Science for All Children: A Guide to Improving Elementary Science Education in Your School District (1997)
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Science for All Children

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A Guide to Improving Elementary Science Education in Your School District

NATIONAL SCIENCE RESOURCES CENTER

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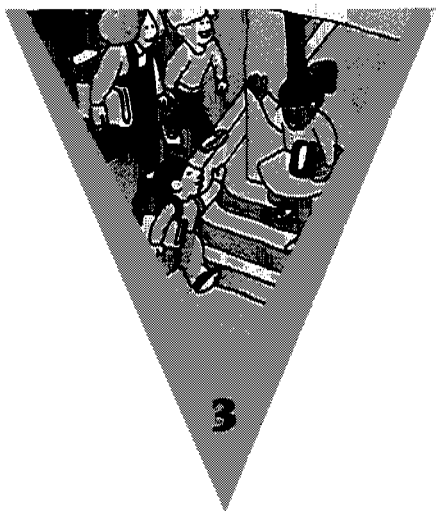

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Sharing the Vision of Exemplary Elementary Science

The more we help children to have their wonderful ideas and to feel good about themselves for having them, the more likely it is that they will some day happen upon wonderful ideas that no else has happened upon before.

—Eleanor Duckworth, *"The Having of Wonderful Ideas" and Other Essays on Teaching and Learning*, 1987

Imagine a science classroom that is very different from the one that most adults experienced as children. The teacher is using the learning cycle to organize the science lesson. As a result, students are up and about, consulting with their classmates about their thoughts and ideas. In addition to reading books, students are mixing different kinds of soils to discover their properties, observing the weather, and measuring the height of plants growing in the classroom. All children, from the academically gifted to those with learning disabilities, have a conviction that they can succeed in science class.

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The role of the teacher in such a classroom is very different from what most people have come to expect. No longer the source of all knowledge, the teacher is a guide who listens to what the children say, asks appropriate questions, and designs activities to help these already curious children become interested in learning more. As the *National Science Education Standards* explains, "Teachers of science constantly make decisions, such as when to change the direction of a discussion, how to engage a particular student, when to let a student pursue a particular interest, and how to use an opportunity to model scientific skills and attitudes."[1]

In classrooms similar to this one, students and teachers work together to create learning communities. Creating one school, or even one classroom, that reflects this vision is daunting; creating thousands of such classrooms in districts of varying sizes and resources nationwide is even more challenging. School districts may wonder where to begin. They are aware of their overall goal; however, they cannot define the steps or processes they need to engage in to reach it.

Fortunately, there is a growing consensus among educators about the elements that are needed to create an inquiry-centered elementary science program. Five essential elements have been identified and can be used to construct a model that provides school districts with a concrete, systematic, and clear-cut path to follow.

The Elements in the Strategic Planning Model

Inquiry-Centered Science Curriculum

Curriculum materials are the "meat" of the science program—what is actually being taught to children. Although many different kinds of curriculum materials can be used to implement inquiry-centered science programs, one of the most effective approaches is to build the science curriculum around a series of science *modules,* or units, each of which focuses on a different area of science and technology. A science kit, specifically designed for each unit, includes all the materials needed for a class of students to investigate a particular science topic for six to eight weeks. Each kit comes with a comprehensive teacher's guide, divided into 12 to 16 *lessons,* that describes the activities to be completed within the

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module. Student activity books, with instructions for conducting investigations and developmentally appropriate reading selections, are part of the kit as well.

Professional Development

Professional development is the process by which school districts prepare teachers to introduce the curriculum materials in their classrooms. School districts can use many strategies to enhance

Early Efforts to Identify the Essential Elements of an Effective Elementary Science Program

The current science education reform movement is built on a foundation laid in the 1960s. At that time, the post-Sputnik national science curriculum reform movement produced elementary science curriculum materials that emphasized student inquiry. A few school districts started using these materials as the basis for inquiry-centered elementary science programs. These districts included Mesa, Arizona; Seattle, Washington; Schaumburg, Illinois; Fairfax County, Virginia; Multnomah, Oregon; Minneapolis, Minnesota; and Anchorage, Alaska. Today, these districts serve as a model for those just starting out.

Each of these districts initially worked alone and did not communicate with other districts. When they began to share their experiences, they were surprised to discover how similar their programs were. Each found that in order to succeed, the district needed to incorporate the elements described in this chapter into its science education reform plan. What determined the differences were local politics in the school districts and the resources available to them.

For Charles Hardy, former assistant superintendent of curriculum and instruction in Highline, a suburb of Seattle, Washington, and chief architect of its inquiry-centered elementary science program, the starting point was teachers. A former high school chemistry and physics

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teachers' professional development. For example, as a way of introducing the new science program, districts can hold workshops where teachers become familiar with the science content of the module and discuss how to manage materials such as chemicals, water, soil, and living organisms in the classroom. Over time, districts can follow these introductory workshops with advanced sessions, during which teachers can perfect new pedagogical strategies, such as asking good questions, encouraging students to

teacher, he came from a tradition of close interaction with his peers, so he decided to try the same strategy at the elementary level. Every opportunity he had, Hardy would go into classrooms to observe what the children enjoyed doing and how the teachers interacted with the children. Using these insights, he then worked with local teachers and curriculum developers to create an inquiry-centered curriculum for the district. Soon after, a materials center, which supplied teachers with the science materials and supplies needed to teach the curriculum, was established.

"Teacher in-service education was—and continues to be—a strong element in our program," Judi Backman, Highline's science coordinator for more than 20 years, recalls. "We know that the only way for the program to work is if teachers are familiar with the curriculum materials and comfortable teaching them."

Highline's science program began with professional development efforts and quickly expanded to include inquiry-centered science kits and materials support. Now, because of increased national interest in inquiry-centered science, Highline is developing new assessment strategies.

"We received a grant from the National Science Foundation to develop assessment techniques more in line with inquiry-centered teaching," says Backman. "When we started, we knew that paper-and-pencil tests were not adequate, but they were all that was available. Now we have some more options, so we are able to round out this element of our program."

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initiate their own learning, and integrating science with other parts of the curriculum. The more proficient teachers become in these areas, the more effectively the science curriculum will be taught and the more children will learn.

Other strategies for districts to consider include recommending that teachers attend programs sponsored by professional societies such as Sigma Xi or the American Chemical Society and providing time for teachers to observe more experienced teachers, attend talks given by other teachers, or work closely with a more experienced colleague.

Science Materials Support

A materials support system is needed to ensure that teachers have access to the science kits and everything else they need to present a module in the classroom. By setting up cost-effective systems for supplying materials and equipment, school districts can remove from teachers the responsibility of inventorying and ordering the materials needed for the science lesson and place it in the hands of support staff who are trained to carry out these tasks. Implementation involves coordinating myriad details. It is crucial to plan the materials support component carefully, because a well-functioning system is essential for a successful science program.

Assessment

A system is needed to provide appropriate tools for teachers to use to assess student learning. Assessments can include both traditional paper-and-pencil tests and observations of student performance. The intent is to assess what students truly know and can do as a result of their experiences with the materials. Assessments also serve to guide instruction for teachers so that they can develop more effective teaching strategies. These new approaches to assessment are a departure from traditional testing, and teaching teachers how to use them must be one goal of the professional development program.

Administrative and Community Support

Building support within the school system and the community is critical to the success of the program. Essential elements of admin-

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istrative support include the endorsement of the superintendent and assistant superintendent of curriculum and instruction, as well as the involvement of the director of the elementary science curriculum and all elementary school principals. Without their support, it will be nearly impossible to address the other four elements.

In addition, the program will be stronger if it has broad community support. Keeping parents informed about the new science program is an important part of building community support. Many school districts strengthen community support by creating partnerships with local colleges and universities, business and industry, or both. A local corporation may agree to allocate space that can be used to house a science materials center. Scientists and science educators from a local college or university can participate in the professional development program. Corporations also may offer in-kind support or provide a grant to get the science program started. Different kinds of community partnerships will be discussed in Chapter 9.

The five elements just described make up the "system" needed for building an effective elementary science program. More than 30 years of experience have shown that addressing only one or two of these elements—the science curriculum or professional development, for example—is not enough. All the elements are equally important and must be addressed simultaneously over a sustained period of time—at least five years—to ensure the institutionalization and long-term success of the program.

This comprehensive approach to the development and implementation of an inquiry-centered science program is called *systemic reform.* By viewing the science program as a system that is made of individual elements, all of which must be addressed simultaneously, school districts can create an environment where all students have an opportunity to learn and all teachers are supported in their teaching efforts.

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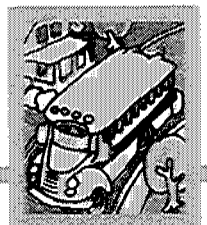

Key Points

- Creating an inquiry-centered classroom requires making significant changes in the way students learn and the way teachers teach.
- Five elements are central to the reform of elementary school science: an inquiry-centered science curriculum, professional development, science materials support, assessment, and administrative and community support. Although each element must be considered separately, they all must work together to create a new science education system.

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