National Science Resources Center

THE NATIONAL ACADEMIES Smithsonian Institution

2006 NATIONAL LASER MIDDLE SCHOOL SCIENCE EDUCATION PLANNING SYMPOSIUM

HELPING SCHOOL DISTRICTS DEVELOP MIDDLE SCHOOL SCIENCE EDUCATION PROGRAMS THAT ALIGN WITH SCIENCE STANDARDS

December 5 - 9, 2006
Birmingham-Jefferson Convention Complex
Birmingham, Alabama

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National Science Resources Center

The National Science Resources Center (NSRC) is an organization of the Smithsonian Institution and the National Academies—the National Academy of Sciences, the National Academy of Engineering, the Institute of Medicine, and the National Research Council. The establishment of the NSRC by two of the nation's most prestigious institutions provides the United States with a unique resource for catalyzing change in science education. Knowledge of research and application of best practices are critical to the development of effective NSRC programs. Both the Academies and the Smithsonian provide the NSRC with access to research and scientific and engineering expertise to inform its services and products.

Leadership and Assistance for Science Education Reform

Beginning in 1985, the NSRC has made a significant contribution to the reform of science education in the nation's schools. One of its most important functions is outreach to school districts—providing leaders with access to research and best practices for developing a vision of effective science learning and teaching and helping them plan, implement, and sustain quality programs for all students.

Building on more than a decade of work, the Leadership and Assistance for Science Education Reform (LASER) Center was launched in 1998 to leverage reform through the development of partnerships with school districts, corporations, foundations, museums, and academic institutions. The strategic work of the LASER Center and its partners is based on a shared vision, informed by research, guided by the NSRC theory of action, and continuously improved to have the maximum impact on student achievement.

Since 1998 through LASER strategic planning institutes, 774 school districts representing more than twenty-two percent of the U.S. student population have participated in weeklong LASER K–8 Science Education Strategic Planning Institutes to develop five-year strategic plans for reforming their K–8 science education programs. The plans are research-driven, focused, incorporate best practices, and are based on a results-oriented systems approach to organizational change.

An estimated 90% of school districts that have participated in NSRC K–8 Science Education Strategic Planning Institutes are implementing their strategic plans and making significant progress in establishing effective K–8 science education programs for all students in their communities.

Sponsors of the NSRC LASER Center

Funding for the LASER Center comes from a combination of participant fees and contributions from corporations, private foundations, science curriculum publishers and government agencies. These contributors are:

Bristol-Myers Squibb Foundation, Inc.
Carolina Biological Supply Company
Delta Education
DuPont
Hewlett-Packard Company
The Lucent Technologies Foundation
Merck Institute for Science Education
The Robert Wood Johnson Foundation
Shell Oil Exploration & Production Company
Burroughs Wellcome Fund
New York State Department of Education

The NSRC would also like to acknowledge the following corporations for their financial support to leadership teams for the 2006 National LASER Middle School Planning Symposium.

Shell Oil Exploration & Production Company

The NSRC Science Education Reform Philosophy

The NSRC philosophy of science education reform is results-oriented and based on research in cognitive development, theories of organizational change, and the impact of program activities on student achievement. It is further enriched by an in-depth understanding of the unique culture of school systems. Major tenets of the NSRC philosophy center on particular understandings of the student, the science curriculum, and the infrastructure necessary to enable successful reform.

Using these tenets, the NSRC has researched, developed, and tested a theory of action over the past 15 years. An integral part of the theory of action is the NSRC reform model, which provides a conceptual framework for helping school districts build the local infrastructure or system needed to support an effective inquiry-centered science education program. The NSRC's philosophy about students and a description of the reform model follows.

The Student

All students can learn science.
Students learn science best in an inquiry-oriented environment that challenges them to build on their previous knowledge and skills.
Student learning experiences must be developmentally appropriate.

The NSRC Model of Science Education Reform

Curriculum. A comprehensive, inquiry-centered curriculum lies at the heart of an effective science program. The curriculum design must provide age-appropriate opportunities for children to expand their conceptual understanding of important science ideas, acquire problem-solving and critical-thinking skills, and develop positive habits of mind toward science. The science curriculum should combine hands-on, inquiry-centered investigations of scientific phenomena with opportunities for reading and reflection and for discussion and analysis, with time for writing and independent study. Science curricula must offer students opportunities to apply newly learned concepts and skills to their everyday lives and to integrate science with other areas of study. An effective curriculum incorporates the critical implementation needs of both teachers and districts, aligns with the National Science Education Standards, and is developed using a rigorous research and development process. This process needs to include field testing with geographically and ethnically diverse student populations representing urban, rural, and suburban districts throughout the country; assessment of the materials by an external evaluator; and technical review by master teachers and scientists and engineers to ensure their scientific and educational integrity.

Professional Development. Competent teachers combined with challenging curriculum increase the potential for increased student achievement in science. To help teachers become competent, they need to become aware of the characteristics of an effective

The NSRC Science Education Reform Philosophy, *cont.*

teacher of science and value the content and skills they will need to acquire. To assist teachers with this process, professional development programs need to help teachers assess their knowledge and skills and use this data to provide differentiated professional development for novice, competent, and expert teachers. For teachers with little to no science background and no experience in using inquiry-centered methodologies, programs initially need to focus on helping teachers become familiar with fundamental science concepts, using inquiry-centered science materials in their classrooms, and developing effective classroom management techniques. After teachers become novices, attention then needs to focus on helping them acquire in-depth knowledge of science content, continuously refining the inquiry-centered approach to learning, developing appropriate methods for student assessment, and integrating science with other subject areas within the overall school curriculum. The strategies used to accomplish these goals need to be based on research, use best practices, and center on building a learning community.

Student and Program Assessment. For the teaching of research-based science programs to be effective, assessment strategies used by teachers, districts, and states need to be aligned with instruction, seen as integral and important to the learning process, and use a variety of methodologies. The science curriculum program needs to incorporate pre-assessment, embedded, and post-assessment strategies that continuously evaluate students' conceptual understanding and skills, including their prior knowledge and skills and progress students are making in achieving the goals of an instructional unit. The assessment strategies need to be designed to have students assess their own progress in learning important science concepts and skills, and to help teachers examine and modify instruction. Pre-assessment strategies need to be designed to evaluate the knowledge and skills students have before beginning the study of an area of science, such as a unit on light or electric circuits. Embedded assessments need to be interwoven throughout the learning process to provide both teachers and students with a way to evaluate progress. Final assessments should be designed to assess what students know and are able to do as a result of their inquiries.

Program evaluations are needed to determine whether the science program is accomplishing its goals. Evaluations need to be designed to incorporate both a formative and summative component and should be conducted both internally and externally. The formative evaluation component should focus on the quality and effectiveness of the science program activities. Strategies should provide quantitative and qualitative data for guiding the entire implementation process ranging from the curriculum piloting and selection, the professional development of teachers, an assessment program that aligns with science instruction, the establishment of the materials support system, and other activities that will lead to the sustainability of the effort.

The summative component needs to focus on the impact the program is having on student learning, beginning with the development of baseline data on students' attitudes, knowledge, and skills as well as teachers' attitudes, knowledge, and skills in teaching inquiry-centered science.

The NSRC Science Education Reform Philosophy, *cont.*

Materials Support. Students who engage in inquiry-centered science need a variety of science materials—from hand lenses to magnets to plastic eyedroppers. A materials support system is needed to ensure that science materials are ready for classroom use throughout the year. An effective system for supplying supplies and equipment for teachers of science needs to have efficient methods for ordering new supplies, refurbishing science kits, and ensuring that the materials are delivered to teachers systematically. Centralizing the materials support function makes materials support activities more cost-effective and should be designed to provide a service to teachers and increase quality assurance. Centralization most commonly occurs at the school district level; small school districts can consolidate their materials support services by forming a consortium.

Administrative and Community Support. Planning and implementing an inquiry-centered science program requires the support of a broad range of stakeholders, including students, teachers, parents, school district administrators, and community officials representing school boards, corporations, museums, academic institutions, parent organizations, and other groups working to improve science learning and teaching. These individuals and groups need to share a vision of effective science learning and teaching and what is needed to create an effective infrastructure to establish a sustainable inquiry-centered science program for all students in their school districts. To build an effective infrastructure, the community needs to establish a vertical team of leaders representing the school district and the community. These leaders need to be committed to spearheading a K–12 science education reform effort, including educating themselves about inquiry-centered science learning and teaching. This education process needs to include their participation in hands-on workshops modeling effective science instruction, visiting classrooms of competent teachers of science, and reviewing the research providing evidence of how people learn. This leadership team needs to take the time to develop a strategic plan with a systemic approach that should be based on research, incorporate best practices, and employ strategies for tracking progress and continuously improving work in five critical areas: curriculum; professional development programs for teachers; science materials support; assessment; and community and administrative support. The infrastructure needs to have local and state policies that support an effective science program, including a policy defining science as a core subject of the K–12 curriculum.

To engage a broad range of district and community leaders, support programs need to provide a variety of ways that individuals and organizations can become involved and add value or quality to the district's science program. For example, scientists and engineers, as well as parents, can help leverage support for science education reform. Scientists also can work as colleagues with teachers in the design and implementation of professional development programs. Parents may volunteer time to help replenish A corporate leader may serve as a spokesperson for science education reform with the business community. Working together, these individuals should form partnerships that will improve the quality and ensure a sustained commitment to the science education program.

Overview

The 2006 National Leadership and Assistance for Science Education Reform (LASER) Middle School Planning Symposium will help prepare and educate leaders to implement research based science education programs for all students within their community. The thirteen leadership teams participating in this institute enroll about 77,957 students. Sixty-six percent of these students are members of minority groups, and sixty-three percent are eligible for federally subsidized lunch.

This 57th NSRC leadership institute builds upon 18 years of leadership development to advance science education reform in the country and throughout the world. Since 1989, more than 1200 leadership teams representing 774 school districts have participated in NSRC institutes. These school districts are in various stages of implementation of the strategic plans they developed at the institutes. Together, these school districts enroll more that twenty-two of the U.S. student population. In addition to the U.S. teams, representatives from eighteen different countries and U.S. territories have taken part in NSRC institutes.

The work of school districts who have attended previous institutes and where the NSRC's theory of action has been implemented with fidelity have shown that students' performance in science will improve. For example:

- All Delaware districts have developed five-year strategic plans while attending NSRC science education strategic planning institutes. As a result of this work, Delaware has closed the achievement gap in science at grade 4 and has made progress in obtaining similar data for grade 8.

- ASSET Inc., located in Pittsburgh, Pennsylvania, is also serving as a model for national and state science education reform efforts.. A 2003 study found a direct link between teacher professional development and use of inquiry-based science materials with increased math and literacy scores of students taking the Pennsylvania System Student Assessment (PSSA).
- Additional case studies from Washington State and Oklahoma show solid evidence that effective professional development of the type supported by LASER has a positive impact on student achievement.

Copies of these reports can be obtained by request to the NSRC at nsrcoutreach@si.edu

Goals

Participants will learn about current research, models of reform, and resources for middle school science education reform to be applied to the development of a strategic plan. Through an intensive program of interactive workshops and discussions, teams will:

- Explore current research on how middle school students learn.
- Explore inquiry learning and teaching.
- Examine inquiry-based curriculum materials and the research supporting the use of these materials in middle school classrooms.
- Address the five elements of reform through the lens of middle school science:
  - Curriculum—Science curricula that are based on the National Science Education Standards and are produced through a careful research and development process
  - Professional Development—Programs that prepare educators to teach inquiry-centered science and that consider professional growth to be a long-term process
  - Materials Support—Cost effective systems for supplying science equipment and materials to classrooms
  - Assessment—Strategies that align the evaluation of student performance with the goals of an inquiry-centered science program
  - Administrative and Community Support—Strategies for building and sustaining district and community support
- Receive technical assistance in the strategic planning process and network with experts and peers involved in middle school science education reform.

Leadership Teams

Alabama

1. Jefferson County Board of Education, Birmingham
2. Phenix City Public Schools, Phenix City
3. Trussville City Schools, Trussville

Arkansas

4. Van Buren School District, Van Buren

Connecticut

5. East Lyme School District, East Lyme

Florida

6. Marion County School District, Ocala

Louisiana

7. The Dunham School, Baton Rouge

South Carolina

8. Horry County Schools, Conway

Texas

9. Houston Independent School District, Houston
10. Houston Independent School District, Houston
11. Houston Independent School District, Houston

Wyoming

12. Goshen County School District #1, Torrington
13. Natrona County School District, Casper

School District Middle School Demographic Information

	% Ethnic Diversity									
Leadership Teams	**African American**	**American Indian/Alaskan Native**	**Asian American/ Pacific Islander**	**Hispanic**	**Other Minorities**	**Total Minority**	**% Federally Subsidized Lunches**	**Total Middle School Students**	**# of Middle Schools**	**# of Teachers Assigned to Science**
The Dunham School Baton Rouge, LA	2.47%	1.40%	0.70%	2.10%	2.10%	15	0.00%	143	1	3
East Lyme School District East Lyme, CT	1.86%	1.03%	6.29%	3.71%	0.00%	125	6.29%	970	1	12
Goshen County School District #1 Torrington, WY	0.24%	1.46%	0.24%	16.30%	0.00%	75	47.69%	411	2	6
Horry County Schools Conway, SC	2.47%	0.19%	1.01%	5.07%	0.75%	2,260	57.35%	7,705	10	110
Houston Independent School District Houston, Texas	1.86%	0.07%	2.92%	57.33%	0.00%	39,504	75.09%	43,356	55	ND
Jefferson County Board of Education Birmingham, AL	39.95%	0.11%	0.47%	2.58%	0.33%	3,877	40.92%	8,967	16	100
Marion County School District Ocala, FL	2.47%	0%	1.32%	13.53%	6.26%	3,775	61.51%	9,888	19	120
Natrona County District Casper, Wyoming	1.86%	1.04%	1.11%	6.98%	0.00%	321	33.44%	2,892	5	12
Phenix City Public Schools Phenix City, AL	65.77%	0.00%	0.54%	1.29%	1.17%	637	64.16%	932	1	12
Trussville City Schools Trussville, AL	2.47%	1.37%	0.00%	2.22%	0.00%	108	9.61%	947	1	70
Van Buren School District Van Buren, AR	1.86%	7.33%	3.67%	11.80%	0.00%	449	48.11%	1,746	4	22
TOTAL						**51,146**		**77,957**	**115**	**467**

Initiating Systemic Reform of Middle School Science Education

3:00 p.m. **Registration**
East Meeting Room Lobby

4:00 p.m. **Welcome**

4:15 p.m. **Developing Goals for Middle School Science Learning and Teaching**
East Meeting Room M

Sally Goetz Shuler
Executive Director
National Science Resources Center
Washington, DC

6:00 p.m. **Opening Reception**
Medical Forum A

6:30 p.m. **Welcoming Remarks, Introductions and Symposium Overview**

Peggy Willcuts
Science Coordinator
Walla Walla Public Schools
Walla Walla, WA

Initiating Systemic Reform of Middle School Science Education

7:00 a.m. **Breakfast**
East Meeting Room Lobby

8:00 a.m. **Opening Remarks**
East Meeting Room M

Peggy Willcuts

8:15 a.m. **Engaging with Inquiry Teaching and Learning, Part I**
East Meeting Room M

Christos Zahopoulos
Research Professor, College of Engineering and School of Education
Executive Director, Center for STEM Education
Northeastern University
Boston, MA

Smith Holt
Senior Scientist/Development
National Science Resources Center
Angel Fire, NM

Cathy Stokes
Science Resource Teacher
Cupertino School District
Santa Clara, CA

10:15 a.m. **Break**

10:30 a.m. **How People Learn**
East Meeting Room M

Susan Donovan (video presentation)
Senior Program Officer and Study Director
Strategic Education Research Partnership (SERP)
National Research Council
Washington, DC

Facilitated by Peggy Willcuts

11:45 a.m. **Lunch**
East Meeting Room Lobby

12:45 p.m. **Introduction to Strategic Planning & Team Planning**
See page 62 for Room Assignments

2:00 p.m. **Systematic Change and Reform of Middle School Science Education: An Interactive Simulation and Discussion about Issues and Effective Reform Strategies**
East Meeting Room M

Lee Meadows
Director
Alabama LASER
University of Alabama at Birmingham
School of Education
Birmingham, AL

Karen Spencer Anderson
Mathematics Science Technology Coordinator
Auburn City Schools
Auburn, AL

Connie Chappelear
AOP-G Materials Resource Center
Anderson Oconee Pickens/
Greenville Math and Science Regional Center
Central, SC

5:30 p.m. **Adjournment**

Making the Case for Research and Development-Based, Inquiry-Centered Middle School Science Curriculum

7:00 a.m. Breakfast
East Meeting Room Lobby

8:00 a.m. Opening Remarks
East Meeting Room M

Peggy Willcuts

8:15 a.m. Exemplary Curriculum: Three Concurrent Workshops

1. Full Option Science System (FOSS) for Middle School
   FOSS Chemical Interactions: Middle School Chemistry
   East Meeting Room L

   Ann Moriarty
   Delta Education
   Berkeley, CA

2. Science and Technology Concepts for Middle School (STC/MS™)
   Grades 7-8 Catastrophic Events
   East Meeting Room K

   Rodney Crosby
   Carolina Biological Supply
   Bainbridge, GA

   Marsha Jones
   Carolina Biological Supply
   Valdese, NC

   Cindy Morgan
   Carolina Biological Supply
   Burlington, NC

3. Science Education for Public Understanding Project (SEPUP)
   Grades 5-8 Exploring the Solar System and My Body and Me
   East Meeting Room D

   Amy Kezman
   Lab-Aids, Inc.
   Charlotte, NC

Lisa Martin-Hansen
Georgia State University
Atlanta, GA

10:15 a.m. Break

10:30 a.m. The Research About Inquiry-Based Curriculum
East Meeting Room M

Bill Watson
Research Assistant
The George Washington University
Washington, DC

12:00 p.m. Lunch

1:00 p.m. Assessment for Learning
East Meeting Room M

Bill Watson

2:15 p.m. Break

2:30 p.m. Engaging with Inquiry Teaching and Learning, Part II
East Meeting Room M

Christos Zahopoulos

Smith Holt

Cathy Stokes

4:15 p.m. Strategic Planning Session
See page 62 for Room Assignments

6:00 p.m. ***Buses Depart from Main Lobby of Hotel for Reception and Dinner***

6:30 p.m.

Reception and Dinner
Vulcan Park
1701 Valley View Drive
Birmingham, AL

Dinner sponsored by Alabama LASER

Keynote Address

Charles Ray Nash
Vice Chancellor for Academic Affairs
The University of Alabama System

Planning Effective Professional Development Programs For Middle School Science Teachers

7:00 a.m. **Breakfast**
East Meeting Room Lobby

8:00 a.m. **Opening Remarks**
East Meeting Room M

Peggy Willcuts

8:15 a.m. **Exploring Effective Professional Development, Part I**
East Meeting Room M

Caroline Kiehle
Associate Director of Professional Development, Center for Inquiry Science
Institute for Systems Biology
Seattle, WA

Mark Cheney

Peggy Willcuts
Science Coordinator
Walla Walla Public Schools
Walla Walla, WA

9:15 a.m. **Break**

9:30 a.m. **Engaging with Inquiry Teaching and Learning, Part III**
East Meeting Room M

Christos Zahopoulos

Smith Holt

Cathy Stokes

11:45 a.m. **Lunch**
East Meeting Room Lobby

12:45 p.m. Exploring Effective Professional Development, Part II
East Meeting Room M

Caroline Kiehle

Mark Cheney

Peggy Willcuts

4:15 p.m. Strategic Planning Session
See page 62 for Room Assignments

5:30 p.m. Adjournment

Establishing an Effective Materials Support System & Building Awareness & Support

7:00 a.m. Breakfast
East Meeting Room Lobby

8:00 a.m. Opening Remarks
East Meeting Room M

Peggy Willcuts

8:15 a.m. Concurrent Workshop Sessions

1. Materials Support
East Meeting Room D

Connie Chappelear
AOP-G Materials Resource Center
Anderson Oconee Pickens/Greenville Math and Science Regional Center
Central, SC

Mark Cheney
Science Specialist
Yakima School District
Yakima, Washington

2. Acquiring Community Support
East Meeting Room L

Nancy Thomas
Engineer/Advisor
Bay Area Schools for Excellence in Education (BASEE)
Newark, CA

Brenda Terry
Interim Director
Alabama Math, Science, and Technology Education Coalition (AMSTEC)
Huntsville, AL

10:15 a.m. Break

10:30 a.m.	**Strategic Planning Session** See page 62 for Room Assignments
11:30 a.m.	**Sharing Strategic Plans** ***East Meeting Room M***
12:30 p.m.	**Lunch & Closing Remarks** ***East Meeting Room M***
1:30 p.m.	**Adjournment**