Revising the AP Biology Curriculum

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t its Advanced Placement (AP) Program annual conference held in July, the College Board released a draft of its new curriculum for the AP biology course (1). Now used in thousands of secondary schools across the country, this course provides some of the best biology instruction in the United States to about 150,000 students every year. Given the growing interest in standards-based education and the absence of official U.S. national standards, AP courses have become increasingly important as de facto standards for high school students, particularly in the sciences. Therefore, it is essential that these courses conform to high standards of both content and pedagogy. As scientific and pedagogical knowledge have advanced in recent years, aspects of the AP program have come under criticism from educators, and revisions of the AP biology course in particular are overdue. The new AP biology curriculum represents a major step toward addressing this criticism. However, questions about its implementation still remain.

AP biology was developed in the 1950s as part of the AP program to offer college-level courses for advanced students in high schools. A major goal has always been to provide credits that students could use to place out of introductory college courses and thereby shorten the time to a degree. As the basis for awarding credit and advanced placement to incoming freshmen, colleges use performance on a single high-stakes test, the national AP examination, administered by the College Board through the Educational Testing Service. Because the AP exam is designed to test knowledge of topics taught in college introductory biology courses, in which most high school teachers received their first exposure to college biology, the content and, to a large extent, the pedagogy of these college courses have driven the design of previous AP biology curricula.

In 1999, the National Research Council (NRC) of the U.S. National Academy of Sciences convened a panel of scientists, educators, and high school teachers to review AP programs in science, assisted by content sub-

panels focusing on mathematics, physics, chemistry, and biology. The 2002 reports of the NRC panel (2) and the Content Panel for Biology (3) (referred to below collectively as the NRC panels) were critical of the AP biology program. During the same period, the College Board conducted its own internal review of AP biology (4), coming to some of the same conclusions as the NRC panels. This Education Forum discusses the NRC panels’ major concerns and how the new AP biology course addresses them.

The Mile-Wide, Inch-Deep Problem

For the past few decades, biology has been growing explosively, in both knowledge about living systems and the number of students enrolling in college biology classes. Instructors and textbook authors have reacted by trying to cram more and more information into introductory college courses, which are generally taught to large classes, through traditional lectures that attempt to cover a broad array of subject matter. The AP biology exam of a decade ago tested primarily recall of factual information on a similar range of topics, and the AP biology curriculum emphasized factual learning rather than in-depth understanding of fundamental concepts. This emphasis was a consequence of an unrealistic goal, that students who achieved high scores on the AP biology exam should be able to place out of any introductory college course in the country, regardless of whether the course’s primary focus was on molecular and cell biology or ecological, organismic, or evolutionary biology. The resulting AP curriculum was “a mile wide and an inch deep,” putting pressure on teachers to cover all possible introductory college course topics and making a superficial approach almost unavoidable.

The emphasis on assimilating a large body of factual knowledge also encouraged traditional pedagogy (e.g., lectures and “cookbook” lab exercises) in AP biology, ignoring recent advances in cognitive science and educational research that have defined more effective approaches for student learning (5, 6). Again, this reflected the introductory college courses that served as models for design and teaching of the AP course.

The NRC panels recommended changes in the AP curriculum and, more important, in the AP exam. AP biology should indeed be a college-level course, demonstrating the ability of AP students to do college-level work eligible for college credit. But courses should place less emphasis on comprehensive coverage and memorization of factual detail, and more on understanding of fundamental concepts, the process of science, and interdisciplinary connections, through more student-centered activities such as problem solving, inquiry-based laboratories, and active learning in the classroom.

What’s New?

In the years since 2002, the College Board has introduced changes that began to address some of the NRC panels’ concerns (7). The revised AP biology curriculum unveiled this summer, however, represents a new departure, substantially different from its counterpart of a decade ago in terms of both content and pedagogy. It encourages teaching prac-

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students should learn to apply (see graphic below). Finally, to highlight the de-emphasis on memorizing facts, the curriculum specifically excludes some details (e.g., the structures of Krebs cycle intermediates) as being beyond the scope of the course and the AP exam.

Although it is not spelled out in the supporting material released so far, the new curriculum implies that AP teachers can, at least to some extent, pick and choose the specific topics they focus on in teaching the principles outlined above, so that different AP biology courses may differ in content. This implication and other questions about the new curriculum are discussed further below.

The development process for the new curriculum has dealt with concerns of the NRC panels about updating the AP course to better reflect the current state of biological sciences. Over the past 7 years, the College Board has enlisted several teams of educators and leading university scientists from all areas of biology to help redesign and rewrite the curriculum and supporting materials. Also under development are new inquiry-based laboratory projects that will give students opportunities to apply the seven science practices listed in the graphic below.

Preparation for AP Biology

Another concern of the NRC panels was that in some schools, students were allowed to take AP biology as their first, and sometimes only, science course. This practice necessitated watering down the AP course, contributing to the quality-control problem discussed above and preventing some students from reaching the level of learning required to perform well on the AP biology exam. To help remedy this situation, the College Board will not only urge schools to require a previous biology course as a prerequisite for AP biology, but will also set standards for such courses. These Science College Board Standards for College Success (8, 9) outline specific performance expectations, such as students’ ability to apply the seven science practices. Widespread adoption of these guidelines could provide a valuable set of national performance standards for middle- and high-school science students.

Questions and Challenges

The College Board plans to release a few new inquiry-based labs annually, beginning this year, so that schools can transition gradually to the new curriculum. In December, the board will announce when the new AP biology course and exam will become required for all participants, probably in 2012 or 2013, but schools can start using the new curriculum as soon as they are ready.

Although the new curriculum is exciting and encouraging, it also raises questions about other aspects of the new program that are not yet released. The nature of the new AP exam, in particular, will be key to the program’s success. How much will it shift the emphasis from recall to application of concepts? Will students be asked simply to memorize concepts as factual information or to apply them to new situations? How the exam is written will determine how concepts are taught. The learning objectives released so far are encouraging in this regard. They stipulate that students should achieve higher Bloom’s levels of understanding [see figure 1 in (6)]: that is, be able to apply, compute, solve, predict, compare, create, design, evaluate, and criticize, rather than simply to define, name, describe, and explain. Also encouraging is that students will be allowed to use calculators on the new exam, permitting inclusion of questions that involve quantitative analysis using equations, graphs, and tables of data.

Will success on the exam still require knowledge of most topics in the curriculum, or will it include alternative questions targeting different areas from which students can choose? The answer to this question will dictate whether the course must still attempt to be comprehensive, or whether AP teachers will be able to follow a path through the new curriculum that best suits their interests and expertise without handicapping their students on the exam.

Finally, teaching the new curriculum effectively will require nontraditional pedagogy. Can enough teachers be trained to successfully implement inquiry-based, student-centered classes and labs that include quantitative reasoning? What new professional development initiatives are planned to meet this need? And will the increased need for professional development restrict access to the new program for schools with fewer resources, which is another concern of the NRC panels?

If the new curriculum can be successfully implemented, it may raise an additional question for colleges and universities, especially those serving large numbers of students. Will graduates of the new AP biology put up with the large-enrollment, fact-oriented, instructor-centered, lecture-based biology courses currently offered in so many of these institutions? An intriguing possible outcome of the AP revision is that it may eventually drive much-needed change in college and university teaching of introductory biology.

The Problem of Quality Control

The NRC panels also raised concerns about the lack of uniform standards for AP biology courses. With no required process for certification of AP teachers and school facilities, the quality of AP biology courses varied markedly between school districts across the country. The College Board has addressed this issue by instituting an AP course audit, in which all AP teachers from a given school must participate in order to receive authorization to use the “AP” label and have their courses listed in the AP course ledger made available to colleges and universities each fall. The College Board has also instituted new professional development workshops for AP teachers, which will have to be adapted to the new curriculum.

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References and Notes

1. The College Board has posted this draft version of the curriculum, which has not yet been edited and will undergo further revisions before being finalized this fall: http://apcentral.collegeboard.com/apbio/DRAFT.
7. College Board, The AP Course Description for AP Biology (College Board, New York, 2009).

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