

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)
- The Science and Engineering Workforce: Realizing America's Potential (National Science Board, 2003)
- 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.



The World Is Flat
A BRIEF HISTORY OF
THE TWENTY-FIRST CENTURY
UPDATED AND EXPANDED

Thomas L. Friedman

Farrar, Straus and Giroux

UPDATED AND EXPANDED

RELEASE
2.0



The World Is Flat

A BRIEF HISTORY OF
THE TWENTY-FIRST CENTURY

Thomas L. Friedman

1970: 90%

2005: 15%

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)

Institute of Education Sciences U.S. Department of Education

ies NATIONAL CENTER FOR EDUCATION STATISTICS

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International Comparisons in Education

TIMSS Trends in International Mathematics and Science Study (TIMSS)

Publications & Products Staff Search

TIMSS 2003 Tables

Country	Math	Average score
International average ¹		466
Singapore		605
Korea, Republic of		589
Hong Kong SAR ^{2,3}		586
Chinese Taipei		585
Japan		570
Belgium-Flemish		537
Netherlands ²		536
Estonia		531
Hungary		529
Malaysia		508
Latvia		508
Russian Federation		508
Slovak Republic		508
Australia		505
(United States)		504
Lithuania ⁴		502
Sweden		499
Scotland ²		498
(Israel)		496
New Zealand		494

16th

Country	Science	Average score
International average ¹		473
Singapore		578
Chinese Taipei		571
Korea, Republic of		558
Hong Kong SAR ^{2,3}		556
Estonia		552
Japan		552
Hungary		543
Netherlands ²		536
(United States)		527
Australia		527
Sweden		524
Slovenia		520
New Zealand		520
Lithuania ⁴		519
Slovak Republic		517
Belgium-Flemish		516
Russian Federation		514
Latvia		512
Scotland ²		512
Malaysia		510

9th

<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



A Special Supplement to *Education Week's*

QUALITY COUNTS

2008

E P E RC
RESEARCH CENTER

With Support from the Pew Center on the States

Education Week

<http://www.edweek.org/ew/index.html>

Quality Counts 2008

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

QC State “Chance for Success” Indicators Include Three Measures:

- **Early Foundations**

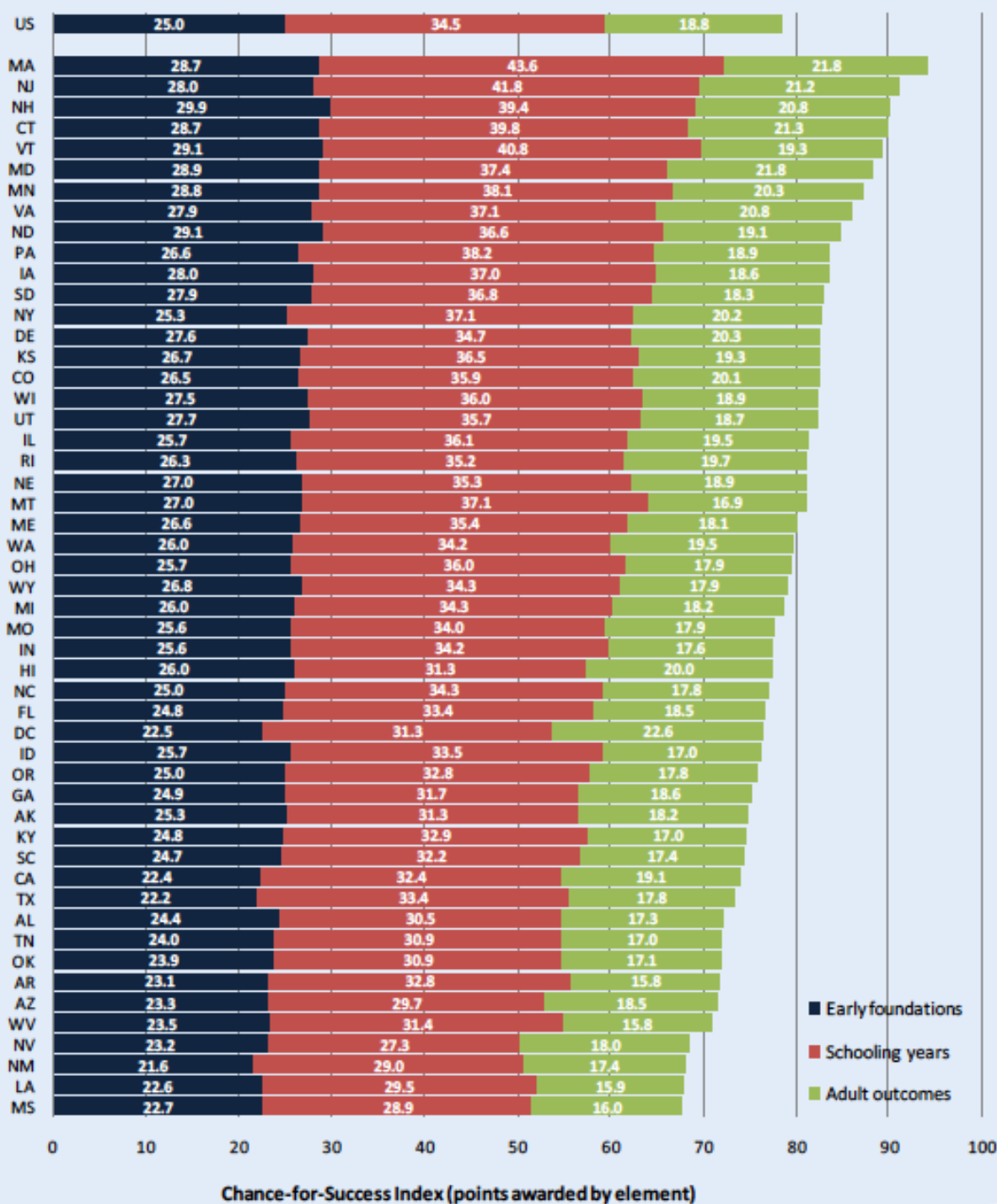
- *Family income, parent education, parental employment, linguistic integration*

- **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*

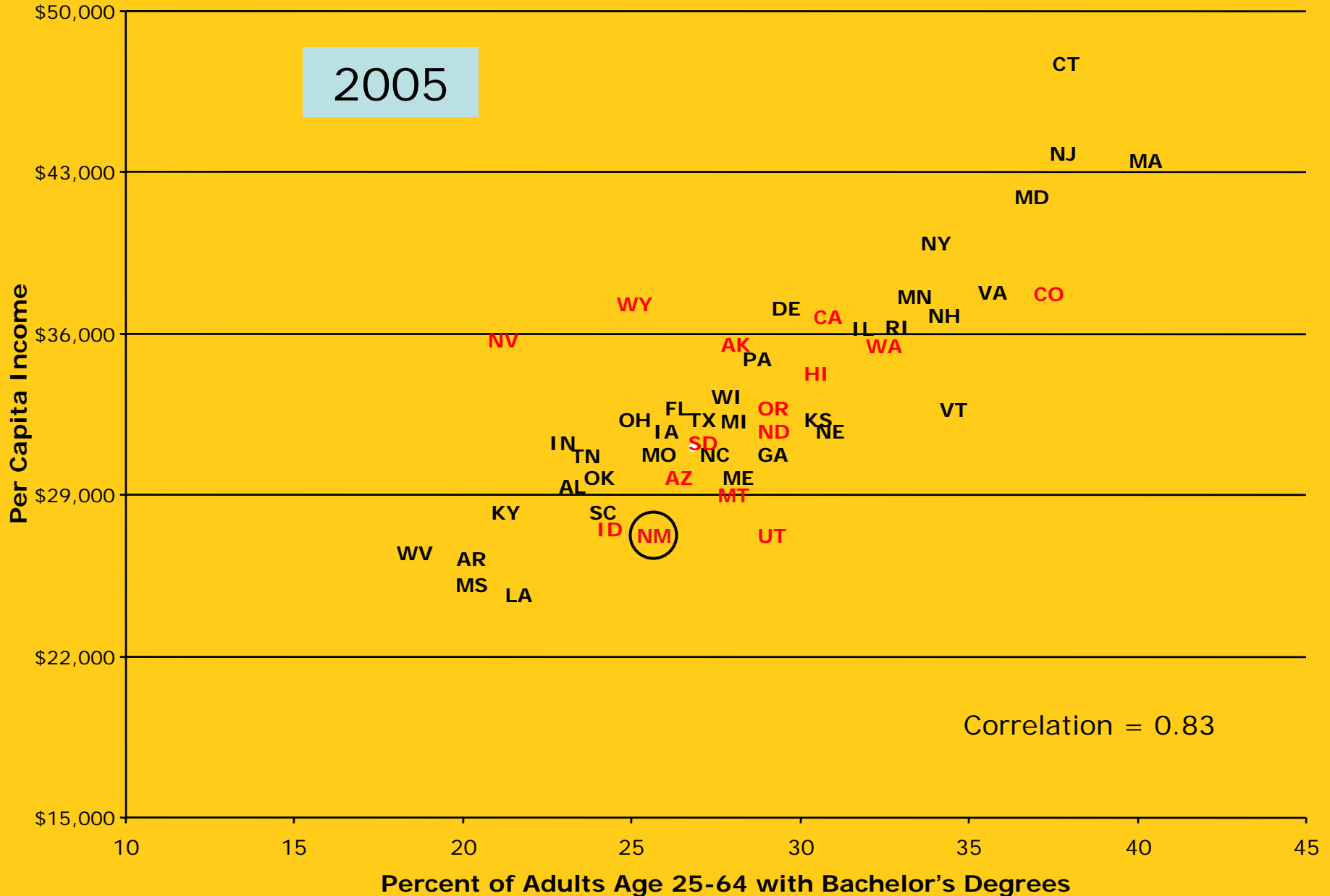


The “Chance for Success” Rankings

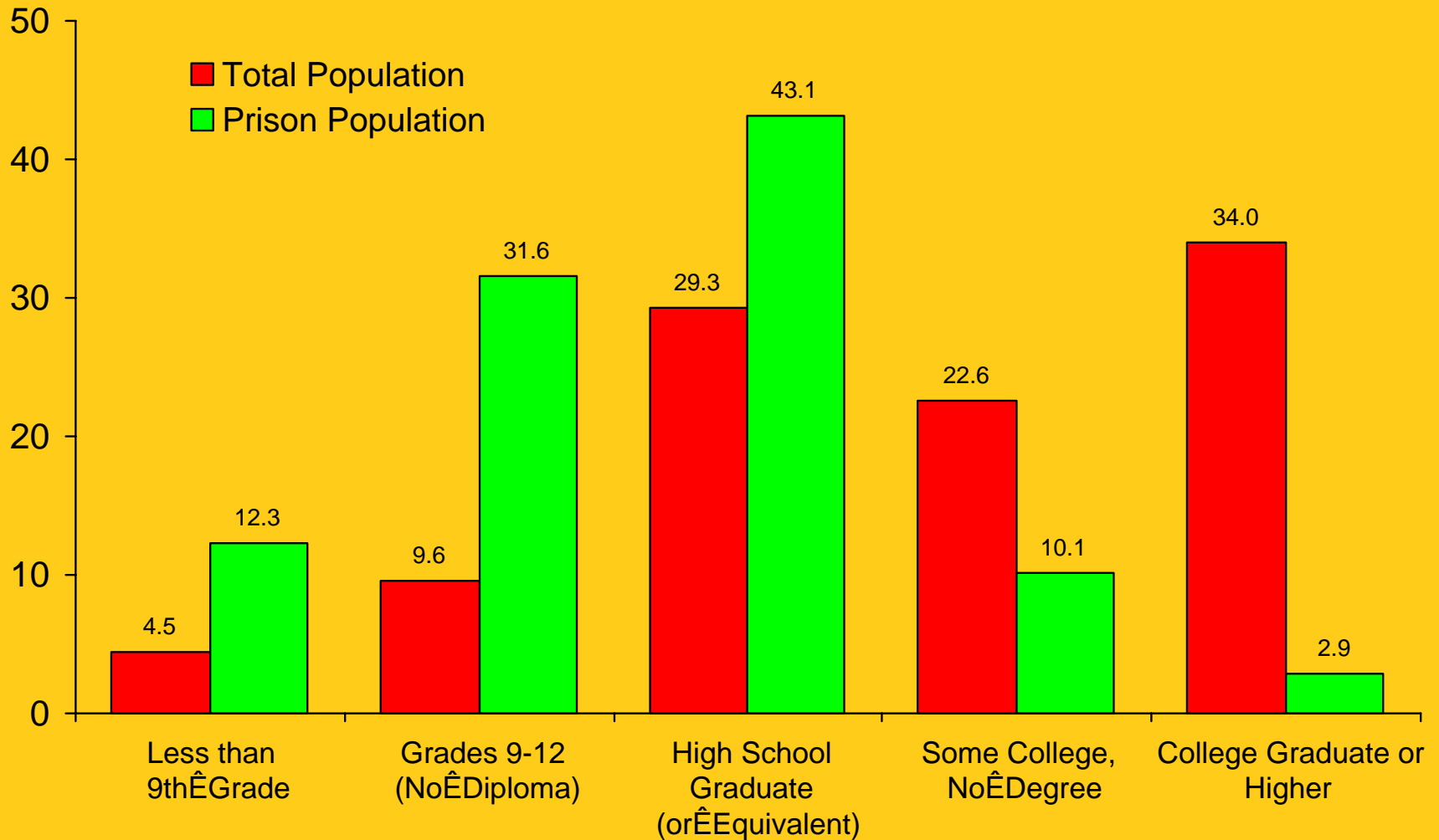
Massachusetts ranks 1st.

New Mexico and Louisiana are tied for 49th.

Educational Attainment and Income



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

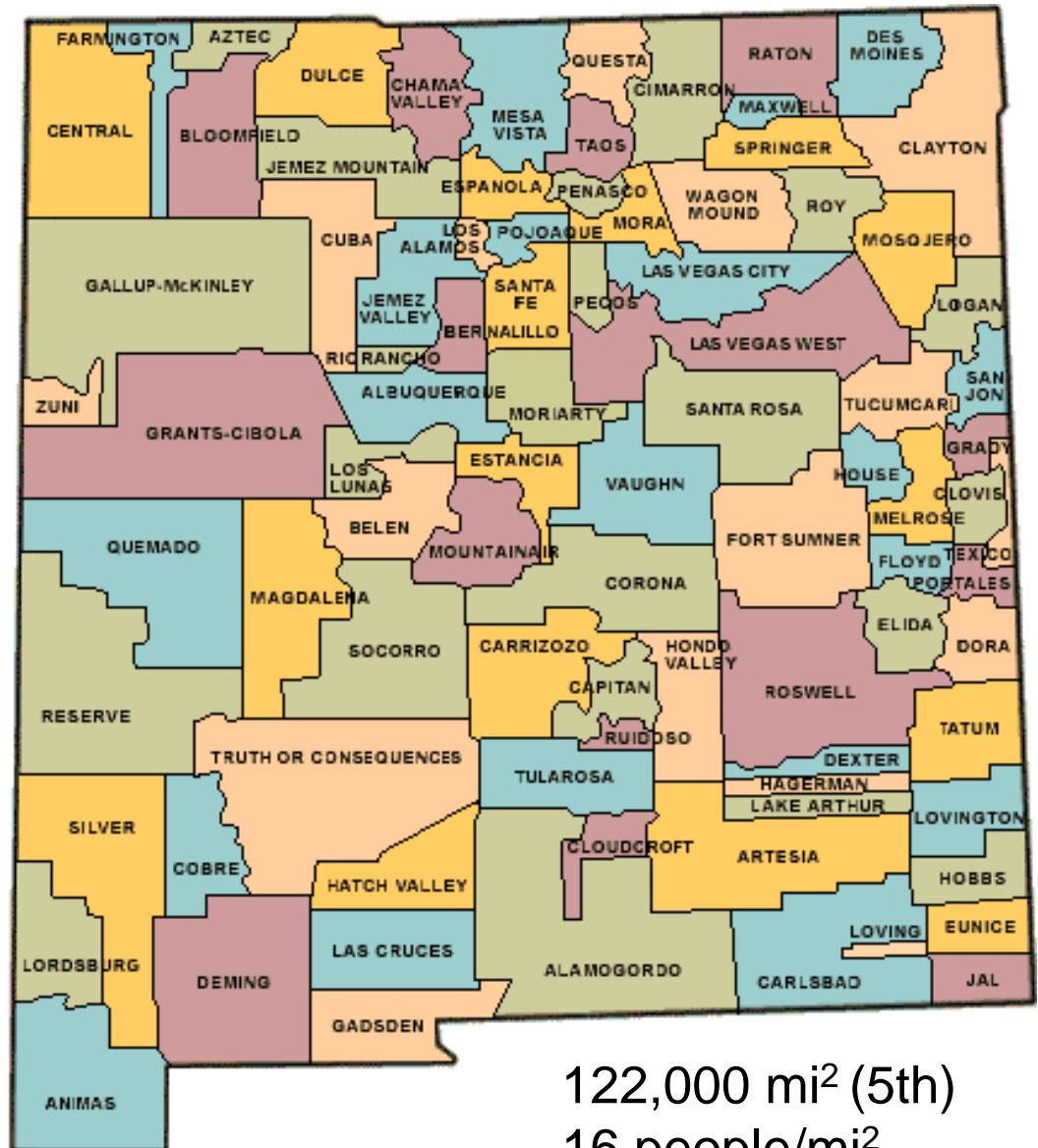
- 1,970,000 people (36th)
- 42% Hispanic, 44% Anglo
- 10% Native American
- 22 indigenous pueblos
- NM is effectively bilingual

- 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.)



Map of Research Infrastructure in New Mexico



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?

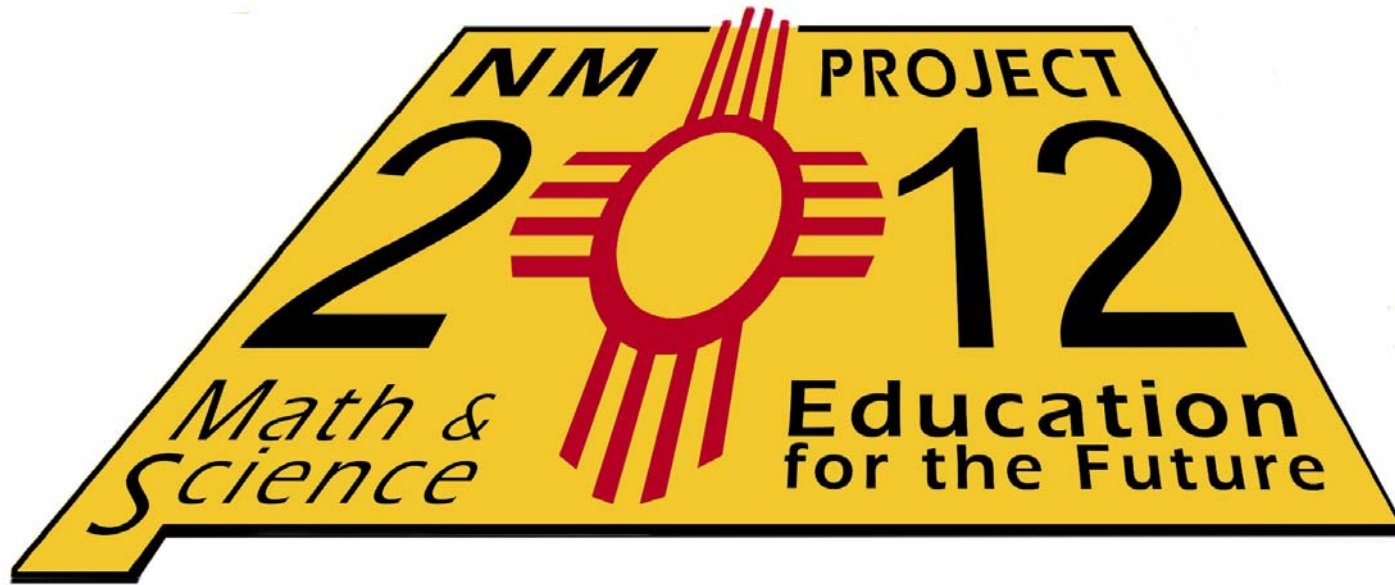
- We have a committed political leadership
- We have strong business support
- NM spends ~ 50% of its annual budget on education! (\$2.5B)
- NM is 46th in p.c. income, but 26th in per-student expenditure
- NM is 3rd in U.S. in per capita STEM professionals
- NM is building a strong effort in distance 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.

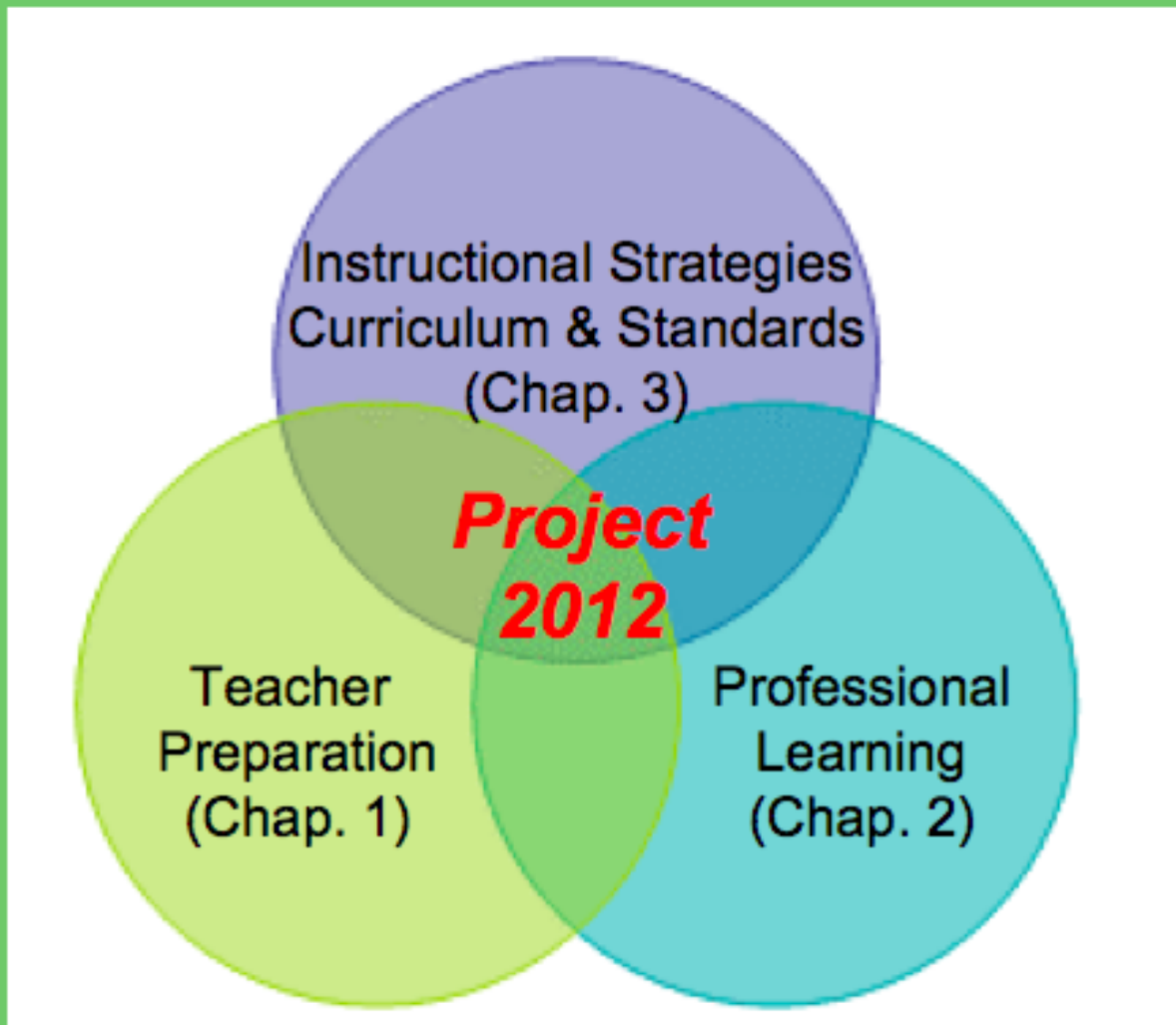
www.sfafs.org/nmproject2012_documentation.asp

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)



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***

Support for SFAFS



McCUNE

Charitable Foundation

LOS ALAMOS
NATIONAL LABORATORY
FOUNDATION



**Los Alamos
National Bank**

Santa Fe

Creating a better way.



Partners
in Education
Foundation
for the Santa Fe Public Schools

STRATEGIC) ANALYTICS

Many Anonymous Individuals



SANTA FE
ALLIANCE FOR SCIENCE

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- Science Cafés
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Local Science Fairs

- Mentoring Students
- Working with Teachers
- Volunteer Subject Areas
- Placements in Schools
- Join SFAPS

Questions?
Comments?

Contact SFAPS



Santa Fe Alliance for Science



The Alliance is a partner of the [Santa Fe Public Schools](#) and is affiliated with Los Alamos National Lab via its [Community Programs Office](#).

Next Science Café: Wednesday, Dec. 10, 2008.

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 SFAPS 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.

www.sfafs.org



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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.

**Six Cafés
per year**

**Videos of
all Cafés
on the
Web**



**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.**

