NSF Enabling the STEM Enterprise for Empowering the Nation

Broader Impacts Infrastructure Summit
University of Missouri

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Overview of Presentation

- Intellectual Framing of Broader Impacts
- Major Observations Related to the Broader Impacts Criterion
- Opportunities for Institutional Leadership
- Representative Examples of Broader Impacts
Mission and Vision

NSF envisions a nation that capitalizes on new concepts in science and engineering and provides global leadership in advancing research and education.
Framers/Drivers

Cutting-Edge Science Research
- Transformative Research
- Interdisciplinary Research

Talent Development
- Under-represented Groups
- Minority-serving institutions, women colleges and institutions for disabilities

Integration of Research & Education
- STEM Learning, Formal and Informal
- Education Venues and Resources for Teaching and Learning

Evaluation Capability
- Metrics and Milestones
- Evaluation for Learning
FY 2014 Priorities

- Cybersecurity
  - SaTC
- Sustainability
  - SEES
- Innovation
  - I-Corps
- Interdisciplinary
  - INSPIRE
- Cyber-enable
  - CEMMSS
- Cyberinfrastructure
  - CIF21

$876M
Informed by:
INSPIRE
Strategic Framing of Broadening Participation in STEM

- US STEM Talent Development: The Underrepresentation Challenge

- Representative Drivers
Milestones in Higher Education

Milestones by Race/Ethnicity and Gender 2010
(rounded numbers)

Advanced Degrees in Science and Engineering
Total: 173,000

Bachelor’s Degrees in Science and Engineering
Total: 525,000

First Time Freshmen Interested in Science and Engineering
Total: 1,232,000

First Time Freshman
Total: 3,209,000

High School Graduates
Total: 3,321,000

Sources: National Center for Education Statistics, IPEDS Completions and Fall enrollment surveys and Common Core of Data; Higher Education Research Institute, American Freshman Survey; and U.S. Census Bureau, Current Population Survey.
Female percentage of full-time science and engineering faculty at 4-year colleges or universities, by rank and field of doctorate: 1997 and 2008

Source: National Science Foundation, Survey of Doctorate Recipients.
URM percentage of full-time science and engineering faculty at 4-year colleges or universities, by rank and field of doctorate: 1997 and 2008

Notes: URM=underrepresented minority (Blacks, Hispanics, American Indians). Computer sciences full professor not shown because of confidentiality.
Source: National Science Foundation, Survey of Doctorate Recipients.
Broadening Participation Through Partnering, Leveraging and Integrating

- Partnerships for vertical connections
- Partnerships for horizontal connections
- Greater roles for community colleges
- Increased engagement with minority-serving institutions, women’s colleges, and institutions for disabilities
Strategic Framing of Education and Outreach
The Future of Cyberlearning: A vision of the year 2015…

School

- Virtual Laboratory Simulations
- Visualizations of real-time data from remote sensors
- Supplemental content

Home

- Mobile technology access to school materials and assignments
- Virtual interaction with classmates
- Lifelong “Digital Portfolio”

Students

Teachers

Parents
Driving Forces

Research on STEM education

Dynamic providers

Learner-sensitive instructional delivery

Shaping Future STEM Education & Workforce Development

Development of a diverse & high quality workforce

Educational entrepreneurship that promotes cyberlearning & international education
**NSF Integrated System of Evaluation, Decision-Making, and Innovation**

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<th>Leadership for Evaluation</th>
<th>Data Collection, Study Design, and Management</th>
<th>Directorate and Office Evaluation Capacity</th>
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| • Lead evaluations of key Foundation-wide programs  
• Recommend models or resources as needed  
• Provide coordination | • Expert support  
• Provide consultation on evaluation design and methodology NSF-wide | • Increased responsibility for assessment, monitoring, and evaluation of programs and activities. |
Sustained Assessment & Evaluation

The extent to which programmatic efforts are based on evidence-based practices

The level of progress toward and the attainment of program goals

The long term impact on individuals and institutions

The contributions of investment for advancing the knowledge base

The extent of effectiveness, based on most appropriate methodologies to test implementation hypotheses
National Science Foundation’s
MERIT REVIEW CRITERIA
Review and Revisions

NATIONAL SCIENCE BOARD

NATIONAL SCIENCE FOUNDATION
Merit Review Principles

• 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.

• 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.
Broader Impacts and Elements of Merit Review

1. Advance knowledge and understanding and benefit society
2. Explore creative, original, or potentially transformative concepts
3. Provide a well-reasoned, well-organized plan with a mechanism to assess success
4. Led by well-qualified individual, team, or institution
5. Make provision for adequate resources to carry out the proposed activities
Major Observations Related to Broader Impacts

• Flawed execution as a “checklist and not clearly understood by the community”
• Need to maintain broadening participation of underrepresented groups as a priority
• Need for reviewers to give more consideration to Broader Impacts
• Inconsistent methods for assessing the outcomes from broader impacts
• Need for more institutional involvement to meet the Broader Impacts criterion
Roles of the Agency and Awardees

- Staying on the Cutting Edge
- Learning and Building Capacity
- Institutional Partnerships & Coordination
- Reporting and Communicating Science Broadly
- Research, Assessment & Evaluation Continuum
Institutional Support

MU Broader Impacts Network

Created in 2012 with seed funding from the Provost and the Vice Chancellor for Research and support from Mizzou Advantage to help primary investigators navigate the broader impacts criterion for externally funded grants, particularly from NSF.

The Broader Impacts Network Goals are to:

• Promote Broader Impact Activities (BIAs)
• Document BIAs
• Train faculty, staff, and future faculty on broader impacts
• Contribute to the national dialogue on broader impacts support/infrastructure
• Evaluate BIAs
• Consult with investigators
Examples

From FY 2010 to mid-FY 2013, Missouri has received 473 awards from NSF.

• Next Generation Engagement for Informal Science Institutions – Missouri Botanical Garden
• Priming the Pipeline for the St. Louis Region-Creating a Future High Technology Workforce – Ranken Technical College
• MRI: Development of High-Resolution Positron Imaging System Dedicated to Plan Research – Washington University
### Key Data Points to Inform Future Directions

| 143,000 STEM jobs in Missouri to fill by 2018 |
| 25.3% of high school students are interested in STEM |
| Women (29%) and minorities (9%) earn just a small share of STEM degrees and certificates |
| Students in Missouri are slightly more likely than students nationally to be interested in Mechanical Engineering |
Why Broader Impacts

“…broader impact efforts bring inspiration, personal satisfaction, and new perspectives on their work.”

“What better way to justify science than through broader impacts.”

Camp & Gilbert, 2010
Thank You!