Third Monterrey International Conference

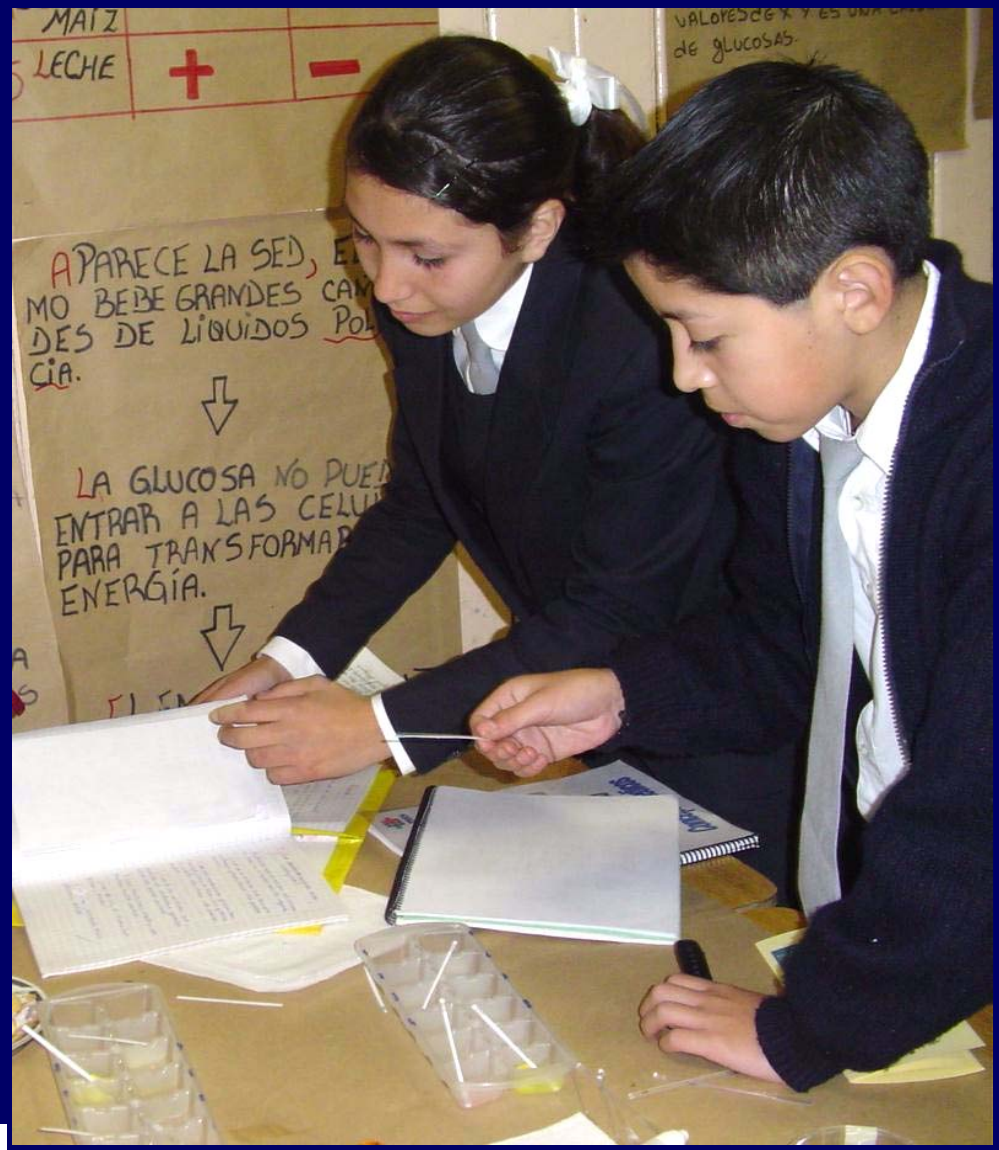
March 16-18-2005

National Science Resources Center

Smithsonian Institution *National Academies*

Background

- Established in response to the report “A Nation At Risk”
- Mission is to improve student performance in science in school districts in the U.S. and throughout the world
- Strategy is to use the two most prestigious scientific institutions to leverage change in school



Context

National and state standards

International, national, state, and local tests

Instability in schools and districts

Textbook adoptions processes

Majority of people that do not value science and teaching

NSRC's Strategic Business Goals

- Champion public understanding of research - based science education programs with officials in the United States and abroad.

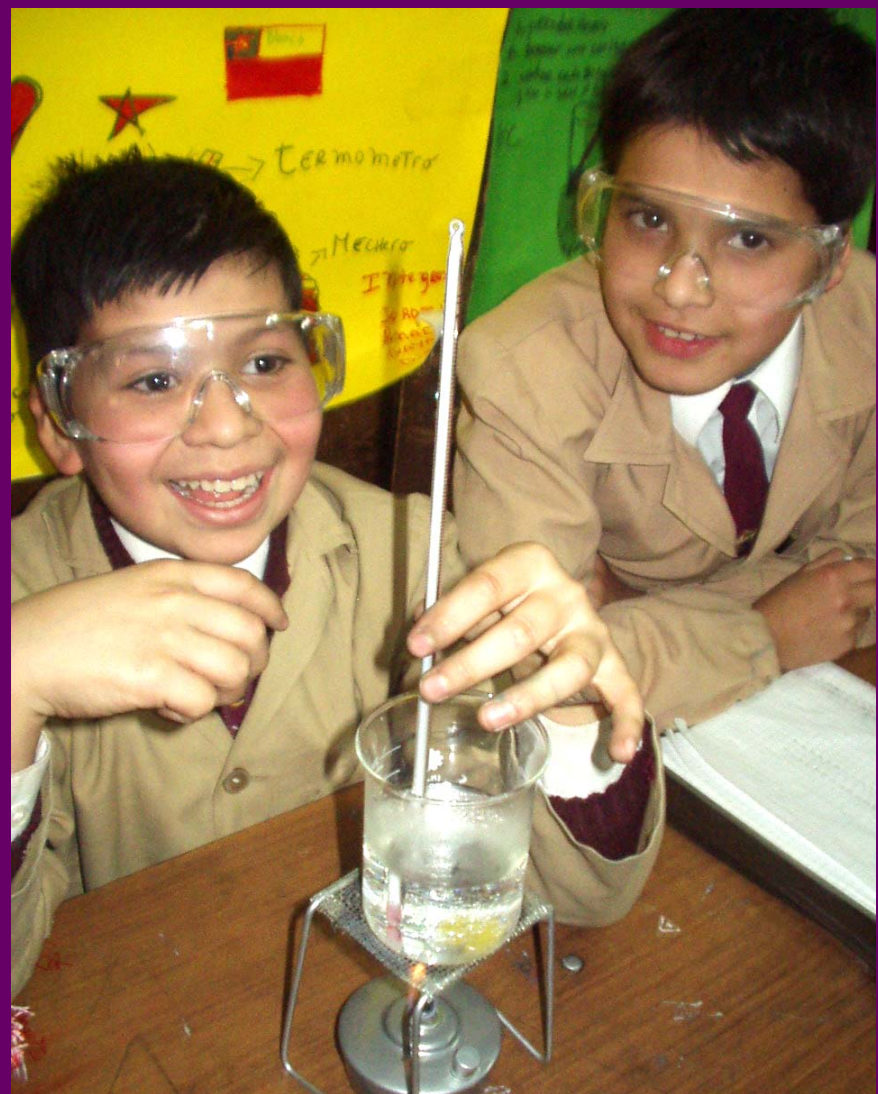
- Assist school districts representing twenty percent of the U.S. K–12 student population to sustain the implementation of their science programs based on research and best practices.

NSRC's Strategic Business Goals

- Engage school districts representing an additional twenty percent of the U.S. K–12 student population to improve their science programs based on research and best practices.
- Work with other countries to develop scientific and leadership capacity in the establishment of research-based science programs.

NSRC's Centers of Excellence

- **Leadership and Assistance for Science Education Reform (LASER) Center**
- **Curriculum Development Center**
- **Professional Development Center**



Leadership and Assistance for Science Education Reform Center

Assists school districts, regions, states, and countries in initiating, implementing, and sustaining research-based K-12 science programs in their communities

Curriculum Development Center

Develops and disseminates research-based curriculum programs and supplementary materials

Professional Development Center

Provides products and services to teachers seeking science content and pedagogical knowledge

Measures of Effectiveness

- Increased student achievement in science, mathematics, and language arts

- Development of more than 60 partnerships with business, industry, and academic institutions that are leveraging change with 750 school districts

Measures of Effectiveness

Adoption of NSRC Theory of Action in several countries throughout the world

Increased public understanding of the value of science and science education

New Directions

- Research
- High School
- Mathematics Reform

Framework for Remarks

Professional Development
Themes for Conference

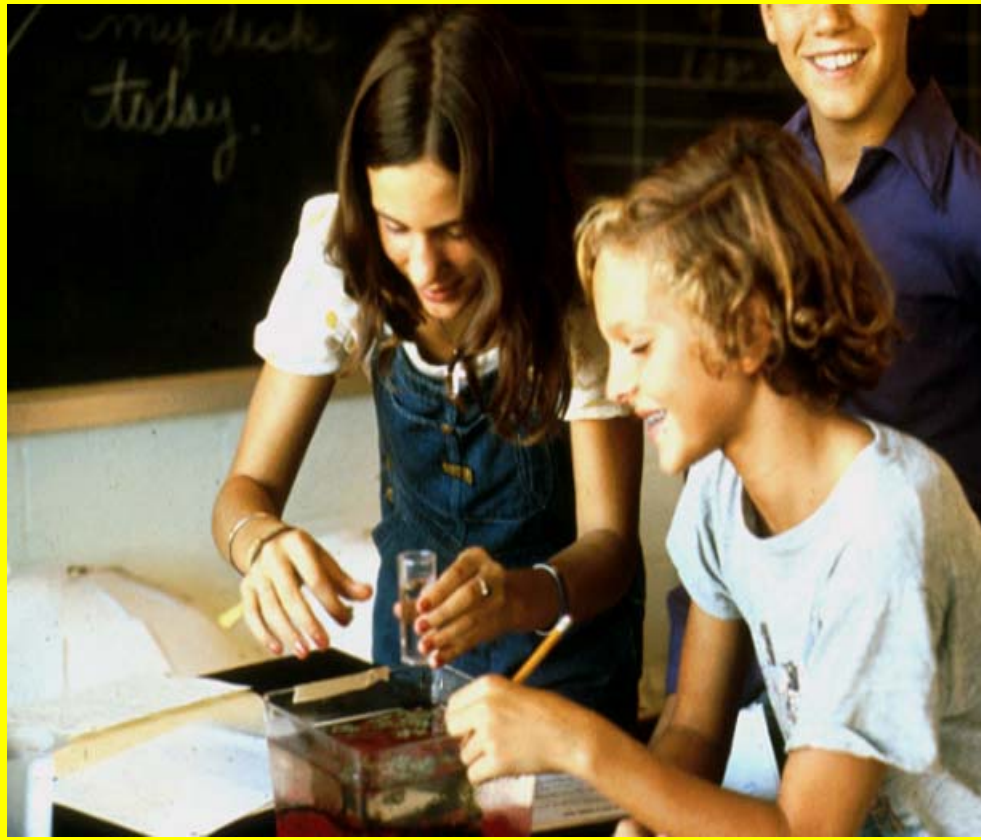
- Designing and implementing programs
- In-service programs
- Classroom support
- Pre-service
- Leveraging expertise
- Web support
- Roles of community, administrative, and parents

Outline of Remarks

Why do our students need to learn differently?

What factors should be considered in designing and implementing professional development programs for teachers of science that will lead to new learning environments that are motivating and productive for students?

Where are there opportunities for action and research?



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Research about learning

Research on *How People Learn*

- **Need to draw out and work with preexisting understandings that both students and teachers bring to learning**

Research on *How People Learn*

- Need to learn some subject matter in depth providing many examples in which the same concept is at work and providing a firm foundation of factual information
- Need to learn metacognitive skills
- Need to apply knowledge and skills to new problem

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What does learning look like for students and teachers when this research is translated into practice?

What are the characteristics of effective learning environments?

Characteristics of Effective Learning Environments

- Learning takes into account prior knowledge
- Provides first-hand , in-depth experiences with science phenomena
- Develops understanding of science concepts in a real-world context
- Fosters the development of scientific attitudes

Characteristics of Effective Learning Environments

- Helps students develop scientific reasoning skills and the ability to solve practical problems.
- Develops effective communication skills.
- Develops abilities for teamwork.
- Creates active and life-long learners

Characteristics of Effective Learning Environments

- Emphasizes authentic performance
- Develops structures to support democratic learning
- Has connections to family and community

What factors should be considered in designing and implementing professional development programs for teachers of science?

Research about learning

Research about effective teaching

What do teachers need to know and be able to do?

Learning

- Knowledge about research about how people learn
- Pedagogical content knowledge about inquiry and design
- Knowledge about motivation

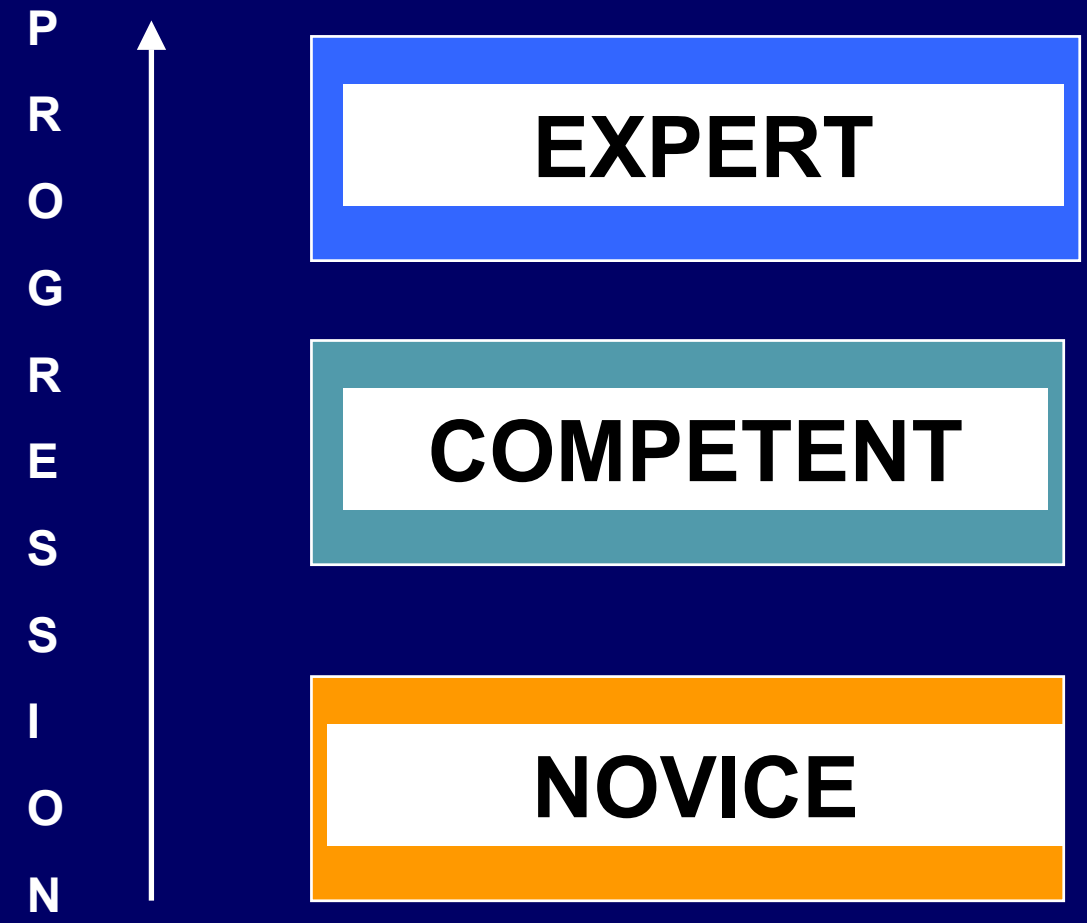
Teaching

- Conceptual knowledge of science
- Knowledge of how to use multiple representations of content
- Knowledge of how students read and write for conceptual understanding
- Knowledge about effective instructional materials and technologies
- Skill in using collaborative learning techniques
- Capacity to work collectively and reflect on practice with other teachers

Assessment

- Knowledge of how to teach students to assess and monitor their learning
- Knowledge about how to effectively use formative assessments of learning

Expertise



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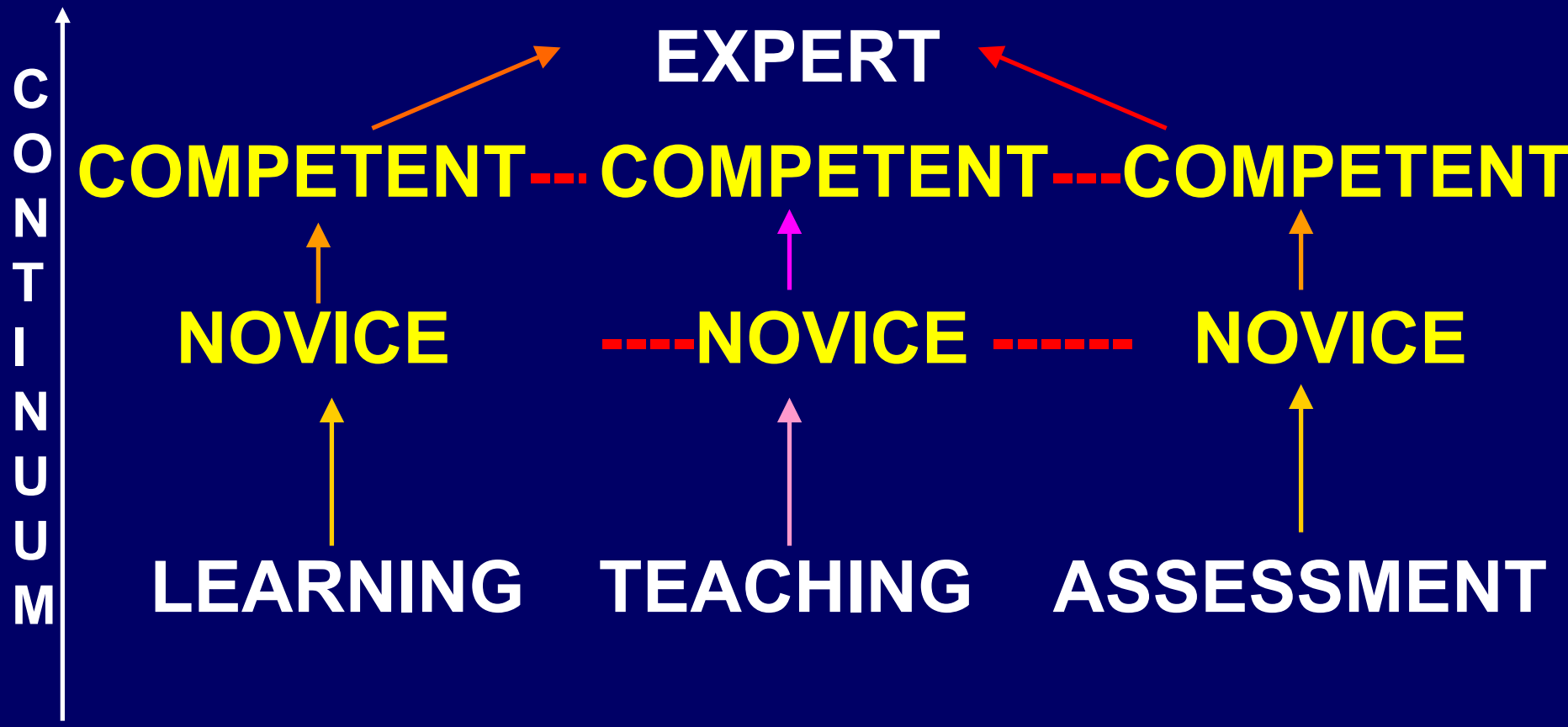
Development of Expertise



Stages of Expertise

Novice

- Has acquired some knowledge of factual information about a science discipline, inquiry, and assessment
- Lacks knowledge and experience required to understand the relationship of factual information to science concepts and inquiry
- Uses instructional strategies that lack an understanding of how students develop conceptual understanding of science concepts

Stages of Expertise

Novice

- Lacks familiarity with practiced routines.
- Performs tasks that are context-free.
- Behaves rationally with little flexibility.

Stages of Expertise

Competent

- Has acquired proficient knowledge of factual information about a science discipline and inquiry
- Understands the relationship of factual information to science concepts and is developing a deep conceptual understanding of science concepts

Stages of Expertise

Competent

- Uses instructional strategies that begin to help students develop conceptual understanding of science concepts while developing critical-thinking and problem-solving skills
- Makes conscious choices about what to teach.
- Sets priorities, goals, and plans.
- Delivers reasonable instruction.

Stages of Expertise

Expert

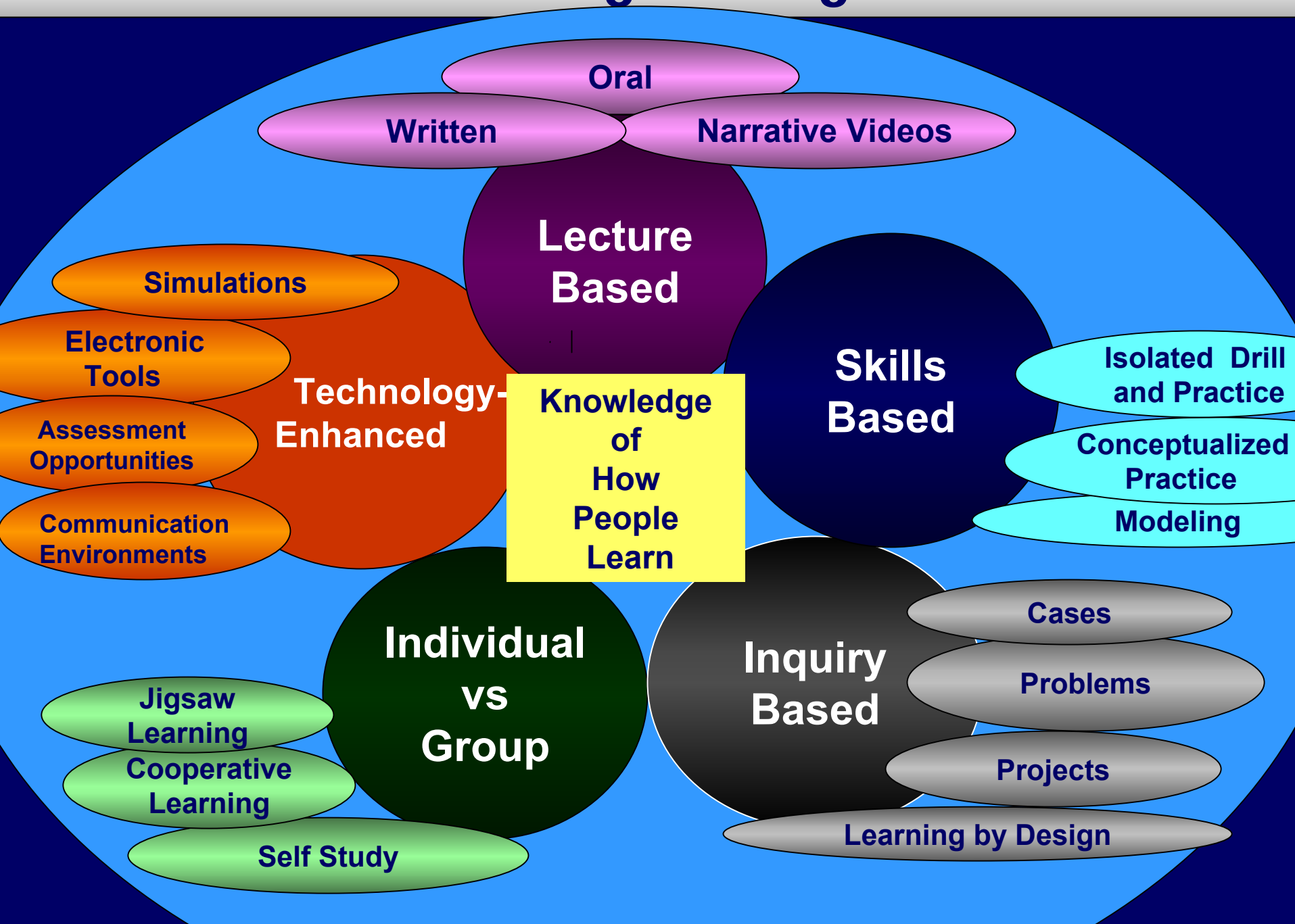
- Consistently uses instructional strategies that are designed to help students develop and assess their understanding of science concepts
- Uses both analytical thought and intuition.
- Shows fluid performance.
- Knows what to do and when to do it.

Stages of Expertise

Expert

- Has comprehensive knowledge of factual information about a science discipline and inquiry
- Understands the relationship of factual information to science concepts
- Can efficiently use and acquire new information about important science concepts

Teaching Strategies

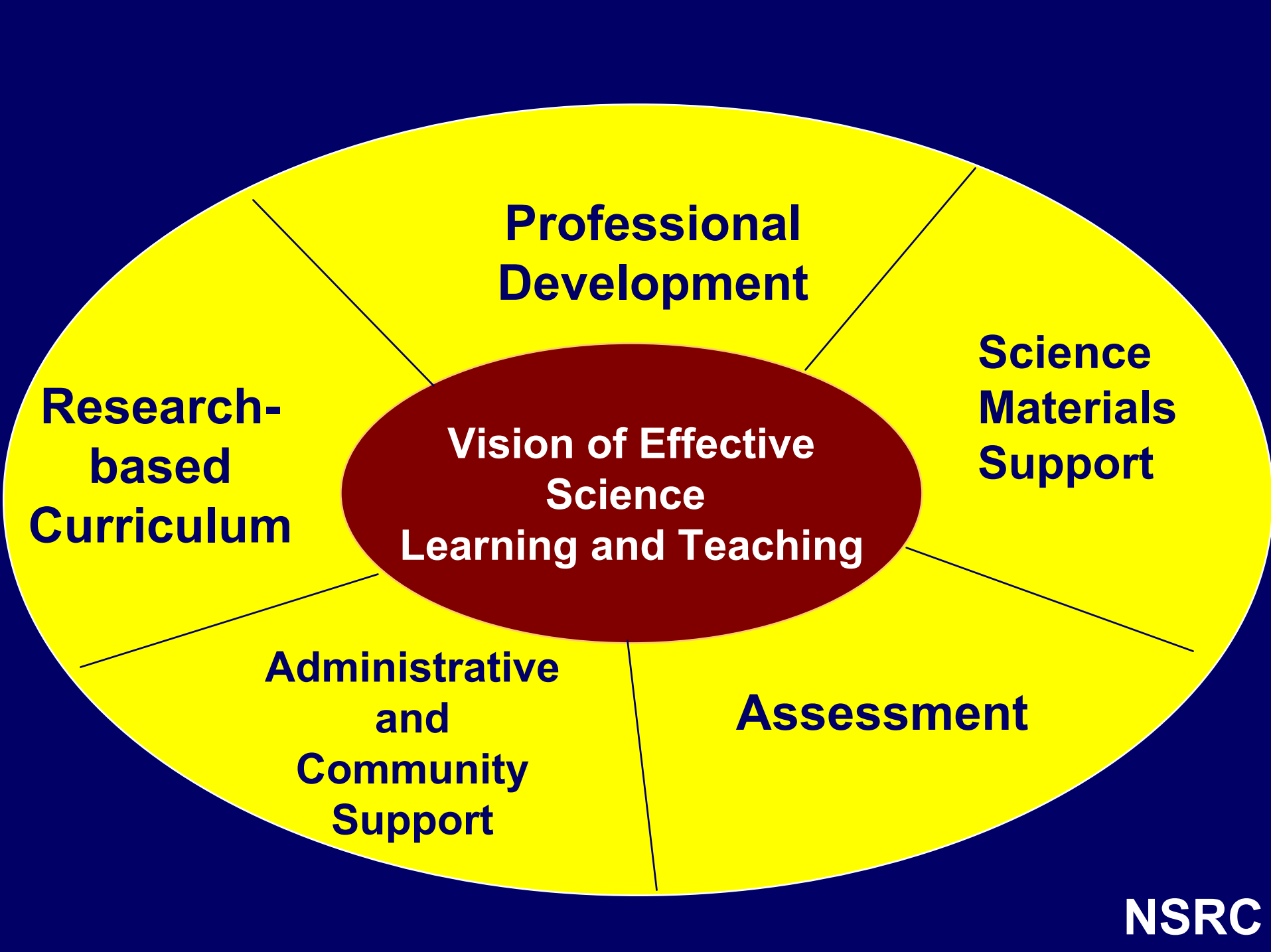


What factors should be considered in designing and implementing professional development programs for teachers of science?

Research about learning

Research about effective teaching

Research about Systems


Professional Development
Science Materials Support
Assessment
Administrative and Community Support
Research-based Curriculum
Vision of Effective Science Learning and Teaching

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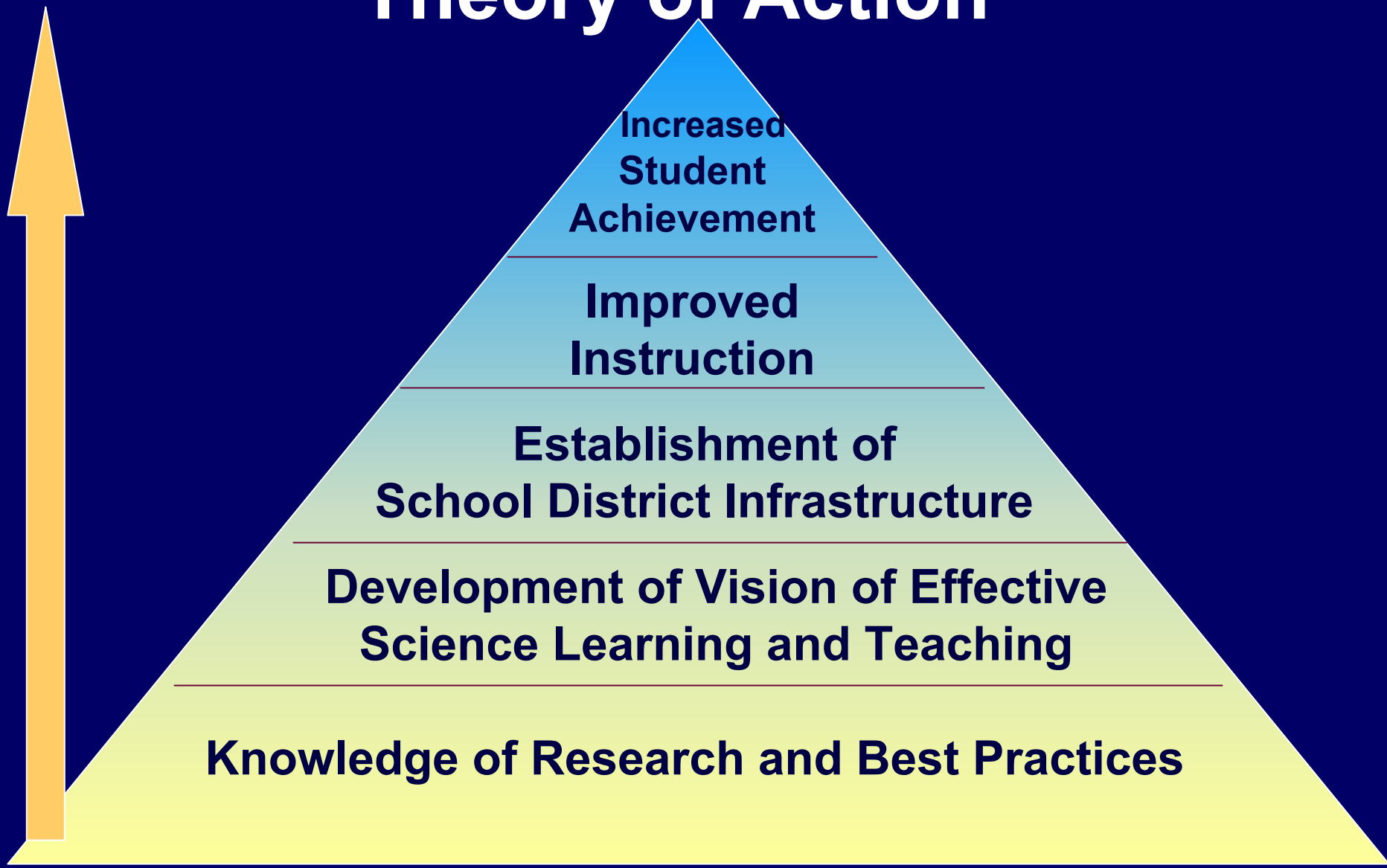
NSRC Science Education Reform Theory of Action



Stages of Work

Initiation Phase

Implementation Phase

Institutionalization Phase

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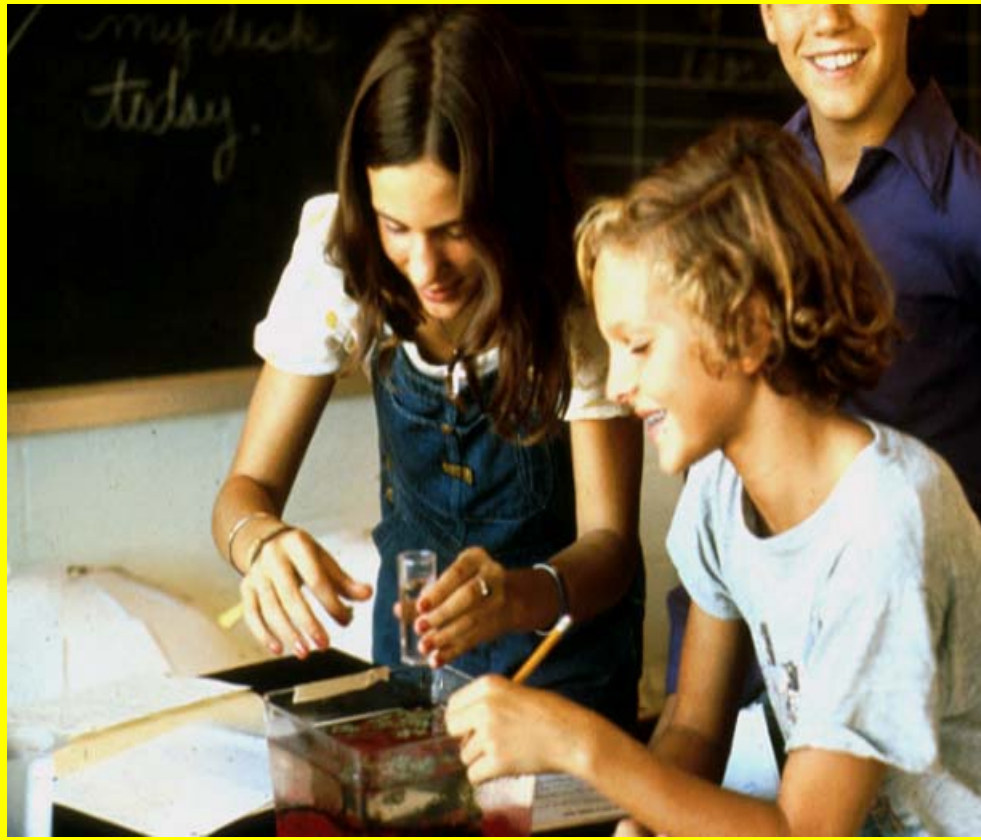
Implications for Professional Development Programs

- **What evidence will you look for in the design and delivery of programs to demonstrate they are being informed by research about learning, teaching, and assessment?**
- **How will your programs for teachers be differentiated to help teachers move from becoming novice to competent?**
- **How will you ensure that you are employing a systems approach?**
- **What strategies will you use to establish to create leadership, build capacity, and create a learning community?**

Outline of Remarks

- Why do our students need to learn differently?
- What factors should be considered in designing and implementing professional development programs for teachers of science that will lead to productive learning for students?
- Where are there opportunities for action and research?



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www.nsrconline.org


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