Pasadena, California

Pasadena Develops a Model for Teacher-Scientist Partnerships

The Pasadena Unified School District's 23 elementary schools (K-6) have 570 teachers and a student enrollment of 12,500. Forty-three percent of students are Hispanic/Latino, 35 percent are African American, and 17 percente are Euro-American. Inquiry-centered science is taught in both English and Spanish. Pasadena's science program is a joint effort of the Pasadena Unified School District and the California Institute of Technology. The program is based on the premise that scientists can contribute much to professional development activities for elementary school teachers.

The Pasadena Unified School District Science Program (formerly known as Project SEED) is the brainchild of Jerry Pine and Jim Bowers, scientists at the California Institute of Technology (CalTech). Pine is a physicist who has been active in elementary school science education reform since the 1960s; Bowers is a neurobiologist. In the mid-1980s, both men had children in the Pasadena schools. They knew that science education in the elementary schools could be better. On their own time, they began to visit exemplary elementary science program such as the one established in Mesa, Arizona. Experience told them that a good deal of progress had already been made in elementary school science reform. They wanted to move forward; they didn't want to reinvent the wheel. So the two scientists formed an alliance with Michael Klentschy, then associate superintendent for instruction in the Pasadena Unified School District, and formulated a plan to introduce inquiry-centered science units into the district's elementary schools.

Scientists: The Heart of It All

The involvement of CalTech scientists is at the heart of Pasadena's science education program. At the beginning, the watchwords were "think small." They approached Klentschy and secured his enthusiastic endorsement. Having gotten the district's permission to begin a pilot program in one school, Bowers and Pine then met Jennifer Yuré, a science teacher at the Eugene Field Elementary School. During the next five years, Yuré recalls, they "just tried things out," as they sought to determine the best way to introduce teachers to hands-on science. "We finally came up with what we thought was the best model," she says. "It's teachers and scientists working together."

It's "working together" that makes the Pasadena program unique. Many programs use scientists as expert consultants; at Pasadena, scientists and teachers work side by side. Rather than lecture, the scientists work as co-facilitators with resource teachers as they train teachers in the use of the science modules that make up the program. The unique training model was supported by a five-year grant from the National Science Foundation.

CalTech's Leila Gonzalez first heard about the program from Bowers, then her professor, when she was a postdoctoral fellow in biology in 1989. The affinity was immediate. "Something inside me said, 'Yes. This is the way science should be taught,'" she recalls.

Today, she works for the program full-time as a liaison between the scientific and educational communities. The recruitment and training of scientists are her major responsibilities.

Recruitment, Gonzalez admits, is not a hurdle, given the degree of local support for the program. Volunteers include not only CalTech faculty but also students, alumni, retirees, and parents. Aware of the need for female role models in science, Gonzalez has made a special effort to recruit volunteers from organizations such as the American Association of University Women. About 150 scientists currently participate in the Pasadena program.

All new recruits undergo an orientation at CalTech. They become acquainted with the science kits and the structure of Pasadena's program. The inquiry-based learning process itself, however, needs no introduction. "This is the way you learn science as a graduate student," Gonzalez notes. After the orientation, they can also check out kits from the science materials center; in addition, program staff are always available for guidance.

Once the scientists are on board, their major responsibility is to participate in the teacher training programs. Approximately 10 teachers attend each of the day-long sessions, which are facilitated by a teacher-scientist team. The teachers break into small groups, and the scientists circulates informally among them. The scientists have two main responsibilities. One is to build the teachers' confidence and make them feel comfortable with the subject. "Our thrust is to support the teacher," Gonzalez emphasizes. "Science is a natural process, and you don't need to be a scientist to teach science." All 570 elementary school teachers in the district eventually underwent the training.

The other responsibility of the scientists is to model the scientific process. "Sometimes teachers have difficulty believing that involvement in the scientific process is more important than just knowing the facts," notes Yuré, who is now coordinator of the Pasadena Unified School District Science Program. "Teachers tell us that they have difficulty, for example, asking open-ended questions. Thus, we ask the scientist to model this process." Scientists also help the teachers keep the "big picture" in mind. Teachers learn to focus on the purpose of experiments and the connection between them rather than on the details.

After they've taught their first module, teachers return for a second training session. These sessions are again facilitated by a teacher-scientist team. At this point, qualms about classroom management have passed. Together, the groups discuss topics such as assessment of student learning or a particular activity within the unit.

It "Just Clicked"

In some cases, the teacher-scientist relationship goes further. A scientist may begin to visit the classroom of a teacher he or she met during a staff development session.

Such was the case with Barbara Bray, a third-grade lead teacher at the Field School, and scientist Josée Morissette, who is completing her doctorate at CalTech. They met, Morissette recalls, by "pure luck" as co-trainers of a module called *Clay Boats*. The relationship "just clicked." Bray emphasizes how easily Morissette has become a part of her classes. Before Morissette's visits, Bray recalls, the children had a "whole stereotypical view of what a scientist was and what they do. Josée changed that. The children feel comfortable having her in the room.

Exactly what happens when a teacher and a scientist get together? Each learns from the other, and learning horizons widen. "Barbara knows what third-graders will find appropriate," Morissette notes. "She's also open to brainstorming ideas about how to do things better." "Having discovered, for example, that *Clay Boats* did not include student activities that involved liquids of different densities, Bray and Morissette decided to enrich the unit by adding activities that involved such liquids as glycerin, alcohol, vinegar, and oil. Moreover, the next time Bray presented the module at a staff development session, she included information on the activities she and Morissette had jointly developed.

The advantages of the teamwork are obvious. Having a scientist in the classroom, Bray believes, strengthens curricular integration. "We can use science as a vehicle or catalyst for other things," she explains. Morissette points to shifts in student attitudes. Students seem more confident. They are more willing to try new things out, and they are more comfortable with "not always knowing the right answer," she believes.

Focusing on Assessment

Opportunities for growth remain, even for a mature program such as Pasadena's. One current focus of staff development activities is assessment.

Assessment study groups have been formed for each grade level. Members include a resource teacher from the Pasadena Unified School District Science Program, a scientist, and three teachers who have extensive experience with the kit for which assessments are being developed. Gail Baxter, a research investigator from the University of Michigan, is a consultant to this grant-supported program.

Assessments are needed for a variety of reasons. Some modules use traditional paper-and-pencil tests, which do not adequately reflect inquiry-based learning. In other cases, the teachers have enhanced the module, and active assessments are needed to document student performance in these new areas. Equally important, Gonzalez observes, is that "in creating an assessment, teachers really get a feel for what's important in the unit."

The study group meetings, Yuré explains, give teachers a chance to ask basic questions: What do we want the kids to learn? What are they learning? How are we teaching it? Morissette adds, "Once teachers get comfortable with the units, they don't necessarily focus on the scientific principles. Designing an assessment helps them get a grasp of the four or five key principles presented in a kit."

The study groups have found that embedded assessments (assessments that are woven into a class activity) are especially helpful,

because they can give teachers feedback about student learning while the module is still in progress. This allows the teacher to modify the activities or teaching approach to meet learners' needs. All assessment instruments are pilot-tested in the classroom. Morissette, for example, has a key role both in the third-grade assessment study group and in testing the assessments in Bray's classroom.

Scientists are an integral part of the district's science program. They are present at the beginning, when new teachers open their first kits. They also continue to be involved as teachers become more skilled at teaching science, contributing their unique perspective to the development of performance-based assessment tools. "The scientists are unbelievably dedicated to making a difference in children's learning," says Bray. The program, she believes, is "not turning students into scientists; it's letting them learn in a vital new way. And it's a wonderful opportunity for teachers."

Lessons Learned

- Scientists and engineers can become involved in all phases of planning and implementing an inquiry-based elementary science program.

- Pairing teachers and scientists in the classroom can be a mutually satisfying learning experience. Such relationships, however, cannot be forced. They work best when they develop naturally over the course of working together.

- Teachers can benefit from the opportunity to work in small groups to develop assessment tools. Many teachers find that focusing on assessment enables them to better understand the scientific principles in a curriculum module.