Director's Notes

Wait Time

Since the late 1960's, education research has suggested that lengthening the time teachers pause after they speak—wait time—elicits more numerous and more thoughtful responses from their students. Perhaps there is a lesson here for all of us who grow impatient with the pace of reform in the nation's schools. For example, consider the ambitious goal of developing "world-class standards by the year 2000." Given the nature of our change-resistant education system, it seems clear that more wait time is in order.

Looking for Results

But it is not easy to make precise time estimates. In the research on wait time most teachers were not able to estimate accurately how long they should pause to allow students to respond. Reports issuing out of the latest Education Summit seem to reflect a similar inability to estimate how long it takes to make changes that we all agree are needed.

We want results and we want them now. Such impatience can be motivating, but it can also be debilitating when we fail to live up to our expectations, however naive they may be. This may cause us to give up on today's reform effort and adopt a new one, or simply give up altogether. But it might temper our impatience somewhat to realize that important milestones have, indeed, been reached. The development of national science education standards is a case in point.

Standards in the Making

In 1985, when AAAS launched Project 2061, there was no national dialogue on standards, no general sense that they were needed. We estimated then that achieving nationwide science literacy would be a 20- to 30-year undertaking.

We believed that the first step toward science literacy was agreement *in detail* on what all students should know and be able to do in science, mathematics, and technology by the time they graduate from high school. This premise led to *Science for All Americans,* the project's 1989 report which offers a credible definition of adult science literacy.

That same year, the National Council of Teachers of Mathematics published *Curriculum and Evaluation Standards for School Mathematics* (the first use of the "standards" designation), and President Bush and the nation's governors met to establish national performance goals. Four years later, in 1993, Project 2061 released *Benchmarks for Science Literacy*, and in 1996 the National Research Council of The National Academy of Sciences released *National Science Education Standards*.

What Matters Most

This has been a productive ten years. But it might not have been so if the many professional associations, scientific societies, and individual teachers and scientists who were involved had not reached agreement on what learning counts most. The overlap between *Benchmarks* and the math and science standards is remarkable, and I urge you to examine the detailed comparison of them that can be found on Project 2061's forthcoming *Resources for Science Literacy: Professional Development* CD-ROM.

In reaching a consensus on learning goals, the participants also came to agree on the guiding principles of reform in science education. These appear in a joint statement issued earlier this year by AAAS, the National Academy of Sciences, and the National Science Teachers Association. These principles (shown at right) suggest that it has been well worth a decade of effort to now be in accord on where reform in science and mathematics education is headed. Hopefully, adequate wait time will now elicit more numerous and thoughtful reform efforts from us all.

F. James Rutherford
Director

Guiding Principles of Reform

The first priority of science education is basic science literacy for **all** students, including those in groups that have traditionally been served poorly by science education, so that as adults they can participate fully in a world that is increasingly being shaped by science and technology.

Education for universal science literacy will, in addition to enriching everyone's life, create a larger and more diverse pool of students who are able to pursue further education in scientific fields and are motivated to do so.

Science literacy consists of knowledge of certain important scientific facts, concepts, and theories, the exercise of scientific habits of mind, and an understanding of the nature of science, its connections to mathematics and technology, its impact on individuals, and its role in society.

For students to have the time needed to acquire essential knowledge and skills of science literacy, the sheer amount of material that today's science curriculum tries to cover must be significantly reduced.

Effective education for science literacy requires that every student be frequently and actively involved in exploring nature in ways that resemble how scientists themselves go about their work.