

Arizona STEM Initiative

September 16, 2010

Knowledge and Competitive Advantage

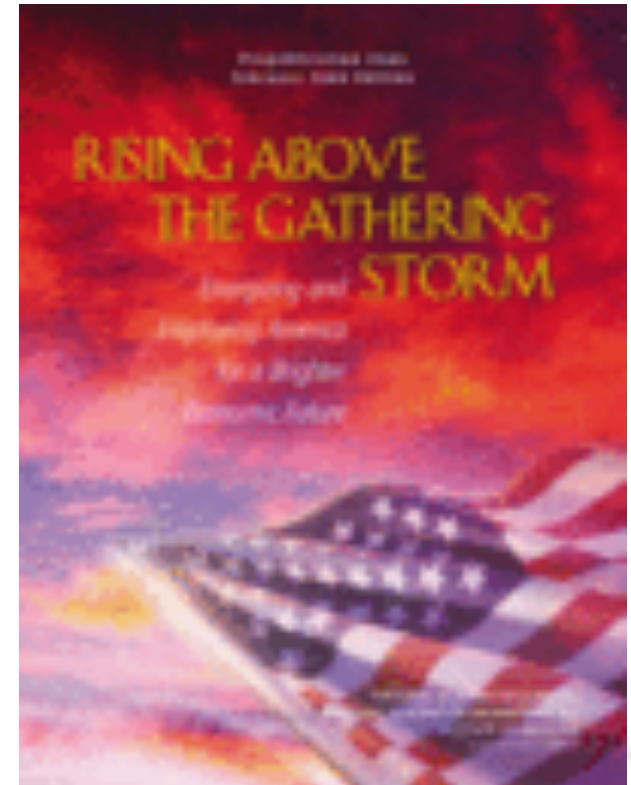
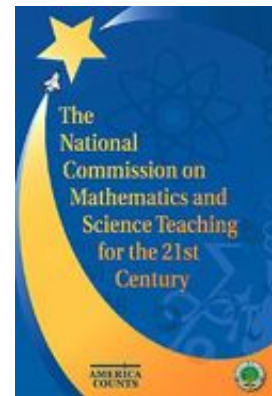
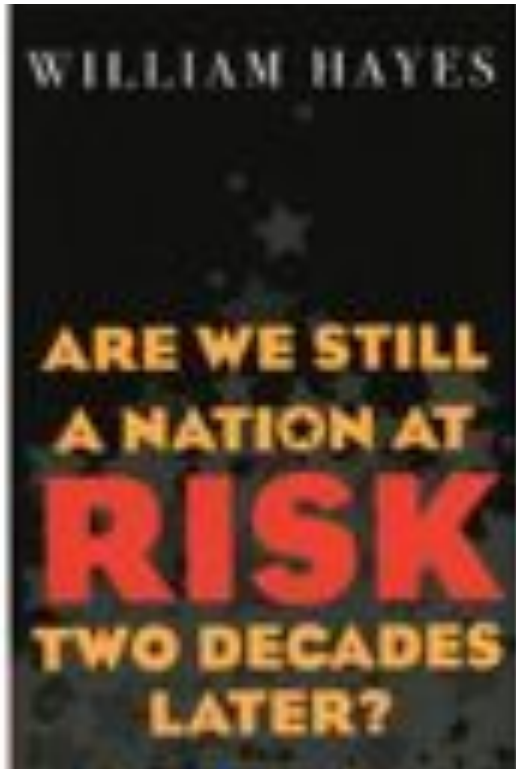


In our current economy, math, science, engineering and technology critically enable competitive advantage, setting the limits of growth and the potential for

- ☐ creating JOBS
- ☐ expanding MARKETS
- ☐ attracting PEOPLE
- ☐ effecting CHANGE



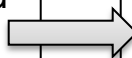
Reforming Science Education in America – a long conversation



**Nation at Risk
1983**



**Splintered Vision
1997**



**Before It Is Too Late
2000**



**Rising Above the Gathering Storm
2006**

Student performance in Science - 4th, 8th and 12th grade



NATIONAL Comparative studies, 1996 – 2009 (NAEP)

GRADE 4: increasing proficiency above basic levels

GRADE 8: slight improvement but average performance basically flat

GRADE 12: declining performance as averages remain below basic levels

Arizona is at the bottom of the national trend in science proficiency (NAEP and AIMS)

GRADE 4: Arizona is 41st in science proficiency

GRADE 8: Arizona is 37th in science proficiency

GRADE 12: Just 1/3 of Arizona 12th graders pass the 10th grade AIMS Science exam

College Graduation Rates in the U.S.



Despite a slight increase in college graduation rate from 34.4% in 2000 to 36.5% in 2007, our rate of increase has been surpassed by 13 other countries¹.

The US has fallen in International Rank from 8th in 2000 to 14th in 2007¹

Less than one third of U.S. degrees are in STEM areas²

1- OECD iLibrary,
<http://www.oecd-ilibrary.org/sites/20755120-2010-table1/index.html?contentType=/ns/KeyTable,/ns/StatisticalPublication&itemId=/content/table/2075>

2 – National Science Board, Science and Engineering Indicators, 2010, NSF

College Graduation Rates in ARIZONA equally dismal



Arizona's increase in college graduation rate was also a dismal 3% over the past 10 years².

And fewer than 20% of these graduates were awarded STEM degrees in 2007, down from 25% a decade ago².

Just 4.5% of these STEM degrees were awarded to Hispanic, African American and Native American students





Changing the Equation

Cathleen Barton
US/SW Education Manager
Intel

September 16, 2010

The Equation has changed...

{Change the Equation} Launched 9-16-2010

A non-profit organization founded by: Intel, Sally Ride, Eastman Kodak, Xerox, Time Warner Cable, Exxon-Mobil

Goals:

- ***Great Teaching:*** Improve STEM teaching at all grade levels, with a larger and more racially, ethnically and gender-diverse pool of highly-capable STEM teachers.
- ***Inspired Students:*** Deepen student appreciation and excitement for STEM programs and careers to increase enrollment and success, especially among females and students of color.
- ***A Committed Nation:*** Achieve a sustained commitment to the STEM movement from business leaders, government officials, STEM teachers and other stakeholders through communication, collaboration and data-based decision making.





Member Companies

- | | | | |
|--------------------------------|------------------------------|--------------------------------------|-------------------------------------|
| 1. Accenture | 26. Corning, Inc. | 51. Eastman Kodak Company * | 74. Sally Ride Science * |
| 2. Activision Publishing, Inc. | 27. Dell | 52. LMI Aerospace, Inc. | 76. Samsung |
| 3. The Aerospace Corporation | 28. Deloitte | 53. Lockheed Martin Corp. | 77. Schlumberger Limited |
| 4. Agilent Technologies, Inc. | 29. Dreamworks | 54. Loral Space&Communications, Inc. | 78. Sempra Energy |
| 5. Alcoa | 30. Discovery Communications | 55. McKinsey & Company | 79. SMART Tech |
| 6. AMD Foundation | 31. Dow Chemical | 56. Merck | 80. State Farm Insurance |
| 7. Amgen | 32. DuPont | 57. Microsoft | 81. Stellar Solutions, Inc. |
| 8. Applied Materials, Inc. | 33. Eaton Corporation | 58. MITRE Corporation | 82. Synopsys, Inc. |
| 9. Archer Daniels Midland Co. | 34. E-line Media | 59. Motorola, Inc. | 83. Teradata Corporation |
| 10. AT & T | 35. EMC2 | 60. National Lab Day | 84. Texas Instruments |
| 11. Aurora Flight Sciences | 36. Epic Games, Inc. | 61. Nature Publishing Group | 85. Time Warner Cable * |
| 12. Autodesk | 37. Ernst & Young | 62. The Nielsen Company | 86. United Launch Alliance |
| 13. BAE Systems | 38. Exxon Mobil Corp. * | 63. Northrop Grumman Corp. | 87. United Space Alliance |
| 14. Ball Corporation | 39. Facebook | 64. Ogilvy Public Relations | 88. United Technologies Corp. |
| 15. Battelle | 40. Fluor Corporation | 65. Oracle | 89. Univision Communications |
| 16. Baxter International, Inc. | 41. Ford Motor Company | 66. Parametric Technology Corp. | 90. Verizon |
| 17. Bayer | 42. GE and GE Foundation | 67. Prescription Solutions | 91. Vernier Software and Technology |
| 18. Bechtel | 43. Glaxo Smith Kline | 68. PricewaterhouseCoopers | 92. Viacom |
| 19. BET | 44. Google, Inc. | 69. Procter & Gamble | 93. Wireless Generation |
| 20. Boeing | 45. HP | 70. Promethean | 94. Xerox Corporation * |
| 21. Carolina Biological | 46. Honeywell | 71. Qualcomm, Inc. | |
| 22. Chevron Corporation | 47. IBM | 72. RAND Corporation | |
| 23. Cisco | 48. Intel * | 73. Raytheon Company | |
| 24. Cognizant | 49. JP Morgan Chase & Co. | 74. Rockwell Collins | |
| 25. Comcast Corporation | 50. Knowledge Universe | | |

- Founding / Board Member

Supporting Arizona's Engagement: States Lead

College and Career Readiness-The Broadest Range of Choices

- **Common Core Initiative:** 48 states and DC
 - 37 state adoptions to date
 - AZ “Governing state” for Assessment Consortia-\$170M
- **Achieve American Diploma Project:** 36 States; Math and ELA; Science coming

States STEM Leadership

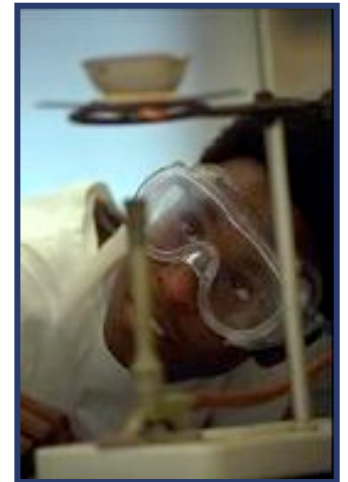
- Bill & Melinda Gates Foundation
- Race to the Top



The Voice of the Public

“Are we beginning to see the Light?” Public Agenda June 2010

- 84% agree that there will be a lot more jobs in the future that require math and science skills.
- 9 in 10 Americans say studying advanced math and science is useful even for students who don't pursue a STEM career.
- 88% of the public agrees that students with advanced math and science skills will have an advantage when it comes to college opportunities.



The Choice is Ours



- While only 3 in 10 Americans see a demand for science and math-focused jobs in the current economy, 84% agree that there will be a lot more jobs in the future that require math and science skills. And 9 in 10 Americans say studying advanced math and science is useful even for students who don't pursue a STEM career. Additionally, 88% of the public agrees that students with advanced math and science skills will have an advantage when it comes to college opportunities.
- Overall, the general public favors a "national curriculum" as one way of improving STEM education: 8 in 10 Americans say establishing a national curriculum in math would improve STEM education, with more than half (53%) saying it would improve it "a lot." And 78% say the same about a national curriculum in science, with 48% saying it would improve it "a lot."
- "Giving today's students a world class science and math education is the key to maintaining our country's economic prowess," said Alan Leshner, Chief Executive Officer of The American Association for the Advancement of Science (AAAS). "Parents are beginning to envision the opportunities for their children in the STEM fields, and I am especially heartened by their receptivity to having high national standards in these critical subjects."
- **Strategies For Improvement**
- At the same time, parents agree with the general public on the value of STEM education. Most parents surveyed want their own children to take advanced math and science courses in high school (60% and 54% respectively). Parents would also like to see their local schools spend more money on up-to-date and well-equipped science labs (70%), more equipment for hands-on learning (69%) and more equipment to help students learn computer and technology skills (68%). A plurality of parents with children in grades 6-12 say they want to see more emphasis in their child's school on STEM topics such as computer programming (65%), basic engineering principles (52%), and statistics and probability (49%).
- "The public is open to many different strategies for improving STEM education, and they're enthusiastic about the overall goal, but much more has to be done to help them understand what's needed for kids in their local schools to have a world-class science and math education," said Jean Johnson, director of Education Insights at Public Agenda. "The problem is particularly acute in science. Many parents don't realize the importance of starting children in science early on. Many think it can easily wait until high school."



STEM Research: Addressing Changes in Teaching and Learning for the 21st Century

THE NATIONAL ACADEMIES

**National Academy of
Sciences**

**National Academy of
Engineering**

Institute of Medicine

National Research Council



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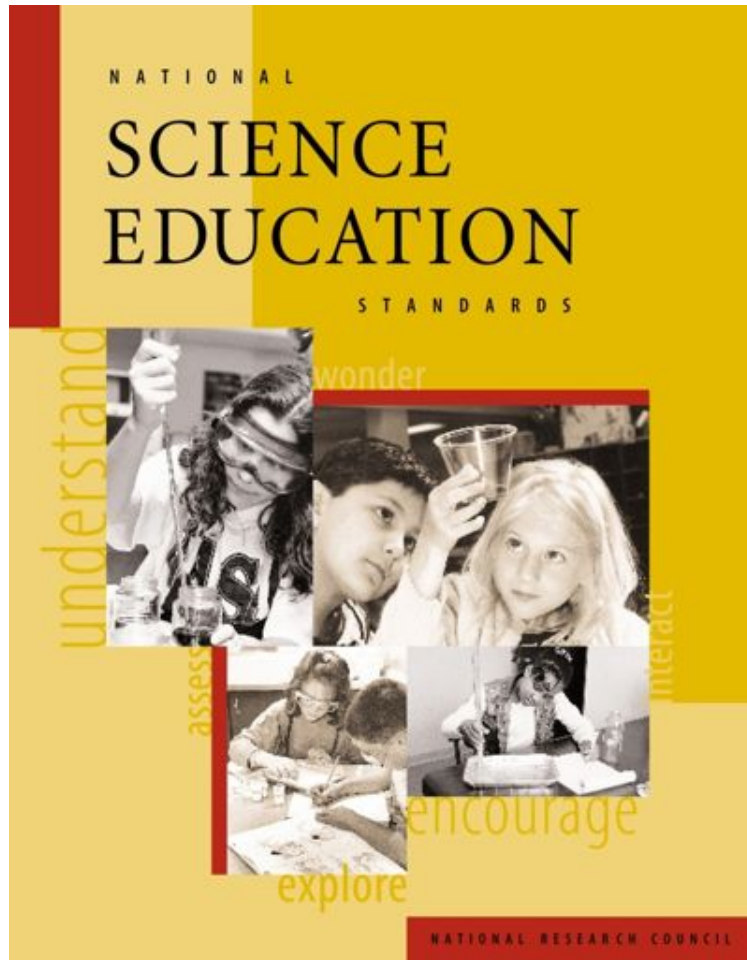
jvasquez@helios.org
<http://www.helios.org>

Premise 1:

Improving STEM Education is
Not Rocket Science

It's a **LOT** harder!

It's a Systems Problem



National Research
Council
1996

Overview of the National Science Education Standards

- **Science Teaching Standards**
- **Professional Development of Teachers**
- **Assessment**
- **Content Standards**
- **Infrastructure Standards**
 - Program Standards
 - System Standards

21st Century Skills

“If I take the revenue in January and look again in December of that year, 90% of my December revenue comes from products which were not there in January.”

Craig Barrett, Chairman of Intel

“Rising Above the Gathering Storm” (NAS, NAE, and IOM, 2007)

"The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn."

Alvin Toffler, American Writer and Futurist

Shifting Job Market

	<u>20th Century</u>	<u>21st Century</u>
Number of Jobs:	1 – 2 Jobs	10 – 15 Jobs
Job Requirement:	Mastery of One Field	Critical Thinking Across Disciplines
Teaching Model:	Subject Matter Mastery	Integration of 21 st Century Skills into Subject Matter Mastery
Assessment Model:	Subject Matter Mastery	Integration of 21 st Century Skills into Subject Matter Mastery

Focus on Learning vs. Teaching

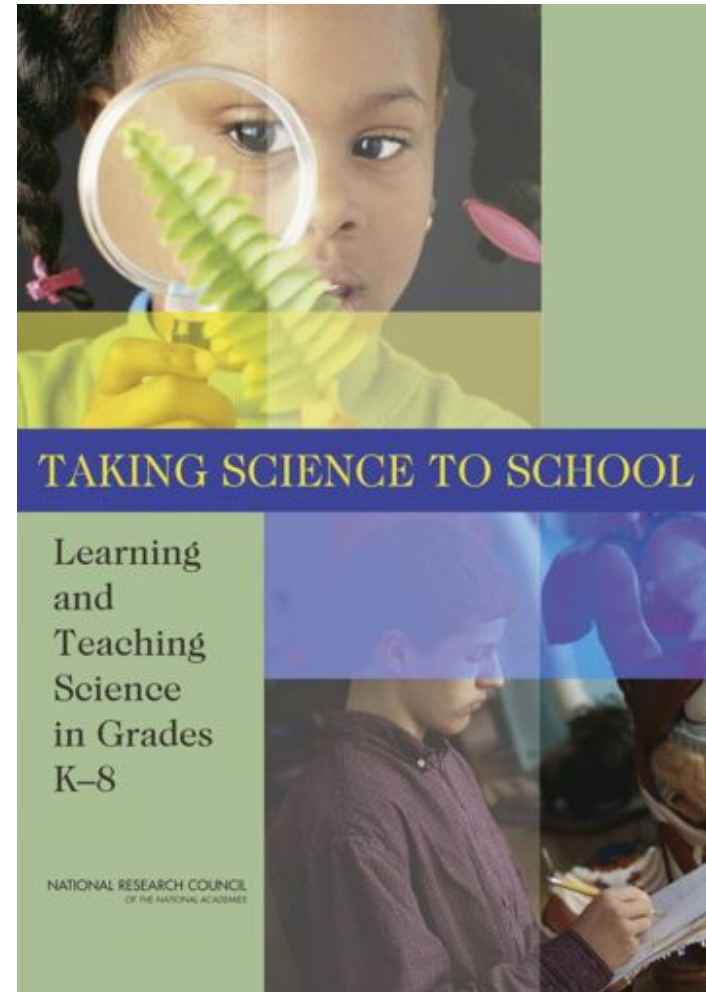
Tiger

By Bud Blake



4 Strands of Scientific Proficiency

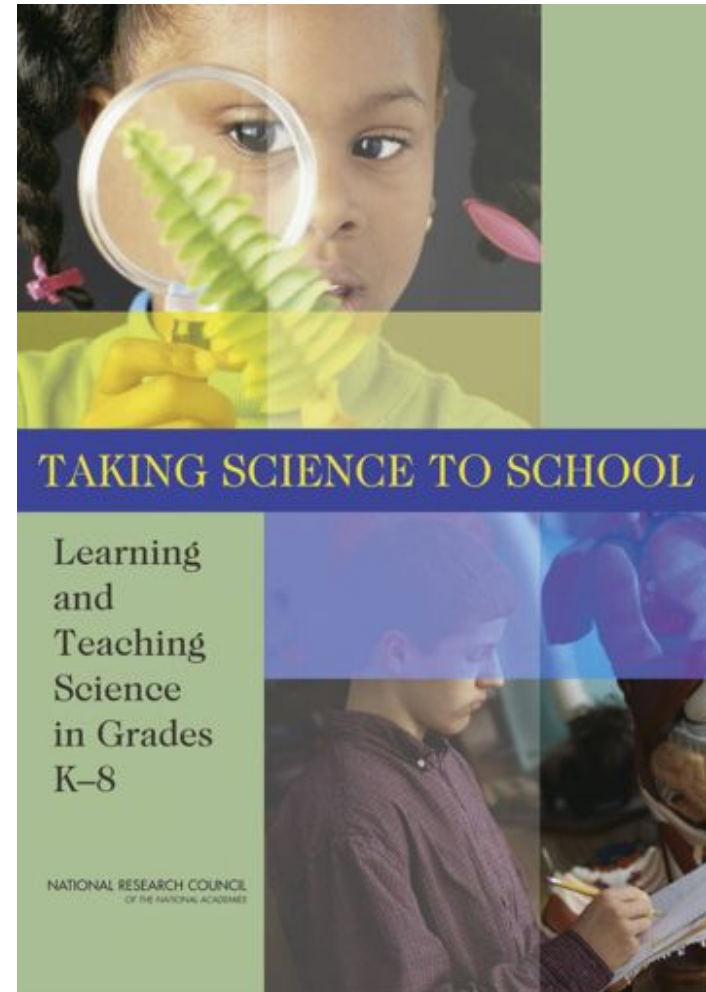
- Know, use and interpret scientific explanations of the natural world.
- Generate and evaluate scientific evidence and explanations.
- Understand the nature and development of scientific knowledge.
- Participate productively in scientific practices and discourse.



National Research Council (2007)

4 Strands of Scientific Proficiency

- Know, ~~use and interpret~~ scientific explanations of the natural world.
- ~~Generate and evaluate scientific evidence and explanations.~~
- ~~Understand the nature and development of scientific knowledge.~~
- ~~Participate productively in scientific practices and discourse.~~



National Research Council (2007)

Teacher Education and National Standards

“Not long ago, a college chemistry professor grew angry with the way her daughter’s high school chemistry class was being taught. She made an appointment to meet with the teacher and marched with righteous indignation into the classroom—only to discover that the teacher was one of her former students.”

National Research Council (1998)



A



A

ssessment
ccountability

THE MONTILLATION OF TRAXOLINE

It is very important to learn about traxoline. Traxoline is a new form of zionter. It is montilled in Ceristanna. The Ceristannians gristerlate large amounts of fervon and then bracter it to quasel traxoline. Our zionter lescelidge may make traxoline one of our most lukizes snezlaus.

THE MONTILLATION AND USES OF TRAXOLINE

QUIZ:

1. What is traxoline?
2. Where is it
montilled?
3. How is traxoline
quaseled?
4. Why is traxoline
important?

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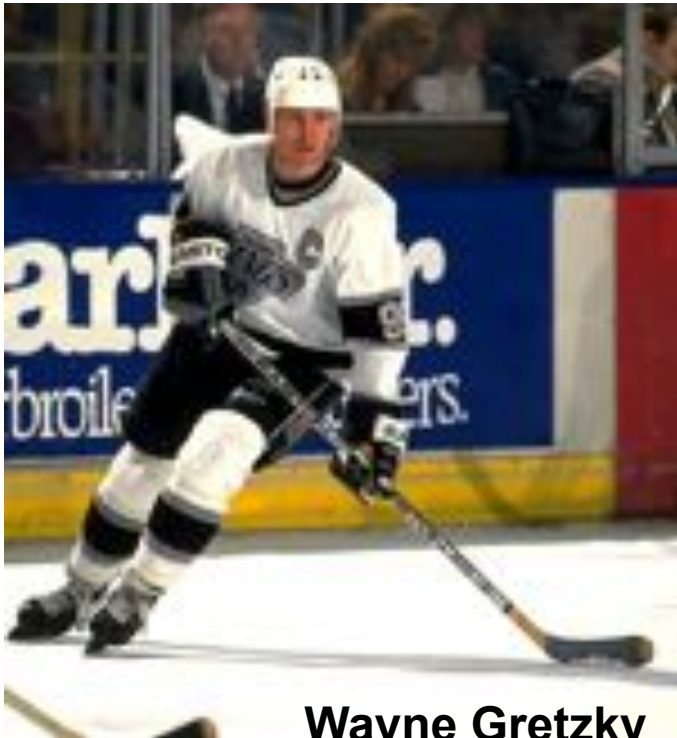
QUIZ:

1. What is traxoline?
2. Where is it montilled?
3. How is traxoline quaseled?
4. Why is traxoline important?

Premise 2:

“A good hockey player plays where the puck is.

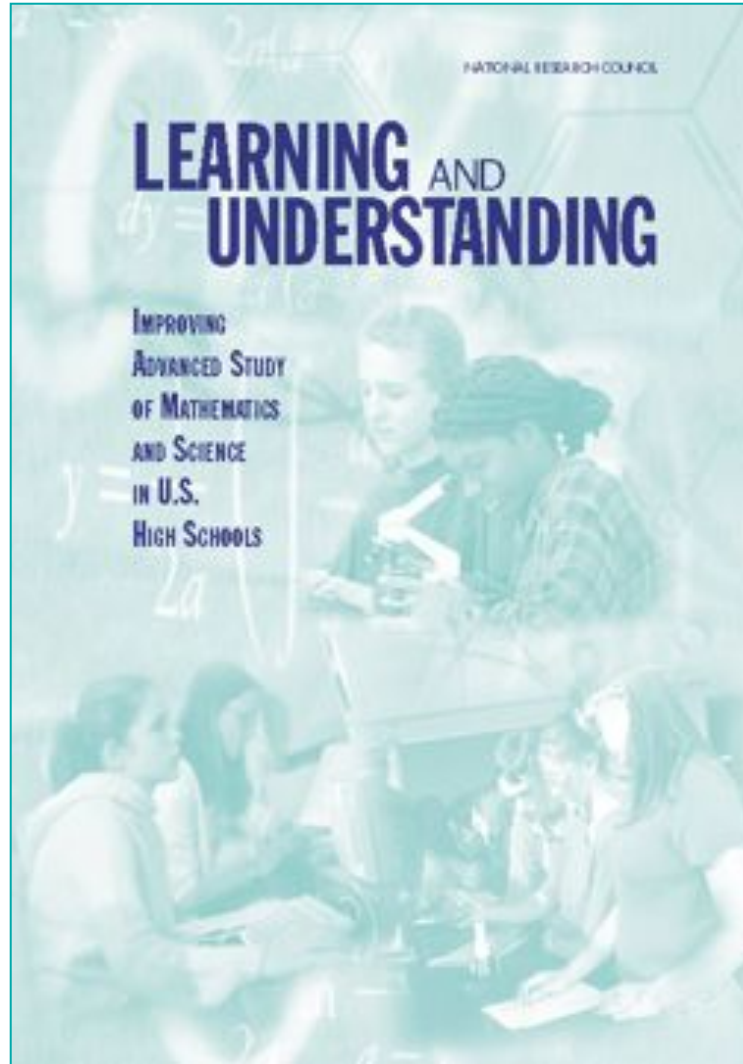
A great hockey player plays where the puck is going to be.”



Wayne Gretzky



Advanced Placement



National Research Council 2002

AP Redesign

Biology, Chemistry, Environmental Science, Physics (2013-16)

- Science Panels

- Big Ideas / Unifying Themes
- Enduring Understandings
- Competencies
- Evidence Models (Formative Assessments)

- Evidence of Learning

- The student can use representations and models to communicate scientific phenomena and solve scientific problems.
- The student can use mathematics appropriately
- The student can engage in scientific questioning
- The student can perform data analysis and evaluation of evidence
- The student can work with scientific explanations and theories
- The student is able to transfer knowledge across various scales, concepts, and representations in and across domains

AAMC/HHMI Committee Defines Scientific Competencies for Future Physicians



Scientific Foundations for Future Physicians recommends that medical and premedical education evolve from a static listing of courses to a dynamic set of competencies... This ... will encourage the development of innovative and interdisciplinary science curricula, maintain scientific rigor, and allow premed students at the undergraduate level the flexibility to pursue a strong liberal arts education.

Association of American Medical Colleges &
Howard Hughes Medical Institute

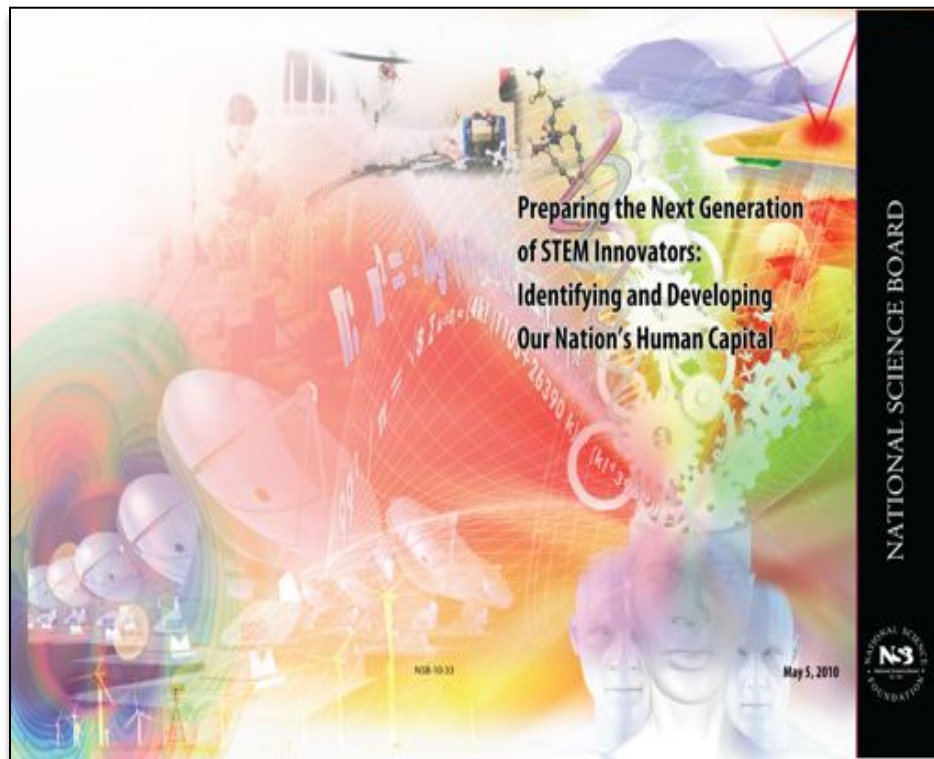
June, 2009

Science and Math vs. STEM Education?

Preparing the Next Generation of STEM Innovators

A New Report from the National Science Board

Dr. Jo Anne Vasquez
September 16, 2010



Preparing the Next Generation of STEM Innovators



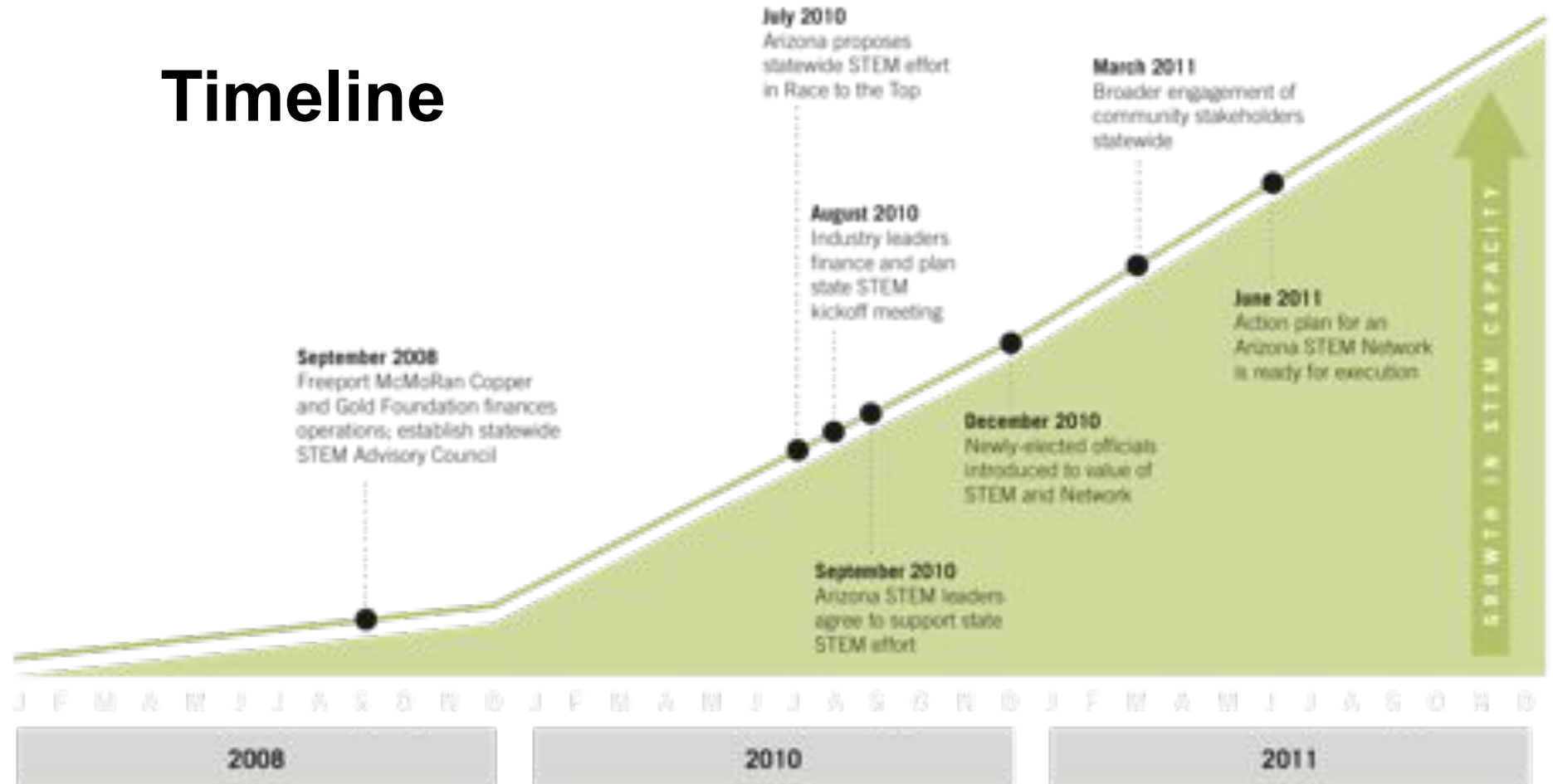
Keystone Recommendations:

- Increase access to and the quality of college-level, dual enrollment, and high-quality enrichment programs.
- Create NSF Programs that offer portable, merit-based scholarships for talented middle and high school students to participate in challenging enrichment activities.
- Expand existing talent assessment tests and identification strategies to the three primary abilities:
 - Qualitative/mathematical, verbal and spatial.
- Increase access to appropriate student identification tests for rural and economically disadvantaged students.





Timeline



September 2008
Create SFAz STEM Initiative

July 2010
Contribute STEM Plan in Arizona's Race to the Top proposal

August 2010
Establish Core Statewide STEM planning committee

September 2010
Arizona STEM Kickoff event with STEM Leaders

December 2010
STEM Network event with state Legislature

March 2011
Regional Community Conversations about STEM

June 2011
Arizona STEM Network Business Plan complete for review

September 2011
Launch Arizona STEM Network

arizona

science technology

stem

engineering math

network