

The politics of science education,

a physicist's personal
perspective.

What are the forces that define how science education proceeds in your schools?

- How does the interplay of Federal, State and Local control over aspects of education work, particularly in the realm of science education?
- Who else plays a major role?
- If you wanted to improve science education nationally or locally what levers could you push?

Federal Role

A bit player in funding -- but to get that funding schools and states must meet federal requirements

Department of Ed

--most of its funding goes directly to the states, a small amount for education research

No Child Left Behind (NCLB)

- required testing

- performance goals and penalties

- emphasis on literacy and numeracy (basic skills)

National Science Foundation

--has funded curriculum development and some education research

--supports some Math-Science projects (a changing agenda)

State Role

- State Education Code –legal requirements on districts
- State funding --% varies by state
- State Standards and Frameworks
- In some states –textbook adoption (California and Texas)
- State HS Exams or graduation requirements
- Teacher credential requirements

Who controls State education policy?

- Political appointees to Boards and Commissions
- State Secretary of Ed (or similar)
- State Board of Education
- Text Book publishers?
- Outside pressure groups
 - eg Intelligent Design advocates

CA Science Standards Experience

- “Left wing”: science as practice
- “Right wing”: science as facts

Two groups appointed by state to work together, process dominated by the political agendas.

School District

- District Policy and budget
- District-defined curriculum
 - usually based on State standards
- Teacher Hiring
- Teacher's Union
- Parental pressures

Classroom

- Teacher experience and knowledge
- Equipment and resources available
- Teacher interest in science
- Competing demands and pressures

Impact of NCLB (elementary level)

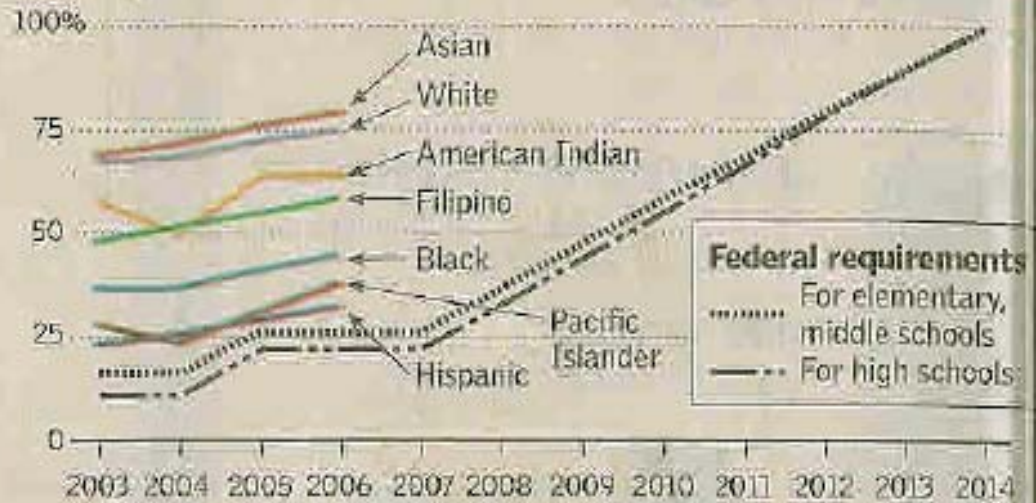
- Testing focus on literacy and numeracy, with \$ penalties for “failing” schools
- In struggling schools this has pushed science out of the classroom
- Testing for science starts next year, but only 2 grades (eg 4 and 8 in CA)
- Consequences for school but not for students

NCLB

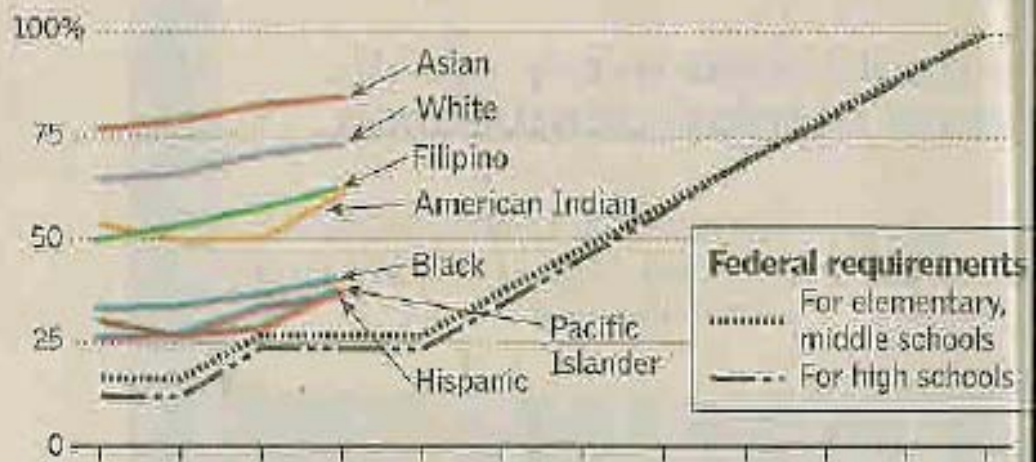
Achievement vs. expectations

Federal requirements for student achievement, as measured on standardized tests, begin climbing steeply after this academic year. Santa Clara County student performance is improving, but within a few years will likely not meet expectations.

SANTA CLARA COUNTY 2006 STAR TEST, ENGLISH-LANGUAGE ARTS
Percent proficient and above



SANTA CLARA COUNTY 2006 STAR TEST, MATHEMATICS
Percent proficient and above



What is tested matters

Most current testing drives teaching towards basic skill drills closely aligned to test items

For science it is easier to test fact recall than to test understanding of how science works

Impact of testing greatest in poorest schools
--so far it is reinforcing the gap in science achievement

Elementary School Science

- Most often single teacher per classroom
- Majority of elementary teachers have little to no science background (1 random required course in college)
- Teacher preparation does not emphasize science (perhaps 1 class on science methods)

Options that help –local level

- District science mentor teacher and teacher network
- Well designed science curriculum
 - learning progression
- New teacher workshops on science curriculum basics
- Ongoing set of teacher in-service options to upgrade science knowledge

Middle School

Science teacher (usually a science specialist)
-- level of knowledge and experience

Text Books and curriculum materials

-- in CA new adoption for science once in 6 years, not enough dollars to buy new books for all grades, so books are typically about ten years old.

Resources- a few dollars per student per year for expendable materials

High School –example physics

- 1/3 of HS physics teacher have 1 year or more of college level physics study
- 1/3 more have several years of physics teaching experience
- Last 1/3 both new to subject and under-prepared

What could make a difference ?

Standards and Curricula focused on core concepts of science, cumulative year to year, well-supported with good materials for student and teacher ----it will take both scientists and educators to build programs

Testing aligned to the best curricula.

Teacher preparation and in-service training linked to curriculum

What can scientists do?

- Get involved in State level policy setting process --standards, credential requirements ...
- Become informed about research on science pedagogy (apply this to University teaching too)
- Develop and support teacher networks for science

Science Courses?

A general science course for elementary school teachers
–pre-service and in-service

A broad look at the key concepts of science, across disciplines

Taught with lots of engaging activities, and opportunities to do
some research

--as you would want elementary teachers to teach

Wouldn't hurt as a course for other non-science majors too!

NAS Study –Taking Science to School

- Children are more capable than has generally been assumed by educators
 - What “develops” depends a lot on what is experienced
 - School science needs to offer a learning progression that fosters good development of science skills --for all students
- (examples provide proof -- it can be done!)

4 strands of science knowledge

- Know, and use and interpret scientific explanations of the natural world
- Generate and evaluate scientific evidence and explanations

4 strands --continued

- Understand the nature and development of scientific knowledge
- Participate productively in scientific practices and discourse

Not either/or, must interweave all 4

Inquiry?



Teaching content alone is not likely to lead to proficiency in science, nor is engaging in inquiry experiences devoid of science content.

Education R&D –stress the D

- Research shows “best bets”
- Putting these into large scale practice requires an R&D approach –to figure out the essential parts that must be provided to make it work –curricula, teacher knowledge (of both science and science pedagogy),...

How do you replicate wisdom?

Learning Progressions

- Elementary science is still mostly a grab bag of disconnected lessons
- Develop the core concepts, progressively across the grades (for all 4 strands)
- Engaging in inquiry is an essential part of learning science, but not the sole tool

Science vs.? Literacy and Numeracy

- Well designed elementary science experiences **MUST** aid in the development of reading, writing and mathematical thinking
 - journal keeping
 - measurement
 - graphs and other data presentation

Complexity – Not a system with obvious levers to push

- School systems are subject to many pressures, and chronically underfunded
- Teacher pay does not draw best students to teaching
- Society does not support or respect teachers

A positive note

- Long-term and consistent networks can yield good results –short term interventions do not
- The political climate is strongly in favor of improving science education – if we can just agree enough on what that means to get on with the job