

Montgomery County, Maryland

A large Suburban School District Works to Build a Cadre of Effective Elementary Science Teachers

Culturally and economically diverse, Montgomery County Public Schools is the nation's 11th largest school district. Extending from the borders of Washington, D.C., to farmlands near Frederick, Maryland, the school district serves 63,000 elementary students in 127 schools and has about 2,600 elementary teachers responsible for teaching science. The children come from upper-middle-class neighborhoods as well as middle- and lower-income areas. The overall minority enrollment is approximately 43 percent, and students from more than 60 foreign countries are learning English as a second language.

The push for science education reform in Montgomery County began in the 1980s, when a group of community leaders expressed concern about the elementary science program. Since that time, the county has made great strides in its reform effort. The district has addressed curriculum selection, professional development, materials support, and assessment. An inquiry-centered science curriculum is in place, and the county has developed a cadre of 68 lead teachers. In addition, teachers from 90 schools have been involved in professional development activities. The program has a permanent materials support center. Finally, performance-based assessments and scoring rubrics have been created for each learning module in the science curriculum.

What happens when school administrators offer teachers state-of-the-art science materials and intensive training, as well as the guarantee that they will never have to go to the store again to buy cups, paper towels, or any other supplies for their science lessons?

In Montgomery County Public Schools, the result has been a powerful partnership between teachers and administrators that has created an exemplary inquiry-centered science program.

"We made teachers an offer they couldn't refuse," explains William McDonald, coordinator of elementary science. "We told them that not only would we give them the best curriculum materials available nationwide, but we also would make a commitment to provide intensive training in each module. As a result, they have been receptive and enthusiastic."

Indeed, professional development lies at the core of Montgomery County's science program. Everyone involved believes that the program must be driven by teachers and that only through ongoing support will teachers become expert and able to assume leadership roles among their peers. This conviction has underscored the program since its inception.

The Foundation for Reform

Montgomery County began its reform effort in 1988, when the superintendent of schools convened a task force to assess the county's K-12

science program. Under the guidance of Gerard Consuegra, then coordinator of elementary science, staff began reviewing and field-testing new curriculum materials. By 1990, staff had selected one module per grade level to place in every elementary classroom.

In 1991, the program received a boost in the form of a Teacher Enhancement Grant from the National Science Foundation (NSF). The grant enabled the county to set up an intensive professional development program while the school system made the commitment to purchase the kits needed to implement the new program. Also in 1991, Montgomery County sent a team to the national Science Resources Center Elementary Science Leadership Institute, where team members had time to plan and learn about the new curriculum modules that were available.

Team members put the information they had gained at the Leadership Institute to use almost immediately. They returned home and held their own two-week summer institute in inquiry-centered pedagogy for a cadre of 40 lead teachers as the first phase of their professional development program. This initial training was bolstered by monthly meetings held throughout the school year.

Working with science educators and scientists from the community, the lead teachers attended sessions on recent research in science education and learned about examples of science curricula in the well-established school districts of Mesa, Arizona; Anchorage, Alaska; and Schaumburg, Illinois. Lead teachers also explored such topics as the nature of science, learning theory, the constructivist approach to learning, cognitive development, integrating math and language arts into science, and cooperative learning. Training emphasized acceptance of a wide variety of learning styles and the importance of solving problems within the rigor of scientific methodology. The institute also focused on the necessity of bringing science to everyone, including children from groups typically underrepresented in the science professions- females and minorities.

Then teachers were acquainted with curriculum modules from several national curriculum projects, as well as trade books to be used in conjunction with the kits. The goal was for the lead teachers to field-test these modules in their classrooms during the 1991-92 school year.

The following school year, an additional 28 lead teachers were added to the project. All 68 lead teachers spent hours poring over curriculum materials, field-testing modules, and considering whether the materials reflected the new pedagogy and included examples of authentic assessments. Each month during the school year, they met to discuss what was happening in their classrooms. From this process, the lead teachers selected curriculum programs, including Science and Technology for Children (STC), Insights, Creative Publications, and the Full Option Science System. Choosing teaching materials from an eclectic assortment of curricula has worked well in Montgomery County.

Assessment is also a key ingredient of the county's program. Teachers are working to develop assessment strategies to measure not just what students know, but also what they can do in science. Teachers are learning how to assess student attainment of science process skills through

performance-based assessments, many of which are embedded in the modules themselves. In addition, final performance-based assessments and scoring rubrics have been created for each module. These assessment strategies help prepare teachers and students for the Maryland State Performance Program assessments, which are given at the end of grades 3 and 5.

Implementing an Ambitious Professional Development Plan

By 1993, the lead teachers and NSF project staff were prepared to begin their ambitious training effort. Their goal was for the lead teachers to train 280 teachers from 18 schools in 1993 and 560 teachers from 31 schools in 1994. The plan is to train all Montgomery County elementary science teachers by the 1997-98 school year.

Working in conjunction with Thomas DuMars, NSF project specialist for the county, the lead teachers conduct a week-long summer institute similar to the one they attended. During the institute, teachers receive an initial overview of the new modules; then they break into small groups by grade level, where they have an opportunity to work closely with their peers and with the experienced lead teachers.

"The teachers benefit from the camaraderie of the other teachers," says Wanda Coates, a third-grade lead teacher. "When they go back to the classroom, they experience a high level of success."

But the training doesn't stop after the summer institute. Teachers receive three units throughout the year in 12-week cycles. Before receiving any materials to support the module, all participating teachers are released from class for a half day of training in the new module. Halfway through the teaching cycle, teachers also attend an after-school support meeting. The purpose of these meetings, Coates explains, is for teachers to go beyond the initial training and discuss ways to extend the experiences, as well as to discuss any problems teachers may be experiencing.

"Even teachers who are reluctant to teach science are able to follow the directions and complete the lessons," says Celeste King, a fifth-grade lead teacher. "As a result, teachers who never taught science are now doing it."

The literature on professional development makes a strong case for ongoing discussions among peers. What makes this possible in Montgomery County is the high degree of administrative support for the efforts. Participating schools release teachers so that they can attend these meetings. In addition, teachers can now receive science content credit for attending the summer institutes. These benefits provide added incentives for teachers new to inquiry-centered science to attend the meetings and institutes.

Teachers aren't the only group that needs administrative support to make a contribution to inquiry-centered science. Principals also need to be informed about the new teaching strategies. "Principals were telling me that they also needed opportunities to get together and talk," says McDonald. "We decided to include them more."

So, starting with the summer institute held in 1995, the county offered its first science training for principals. During the institute and four follow-up meetings held during the 1995-96 school year, principals were given much-needed information about the new pedagogy and the science materials. The result has been more knowledgeable principals who are better equipped to observe teachers engaged in inquiry-centered science and to offer constructive advice and criticism.

Bringing Scientists on Board

Recently, the project has added a new dimension to training- scientists. Through a partnership with the American Physical Society, Montgomery County is working with 45 scientists who have been trained to work with elementary school teachers. After attending a day-long workshop where scientists are alerted to the issues facing elementary school teachers, the kinds of curriculum materials they are using, and the role they can play in training, scientists volunteer their time by participating in workshops designed to introduce teachers to inquiry-centered modules. In that setting, scientists join teachers as learners, model inquiry, and validate science as an interesting way to explore the world.

"Science is inquiry," says Ramon Lopez, the director of education and outreach programs for the American Physical Society and the creator of the program. "Give scientists materials and they are off asking questions and experimenting. We try to instill the same spirit into the teachers."

In addition to serving as a model for the pedagogy behind inquiry-centered science, scientists can answer teachers' questions about content. Lopez recalls a moment during the meeting on the STC module *Electric Circuits* when several of the teachers were puzzled by a phenomenon they had noticed while making a model of a light bulb using nichrome wire. The teachers had observed that if the nichrome wire was too long, the bulb did not glow. They wondered why.

"That's a great question for physicists," says Lopez, "and they provided a good, simple explanation. The teachers then responded by discussing how they could use the information to extend the activity. It was a perfect example of professionals interacting and providing expertise from their respective areas."

Establishing a Science Materials Support Center

As part of Montgomery County's commitment to teachers, program leaders established a science materials support center within the first two years of the program. As in many school districts around the country, it was a challenge to find a space large enough for such a facility. The materials center has already been housed in three different spots. Now, however, it has found a permanent home in an unused elementary school building in the western part of the county. DuMars runs the materials center.

"There's a lot to do," DuMars says. "The logistics of picking up kits and delivering them requires planning, not to mention constructing kits and replenishing those that come back from the teachers."

One of DuMars's biggest discoveries is the importance of bidding to get the best deals. "The big wholesale suppliers will help you keep your prices down," he says. "And it is far cheaper to construct your own kits than to buy the materials from the publishers." By cheap, DuMars means about \$3 per child for refurbishing for a whole year. And buying consumables, such as different kinds of liquids, in bulk is another way to save money on some of the more expensive items.

To help pack, ship, and refurbish approximately 3,100 kits three times a year, DuMars depends on four full-time employees for assistance. Currently, there are enough kits available for 150 teachers to teach a module simultaneously.

Does the system work perfectly? No. Are there problems? Of course. But on the whole, teachers get the supplies when they need them so that they can teach science on time.

"Teachers need to be educated, too," says DuMars. "Our teachers have a tendency to hold on to the kits, which jams up the system. When the 12 weeks are up, we need to have the kits back."

The project also realized that the support of secretaries and building service workers is critical in getting the kits in and out of schools on time. To help enlist this support, DuMars implemented training for these individuals during the summer institute and maintains direct contact with them throughout the year.

Plans for the Future

In less than a decade, Montgomery County has evolved from a district depending largely on textbooks to one using materials as a springboard for inquiry-centered learning. Although the district has come a long way, much work remains to be done. Even with an intensive professional development program in place, many teachers have yet to be introduced to the science modules. And those using the modules would like to reach the point where they can tailor the science module to the interests of their class.

Montgomery County is also working to take greater advantage of computer technology to enhance student learning in science. For example, the county is working toward creating a districtwide telecommunications network, which will enable students to transmit collected data and conclusions to their peers at other schools. Some schools in the county already have this capacity. Students are also using graphing software in their investigations and experimenting with specially designed cameras, which offer innovative ways for students to communicate what they have learned and to create student portfolios.

To continue to grow professionally so that they can use innovative curricula and technology effectively, many teachers would like additional training. "The training I have received is sufficient, but it is not enough," says King. "I would like to have a stronger science background so I can answer my students' questions more completely."

"We would all welcome additional training," says McDonald. "Our goal is to raise all our teachers to the next level."

Lessons Learned

- Teachers need support and extensive professional development to be prepared to teach inquiry-centered science effectively.
- Operating an efficient science materials support center is difficult. Teachers must assist materials support center staff by returning their kits on time.
- Involvement of principals and building staff is critical to the success of the program.