

Science-Centered Curriculum in Elementary School

A promising model for elementary schools makes science meaningful to students by connecting content in engaging ways with other subjects in the curriculum.

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While construction was under way on the permanent home for Laurel Wood School in the rapidly growing Salinas City School District, Vicki Ogborn's 1st grade students were housed in an adjacent portable building. Recognizing a unique learning opportunity, Mrs. Ogborn embraced the new school's development as the subject of a year-long theme—Bit by Bit—Building It Together—through which her students carefully observed and learned from the construction process.

Starting with design and planning, students developed scale drawings of their bedrooms with the help of their parents. Later, they produced blueprints in their classroom. Soon the 1st grade room was filled with an array of building materials—wooden blocks, legos, tinkertoys, and toothpicks—as students constructed their own designs. Next, they studied rocks and soil and experimented with core sampling. Then, while the soundproofing was being installed in the new school, they explored the properties of sound. Language arts was also woven into the theme. After reading *The Three Little Pigs*, the children made models comparing houses made of straw, sticks, and bricks. *Mike Mulligan and His Steam Shovel* served as a springboard for students to write and illustrate their impressions of the construction process.

Finally, as the building was being landscaped, the 1st graders learned about plants. (See fig. 1.)

Mrs. Ogborn's yearlong theme provided a meaningful structure to connect her students' learning in all subject areas. Clearly, they learned that science is all around them—a part of their everyday lives—and will view their completed school with a special perspective.

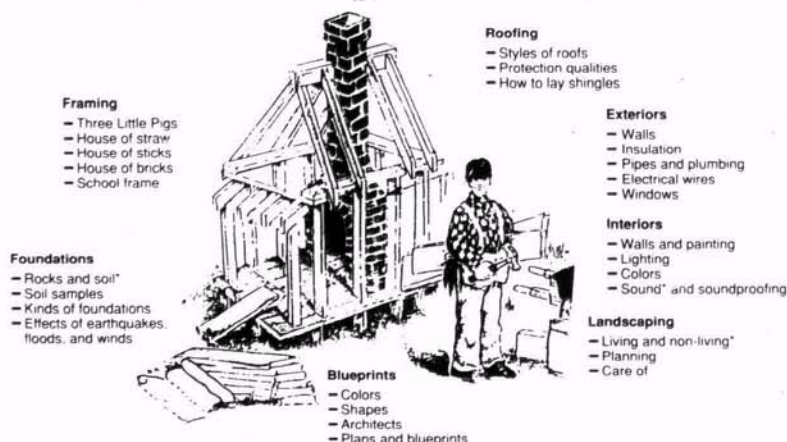
Science as the Curriculum Centerpiece

This inventive 1st grade curriculum demonstrates the fundamentals of the Mid-California Science Improvement Program (MCSIP), based on Susan Kovalik's integrated, thematic learning model (Kovalik 1986). The project got its start in 1987, when the David and Lucile Packard Foundation looked at the status of science education in Monterey County's elementary schools. A survey of 350 teachers in 7 districts yielded predictable findings: teachers felt that they did not have the training required to teach science, the access to appropriate materials, nor the strategies for integrating science into their overcrowded days. These and others find-

FIGURE 1

BIT - BY - BIT: BUILDING IT TOGETHER

Vicki Ogborn's 1st Grade Theme, Laurel Wood School, Salinas City School District



*Topics mandated for 1st grade by the Salinas City School District.

ings are consistent with those reported in *Science for All Americans*, published by the American Association for the Advancement of Science (AAAS, Rutherford et al. 1989). As a result of this preliminary research, MCSIP was initiated in 1987, with a grant from the Packard Foundation. The first year, 60 teachers in 11 schools joined the program.

The project's purpose is to assist and support elementary school teachers in implementing science education, on a daily basis, for all students as an integral part of the educational program. Using a hands-on, application-oriented approach, the project emphasizes a balanced curriculum, including physical, earth, and life sciences.

Another aspect of the program's philosophy is that a classroom should be a place marked by trust and respect. That is, in order to learn, students must feel safe and be free of fear, anger, and anxiety. Cooperative learning and carefully planned groupwork are used extensively. The program also stresses the importance of meaningful content presented in an enriched environment. Students often choose their own assignments and materials, allowing the teacher to accommodate a range of learning styles and abilities. Finally, MCSIP acknowledges that learning takes time and that each child learns at his or her own pace.

An Integrated, Thematic Approach

The program asks each teacher to develop a theme for the year, identifying major components for each month. The newly approved California Science Framework advances this strategy of themes as its first recommendation (California State Department of Education 1990). Such an approach provides a scaffold to unite the entire curriculum, avoiding the common fragmentation that occurs with separate, unrelated subject areas. The diversity of the themes—which blend science, language arts,

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social studies, mathematics, and fine arts—illustrates the creativity of the teachers. They include:

- The World Beneath My Feet
- A Shovelful of Dirt
- All Around You—Between, Below, Beyond
- Keepers of the Earth
- California, the Edge
- Magic, Marbles, and Motors: The Many Faces of Motion

Unlike other improvement programs, MCSIP does not ask teachers to add yet another subject to an already jam-packed day. Instead, the program actually turns the tables on the design of the school day, making science the ingredient that unites all other subjects.

Students read and write about science. Working in groups, they investigate and solve problems requiring measurement and computation. They learn about the innumerable applications of science to the world beyond the classroom and the exciting associated career opportunities. Finally, the fine arts complement and reinforce the thematic approach, as students express their understanding through art, music, and movement. The yearly theme, which is displayed in the classroom, represents a year's worth of work and learning that showcases science as the fully integrated centerpiece of the curriculum.

Teacher Training and Coaching

The success of the project is attributable in part to the well-planned training and



After a classroom lesson, Sharon Ridge's 3rd graders at James B. Flood Elementary School, Ravenswood School District, work cooperatively to draw some of their own conclusions in the school's science lab, funded by the David and Lucile Packard Foundation.

the subsequent coaching that occurs in the classrooms. Each summer, during an intensive two-week training institute, teachers learn effective strategies for teaching science, study science content appropriate to their grade levels, and develop highly personalized, integrated science curriculum based upon the themes of their choice. Scientists from the University of California, Lawrence Hall of Science, and San Jose State University helped develop the science content portion of the training.

As teachers design activities, project staff urge them to strive to include all levels of thinking: knowledge, comprehension, application, analysis, evaluation, and synthesis. By the end of the institute, teachers have developed their themes for the year, and they receive a stipend to purchase science materials.

When they return to school in the fall, teachers are supported by the school principal and their fellow MCSIP teachers. In addition, MCSIP staff provide continuous staff development and classroom coaching. Program coaches visit each school at least twice a month to demonstrate lessons, observe the teachers in action, or provide consultation. The impact of the summer training is evident back in the classrooms, where renditions of Bloom's Taxonomy and references to Hart's (1983) "brain-compatible" theories of learning are displayed at all grade levels. To reinforce their summer learning and further develop their skills, teachers attend periodic training sessions.

Early Evaluation Findings

With the assistance of the Stanford University School of Education, an early evaluation of the project was conducted. Evaluators measured the attitudes of students and teachers and assessed the program's impact on the science achievement of the participating students. At the end of the second year, students' achievement showed substantial and statistically significant gains.

Developed by the National Assess-



In Flood Elementary's science lab, a student in Sharon Ridge's 3rd grade class tests a hypothesis. Hands-on activities are central to the science program.

ment of Educational Progress (1987), test items covered biology, physical science, earth science, and an NAEP area called the "process of inquiry." Of the students taking part in the project, 78 percent improved their scores, exceeding the NAEP nationwide figures and leading one evaluator to conclude that "MCSIP proved to be successful in improving student achievement in science" (Okamoto 1989).

In the spring of the project's third

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year, the Packard Foundation invited James Rutherford, Director of AAAS's Project 2061, to visit some project schools and classrooms. Rutherford concluded that MCSIP had "unusual promise," which was "quite possibly of significance nationally." Specifically, he commented on:

The insightful use of science, substantive science, as the conceptual focus for instruction in reading, arithmetic, social studies, and other subjects.

An approach to changing the attitudes, skills, and knowledge of elementary teachers that promises to be more than superficial and fleeting, that seems to foster teacher creativity, and that may be affordable. (Rutherford 1990)

Impressions from the Classroom

Aside from the more formal findings, the effectiveness of MCSIP can be seen in the classrooms of project teachers.

For example, on one such visit, I observed young scientists in Janet

Conn's 1st grade class at Flood School in the Ravenswood School District as they gingerly retrieved earthworms from their muddy containers. At last "Michael Jackson," a particularly recalcitrant worm, was located by the probing finger of a delighted child. Placing the specimen between two paper towels, one wet and one dry, she watched to see which surface "Michael" preferred. Armed with a magnifier, she searched for attributes Mrs. Conn had described earlier.

These children were studying science through the theme, *Over in the Meadow*. Like her fellow project teachers, Mrs. Conn provides direct instruction in science and then orchestrates opportunities for her students to hypothesize, experiment, draw conclusions, and record their observations on such topics as: the senses, weather, rocks and soil, nutrition, birds of prey, life underground, metamorphosis, new life, and plants. Students work cooperatively in small groups helping and learning from one another, and sharing the joy of discovery.

The program has proven to have broad applicability over its four-year existence. Both teachers and principals report its success with educationally disadvantaged students as well as those identified as gifted. In addition, language differences have not been a barrier to the project teachers. In fact, project staff have found that real-world, firsthand science activities have actually accelerated the rate of language acquisition, particularly for bilingual students. For example, at Virginia Rocca Barton School in Alisal, 1st grade teachers Paula Tielsch and Esther Bench have teamed to provide a bilingual program for their students. Using the theme *Every Creature's Home Is a Castle*, they've devised techniques that make science accessible and exciting to all students.

Enthusiastic Principals and Teachers

Principals and teachers alike are delight-

ed about the project's effects. Henry Karrer of Alisal School feels that it helped turn his school around by giving his staff an opportunity to reorganize their curriculum and rethink their entire

The project's strong partnership combines the power of the schools, private support, and university resources to improve both the content and methodology of science instruction.

approach to teaching. At Bayview School in the Santa Cruz City School District, Principal Don Kavanaugh sees MCSIP as "a way to provide staff development for teachers that will have a lasting effect." He finds the coaching invaluable because project "coaches have been able to work on what each teacher needs and wants."

After the first year, participating teachers met with an independent evaluator, who assessed the project using California's program quality review criteria for science. The evaluator noted that "virtually every teacher reported a dramatic increase in the amount of science instruction time as a result of MCSIP." She added that "most teachers [exhibited] an increased sense of comfort with science and a desire to know more science so as to better teach it to the students" (Sandman 1988). Teachers themselves report that they are teaching science more often and in more depth.

Regarding teachers' attitudes toward



In Janet Conn's 1st grade class at Flood Elementary, as in other classes involved in the MCSIP program, students learn at their own individual pace, often choosing their own assignments.



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teaching science, project leaders and principals have seen a notable shift from one of fear and reticence to one of openness and enthusiasm. In several instances, principals feel that, with the support of MCSIP, struggling teachers have grown into accomplished educators. Teachers' informal comments reinforce these findings. One teacher, who was ready to abandon teaching before she became involved with MCSIP, says that the project saved her career. As a result of the project, Vicki Ogborn, the 1st grade teacher described at the beginning of the article, reappraised not only her students' abilities but her own as well. Her subsequent enrollment in geology and conceptual physics at the local college was particularly notable in light of the fact that she had always avoided science courses during her own education because she thought they were too difficult.

A Beacon for Science Reform

The Mid-California Science Improvement Program is a beacon for the reform of science education at the elementary level.

The dedicated program staff and participating teachers and principals have developed a model for other educators to consider as they seek to improve the teaching of science in their locales. Now entering its fifth year, MCSIP has trained and assisted 300 teachers in 30 schools throughout a dozen school districts in 5 counties. Two districts in Monterey County—Alisal and Santa Cruz—have adopted MCSIP districtwide and serve as models of the program, welcoming visitors from other districts. A new school, now under construction in Alisal, will eventually become a demonstration school.

MCSIP's strong partnership combines the power of the schools, private support, and university resources to improve both the content and methodology of science instruction. Starting with a clear understanding of the obstacles to effective science instruction, the project

offers intensive staff development, comprehensive curriculum development, and long-term financial and professional support to enable schools to achieve lasting change. Further, the project acknowledges that change takes time and that the innovators need consistent and useful support. Finally, MCSIP has infused science into the lives of hundreds of children making it an integral part of their learning for the entire school year. In its efforts to achieve scientific literacy for all students, the project has proved its merit with a wide range of students representative of California's schools of tomorrow. □

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