Editorial

Comparative Biology

By now we're all too familiar with the various studies showing that our students can't compete effectively with students from other countries on tests of biology, math and other subjects. Consistent with these studies are the results of national competency tests and surveys administered by organizations such as the American Museum of Natural History, the National Science Board, the National Science Foundation, and the U.S. Departments of Agriculture and Education that document the dismal state of science education. For example:

- 41% of adults do not believe that human beings, as we know them today, developed from earlier species of animals.
- 41% of adults do not know that DNA regulates inherited characteristics.
- 42% of high school seniors do not know that increases in carbon dioxide levels could increase the greenhouse effect.
- 60% of fourth graders cannot explain why stars appear smaller than Earth's moon, even though stars are vastly larger.
- 65% of adults do not know how many planets there are in the solar system.
- 25% of high school seniors say they never did *any* experiments in *any* their science classes. Lecturing and textbooks are a mainstay.
- 87% of adults cannot identify the cause of the hole in the ozone layer.
- 92% of adults cannot correctly identify the causes of acid rain.
- 35% of adults believe that humans and dinosaurs lived at the same time.

While we wait for the National Academy of Sciences to complete its standards for precollege science education in the United States—five months overdue as of this writing—a recently released "comparative biology" report cosponsored by the American Federation of Teachers and the National Center for Improving Science Education suggests an explanation for our failing system of science education. Not surprisingly, the writers of that report concluded that our counterparts in foreign countries expect more from their students than we do. *Much* more.

The report, called "What College-Bound Students Abroad Are Expected to Know About Biology,"[1] documents science tests that people in other countries must pass if they want to attend a university. The report contains samples from the French Baccalauréat, the British A-Levels, the German Abitur, and the Tokyo University entrance exam, as well as a U.S. Advanced Placement exam. Here are some of the key findings:

- Between 30% and 50% of students in other countries take advanced, subject-specific exams, and 62 to 92% pass them. In the United States, only 7% of our 18-year-olds take the Advanced Placement exams; of these, 64% pass. This means that among all young adults in other countries, one-fourth to one-third meet the standards reflected in the high-level exams. In the United States, only 4% of 18-year-olds meet the AP standard (AP exams were used for comparison with tests given in other countries because they are the most challenging tests that U.S. students can take and are based on a specific curriculum).
- More than 95% of U.S. high school students take a biology course, but only 4% can pass high-level achievement tests that require in-depth knowledge and reasoning skills about biology.
- Far more students in other countries know how to interpret charts, evaluate data, design experiments and use detailed information.
- Although we claim that we stress "problem solving" and "critical thinking," our AP exams consist mainly of multiple-choice questions that ask students to recall isolated facts and definitions. The tests ensure that students have a fair chance of guessing the correct answer.
- Unlike the U.S. exam, foreign exams have few multiple-choice questions, using instead open-ended questions that require sophisticated problem-solving skills and a thorough understanding of biological concepts. For example, the Baccalauréat contains a section called "organized recall of knowledge" that directs students to "show that the hypothalamus is the integration center in fighting cold. In doing this, explain the process of integration of afferent messages at the level of a neuron of this center, and using the example of an effector controlled by hormones, show that the hypothalamus participates in maintaining body temperature in response to cold by adapting the response of the effector selected." A suggested answer takes a full page.

Despite these discouraging findings, all is not lost. Indeed, the public has a positive attitude about science: 68% of the public agrees with the statement that, "Science will solve many of the world's problems," and a similar percentage say that they are interested in science, environmental pollution and new medical discoveries (e.g. 66% believe that medical research is the most valuable type of scientific inquiry; 18% ranked environmental research as the most valuable). This is the good news: People have confidence in and are interested in science. We can succeed if we can better exploit the positive attitudes and interest.

However, despite their professed interest and confidence in science, Americans' understanding of the natural and physical world remains disturbingly—even dangerously—low. Moreover, most people view science as remote and nonaccessible: Only one of 10 adults considers himself or herself to be well-informed about scientific discoveries or the use of new inventions and technologies. Most

[1] The 108-page report (Item #250) is available for $10 from the AFT Order Department, 555 New Jersey Avenue NW, Washington, DC 20001-2079. Reports about chemistry, physics and math are due later this year.

agree with the statement that, "I understand less and less of what scientists are doing today."

Thus, the public apparently has a "love-hate" relationship with science: Although 86% of adults believe that most problems can be solved by applying more and better technology, 58% believe that science and technology have made the world a riskier place to live. The public recognizes the contributions that science has made, but fears the many problems and ethical issues produced by science.

Our students will soon be responsible for shaping society for the next century. If we really think that science is an important part of that future, then we must do a better job of teaching them, for the challenge of teaching the public about science begins with us.

Randy Moore
Editor