STEM Education At NSF:  
*Perspectives from the Education & Human Resources Directorate*

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National Science Foundation
WHERE DISCOVERIES AND DISCOVERERS BEGIN

“To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense...”

-NSF Act of 1950
“We shall have rapid or slow advance on any scientific frontier depending on the number of highly qualified and trained scientists exploring it.”

Vannevar Bush, 1945

Science – The Endless Frontier, p. 14
NSF continues to advance research where discoveries begin.

- $8 billion FY 2017 request
- 12,000 awards funded
- 2,000 NSF-funded Institutions
- 350,000 NSF-supported researchers
- 217 Nobel Prize winners

Other than the FY 2017 request, numbers shown are based on FY 2015 activities.
EHR is committed to an inclusive STEM enterprise for science and society.

- $953 million FY 2017 request
- 4,243 proposals
- 831 awards funded
- 650 EHR-funded Institutions
- 147,000 EHR-supported researchers
- Funds all S&E disciplines
- Funds research in STEM education
- 42 former GRF fellows received Nobel Prize

Other than the FY 2017 request, numbers shown are based on FY 2015 activities.
EHR’s organizational structure

Office of the Assistant Director (OAD)

- Division of Research on Formal and Informal Settings (DRL)
- Division of Graduate Education (DGE)
- Division of Undergraduate Education (DUE)
- Division of Human Resource Development (HRD)
EHR Mission:
• Develop a diverse workforce ready to advance the frontiers of science and engineering for society
• Grow and sustain a STEM-literate public
STEM Workforce and STEM-Literate Public

STEM Workforce

Graduate School

Postdoctoral Experiences

Undergraduate Education

Community College

High School

Middle School

Elementary School

Early Childhood Education
STEM Workforce and STEM-Literate Public

- After-school Programs
- Science Centers
- Museums
- Games
- Online Learning
- Social Media
- Citizen Science
- Making
- Augmented Reality
- Virtual Worlds
EHR investments address three goals

DEVELOP THE CAREERS OF SCIENTISTS AND ENGINEERS

BUILD KNOWLEDGE THROUGH RESEARCH

TRANSFORM INSTITUTIONS
DEVELOP THE CAREERS OF SCIENTISTS AND ENGINEERS

- Scholarships
- Traineeships
- Fellowships
IMPACT: Well-prepared experts in the STEM professions

- Cybersecurity experts for government
- Scientists and engineers for the research of the future
- K-12 STEM teachers
Institutional change to prepare a diverse STEM workforce and science-literate society
Education and Human Resources Overview

**IMPACT:** New capacity, practices, partnerships, and pathways

Institutions broaden participation and develop talent

Tribal colleges and universities create new programs and degrees

Community colleges partner with industry to provide cutting-edge training
Research and development

BUILD KNOWLEDGE THROUGH RESEARCH
“EHR should continue to encourage high-risk/high-pay-off education research proposals that are scientifically rigorous, potentially transformative, and informed by cutting-edge, interdisciplinary discoveries about [STEM] learning.... Of special interest are various problem-solving tools and resources that significantly increase students’ interest, persistence, and motivation in building STEM knowledge and skills across the life-span.” (p. 7)
IMPACT: Findings for improving teaching and learning

Children learn complex STEM concepts earlier than we thought possible

“Active learning” instructional approaches improve achievement in STEM courses
**IMPACT**: Successful models to engage the public of all ages with STEM

Interactive visualization museum exhibits engage learners and support inquiry

Instructional television promotes learning and STEM engagement (and wins awards!)
IMPACT: Groundbreaking research that generates new inquiry approaches

Diagnostic assessments open windows into science learning

International collection of data about mathematics instruction through video leads to new ways of studying teaching
EHR’s Focal Areas

- Learning & Learning Environments
- Broadening Participation & Institutional Capacity
- Workforce Development
<table>
<thead>
<tr>
<th>EHR Division</th>
<th>Learning and Learning Environment</th>
<th>Broadening Participation &amp; Institutional Capacity</th>
<th>STEM Professional Workforce</th>
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<tr>
<td>Research on Learning (DRL)</td>
<td>ECR - Learning DR-K12 AISL</td>
<td>ECR includes:</td>
<td>STEM+C Partnerships for the 21st Century</td>
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<td></td>
<td></td>
<td>• Research on Gender in Science and Engineering (GSE)</td>
<td>ITEST - Innovative Technology Experiences for Students and Teachers</td>
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<td></td>
<td>• Research in Disabilities Education (RDE)</td>
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<td>Human Resource Development (HRD)</td>
<td>ADVANCE AGEP HBCU-UP TCUP</td>
<td>ECR- Broadening Participation and Capacity LSAMP</td>
<td></td>
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<tr>
<td>Undergraduate Education (DUE)</td>
<td>ECR-Learning Environment Improving Undergraduate STEM Education (IUSE)</td>
<td></td>
<td>Advanced Technological Education (ATE) Robert Noyce Teacher Scholarship Program S-STEM Scholarship Program</td>
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EHR Core Research (ECR) across all themes: EHR invests in foundational research for the strategic improvement of STEM education.
Research, Development, and Model-Building for STEM Learning:

A  Core Knowledge
   Foundational Research
   Early Stage and Exploratory Research

B  Design and Development Projects

Knowledge and Evidence Resources

C  Impact: Studies
   Efficacy Studies
   Effectiveness Studies
   Scale-up Studies

Common Guidelines for Education Research & Development
Ongoing Initiatives

• INCLUDES
• CS For All
• Change Makers
• Maker
• Leveraging GLOBE

....and More. (Stay Tuned!)
NSF INCLUDES (16-544, 16-408)
Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science

- Comprehensive initiative to enhance U.S. leadership in science and engineering by seeking and developing STEM talent from all sectors and groups in our society

- Long-term goal
  
  Support innovative models, networks, partnerships, and research that enable the U.S. science and engineering workforce to thrive by ensuring that all groups are represented in percentages comparable to their representation in the U.S. population

FY 2016: NSF 16-544, 16-081, $15.5M
FY 2017 Budget Request $16M
NSF INCLUDES National Network

**Design and Development Launch Pilots**
- **FY16**: 2 year awards @ $300K (30-40 awards)
- **FY17**: 2 year awards @ $300K
- **FY18 and beyond**: 2 year awards @ $300K

**Alliances**
- **FY16**: 2 year awards @ $300K (30-40 awards)
- **FY17**: 5 year awards @ $12.5M (3-5 awards)
- **FY18 and beyond**: 5 year awards @ $12.5M

**Backbone Organizations**
- **FY16**: Conferences and Workshops
- **FY17**: 5 year award(s) @ $3.5M
- **FY18 and beyond**: 5 year awards @ $3.5M

**Other Activities**
- **FY16**: PI Meeting Evaluation & Assessment
- **FY17**: Link to BP Portfolio Evaluation & Assessment
- **FY18 and beyond**: Link to BP Portfolio Evaluation & Assessment
Computer Science for All

• Announced in the President’s Weekly Address on January 30, 2016
• Focus is ensuring **ALL** students have access to learning computer science
• CS for All at the National Science Foundation:
  • $135M available over 5 years to build on NSF’s research developing instructional materials, assessments, in-service, and pre-service models of teacher professional learning, and approaches to support classroom teaching and learning.
  • 2 new high school courses: Exploring Computer Science and AP CS Principles
  • Professional Development to support high school teachers in CS instruction
  • Research to integrate CS and Computational Thinking in K-12 (esp. K-8) STEM curriculum and instruction
Funding for NSF’s CS For All

• FY16: EHR Core Research, ITEST, DRK-12, STEM+C, and Cyberlearning programs, regular competition deadlines apply; EAGERs and Conference/Workshops, May 31, 2016

• FY17: To Be Determined...STAY TUNED!
Change Makers

• Focus is on innovative research and development that supports Learners as Change Makers, identifying and working to solve problems that matter to them, while advancing their own understanding and expertise.

• R&D should advance STEM learning, while exploring solutions to multidisciplinary or transdisciplinary global challenges in either formal or informal settings for learners of all ages and prior educational experience, including learners traditionally under-represented in STEM.

• AISL, DRK-12, and IUSE programs, regular competition deadlines apply
  • AISL(NSF 15-593), Nov 8, 2016
  • DRK-12 (NSF 15-592), December 5, 2016
  • IUSE (15-585), November 9, 2016, January 11, 2017
Leveraging GLOBE to Increase Student Engagement and Diversity

• Focus on building capacity for engagement of diverse student populations in the environmental sciences and geosciences and to evaluate GLOBE’s impacts on student attitudes and learning

• AISL, DRK-12, and INCLUDES, regular competition deadlines apply
  • INCLUDES (NSF 16-544), June 24, 2016
  • AISL(NSF 15-593), Nov 8, 2016
  • DRK-12 (NSF 15-592), December 5, 2016
Enabling the Future of Making to Catalyze New Approaches in STEM Learning and Innovation (15-086)

• Focus is on exploratory research to advance the frontier of knowledge with respect to STEM learning and design thinking. For example:

  • Elucidate the processes and potential benefits of learning, e.g. design thinking, in the Maker context;
  • Leverage Making to develop and test its role in improving the effectiveness of formal and informal learning pathways for increasing retention and broadening participation in STEM for students and faculty;

• EAGERs, December 15, 2016
Prospective Principal Investigators

• Engage with NSF
• Answer fundamental questions
• Seek Collaborations, Strengthen Interdisciplinary Partnerships
• Stay Connected!
Engage with NSF

- Submit Proposals
- Serve as Reviewers & Panelists
- Be Active as Workshop Participants and Organizers
- Consider Being a Rotator
  http://www.nsf.gov/about/career_opps/rotators/index.jsp

For information on a particular EHR division and program, go to the EHR website and choose a division.

Contact NSF Program Directors for questions and suggestions
Answer fundamental questions

What are you trying to accomplish? (Goals)
What will be the outcomes?

Why do you believe that you have a good idea? (Rationale)
Why is the problem important?
How does it tie into previous literature/efforts?
Why is your approach promising?

How will you manage the project to ensure success? (External Review/Evaluation)
How will you know if you succeed?

How will others find out about your work? (Dissemination)
How will you interest them?
How will you excite them?
Stay connected

• NSF: www.nsf.gov
• Guide to Programs: www.nsf.gov/funding/browse_all_funding.jsp
• Award Information: www.nsf.gov/awardsearch
• FastLane: www.fastlane.nsf.gov
• Data Management Plan: www.nsf.gov/bfa/dias/policy/dmp.jsp
• Funding Opportunities: www.nsf.gov/funding
A Continuing Journey...
The education of the scientists and engineers and the public of 2050 begins today.
QUESTIONS?

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