the empirical effort, as well as the capacity of the interdisciplinary team to conduct the proposed research:.

Level I proposals:

- Maximum award size: $500,000
- Maximum duration: 3 years

Level II proposals:

- Maximum award size: $1,500,000
- Maximum duration: 3 years

Level III proposals:

- Maximum award size: $2,500,000
- Maximum duration: 5 years

Deadline (All Levels):
Second Thursday in September, Annually.

Helpful Links

- Big Ideas: https://www.nsf.gov/news/special_reports/big_ideas/
- Reviewer Survey (volunteer as reviewer): https://www.surveymonkey.com/s/NSF_DUE_Reviewer_Info
- Conduct a search of previously funded awards at https://www.nsf.gov/awardsearch/
- Contact a program officer (names and contact info are available on program web pages)
- View resources on program webpages (webinars, FAQs, etc.)

Questions?

National Science Foundation
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Helpful Hints and Fatal Flaws

PROPOSAL WRITING TIPS

NSF Proposal Process

NSF Merit Review

Intellectual Merit (IM): What is the potential for the proposed activity to advance knowledge and understanding within its own field or across fields?

- What will we learn from the work?

Broader Impacts (BI): What is the potential for benefitting society or advancing desired societal outcomes?

- Why is the work important to society?

Intellectual Merit (unpacked)

Intellectual merit may consist of

- The potential to advance **knowledge** and understanding within its own field or across different fields;
- The **PI and team's** capability in conducting the development and knowledge generation;
- The access to the necessary **resource**s, including unfunded collaborations to conduct the proposed work;
- A clear **plan** for what the project will do, who will do it, when it will be done, and **why**;
- A mechanism to assess the **success** of the proposed projects' attempts to advance knowledge and understanding and provide feedback to the PI and team.

Broader Impact (unpacked)

Societally relevant outcomes may include, but are not limited to:

- Full participation of women, persons with disabilities, and underrepresented minorities in 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 US
- Enhanced infrastructure for research and education.

Other review considerations

- To what extent do the proposed activities suggest and explore **creative, original, or potentially transformative** concepts?
- 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**?
- How **qualified** is the individual, team, or institution to conduct the proposed activities?
- Are there **adequate resources** available to the PI (either at the home institution or through collaborations) to carry out the proposed activities?

Please Note: Reviewers are also asked to review Facilities, Equipment and Other Resources, Data Management Plan, Postdoctoral Researcher Mentoring Plan, and required Supplementary Documents.

Is it IM or BI?

In addition to development and implementation of a novel curriculum, the project will include educational research to uncover new information about undergraduate model-based-reasoning through detailed assessment of classroom learning.

- Intellectual merit

Is it IM or BI?

Activities planned will provide in-depth faculty development through a national series of workshops, and an expansion of an ongoing national study of the effectiveness of this approach for learning about the nature of science.

- Broader Impact

10 HELPFUL HINTS for proposal writing

1

Read the Program Announcement

- **NSF has no hidden agendas. It's all there in the program announcement.**
- **If you are not sure that your ideas fit the program, ask a program officer. If the program says that your ideas are too narrow or don't fit an NSF program, look for other sources.**
- **Make sure that your project is worthwhile, realistic, well-planned, and innovative.**

10 HELPFUL HINTS for proposal writing

2

Work on Projects You Care Deeply About

- **Let your commitment come through in the proposal.**
- **Make sure reviewers can understand the importance of this work to your institution and to others.**
- **Caveat: Don't forget to listen to others.**

10 HELPFUL HINTS for proposal writing

3

Build on What Others Have Done

- **Like any research project, you must build on what others have done previously and then add to that base of knowledge.**
- **Don’t reinvent the wheel.**
- **Read the literature, go to workshops, talk with others.**
- **Be current.**
- **Discuss the value added by your project. What are you adding to the knowledge base?**

10 HELPFUL HINTS for proposal writing

4

Think Global, Act Local and Global

- **Your project must have more than just a local impact. It must impact more than just your students and your institution. How can others use and build on your work?**
- **But we really do want you to be a "prophet in your own land." If the project is good enough for you and your institution to use, explain why others should use it too.**

10 HELPFUL HINTS for proposal writing

5

Have Measurable Goals and Objectives

- **Enhancing student learning, improving undergraduate education, and other similar things are lofty, but not measurable. Make sure that you have measurable goals and objectives.**
- **What will be delivered?**
- **What is needed to convince others that this works and is worth supporting or emulating?**

10 HELPFUL HINTS for proposal writing

6

Think Teamwork

- **Successful projects are often team efforts, although individuals matter too. Your project team should be greater than the sum of the parts.**
- **You work in a department. Department efforts are more likely to be successful than individual efforts.**
- **You must have support of administrators. Keep them involved, make them look good, give them credit, find out what they need to support you.**
- **Get a good group of internal and external advisors and an outside evaluator or evaluation team.**

10 HELPFUL HINTS for proposal writing

7

Use Good Management Skills

- **Have a realistic timeline and implementation schedule from the beginning and stick to it.**
- **Have milestones and specific deliverables (with dates).**
- **Use carrots when you can (but be prepared to use the stick when you must). Don't reward until people deliver.**
- **Assign responsibilities, but also give folks needed authority to do them, and then hold them accountable.**

10 HELPFUL HINTS for proposal writing

8

Evaluation is Impact and Effectiveness

- **You do need numbers. How many students are impacted? How many faculty? How many students succeed in the next course? These are the types of questions that can help measure effectiveness.**
- **You need evidence that your project is having an impact and that it is effective. How do you know the project is working and that it is worthwhile?**
- **Ask who needs to be convinced and what evidence will they accept.**
- **You cannot evaluate yourself. You must have outside validation.**
- **Build in evaluation from the beginning.**

10 HELPFUL HINTS for proposal writing

9

Spread the Word

- **Work with other faculty and support them as they try to implement your materials. Doing new things is not easy.**
- **Try to get a team of people who have used your materials to help spread the word.**
- **Work not only with faculty in your discipline, but also reach out to other disciplines.**
- **Have a proactive dissemination plan. A website is necessary, but not sufficient.**

10 HELPFUL HINTS for proposal writing

10

After You Receive the Grant… Payback Time

- **Keep NSF or your funder informed. They have to report too. It's all a cycle.**
  - **Send in reports on time. Use the required format.**
  - **Send in "highlights," information about awards, student impact, pictures, etc.**
- **Give credit to NSF, your administrators, your team members, your department, etc. Giving credit to others makes you look better and may help you get additional support later.**
- **Offer to be a reviewer and to help others.**

FATAL FLAWS

10 WAYS TO WRITE A GOOD PROPOSAL That Won't Get Funded

1

Assume deadlines are not enforced

Instead…

- **Work early with your Sponsored Research Office (SRO).**
- **Test-drive FastLane or Research.gov and make sure your SRO knows how to use it too.**
- **Set your own final deadline a day or so ahead of the formal deadline to allow time to solve problems.**

FATAL FLAWS
10 WAYS TO WRITE A GOOD PROPOSAL That Won't Get Funded

2

Assume page limits and font size restrictions are not enforced

Instead…

- **Consult the program solicitation and the PAPPG (*Proposal & Award Policies & Procedures Guide*) carefully.**
- **Proposals that exceed page and/or font size limits are returned without review.**

FATAL FLAWS

10 WAYS TO WRITE A GOOD PROPOSAL That Won't Get Funded

3

Substitute flowery rhetoric for good examples

Instead…

- **Avoid complaints about students, other departments, the administration, etc., and describe what you will do and why.**
- **Ground your project in the context of related efforts.**
- **Provide detailed examples of learning materials, if relevant.**
- **Specify whom you will work with and why.**
- **State how you plan to assess progress and student learning.**
- **Detail the tasks and timeline for completing activities.**
- **Specifically address *intellectual merit* and *broader impacts* and use the phrases explicitly in the Project Summary.**

FATAL FLAWS
10 WAYS TO WRITE A GOOD PROPOSAL That Won't Get Funded

4

Don't check your speeling, nor you're grammer

Instead…

- **Check and double-check; first impressions are important to reviewers.**
- **State your good ideas clearly. Ignore the bad ones.**
- **Have a trusted colleague who is not involved in the project read your drafts and final proposal.**

Note: Don't use *complimentary* when you mean *complementary,* or *principle investigator* when you mean *principal investigator*, etc.

FATAL FLAWS

10 WAYS TO WRITE A GOOD PROPOSAL That Won't Get Funded

5

Assume the program guidelines have not changed; or better yet, ignore them!

Instead…

- **Read the current solicitation completely and carefully.**
- **Address each area outlined in the solicitation that is relevant to your project.**
- **Check the program solicitation carefully for any additional criteria, e.g., the Integration of Research and Education, or integrating diversity into NSF Programs, Projects, and Activities.**

FATAL FLAWS

10 WAYS TO WRITE A GOOD PROPOSAL That Won't Get Funded

6

Assert: "Evaluation will be ongoing and consist of a variety of methods"

Instead…

- **Plan for formative and summative evaluation.**
- **Include an evaluation plan with specific timelines and projected benchmarks.**
- **Engage an objective evaluator early.**

FATAL FLAWS
10 WAYS TO WRITE A GOOD PROPOSAL That Won't Get Funded

7

Assume a project website is sufficient for dissemination

Instead…

- **A website may be necessary, but who will maintain it and how in the long run?**
- **Engage beta test sites. "Early adopters" can serve as natural dissemination channels.**
- **Plan workshops and mini-courses; identify similar projects and propose sessions at regional and national meetings.**
- **Learn about and use digital repositories.**

FATAL FLAWS

10 WAYS TO WRITE A GOOD PROPOSAL That Won't Get Funded

8

Assume your past accomplishments are well known; after all, NSF may have funded them

Instead…

- **Thoroughly describe results from prior funding; this includes quantitative data and information on impact.**
- **Describe how new efforts build on this previous work, and how it has contributed to the broader knowledge base about educational improvement.**
- **Recognize that the review panelists are diverse and not all familiar with your institutional context.**

FATAL FLAWS
10 WAYS TO WRITE A GOOD PROPOSAL That Won't Get Funded

9

Provide letters of "support" instead of letters of "collaboration"

- **Describe collaborator roles/commitments within the proposal.**
  - **This includes administrative commitments (e.g., release time, faculty development, new course approvals, etc.).**
- **Document collaborative arrangements with *appropriate* letter (see PAPPG for format).**

FATAL FLAWS
10 WAYS TO WRITE A GOOD PROPOSAL That Won't Get Funded

10

Inflate the budget to allow for negotiations

Instead…

- **Make the budget reflect the work plan directly.**
- **Provide a Budget Justification that ties your budget request to project personnel and activities.**
- **Make it clear who is responsible for what.**
- **Provide biographical sketches for all key personnel.**