The Intersection of Policy and Practice in Teacher Education:

Perspectives from the Work of the U.S. National Research Council

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Advisers to the Nation on Science Engineering, and Medicine

Overview of Presentation

- The Structure and Work of the U.S. National Academies
- Education Structure and Policy in the U.S.: Challenges to Implementing Inquiry-Based Teaching and Learning
  - K-12 Education
  - Higher Education
- National Academies Resources

The National Academies

National Academy of Sciences (1863)

National Academy of Engineering (1964)

Institute of Medicine (1970)

National Research Council (1916)

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PURPOSES OF THE NATIONAL ACADEMIES

- To advance science and technology
- To advise government
  - on applications of science and engineering to policy
  - on policy for science, engineering, and health care

NAS ACT OF INCORPORATION: 1863

- **Added to the end of the Act,**
  "... shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art ..."

- **"... but the Academy shall receive no compensation whatever for any services to the Government of the United States."**

As a result of the charter's restrictions, the U.S. National Academies are a private, non-profit organization that are independent from the U.S. Government and whose work depends on volunteers.

NAS, NAE, and IOM Membership
July, 2004

NAS	**Members (Active)**	**1,914**
	Members (Emeritus)	**94**
	Foreign Associates	**339**
	Total	**2,347**
NAE	**Members (Active)**	**1,873**
	Members (Emeritus)	**246**
	Foreign Associates	**162**
	Total	**2,281**
IOM	**Members (Active)**	**1333**
	Members (Emeritus)	**45**
	Foreign Associates	**66**
	Total	**1,444**

PRINCIPLES OF THE NRC

- Independence
- Balance
- Objectivity

METHODS OF OPERATION

- CONSENSUS STUDIES
  - Balance and Composition of Committees
  - Report Review
- CONVENING ACTIVITIES
  - Workshops
  - Roundtables
- OPERATIONAL PROGRAMS
  - Fellowships and Associateships
  - Research/Surveys
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NUMBER OF NRC/IOM COMMITTEES AND COMMITTEE MEMBERS

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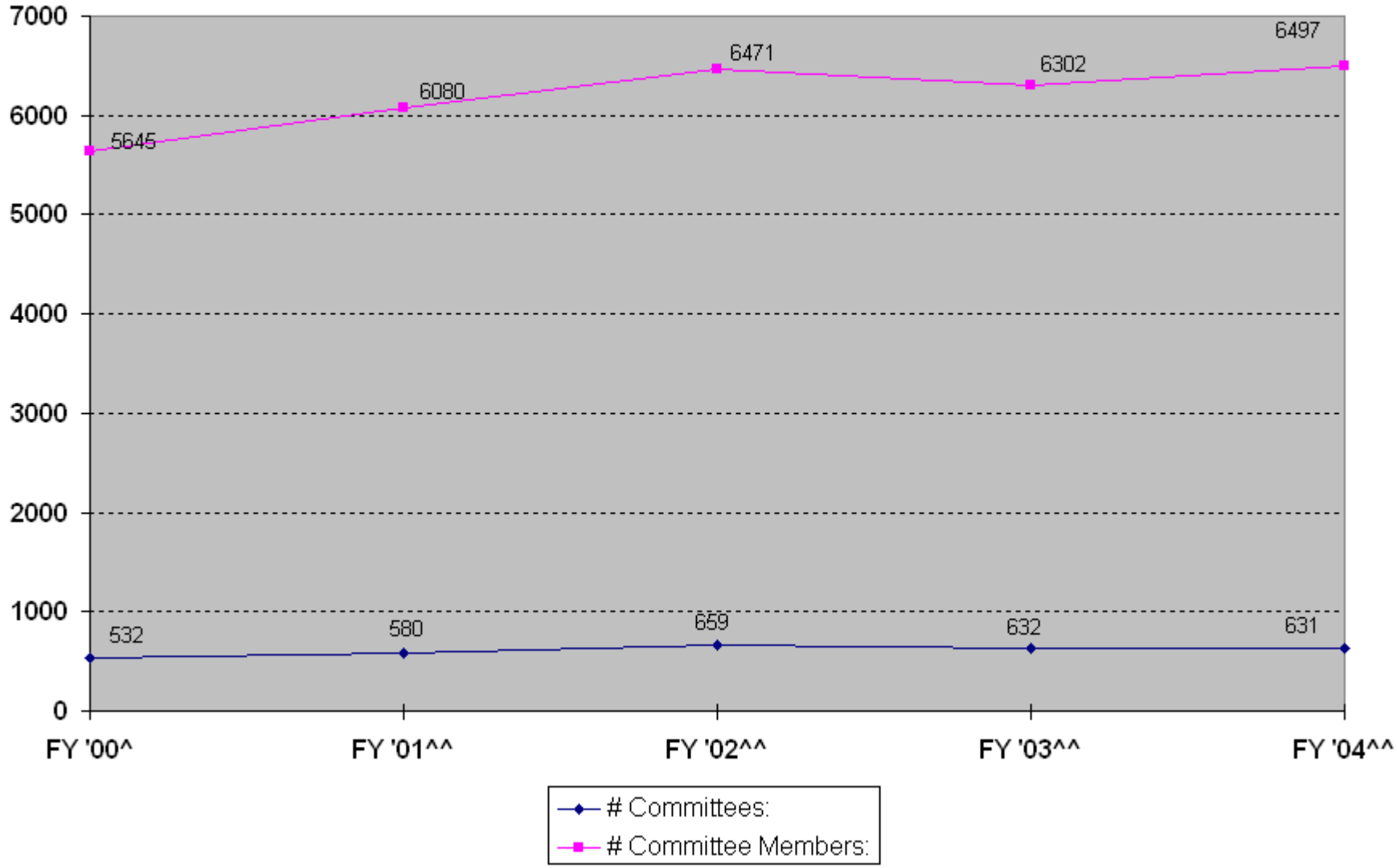

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TOP NEWS

The latest news from the Academies

U.S. Army Should Expedite Destruction of Chemical Weapons at Anniston

Oct. 15 -- The U.S. Army should pursue options to hasten the disposal of rockets that contain gelled sarin, a toxic chemical-warfare agent, stored at the Anniston Chemical Agent Disposal Facility in Anniston, Ala., says a report from the National Academies' Board on Army Science and Technology.

SCIENCE IN THE HEADLINES

Breaking stories in science

FDA Panel Recommends Approval of Silicone Breast Implants

Oct. 16 -- A U.S. government advisory panel recommended Wednesday that silicone breast implants again be approved for sale after 11 years of market restrictions on the devices. A 1999 Institute of Medicine report found that women with silicone breast implants are no more likely than the rest of the

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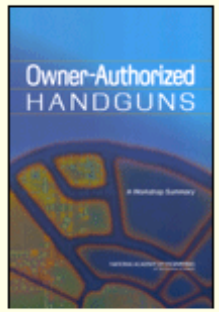

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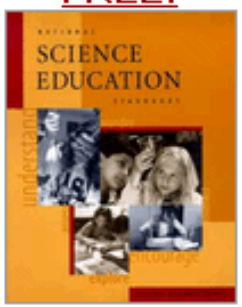

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National Science Education Standards

National Committee on Science Education Standards and Assessment, National Research Council

272 pages, 8 1/4 x 10 1/2, 1996

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Policies and Practices that Influence Inquiry-Based Approaches to Teaching and Learning in the U.S.

- **Grades K-12**
  - Brief Overview of the U.S. System of Education
  - State Science Standards
  - Assessments and Accountability
  - Requirements for “Highly Qualified” Teachers
  - Teacher Professional Development and Retention
- **Higher Education**
  - Introductory Science Courses
  - Teacher Education

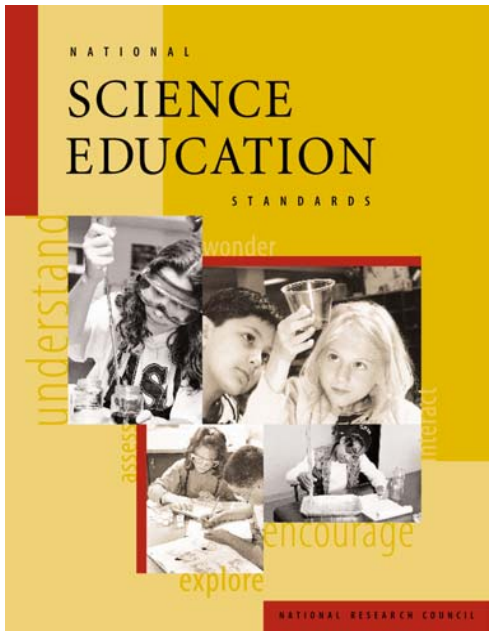
Brief Overview of the U.S. System of Education

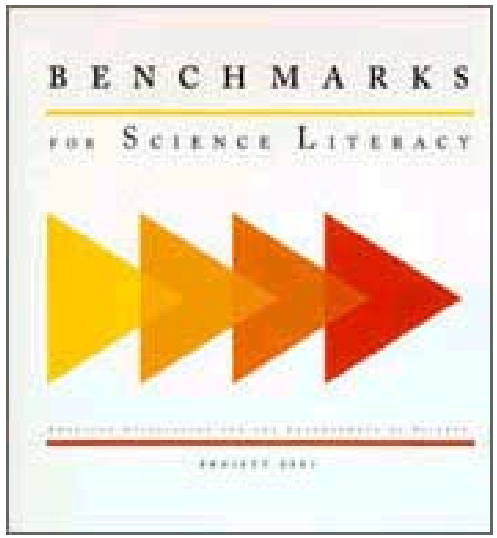
- The U.S. system of K-12 education is decentralized
  - 50 States and District of Columbia (Washington, DC)
  - ~16,000 local school districts overseen by elected boards of education
  - More than $300 billion spent annually
    - Most funding for schools from local property taxes
    - The U.S. Government contributes ~8% of this money
  - Current federal role in improving education is through the “No Child Left Behind Act” of 2001

Brief Overview of the U.S. System of Education

- More than 3500 Institutions of Higher Education in the U.S.
  - Two-Year Colleges (~45% of undergraduates nationwide)
  - Four-Year Colleges and Universities
- Higher Education in the U.S. is both publicly and privately funded
  - Support for public institutions primarily from States, but support has been declining.
  - Federal support primarily to students and through research grants and contracts to institutions
  - Private sources (foundations, corporations, individuals)
  - Student Tuition
- No single system of accountability for higher education.
  - Federal Higher Education Act
  - Oversight by state legislatures

National and State Science Standards for Grades K-12





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http://project2061.aaas.org/ ⇨

Principles Underlying the National Science Education Standards:

- **EQUITY: All students, regardless of gender, cultural or ethnic background, physical or learning disabilities, aspirations, or interest and motivation in science, should have the opportunity to attain higher levels of scientific literacy than they do currently.**
- **CONTENT: All students will learn all science in the content standards.**
- **RELEVANCE: All students will develop knowledge and understanding of science from personal, social, and historical perspectives.**
- **LEARNING science is an active process.**
- **UNDERSTANDING science deeply requires that less emphasis be given to some science content. More time, personnel, and materials must be devoted to science education.**
- **PRACTICE: School science should characterize contemporary practice of science.**

CHANGING EMPHASES IN SCIENCE CONTENT

LESS EMPHASIS ON:	MORE EMPHASIS ON:
Knowing scientific facts and information.	Understanding science processes and developing abilities of inquiry.
Studying subject matter disciplines (e.g., physics, earth sciences) for their own sake.	Learning subject matter disciplines in the context of inquiry, technology, science in personal and social perspectives, and history and nature of science.
Separating science knowledge and science process.	Integrating all aspects of science content.
Covering many science topics.	Studying a few fundamental science concepts
Implementing inquiry as a set of processes.	Implementing inquiry as instructional strategies, abilities, and ideas to be learned

States have adapted national standards in science for their education systems

- 49 of the 50 U.S. states have developed or are developing standards and curriculum frameworks.

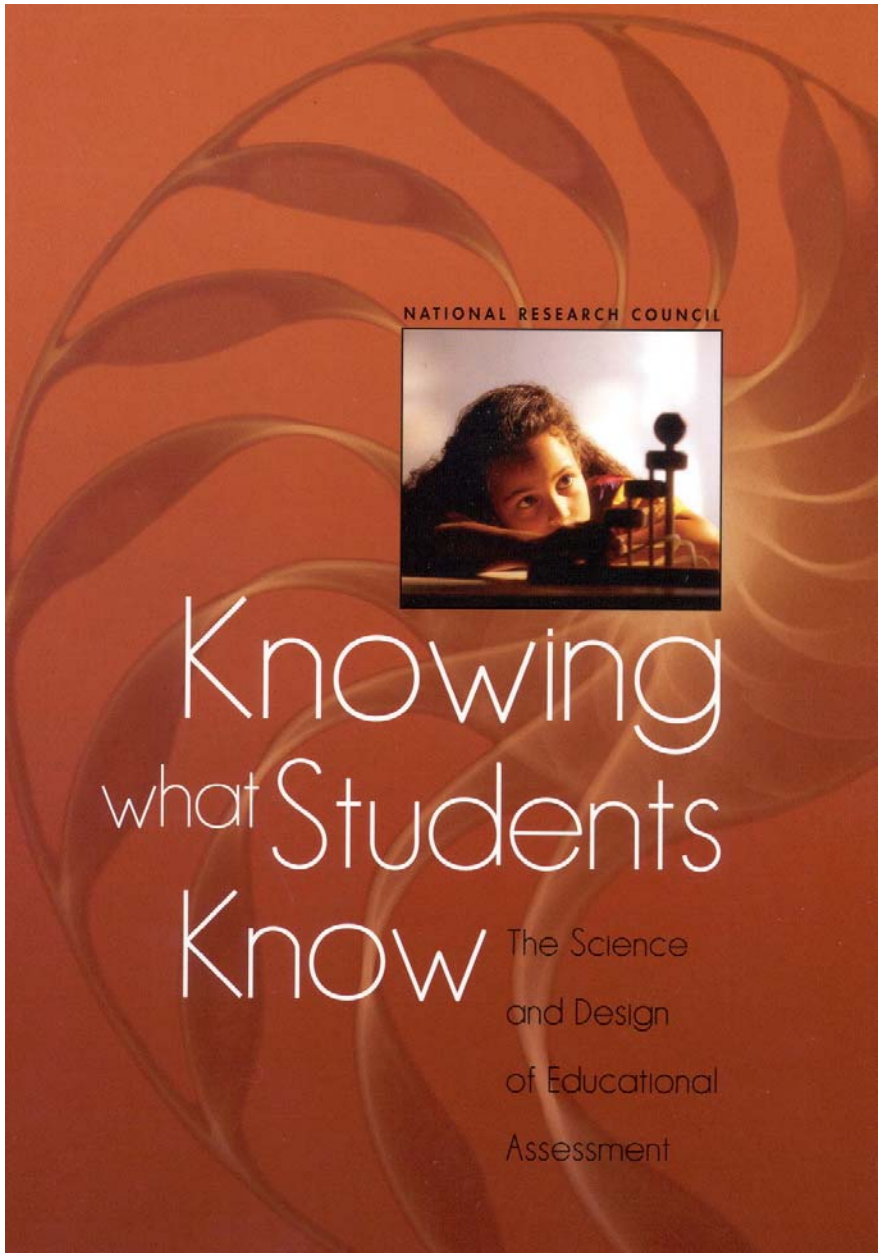
- Some state standards and frameworks do not resemble the goals and vision outlined in national standards.

Assessments and Accountability

- **Federal No Child Left Behind Act (2001)**
  - Reading and mathematics tests administered to all students in Grades 3 – 8 and a high school grade
  - Science tests to be administered within grade bands (2007-2008)
  - The same assessments used for all students
  - Data disaggregated by gender, ethnicity, socioeconomic status, physical and learning disabilities, limited English proficiency
  - Assessments must be aligned with challenging state standards
  - All students proficient by 2014; schools must demonstrate “Adequate Yearly Progress”

CHANGING EMPHASES IN *ASSESSMENT* OF SCIENCE LEARNING

LESS EMPHASIS ON:	MORE EMPHASIS ON:
Assessing discrete knowledge.	Assessing rich, well-structured knowledge.
Assessing scientific knowledge.	Assessing scientific understanding and reasoning.
Assessing to measure what students do not know.	Assessing to measure what students do know.
Assessing what is easily measured.	Assessing what is most highly valued.
Assessing only achievement.	Assessing achievement and opportunity to learn.
End-of-term assessments by teachers.	Students engaged in ongoing assessment of their work and that of others.



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Requirements for "Highly Qualified" Teachers

- States must place a *highly-qualified teacher* in every public school classroom where core academic subjects are taught (2006)
- *Highly qualified* means that a teacher must be fully certified or licensed, have a bachelor's degree, and show competence in subject knowledge and teaching skills (generally demonstrated by passing a rigorous state test).

Indicators of Teacher Quality

- Research suggests a strong positive correlation between the amount of course preparation in math and science by teachers and the level of student achievement in those subjects.

- But the number of certified high school science teachers has declined steadily during the past 10+ years.

Percentage of High School Teachers Certified in Assigned Fields, 1990 to 2002

	Math	Biology	Chemistry	Physics	Earth Science
1990	90%	92%	92%	88%	n/a
1994	88	90	92	86	81
1998	88	86	89	86	68
2000	86	88	88	85	82
2002	80	83	82	75	72

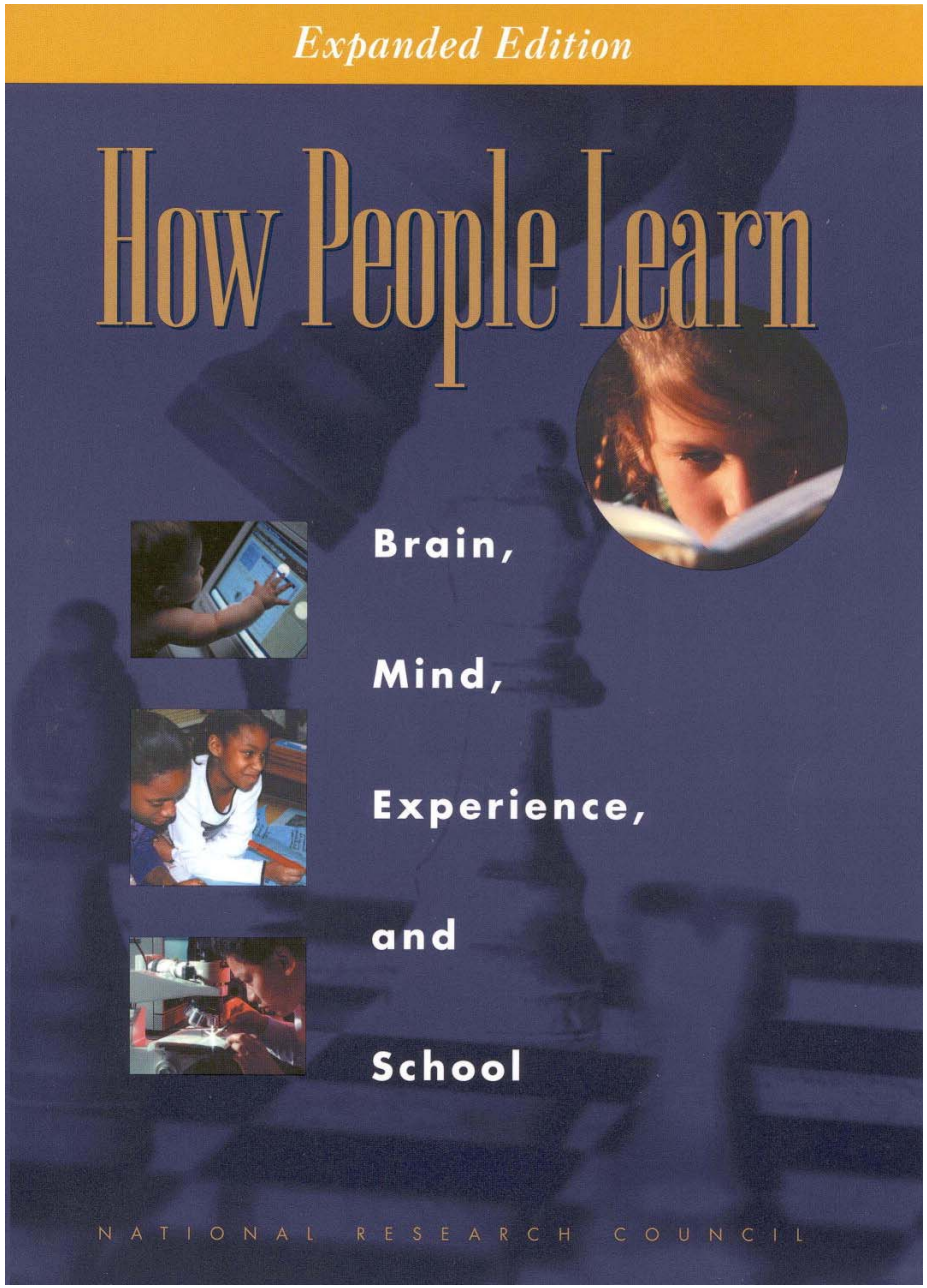
In 2002, only 58% of middle school teachers were certified in science, down 5% since 1992.

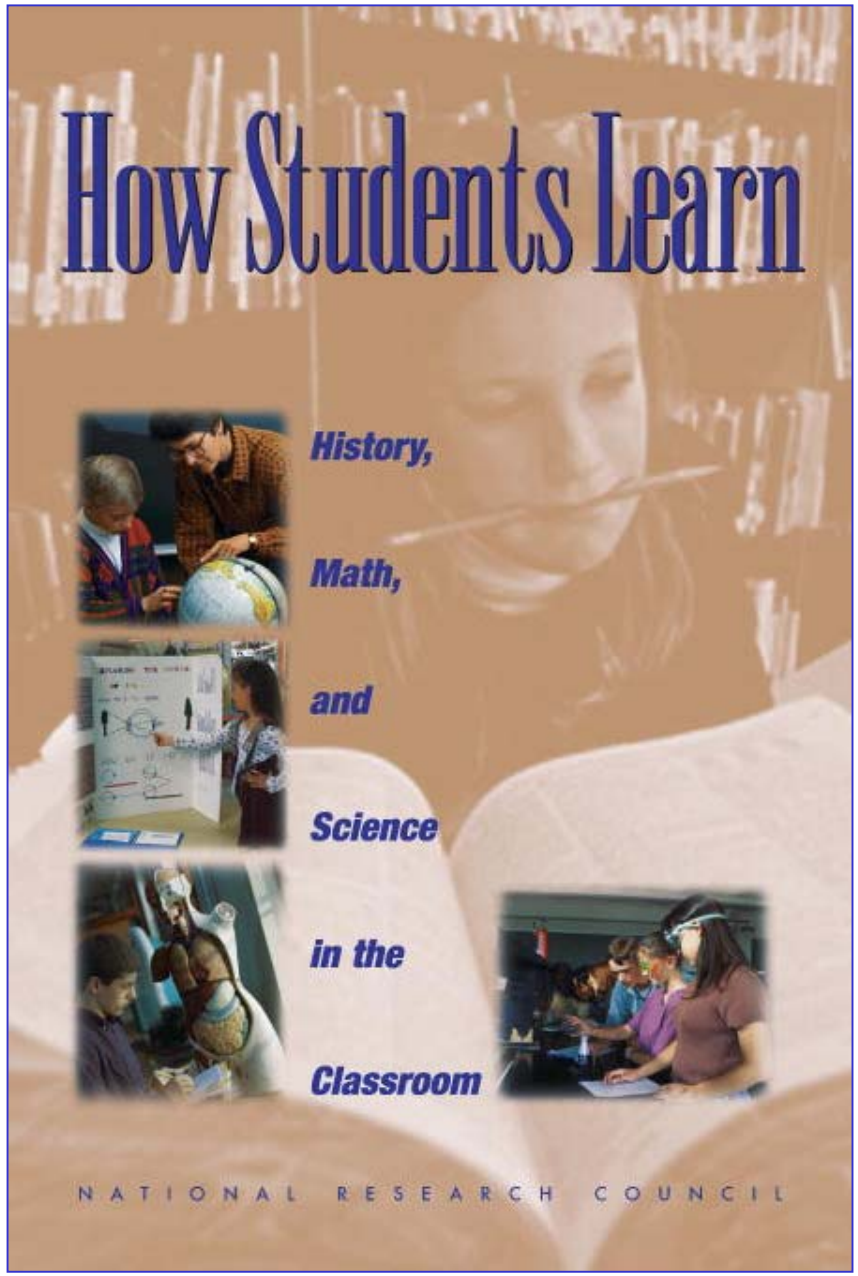
Data from: *State Indicators of Science and Mathematics Education, 2003.* Washington, DC: Council of Chief State School Officers.

Teacher Professional Development and Retention

- In the U.S. 30% of teachers leave the profession after one year of teaching.
- 50% of teachers leave within five years of starting to teach.
- In most states, professional development for teachers is based on policies of districts.

Changing Focus from Teaching to *Learning*





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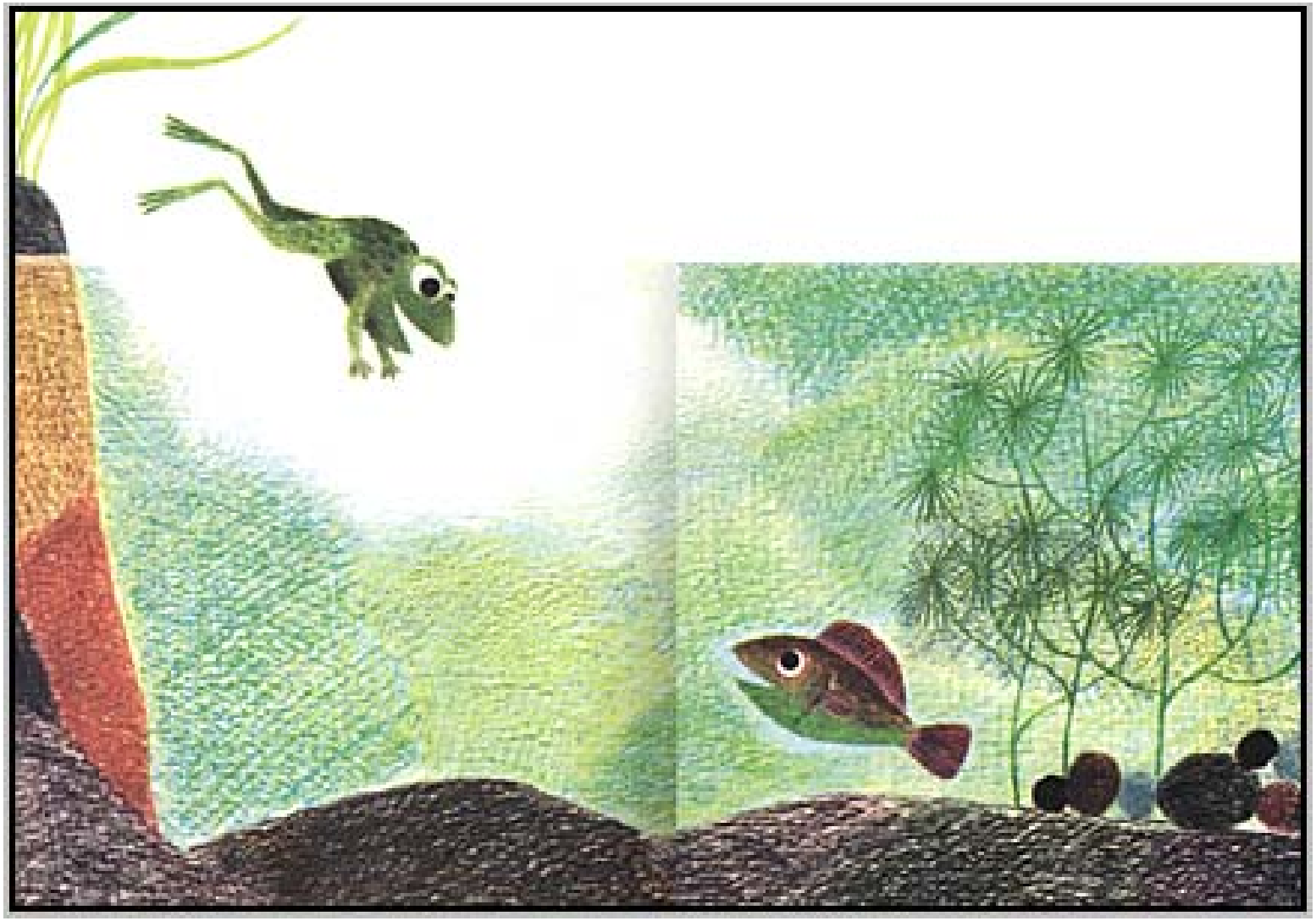
Understanding Students' Preconceptions: Lionni's Fish is Fish



The Fish's Image of Birds

The Fish's Image of Cows

The Fish's Image of People

Higher Education

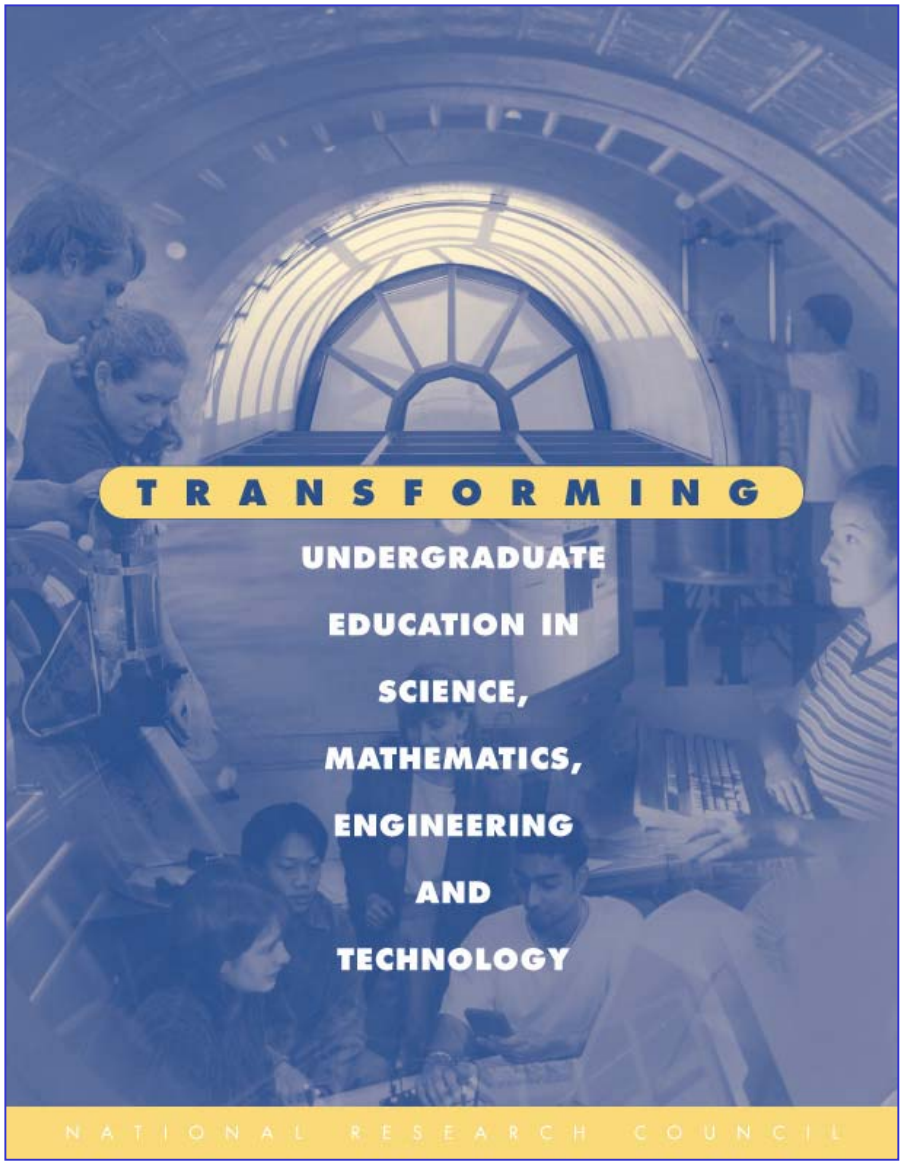
"Not long ago, a college chemistry professor grew angry with the way her daughter's high school chemistry class was being taught. She made an appointment to meet with the teacher and marched with righteous indignation into the classroom—only to discover that the teacher was one of her former students."

Introductory Courses

- We can't be certain which students in introductory courses are likely to be future science, mathematics, or engineering majors, despite their initial declarations.
- Up to 50% of prospective science majors switch majors after the first year.
  - The academic credentials of those students who come to college planning to major in science and then switch *are not significantly different* from those who continue in science.

Higher Education

- Introductory Science Courses
  - Future Science Majors
  - Future Industry Regulators and Policymakers
  - Future artists, historians, journalists…..
  - Future Parents
  - Future Teachers



Regardless of the theme or topic of the course, the common themes might include:

- The scientific and engineering method
- Evidence and Proof
- Science as a "way of knowing" and the limits to such knowledge
- Relationships among basic and applied science and technology
- Connections between the natural and mathematical sciences
- The relationship, relevance, and importance of science to other fields of knowledge and to society Scientific conduct and ethics.

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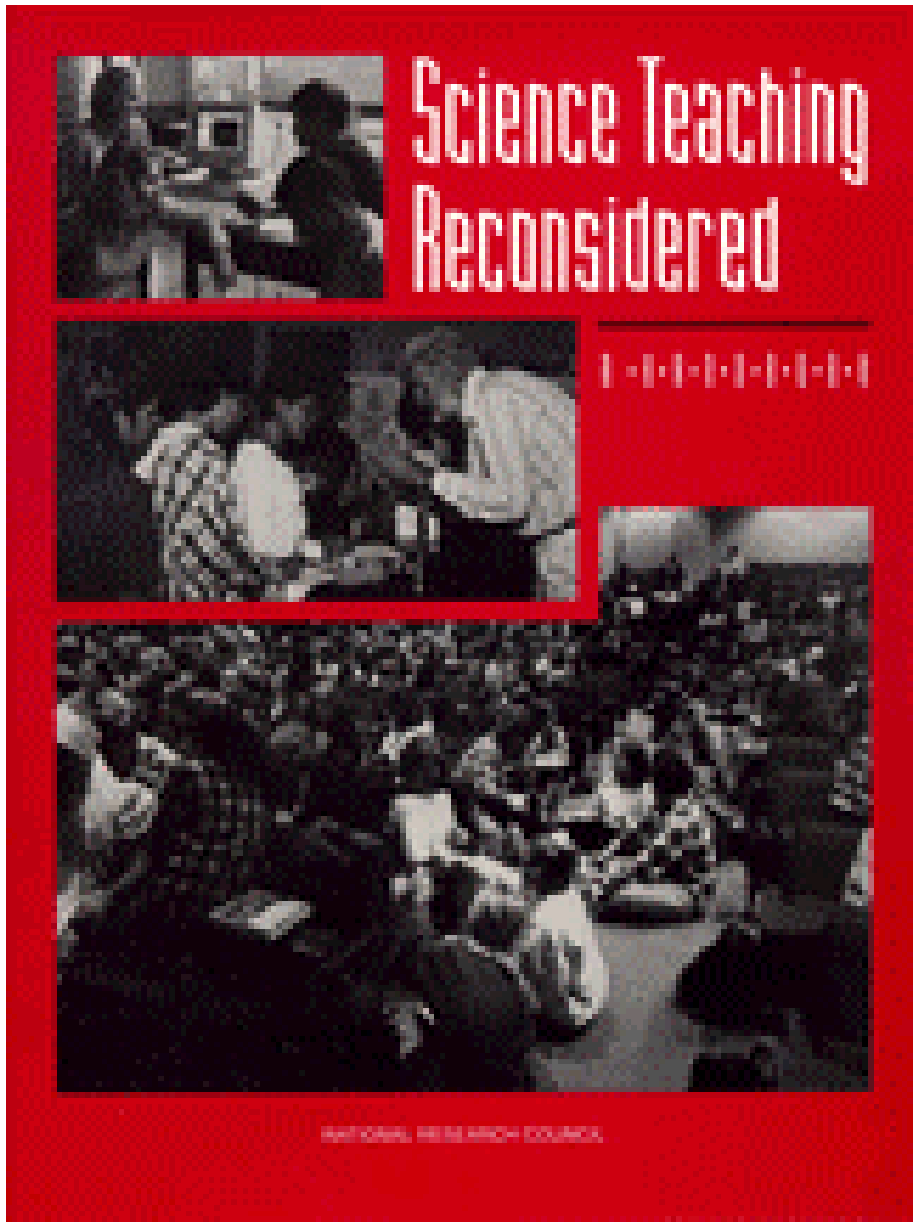

Science Teaching Reconsidered: A Handbook (1997) provides both beginning and more senior faculty with ideas about ways to change their pedagogy.

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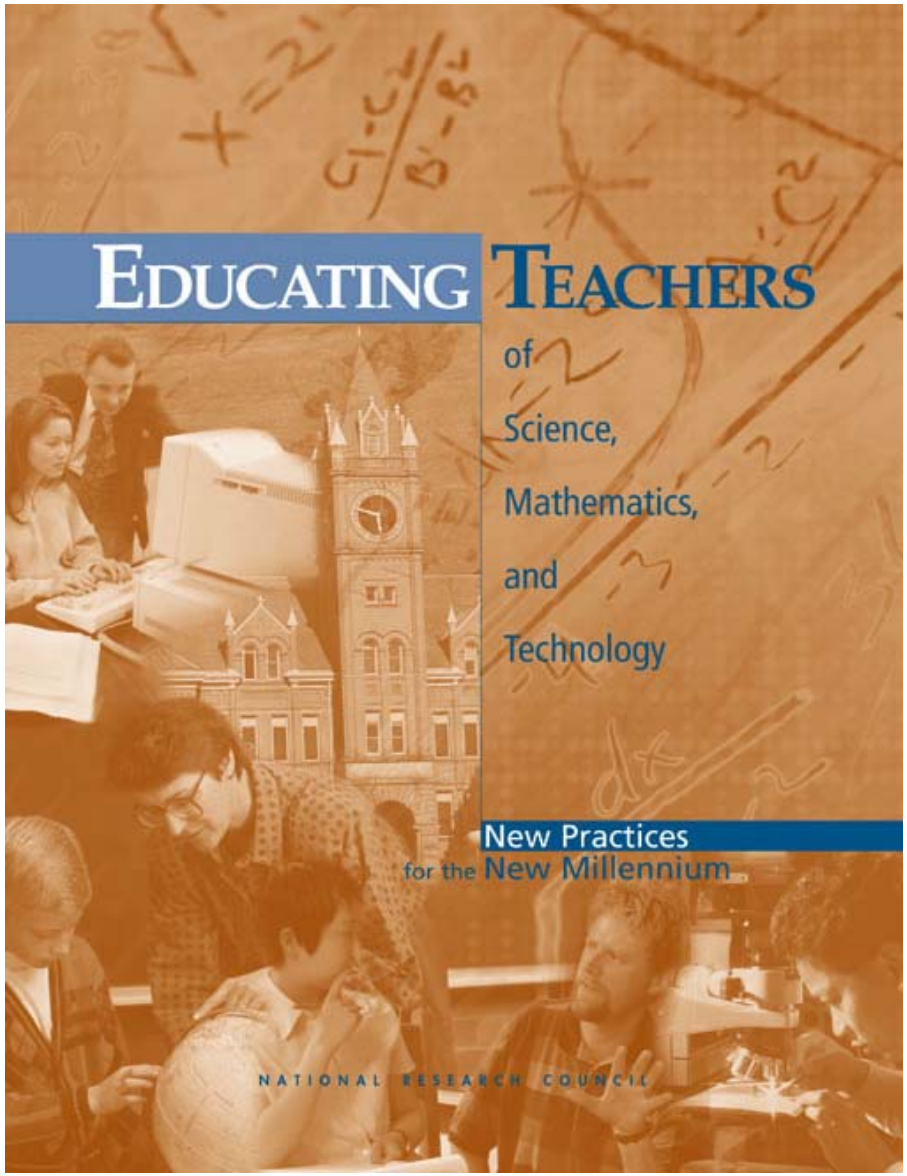

Educating Teachers of Science, Mathematics, and Technology: New Practices for the New Millennium

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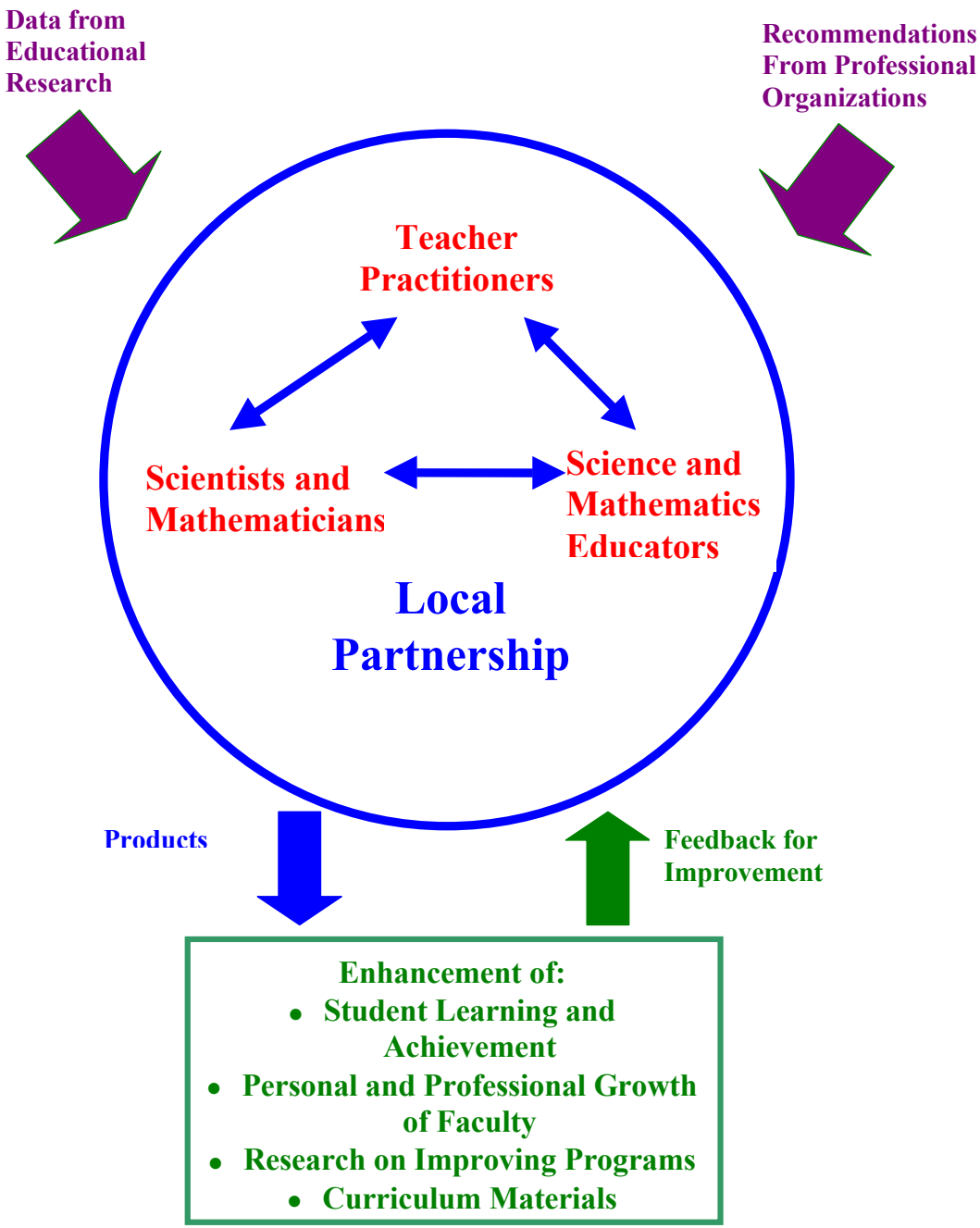
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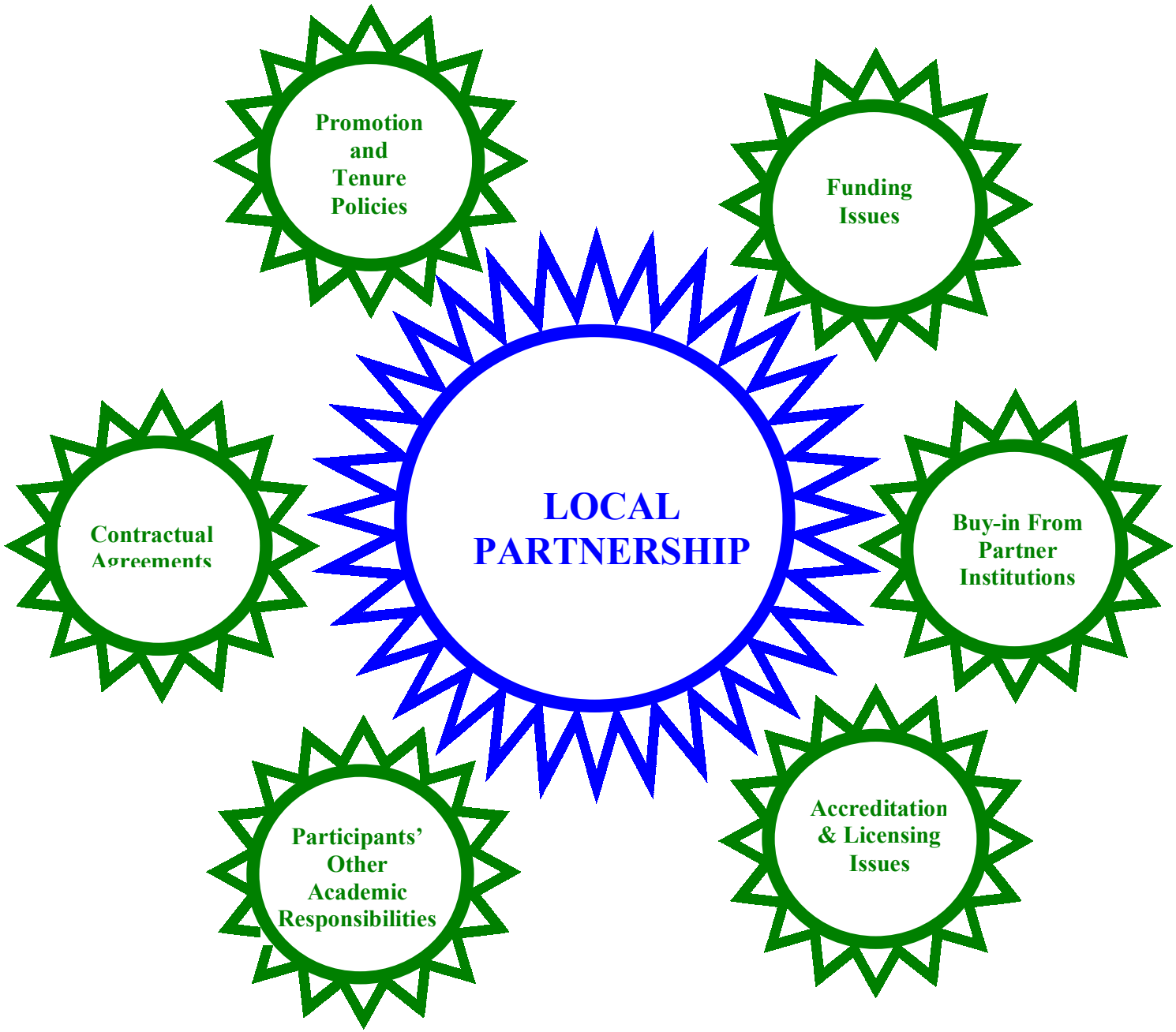
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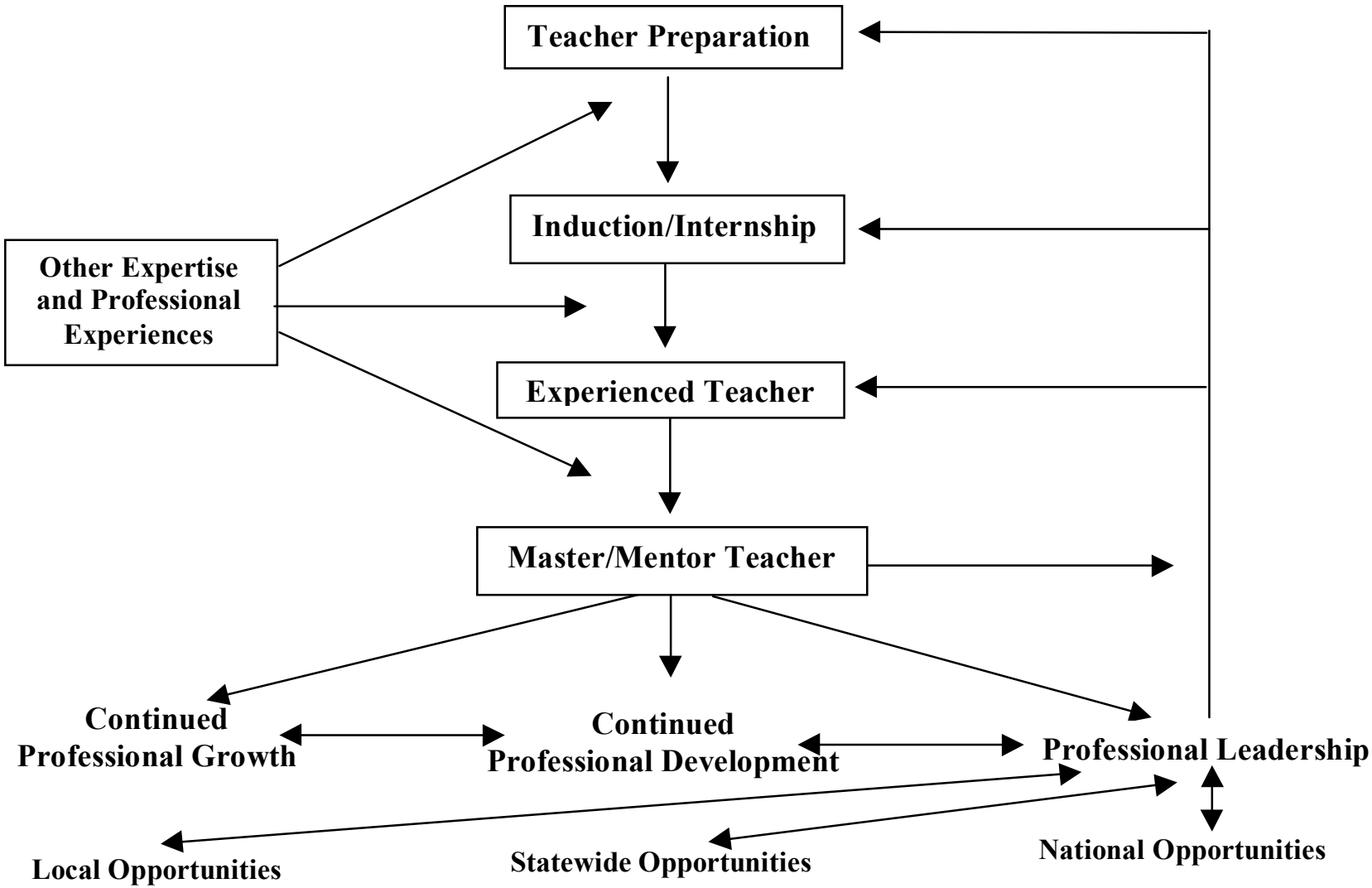

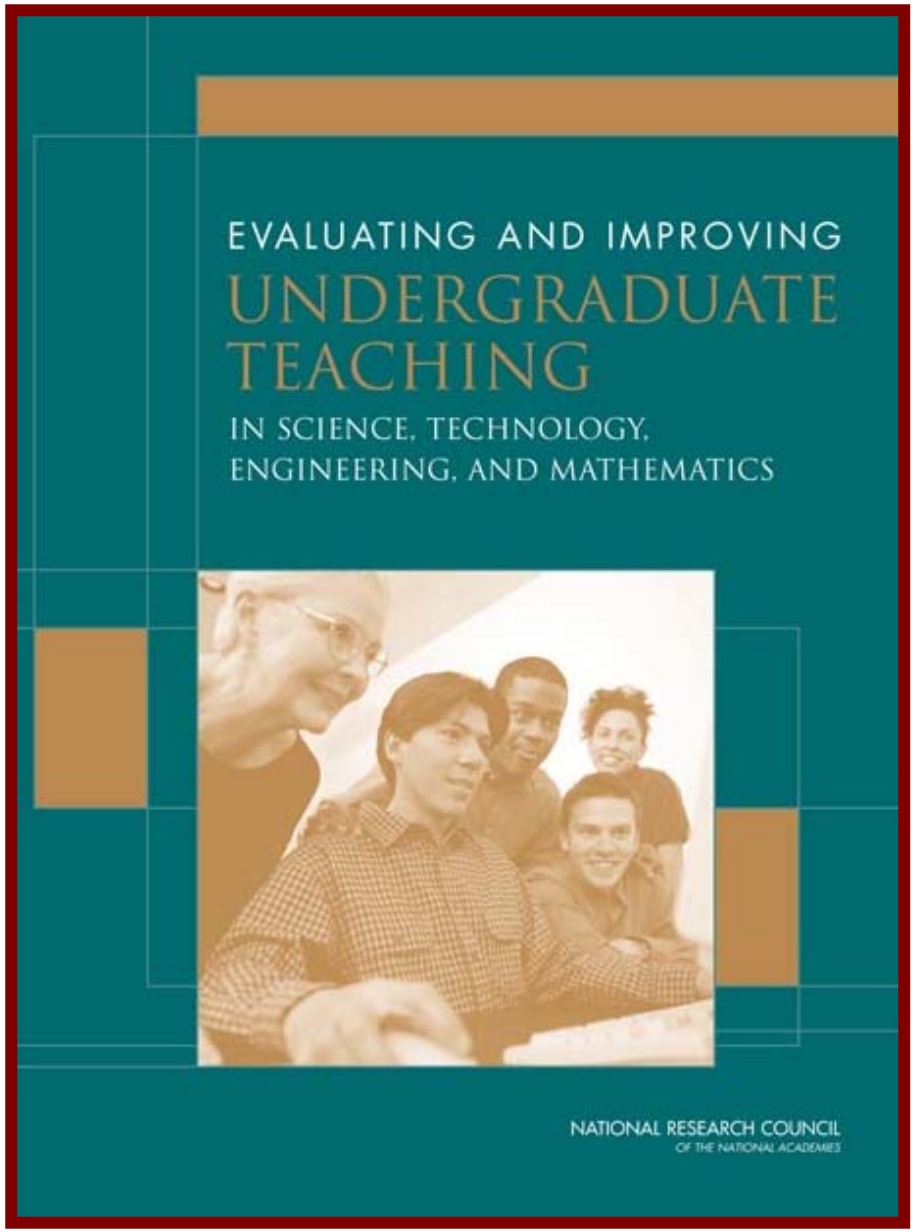

Evaluating and Improving Undergraduate Teaching in Science, Technology, Engineering, and Mathematics (2003)

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National Academies Teacher Advisory Council: Bringing the Wisdom of Practice to Help the Academies Do Better Work in Education

The only thing that interferes with my learning is my education.

Education is what remains after one has forgotten everything he learned in school.