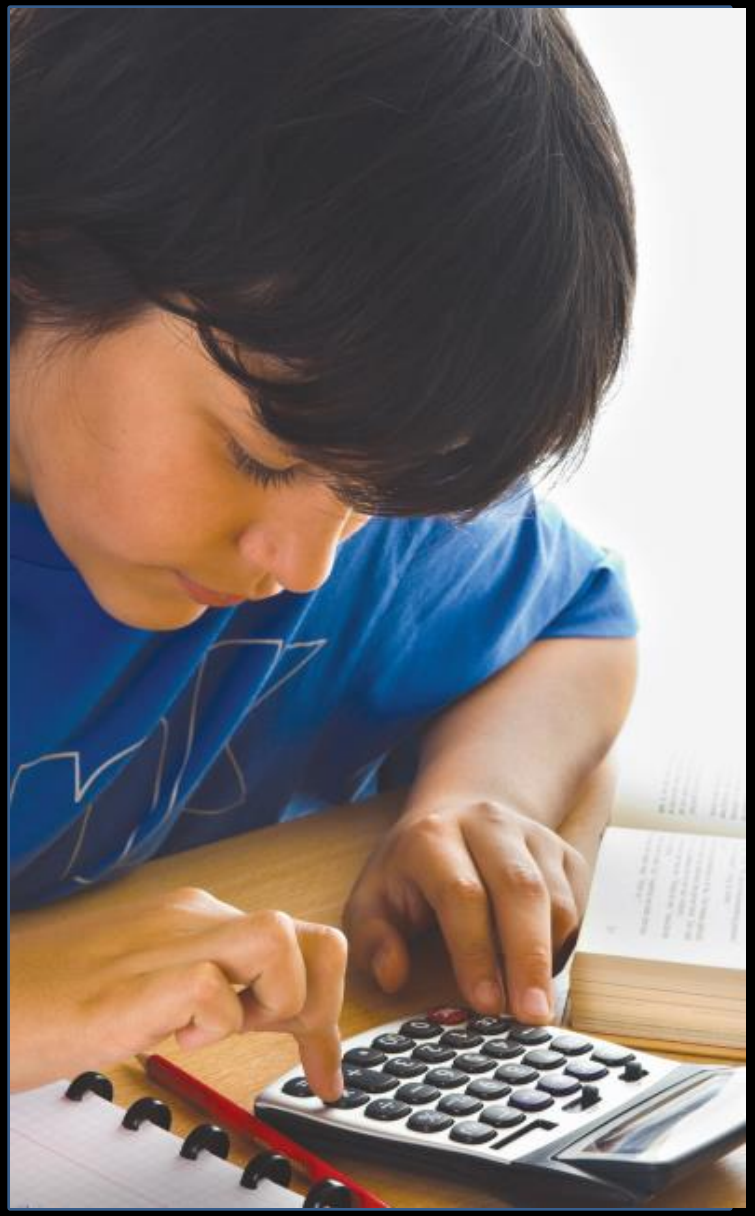
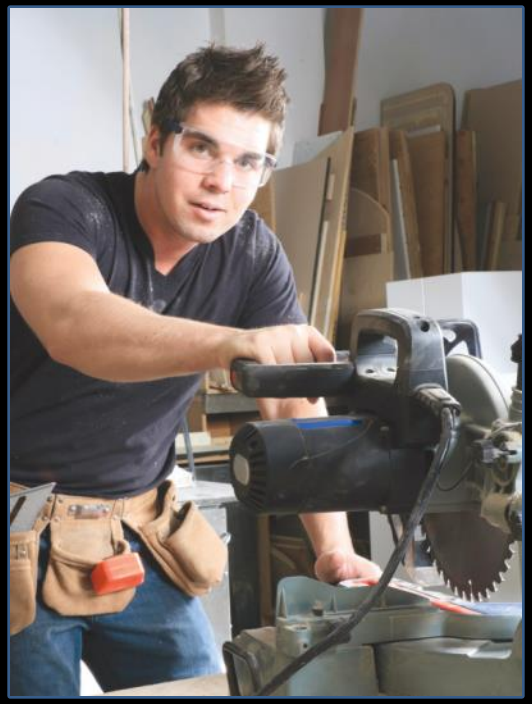
STEM Smart: Lessons Learned From Successful Schools

A Conference Hosted by
the National Science Foundation
at University of Maryland, Baltimore

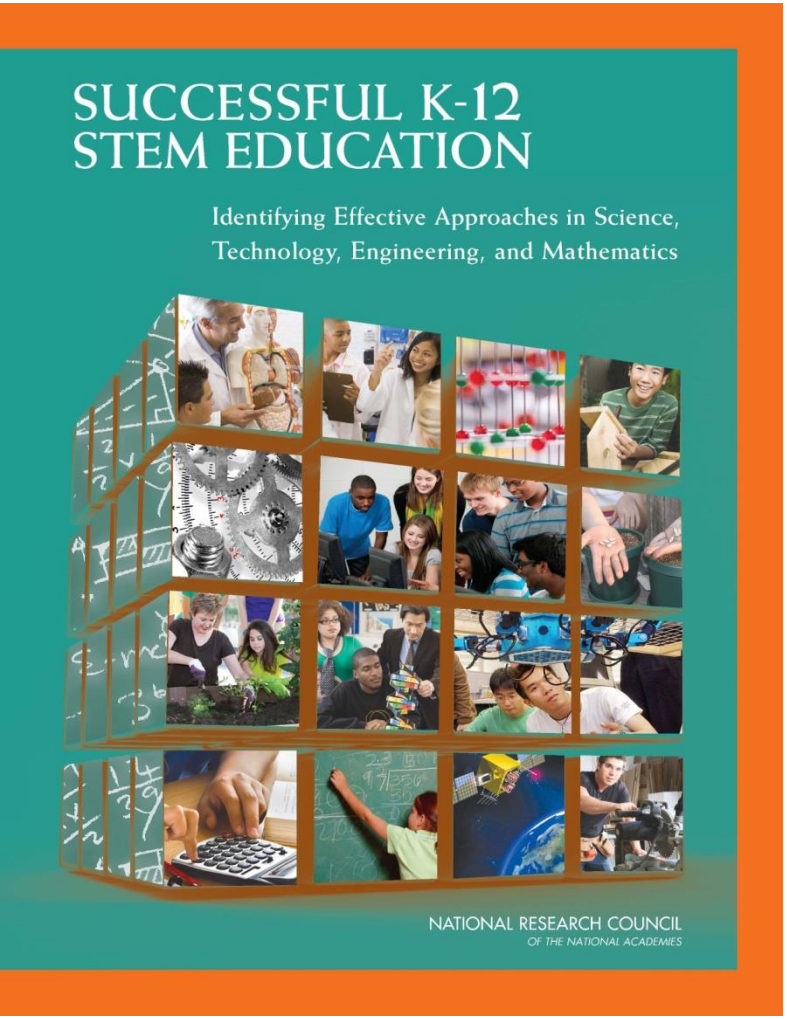


Welcome by the National Science Foundation & Opening Addresses

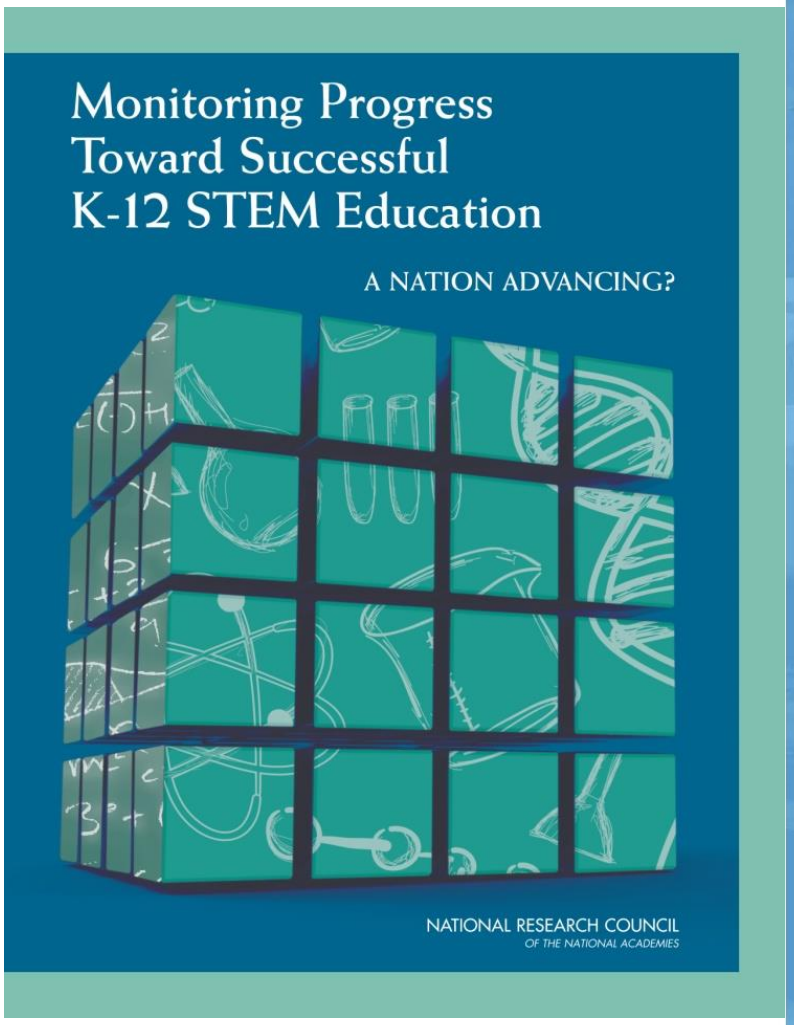


What Everyone Should Know About Successful K-12 STEM Education

2011


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

2012


Monitoring Progress
Toward Successful
K-12 STEM Education
A NATION ADVANCING?
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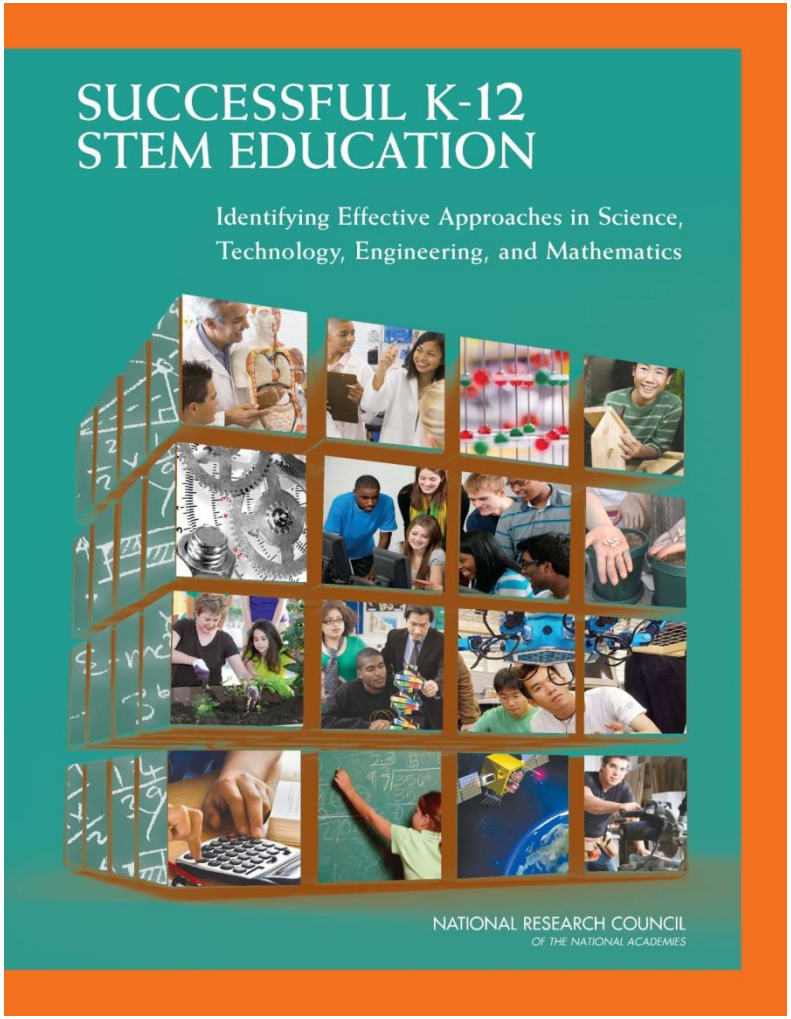
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The Need To Improve STEM Learning

- Successful K-12 STEM is essential for scientific discovery, economic growth and functioning democracy
- Too many students leave school unprepared
- Gaps among students from different race/ethnic and economic backgrounds are wide

Goals for U.S. STEM Education

- Expand the number of students who pursue STEM careers, and increase women and minority participation.
- Expand the STEM-capable workforce and increase women and minority participation.
- Increase STEM literacy for all students.

Three types of STEM-focused schools

1. **Selective STEM schools:**

   Mainly high schools that enroll small numbers of highly talented and motivated students

2. **Inclusive STEM schools:**

   Organized around STEM disciplines but without selective admissions criteria

3. **STEM-focused CTE schools:**

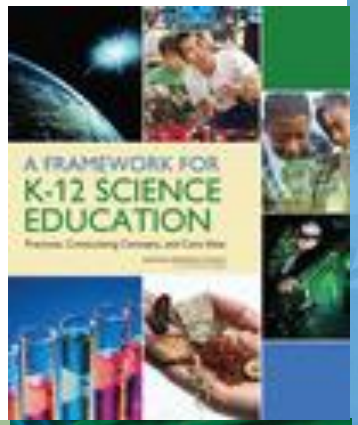
   Mainly high schools, aim to foster engagement and to prepare students for STEM-related careers

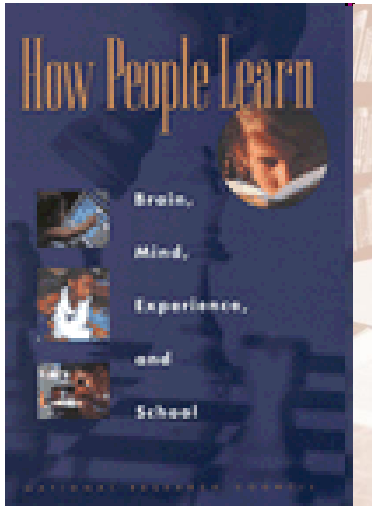
STEM-focused schools

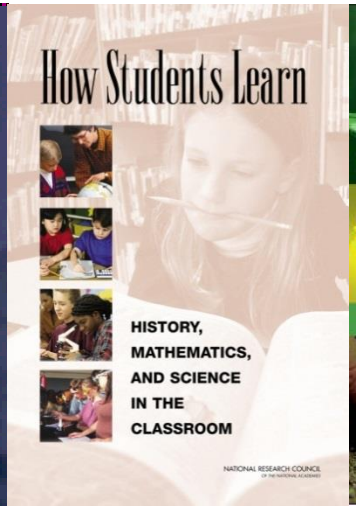
- Limited research base to compare effectiveness
- Potentially promising findings for each type of school
  - Success in selective schools occurs through student research experiences
  - Inclusive schools promote engagement and modestly lift test scores
  - Mathematics instruction and occupational education can be successfully integrated in CTE schools
- Specialized programs in regular schools such as AP and IB may also promote advanced study and career preparation

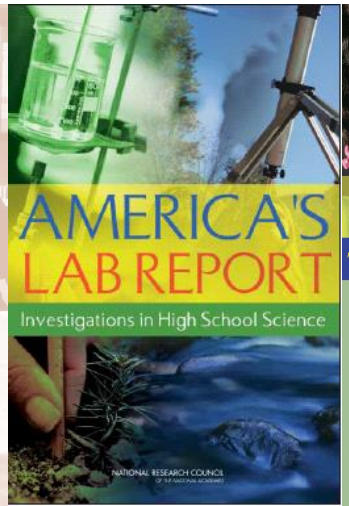
Effective STEM instruction

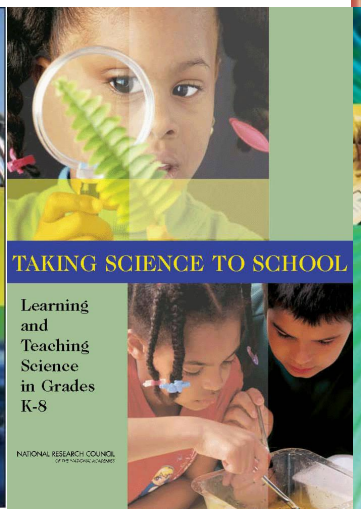
- Research base is much stronger
- Effective instruction capitalizes on students' early interest, builds on what they know, provides experiences to engage in the practice of science
  - Vision consistent with the *A Framework for K-12 Science Educations*
- Effective instruction can occur in all school types

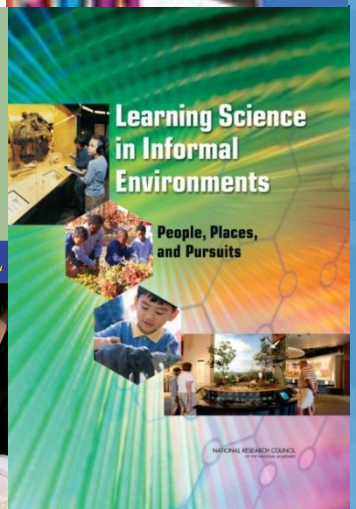












Key elements of effective instruction

1. A coherent set of standards and curriculum
2. Teachers with high capacity to teach in their disciplines
3. A supportive system of assessment and accountability
4. Adequate instructional time
5. Equal access to high-quality learning opportunities

School conditions that support learning

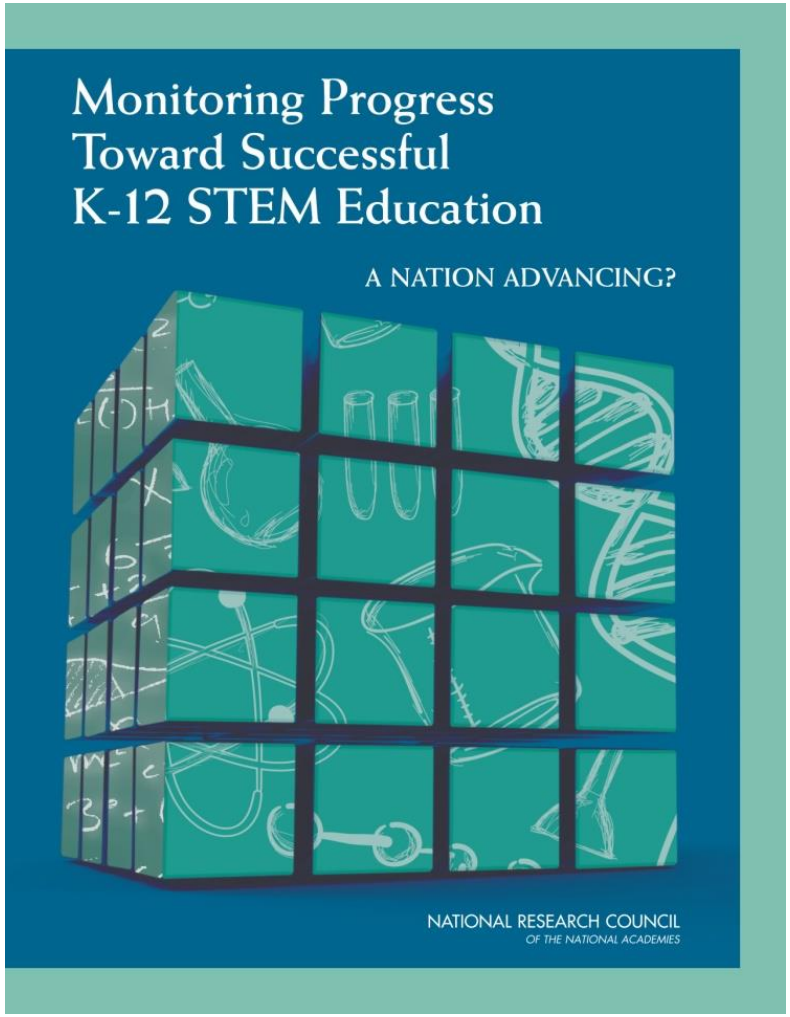
1. School leadership as the driver for change
2. Professional capacity of faculty and staff
3. Parent-community ties
4. Student-centered learning climate
5. Instructional guidance for teachers

Recommendations for districts

- Consider all models of STEM-focused and comprehensive schools
- Devote adequate instructional time and resources to K-5 science
- Ensure that STEM curricula are focused on core topics, are rigorous, and articulated as a sequence
- Enhance K-12 teacher capacity
- Provide instructional leaders with professional development to create supportive conditions

Recommendations for policy makers

- Elevate science to the same level of importance as reading and mathematics
- Develop science assessments aligned with standards and emphasize science practices
- Invest in a coherent, focused, and sustained set of supports for STEM teachers
- Support research that addresses key gaps in current knowledge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Charge to the NRC

Conduct a […] study to identify methods for tracking and evaluating the implementation of the improvements for K-12 education recommended by the 2011 NRC report, *Successful K-12 STEM Education*.

Criteria for Selecting Indicators

Indicators must:

1. Be shown by research to be related to a given recommendation.
2. Generate information that clearly enhances understanding of progress toward the recommendation for all student groups.
3. Have the potential to be used for continuous improvement.
4. Be feasible to measure on a large scale.

Students' Access to STEM Learning

Recommendations from Successful K-12 STEM Education	Indicators
A. Districts Should Consider Multiple Models of STEM-Focused Schools	1. Number of, and enrollment in, STEM-focused schools and programs in each district.
B. Districts Should Devote Adequate Instructional Time and Resources to Science in Grades K-5	2. Time allocated to teach science in grades K-5. 3. Science-related learning opportunities in elementary schools.
C. Districts Should Ensure that their Science and Mathematics Curricula are Focused on the Most Important Topics in Each Discipline, are Rigorous, and are Articulated as a Sequence of Topics and Performances	4. Adoption of instructional materials in grades K-12 that embody Common Core State Standards in mathematics and *A Framework for K-12 Science Education*. 5. Classroom coverage of content and practices in Common Core and *A Framework for K-12 Science Education*.

Educators' capacity

Recommendations from *Successful K-12 STEM Education*	Indicators
D. Districts Need to Enhance the Capacity of K-12 Teachers	6. Teachers' science and mathematics content knowledge for teaching. 7. Teachers' participation in STEM-specific professional development activities.
E. Districts Should Provide Instructional Leaders with Professional Development that Helps them to Create the School Conditions that Appear to Support Student Achievement	8. Instructional leaders' participation in professional development on creating conditions that support STEM learning.

Funding and policy initiatives

Recommendations from *Successful K-12 STEM Education*	Indicators
F. Policy Makers at the National, State, and Local Levels Should Elevate Science to the Same Level of Importance as Reading and Mathematics	9. Inclusion of science in federal and state accountability systems. 10. Proportion of major federal K-12 education initiatives that include science. 11. State and district staff dedicated to supporting science instruction.
G. States and National Organizations Should Develop Effective Systems of Assessment that Are Aligned with A Framework for K-12 Science Education *and that Emphasize Science Practices Rather Than Mere Factual Recall*	12. States' use of assessments that measure the core concepts and practices of science and mathematics disciplines.

Funding and policy initiatives, cont.

Recommendations from *Successful K-12 STEM Education*	Indicators
H. National and State Policy Makers Should Invest in a Coherent, Focused, and Sustained Set of Supports for STEM Teachers	13. State and federal expenditures dedicated to improving the K-12 STEM teaching workforce.
I. Federal Agencies Should Support 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	14. Federal funding for the three broad kinds of research identified in *Successful K-12 STEM Education*.

State of development of indicators

- Existing data provide information on some indicators
- Existing surveys can be modified to provide information about some indicators
- Conceptual and empirical development are required to begin specifying some indicators

K-12 STEM education monitoring and reporting system: capabilities

- Assess progress toward the recommendations in *Successful K-12 STEM Education*.
- Measure student knowledge, interest, and participation [linking inputs to outcomes].
- Track investments.
- Provide information about the STEM-education workforce.
- Facilitate strategic planning for federal investments in STEM education and workforce development.

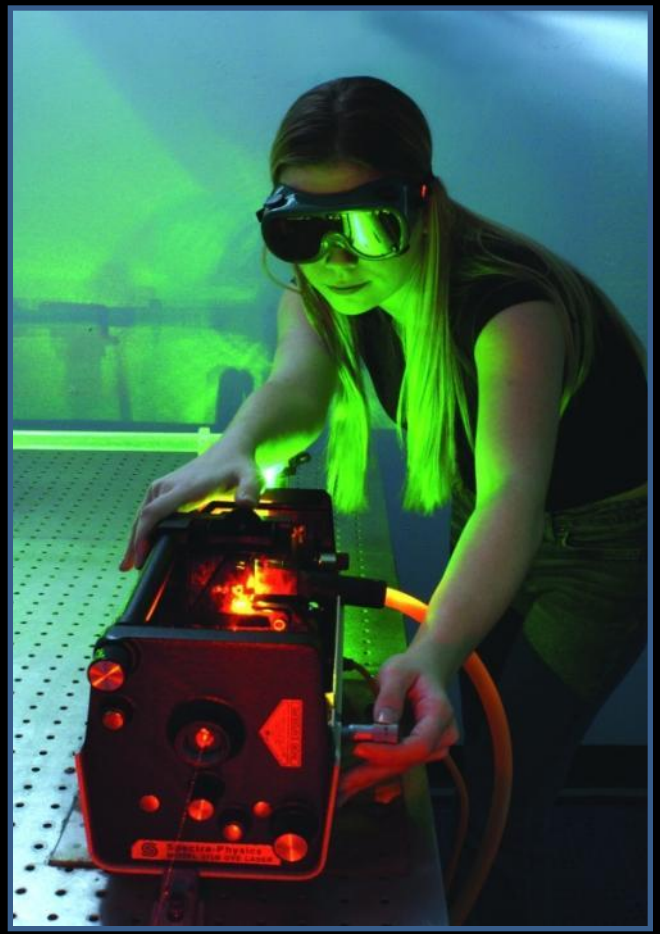
The time to act is now!

- We have data to serve the hunger for data driven reform
- New standards provide new opportunities
- Political interest in improving STEM education is high
- Let’s ride the wave!

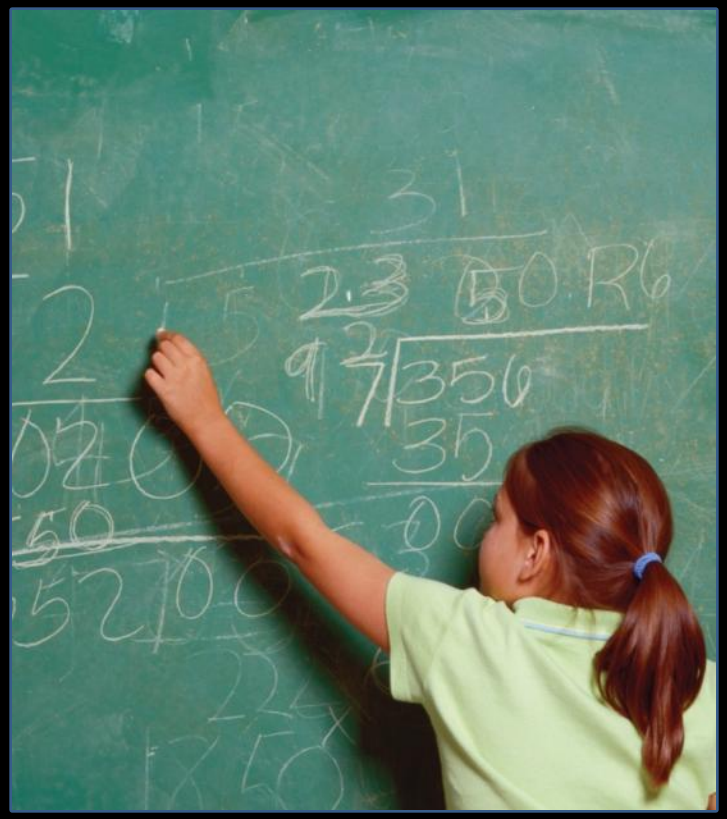
Acknowledgements

- Congressman Wolf and committee staff
- National Science Foundation, Directorate of Education and Human Resources
- Various volunteers:
  - Committees
  - Reviewers
  - Report Review Monitors and Coordinators
- NRC Staff

How Do We Make ALL Children Smart in STEM?



The Federal Role in Smart STEM



Team and Whole Group Discussion