
Preface

Two decades after science became the favored child of American education—with hundreds of millions of Federal dollars at its disposal and a clear-cut mandate to assure national security and lead American society into the technological age—biology, chemistry, and physics are once again fighting for their place in American schools.

Edward B. Fisk, April 1979
The New York Times

American students will move from the middle of the top—from the middle to the top of the pack in science and math over the next decade—for we know that the nation that out-educates us today will out-compete us tomorrow. And I don't intend to have us out-educated. We can't start soon enough.

President Barack Obama, April 2009
Presentation to the National Academy of Sciences

When *Sputnik's* first “beeps” reached the earth on October 4, 1957, a sense of concern and paranoia swept over the United States as the Soviets had beaten the Americans into space. That concern sparked a refocusing of resources and a much-needed revolution in science education, scientific inquiry, and the development of intellectual and cognitive capacity in the United States. Since that burst of enthusiasm over 50 years ago, science education slowly has been taken over by new national demands and shifts of emphasis. The stature of science, science education, and scientific reasoning has been diminished in the classroom, and the cumulative effect of this resonates through science learning outcomes for generations of students. This is reflected in international assessments and choices students make for their careers. The good news is that President

Barack Obama is now calling for a revival of the *Sputnik*-era focus and a renewed commitment to the sciences and science education.

This leaves 21st-century science educators in a challenging position. Concerns about science education are becoming especially focused and rising to a level in Congress and federal agencies rarely seen since the *Sputnik* era. Science again matters, and we have reasons to be optimistic! We now have the attention of policy makers at the highest level. We must prepare and be ready to do our part. We need to reinvent ourselves as science teachers and developers of instruction.

Science, as practiced, is a beautiful example of an eloquent process of how humans strive to understand and define their world. However, in the classroom, underlying concepts, clear definitions, and simple answers and explanations are hidden in complex and tangled intellectual structures and curricular details. Textbook content and general science curriculum are often very far removed from the ways in which science is actually conducted and utilized today. The unifying concept, collectively called the nature of science, is often missing or hidden within the day-to-day details. Much of the time, we teachers haphazardly meander through a maze of different topics, under the banner of “coverage.”

Where can teachers look for guidance and validation for their instruction and choices? For overall views, the National Academy of Sciences, the American Association for the Advancement of Science, and the National Science Teachers Association are three of the main organizations involved with science education. Fortunately, many of their policy positions and standards are in alignment.

Each subdiscipline in the sciences also has a range of professional organizations providing direction as to what to teach and how to teach. States also have governmental departments that deal with specific frameworks, scope and sequences, textbook adoptions, and a range of administrative tasks. Many of these look to the three main science organizations as a source of guidance when constructing their own documents.

Our overall aim in writing this book is to look for common ground and to search science education research for instructional, curricular, general education, and community-based strategies that unite the goals of all of those involved in facilitating science literacy. We were guided by seven central learning and teaching goals that we feel come close to defining what science literacy is:

1. Mastery of subject matter
2. Mastery and understanding of scientific reasoning
3. Understanding of the nature of science
4. Understanding the complexity of real empirical work, experimental design, and validity assessment

5. Mastering practical procedural and scientific process skills
6. Promotion and mastery of teamwork
7. Generating interest and motivating curiosity in science

Reflecting on these goals, especially the seventh goal related to curiosity, we recognize that many intangible factors resonate deeply with students as they form their views of science and decide the role science will play in their lives. School practices sometimes diminish curiosity from the important goal it should be. Curiosity is a quality that serves the sciences well and is a key element in what makes a science-literate person either a citizen consumer or a practitioner of science. A curious student is one we all want to have and foster in our classrooms, especially in the science classroom. We want to nurture curiosity and revive it in those who have lost it. With curiosity, soul, and passion, knowledge and skills can become extraordinary.

Students usually come to us seeking mastery over procedures, materials, processes, and content. Early in a career, teaching to these goals is enough. But we serve our students best once we introduce the deeper, more complex, and very personal engagement that produces the greatest worth over the long periods of time. Science is much more than procedures, materials, processes, and content. Teaching students how to think is more important than what to think. This may not always make professional sense in the age of standardized tests, but it makes lots of sense for future thoughtful citizens and decision makers. This is why we keep curiosity and scientific reasoning as themes in the back of our minds when writing.

Barnett and Kitto (2004) describe a research-practice gap in science and math education that they attribute to teachers having little interest in or use for the academic products of educational researchers. We have tried to fill that gap by closely examining the national standards and the academic research. We then filter that information through our own classroom, school, and community experiences to produce summaries, reflections, ideas, and curricular and instructional strategies that will help teachers move beyond simple “coverage” focused instruction. In this way, immersion in science will yield students who are curious, motivated, and ambitious, in addition to literate, with content mastery capable of higher levels of scientific reasoning and inquiry.

Source

Barnett, J., & Kitto, R. (2004). Mind the gap: A proposal for science, mathematics, and technology education. *Canadian Journal of Science, Mathematics and Technology Education*, 4(4), 529–535.