



Photo credits (from left) : U.S. Army Corps of Engineers, Intel Free Press, Kate Ter Haar, Woodley Wonder Works, Ohio Sea Grant, U.S. Army RDECOM, Trevor Prentice

Educating the Neuroscience Workforce of the Future

Defining the Expertise Needed for the 21st Century Neuroscience Workforce:
A Workshop
Institute of Medicine of the National Academies

October 28, 2014
Washington, DC

Joan Ferrini-Mundy
Assistant Director, National Science Foundation
Education and Human Resources

Directorate for Education and Human Resources



The 21st Century STEM Workforce: Trends and Opportunities

Considerations in preparing the future neuroscience workforce

Federal efforts to improve STEM education
and to increase the number of graduates
prepared for careers in STEM

Neuroscience for improving education



The Future of Neuroscience is Interdisciplinary

- In April 2013: President Obama announces BRAIN initiative.
- Building from the first \$100 million in commitments in year one, now five federal agencies are participating:
 - National Institutes of Health
 - Food and Drug Administration
 - Defense Advanced Research Projects Agency
 - Intelligence Advanced Research Projects Activity
 - National Science Foundation



Training for Interdisciplinarity

<i>Cognitive Outcomes</i>	<i>Intrapersonal Outcomes</i>	<i>Interpersonal Outcomes</i>
Cognitive processes and strategies	Intellectual Openness	Teamwork and Collaboration
Knowledge	Work Ethic and Conscientiousness	Leadership
Creativity	Positive Core Self-Evaluation	Communication
Critical Thinking	Metacognition	Responsibility
Information Literacy	Flexibility	Conflict Resolution
Reasoning	Initiative	
Innovation	Appreciation of Diversity	

Source: Committee on Defining Deeper Learning and 21st Century Skills. (NRC, Education for Life and Work.



Directorate for Education and Human Resources

Institute of Medicine, October 28, 2014

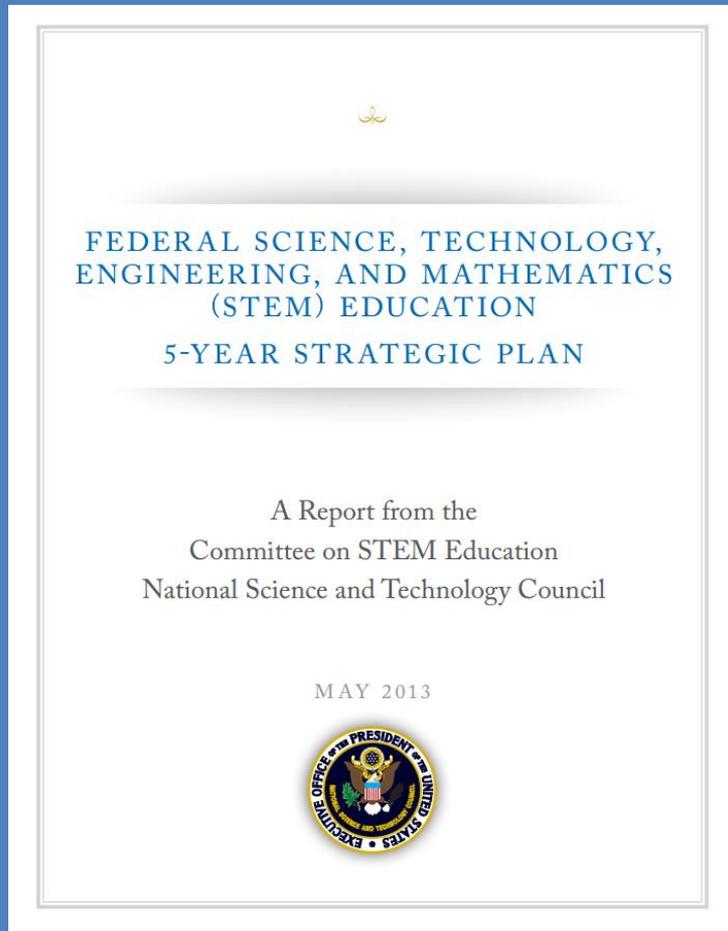
Considerations in preparing for the future
neuroscience workforce

***Federal efforts to improve STEM education
and to increase the number of graduates
prepared for careers in STEM***

Neuroscience for improving education



Federal Science, Technology, Engineering, and Mathematics (STEM) Education 5-Year Strategic Plan



Priority Areas

- P-12 STEM education
- Undergraduate education
- Graduate education
- Broadening participation
- Public engagement
- Coordination and evaluation



Directorate for Education and Human Resources

Institute of Medicine, October 28, 2014

Promising practices

NSF Integrative Graduate Education and Research Traineeship (IGERT)

- From 1998-2014, IGERT has made 278 awards to over 100 lead universities to nearly 6,500 graduate students.
- Builds foundational disciplinary knowledge with interdisciplinary, collaborative training and professional development. Interdisciplinary themes include:

<ul style="list-style-type: none">• Neuroscience: biology and psychology (~15% of total awards)	<ul style="list-style-type: none">• Materials science and engineering	<ul style="list-style-type: none">• Energy: alternate and renewable resource and conservation
<ul style="list-style-type: none">• Computational science and engineering	<ul style="list-style-type: none">• Sensing, signals, imaging, and signals processing	<ul style="list-style-type: none">• Climate change: impact and factors
<ul style="list-style-type: none">• Human and social dimensions of new knowledge & technology	<ul style="list-style-type: none">• Civil infrastructure monitoring and improvement	<ul style="list-style-type: none">• Biological evolution and development
<ul style="list-style-type: none">• Nanoscience: engineering and technology	<ul style="list-style-type: none">• Sustainability: ecology and the environment	<ul style="list-style-type: none">• Diverse device development
<ul style="list-style-type: none">• Bioinformatics		



Promising practices, cont.

Graduate Research Opportunities Worldwide (GROW)

Partner: U.S. Agency for International Development

NSF Graduate Research Fellows are provided an opportunity to engage in international collaborations with investigators in partner countries around the world.

Graduate Research Internship Program (GRIP)

Partners: Environmental Protection Agency, Smithsonian Institution, Office of Naval Research, and Department of Homeland Security

NSF has signed memoranda of understanding that will allow NSF Graduate Research Fellows to pursue research internship opportunities with the partner agencies.



Interdisciplinary Initiatives at NSF

Integrative strategies for understanding neural and cognitive systems (NSF-NCS)

Supports integrative research on the understanding of neural and cognitive systems focused on two major themes:

- Neuroengineering and brain-inspired concepts and designs
- Individuality and variation

Participating directorates:

- Computer and Information Science and Engineering
- Education and Human Resources
- Engineering
- Social, Behavioral, and Economic Sciences



Interdisciplinary Initiatives at NSF

Industry/University Cooperative Research Centers (I/UCRC)

- Supports partnerships between universities and industry to promote industrially relevant fundamental research and collaboration in research and education.
- Currently there are 60 I/UCRCs with 900 faculty members, 1,500 graduate students, and 300 undergraduate students
- Participating directorates:
 - Computer and Information Science and Engineering
 - Engineering
 - Geosciences



The 21st Century STEM Workforce: Trends and Opportunities

Considerations in preparing for the future neuroscience workforce

Federal efforts to improve STEM education and to increase the number of graduates prepared for careers in STEM

Neuroscience for improving education



Key Issues for the Research Community

- Translation: How is neuroscience translated into practice, e.g. education?
 - Undertranslation (not applying research findings)
 - Overtranslation (neuromyths)
- Capacity: How can we reach our potential for interdisciplinary research and training?



NSF Education Core Research (ECR)

One of three foci is workforce development with the aim to support research that informs investment in STEM workforce preparation. Evidence-based understanding of STEM learning is necessary with respect to:

- STEM career pathways and transitions;
- academic and non-academic STEM careers;
- emerging practices and changing contexts of STEM workforces;
- and the changing higher education climate and capacity for reforming STEM workforce development efforts.



EHR and Neuroscience

From 2009 to 2014, EHR has made over 20 awards (~\$16M) on the neural basis of STEM learning.

Work has included:

- Interdisciplinary efforts using fMRI or EEG to study math or science learning at various ages.
- Collaborations resulting in educational gains with scientific insights into the nature of learning as well as how the brain changes in complex environments.
- Funding over 500 graduate research fellows in neuroscience, cognitive psychology, and cognitive neuroscience



EHR Program: NSF Research Traineeship Program (NRT)

NRT provides master's and doctoral students the opportunity to build technical skills and gain professional development experience through research paired with mentorship. NRT features:

- An emphasis on training for multiple career pathways*
- Rotating priority research themes*
- A focus on developing models and knowledge that promote transformation in graduate education*

Photo Source: Widdowquinn (Creative Commons)

Directorate for Education and Human Resources

Institute of Medicine, October 28, 2014



THANK YOU

Joan Ferrini-Mundy

jferrini@nsf.gov



Directorate for Education and Human Resources

Institute of Medicine, October 28, 2014

John Anderson

Carnegie Mellon University

The Extension of Mathematical Knowledge: A Cognitive and Neuroscience Investigation (DRL 1007945)

- Focus on using understanding how students extend their mathematical knowledge and discover new mathematical relationships
- Data collection involves a combination of performance measures, verbal protocols, and fMRI brain imaging patterns
- Research will develop a computational model of cognition

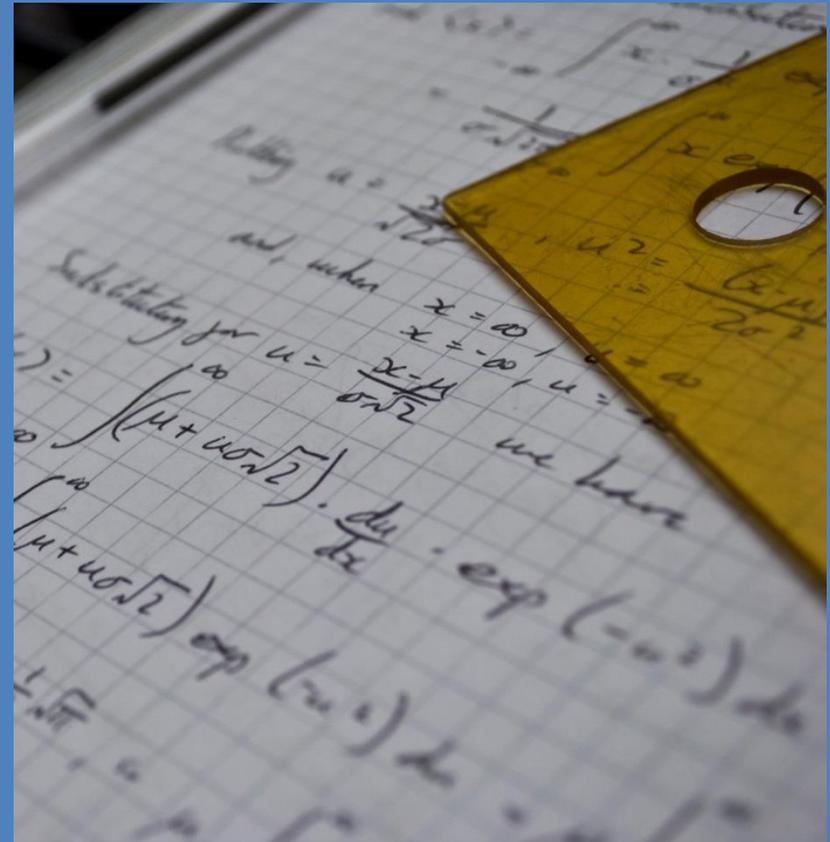


Photo source: Widowquinn (Creative Commons)



Directorate for Education and Human Resources

Institute of Medicine, October 28, 2014

Sian Beilock

University of Chicago

Embodied Physics Learning (DUE 1348614)

- EHR Core Research project on STEM learning
- Focus on cognitive science theories of embodied cognition to enhance student learning in physics.
- Laboratory experiences where students feel physics quantities may lead to the recruitment of brain areas devoted to sensorimotor processing when students later think and reason about the physics concepts they experienced





Photo credits (from left) : U.S. Army Corps of Engineers, Intel Free Press, Kate Ter Haar, Woodley Wonder Works, Ohio Sea Grant, U.S. Army RDECOM, Trevor Prentice

Thank You!

jferrini@nsf.gov



Directorate for Education and Human Resources

Institute of Medicine, October 28, 2014

Back up slides



Directorate for Education and Human Resources

Institute of Medicine, October 28, 2014

Understanding the Brain at NSF

Activities promise innovative and integrated solutions to challenges in our ability to predict how collective interactions between brain function and our physical and social environment enable complex behavior.

Five thematic areas:

- Multi-scale integration of the dynamic activity and structure of the brain
- Neurotechnology and research infrastructure
- Quantitative theory and modeling of brain function
- Brain-Inspired concepts and designs
- BRAIN Workforce development

Photo source: Andrew Ostrovsky (Creative Commons)



Directorate for Education and Human Resources

Institute of Medicine, October 28, 2014

BRAIN Initiative at NSF

DCL: Intent to support ideas Lab on multiscale integration of brain activity and structure (14-126)

- An intensive workshop focused on finding innovative solutions to the White House's Grand Challenge on the BRAIN
- Assemble diverse group of researchers to facilitate the generation and execution of innovative research projects.

Participating directorates:

- Biological sciences
- Mathematical and physical sciences



Building knowledge on what works

- What strategies lead to retention and degree attainment for undergraduates?
 - Authentic science experiences
 - Real mentorship
 - Interdisciplinary experiences
 - Fostering broadly applicable data analysis and communication skills
- How do different funding models at the undergraduate and graduate levels equip STEM workers to tackle 21st century challenges?
- How can public/private partnerships and interested stakeholders help prepare students for STEM careers?



Trends in the STEM Workforce

- Growing need for critical thinking skills that have broad application in a variety of STEM fields and interdisciplinary contexts
- Major shifts in U.S. demographics

