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"We're telling teachers 'Don't do what you've normally done for years.' It's a profound shift."

Diane Briars, co-director of the Pittsburgh Reform in Mathematics Education program

FULL STORY ON PAGE 4

Improving Mathematics and Science Education

Report Finds Professional Development Key to Quality Performance

To enable the nation's children to become world-class learners in math and science, the key is to improve teacher quality—and to do so immediately, recommended the National Commission on Mathematics and Science Teaching for the 21st Century.

"[T]he way to interest children in mathematics and science is through teachers who are not only enthusiastic about their subjects, but who are also steeped in their disciplines and who have the professional training—*as teachers*—to teach those subjects well," the Commission suggested in its recent report *Before It's Too Late.*

The report is the result of a yearlong investigation into the quality of K–12 mathematics and science teaching in America's schools. U.S. Secretary of Education Richard Riley launched the 25-member panel in the summer of 1999, appointing former U.S. senator and astronaut John Glenn as chair.

"It is imperative to move swiftly," said Glenn. "Two-thirds of the nation's teachers will leave their positions over the next decade, giving us an unprecedented opportunity for improvement."

The Glenn Commission called for a number of efforts to improve math and science teaching, including making available to all teachers high-quality professional development that includes summer institutes, inquiry groups and incentive programs.

The report asserts, "Teachers must be given the time they need within the school day to keep up with new developments in their fields, teaching aids, materials, and technology."

Principal Carol Daniels, who was invited to the press conference in September announcing the release of the

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The Class That Taught the Teacher

By Anne Jolly, *Mobile, Alabama*

I'll always remember "The Class"—the one where kids came in thinking, "I don't like science. I don't like math. I don't see how any of this stuff relates to me."

My careful planning and preparation did nothing to change their minds. Neither did attempts to help these students experience success by praising their occasional progress. Worse, I kept hitting a blank wall as I struggled to build the vital student-teacher rapport so necessary to learning.

In desperation, I decided to try a radically different teaching approach with these eighth-graders. Our new school facility was causing environmental problems. Excessive sedimentation, coupled with runoff from the oversized asphalt parking lot, drained directly into a creek that fed Mobile Bay. I wondered what would happen if The Class tackled this real-life problem by building a wetland. Of course, I had no idea how to actually construct a wetland, but the community came to my rescue.

A local education foundation funded the wetland project. A forestry service employee provided advice on the kinds of plants to include. A civil engineering professor helped the class understand the impacts of the sedimentation and runoff, and the role of a wetland in addressing this problem. He led the students on a scouting expedition around the campus and helped them apply appropriate criteria to selecting a site for the wetland. Students from his engineering classes scoped out the situation and recommended a wetland design as my students shadowed them.

PTA parents provided plants for the wetland. Parents who normally appeared at school only for discipline conferences brought materials and provided students with information about constructing a weir to back up water in the wetland. Chronically tardy students arrived before school with shovels, rakes, hoes, nails, hammers and other materials they needed to construct the weir, shape the wetland area and relocate plants.

School personnel also pitched in. Coaches allowed muddy students to track across the gym floor and use the showers in the locker rooms to clean up. Custodians mopped up the mud good-naturedly. The eighth-grade teaching team rearranged class schedules to accommodate the time needed to construct the wetland.

Somewhere along the way, those students and I connected. Most knew a lot about construction work and they willingly taught me what they knew. Previously labeled as "lazy," these teens worked together long hours in the blistering heat. The project foreman, a young man who had failed twice, interpreted the detailed schematic diagrams provided by the engineering class and kept the project on track. Uninterested math students seemed to understand exactly why they needed to calculate areas and angles to build the frame for the weir.

More important than constructing the wetland, these students finally experienced success. They learned science concepts and saw a reason for knowing these things. They applied math that previously had had no meaning for them. They had a reason to look forward to school. "The Class" taught me a lot about teaching science that year. I'll always be grateful to them.

Anne Jolly taught science in the Mobile County Public School System for 16 years and in 1994 was named the Alabama Teacher of the Year. Last year, she served as a member of the National Commission on Mathematics and Science Teaching for the 21st Century. She now works as an education program specialist for SERVE, a federally funded research and development laboratory covering the southeast states.

(CONTINUED FROM PAGE 1)

report, attributed the turnaround of student performance at Jeb Stuart Middle School in Jacksonville, Florida, to its ongoing professional development program. "The change took place with the teachers. Simply, they became better at teaching the complicated subject of mathematics," she said.

Increasing the salaries of math and science teachers to compete with wages offered in the private sector is among the Commission's recommendations. Statistics show that teachers earn 29 percent less than other workers with a bachelor's degree—$35,048 per year compared to $49,362 per year in 1997.

The Commission set three goals for action at the local, state and federal levels, which will require a nationwide investment of more than $5 billion annually: (1) establish an ongoing system to improve the quality of mathematics and science teaching in grades K–12; (2) increase significantly the number of mathematics and science teachers and improve the quality of their preparation; and (3) improve the working environment and make the math and science teaching professions more attractive.

However, the Commission pointed out, teachers are just one of the groups with a stake in mathematics and science education. It targeted six other stakeholder groups—parents, administrators, school board members, higher education institutions, state political leaders and business leaders—as also responsible for raising student achievement.

In the section of the report entitled, "What Can You Do?", several questions are posed to each group, along with a checklist for action. Below is a snapshot of what each stakeholder is asked to consider:

School Board and Superintendent Team
How many individuals assigned to teach mathematics and science in your district have a major or minor in these fields?

Principals
Are you satisfied that the science and mathematics preparation that your students receive is adequate preparation for the next level of schooling?

Teachers
Are you actively seeking to learn effective teaching methods for diverse student learners?

Parents
Do your child's teachers have the necessary background to teach the courses to which they are assigned?

State Leaders
How do certification requirements for K–12 mathematics and science teachers in your state compare to those of neighboring states and national standards?

Higher Education Institutions
Do your graduates report that your program prepared them for successful teaching? Are schools that hire your graduates satisfied with the quality of their instruction?

Business Partners
Does your business encourage its employees to work as advocates in the schools, with the goal of achieving high-quality mathematics and science education?

For a copy of *Before It's Too Late*, call the Department of Education's Publications Center at 1-877-4-ED-PUBS (1-877-433-7827) with order number EE0449P, while supplies last. The report is also available online at www.ed.gov/inits/Math/glenn/.

NOVEMBER
Satellite Town Meeting
Partners for Excellence

"Education is everybody's business," notes U.S. Secretary of Education Richard Riley, who will host the final Satellite Town Meeting of his administration on Tuesday, November 21. The broadcast, "Partners for Excellence: Families, Businesses, and Communities Working Together," will air live from 8:00 p.m. to 9:00 p.m. Eastern time.

Across the country, creative partnerships are bringing together new resources, ideas and volunteers to help local schools succeed. Businesses are not only allowing more time for parents to participate in their children's schools; they are establishing on-site schools in partnership with local districts. Communities are expanding the classroom curriculum by providing hands-on learning experiences in parks, offices and museums. And parents are providing expertise and time to help govern schools and set standards.

To join the Satellite Town Meeting, call 1-800-USA-LEARN (1-800-872-5327), or visit www.ed.gov/satelliteevent. Also, view live or archived Webcasts of the meeting by visiting Apple Computer's Apple Learning Interchange at http://ali.apple.com/events/aliqttv/.

The Satellite Town Meeting is produced by the U.S. Department of Education in partnership with the U.S. Chamber of Commerce and the National Alliance of Business, with support from the Bayer Foundation, the Procter and Gamble Fund and Target Stores.

Prime Numbers

Boosting Math Teaching in Pittsburgh

This school year, as Pittsburgh teacher Jeremiah Schroeder teaches math for the first time, he has the support he needs to help students reach high standards. For instance, when he was teaching his eighth-grade class how to use a graphing calculator and was overwhelmed by a manual he said is "as thick as a dictionary," veteran teacher Marianne O'Connor came in to demonstrate both to him and the class how to use the device.

"I was getting stressed out about it," says Schroeder about the calculator. "But it's fairly easy to use if you have someone explaining the important parts of it."

As part of the Pittsburgh Reform in Mathematics Education initiative—aptly called PRIME—teachers receive on-site modeling from specially trained demonstration teachers like O'Connor. After each class visit, the demonstration teacher gives feedback to the classroom teacher and follows up to see how he or she and the students are doing. If there is another lesson with which the teacher might have difficulty, the demo teacher returns to the class.

PRIME is a comprehensive effort by Pittsburgh Public Schools (PPS) that aligns content and performance standards, assessments, high-quality instructional materials, rigorous professional development and accountability. The goal is to move away from the traditional lecture approach to teaching math toward one that is student-centered and standards-based.

"We're facilitators in the classroom, as opposed to being the sage giving out information," says O'Connor, about the role of teachers. "If you let the kids construct their own learning, then they'll remember it."

Putting the Pieces Together

In the mid-1980s, PPS began a radical effort to reform its mathematics program. Over the years, new textbooks, curricula and assessments were put into place to support newly adopted standards. By 1996, PPS finalized its efforts with a professional development program designed to help its 924 math

Demo teacher Marianne O'Connor.

teachers use the materials successfully. The result is a substantial increase in student achievement, including significant gains in schools with high-poverty and high-minority populations, says Diane Briars, co-director of the PRIME program.

"What's really made the difference in Pittsburgh over the past four years is that all of the elements for true systemic change are now in place," Briars explains. "Just one or two of those pieces is not enough. You need the whole thing."

Systemic mathematics reform, Briars admits, "requires a lengthy and complex process," especially for an urban district as large as Pittsburgh's, the second largest in Pennsylvania, with 97 public schools and approximately 40,000 students.

What initially limited the district's plan to raise student achievement was that its assessments were norm-referenced—student performance was gauged against a norm group instead of against high standards—and textbooks that were truly standards-based were not yet available.

PRIME draws on the standards-based curricula *Everyday Mathematics* for the elementary level and *Connected Mathematics* for middle schools. The development of a high school component is underway.

Pushing Everyone's Thinking

To implement standards-based instruction in every Pittsburgh classroom, PRIME provides a continuum of experiences to prepare all math teachers. Curriculum Previews, which go through new materials unit by unit, lesson by lesson, help teachers use the instructional materials for the first time. The previews are held during a week in the summer and continue during the school year for a total of 50-60 hours. Other workshops focus on pedagogical issues, assessments and cross-grade content, including probability, algebraic reasoning and geometry.

"We try to push everybody's thinking and demonstrate how they can do that in the classroom," says O'Connor.

In addition to deepening their mathematical understanding, workshops allow the teachers an opportunity to hear from each other and to share different methods of teaching math with their students. Many of the principals are trying to schedule more time for teachers to meet during the day.

However, more demonstration teachers are needed. O'Connor is one of only two demo teachers covering two dozen schools with grades six to eight; another six demo teachers provide services to nearly 60 elementary schools. When a teacher is chosen, based on performance and recommendations, he or she moves out of the classroom, which creates a need as it fills one.

New Attitudes

PRIME requires not only a change in the style of teaching, but in attitudes among the teachers.

"Part of what's so hard is we're telling teachers 'Don't do what you've normally done for years.' It's a profound shift," says Briars.

She says the new materials have been developed by teams of mathematicians, teachers and curriculum experts, then tested in the classroom and revised based on what works. The standards-based approach, Briar adds, encourages teachers to work collaboratively to discuss, evaluate and improve their instruction, instead of working in isolation.

Students team up for a math assignment.

"How would you feel if you were going in for gall bladder surgery and your surgeon decided she wanted to do her *own* thing?" she questions. "That would never happen in the medical profession. Why then should teaching be any different? What we're saying is instruction—really effective instruction—should be a professional practice."

PRIME was made possible through a grant from the National Science Foundation. For more information, visit the Pittsburgh Public Schools' Web page at www.pps.pgh.pa.us, select the "Links" icon and then the option "Pittsburgh Reform in Mathematics Education," or e-mail Diane Briars at briars@pps.pgh.pa.us.

O'Connor demonstrates a lesson to new math teacher Jeremiah Schroeder.

PARTNERSHIP
for Family Involvement in Education

A coalition of more than 6,000 business, community, religious and education organizations nationwide. To join the Partnership, call 1-800-USA-LEARN or visit http://pfie.ed.gov.

Arkansas Center Helps Students Discover Science Outdoors

As part of the science curriculum, fifth-graders in the Rogers School District in Rogers, Arkansas, leave the classroom for two days to camp overnight at the Ozark Natural Science Center (ONSC), where they discover science beyond their textbooks.

"When students return to school, their work reflects a different understanding of their environment," says Principal Nancy Swearingen of West Side Elementary.

Rogers is one of 10 school districts bringing its elementary students to the 486-acre campus of ONSC in the Ozark Mountains of northwest Arkansas. The center is equipped with an amphitheater, tenting areas, hiking trails, classrooms, a library, a laboratory and dormitories that accommodate 68 people.

ONSC's residential program, which includes 18 hours of outdoor instruction that involves night hikes to study astronomy, is a complement to the classroom. "We find that those kids who have difficulty in the classroom thrive out here, because it's hands-on and discovery-oriented," says assistant program director Lori Spencer.

Students return from a caving adventure.

For instance, students take a natural history hike through the mountains to study plant and animal life, as they record their observations in field journals. They work as research scientists exploring the surrounding forest and streamside communities, where an additional 15,000 acres circumvent the center. They also learn to look for and read animal tracks and signs.

According to Spencer, helping those students struggling in science was part of the reason the center was created. Built in 1990 by volunteers as a year-round science education facility for the community, ONSC hosts regional conferences and serves over 2,500 students each year from districts in the tri-state area of Arkansas, Kansas and Oklahoma.

The center also draws support from across the community. Retirees sew safety vests and collate the newsletter and students' journals. High school and college students help office staff and provide routine maintenance. Other volunteers build and maintain trails, create murals, and care for the trails for two weeks each year.

Beth Carnes, parent and long-term ONSC volunteer, says "the best way to learn science is to experience it."

For more information about the Ozark Natural Science Center, call 501-789-2754 or visit http://onsc.uark.edu.

Iowa School Engages Early Learners in Math and Science

When first walking into the Martin Luther King, Jr. Academy of Math and Science, visitors get an eyeful. Three large panels drawn with plants, animals and computers extend from the ceiling, from which a fourth panel displaying the universe hangs.

"They usually don't believe what they see," says Principal Marlene Doby, "but it is indicative of what we offer extra to our children."

Doby says that many newcomers are surprised to find such grand illustrations in the Des Moines, Iowa, school because the academy has a very young student population—from pre-K to grade 3—and is located in a low socio-

Principal Doby in the academy's foyer.

economic area.

The Academy has had to be resourceful in providing students a hands-on experience for learning science and math. Parents and faculty created a pond full of fish and lily pads. In the schoolyard, children maintain a garden of corn, green beans, pumpkins and tomatoes, from which they learn what creatures in the soil are helpful to the plants. They even make stew from the vegetables they pick with the help of teachers.

This fall, pre-med students from Des Moines University bring in preserved organs to help students learn about the human body. In the spring, professors from Iowa State University will discuss environmental science and teach the children how to test and analyze soil samples.

In the summer, with a grant from the U.S. Department of Education's 21st Century Community Learning Centers program, the school extends its services to the fifth grade for a six-week "Hike Across America." The program provides a virtual trip in which students use the Internet to chart mileage, calculate travel expenses and gain knowledge about natural resources, vegetation and wildlife in the areas of travel.

For more information about the Martin Luther King, Jr. Academy of Math and Science, contact Marlene Doby at 515-243-1297 or by e-mail at marlene.doby@dmps.k12.ia.us.

ABOUT *our* PARTNERS

Winterthur Museum, a former country estate built in Delaware in 1839, provides pre-K–12 students an interactive experience for learning about early American life. Through hands-on instruction, young visitors explore historical artifacts from a collection of more than 89,000 pieces that include furniture, textiles and paintings made in America between 1640 and 1860.

"A lot of historical places try to give children a sense of the past, but we offer a large slice of American history under one roof," says Tracey Beck, associate curator of education.

Sitting on over 900 acres, Winterthur once belonged to Henry Francis Du Pont, an avid collector and trained horticulturist. Du Pont's pursuits led to the creation of a research library and naturalistic garden, which are also open to the public. In 2001, Winterthur will introduce its "Enchanted Woods" garden designed especially for children.

On November 11, the museum will begin its annual "Yuletide at Winterthur" to highlight the holiday celebrations of U.S. presidents in the 18th and 19th centuries. The exhibition, which will run through the end of the year, features a children's party in the room of former President Andrew Jackson.

For more information, call 1-800-448-3883, or visit www.winterthur.org.

CALENDAR

November 29–December 2, Reno, Nev. *National Community Education Association 35th Annual Conference.* Call 703-359-8973, or visit www.ncea.com/conferences.

December 1–3, Washington, D.C. *Zero To Three 15th National Training Institute*, "Because Babies Are Our Future." Call 1-888-733-5364, or visit www.zerotothree.org.

December 13–15, Washington, D.C. Final in a series of fall conferences for *Improving America's Schools*. The Partnership will hold meetings and a materials fair on the third day. For more information, call 1-800-203-5494, or visit www.ncbe.gwu.edu/iasconferences.

ANNOUNCEMENTS

The Southern California Edison utility company is using a section of its monthly bill inserts through 2001 to provide tips on improving children's education to more than four million customers. For more information about Edison's family and education efforts, call 1-800-655-4555, or visit www.edison.com.

The Museum of Science and Industry is offering a new mentoring program for high school students interested in building skills in math, science and technology, called "Inspiring Minds in Action." For more information, call 773-684-9844 extension 2424. Also, visit www.msichicago.org/ed/imap/index.html.

While these resources are relevant to the mission of the Partnership for Family Involvement in Education, they are available from a variety of sources and their presence here does not constitute an endorsement by the U.S. Department of Education.

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FIRST CLASS

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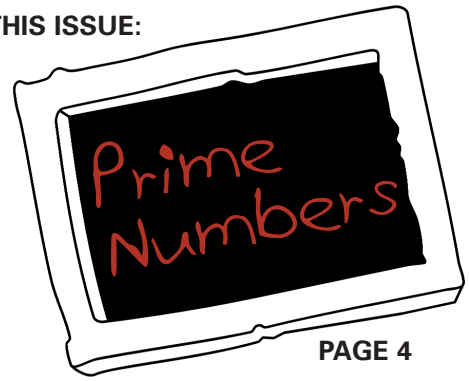

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Engaging Students in Mathematics and Science

At the dawn of the new millennium, students will need better math and science skills and better knowledge in order to succeed in college, careers, and everyday life. Below are a few resources available from the U.S. Department of Education and its partners for increasing excellence.

www.figurethis.org is an interactive Web site with math challenges for middle school students and their families. A paper copy of this resource can be ordered by calling 1-877-4-ED-PUBS (1-877-433-7827) with order number EK0258P.

www.ed.gov/pubs/EarlyMath, an online version of the publication *Early Childhood: Where Learning Begins—Mathematics*, provides activities for young children ages 2–5. The booklet may also be ordered by calling 1-877-4-ED-PUBS with order number ER0646P.

www.enc.org, the Web site of the Eisenhower National Clearinghouse, includes a search engine for math and science resources for all ages that can sort results by grade level, subject and cost.

www.ars.usda.gov/is/kids is a science learning center offered by the Department of Agriculture with English and Spanish versions. Topics include biology, astronomy and the environment.

http://timsschallenge.cse.ucla.edu gives visitors the opportunity to compare their math skills to those of middle school students in numerous countries.

For more information, call 1-800-USA-LEARN (1-800-872-5327).