Start Them Young

THREE HHMI-SUPPORTED PROGRAMS AND A MAJOR REPORT FROM THE NATIONAL RESEARCH COUNCIL PRESENT A BETTER WAY TO TEACH SCIENCE—BY DOING SCIENCE—IN GRADES K–8.

Boston-area elementary school students experience hands-on science in a Harvard University lab, a visit made possible through an HHMI-sponsored outreach program.

CANDICE MARSHALL, A FIRST-GRADE TEACHER in the Montgomery County (Maryland) Public Schools, or MCPS, considered herself a good science teacher, but she was also aware of her limits. "I was doing a lot of telling instead of letting students find out for themselves, and I never thought of science as a process," she recalls. "I was missing the big picture."

That all changed after she participated in the MCPS Elementary Student Inquiry Project, an intensive two-week summer program that trains teachers first to think and act like scientists, and second to use methods that encourage students to do the same. "We learned what science really is by collecting and organizing data and making predictions," she says. "That is, I got to do science, as opposed to following a science lesson plan."

The program radically changed Marshall's perspective. The realization that the quality of her teaching had changed as well came during the 2005 Student Inquiry Conference, when students presented their science experiments. Her first-graders confidently fielded questions from fourth- and fifth-graders, explaining what happened to the flowers they immersed in hot or cold water or the ping-pong balls they floated in salt water. "This [competence level] was beyond my wildest expectations," Marshall says.

The MCPS program and two others—one in Boston, Massachusetts, and the other in San Jose, California—are among a number of HHMI-supported science education programs that are improving the ways teachers teach and students learn science in elementary and middle school. Their approaches are consistent with a new report from the National Research Council, *Taking Science to School: Learning and Teaching Science in Grades K–8*, which recommends that students learn science by actively and collaboratively practicing it. The report contends that teachers can build on children's basic reasoning skills, perceptions of the natural world, and curiosity to help them achieve science proficiency. (See box, this page.)

In Boston, The Science Connection Program, a long-running partnership between Boston public schools and Massachusetts General Hospital (MGH), gives students tools to investigate questions that intrigue them. For example, the Science Fair Mentoring Program (a component of the Science Connection) pairs 30 seventh- and eighth-graders at the James P. Timilty Middle School, located in one of Boston's

A CALL FOR BIG CHANGES

The National Research Council report calls for fundamental changes in how science is taught to children and suggests a dramatic departure from current professional development practices. A summary of the report's recommendations:

- New standards, curricula, and assessments should reflect new models of children's thinking and take better advantage of their capabilities.
- Standards and curricula should be structured around a few core scientific ideas that have the potential for sustained exploration at increasingly sophisticated levels across grades K–8.
- Science should be presented as a process of building theories and models using evidence, checking them for consistency and coherence, and testing them empirically. Methodologies need to go beyond experimentation, to historical reconstruction and analysis, and other nonexperimental methods.
- All K–8 teachers should experience sustained professional development to learn about science, about current research on how children learn science, and about how to teach science.

For a copy of the report, Taking Science to School: Learning and Teaching Science in Grades K–8, *visit* www.nap.edu/catalog/11625.html.

Stephanie Mitchell / Harvard University News Office

most economically disadvantaged neighborhoods, with mentors from MGH. The professionals collaborate with students, offering support, establishing structure, and sometimes even providing laboratory facilities and equipment for their projects.

"We take a range of kids, not just the top students, but those who are struggling and can use the help of a mentor," says Susan Berglund, a science educator and MGH employee who manages the partnership from her school office.

Karlotta Fitch, administrator of the MGH Brain Bank and a mentor to some 20 students over the past 15 years, recalls a student—a "dinosaur kid, it had to be dinosaurs"—who, in sixth grade, wanted to figure out what *Tyrannosaurus rex* weighed. In seventh grade, he wanted to know what modern animal *T. rex* was most closely related to. When Fitch became his eighth-grade mentor, she made her microscope and slides available for a comparative anatomy experiment in which he analyzed the blood and bone of various species and extrapolated the answer to his question: Was *T. rex* warm-blooded?

"My part is to help students do the experiments and maybe have a hand in guiding them to a conclusion so that it at least leans toward reality," Fitch says.

The environmental education program in San Jose builds on children's curiosity about the natural world, joining elementary and high school students and their teachers into a community of learners who share and discuss findings. The BioSITE (Students Investigating Their Environment) project, run by the Children's Discovery Museum (CDM) with start-up support from HHMI, annually trains some 60 high school students to mentor fourth- and fifth-graders as they conduct yearlong field investigations of the health of the Guadalupe River, which runs through town. During their field days, students collect water samples at different sites, test their samples, and observe and document plant and animal species.

Later, "we all gather as a full group and report our data to each other," says Sandra Derby, CDM program coordinator. "If a water quality test has a different reading from a previous one, we try to interpret why that data changed and what environmental factors could be affecting the outcome. This becomes a habit for students. Even before they get into the full group debriefing, they start looking at their data to try and figure out if the results are what they expected."

Students are more engaged in this scientific process because they have collected, and feel responsible for, the data, says Derby, and many of them remain engaged in science, in the river's health, and in the BioSITE program. She notes that more than 20 percent of this year's 63 high school facilitators participated in the program during their elementary school years. ■

– JUDITH B. SAKS