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From the National Academies

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Our nation turns to the National Academies—the National Academy of Sciences, the National Academy of Engineering, the Institute of Medicine, and the National Research Council—for independent, objective advice on issues that involve one or more aspects of science or technology. Typical examples of the Academies' work are the initial study that formulated the Human Genome Project in 1988 (http://www.nap.edu/catalog/1097.html), the year 2000 report *Enhancing the Postdoctoral Experience for Scientists and Engineers* (http://www.nap.edu/catalog/9831.html), and the recent report *Making the Nation Safer: The Role of Science and Technology in Countering Terrorism* (http://www.nap.edu/catalog/10415.html).

The Center for Education at the National Academies was established on the premise that we urgently need to harness science to improve the education that we provide to all Americans. This includes not only emphasizing an inquiry approach to science education from kindergarten through college (see http://www.nap.edu/catalog/9596.html), but also promoting an energetic attempt to use scientific evidence regarding how students learn in ways that help us to improve teaching and learning in our classrooms (see http://www.nap.edu/catalog/9853.html).

Four current projects should be of special concern to *Cell Biology Education* (*CBE*) readers. One is a just-released report by a distinguished committee chaired by Academy member Lubert Stryer—a biochemist from Stanford University: *Bio2010: Undergraduate Education to Prepare Biomedical Research Scientists* (http://www.nap.edu/catalog/10497.html). This report points out that the next generation of biomedical researchers will need to acquire a higher degree of quantitative skills for success, and it outlines what type of chemistry, physics, engineering, computer science, mathematics, and biology education we might aim for in a completely restructured undergraduate curriculum. During the next year, we will be disseminating this report and seeking examples of existing courses that match the suggestions made for the new curriculum. Communications with the Academies on this issue should be directed through Kerry Brenner at kbrenner@nas.edu.

A second project that should be of interest to *CBE* readers is being guided by a new Committee for Undergraduate Science Education (CUSE). This effort is chaired by Academy member Dick McCray—an astrophysicist from the University of Colorado—and staffed by a distinguished American Society for Cell Biology member, Bob DeHaan. In addition, two *CBE* editors are members of the committee: Sarah Elgin and John Jungck. In this effort, the National Academies are attempting to answer the important question "How can we analyze and disseminate the best practices for undergraduate teaching and curriculum to change the nature of the typical introductory college science course (for example, Biology 101)?" The goal is for us to engage students in meaningful inquiry in introductory courses taken by large numbers of people while we make efficient use of both limited financial resources and faculty time. The Academies would hope in this way to attract more outstanding students as science majors and, of equal importance, provide many more American adults with an understanding of the nature of science, as well as a respect for its judgments.

As a way to promote the preceding agenda, a workshop highlighting some outstanding examples of existing courses will be held in Washington, DC, on November 19–20, 2002, in connection with the next meeting of the CUSE. Participants will address two major questions: 1) What are the most effective instructional approaches to achieve optimal learning outcomes? and 2) What qualities of organization, governance, and incentive structures can be identified at the departmental and institutional levels that promote high-quality science instruction? All persons with interesting ideas and examples to suggest to us should contact Bob DeHaan by email at rdehaan@nas.edu.

A third project concerns the Advanced Placement (AP) and International Baccalaureate (IB) courses in science and mathematics that are taken by large numbers of U.S. high school students every year. Administered through the College Board in the form of national examinations for competency, nearly 500,000 AP exams are taken each year in science and mathematics. There has been great concern over the poor performance of even our most advanced students in the Third International Mathematics and Science Study (TIMSS) compared with the performance of students in other nations. This concern led the U.S. Department of Education (DOEd) to ask the Academies to prepare the report *Learning and Understanding*: *Improving Advanced Study of Mathematics and Science in U.S. High Schools*. Subpanels of the committee were formed to prepare detailed reports on the AP examinations in biology, chemistry, physics, and mathematics. The biology panel was chaired by Academy member William Wood, also a *CBE* editor. Another *CBE* editor on the panel was John Jungck. The biology panel report (http://www.nap.edu/catalog/10129.html) called for major changes in the AP and IB biology course and exam. It points out that students are currently being required to cover far too

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much material, which inhibits the type of deep understanding and appreciation of biology that we would like to promote. With the encouragement of the College Board, follow-up efforts are planned to assist the Board in revising the biology, chemistry, and physics curricula and exams, guided by the suggestions in the full report. (See the related book review by Debra Tomanek and the essay by William Wood in this issue of *CBE*.)

The last project that I would like to discuss is an important one that is just beginning on science assessments. In our nation, education is a states rights issue, with nearly all decisions reserved to state and local jurisdictions. However, a large amount of federal funding for education is provided to the states each year through the DOEd, and the federal government inserts requirements for receiving this funding that enable it to have an effect on state education policies. The DOEd's influence is based on the Elementary and Secondary Education Act, which is reauthorized about once a decade. The most recent reauthorization occurred in January 2002, in the form of the No Child Left Behind Act. This Act is revolutionary in requiring that each state test every student in each of three grade spans: grades 3–5, grades 6–9, and grades 10–12. Current emphasis is on testing students in mathematics and in reading. However, beginning in the 2007–2008 school year, science achievement must also be tested at least once in each grade span.

The current high-stakes assessments that states have implemented in mathematics and reading are having a detrimental effect on science teaching. Teachers are only human, and a rational response to the current pressure of examinations is causing them to focus so strongly on reading and math that often little time is left for science. Once the new science assessments are implemented, we can expect a renewed emphasis on science teaching. However, if the states produce the wrong kind of assessments of science achievement, the science test could strongly inhibit the type of reforms in science education that are recommended by the *National Science Education Standards* (http://www.nap.edu/catalog/4962.html). Unfortunately, it is much easier to test for a superficial knowledge of science words than it is to test for science understanding. For example, consider the infamous multiple-choice exams that ask eighth graders to associate the word mitochondrion with the phrase "the powerhouse of the cell," and so on for all the other parts of a cell.

In a project jointly sponsored by the National Science Foundation and the DOEd, our Center for Education has been asked to produce a document that would help guide the states in the development of a different type of science assessment. This assessment would reward teachers for teaching about science as a process through inquiry-based lessons, because it would test students on their understanding of science concepts and their science abilities. Our project is to be completed by 2004, in time for the states to use it to produce their own assessments. To begin this process, we convened a group of the nation's most outstanding science teachers of kindergarten through 12th grade. I attended this meeting, which took place at our Woods Hole facility in mid-August 2002. The focus was on getting teachers' input on the design of our upcoming science assessment projects. Among the persons in attendance were Bob DeHaan, Susan Hackwood (Director of the California Council of Science and Technology—a state analogue of the National Academies), and Sally Shuler (Director of our joint project with the Smithsonian Institution in science education, the National Science Resources Center, http://www.si.edu/nsrc).

All the nonteachers present were enormously impressed with the advice we received from those who are most deeply involved with the nation's education process—the teachers. For this reason, we will establish a new Teacher Advisory Council, composed entirely of active classroom teachers, to ensure that all the education projects at the National Academies are strongly influenced and guided by teacher wisdom. For information about this project, please contact the deputy director of our Center for Education, Jay Labov, at jlabov@nas.edu. Jay is a former biology professor at Colby College who has been leading many of our education efforts.

The National Academies aim to incorporate the best science into guiding U.S. education at all levels. To improve education effectively, we need to invigorate education research with a new group of talented young researchers whose efforts are focused on generating sound evidence for what works best in education at all levels—from preschool through graduate education. Two of our recent reports are especially relevant here: *Attracting PhDs to K–12 Education* (http://www.nap.edu/catalog/10433.html) and *Scientific Research in Education* (http://www.nap.edu/catalog/10236.html). Also critical is our ongoing work on developing the framework for a Strategic Education Research Program (SERP) at http://www7.nationalacademies.org/bcsse/Strategic_Education_Research_Partnership.html. By directly connecting research and practice through new types of learning networks, the SERP project hopes to help drive the creation of the high-quality, continuously improving education system that we owe to our children and grandchildren.