Project 2061

Science Literacy for a Changing Future

PROJECT 2061 OF THE AMERICAN ASSOCIATION FOR THE Advancement of Science is a long-term, comprehensive effort to reform K-12 science education nationwide so that all high-school graduates are science literate—able to make sense of how the world works, to think critically and independently, and to lead interesting, responsible and productive lives in a culture increasingly shaped by science and technology. The Project first laid out goals for student learning, and is now creating a coordinated set of reform tools to help educators design curricula to meet those goals in their districts.

Science for All Americans

In its 1989 report, *Science for All Americans (SFAA)*, Project 2061 outlined what all high-school graduates should know and be able to do in science, mathematics, and technology. *SFAA* recommends not only specific, interconnected understandings in these three areas, but also habits of mind essential to science literacy and some principles to guide teaching and learning for science literacy. *SFAA* specifies literacy in the following areas:

Chapters 1-3 focus on the nature of science, mathematics, and technology as human enterprises: how they differ and how they are alike, their reliance on evidence, their use of imagination, and how they identify and avoid bias.

Chapters 4-9 present the picture that science currently paints of how the world works. These chapters include:

- *The Physical Setting*, which describes basic knowledge about the overall contents and structure of the universe on astronomical, terrestrial, and submicroscopic levels and about the physical principles on which it seems to run;
- *The Living Environment*, which presents basic knowledge of how living things function and how they interact with one another and their environment;
- *The Human Organism*, which discusses our species as one that is in some ways like other living things and in some ways unique;
- *Human Society*, which examines individual and group behavior, social organizations, and the process of social change;
- *The Designed World*, which considers how people shape and control the world through technology; and
- *The Mathematical World*, which presents basic mathematical ideas, especially those with practical application, that together play a key role in almost all human endeavors.

Chapter 10, *Historical Perspectives*, illustrates the nature of the science enterprise with ten examples of changes and discoveries that are of exceptional significance to our cultural heritage: the planetary earth, universal gravitation, relativity, geologic time, plate tectonics, the conservation of matter, radioactivity and nuclear fission, the evolution of species, germs as a source of disease, and the industrial revolution.

Chapter 11, presents *Common Themes* that cut across disciplines and can serve as tools for scientific thinking about phenomena as diverse as ancient civilization, comets, and the human body.

Chapter 12, *Habits of Mind*, presents recommendations about values, attitudes, and skills—including mathematical skills, manipulation and observation skills, communication skills, and critical-response skills.

Chapter 13, *Effective Learning and Teaching*, lays out principles that underlie all Project 2061 tools.

Benchmarks for Science Literacy

Created in collaboration with school district teams of teachers across the country, *Benchmarks for Science Literacy* (1993) and *Benchmarks on Disk* (1994) translate the science literacy goals of *SFAA* into learning expectations for grades 2, 5, 8, and 12. *Benchmarks* can be used with *SFAA* to help guide curriculum design and reform in science, mathematics, and technology education and can help educators decide what content to include in (or exclude from) a core curriculum, what order to teach it in, and why. It differs greatly from conventional tools for curriculum planning:

- *Benchmarks* is a tool to be used by educators in designing a curriculum that makes sense to them and that meets the goals for science literacy recommended in *SFAA*. *Benchmarks* does not advocate any particular curriculum design—in fact, it should allow greater curriculum diversity than is common today.
- *Benchmarks* is a compendium of specific science-literacy goals that can be organized however one chooses.
- *Benchmarks* specifies thresholds rather than average or advanced performance. It describes levels of understanding and ability that all students are expected to reach on the way to becoming science literate.
- *Benchmarks* concentrates on the common core of learning that contributes to the science literacy of all students. It does not spell out all science, mathematics, and technology goals that belong in the K-12 curriculum. Most students have interests, abilities, and ambitions that extend beyond the core studies, and some have learning difficulties that must be taken into account.
- *Benchmarks* avoid technical language used for its own sake. The 12th-grade benchmarks use only those relatively few technical terms that usually appear in the vocabularies of science-literate adults. The language in the benchmarks for earlier grades is intended to signal the nature and sophistication of understandings to be sought.
- *Benchmarks* is informed by research. Research on students' understanding and learning bears significantly on the selection and grade placement of the benchmarks.
- *Benchmarks* is a developing product. It will undergo periodic updates as more research on learning becomes available and as users of *Benchmarks* report their experiences.

Developing Tools for Reform

SFAA and *Benchmarks* will soon be joined by:

- *Resources for Science Literacy*, a two-part computer-based tool to help educators enhance their own science literacy and to analyze curriculum resources and identify those that promote science literacy.
- *Designs for Science Literacy*, a handbook to help educators take a systematic design approach to planning a K-12 curriculum.
- *Blueprints for Reform*, recommendations for how aspects of the education system must change to accommodate the curriculum reforms being proposed by Project 2061.

All of these tools will eventually be integrated in a computer-based curriculum-design system for the construction and management of local, K-12, cross-subject curricula.

Project 2061's Vision of Reform

What will successful science, mathematics, and technology education look like in the 21st century? What must take place in the schools to know that Project 2061's reforms have had an impact?

The following characteristics define Project 2061 reform in terms of anticipated results:

Curriculum content

- Science literacy will be central to a common core of learning in science, mathematics, and technology and will be closely allied with a common core of learning in the arts and humanities.
- Educators and curriculum developers use *Benchmarks* in the analysis, design, and improvement of the K-12 curriculum and of resources and materials.
- The curriculum will be streamlined, omitting marginal content and rote memorization of technical terms, so that students will be able to concentrate on learning well a basic set of ideas and skills that will lead to science literacy and promote further learning.
- Curricula will emphasize connections across grades, topics, and disciplines and will address the particular needs, interests, and talents of individual students.

Teaching and learning

- All students will be provided with wide-ranging learning experiences, including hands-on activities as well as reflective thinking.
- Instruction will take place in contexts that are meaningful to the students, such as explaining everyday phenomena, solving practical problems, or making a decision about an issue.
- Instructional methods will be varied—projects, seminars, independent study, peer teaching, individual and cooperative-group work, and even traditional lecture-discussion.
- Learning materials will be diverse, with less reliance on textbooks and more on computers and technology.
- Teachers will have primary responsibility for planning, implementing, and monitoring curriculum within their individual systems. K-12 teams will plan for K-12 continuity of experiences and cross-discipline groups will plan for how students will encounter connections within the curriculum.
- Teachers will use *Science for All Americans*, *Benchmarks for Science Literacy*, and *Resources for Science Literacy* to set student learning goals and then to develop, revise, and manage curricula and to foster ongoing professional development aimed at helping students achieve those goals.

Schools and community

- The school environment will support science literacy goals and the curriculum designed to achieve them.
- Schools will be open to information and participation from outsiders who can contribute to the specified learning goals.
- Students and teachers will have opportunities to participate in activities and experience phenomena in instructional settings outside the school.
- Resources will be readily available for teachers and administrators to learn about new research findings and their implications for practice and to engage in similar study themselves.
- Scheduling of time and personnel will be suited to the demands of the learning experience.
- Educators, parents, policymakers and everyone involved in reform will understand that reform is a continuing process, requiring sufficient resources, consistent effort, and time.

For more information about Project 2061 contact:
Project 2061/AAAS, 1333 H Street, NW
Washington, DC 20005
Or call 202/326-6666, Fax 202/842-5196
E-mail: project2061@aaas.org
Internet: gopher.aaas.org
World Wide Web: http://www.aaas.org

Project 2061 publications are available from Oxford University Press. For ordering information, please call **1-800/451-7556**.

About Science for All Americans . . .

"This pioneering effort has profound implications for the future of our nation and, indeed, of the world."

David A. Hamburg
President, Carnegie Corporation of New York

"A humanistic vision, beautifully presented, of science as basic education, science as cultural heritage, science as a quest for understanding."

A. Graham Down
President, Council for Basic Education

"[The] National Science Foundation is very proud to be a part of this particular project. . . . We must find ways to teach this material to students who have often not been attracted to technical subjects and who do not expect to make careers in science, mathematics, or engineering. ***Science for All Americans*** *is important precisely because this broad and challenging goal is its concern."*

Erich Bloch
Former Director, National Science Foundation

and Benchmarks for Science Literacy . . .

"This publication is another milestone in the longstanding effort of Project 2061 to improve the teaching and learning of science for all Americans."

Bruce Alberts
President, National Academy of Sciences

"Benchmarks for Science Literacy *will surely become a landmark contribution in efforts to reform science, mathematics, and technology education . . . I, as well as others, appreciate the intense effort that was involved in its preparation."*

Governor James B. Hunt
North Carolina

"I am . . . impressed with the clarity, precision and thoughtfulness of [this] work. I only hope that science educators across the country understand, appreciate and utilize the fine material produced by Project 2061."

Harold Pratt
National Science Education Standards Project

"Benchmarks for Science Literacy *delineates the broad framework for science education toward which we . . . are diligently working in order to prepare our students for the twenty-first century."*

Ramon C. Cortines
Chancellor, Board of Education of the City of New York

"Benchmarks *will affect millions of students. It will have enormous impact on state tests and on what is taught."*

Bill Aldridge
Director, National Science Teachers Association

"Benchmarks *has been critical in helping us develop a new curriculum framework that incorporates science with math and technology. There's no other document like it that describes what students need to know about science, and when they need to know it."*

Frances Brock
Acting Supervising Director of Science D.C. Public Schools

"I congratulate the AAAS on the bottom-up approach used to develop the reports and curriculum change by involving the several school sites, as well as many other educators throughout the country in a consensus building process."

James D. Gates
Executive Director, National Council of Teachers of Mathematics

"In an industry that deals daily with new technologies, the scientific knowledge and ability of our workforce is a key to our success. If educators truly use . . ***Benchmarks****, today's children and tomorrow's workforce will be better prepared to participate in and contribute actively to our increasingly technological society."*

John Zimmerman
Senior Vice President for Human Resources, MCI