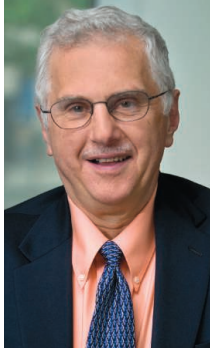

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Reframing Science Standards

A PROMISING DRAFT *FRAMEWORK FOR SCIENCE EDUCATION* WAS RECENTLY POSTED BY THE U.S. National Academies for public comment (until 2 August) and review (see www7.nationalacademies.org/bose). Its goal is to define the science that all students should be taught from age 5 through precollege in the United States, building on lessons learned from the 1996 National Science Education Standards (NSES). Will this new effort, initiated to help produce a common core for science education across states,* be more successful than the last one?

In 1989, the governors of all 50 states issued a call for "voluntary national standards" in each of the major academic disciplines. In response, the NSES were issued by the National Academy of Sciences in 1996. The results have been disappointing. In particular, the requirement for students to master a large number of facts and concepts took precedence over the strong emphasis on "science as inquiry" in the NSES. The new *Framework* attempts to overcome this problem in several interesting ways.

First, the draft *Framework* focuses on only four core concepts in each of four disciplines: life sciences, physical sciences, earth and space sciences, and engineering and technology. And differing from the NSES, each core concept extends over all years of schooling. The intention is to leave room during the school day for three important strands of science learning that have been systematically ignored in favor of the traditional content strand, which focuses on knowing, using, and interpreting scientific explanations of the natural world. The critical strands that have been missing are generating and evaluating scientific evidence and explanations, understanding the nature and development of scientific knowledge, and participating in scientific practices and discourse.†

Second, the *Framework* supplements the dominant theme of inquiry in the NSES with a greatly expanded discussion of why any definition of science education must center around active participation in scientific practices and extensive experience with evaluating evidence. The current focus on transmitting only the knowledge that scientists have discovered fails to provide students with the thinking and problem-solving skills that are essential for life in our complex societies, and it also fails to give them a sound understanding of why science has been so successful as a special way of knowing about the world. Thus, the draft *Framework* contains a powerful chapter containing 16 useful tables entitled Scientific and Engineering Practices. (The inclusion of engineering itself represents a major, positive break with tradition.)

The *Framework* also stresses the importance of building coherence into the science curriculum from year to year through reference to the ongoing research on "learning progressions." As an example, the recognition that any object is composed of specific materials, and has certain properties because of those materials, is known to be an important first step toward understanding atomic-molecular theory. To guide curriculum design, the last half of the draft document presents prototype learning progressions for each of the core concepts to be learned, expanding on the landmark *Atlas for Science Literacy* produced by the American Association for the Advancement of Science.

The *Framework* will be finalized in response to the feedback received on the public draft, and then, because responsibility for education is assigned to each state by the U.S. Constitution, the final standards will be developed through a coalition of states led by the nonprofit organization Achieve. The worst thing that scientists could do would be to insist that the core disciplinary ideas be expanded to include their specialties. Instead, the scientific community should focus on preparing college students to "ask questions; collect, analyze, and interpret data; construct and critique arguments; communicate and interpret scientific and technical texts; and apply and use scientific knowledge"—precisely as the *Framework* specifies for the precollege years.

– Bruce Alberts

10.1126/science.1195444

*A. I. Leshner, S. Malcom, J. E. Roseman, *Science* **328**, 1075 (2010). †B. Alberts, *Science* **323**, 437 (2009).

Published by AAAS