K-12 Math and Science Education: A Scientist Meets Reality

Denver APS Meeting

Robert Eisenstein
Santa Fe Alliance for Science

May 2, 2009
A Much-Studied Problem

- Rising Above the Gathering Storm (National Research Council, 2005)
- Tapping America’s Potential (Business Roundtable, 2005)
- The Knowledge Economy (Business Roundtable, 2005)
- Road Map for National Security (Hart-Rudman Commission, 2001)
- Before It’s Too Late (Glenn Commission, 2000)
- A Nation At Risk (Nat. Comm. on Excellence in Education, 1983)

So far, not much has come of these except to identify and frame the issues.
We have lots of excellent competition now that was not present 35 years ago.
Percentage of world-wide STEM PhD’s residing in the United States. (Data from the U.S. Dept. of Education)
## Trends in International Math and Science Study (TIMSS)

### TIMSS 2003 Tables

<table>
<thead>
<tr>
<th>Country</th>
<th>Math Average score</th>
<th>Science Average score</th>
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<tbody>
<tr>
<td>International</td>
<td>466</td>
<td>473</td>
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<tr>
<td>average¹</td>
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<tr>
<td>Singapore</td>
<td>609</td>
<td>578</td>
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<td>Korea, Republic of</td>
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<td>571</td>
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<td>556</td>
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<tr>
<td>New Zealand</td>
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</table>

http://nces.ed.gov/timss/
What’s Going On?

What Can We Do About It?
Things My High School Didn’t Have

- Serious security-safety issues.
- A serious drug problem.
- A day care center for the infants of students.
- Many students coming from fractured homes.
- Most kids with non-existent math skills.
- Kids with little interest in studying and doing homework.
- A 35% graduation rate.
- A community culture of “blame the teachers & school.”
For many students, schools are a place of refuge, stability and security that they don’t have elsewhere.
Physics is easy .... Politics is hard.

(Albert Einstein)

Education is an issue of almost unbelievable complexity
So Why Aren’t Things Worse?

At this meeting, STEM folks are

Locally Dense

But at large:

Trained engineers, mathematicians and scientists make up only ~ 1-2% of the U.S. population.

This has been a saving grace. However, many of these people were not born in the U.S. but have come here for their education.
New Mexico

The Land of Enchantment …
But what does its future hold?
New Mexico

Quality Counts 2008

- Discusses education within a societal matrix
- “You can’t think of fixing the schools in isolation” – Chris Swanson, project director

Education Week
http://www.edweek.org/ew/index.html
QC State “Chance for Success”
Indicators Include Three Measures:

• **Early Foundations**
  - Family income, parent education, parental employment, linguistic integration

• **The Schooling Years**
  - Preschool enrollment, kindergarten enrollment, elementary reading, middle school math, high school graduation, post-secondary education

• **Adult Outcomes**
  - Educational attainment, annual income, steady employment
Massachusetts ranks 1st.

New Mexico and Louisiana are tied for 49th.
Educational Attainment and Income

Source: U.S. Census Bureau, Decennial Census' and American Community Survey

Correlation = 0.83
Educational Attainment of Adults Age 18-64 — Total U.S. Population vs. Prison Population (Percent)

Source: U.S. Bureau of Justice Statistics 2002 data, U.S. Census Bureau 2005 data
New Mexico Demographics

- 1,970,000 people (36th)
- 42% Hispanic, 44% Anglo
- 10% Native American
- 22 indigenous pueblos
- NM is effectively bilingual
- 89 school districts
- 1061 K-12 schools
- 325,000 students
- 21,700 teachers
- 15/1 ratio
- PCI: $27,644 (46th)
- $8200/yr/student (26th)
- ~10,000 STEM professionals (3rd p.c.)

122,000 mi² (5th)
16 people/mi²
Federal Govt spends ~ $6B per year in NM!

More than the State annual budget.

By far the largest outlay.

Is this a "tipping point"?
Education in New Mexico

- NM ranks nearly last in reading and math (4th and 8th grade).
- Barely 50% of freshmen graduate high school in 4 years.
- Employment prospects are diminished.
- Hard to attract business. Schools are often stated as a reason.

**BUT ...**

- NM spends almost half of its annual budget on education!
- Without a larger tax base this is unlikely to change.

*Maybe we should try something else!*
A New Beginning for New Mexico?

- We have a committed political leadership
- We have strong business support
- NM spends ~ 50% of its annual budget on education! ($2.5B)
- NM is 46th in p.c. income, but 26th in per-student expenditure
- NM is 3rd in U.S. in per capita STEM professionals
- NM is building a strong effort in distance learning
  - IDEAL-NM
  - NM Computing Applications Center
- NM has highly-regarded math & science state education standards
New Mexico Math and Science Bureau

(Established by the NM State Legislature in 2006. It resides in the NM Public Education Department and has overall responsibility state-wide for K-12 math and science education. NM may be the only state in the union with such an office.)
New Mexico Math and Science Advisory Council

(Established by the NM State Legislature in 2006. It advises and reports to the Secretary of Education.)
Produced by the Math and Science Advisory Council, **NM Project 2012** is a comprehensive plan for transformative change in K-12 education in New Mexico.

**Goal**

*In five years New Mexico students will be among the nation’s leaders in math and science achievement.*

New Mexico Project 2012

1. Producing More K-12 Math and Science Teachers with Better Content and Pedagogical Preparation

2. Expanding Professional Learning Opportunities for In-Service Math and Science K-12 Teachers

3. Optimizing Instructional Strategies for K-12 Math and Science Education

4. Connecting New Mexico: The Importance of High-Bandwidth Connectivity to K-12 Math and Science Education

5. Engineers, Mathematicians, and Scientists in K-12 Math and Science Education

6. Partnerships for Improved K-12 Math and Science Education

7. Enhancing Public Involvement in K-12 Math and Science Education: A Public Awareness Campaign
Improving K-12 Math and Science Education in New Mexico

Statewide Connectivity (Chap. 4)

Instructional Strategies Curriculum & Standards (Chap. 3)

Teacher Preparation (Chap. 1)

Professional Learning (Chap. 2)

Project 2012

Parental and Public Support (Chaps. 6, 7)

Government and Business Partners (Chaps. 6, 7)

Engineering, Math and Science Community Contributions (Chap. 5)
The Santa Fe Alliance for Science

www.sfafs.org
Santa Fe Alliance For Science

• A non-profit founded May, 2005

• Purpose: to capitalize on the rich base of STEM talent in the Santa Fe area to help in K-14 math and science education

• > 80 volunteers to date

• Strong partnership with Santa Fe Public Schools

• Active in 19 schools and community colleges so far
The Alliance is a partner of the Santa Fe Public Schools and is affiliated with Los Alamos National Lab via its Community Programs Office.

Murt Byrne, DVM, El Dorado Animal Clinic – “A Day in the Life of a Veterinarian”

See this year's winners of the Santa Fe Institute/Santa Fe Alliance for Science Prize for Scientific Excellence.

Click here to ask SFAFS a question about science or careers in science.

Join us! Together we are making a difference!

The Alliance is a non-profit organization registered in the State of New Mexico and can receive tax-deductible donations under section 501(c)(3) of the US tax code. It has received generous financial support from anonymous donors and from several local businesses and philanthropies.
What Do SFAFS Volunteers Do?

• Tutoring/mentoring high school students

• Advise/judge science fair projects

• Evening “Science Cafés for Young Thinkers”

• Teach HS or CC courses (e.g. physics, math, CS)

• Special classroom presentations

• Advise on career/college choices
Santa Fe Science Café For Young Thinkers

“Trying To Make A Vaccine Against A Moving Target: HIV And Its Diversity”

Dr. Bette Korber, LANL
Tuesday, October 16
6 – 8 PM
Georgia O’Keeffe Museum Education Annex
123 Grant Street, Santa Fe

It is now 25 years after the discovery of HIV, yet we still do not have a working vaccine. Meanwhile, an estimated 40 million people have become infected globally (there were 4.3 million new infections last year) and 2.9 million AIDS deaths. While therapy has helped many people with HIV have better and longer lives, it is expensive, not available to many people, and must be taken for life. Despite the tremendous progress in treatment, we need a vaccine!

We will discuss how our immune systems fight infection, learn about immune "memory" and how vaccines work, and discuss the scientific front lines in the global HIV-AIDS effort.

The Café is sponsored by the Santa Fe Alliance for Science, the Santa Fe Institute, the Santa Fe Public Schools, the Georgia O’Keeffe Museum and the N.M. Public Education Department.

Admission is Free. Youth (ages 13-19) seating a priority. Light refreshments will be served.

Dr. Korber will also appear on The Santa Fe Radio Café with host Mary-Charlotte Domandi at 8:30 am on Tuesday, October 16, on KSFR 101.1 FM, streaming on the web live at http://www.ksfr.org.

Dr. Korber is a biologist at the Los Alamos National Laboratory and is an external faculty member at the Santa Fe Institute.
The Santa Fe Institute and the Santa Fe Alliance for Science wish to congratulate the Student Recipients of the 2008 Prize for Scientific Excellence and the Outstanding Teacher in Math / Science.
How Is SFAFS Doing?

A semi-quantitative evaluation: we don’t test students, but we continue to attract increasing numbers of students and volunteers.
Lessons Learned (??)

• You can be successful.

• Trust is key.

• Scientists are not experts at K-12 pedagogy.

• Teachers are very busy. Must bring value added.

• Patience, patience. It’s a marathon, not a sprint.

• Today’s public school is a complex place with many issues and responsibilities.

• U.S. social fabric has changed hugely in 50 years.
Our schools, and our attitude toward education, mirror our society.
WE HAVE MET THE ENEMY AND HE IS US.