Fifth International Conference

Quality Growth of Inquiry-Based Science Education Programs

City of Knowledge
Panama City

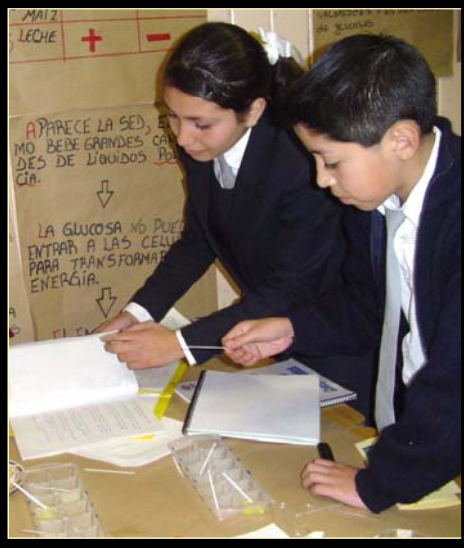
June 12, 2009

National Science Resources Center

Smithsonian Institution – The National Academies

- **Established in 1985 in response to the report "A Nation At Risk"**

- **Strategy is to leverage the resources and expertise of the National Academies, the Smithsonian Institution, and other organizations to catalyze transformational change of K-16 science programs in the United States and the world**



National Science Resources Center

Smithsonian Institution – The National Academies

Vision

Develop a scientifically-literate citizenry and a 21st century workforce

Mission

Transform K-16 science education programs for all students in the United States

NSRC Strategic Goals

1. **Improve public understanding of science education**
2. **Scale up the implementation of research-based K-16 science education programs in states and other countries**
3. **Contribute to the sustainability of research-based science education programs in U.S. districts and states**
4. **Strengthen international capacity**

United States Context ….

….Long-term systemic problems

Value of Science in the School Curriculum by School Administrators and Policy Makers

Science not seen as a core subject or as important as reading and mathematics

Effectiveness of Instructional Materials

National and state curriculum programs that advocate the use of materials that are not produced using a rigorous research and development process

Effectiveness of Teacher Preparation

Most academic institutions not using research and promising practices to prepare teachers

Effectiveness of Science Learning and Teaching

Performance on United States and International Tests

US 15 Year-Olds Rank Near Middle Of The Pack Among 32 Participating Countries: 1999

	U.S. RANK
READING	15TH
MATH	19TH
SCIENCE	14TH

PISA 2003: US 15 Year-Olds Rank Near The End Of The Pack Among 29 OECD Countries

	U.S. RANK
READING	20TH
MATH	24TH
SCIENCE	19TH

Source: NCES, 2005, International Outcomes of Learning in Mathematics, Literacy and Problem Solving: 2003 PISA Results. NCES 2005-003

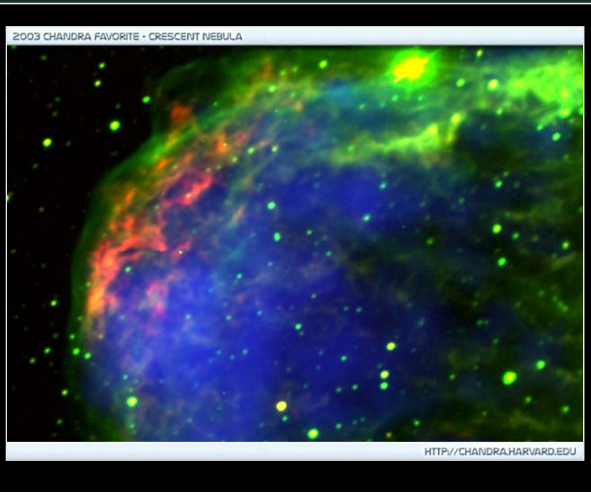
The new ones?

PISA 2006: US 15 Year-Olds Rank Near The End Of The Pack Among 30 OECD Countries

	U.S. RANK
READING	-
MATH	25TH
SCIENCE	21st

Source: 2006 PISA Results.

Interest in Science and Engineering



Declining at all levels

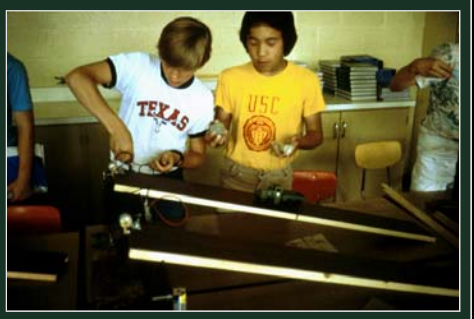
The number of university students in engineering and physical sciences has declined by 25% (1980-2004).
Source: U.S. Department of Labor

U.S. Talent Pool of Scientists and Engineers

Insufficient and Declining

25% of the current science and engineering workforce is more than 50 years old and will retire by the end of the decade.
Source: National Science Board

Workforce with Scientific and Technological Knowledge and Skills



Inadequate with need growing

The number of jobs requiring science degrees are growing at three times the rate of other jobs.
Source: U.S. Department of Labor

Impact of Decades of K-16 Science Learning and Teaching and Learning Environments Not Based on Research and Promising Practices

ADD IT ALL UP...

Of Every 100 White Kindergartners:

- ***94*** **Graduate from high school**
- ***66*** **Complete at least some college**
- ***34*** **Obtain at least a Bachelor's Degree**

(25-to 29-Year-Olds)

Source: US Department of Commerce, Bureau of the Census. March Current Population Surveys, 1971-2003, in The Condition of Education 2005. http://nces.ed.gov/programs/coe/2005/section3/indicator23.asp#info

Of Every 100 African American Kindergartners:

- ***89*** **Graduate from High School**
- ***51*** **Complete at Least Some College**
- ***18*** **Obtain at Least a Bachelor's Degree**

(25-to 29-Year-Olds)

Source: US Department of Commerce, Bureau of the Census. March Current Population Surveys, 1971-2003, in The Condition of Education 2005. http://nces.ed.gov/programs/coe/2005/section3/indicator23.asp#info

Of Every 100 Latino Kindergartners:

- ***62*** **Graduate from high school**
- ***31*** **Complete at least some college**
- ***10*** **Obtain at least a Bachelor's Degree**

(25-to 29-Year-Olds)

Source: US Department of Commerce, Bureau of the Census. March Current Population Surveys, 1971-2003, in The Condition of Education 2005. http://nces.ed.gov/programs/coe/2005/section3/indicator23.asp#info

Of Every 100 American Indian/Alaskan Native Kindergartners:

71 Graduate from high school

30 Complete at least some college

12 Obtain at least a Bachelor's Degree

(25 Years Old and Older)

Source: U.S. Census Bureau, *We the People: American Indians and Alaska Natives in the United States.*
Data source: Census 2000, www.census.gov/population/www/socdemo/race/censr-28.pdf

Scientific Literacy of Citizens

Citizens ……

Majority have little to no understanding of the nature of science and no direct experiences with effective science learning and teaching

These figures help illustrate the potential economic benefits to individuals and the state of investing in an improved high school system that better prepares all high school students for graduation.

- More than 1.2 million students did not graduate from American high schools in 2007; **the lost lifetime earnings in America for that class of dropouts alone totals nearly $329 billion**.
- America would **save more than $17 billion in health care costs** over the course of the lifetimes of each class of dropouts had they earned their diplomas.
- American households would have **over $74 billion more in accumulated wealth** if all heads of households had graduated from high school.

- More than $**310 billion would be added to the American economy by 2020** if students of color graduated at the same rate as white students.

- If American high schools graduated all students ready for college, the U.S. would **save more than $3.7 billion a year in community college remediation costs and lost earnings**.

- The American economy would see a **combination of savings and revenue of more than $7.7 billion in reduced crime spending and increased earnings** each year if the male high school graduation rate increased by just 5 percent.

U.S. reports documenting the impact of this problem

1983 Reports -
National Commission on Excellence in Education

- **"Our once unchallenged preeminence in commerce, industry, science, and technological innovation is being overtaken by competitors throughout the world." 1983**
- **Report called special attention to how far American students lagged behind the rest of the developed world in science and mathematics education**

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2005 Reports

Rising Above the Gathering Storm
National Research Council, 2005

Tapping America's Potential: The Ed for Innovation Initiative
Business Roundtable, 2005

A Commitment to America's Future: Responding to the Crisis in Mathematics and Science Education
Business-Higher Education Forum, 2005

Quality Growth of Inquiry-Based Science Programs

…….

A strategic, systemic, sustainable and scaleable strategy

Strategic Approach for Quality Growth

Start with districts and move to states as units of change

Principle - 1

Approach science education reform as a social norm problem

Problems are analogous to many health issues that require long- term and complex strategies

Principle - 2

Identify and educate a distributive leadership team

Identify and educate teams of national, state, and local leaders from multiple sectors who will assume responsibility for leading reform in their communities and states.

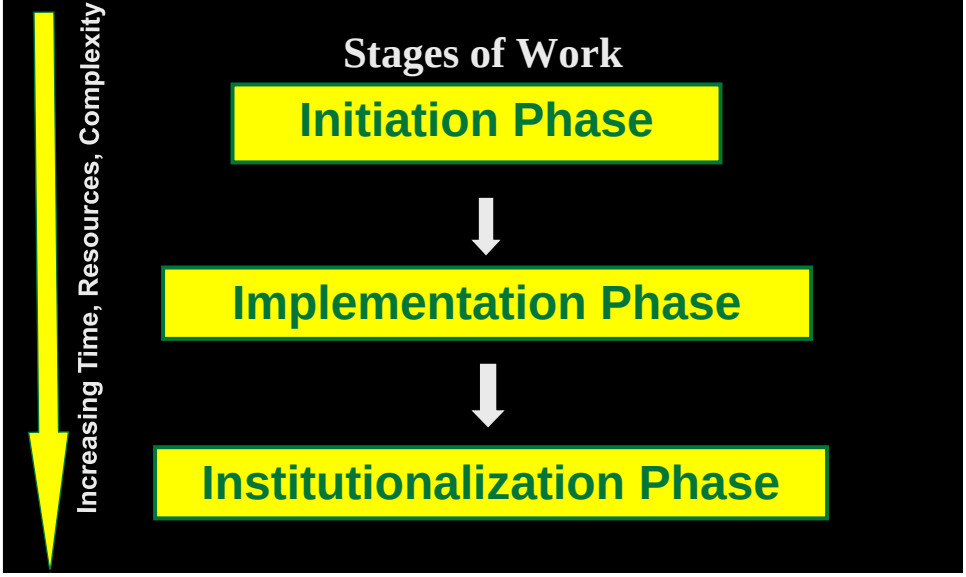
Principle – 3

Adopt a Long-Term Perspective

Work will never be finished !

Principle – 3

Adopt a Long-Term Process

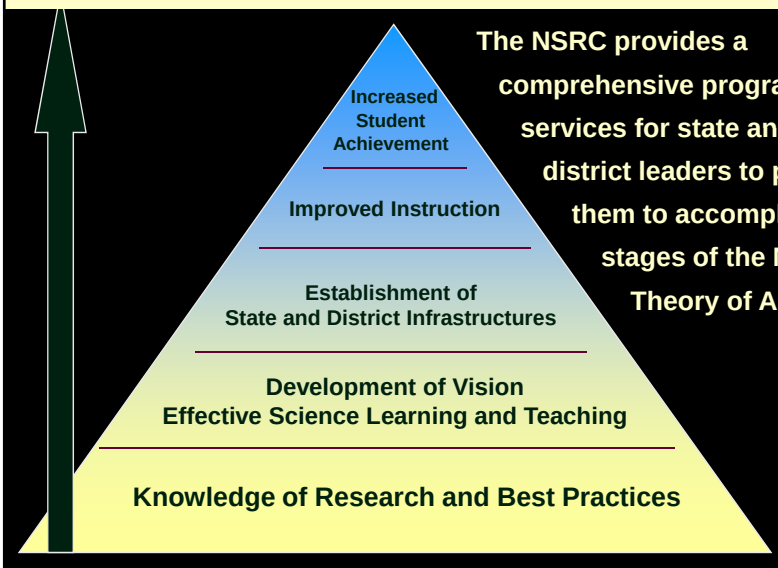


Principle - 4

Develop A "Theory of Action"

Employ a theory of action based on new vision of science learning and teaching informed by research and promising practices

NSRC Theory of Action



The NSRC provides a comprehensive program of services for state and school district leaders to prepare them to accomplish the stages of the NSRC Theory of Action

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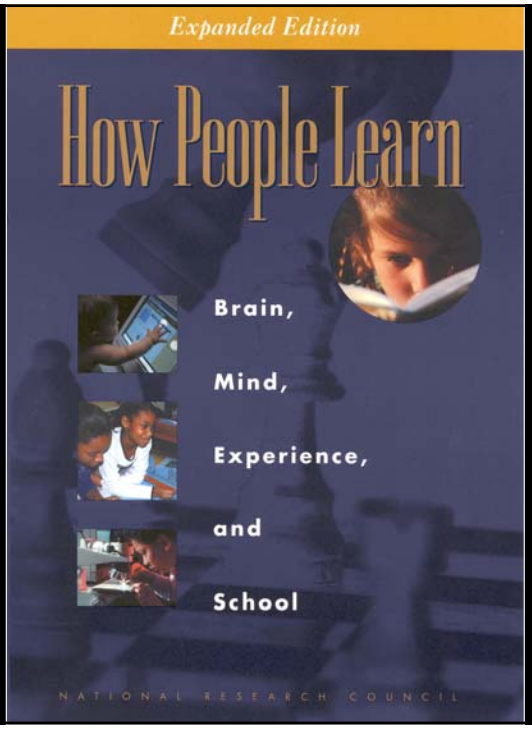
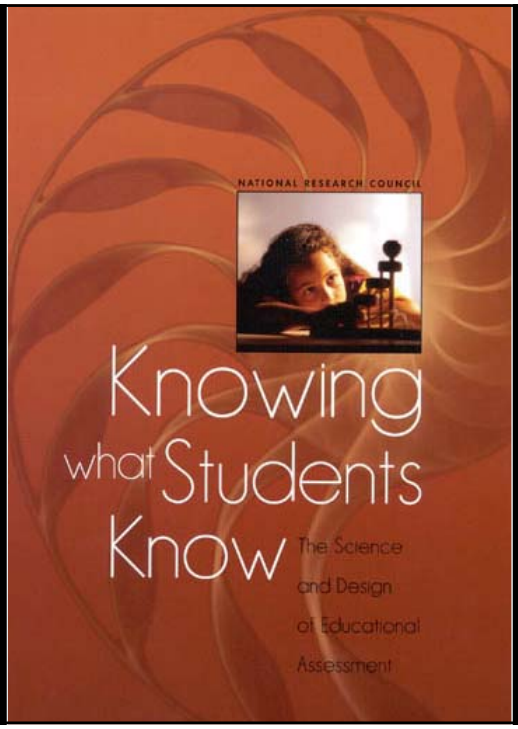
Principle - 5

Study Research and Promising Practices

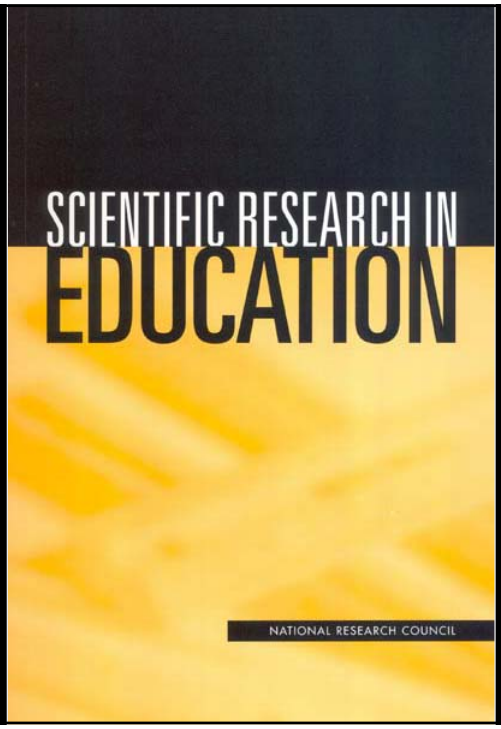
Inform theory of action with research studies and promising practices primarily from the reports and studies of the National Research Council



Describes the science and design of educational assessment



Defines what is good research in education



Principle - 6

Build Awareness

Spend time annually educating officials representing education, government and business about a new vision and the infrastructure needed to support it

Principle - 7

Conduct SWOT Analysis…..

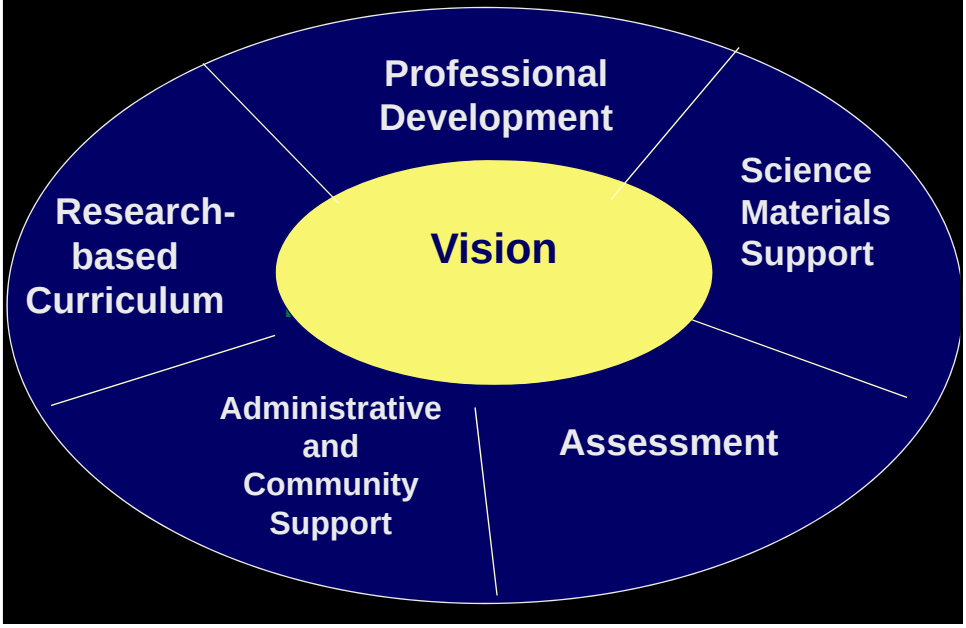
Periodically identify strengths, weaknesses, opportunities and threats

Principle - 8

Develop Strategic Plans

Develop strategic business plans with states and districts that have measurable goals

NSRC Science Education Systemic Reform Model for the Establishment of School District Infrastructure



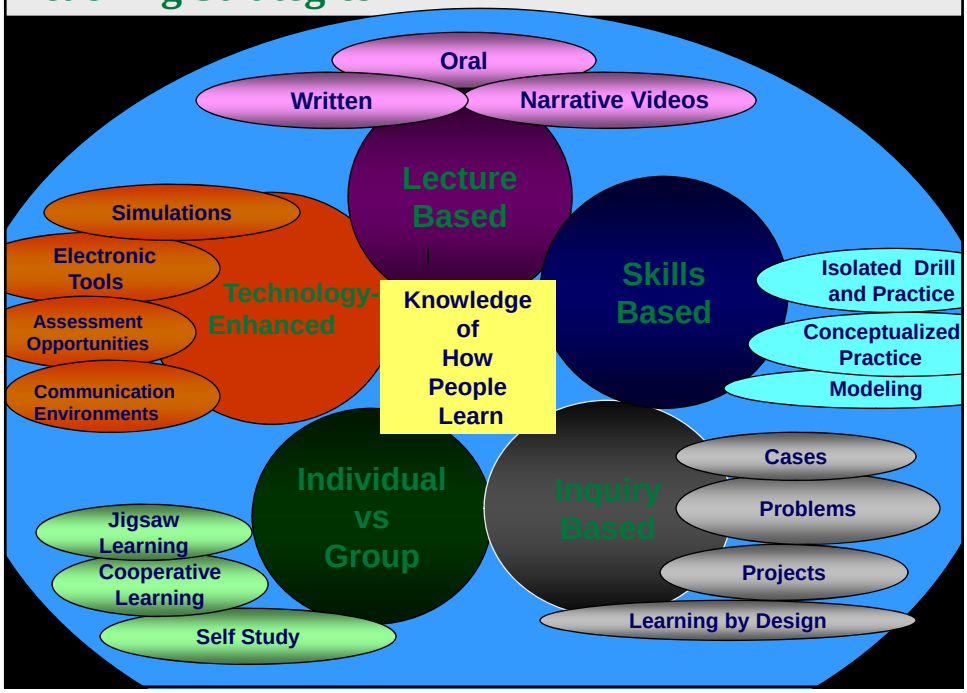
Research-Based Curriculum

Use research-based instructional materials as the component to drive reform of professional development of teachers and obtain gains in student achievement

Science Materials Research and Development Process

- Research and Development
- Preparation of Trial-Teaching Materials
- Trial Teaching with Students
- Analysis of Trial Teaching Results
- Revisions and Preparation of Field-Test Edition
- National Field Testing
- External Formative and Summative Evaluation
- Revision of Field-Test Editions
- Final Technical Review
- Publication

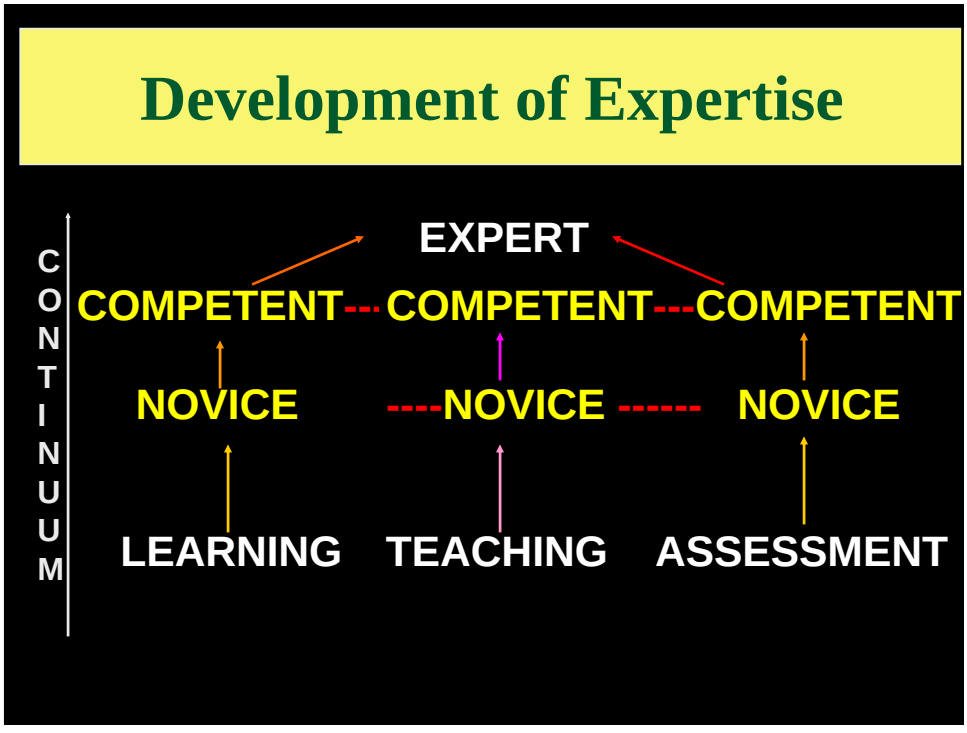
Teaching Strategies



STC AND STC/MS SCIENCE CURRICULUM PROGRAMS

Grade Level		Life and Earth Sciences		Physical Sciences and Technology	
STC	K–1	Organisms	Weather	Solids and Liquids	Comparing and Measuring
	2	The Life Cycle of Butterflies	Soils	Changes	Balancing and Weighing
	3	Plant Growth and Development	Rocks and Minerals	Chemical Tests	Sound
	4	Animal Studies	Land and Water	Electric Circuits	Motion and Design
	5	Microworlds	Ecosystems	Food Chemistry	Floating and Sinking
	6	Experiments with Plants	Measuring Time	Magnets and Motors	The Technology of Paper
STC/MS	6–8	Human Body Systems	Catastrophic Events	Properties of Matter	Energy, Machines, and Motion
	6–8	Organisms — From Macro to Micro	Earth in Space	Light	Electrical Energy and Circuit Design


Differentiated Professional Development
Development of Expertise
PROGRESSION
EXPERT
COMPETENT
NOVICE
NSR


Development of Expertise
CONTINUUM
EXPERT
COMPETENT
COMPETENT
COMPETENT
NOVICE
NOVICE
NOVICE
LEARNING
TEACHING
ASSESSMENT

Principle - 9

Initiate Reform

Start with few areas that have the highest potential for success and to build capacity in regions

Principle - 10

Work to create a “proof of concept”

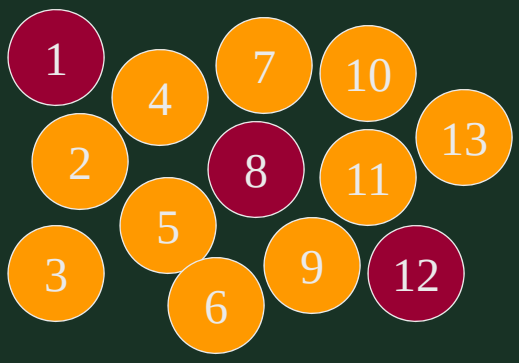
Start with a pilot in one place to develop a proof of concept and demonstration site and then scale

Principle - 11

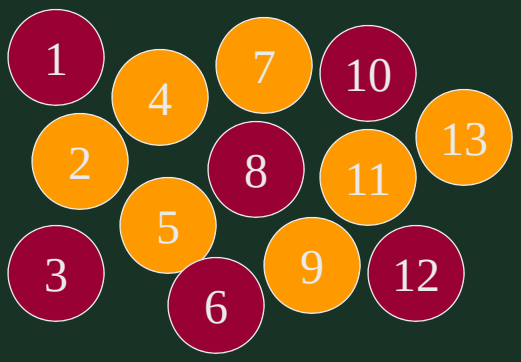
Phase work

Phase expansion carefully over time to ensure you are Building robust regions infrastructures for Systematically supporting students, teachers, schools, and communities

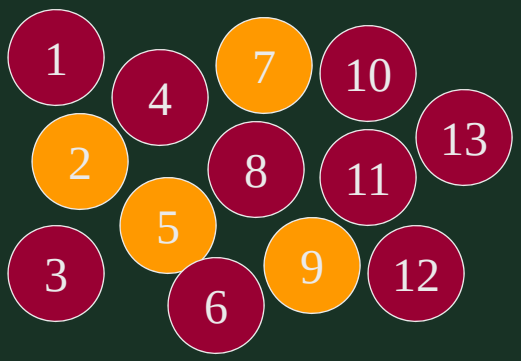
Years one to three



Years three to six

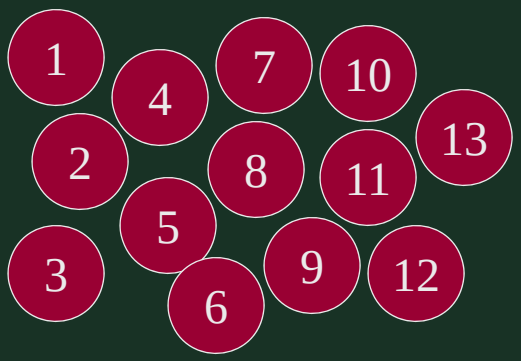


Years six to nine



Years nine to twelve

Years ten and ….



Principle - 12

Leverage resources

Leverage resources through strategic partnerships with corporations, academic institutions, museums, and other organizations

Principle - 13

Build capacity to ensure sustainability

Principle - 14

Develop systems for evaluating work and documenting progress annually

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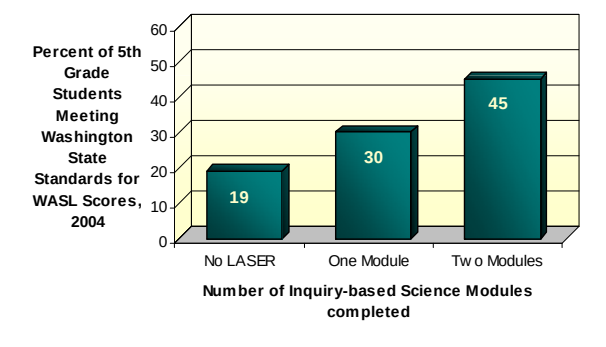
Evidence of Impact

Working with districts representing 30% of the U.S. student population, as well as numerous countries, resulting in significant gains in student achievement in states where we have worked for a decade or longer

Systemic Reform in Washington State



- > 70% of the students are served by LASER
- State-wide, self-sustaining Materials Resource Center
- Strong links with higher education and the business community

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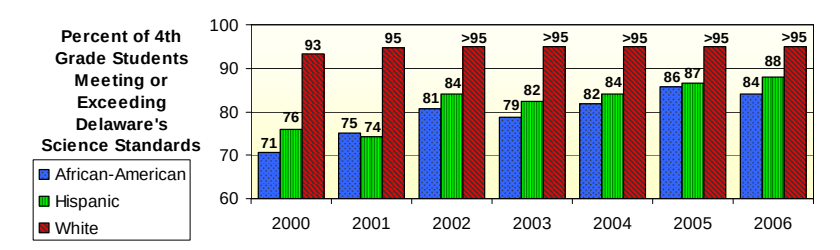
Systemic Reform in Delaware



- Research-based K-12 science curriculum
- Comprehensive, on-going professional development for all science teachers
- State-wide, self-sustaining Materials Resource Center
- Strong links with higher education and the business community

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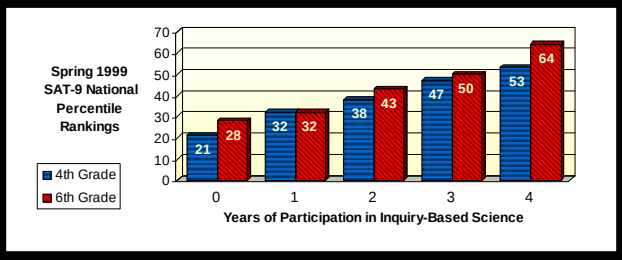
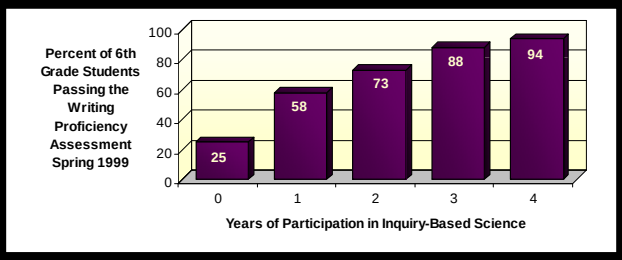
Education Reform in El Centro, CA





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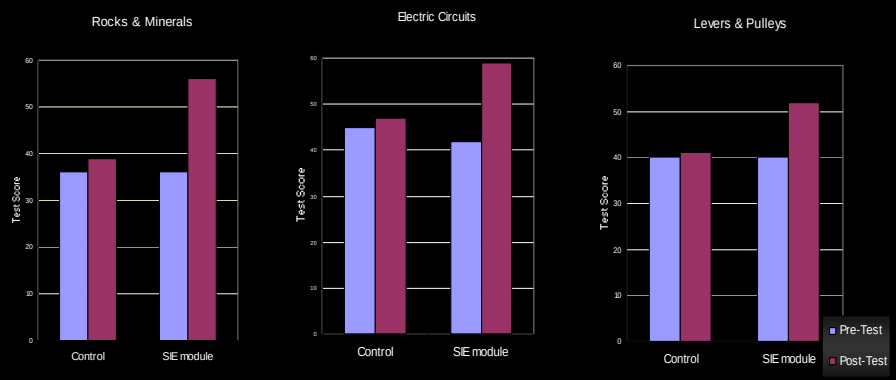
Pennsylvania: Elementary Science Reform

Student Subject Area Achievement: Control Group v. Students Using Module

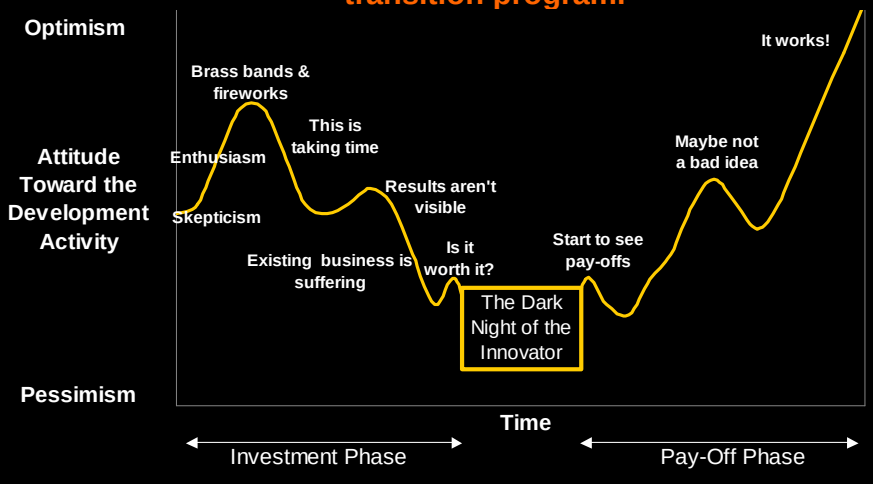


Principle - 15

Celebrate and communicate progress annually

The Anatomy of Innovation

A map of the organization energy during any major transition program.



Hewlett* Packard

Sources

Business-Higher Education Forum, bhef.com

Business Roundtable, businessroundtable.org

Education Trust, edtrust.org

National Science Foundation, nsf.gov

Public Agenda, publicagenda.org

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www.nsrconline.org

Thank you

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Questions ?????