Resistance to Expanding and Enhancing STEM Education: From Colonial Times to the Present.

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Hazards to Productive STEM Education from Excessive Standardized Testing

- History of STEM education up to WWII;
- Post WWII/Sputnik flowering of STEM education;
- Reversal of progress and the efforts to undermine and retard public education;
- Continuing efforts to cast doubt on scientific method and findings; evolution and global warming examples.

Early 1800's Pressure for Public Education

- Farm to factory transformation;
- Child labor and the growth of the social movement against child labor.
- Education and schooling as the path to advancement;
- Huge increase in immigrant population with high expectations;

Schooling as the alternative to child labor

Origin of Public High Schools

- First publicly funded high schools, 1830s in Massachusetts.
- Establishment of State Board of Education, 1837.
- Appointment of Horace Mann as first state Commissioner of Public Education.
- Mann became advocate and voice of those who wanted to expand education to agrarian and working classes.

Suppression of Public Education in Plantation South:

- Jefferson's proposals for public education voted down in Virginia.
- Teaching slaves to read illegal in plantation south.
- Suppression of schooling for Blacks undermined development of public school for agrarian whites.
- Universities in South not formally desegregated until 1962-1963.

Origins of Public Higher STEM Education

- **1862 Morril Act -** First proposed in 1859, vetoed by Pres. Buchanan.

- Lincoln signed Morril Act in 1862 to help provide trained engineers and personnel for Union forces in the Civil War.

- States were to establish at least one”Land Grant” institution offering instruction in **"agriculture, and the mechanic arts without excluding other scientific and classical studies and including military tactics"** .

- Within eight years, 37 states opened public universities.

Coupling of R&D with Education in the US

- **1887 Hatch Act - Agricultural extension centers** (R&D and demonstration projects).
- **1890 Second Morril Act** - Provided for annual federal expenditures to support higher ed programs at Land Grant Colleges

Enrollment in Higher Education 1900- WWII

	U.S. Population	In College	Degrees
➢ 1900:	76,000,000	238,000	30,000
➢ 1930:	123,000,000	1,000,000	140,000

- Less than 2%.of population with college degrees;
- Can't disseminate knowledge effectively, can't train teachers, engineers, or scientists.

Science Education Before WWII

- Prior to WWII, less than 2% of population were college graduates;
- Science literacy limited to very small minority of population;
- Human resources unavailable for broadening education in the sciences.

Scopes Trial, 1925

TOP: Clarence Darrow (l) and William Jennings Bryan (r). BOTTOM: the Scopes jury with Judge John Ralston on the far right.

End of Scopes Trial Precedent

Epperson v. Arkansas, 393 U.S. 97 (1968)

The Supreme Court ruled unconstitutional an Arkansas statute that prohibited the teaching of evolution in the public schools, on the grounds that it violated the Establishment Clause of the First Amendment. The Court held that the First Amendment to the United States Constitution prohibits a state from requiring, "that teaching and learning must be tailored to the principles or prohibitions of any religious sect or dogma."

WWII Scientific Crises

- Onset of W.W.II brought nation a variety of military problems requiring scientific and technological solutions;
- Radar, proximity fuses, navigation, Sonar, and many other tasks;
- But serious shortage of trained scientific personnel.

How to Solve the War's Scientific Problems?

- **Office of Scientific Research and Development (OSRD)** formed under Vannevar Bush to mobilize the nation's scientific resources. The OSRD instituted mechanisms for
- Cooperative research projects at the national level:
  - Salaries;
  - Drafts deferments;
  - Access to scarce materials otherwise unavailable;
  - Journals, Publication and Meetings.
  - Gather national scientific/technically trained people in a few sites (eg MIT).
  - Basis for modern NIH, NSF research grant system.

OSRD Successes: Large Scale Production of Penicillin

- Responding to the serious problems of wound infections among the Armed Forces, the federal government initiated a publicly financed cooperatively organized large program to mass produce penicillin, with Merck as the primary contractor. In less than two years after its initiation penicillin was available for treating wound infections.

Millions of G.I.s Return Home

Post WWII Expansion of Public Ed – The “GI Bill”.

- What to do with three million veterans re-entering job markets at end of War?
- **Serviceman's Readjustment Act, the “GI Bill”!.**
- Colleges and universities, expanded enormously, absorbing more than 2.25 million veterans.
- Part of basis for industrial and technological boom of 1950-1974.

1957 - Sputnik!

- In the Cold War environment, the 1957 launch by the USSR of the first orbiting satellite - Sputnik - shocked the nation.

Sputnik and the Cold War Pressure for Science and Math Education:

- Soviet launching of Sputnik Satellite in 1957 was a national shock.
- Congress rapidly created National Defense Education Act and voted huge sums of money to strengthen educational and scientific programs;
- National campaign together with infusion of Federal broadened and deepened science education in schools and colleges across the nation.

National Defense Education Act

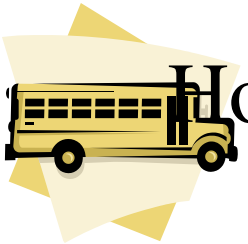
- Title II established repayable college loan program;
- Title IV created substantial 3 year fellowship program to help college graduates become high school and college teachers;
- Title VI set up a program to assist in teaching of modern foreign languages.
- Federal funds for secondary science education;
- Modernization of textbooks;
- Recruitment of science teachers.

Post-Sputnik Expansion 1960-1984

- NDEA, NSF, NASA support for math and science;
- Corporate support for trained workforce to staff high technology manufacturing expansion;
- State legislature support for higher ed and secondary ed expansion to gain local economic advantages; eg California, NY, MA state systems.
- Successful civil rights and women's rights struggles.

1960 – 2000: US emerges as world leader in Science and Technology

- Growth of “route 128” and “Silicon Valley” computer hardware and software;
- Development of genetic engineering, biomedical research, biotechnology and pharmaceuticals;
- New level of telecommunication, computer graphics and image processing;
- Leading Research Universities and Medical Schools.



How were these scientists and engineers educated?

- Initially in American pubic schools!
- Across the nation;
- Urban and rural;
- Without controlling standardized testing!
- Subsequently in public and private research universities in all regions of the country.

Successful STEM Education

- Encountering the natural world.
- Observing the natural world.
- Asking questions.
- Designing experiments.
- Performing experiments.
- Collecting data.
- Interpreting your results.

Successful STEM Education

- Well-educated, trained and committed teachers;
- Well-compensated and supported;
- Ongoing professional development;
- Tight linkage with university and research communities.

Required Investments

- Laboratory facilities and supplies,
- Teacher training and professional development
- Computer access and upkeep
- Resources for projects and field trips.

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Key National STEM Education Policy Statements

- *Science for all Americans*, Project 2061, American Association for the Advancement of Science, Washington DC (1989).
- *High Stakes: Testing for Tracking, Promotion and Graduation*, (Edited by Jay P. Heubert and Robert M. Hauser), National Research Council (1999)

"Science for All Americans[1]

- U.S. scientific leadership clearly identified the need to replace rote learning methods with inquiry-based instruction.

- Such teaching places scientific method - experiments, data gathering, observation and interpretation - at the center of instruction.

Reversal of Expansion under Reagan

- Cutback in federal programs, for example grants > loans.
- Aggressive cuts in state budgets for public education
- Proposition 21/2 initiatives limiting tax base
- Rise of right wing think tanks

Reagan to Bush: A Different Agenda for Public Education

- "Standards-based reforms"
- Vouchers;
- High stakes tests;
- Dismantling of local control;
- NCLB;
- Sanctions and discrediting of public schools;
- Privatization - Edison, Beacon, Sabis, etc.

Some Problems in Massachusetts

- Proposition 2 1/2 limiting community investments
- Absence of STEM educators on Weld/Silber/Peyser State Board of Education 1990 through 2008;
- No institutional statewide program linking secondary schools with higher ed and R&D institutions.
- Weld/Silber/Peyser major effort imposition of high stakes MCAS tests.

Recent NCLB Critiques

- *Many Children Left Behind*, by Deborah Meier and George H. Wood (2004);
- *Collateral Damage: How High-Stakes Testing Corrupts America's Schools,* by Sharon L Nichols and David Berliner (2007);
- *When School Reform Goes Wrong*, by Nel Noddings (2007).

- *President Barack H. Obama, Inaugural Address, January 20, 2009:*

  "We will restore science to its rightful place and wield technology's wonders to raise health care's quality and lower its cost. We will harness the sun and the winds and the soil to fuel our cars and run our factories. And we will transform our schools and colleges and universities to meet the demands of a new age."

Louisiana Gov. Jindal pushed 2008 'Science Education Act'

- Under the guise of "academic freedom," allows teachers to teach "critical thinking and creationism" in science classes
- Allows teachers to introduce classroom material questioning the validity of evolution and other sciences that are deemed "controversial"

Tea Party STEM Ed

- "I support intelligent design," Bachmann told reporters in New Orleans following her speech to the Republican Leadership Conference. "What I support is putting all science on the table and then letting students decide. I don't think it's a good idea for government to come down on one side of scientific issue or another, when there is reasonable doubt on both sides."

Tea Party STEM Ed

- Santorum Senate speech on NCLB 2001: “Just as has happened in other subjects in the history of science, a number of scholars are now raising scientific challenges to the usual Darwinian account of the origins of life. Some scholars have proposed such alternative theories as intelligent design. In the Utah law review article the authors state, ``..... The time has come for school boards to resist threats of litigation from those who would censor teachers, who teach the scientific controversy over origins, and to defend their efforts to expand student access to evidence and information about this timely and compelling controversy."]

Wisconsin Public Schools

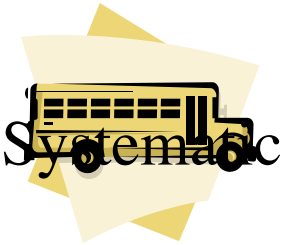
- Wisconsin Governor Scott Walker pushed through Act 10, a law ending teachers collective bargaining rights, which prompted unprecedented protests and a June 5 recall election.
- The Republican legislature also cut school funding, resulting in a loss of 2,300 educators, a 50% increase over the previous year's cuts.

Ohio schools on the ropes

- Ohio federal and state public school funding plunged $2.8 billion in two years. Cleveland cut 500 jobs; Cincinnati announced 227; and Northwest Local schools cut 128 jobs since 2010.
- Ohio legislators last year stripped public workers, including teachers, of collective bargaining rights.
- Voters overturned the law in November, 62% to 38%.

Louisiana Gov. Jindal moves to privatize public schools

- Offer vouchers to more than half the students in the state
- Vastly expand the number of privately managed charters
- Introduce academic standards and letter grades for pre-schoolers
- End seniority and tenure for teachers



Systematic Corporate Efforts to Cast Doubts on Climate Science

- Global Climate Coalition;
- Americans for Prosperity;
- Heartland Institute;
- Cato Institute;
- Competitive Enterprise Institute;
- Direct donations to anti-regulation Congressiona Reps;
  - Financed by Exxon, General Motors, Georgia-Paciifc, Koch Industries, etc.

Tea Party STEM Ed

- *During a speech at the Ohio Christian Alliance, Santorum told the crowd that public education is "an artifact" that must come to an end, and that parents should withdraw their children and rely on home schooling and online education*