Chapter 3

IMPLEMENTING A STANDARDS-BASED SCIENCE CURRICULUM

INTRODUCTION

The *New Jersey Core Curriculum Content Standards* in science (referred to in this document as the *Science Standards*) elaborate specific learning goals for all students. The cumulative progress indicators (CPIs) identify the concepts and skills associated with each of the twelve *Science Standards*. Together, the standards and their progress indicators provide a map for learning. This map helps school districts, teachers, administrators, and curriculum developers trace a path that will guide all students to achievement in science.

Implementation of a standards-based curriculum can be achieved by the following steps:

- Establishing a coherent district philosophy of science education
- Emphasizing research on learning and teaching
- Aligning the K-12 curriculum
  - Identifying the standards in the current curriculum
  - Comparing established practices to the *Science Standards*
  - Recognizing curriculum deficiencies
  - Using the *New Jersey Science Curriculum Framework* as a model to develop activities that support the standards
  - Implementing the standards
  - Aligning both teaching and assessment with the standards
- Providing ongoing staff development

These steps incorporate a philosophy of science education, an understanding of learning and teaching, a strategy for curriculum alignment, and a plan for professional development.

PHILOSOPHY OF SCIENCE EDUCATION

The basic assumption that underlies the implementation of the *Science Standards* is that science is for all students. This assumption is consistent with the principles that guided the development of the *National Science Education Standards*.

Equity of educational opportunity is a primary purpose of the *Science Standards*. All students in New Jersey's schools can and should learn science. Schools should have high expectations for all students regardless of their age, racial or ethnic background, disability, or gender. As education professionals, we must share the belief that all youngsters can achieve the standards if they are given the opportunity. The *New Jersey Science Curriculum Framework* provides numerous examples of learning activities over all grade levels.

LEARNING AND TEACHING SCIENCE

The *Science Standards* view learning as an active process in which students construct their own understanding of the natural world and establish connections between science and technology. By engaging students in activities that are both "hands-on" and "minds-on," teachers can guide their classes through challenging science experiences. To achieve the standards, students need to transfer concrete experiences to abstract concepts. Teachers should encourage students to explore, experiment, and use technology. Students should be actively involved in their own learning by observing, comparing, classifying, measuring, predicting, and communicating results.

The *Science Standards* reflect the true nature of science: students should learn science by doing science. Inquiry is the process by which scientists and students learn about the natural world. Inquiry teaching requires students to use critical-thinking skills. Students formulate questions that guide their exploration and investigation of natural phenomena. This inquiry approach to science can be incorporated at every grade level. As a result, students learn science in the same way that scientists do the work of science.

The most effective way to achieve the *Science Standards* in a textbook- and lecture-based curriculum is to use an active, interdisciplinary approach. An active approach to learning science includes inquiry-oriented experiences for all students. An interdisciplinary approach helps teachers efficiently integrate science with math, literature, social studies, health, and other subjects.

CURRICULUM ALIGNMENT AND DEVELOPMENT

A district's science curriculum should define the scope of content and the sequence of skills that are developed at every grade level. Teachers and administrators should work together to coordinate the development of a standards-based K-12 science program. This collaborative effort is fundamental to the implementation of the standards.

Identifying the standards in the current curriculum; comparing established practices to the standards; and recognizing curriculum deficiencies. The present curriculum should be compared to the *Science Standards* and their indicators. This comparison is the first step in curriculum alignment. A simple grid or content matrix can compare standards and indicators to activities within the curriculum. Teachers' lesson plans provide a valuable resource for this purpose. This process identifies those standards that need to be addressed in the curriculum. Many schools will probably find that much of their present science program is aligned with the *Science Standards*.

A standards-based science program should reflect the development of concepts within the K-4, 5-8, and 9-12 grade clusters. These clusters parallel the cumulative progress indicators for each of the twelve *Science Standards*. Teachers should recognize that concepts are developed at increasing levels of difficulty through each grade cluster. This spiral approach allows students to develop an understanding of each standard through various grade levels.

Using the New Jersey Science Curriculum Framework as a model to develop activities that support the standards. Once specific standards are identified, curriculum revision can begin. The *New Jersey Science Curriculum Framework* is designed to facilitate the implementation of the standards by providing the scaffolding on which schools can build or modify their curriculum. By painting a descriptive picture of the *Science Standards* in action, the *Framework* acts as a learning manual for schools and makes the standards user friendly.

Implementing the standards. The classroom teacher is ultimately responsible for the implementation of the standards. Teachers at every grade level should have the opportunity to develop their own framework (lesson plan) for the *Science Standards*. Implementation of a standards-based curriculum will require teachers to experiment and explore new ways of teaching. At times, established classroom practices may have to be abandoned for more innovative and focused science instruction. Creative and reflective teaching will lead to exciting and challenging science experiences for all students.

Aligning both teaching and assessment with the standards. The final step in the curriculum alignment/development process is to align both teaching and assessment with the *Science Standards*. In this respect, assessment becomes a critical part of instruction. Likewise, assessment becomes an important part of planning the curriculum. Teachers can use the data that they collect from assessment to make decisions about the developmental appropriateness of the science content, student interest and motivation, the effectiveness of the learning activities, and the effectiveness of specific examples. When linked to the content standards, routine assessment (e.g., tests, quizzes, lab reports, portfolios, essays, homework) is transformed into a valuable feedback system that provides the teacher with information about students' level of understanding.

PROFESSIONAL DEVELOPMENT

The most important factor in the implementation of a standards-based science curriculum is the teacher. The instructional skill of the teacher is the most significant variable that affects student learning. The *Science Standards* provide goals for learning, and teachers will need professional development programs that focus their skills on these learning goals.

School districts should promote an awareness of the *Science Standards*. The function of the cumulative progress indicators for each grade cluster should be understood. Teachers need to embrace the standards as the guidelines for what students need to know.

As described in the *National Science Education Standards* and *Benchmarks for Scientific Literacy*, professional development requires a change in emphasis. Professional development activities should place more emphasis on inquiry teaching and collaborative learning. Fragmented, one-shot workshops should be replaced with coherent, long-term professional development activities. The teacher should be viewed as an intellectual, reflective practitioner who produces knowledge about teaching. Effective professional development programs enable science teachers to become sources and facilitators of change rather than the target of change.

SUMMARY

An effective standards-based science curriculum incorporates a clear vision of science education. This vision should provide equal opportunity for all students to participate in an active and engaging learning environment. By comparing current practice to the *Science Standards*, school districts can more closely align the curriculum to the standards. Professional development activities can be redirected to incorporating teachers' efforts in the implementation of the standards.

In the final phase of the implementation process, teachers should use the standards as the basis for improving science content, teaching, and assessment. Science supervisors should use the standards to implement new long-range plans for improving science education at the state and local level. School administrators should focus on the need for materials, equipment, and staff development aligned with the standards.

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