C^3 *Investing in Idaho's Future*

Context, Challenges *Opportunities* and Conversation in STEM Education at the Idaho STEM Summit 2012

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National Science Foundation

The Conversation

- **Who am I? (and why am I here?)**

…But first…

- **National Context**
- **Opportunities (a.k.a. challenges)**
- **One *Particular $1.2M Opportunity***

Take away message…data, data, data…

Evidence-based design

Evidence-based outcomes

"If your actions inspire others to dream more, learn more, do more and become more, you are a leader." John Quincy Adams, 6th U.S. President

But first…

…Write down one thing you would like to get out of the next 45 minutes.

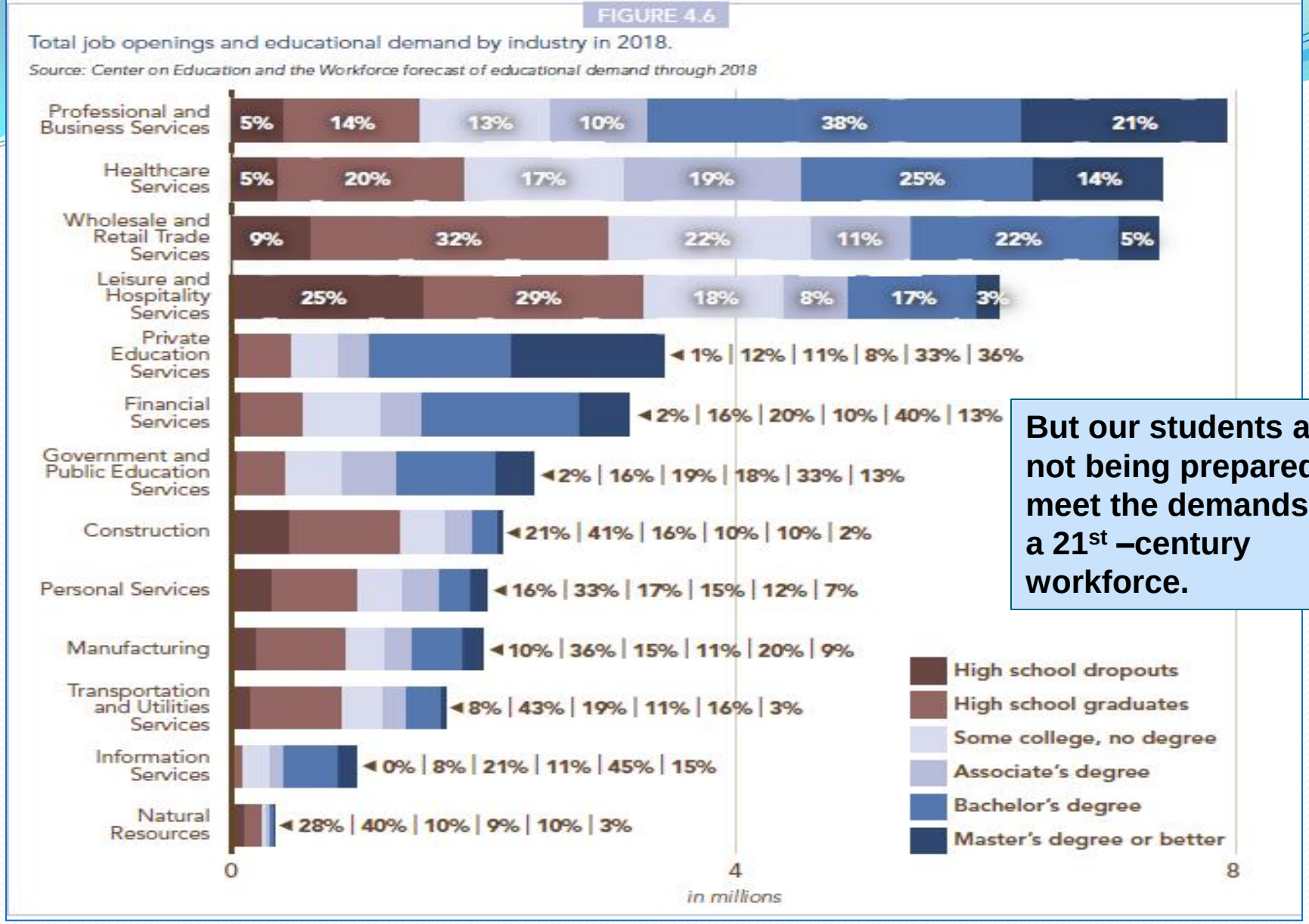
…Write down one action item you are willing to do within one month of this meeting.

“Basic scientific research is scientific capital…How do we increase this scientific capital? First, we must have plenty of men and women trained in science, for upon them depends both the creation of new knowledge and its application to practical purposes.”

Vannevar Bush (1945) *Science: The Endless Frontier*
http://www.nsf.gov/about/history/vbush1945.htm#transmittal

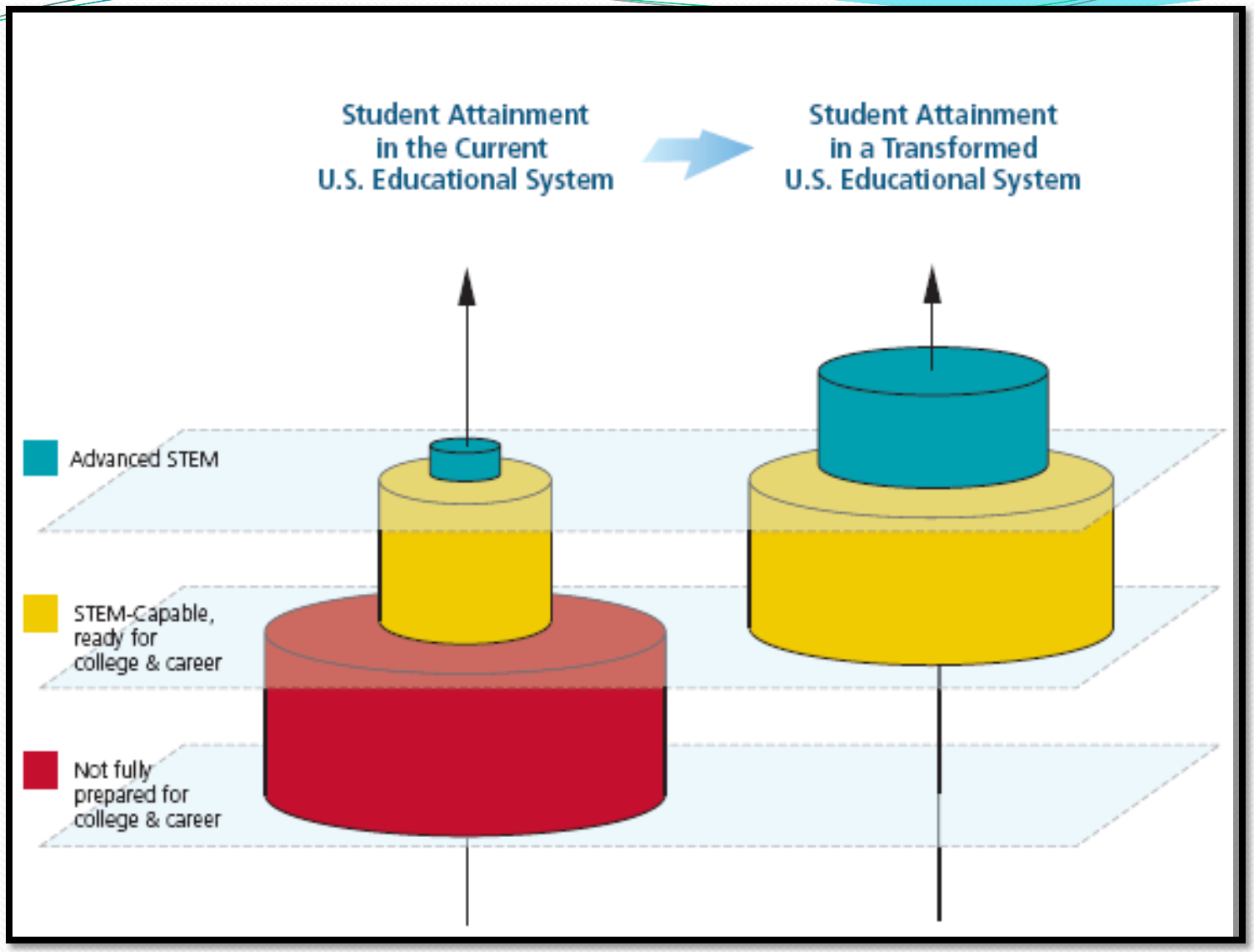
“Educational excellence in all of NSF’s research activities and research excellence in all of NSF’s education activities.”

Subra Suresh, NSF Director, 2011



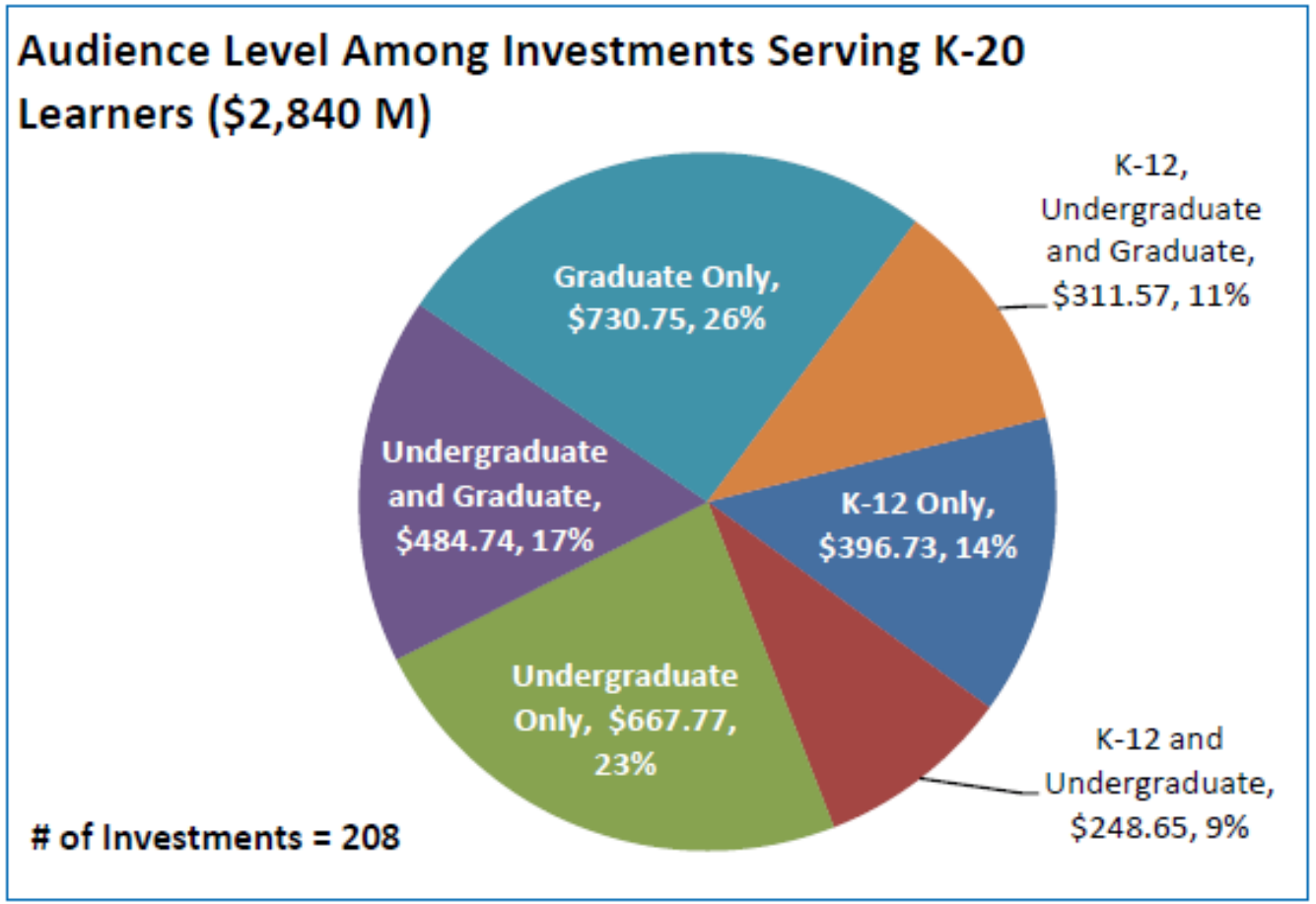
But our students are not being prepared to meet the demands of a 21st –century workforce.

Carnevale, Anthony P., Smith, Nicole, Strohl, Jeff. (June 2010). Help Wanted: Projections of jobs and education requirements through 2018. Center on Education and the Workforce, Georgetown University: Washington, DC., pg.71



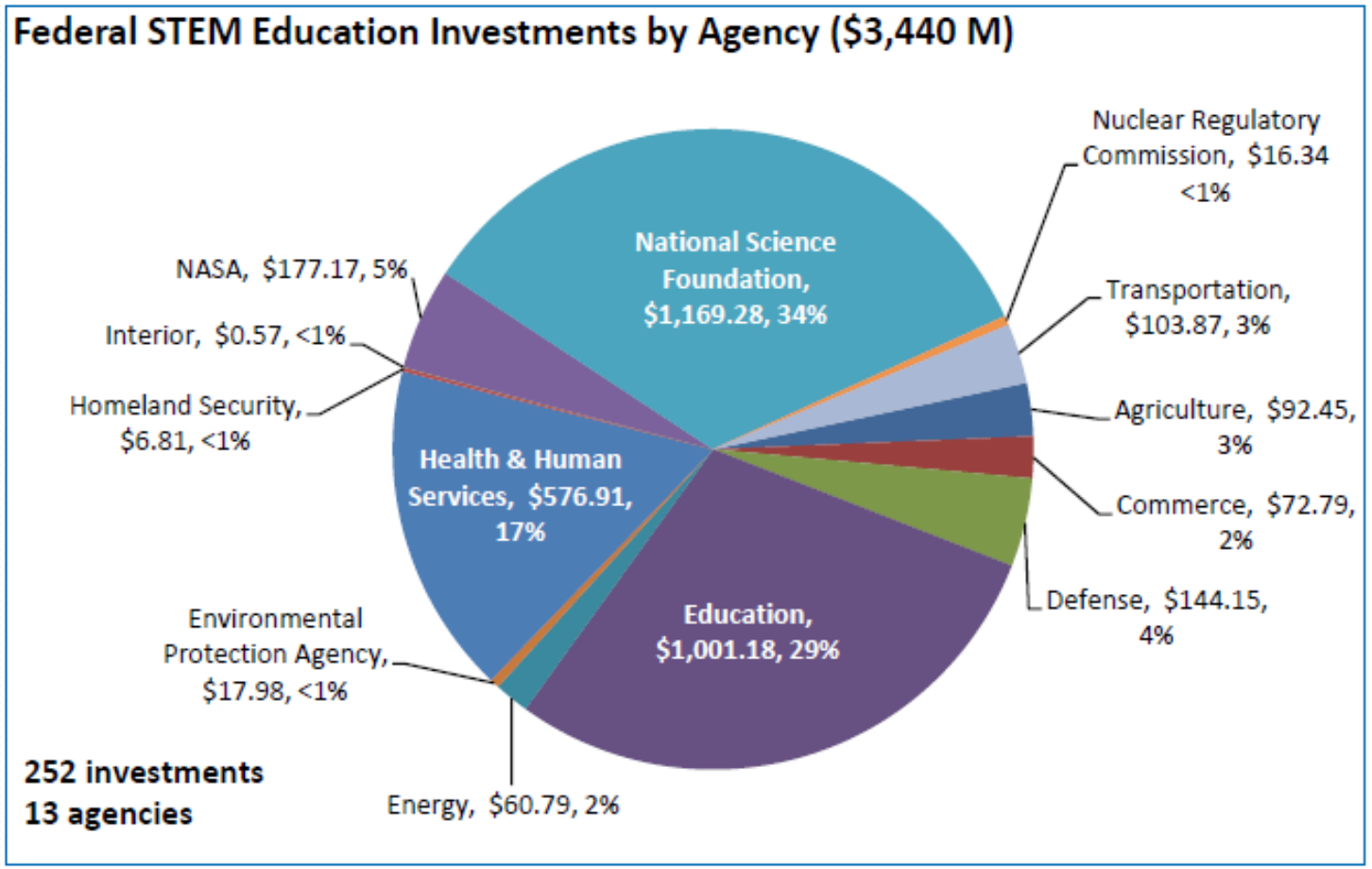
Carnegie Corporation of New York and Institute for Advanced Study, 2009, ***The Opportunity Equation: Transforming Mathematics and Science Education for Citizenship and the Global Economy***, p. 6

Co-STEM major findings



The Federal Science, Technology, Engineering, and Mathematics (STEM) Education Portfolio, December 2011, pp. 10, 21

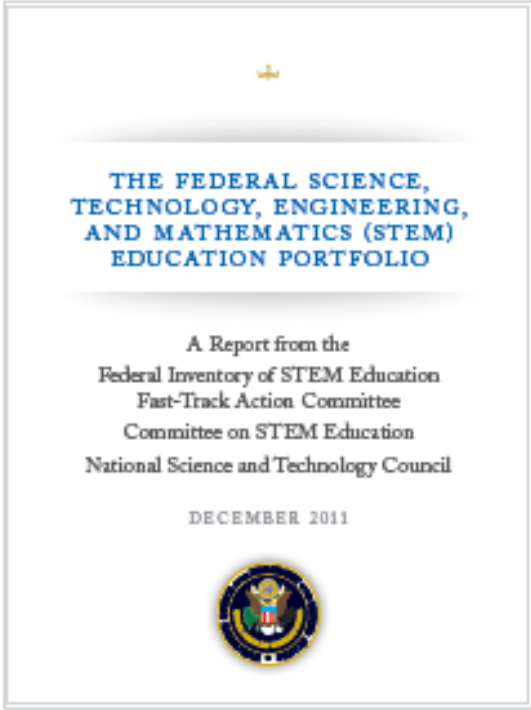
Co-STEM major findings



***The Federal Science, Technology, Engineering, and Mathematics (STEM) Education Portfolio*, December 2011, pp. 10, 21**

The National Investment in STEM Education: Co-STEM

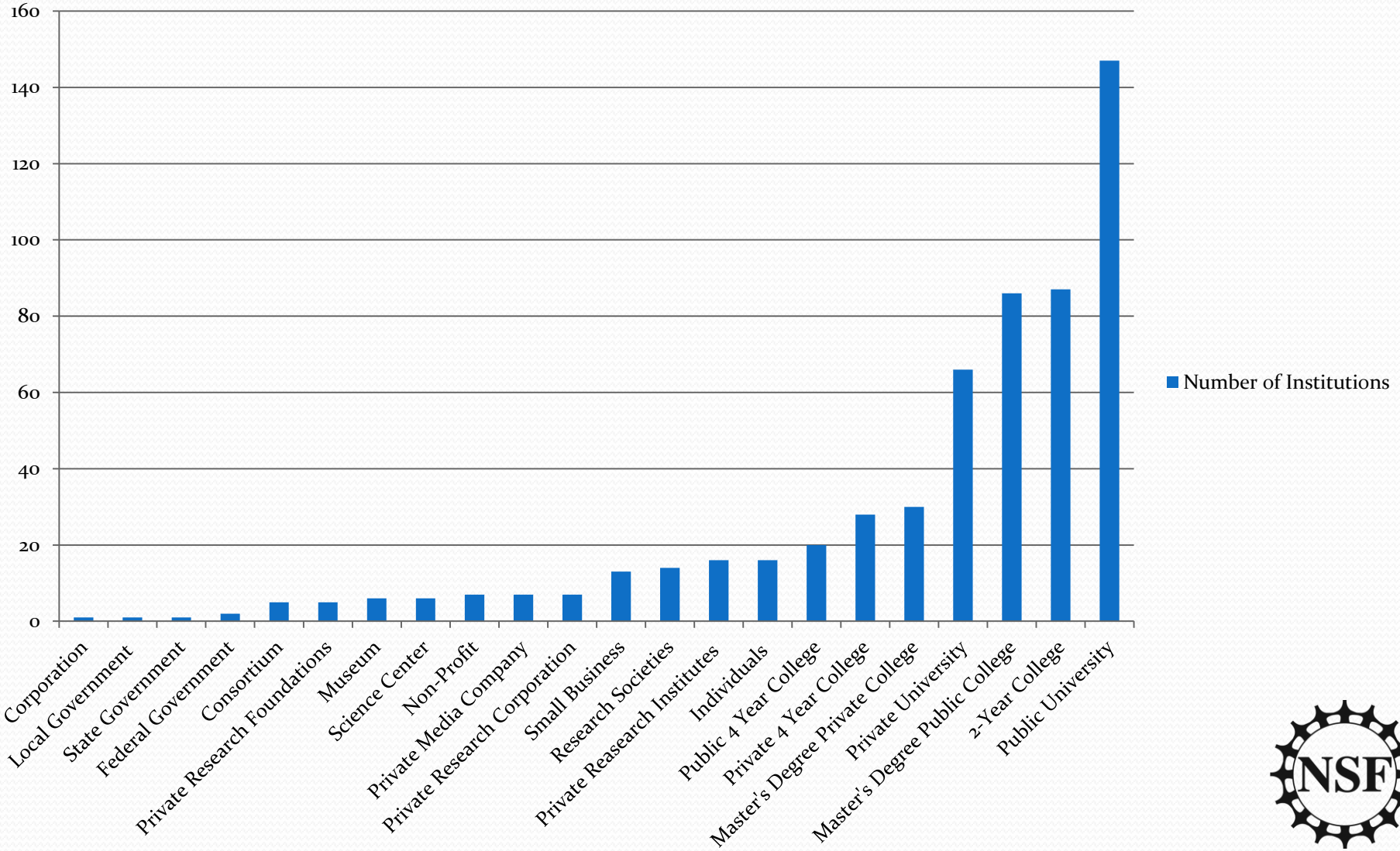
"Our analysis indicates that the critical issue related to Federal investments in STEM education is not whether the total number of investments is too large or whether today's programs are overly redundant with one another. Rather, the primary issue is how to strategically focus the limited Federal dollars available so they will have a more significant impact in areas of national priority. "


THE FEDERAL SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) EDUCATION PORTFOLIO

A Report from the
Federal Inventory of STEM Education
Fast-Track Action Committee
Committee on STEM Education
National Science and Technology Council

DECEMBER 2011

EHR Awardee Institutions FY2011



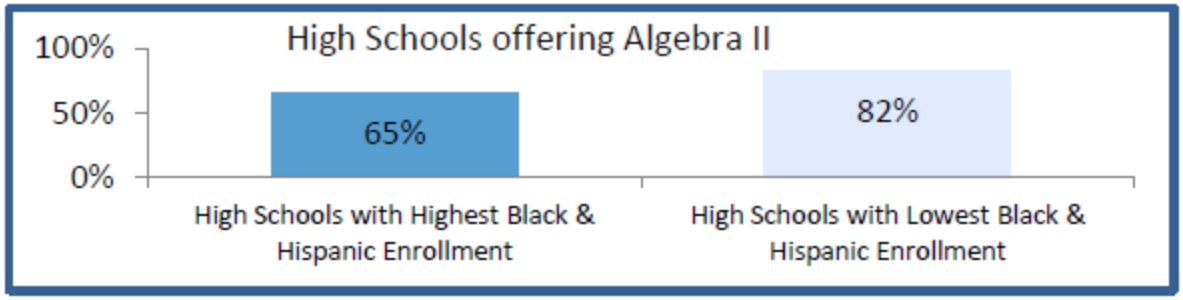
EHR at a Glance

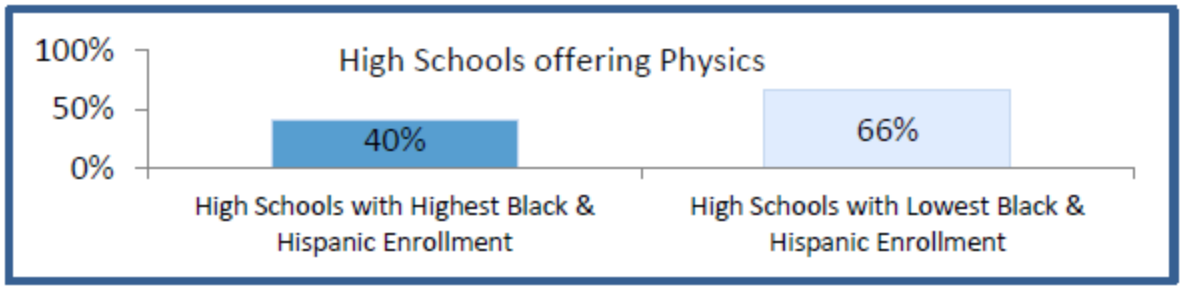
Division	No. of Currently Active Awards*	FY 13 Budget Request
Research on Learning	901	$309.51 M
Undergraduate Education	2,598	$246.65 M
Graduate Education	658	$184.82 M
Human Resource Development	547	$134.63 M
Total	4704	$875.61 M

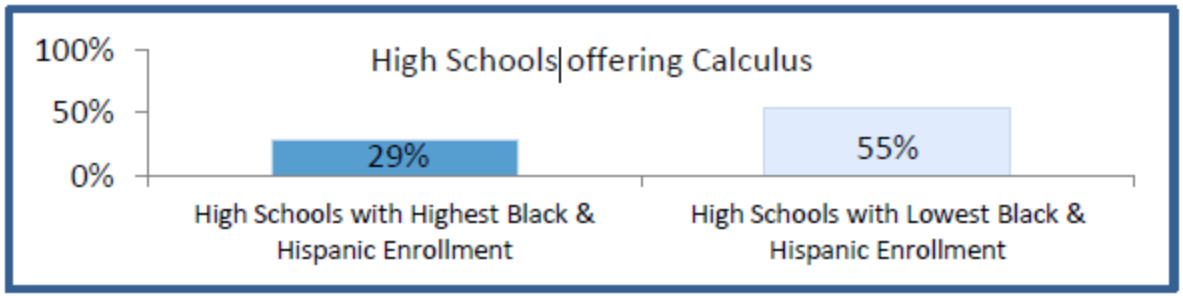
*Source: NSF Award Data Base, April 23, 2012

Challenges: Improving STEM Learning for ALL

- K-12 students are not succeeding in STEM
- Undergraduates are leaving STEM majors
- Gaps in STEM achievement and access still exist
- Size and readiness of STEM workforce not what it needs to be
- Knowledge for improvement not being used at scale







Office for Civil Rights (March 2012). *Revealing New Truths About Our Nation's Schools: The Transformed Civil Rights Data Collection (CRDC). pg. 6*

2010/2011 Adequate Yearly Progress Report State of Idaho

	ISAT MATH % Proficient	Graduation (%)
All Students	88.4	92.4
African American	74.9	
Asian	89.6	
American Indian	75.6	
Hispanic	79.9	
Native Hawaiian/Pacific Islander	86.3	
White	90.4	
Limited English Proficiency	69.1	
Economically disadvantaged	83.6	
Students with Disabilities	58.7	
Goal	**83.0**	**90.0%**

Idaho Department of Education:
http://apps.sde.idaho.gov/AYP/Results/Results?SchoolYearId=8&DataPlanId=6&SDESchoolCode=999&Scope=State&p=1

Persistence rates at the undergraduate level

Nationally--

Of the 2002 starting cohort (4-yr institutions)

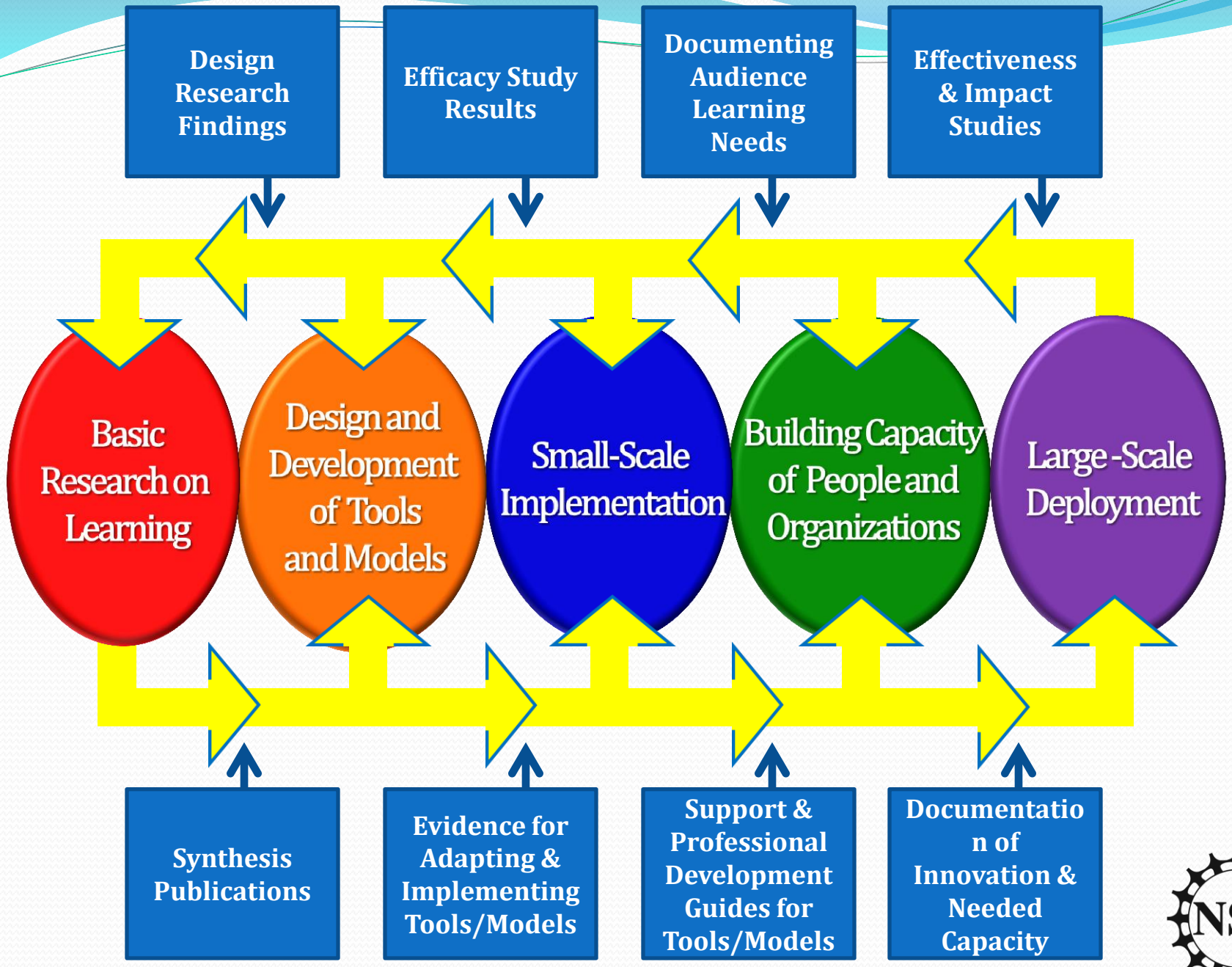
- **36.4 percent completed in 4 years**
  - **39.3 percent of white students**
  - **20.4 percent of black**
  - **26.4 percent of Hispanic students**
- **52.3 percent completed in 5 years**
  - **55.7 percent of white students**
  - **34.4 percent of black students**
  - **42.5 percent of Hispanic students**
- **57.2 percent completed in 6 years**
  - **60.2 percent of white students**
  - **40.1 percent of black students**
  - **48.9 percent of Hispanic students**

What about in Idaho?

U.S. Department of Education, National Center for Education Statistics, 2001-02 to 2008-09
Integrated Postsecondary Education Data System, Fall 2001, and Spring 2002 through Spring 2009. This table was prepared July 2010.)
http://nces.ed.gov/programs/digest/d10/tables/dt10_341.asp

Critical Needs/Challenges/Opportunities

- More research, development, and dissemination about what works
- Engage in research and and development work about the appropriate and essential mathematics and science content for students in the 21st century
- Research on STEM learning and diverse learners with more attention to implications for practice
- Partner with other government agencies and private sector to support more effective STEM teacher preparation
- Research and development of better state assessment systems and tools
- Research to evolve blended models of formal and informal education


Design Research Findings
Efficacy Study Results
Documenting Audience Learning Needs
Effectiveness & Impact Studies
Basic Research on Learning
Design and Development of Tools and Models
Small-Scale Implementation
Building Capacity of People and Organizations
Large-Scale Deployment
Synthesis Publications
Evidence for Adapting & Implementing Tools/Models
Support & Professional Development Guides for Tools/Models
Documentation of Innovation & Needed Capacity
NSF



“To this point, research in mathematics education has rarely focused explicitly on understanding the process of improving mathematics teaching and learning at scale.”

Paul Cobb, Peabody Chair in Teaching and Learning, Professor of Education, Vanderbilt University. Description of Research Area accessed at http://peabody.vanderbilt.edu/cobb_paul.xml on April 23, 2012.

Discovering What Works

"Knowing that a program *can* work is not good enough; we need to know *how to make it work* reliably over many diverse contexts and situations.

Anthony Bryk, President of the Carnegie Foundation for the Advancement of Teaching (2009), page 298 [as cited by Paul Cobb, February 2, 2012]

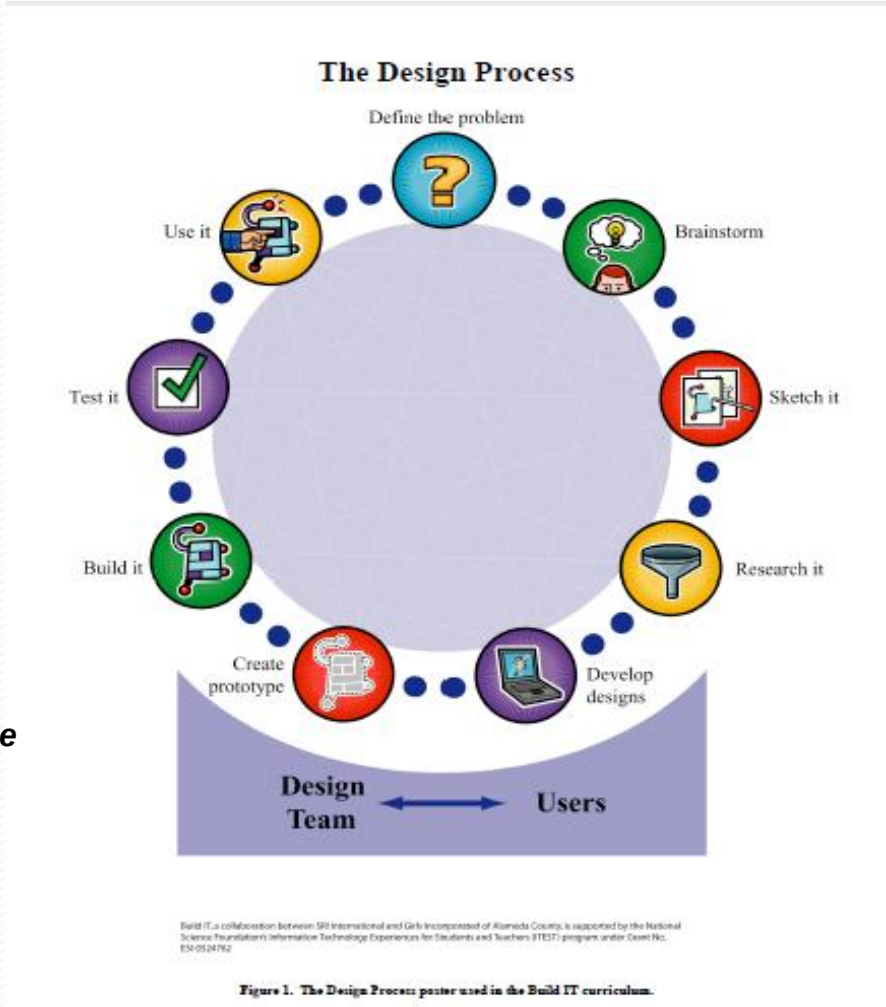


Figure 1. The Design Process poster used in the Build IT curriculum.

NSF Award #1054086. Division of Research on Learning in Formal and Informal Settings. *Developing and Testing Theories of Implementation: A Workshop on Design Research with Educational Systems.* University of Colorado; PI: William Penuel

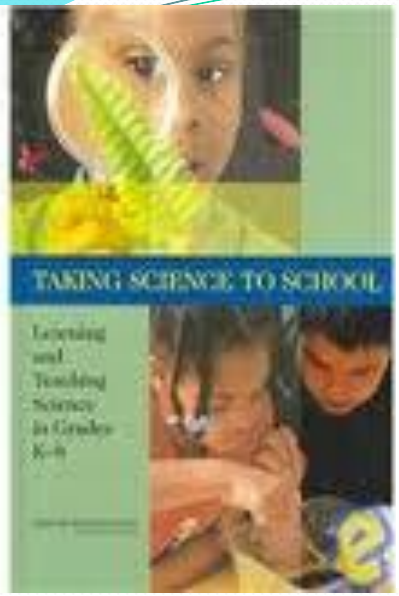
Context and Opportunities for Building the STEM Workforce

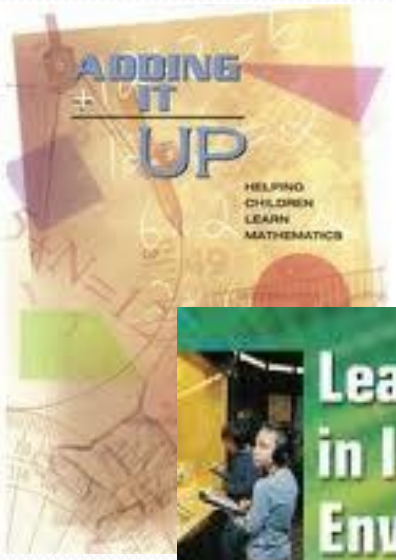
Create partnerships that are purposefully structured to:

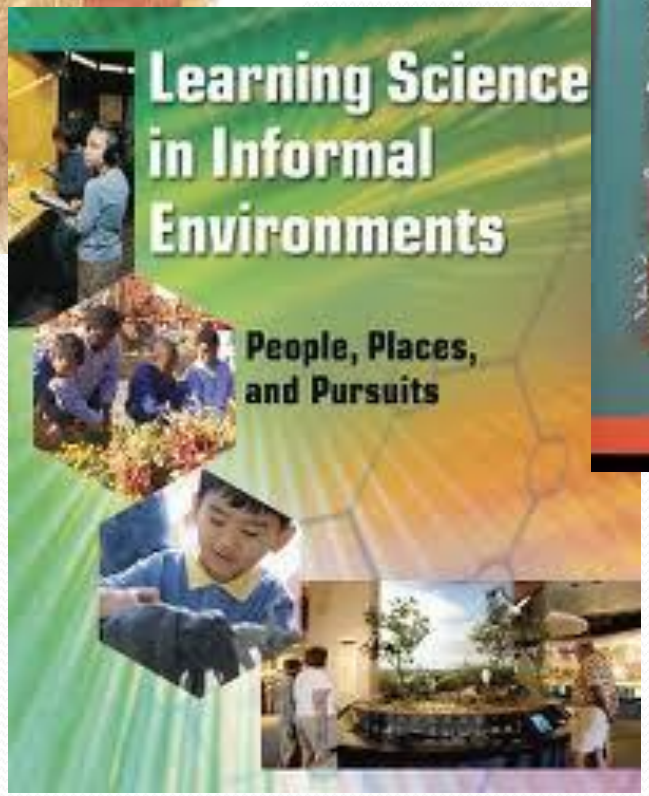
- **leverage the education and outreach work of NSF-funded centers and facilities;**
- **capitalize on the rich array of STEM education research and development in EHR and across NSF;**
- **connect upstream STEM education with downstream industry/academic customers; and**
- **build upon recognized strengths among partners in research and development.**

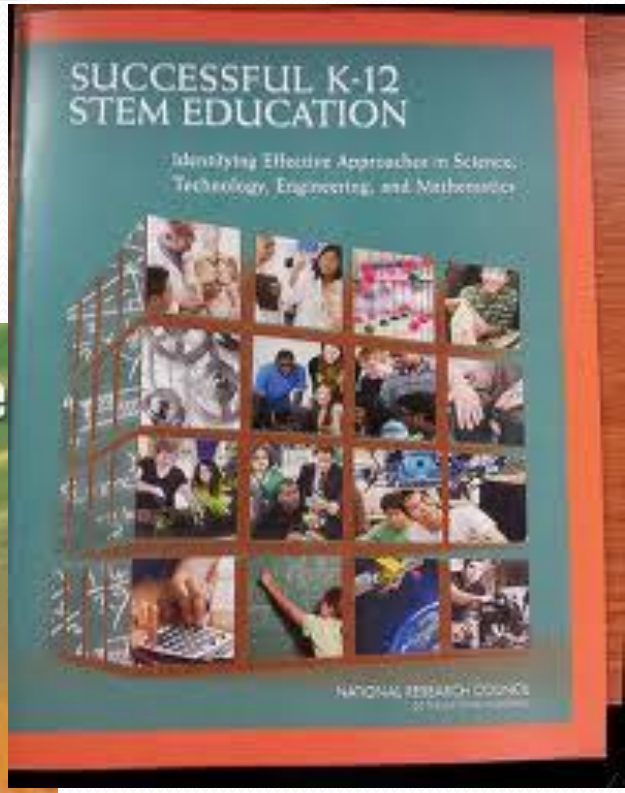
Essential Keys

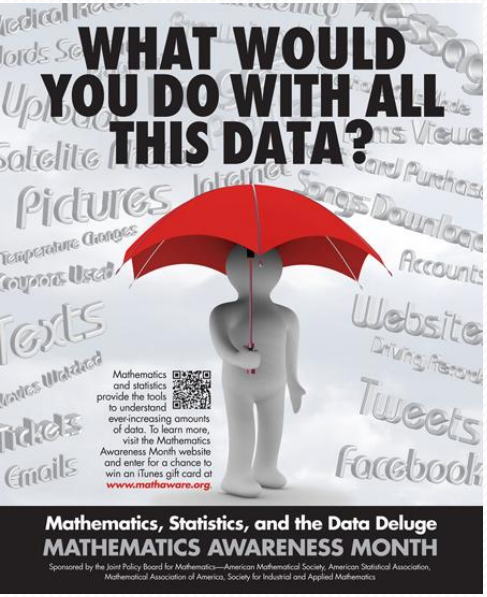
KNOWLEDGE


TAKING SCIENCE TO SCHOOL


ADDING IT UP
HELPING CHILDREN LEARN MATHEMATICS


Learning Science in Informal Environments
People, Places, and Pursuits


SUCCESSFUL K-12 STEM EDUCATION
Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics
NATIONAL RESEARCH COUNCIL


WHAT WOULD YOU DO WITH ALL THIS DATA?
Mathematics and statistics provide the tools to understand ever-increasing amounts of data. To learn more, visit the Mathematics Awareness Month website and enter for a chance to win an iTunes gift card at www.mathaware.org
Mathematics, Statistics, and the Data Deluge
MATHEMATICS AWARENESS MONTH

What Policy Makers can do:

- "Elevate s**cience** to the same level of importance as reading and math
- Develop effective systems of **assessment**
- Invest in coherent, focused, and sustained support for STEM **teachers**
- Support **educational research** that disentangles the effects of school practice from student selection, recognizes the importance of contextual variables, and allows for longitudinal assessments of student outcomes."

"Effective instruction capitalizes on students' early interest and experiences, identifies and builds on what they know, and provides them with experiences to engage them in the practices of science and sustain their interest."

National Research Council . (2011). ***Successful K-12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics.***

Building a future STEM workforce by engaging students at a young age

What does it take to enable elementary school students to engage with increasingly sophisticated scientific content and practice over multiple years?

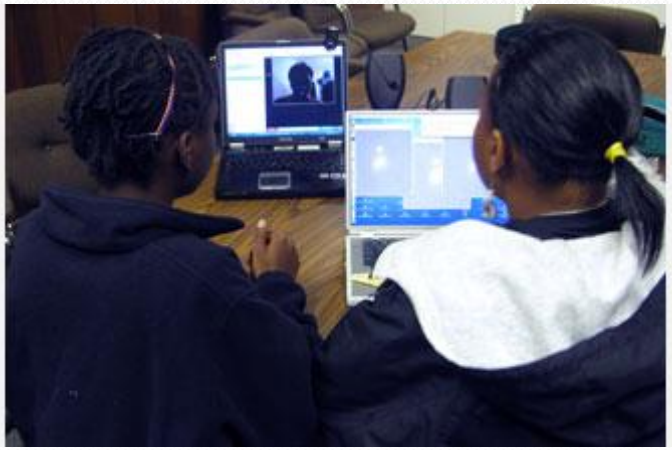
NSF Award #0628151(Division of Research on Learning in Formal and Informal Settings).
DeepThink: Thinking Deeply about Biodiversity and Ecology
PI: Nancy Songer, University of Michigan

DIVERSITY




Unprecedented growth and diversity of learners

CONNECTIVITY

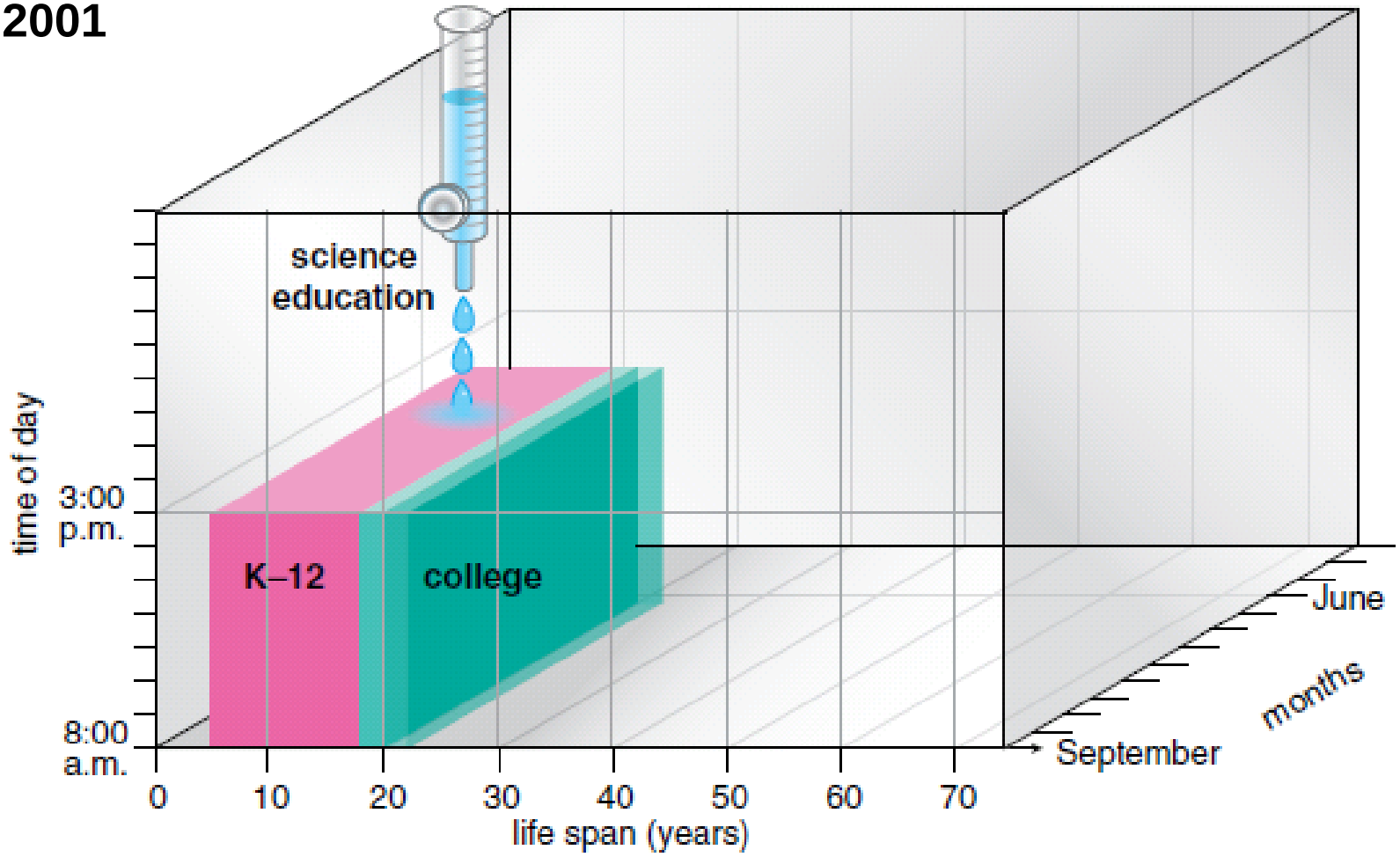


Opportunities for "anyone, anytime, anywhere" learning

"NSF can continue to lead this revolution [in cyberlearning] by leveraging its investments in the productive intersections between technology and the learning sciences."

Fostering Learning in the networked World:
The Cyberlearning Opportunity and Challenge; a 21st Agency for the National Science Foundation (June 2008), p. 5

Falk, 2001



Falk, John. and Dierking, Lynn D. (2010) *The 95 Percent Solution,* p. 488. American Scientist, 98.

Connectivity—Harvard, MIT to Partner to Offer Free Online Courses

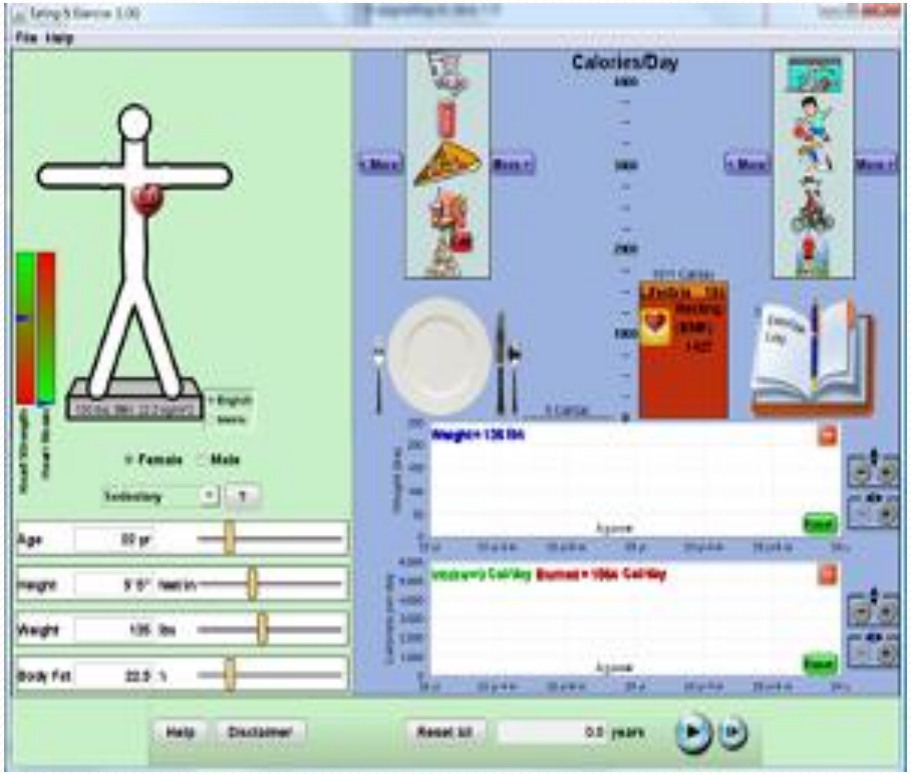
- The **Boston Globe** (5/3, Carmichael) reports, "Harvard University and the Massachusetts Institute of Technology will team up on a $60 million initiative to offer free online, college-level courses under a joint superbrand known as edX, the universities said" yesterday. "
- **Bloomberg News** (5/3, Staley, Lauerman) reports the venture "will be funded with $30 million from each of the universities and will begin offering courses this year, the" universities said in a statement. "Expanding and studying online education has become an important part of the teaching and research functions of nonprofit universities," Harvard President Drew Faust said in an interview.
- **Inside Higher Ed** (5/3, Kolowich) adds, "Harvard and MIT say one of their main goals with edX is to generate learning data that the universities can share freely with education researchers. The MITx platform, which will serve as the technology platform for edX, 'already has a lot of mechanisms for understanding how students are learning,'" Agarwal said.

Learning approaches that allow a learner to experience an environment first-hand can improve student learning.

"Scratch is developed by the Lifelong Kindergarten Group at the MIT Media Lab. See http://scratch.mit.edu".

Accessed on April 23, 2012, at http://scratch.mit.edu/

PhET:
Providing interactive simulations to improve science teaching and learning.



Use optical tweezers to stretch a single strand of DNA.

Simulation exploring the interaction of light with molecules

NSF Award #0817582, (Division of Undergraduate Education). PI: Katherine Perkins, *Physics and Chemistry Education Technology Project,* University of Colorado at Boulder

MSP Solicitation 12-518: Research on State Plans for STEM education (Proposals Due—December 18, 2012)

Projects that enable states to identify and coordinate the **infrastructure/resources**, both organizations and people, that can be **mobilized** within a state, multiple states or a region and the **use of extant data** to support the identification of specific and targeted needs to advance K-12 STEM education. Such proposals will **demonstrate** an **understanding of public policy issues** impacting STEM education, conduct a **self-study** leading to the generation of a state plan for advancing STEM education, and **conduct research on the development of the plan** so that **others may learn** from the process.

Research on State Plans *cont.*

Proposals for these projects should focus on the:

1. identification of the resources (e.g., school districts, institutions of higher education, federal/state-funded MSP projects, museums/zoos/parks/aquariums, business & industry, federal/state-funded science laboratories and centers) that a state or region can coordinate to develop a specific plan for advancing K-12 STEM education;
2. use of existing data at the district, state or regional level that can identify the specific needs that should be addressed by this coordinated effort and/or the identification and development of data elements that must be improved in data systems to provide more information to identify specific needs; **and**
3. characterization of the facilitating conditions and barriers to the development and implementation of a coordinated plan that addresses targeted and specific K-12 STEM education needs.

MSP Resources

- *MSPnet.org*: A comprehensive site with information about MSP, awardees, related articles etc.
- *Horizon-research.com*: Findings from a Knowledge and dissemination project on MSP

Opportunities for Funding Teacher Preparation at NSF

Programs that further the evidence base for producing new K-12 STEM teachers (pre-service) and through support of new teachers during their induction phase (in-service) .

Programs in the Directorate for Education and Human Resources (EHR):

EHR Programs that actively solicit new projects related to new teachers

ATE, DRK-12, HBCU-UP, MSP, PRIME, NOYCE, TUES, TCUP

EHR Programs that have supported projects related to new teachers in the past

ITEST, TEESE, RDE

Programs in other NSF Directorates:

CE-21, GeoEd, RET

See the handout for more information on the programs.

One NSF

"The Dream of flight is born within the heart of [each of us], embracing the desire to be free from the confines of the earth's surface. Hopefully the dreams include the possibility of **freedom from limiting thought and action.** As our imagination is freed to receive greater truths, then fear, closed thinking, and poverty of spirit will be left behind...far below."

Lincoln Fox, Sculptor, Albuquerque International Sunport

"Make no little plans; they have no magic to stir [people's] blood." Daniel Burnham, Architect, Columbia/Exposition, 1892/93

On behalf of the students, families, and other human and natural assets that are Idaho, I Thank You!

Time for Questions?

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