

problem-based learning is so very different from more traditional ways of teaching and learning. Students are asked to work together, often somewhat independently of their teacher. They may not (initially) know what to do and may demand clearly laid out expectations for everything they are expected to do to receive a high grade on their work. Success also requires good skills for working as part of a group.

Teachers are also asked to undergo major adjustments. Extra work must be done ahead of time in preparing the case and accompanying materials, and teachers have to learn how to assist students without directing everything they do (Good and Brophy 1992).

Still, examples do exist of commercially available and well-regarded problem-based curriculum materials. For instance, the modules in Dale Seymour Publications' *Event-Based Science* are often centered on a case study representing a real-world problem. In the *Oil Spill!* module, for example, students role-play different types of consultants working in teams to make decisions about where to locate a new port for oil tankers. Along the way, students engage in activities in which they learn about density, buoyancy, tides, and a variety of other topics.

## **integrated science, coordinated science**

The phrase “integrated science” has dif-

ferent meanings among educators. All definitions of the phrase relate to the idea of teaching students about a science discipline simultaneously with something else. Differences in definitions for the term center around two issues. The first is what the “something else” is that students are learning simultaneously with a particular science discipline. The second difference among definitions deals with the degree of integration between different subject matters (or how the integration occurs).

In defining the idea of integrated science, the first question to address is what subjects are being integrated with science. At least three broad classifications of subject matter integration exist (Davison, Miller, and Metheney 1995). First, teachers frequently integrate multiple science disciplines (biology and chemistry, for example). Second, science and a separate school subject are sometimes taught together, most commonly science and mathematics. A third classification of integration is science with multiple school subjects. Teachers often accomplish this through thematic instruction, where teachers in multiple disciplines are teaching about ideas related to a theme running through several classes. The theme may represent a particularly relevant or “real” idea. In addition, elementary teachers are often interested in integrating science instruction with reading and writing instruction.

Beyond defining *what* is to be inte-

grated, advocates also must describe *how* the curriculum will be integrated. The adjective “integrated” usually implies more “togetherness” than “coordinated.” Integrated science units teach subject areas simultaneously, whereas coordinated science units are more sequenced, with one following the other.

In recent years, coordinated science has most strongly been associated with the National Science Teachers Association’s Scope, Sequence, and Coordination project (SS&C, which is described more fully in Chapter 10). SS&C’s vision was one in which the traditional “layer cake” of high school science—with students learning biology, then chemistry, then physics—would be replaced by a curriculum in which students learned every science, every year. In theory, students would revisit core science ideas as they progressed through high school (or K–12). As students aged, they would learn more abstract aspects of the science curriculum’s key ideas. Students might very well still take courses in biology, chemistry, and so forth—just every year, for part of the year, rather than all at once for an entire school year.

The education community finds it difficult to define “integrated science” and “coordinated science” because much integrated/coordinated science fits somewhere between the spectrum of totally integrated and totally coordinated science.

Despite vagaries in deciding *what* is to be integrated with science, and *how* it

is to be integrated, proponents of integrated science agree on a few basic assumptions. The science disciplines themselves are becoming increasingly integrated (e.g., biochemistry, geophysics). Science and mathematics go hand in hand so strongly, supporters argue, that it makes sense to teach them together (of course, this idea also has its detractors). Science that is personally relevant or oriented toward real-life applications almost always draws on multiple disciplines. Finally, science is deeply integrated with important public policy issues that every citizen should understand.

## thematic instruction

is a type of integrated instruction in which a general theme or idea is the centerpiece of instruction in multiple disciplines. For example, consider a middle school thematic unit about agriculture. Students learn about the importance of agriculture to developing culture in a world history class, read classic stories about farm lives in an English class, and study plant germination in a science class. The social studies, English, and science teachers work together—perhaps teaching students in a school-within-a-school setting.

Thematic instruction is most popular at the elementary school level, where classes are self-contained and the same person is likely to teach English, social studies, math, science, and other subjects to a group of students. Teachers tend to