Making Science Matter in Middle School

Preteens need to know how science can change the world.

The year is 2025, and the problems that plagued humanity at the turn of the century have all but disappeared. Scientists have repaired the ozone layer, discovered cures for most diseases and developed agricultural techniques that make it possible to feed all the people on earth.

Welcome to the world that Arizona middle school students would like to create, a world where science plays a central role in improving the quality of life. "We wanted to start with the real passions of kids and make that the driving force for a science program," says Laura Martin, vice president for education and research at the Arizona Science Center in Phoenix. "So we asked 400 students from three middle schools what they would most like to be remembered for. They talked about ending war and poverty, and conquering disease. This age group is passionate about curing the ills of the world. Moral and ethical issues are vitally important to them."

The Arizona Science Center's creative approach couldn't come at a better time in these children's lives. Middle school, it turns out, is a now-or-never window for engaging youngsters in science. Students who greatly enjoy math and science in elementary school often grow apathetic in middle school because those subjects are no longer engaging or relevant to them, says Kit Peixotto, director of the Program on Science and Mathematics at the nonprofit Northwest Regional Education Laboratory in Portland, Oregon. In elementary school, she says, students learn science through appealing activities such as growing plants, constructing simple machines and measuring rainfall. By middle school, however, teachers tend to

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abandon hands-on science in favor of lectures and exercises from books. As the curriculum gets dry, technical and remote, it loses pizzazz. It fails to intrigue. It's the *opposite* of fun.

TURNING POINT

If a student's interest in science fades in middle school, he or she may never recover it. The Third International Math and Science Study (TIMSS) of 1995 and 1999, published by the National Center for Education Statistics, documents this slippage. While scores among U.S. fourth graders were well above the international average—only one country, Korea, outperformed the United States in both math and science—the scores of U.S. eighth graders were just average (with students from 20 of the 41 participating countries scoring higher). By the time U.S. students reached twelfth grade, their scores had plummeted—they outperformed only two other countries (Cyprus and South Africa).

According to TIMSS: "The better performance of U.S. fourth-graders . . . suggests that our children do not start out behind those of other nations in mathematics and science achievement, but somewhere in the middle grades they fall behind. These results point out that U.S. education in the middle grades is particularly troubled—the promise of our fourth-grade children (particularly in science) is dashed against the undemanding curriculum of the nation's middle schools."

With support from an HHMI grant, the Arizona Science Center is developing a hands-on biotechnology curriculum that will harness the youngsters' idealism, enthusiasm and openness to new ideas. "We want to introduce the kids to cutting-edge science, and we'd like them to build or do something that matters," Martin explains. "We want to excite them about their future."

Science center staff are collaborating with local teachers, as well as university and industry scientists, to design curricula that will allow students to develop ideas for new medical devices or implants or for genetically engineered crops to end world hunger.

At St. John's College in Annapolis, Maryland, faculty member Howard Zeiderman is pioneering a different solution to the middle school science slump. Because middle school students have a poor understanding of basic concepts in math and science—the kinds of problems that fascinated thinkers such as Aristotle and Galileo—Zeiderman and two other St. John's faculty members founded the Touchstones Discussion Project, a program designed to enrich science lessons by illuminating the ideas behind the facts and formulas.

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Students use a short original text as a springboard. For example, they read a passage by Sir Isaac Newton before discussing why a ball keeps moving after it is thrown. Euclid's works introduce them to the idea of symmetry. The key to the program's success, says Zeiderman, is group discussion. Students hash out questions such as How straight is a straight line? Does the universe ever end? How does a scientist think?

"We've found that discussion is a real equalizer," he says. "The topics are not ones with correct or incorrect answers, so everyone's ideas are welcomed. Once they find themselves engaging in math and science discussions, students who were convinced they couldn't do math or science become much more confident."

To see how students from diverse backgrounds would respond, Touchstones was pilot tested in schools in Arizona, Connecticut, Maryland, New Mexico and Pennsylvania. Students in the pilot schools showed a dramatic improvement in their ability to think and write about mathematic and scientific concepts, Zeiderman says. This year, schools in New York, San Francisco, and Washington, D.C. have introduced the program and will act as regional centers to train educators to use the method.

QUANTUM LEAP

Kevin Williams, a science teacher at Frederick Douglass Academy II in Harlem, New York, has been using the program with his sixth- and seventh-grade classes. Through the discussions, he says, students have made a quantum leap in understanding. "The program allows them to form ideas and even to have the wrong idea. But they can then go back and figure out why it was wrong and what would be better," he explains. "We don't laugh at anything anyone says; no matter how wild and crazy it may seem, it may spark an idea in someone else. In our discussions, there is a lot of discovery going on."

In one class, for example, after students discussed a short passage by the scientist S.H. Scudder on the difference between seeing and observing, they spent an hour inspecting and drawing a leaf. They discovered that leaves are far more complex than they had realized, Williams says. More important, they learned the skill of scientific observation.

Now, instead of skimming the surface of subjects, Williams' middle schoolers observe the experimental process in depth, he says. Then, using the Touchstones principles, students formulate intelligent hypotheses based on their observations. They better understand the purpose and meaning of their studies. In the process, they are getting turned on, rather than turned off, to science.

—HELEN SILVIS

More in the Middle

Science is coming alive for middle school students and teachers at other HHMI-supported programs, including the following:

Day in the Lab Run by Hampshire College (Amherst, Massachusetts), this program brings middle school students and teachers to the college campus for hands-on science experiences. One of the sessions is especially designed to engage girls in science. For more information: *carbon.hampshire.edu/%7Estep*

Kenyon Summer Institute Kenyon College (Gambier, Ohio) invites middle school teachers to participate in research projects. The program also provides equipment and expertise to middle schools. For more information: *www2.kenyon.edu/depts/biology/HHMI/index.htm*

Water and Life Headwaters Science Center in Bemidji, Minnesota, takes research on water quality in two lakes at the head of the Mississippi into seventh and eighth grade classrooms. Hands-on activities use water and the local environment to teach the scientific method of inquiry. For more information: *www.hscbemidji.org/index.htm*