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Setting a Policy for AP[®] Biology

The purpose of this guide is to provide college faculty and administrators with research data, participation and performance data of AP[®] Biology students, curricular content, and sample exam questions to facilitate the establishment of appropriate credit and placement policies for AP Biology.

The Advanced Placement Program[®] (AP) provides motivated students with the opportunity to take college-level courses while still in high school. Students demonstrate their mastery of the curriculum by taking AP Exams—35 exams are available in 20 subject areas. In 2005, more than 1.2 million students took AP Exams worldwide. Of the 2.1 million AP Exams taken in 2005, about 122,000 were in Biology. More than 3,000 colleges and universities, including many international institutions, accept qualifying AP Exam scores for credit, placement, or both.

Throughout its 50-year history, the AP Program has maintained high standards of rigor in its courses and exams. Since its inception, AP has been a respected force in American education due to the critical involvement of college and university faculty members.

Biology Faculty Involvement in AP

College and university faculty members play a vital role in every stage of development of an AP course and exam, helping to ensure their high quality. Each AP discipline has its own Development Committee—composed of college and university professors and experienced AP teachers—that is responsible for creating the course guidelines and exam questions. College and university faculty members also serve as the Chief Readers, responsible for establishing the exam-scoring guidelines and overseeing the annual AP Reading of the free-response section for their academic discipline.

“I believe that I am a better teacher because of my involvement in AP Biology, and being an AP Reader for over 16 years. Through my conversations with high school AP teachers I have come to realize that often “less is more” in my teaching. I am more aware of the need to remind my students about the big picture/concept when I am lecturing in my classes. I now try more cooperative learning/small group projects in my classes than I ever did before, and, I believe, that has engaged students more in their own learning processes.”

—Robert Cannon, AP Biology Development Committee Chair
University of North Carolina, Greensboro

How to Set an AP Policy

The College Board encourages higher education institutions to base their AP policy decisions on data and research, and recognizes that different institutions and departments will set different policies, based upon factors unique to their institution, student body, and academic discipline. The best way for colleges and universities to determine their AP credit and placement policies is to conduct their own research on the performance of AP and non-AP students at their own institution and in their own department.

Research on AP Biology Student Performance

Research studies show that students who do well on an AP Exam are academically prepared to place out of a corresponding college course and move on to the next higher-level course in the discipline. See Table 1 for data from a 1998 research study comparing AP and non-AP student performance in second- and third-level college biology courses.

Table 1: Student Performance in Second- and Third-Level Biology Courses
AP Biology Students Versus Non-AP Students

	AP EXAM GRADE	SECOND-LEVEL COURSES		THIRD-LEVEL COURSES	
		GPA	PERCENT OF STUDENTS SCORING AN A OR B	GPA	PERCENT OF STUDENTS SCORING AN A OR B
AP Students Who Place Out of Intro. Course	AP 5	3.22	82	3.23	86
	AP 4	2.93	69	2.98	76
	AP 3	2.63	57	2.81	59
Students Who Complete Intro. Course	Non-AP	2.68	61	2.87	69

Taking the AP course and exam stimulates further interest in the subject area and encourages deeper disciplinary knowledge.

Research studies show that students who take the AP Biology Exam are significantly more likely to take further course work in biology than students who do not take the AP Exam. See Table 2 for data from this 2000 research study.

Table 2: Additional College Biology Course Work
AP Biology Students Versus Non-AP Students

	AP EXAM GRADE	PERCENT TAKING COURSE IN BIOLOGY	AVERAGE NUMBER OF COURSES TAKEN IN BIOLOGY
AP Biology Students	AP 5	72	3.7
	AP 4	68	3.3
	AP 3	68	3.2
	AP 2	74	3.1
	AP 1	72	2.6
Non-AP Students	Non-AP	56	1.9

PDF copies of these and other research studies can be found at apcentral.collegeboard.com/colleges/research.

In addition to research studies on AP student performance, the College Board conducts college comparability studies to measure the degree to which the AP courses and exams are equivalent in content and difficulty to corresponding college courses. The AP Exam scoring rubric is established so that the lowest composite score that earns an AP grade of 5 is equivalent to the average score earned by college students who received grades of A in a comparable course. The lowest score that earns an AP grade of 4 is equivalent to the average B, and the lowest score that earns an AP grade of 3 is equivalent to the average C.

The research that the College Board conducts is intended to help institutions and academic departments as they establish appropriate AP policies. AP Central® (apcentral.collegeboard.com), the College Board's online home for AP professionals, contains other resources that may assist in this process, including the Course Description, released exam questions, and sample student responses at different levels of ability.

For more information go to:
apcentral.collegeboard.com/biology/exam

AP Credit Policy Info on the Web

Information about AP credit and placement policies at more than 1,000 colleges and universities is available on the College Board's Web site at www.collegeboard.com/ap/creditpolicy.

AP Biology Students, Course, and Exam

Participation and Performance Data for AP Biology Students in 2005

Total Number of Schools Offering AP Biology: 7,727

Table 3: AP Biology Exam Score Distribution, 2005

EXAM GRADE	NUMBER OF EXAMINEES	% AT
Score of 5	22,055	18.2%
Score of 4	24,448	20.1%
Score of 3	27,820	22.9%
Score of 2	28,357	23.3%
Score of 1	18,766	15.5%
	121,446	100.0%

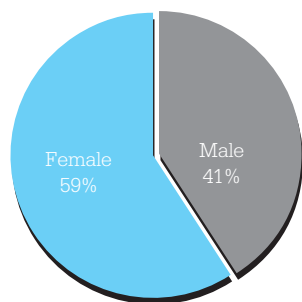
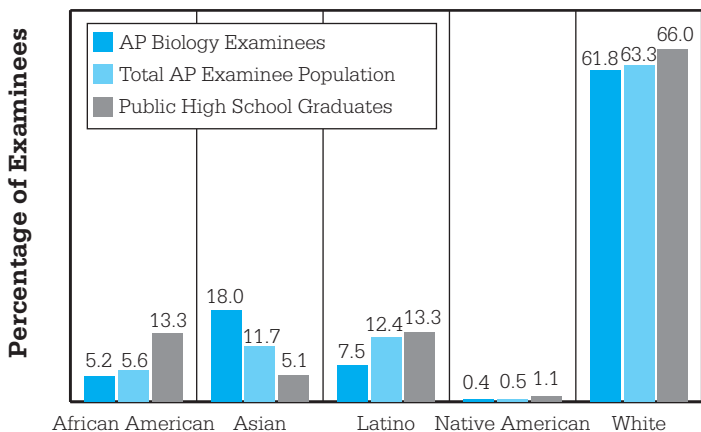


Figure 1: AP Biology Examinees by Gender, 2005

Figure 2: AP Biology Examinees by Race and Ethnicity, 2005



The AP Biology Course

The AP Biology course is designed to be the equivalent of a two-semester college introductory biology course usually taken by biology majors during their first year. The AP Biology course requires the use of a college-level textbook and at least 12 college-level laboratories on specific topics. The course aims to provide students with the conceptual framework, factual knowledge, and analytical skills necessary to deal critically with the rapidly changing science of biology.

The College Board recently began a major long-term initiative, in conjunction with the National Science Foundation, aimed at improving the quality of learning and teaching in AP science courses. This was undertaken in response to a 2002 report on advanced studies in mathematics and science by the National Research Council that recommended specific changes in advanced high school studies in the sciences. A special task force is currently evaluating the AP Biology course and will draft recommendations to be presented to the Development Committee, which develops the course guidelines and designs the AP Exam.

The Development Committee has identified eight major themes that, as overarching features of biology, apply throughout the course. These are:

1. Science As a Process
2. Evolution
3. Energy Transfer
4. Continuity and Change
5. Relationship of Structure to Function
6. Regulation
7. Interdependence in Nature
8. Science, Technology, and Society

Additionally, the Committee has created a topic outline that covers the main content areas that should be taught, along with the relative weight to be assigned to each topic.

- I. Molecules and Cells.....25%
 - A. Chemistry of Life.....7%
 - Water
 - Organic molecules in organisms
 - Free energy changes
 - Enzymes
 - B. Cells.....10%
 - Prokaryotic and eukaryotic cells
 - Membranes
 - Subcellular organization
 - Cell cycle and its regulation
 - C. Cellular Energetics.....8%
 - Coupled reactions
 - Fermentation and cellular respiration
 - Photosynthesis

II.	Heredity and Evolution.....	25%
A.	Heredity.....	8%
	Meiosis and gametogenesis	
	Eukaryotic chromosomes	
	Inheritance patterns	
B.	Molecular Genetics.....	9%
	RNA and DNA structure and function	
	Gene regulation	
	Mutation	
	Viral structure and replication	
	Nucleic acid technology and applications	
C.	Evolutionary Biology.....	8%
	Early evolution of life	
	Evidence for evolution	
	Mechanisms of evolution	
III.	Organisms and Populations.....	50%
A.	Diversity of Organisms.....	8%
	Evolutionary patterns	
	Survey of the diversity of life	
	Phylogenetic classification	
	Evolutionary relationships	
B.	Structure and Function of Plants and Animals.....	32%
	Reproduction, growth, and development	
	Structural, physiological, and behavioral adaptations	
	Response to the environment	
C.	Ecology.....	10%
	Population dynamics	
	Communities and ecosystems	
	Global issues	

“Laboratory experience must be included in all AP Biology courses....One-fourth to one-third....of emphasis should be placed on laboratory experience in an AP course....Laboratory work should encourage the development of important skills such as detailed observation, accurate recording, experimental design, manual manipulation, data interpretation, statistical analysis, and operation of technical equipment. Laboratory assignments offer the opportunity for students to learn about problem solving, the scientific method, the techniques of research, and the use of scientific literature.”

—AP Biology Course Description

The AP Biology course requires 12 laboratories on the following topics, and the Course Description provides an overview and objectives for each. Lab manuals for students and teachers are also available, and can be provided to your department upon request.

1. Diffusion and Osmosis
2. Enzyme Catalysis
3. Mitosis and Meiosis
4. Plant Pigments and Photosynthesis
5. Cell Respiration
6. Molecular Biology
7. Genetics of Organisms
8. Population Genetics and Evolution
9. Transpiration
10. Physiology of the Circulatory System
11. Animal Behavior
12. Dissolved Oxygen and Aquatic Primary Productivity

“The AP Biology laboratory exercises are very similar to those used at my institution in the introductory biology sequence. They have been constructed to develop the students’ analytical skills and ability to synthesize ideas. The free-response portion of the AP Exam requires the students to apply these skills and concepts to solving new problems.”

—Eileen Gregory, AP Biology Development Committee
Rollins College

Beginning in fall 2006, AP Biology teachers and principals of schools where AP Biology is taught must certify that their 2007-08 courses follow all the requirements stipulated by the Development Committee, including using a college-level textbook and providing the class time and equipment to complete the required laboratories, in order to ensure that the AP course reflects college-level standards. By completing this AP Course Audit, high schools will receive individual licenses to label their biology courses “AP.” In fall 2007, colleges and universities will receive a list of all high schools authorized to use the “AP” designation for their biology courses.

The AP Biology Exam

The AP Biology Exam consists of a multiple-choice and a free-response essay section. The multiple-choice section includes 100 test items to be answered in 80 minutes and constitutes 60 percent of the total grade. This section examines the student's understanding of representative content and concepts drawn from across the entire course. The free-response section, constituting 40 percent of the total grade, includes four equally weighted essay questions encompassing broader topics to be evaluated and answered in 100 minutes. Usually one essay question is taken from the Molecules and Cells unit of the curriculum, another from the Heredity and Evolution unit, and two questions from the Organisms and Populations unit. Any of these four questions may require the student to analyze and interpret data or information drawn from laboratory experience, as well as from lecture material, and may require students to integrate material from different areas of the course. The free-response section asks the students to organize answers to broad questions, thereby demonstrating reasoning and analytical skills as well as an ability to synthesize material from several sources into a cogent and coherent essay.

AP Biology free-response questions from recent exam years are listed below.

Example 1 (2005 exam)

The unit of genetic organization in all living organisms is the chromosome.

- Describe the structure and function of the parts of a eukaryotic chromosome. You may wish to include a diagram as part of your description.
- Describe the adaptive (evolutionary) significance of organizing genes into chromosomes.
- How does the function and structure of the chromosome differ in prokaryotes?

Example 2 (2005 exam)

Angiosperms (flowering plants) have wide distribution in the biosphere and the largest number of species in the plant kingdom.

- Discuss the function of FOUR structures for reproduction found in angiosperms and the adaptive (evolutionary) significance of each.
- Mosses (bryophytes) have not achieved the widespread terrestrial success of angiosperms. Discuss how the anatomy and reproductive strategies of mosses limit their distribution.
- Explain alternation of generations in either angiosperms or mosses.

Example 3 (2005 exam)

An important defense against diseases in vertebrate animals is the ability to eliminate, inactivate, or destroy foreign substances and organisms. Explain how the immune system achieves THREE of the following:

- Provides an immediate nonspecific immune response
- Activates T and B cells in response to an infection

- Responds to a later exposure to the same infectious agent
- Distinguishes self from nonself

Example 4 (2004 exam)

Meiosis reduces chromosome number and rearranges genetic information.

- Explain how the reduction and rearrangement are accomplished in meiosis.
- Several human disorders occur as a result of defects in the meiotic process. Identify ONE such chromosomal abnormality; what effects does it have on the phenotype of people with the disorder? Describe how this abnormality could result from a defect in meiosis.
- Production of offspring by parthenogenesis or cloning bypasses the typical meiotic process. Describe either parthenogenesis or cloning and compare the genomes of the offspring with those of the parents.

Example 5 (2004 exam)

Darwin is considered the “father of evolutionary biology.” Four of his contributions to the field of evolutionary biology are listed below.

- The nonconstancy of species
 - Branching evolution, which implies the common descent of all species
 - Occurrence of gradual changes in species
 - Natural selection as the mechanism for evolution
- For EACH of the four contributions listed above, discuss one example of supporting evidence.
 - Darwin's ideas have been enhanced and modified as new knowledge and technologies have become available. Discuss how TWO of the following have modified biologists' interpretation of Darwin's original contributions.

- Hardy-Weinberg equilibrium
- Punctuated equilibrium
- Genetic engineering

Example 6 (2003 exam)

Regulatory (control) mechanisms in organisms are necessary for survival. Choose THREE of the following examples and explain how each is regulated.

- Flowering in plants
- Water balance in plants
- Water balance in terrestrial vertebrates
- Body temperature in terrestrial vertebrates

Example 7 (2002 exam)

The following experiment was designed to test whether different concentration gradients affect the rate of diffusion. In this experiment, four solutions (0% NaCl, 1% NaCl, 5% NaCl, and 10% NaCl) were tested under identical conditions. Fifteen milliliters (mL) of 0% NaCl were put into a bag formed of dialysis tubing that is permeable to Na^+ , Cl^- , and water. The same was done for each NaCl solution. Each bag was submerged in a separate beaker containing 300 mL of distilled water. The concentration of NaCl in mg/L in the water outside each bag was measured at 40-second intervals. The results from the 5% bag are shown in the table below.

Concentration In mg/L of NaCl Outside the 5% NaCl Bag

TIME (SECONDS)	NACL (MG/L)
0	0
40	130
80	220
120	320
160	400

- On the axes provided, graph the data for the 5% NaCl solution.
- Using the same set of axes, draw and label three additional lines representing the results that you would predict for the 0% NaCl, 1% NaCl, and 10% NaCl solutions. Explain your predictions.
- Farmlands located near coastal regions are being threatened by encroaching seawater seeping into the soil. In terms of water movement into or out of plant cells, explain why seawater could decrease crop production. Include a discussion of water potential in your answer.

“When I have shown free-response questions to my faculty colleagues, their typical response is that the free-response questions would be more suitable to biology majors in more advanced classes rather than for our introductory biology students. There is no doubt in my mind that biology’s free-response questions are extremely challenging, and that students who do well on the AP Biology Examination know a lot about biology.”

—Robert Cannon, AP Biology Development Committee Chair
University of North Carolina, Greensboro

How to Get Involved

There are many ways college and university faculty members can help maintain the high standards of the AP Program:

- Participate in a college comparability study
- Be an AP Reader
- Contribute multiple-choice test items for the AP Exam
- Become an AP Faculty Consultant

For more information, please go to: apcentral.collegeboard.com/highered/getinvolved

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