

**Innovative Projects
and Funding
Opportunities in
Applied
Mathematics
Education
Supported by the
National Science
Foundation**



Ron Buckmire
SIAM Annual Meeting
July 10, 2018

Presentation Outline

- 1) Brief Overview of NSF
- 2) Introduction to the IUSE:EHR Program
- 3) Examples of Applied Math Projects Supported by NSF
- 4) Other Funding Opportunities for Applied Math Education at NSF
- 5) Questions?

History of NSF in a Nutshell

The National Science Foundation (NSF) is an independent federal agency created by Congress in 1950 "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense..."

With an annual budget of \$7.5 billion (FY 2017), NSF is the funding source for approximately *24 percent of all federally supported basic research* conducted by America's colleges and universities. In many fields such as mathematics, computer science and the social sciences, NSF is the major source of federal backing.



NSF by the Numbers

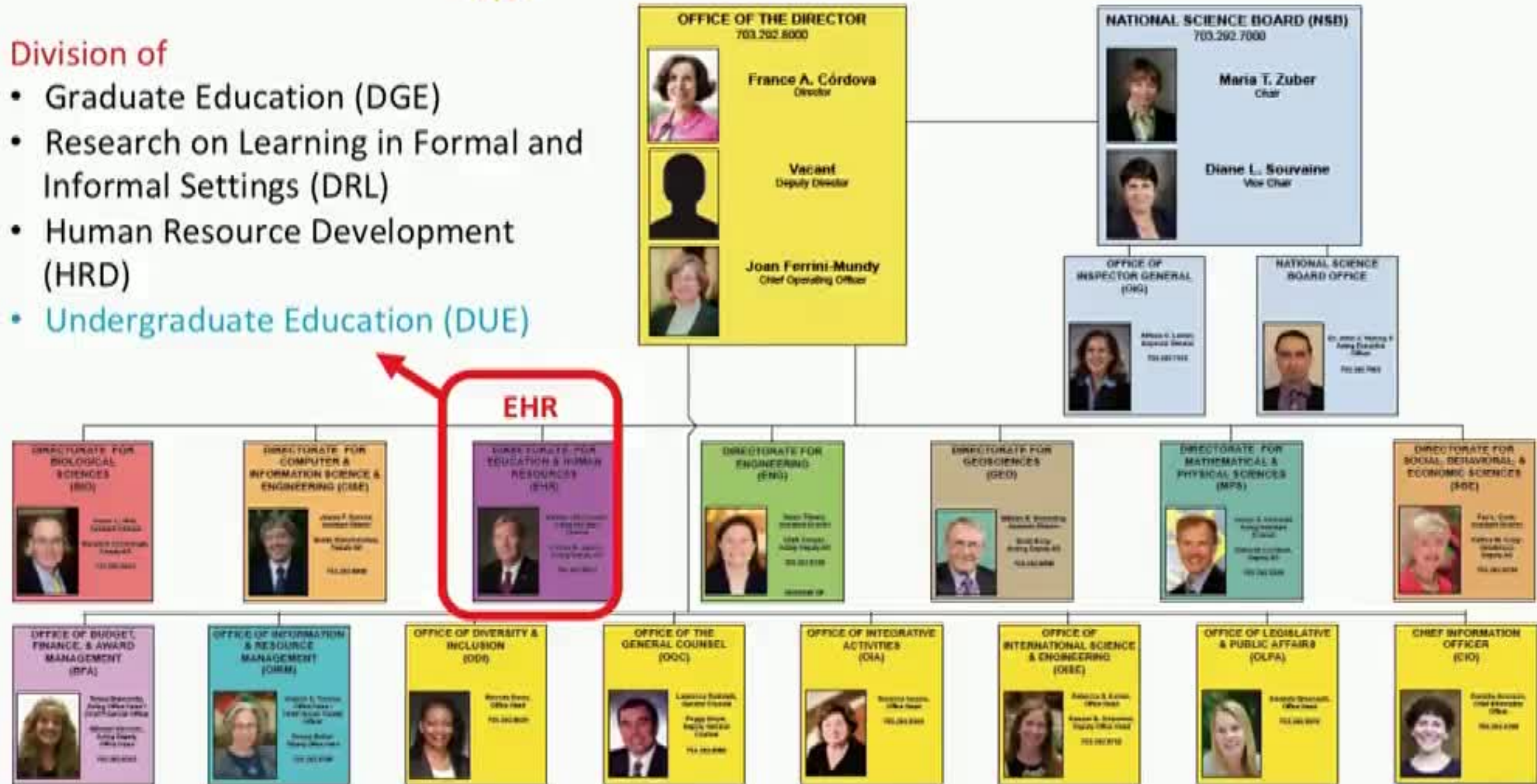




NATIONAL SCIENCE FOUNDATION

Division of

- Graduate Education (DGE)
- Research on Learning in Formal and Informal Settings (DRL)
- Human Resource Development (HRD)
- Undergraduate Education (DUE)



EHR

National Science Foundation
 2415 Eisenhower Avenue
 Alexandria, Virginia 22314
 TEL: 703.292.5111 | FIRS: 800.877.8339 | TDD: 800.281.8749

December 2017



EHR is committed to an inclusive STEM enterprise for science and society

\$952 million FY 2017 budget request

97% funds research, education and related activities

4,250 proposals



845 awards funded



650 EHR-funded Institutions



145,100 EHR-supported individuals



All S&E disciplines funded



Funds research into STEM education



42 former GRF fellows received Nobel Prize

History of the IUUSE: EHR Program

CCLI
2000-2010



TUES
2010-2013

STEP
2002-2013

WIDER
2013-2014

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IUSE: EHR
2014 – 20??

IUSE: EHR promotes the development, use and testing of instructional practices and curricular innovations that engage and improve student learning and retention in STEM. **(Engaged Student Learning)**

IUSE: EHR also promotes community and institutional transformation that will increase opportunities for the application of highly effective STEM teaching methods. **(Institutional and Community Transformation)**



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IUSE: EHR

Engaged Student Learning Track

Focus on creation, exploration, or implementation of **tools, resources and models** that show promise in increasing engagement of students in STEM learning

Rigorous **research** and **evaluation** of the effectiveness of these tools, resources, and models to demonstrate their value in STEM education

Identification and investigation of **evidence-based practices** leading to measurable and lasting learning gains



IUSE: EHR

Institutional and Community Transformation Track

Supports projects that use innovative approaches to increase the use of highly effective, evidence-based STEM teaching and learning practices, curricular reform, and co-curricular practices in institutions of higher learning or across or within disciplinary communities



Improving Undergraduate STEM Education (IUSE: EHR)

Competitive proposals should **build on available evidence** and **theory, generate evidence,** and **build knowledge.**

Program Goals		
Improve STEM Learning and STEM Learning Environments	Build the Professional STEM Workforce for Tomorrow	Broaden Participation and Institutional Capacity for STEM Learning
Improve the knowledge base for defining, identifying, and innovating effective undergraduate STEM teaching and learning, and foster widespread use of evidence-based resources and pedagogies in undergraduate STEM education.	Improve the preparation of undergraduate students so they can succeed as productive members of the future STEM workforce, regardless of career path, and be engaged as members of a STEM-literate society	Increase the number and diversity of undergraduate students recruited and retained in STEM education and career pathways through improving the evidence base for successful strategies to broaden participation and implementation of the results of this research

IUSE: EHR Program

Two Program Tracks

Engaged Student Learning

Institutional and Community Transformation

Two Approaches

Two Approaches

Exploration & Design (smaller scale)

Development & Implementation (larger scale)

Exploration & Design (smaller scale)

Development & Implementation (larger scale)

Up to \$300K
Up to 3 yrs

Level I:
Up to \$600K Up to 3 yrs
Level II:
\$601K to \$2M Up to 5 yrs

Up to \$300K
Up to 3 yrs

Up to \$3M
Up to 5 yrs

Focuses on design, development, implementation of and research on STEM learning models, approaches, and tools

Focus on approaches to increase the propagation of highly effective methods of STEM teaching and learning

D&I Deadline: December 11, 2018

E&D Deadline: NONE

NSF Solicitation: 17-590



10 Examples of Projects in Applied Mathematics Education Supported by NSF (DUE and DMS)

Examples of IUSE (Applied Math) Projects

“Professional Development Emphasizing Data-Centered Resources and Pedagogies for Instructors of Undergraduate Introductory Statistics (StatPREP)” (NSF-DUE-1626337) will catalyze the widespread use of data-centered methods and pedagogies in undergraduate introductory statistics courses. It will work directly with 240 college-level instructors by (1) offering an extended professional development program for mathematics instructors, particularly at two-year institutions, who teach introductory statistics; (2) establishing regional communities of practice to support instructors who teach introductory statistics; and (3) establishing a national online support network comprising instructors who teach introductory statistics and statistics education experts.

Examples of IUSE (Applied Math) Projects

“Collaborative Research: A National Consortium for Synergistic Undergraduate Mathematics via Multi-institutional Interdisciplinary Teaching Partnerships (SUMMIT-P)” (NSF-DUE-1625771) is a consortium of eleven institutions to revise and improve the curriculum for lower division undergraduate mathematics courses. A key element of these innovations will be interdisciplinary partnerships, with partner disciplines directly involved in decisions about curricular needs. The consortium will impact over 52,000 undergraduate students and 200 college faculty from a wide array of disciplines to change the undergraduate mathematics curriculum.

Examples of IUSE (Applied Math) Projects

“UTMOST: Undergraduate Teaching in Mathematics with Open Software and Textbooks” (NSF-DUE-1624634) The UTMOST 2.0 project will design, develop and study innovative approaches to the teaching and learning of undergraduate mathematics using open software and electronic textbooks. This project studies students' use of electronic textbooks when these are made freely available in a variety of formats and on a variety of devices. These textbooks will support interactive computation through a seamless integration of Sage, the leading open-source computing system for mathematics. This project also supports the further adoption of PreTeXt, an authoring platform that enables the creation of highly functional, open-source textbooks.

Examples of IUSE (Applied Math) Projects

“Collaborative Research: Student Engagement In Mathematics through an Institutional Network for Active Learning (SEMINAL)” (NSF-DUE-1624610)
This project will investigate teaching and learning environments at six institutions that have successfully improved their Precalculus-to-Calculus 2 (P2C2) sequence by employing active learning in mathematics (ALM). The results of this work will lead to important strategies for adapting, implementing, supporting, and assessing ALM in P2C2 courses, especially at large public universities like the University of Colorado at Boulder (1624628), San Diego State University (1624639), and the University of Nebraska-Lincoln (1624643).

Examples of IUSE (Applied Math) Projects

“Building Community Through Systemic Initiative for Modeling Investigations and Opportunities with Differential Equations (SIMIODE)” (NSF-DUE-1724796) uses best practices in STEM undergraduate teaching: it is hands-on, problem-based, inquiry-driven, and incorporates group learning. The project creates teaching materials that focus on real world data and encourage students to transfer knowledge between mathematics and other disciplines. SIMIODE combines in-person and virtual support for faculty seeking to adopt a mathematical-modeling approach in their own classrooms. This support includes workshops, panel discussions, presentations at regional and national conferences, and mentoring in an online community.

Examples of IUSE (Applied Math) Projects

“Collaborative Research: Data-Driven Applications Inspiring Upper-Division Mathematics” (NSF-DUE-1642095) will create a body of applied data-driven instructional modules that will center on image and data analysis problems. Investigators from St. Mary's College of Maryland (Lead Institution), Hendrix College, Kenyon College, and Washington State University will collaborate to (1) introduce current cutting-edge research and practical data problems from science, industry, and government to students in undergraduate upper-division mathematics courses and (2) lead these students to develop the problem-solving, collaborative, and research skills that are so crucial in today's work environment.

Examples of DMS (Applied Math) Projects

“A Distributed Learning Environment for the Mathematics of Climate and Sustainability” (NSF-DMS-1722578) envisions a new approach to both graduate and undergraduate student research training in applied mathematics. Through this program, four cohorts of students will be trained in the mathematics underlying the all-important societal and scientific issues emanating from climate and sustainability. The project will span a five year period and encompass four intensive week-long summer camps with each cohort consisting of seven graduate and three undergraduate students. The effort is a partnership between the Mathematics and Climate Research Network (MCRN) and the American Institute of Mathematics (AIM).

Examples of DMS (Applied Math) Projects

“Preparation for Industrial Careers in Mathematics (PIC-Math)” (NSF-DMS-1722275) provides faculty with tools and training to help them better prepare students for business, industry, and government (BIG) careers. To accomplish this, the project includes summer training workshops for faculty, helps faculty organize a semester-long research-focused course for undergraduate students, organizes a nationwide competition and summer recognition conference for participating undergraduate students, and secures support and participation from BIG entities. The faculty participants mentor undergraduate students so they develop skills that will help them to succeed in a career in STEM such as the effective writing and presentation skills.

Examples of DMS (Applied Math) Projects

“Travel Support for International Congress on Industrial and Applied Mathematics (ICIAM) 2019” (NSF-DMS-1803187) enables the Society for Industrial and Applied Mathematics (SIAM) to administer a travel grant program for approximately one hundred U.S. based mathematical and computational scientists, early career faculty, and graduate students to attend the International Congress on Industrial and Applied Mathematics (ICIAM 2019), to be held July 15-19, 2019 at the Universidad Valencia, Valencia, Spain. The ICIAM is the premier international conference for applied mathematics, with approximately 500-750 U.S. participants anticipated. Travel grants to applicants will be awarded on a competitive basis.

Other NSF Funding Opportunities to Support Applied Mathematics Education

DMS INFRASTRUCTURE PROGRAM

Deadline: December 17, 2018

NSF Program Description: 18-1260

- Unsolicited training projects aimed at the undergraduate, graduate, or postdoctoral levels that include a core mathematical sciences research component for trainees.
- Novel projects that can have a large impact by promoting partnerships, broadening participation, and/or serving as models to be replicated.
- projects that positively influence the entire community, most often those cutting across multiple sub-disciplines.
- Conferences and Workshops aimed at students and broadening participation activities (12-month lead time).



Programs of special interest to students and junior faculty

- Faculty Early Career Development (CAREER) [**07/18/18**]
- Graduate Research Fellowships (GRFP) [**late October 2018**]
- Research Experiences for Undergraduates* (REU) [**8/22/18**]
- Mathematical Sciences Postdoctoral Research Fellowships* (MSPRF) [**10/17/18**]
- Mathematical Sciences Graduate Internships* [**02/01/2018**]

*Part of the **DMS Workforce Program**



Mathematical Sciences Graduate Internships

- Provide an opportunity for mathematical sciences doctoral students to participate in internships at national laboratories, industry and other approved facilities
- Aimed at students who are interested in understanding the application of advanced mathematical and statistical techniques to "real world" problems, regardless of whether the student plans to pursue an academic or nonacademic career
- 40 graduate students from 38 universities worked in 10 National Labs in the Summer of 2017



SIAM News Article
(12/01/2017)

Managed by Oak Ridge Institute for Science and Education

Division of Mathematical Sciences