Education at the National Academies

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In the previous issue of *CBE* (Vol. 1, Winter 2002), Bruce Alberts, president of the National Academy of Sciences, provided readers with an overview of some of our many initiatives in education (pp. 109–110). Much of that article focused on the work within the Center for Education of the National Research Council (NRC).¹ That issue also contains an article by ASCE member William Wood (pp. 123–127) about a recent NRC report on advanced study programs for high-school students (with a focus on the Advanced Placement and International Baccalaureate programs in biology, chemistry, mathematics, and physics), as well as a review of the report (NRC, 2002). In a future issue of *CBE*, NRC program officer Kerry Brenner will describe a major report from the Academies, *BIO2010: Transforming Undergraduate Education for Future Research Biologists*. Here, I discuss three other education activities across the National Academies that are likely to be of interest to biologists.

The National Academies publishes some 250 technical and popular reports each year on topics related to virtually all aspects of science and public policy.² It convenes more than 500 committees annually with the aid of more than 6000 committee members. The NRC is comprised of autonomous disciplinary boards and study committees that are overseen by larger divisions. As with other types of institutions, collaboration is sometimes constrained by financial and other barriers. However, under Alberts's leadership, the National Academies is making a concerted effort to foster greater coordination and collaboration among its education initiatives, with the Center for Education serving as the nucleus of education knowledge that can be shared with other program units in the disciplines. For example, while the NRC's Board on Life Sciences assumed primary responsibility for producing

the *BIO2010* report, the Center for Education provided advice about the general educational issues that the committee was investigating. All of the Academy's education activities can be found at <http://www.nationalacademies.org/education>.

I would like to highlight several other programs at the National Academies that should be useful to educators in biology. They include work under the aegis of the National Academy of Sciences' Office on Public Understanding of Science, the National Academy of Engineering's (NAE's) ongoing work on improving technological literacy, and joint work by the NRC's Board on Life Sciences and the Center for Education to help scientists better integrate education and outreach components into their research programs. In a subsequent issue of *CBE* we will provide information on the Academy's ongoing efforts to deal with current challenges to the teaching of evolution.

OFFICE ON PUBLIC UNDERSTANDING OF SCIENCE (NATIONAL ACADEMY OF SCIENCES)

The National Academy of Sciences' Office on Public Understanding of Science (OPUS) focuses on the informal education of adults, particularly those who are involved with policy, the media, and education. OPUS manages programs ranging from public lectures, presented by well-known scientists, to print and web-site articles describing scientific discoveries. It aims to increase adults' understanding of the nature and process of science.

One OPUS project that may be of particular interest to readers of *CBE* is a series of nearly 20 articles entitled *Beyond Discovery: The Path from Research to Human Benefit*. These eight-page articles describe the often-unanticipated benefits of basic research by tracing the scientific history behind familiar medical and technological applications. They may be used as supplementary materials for classroom discussions or as handouts at public events, such as lectures and open houses. They can also form the basis for presentations by scientists to the public. Several of these articles describe advances in cell biology. Of particular interest are "Polymers and People," which describes the research behind the development of artificial skin; "Disarming a Deadly Virus," which details the development of some antiretroviral drugs; "From Explosions to the Gas That Heals," which describes the discovery of the nitric oxide signaling pathway; and "Curing Childhood Leukemia," which includes information on enzyme pathways. Additionally, OPUS is revising one of the earliest articles in the series, "Human Gene Testing." The current article begins

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¹The National Research Council is the operating and research arm of the National Academies, which also includes the National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. The National Academies is a private, not-for-profit organization that is chartered to assist the federal government and the American people in analyzing pressing scientific and science policy issues. Most of this work is undertaken by leading scientists, mathematicians, engineers, social scientists, and policy experts who provide pro bono service to the National Academies and the nation.

²All National Academies reports are freely available for reading on-line or for purchase at the web site of the National Academies Press, <http://www.nap.edu>. More than 150 reports on education issues have been published since 1994 and all are available on-line.

with the discovery of the structure of DNA and includes the use of PCR and the discovery of specific disease genes. We plan to expand the article to include the sequencing of the human genome and the many biotechnology advances that have occurred in the past 5 years.

All of the articles are available at <http://www.BeyondDiscovery.org>, from which pdf versions may be downloaded for copying and distribution. Communications about this project or suggestions of additional topics should be directed to OPUS at opus@nas.edu.

IMPROVING TECHNOLOGICAL LITERACY (NATIONAL ACADEMY OF ENGINEERING AND CENTER FOR EDUCATION)

At first glance, a project on improving technological literacy among the general public might seem to have little to do with education in biology. However, cutting-edge research by biologists depends on sophisticated and often very expensive technology. Continued public support for this work is predicated in part on life scientists in these fields being able to speak honestly about the risk and trade-offs involved in using such technology, as well as being able to explain its societal benefits. The project's report, *Technically Speaking: Why All Americans Need to Know More About Technology* (NAE and NRC, 2002), offers a compelling argument and rationale for improving technological literacy. It highlights specific issues of concern: the state of technological studies in K–12 schools, the reach of the Internet into our homes and lives, and the crucial role of technology in today's economy and workforce requirements. Three case studies of current issues—automobile airbags, genetically modified foods, and the California energy crisis—illustrate why ordinary citizens need to understand technology to make responsible decisions. The report emphasizes that it is not addressing the ability of people to understand and use computers and similar machines but, rather, the broad role of technology in society. This includes understanding such distinctions as technology versus science and technological literacy versus technical competence.

The report clearly and decisively explains what it means to be a technologically literate citizen:

Technological literacy encompasses three interdependent dimensions—knowledge, ways of thinking and acting, and capabilities. Like literacy in reading, mathematics, science, or history, the goal of technological literacy is to provide people with the tools to participate intelligently and thoughtfully in the world around them. The kinds of things a technologically literate person must know can vary from society to society and from era to era.

Chapter 1 details the characteristics of a technologically literate citizen. The NAE also has established an educational web site (<http://www.nae.edu/techlit>) that expands upon this report, offering users a variety of educational resources and ideas for educational activities.

The NAE and the Center for Education are now collaborating on a follow-on study to *Technically Speaking*. This project, also funded by the National Science Foundation, is examining approaches for assessing technological literacy in stu-

dents, teachers, and the public at large. Although indirect evidence strongly suggests that Americans are not very technologically literate, there are few empirical data that shed light on this crucial question. This 2-yr project is expected to provide guidance to public- and private-sector test developers, among others, about methods for determining what people know about technology.

INTEGRATING EDUCATION AND OUTREACH IN RESEARCH PROJECTS (BOARD ON LIFE SCIENCES AND CENTER FOR EDUCATION)

The National Science Foundation and other federal agencies are calling for research grantees to incorporate education or outreach activities into the plan for their research projects. For example, in its 2001 request for proposals for the multimillion dollar initiative on "Biocomplexity in the Environment: Integrated Research and Education in Environmental Systems," the NSF stated,

Encouraging the development of a new generation of scientists and engineers trained in comprehensive approaches to investigation of environmental systems is an important goal of this initiative. Competitive projects will be those that provide integrated research and education experiences for participants that may include undergraduates, graduate students, teachers, and postdoctoral associates. Investigators are encouraged to include students in research teams, in various interdisciplinary settings, or in various work sectors or research platforms.

NSF encourages inclusion of specific formal educational activities from pre-college to faculty levels, as well as informal education for the lay public, resource managers, and policymakers. Proposals in the topical areas may address, for example, the development of materials for use in integrative, comprehensive curricula that will educate students in the diverse character of biocomplexity in the environment. Informal education channels such as science centers, aquariums, and similar facilities that are easily accessible and attractive to the public may also be utilized to help enhance the public's ability to deal with complex environmental information and make informed decisions about the environment. Educational efforts at the K–12 level should promote the acquisition of scientific inquiry skills, take advantage of technology and use it appropriately, and be consistent with the National Science Education Standards.³ (For more information about these standards, see <http://www.nap.edu/catalog/4962.html> and www.nap.edu/catalog/5704.html). (NSF 01-34)

³The NRC released the *National Science Education Standards* (NSES) in 1996 following a request from the National Governor's Association to develop this document. The standards offer a vision for new approaches to teaching and learning science for Grades K–12, emphasizing science as inquiry. In addition to content standards, the NSES offer guidance on teacher preparation and professional development, instruction, assessment of learning, and the kinds of systemic infrastructures that are required to sustain these new approaches to science education. The NSES (NRC, 1996) and a series of addenda and related reports on standards are available at the web site of the National Academies Press (<http://www.nap.edu>).

Researchers who have not had to address such issues in proposals for research funds may be at a loss about how to structure, execute, and evaluate the efficacy of such activities. Accordingly, the NSF asked the National Academies to design and host a workshop that would assist principal investigators in the NSF's Biocomplexity initiative (as well as other scientists) who are required to integrate education with research and to communicate with the public more effectively about the nature and significance of their research. This workshop was held at the National Academies facilities in April 2002. Scientists and educators with expertise in fields related to the environment or biocomplexity and who had successfully integrated education or outreach components with their research were invited to give formal presentations about those experiences. A workshop summary describing the discussions that took place at the meeting (NRC, 2003) is available at the web site of the National Academies Press (<http://www.nap.edu/catalog/10627.html>).

REFERENCES

- National Academy of Engineering and National Research Council (2002). *Technically Speaking: Why All Americans Need to Know More About Technology*. Washington, DC, National Academies Press. (Also available at <http://www.nap.edu/catalog/10250.html>)
- National Research Council (1996). *National Science Education Standards*. Washington, DC, National Academies Press. (Also available at <http://www.nap.edu/catalog/4962.html>)
- National Research Council (2002). *Learning and Understanding: Improving Advanced Study of Mathematics and Science in U.S. High Schools*. Washington, DC, National Academies Press. (Also available at <http://www.nap.edu/catalog/10129.html>)
- National Research Council (2003). *Integrating Research and Education: Biocomplexity Investigators Explore the Possibilities: Summary of a Workshop*. Washington, DC, National Academies Press. (Also available at <http://www.nap.edu/catalog/10627.html>)