

Introduction

How You Should Use This Book

The Advanced Placement Program is designed to encourage students to take challenging courses in high school and receive college credit for their efforts. Many high schools offer classes especially designed for the AP program, but any course or program of study, whatever it is called, is appropriate as preparation for taking the AP exam if the content is college level. This book helps you to prepare for the Advanced Placement Examination in Biology. It does this in three ways:

- First, it reviews the important material that you need to know for the actual AP exam. These reviews are detailed but written in an organized and condensed format, making them especially useful for studying.
- Second, after each section review, the book provides you with questions that reinforce the review. These questions are typical of AP exam questions, and many of them, like those on the AP exam, require considerable thought to determine the correct answer. In addition, some of the review questions ask you to apply the reviewed material to new situations and, as a result, increase your breadth of understanding. Answers with complete explanations are provided.
- Third, two complete practice tests are provided, giving you the opportunity to evaluate your knowledge and your test-taking skills. Taking these practice tests helps to improve your AP exam score because these tests are similar in content and format to the actual AP exam. Complete explanations are given for each question, and a scoring worksheet is provided to help you determine your score.

For more test-taking practice, a companion book by the author of this book is available. *CliffsAP: 5 Biology Practice Exams* provides five additional practice exams, complete with answers and explanations. The 500 multiple-choice questions and 20 essay questions in the companion book and the more than 650 multiple-choice questions and 75 essay questions in this book are unique; little overlap of content exists among the questions. The entire range of potential AP exam content is thoroughly covered.

When preparing for a test, have you ever wished that you had a copy of your teacher's lecture notes? The review sections in this book are very much like lecture notes. Each section contains all the important terminology with brief descriptions. All the important biological processes are outlined with a key word or phrase, listed in an easy-to-remember sequence. After each key word or phrase, a short explanation is given. When you study the material the first time, you can read the key words and the short explanations. When you review, you can just study the key words, rereading the explanations only as needed.

You should consider this book, however, as a supplement to your textbook, your laboratory exercises, and your teacher's lectures. Much of the excitement and adventure of biology can be obtained only through hands-on activities and discussions with teachers. In addition, textbooks provide background information, extensive examples, and thought-provoking questions that add depth to your study of biology.

Each time you study a topic in class, after listening to the lectures and reading the textbook, use this book to review. Underline or highlight material to help you remember it. Write in the margins any additional material that you heard in lectures or read in your textbook that you or your teacher thinks is important. Then answer the questions and read the answers at the end of each section. This will reinforce your learning.

At the end of your biology course, this book will be a single, condensed source of material to review before the AP exam. Begin your final preparation several weeks before the AP exam by reviewing the material in each section. Then take the two practice AP exams at the end of the book.

What to Bring to the Exam

1. A No. 2 pencil and an eraser are required for the multiple-choice section.
2. A pen with black or dark-blue ink is required for the free-response (essay) section.
3. You are not allowed to bring your own scratch paper. For the multiple-choice section, you can use the margins of the test. For the free-response section, scratch paper is provided.
4. No calculators are allowed. Any calculations that might be required to answer a question will be basic enough to complete without a calculator. If while answering a question you find that you need a calculator to complete a calculation, you are probably doing the calculation incorrectly.

Exam Format

The AP exam in biology consists of two parts. The first part is a 100-question, multiple-choice test. You have 80 minutes to complete this section. The second part of the exam consists of four free-response, or essay, questions. First, you are given a 10-minute reading period to read the four questions, organize your thoughts, and record notes or create an outline on provided paper. Then you have 90 minutes to write your essay response to all four questions. The multiple-choice section counts for 60 percent of the exam, and the essay section counts for the remaining 40 percent. The exam is administered in May of each year along with AP exams in other subjects.

Section I	Multiple Choice	100 questions	80 minutes	60%
Section II	Reading Period		10 minutes	
	Writing Period	4 questions	90 minutes	40%

Exam Grading

Exams are graded on a scale of 1 to 5, with 5 being best. Most colleges accept a score of 3 or better as a passing score. If you receive a passing score, colleges give you college credit (applied toward your bachelor's degree), advanced placement (you can skip the college's introductory course in biology and take an advanced course), or both. You should check with the biology department at the colleges you're interested in to determine how they award credit for the exam.

The distribution of student scores for some recent AP exams in biology is as follows.

	<i>Exam Grade</i>	<i>Percentage of Students</i>		
		<i>2004</i>	<i>2005</i>	<i>2006</i>
Extremely well qualified	5	18.9	18.2	19.6
Well qualified	4	20.2	20.1	20.3
Qualified	3	21.9	22.9	21.2
Possibly qualified	2	24.6	23.3	23.3
No recommendation	1	14.4	15.5	15.6
Mean Score (1 to 5)		3.05	3.02	3.05

The multiple-choice section is designed with a balance of easy and difficult questions to produce a mean score of 50 out of 100 (on one recent test, the actual mean was 55 percent). Essay questions are also designed to obtain a 50 percent mean score, but scores vary significantly with individual questions and from year to year. On the 2005 exam, mean

scores for an essay question ranged from 2.78 to 4.88 (out of a possible 10 points) for the four questions. Clearly, both sections of the exam are difficult. They are deliberately written that way so that the full range of students' abilities can be measured. In spite of the exam difficulty, however, 61 percent of the students taking the exam in 2006 received a score of 3 or better. Therefore, the AP exam is difficult, but most (prepared) students do well.

What's on the Exam

The multiple-choice section of an AP exam is written with a certain number of questions from each area in biology. Generally, each of the major topics is represented by the percentages given in the following table. These same percentages were used to choose the questions for the two exams in this book. Since 100 questions are on the exam, a topic with a 7 percent representation, such as chemistry, is addressed in 7 questions. However, many questions address topics in more than one area, so the number of questions per topic may be higher than indicated here.

Area I.	Molecules and Cells	25%
	Topic 1: Chemistry	7%
	Topic 2: Cells	6%
	Topic 3: Photosynthesis	4%
	Topic 4: Respiration	4%
	Topic 5: Cell Division	4%
Area II.	Genetics and Evolution	25%
	Topic 6: Heredity	8%
	Topic 7: Molecular Genetics	9%
	Topic 8: Evolution	8%
Area III.	Organisms and Populations	50%
	Topic 9: Five-Kingdom Survey	8%
	Topic 10: Plants	12%
	Topic 11: Animal Structure and Function	10%
	Topic 12: Animal Reproduction and Development	6%
	Topic 13: Animal Behavior	4%
	Topic 14: Ecology	10%

In order to make your review as easy as possible, the sections in this book are organized in the same order used in most college textbooks. For this reason, the percentages given in the table differ somewhat from those given in the official *AP Course Description in Biology* (called the "Acorn Book" for its acorn logo), because its content outline is organized differently.

Laboratory experience contributes a very important component to the AP biology course. So that all students taking the AP exam have appropriate laboratory preparation, the College Board provides a laboratory manual with 12 laboratory exercises. The exercises accompanying these labs provide valuable skills in experimental design and collecting and analyzing data. About 10 percent of the multiple-choice questions and usually one essay question are devoted to evaluating your laboratory knowledge. To help you review for the AP exam, Part II in this book reviews all twelve of the AP laboratory exercises.

Hints for Taking the Multiple-Choice Section

In the AP exam, questions for the multiple-choice section are provided in a booklet. While reading the questions in the booklet, feel free to cross out answers you know are wrong or underline important words. After you've selected the answer from the various choices, you carefully fill bubbles, labeled A, B, C, D, or E, on an answer sheet. Mark only your answers on the answer sheet. Since unnecessary marks can produce machine-scoring errors, be sure to fill the bubbles carefully and erase errors and stray marks thoroughly.

Some specific strategies for answering the multiple-choice questions follow.

- 1. Don't let easy questions mislead you.** The multiple-choice questions range from easy to difficult. On one exam, 92 percent of the candidates got the easiest question right, but only 23 percent got the hardest question right. Don't let the easy questions mislead you. If you come across what you think is an easy question, it probably is. Don't suspect that it's a trick question.
- 2. Budget your time by skipping hard questions.** You have 80 minutes to answer 100 questions, 48 seconds per question. If you come across a hard question that you can't answer quickly, skip it, and mark the question to remind you to return to it if time permits. If you can eliminate some of the answer choices, mark those also so that you can save time when you return. It's important to skip a difficult question, even if you think you can eventually figure it out, because for each difficult question you spend three minutes on, you could have answered three easy questions. If you have time at the end of the test, you can always go back. If you don't have time, at least you will have had the opportunity to try all the questions. Also, if you never finish the test, don't be overly concerned. Since the test is designed to obtain a mean score of 50 percent, it is not unusual for a student to leave some answers blank.
- 3. Make only educated guesses.** If you're not sure of the answer to a question, don't guess unless you can make an educated guess. You make an educated guess when you can reduce the answer to two or three choices. If you get an answer right, you receive one point. If you leave it blank, you receive no points. *However, for each wrong answer, $\frac{1}{4}$ point is deducted from your score.*
- 4. Avoid wrong-answer penalties.** One-fourth point is deducted for each wrong answer. The one-fourth point deduction for wrong answers adjusts for random guessing. Since each question has five choices, you have a one-in-five chance that you can *randomly* select the correct answer. If you choose five answers randomly for five questions, probability predicts that you will guess one correct answer and four wrong answers. Your total score for the five guesses would be $1 - \frac{1}{4} - \frac{1}{4} - \frac{1}{4} - \frac{1}{4} = 0$. By deducting one-fourth point for each of the wrong answers, your total score would be zero. That's reasonable because you really didn't know any of the answers. But if you can reduce your choices to two or three, the odds are in your favor that the number of questions you get right will exceed the number of points deducted. That's also reasonable, because you knew some of the answer choices were wrong.
- 5. Carefully answer reverse multiple-choice questions.** In a typical multiple-choice question, you need to select the choice that is true. On the AP exam, you will find many *reverse* multiple-choice questions where you need to select the *false* choice. These questions usually use the word "EXCEPT" in sentences such as "All of the following are true EXCEPT . . ." or "All of the following occur EXCEPT. . ." A reverse multiple-choice question is more difficult to answer than regular multiple-choice questions because it requires you to know four true pieces of information about a topic before you can eliminate the false choice. It is equivalent to correctly answering five true-false questions correctly to get one point; if you get one of the five wrong, you get them all wrong. Reverse multiple-choice questions are also difficult because halfway through the question, you can forget that you're looking for the false choice. To avoid confusion, do the following: After reading the opening part of the question, *read each choice and mark a T or an F next to each one to identify whether it is true or false.* If you're able to mark a T or an F for each one, then the correct answer is the choice marked with an F. Sometimes you won't be sure about one or more choices, or sometimes you'll have two choices marked F. In these cases, you can concentrate on the uncertain choices until you can make a decision.

Hints for Taking the Essay Section

Four questions are on the essay section of the test. One of the questions is taken from Area I (molecules and cells), one from Area II (genetics and evolution), and two from Area III (organisms and populations). One of the four questions also evaluates your ability to design experiments or to analyze experimental results. Each of the four questions can earn a maximum of 10 points. The 40 points on this section of the exam count as 40 percent of your total test score.

The essay questions are provided in a green (or lavender) booklet. During the 10-minute reading period, read the questions thoroughly, circling key words. Next, write a brief outline using key words to organize your thoughts. When the writing period begins, begin writing your answer on the answer sheets that are provided separately. If for some reason you don't write an outline, go back and reread the question halfway through writing your answer. Make sure that you're still answering the question. It's easy to get carried away, and by the end of your response, you might be answering a different question.

Strategies for answering the essay questions follow.

- 1. Don't approach the essay section with apprehension.** Most students approach the essay section of the exam with more anxiety than they have when approaching the multiple-choice section. However, in terms of the amount of detail in the knowledge required, the essay section is easier. On essay questions, *you* get to choose what to write. You can get an excellent score without writing every relevant piece of information. Besides, you don't have time to write an entire book on the subject. A general answer that addresses the question with a limited number of specifics will get a good score. Additional details may (or *may not*) improve your score, but the basic principles are the most important elements for a good score. In contrast, a multiple-choice question focuses on a very narrow and specific body of knowledge, which you'll either know or you won't. The question doesn't let you select from a range of correct information. This isn't true for the essay questions.
- 2. Give specific information in your answer.** You need to give specific information for each essay question. Don't be so general that you don't really say anything. Give more than just terminology with definitions. You need to use the terminology to explain biological processes. The combination of using the proper terminology and explaining processes will convince an AP exam reader that you understand the answer. Give some detail when you know it—names of processes, names of structures, names of molecules—and then tell how they're related. The reader is looking for specific information. If you say it, you get the points. You don't have to say everything, however, to get the maximum 10 points.
- 3. Answer each part of an essay question separately.** Many of the AP essay questions ask several related questions. A single question, for example, might have two or three parts, each requesting specific information. You should answer each part of the question in a separate paragraph, which helps the reader recognize each part of your answer. Some questions are formally divided into parts, such as a, b, c, and d. Again, answer these questions separately, in paragraphs labeled a, b, c, and d.
- 4. Answer all parts of an essay question.** When you answer the essay questions, it is extremely important that you give a response for each part of the question. Don't overload the detail on one part at the expense of saying nothing in another part because you ran out of time. Each part of the question is apportioned a specific number of points. If you give abundant information on one part, and nothing on the remaining parts, you receive only the maximum number of points allotted to the part you completed. In a four-part question, that's often only 2.5 points. You won't get any extra points above the maximum 2.5, even if what you write is Nobel-Prize quality.
- 5. Budget your time.** You have 90 minutes for four questions, about 23 minutes each. Just as it's most important to answer all parts of a question, it's best to respond to all the essay questions rather than to answer two or even three of them extremely well, with no response on the last one or two. You'll probably know *something* about every question, so be sure you get that information written for each question. If you reach the last question with five minutes remaining, for example, use that time to write as much information as possible. One or two points is a lot better than zero.
- 6. Don't worry if you make a factual error.** What if you write something that is incorrect? The AP exam readers look for correct information. They search for key words and phrases and award points when they find them. If you use the wrong word to describe a process, or identify a structure with the wrong name, no formal penalty is assessed (unlike the deduction for guessing on the multiple-choice test). If you're going to get any points, however, you need to write correct information.
- 7. Don't be overly concerned about grammar, spelling, punctuation, or penmanship.** The AP exam readers don't penalize for incorrect grammar, spelling, or punctuation or for poor penmanship. They are interested in *content*. However, if your grammar, spelling, or penmanship impairs your ability to communicate, then the readers cannot recognize the content, and your score will suffer.
- 8. Don't write a standard essay.** Don't spend your time writing a standard essay with introduction, support paragraphs, and conclusion. Just dive right into your outline and answer the question directly. On the other hand, your essay response cannot be an outline; it must have complete sentences written in paragraph form.

- 9. Drawings can improve your score.** Drawings and diagrams may sometimes add as much as 1 point to your essay score. But the drawings must be explained in your essay, and the drawings must be labeled with supporting information. If not, the AP exam reader will consider them doodles, and you will get no additional points.
- 10. Pay attention to direction words.** A direction word is the first word in an essay question that tells you how to answer the question. The direction word tells you what you need to say about the subject matter that follows. Here are the most common direction words found on the AP exam:
- *Discuss* means to consider or examine various aspects of a subject or problem.
 - *Describe* means to characterize or give an account in words.
 - *Define* means to give a precise meaning for a word or phrase.
 - *Explain* means to clarify or make understandable.
 - *Compare* means to discuss two or more items with an emphasis on their *similarities*.
 - *Contrast* means to discuss two or more items with an emphasis on their *differences*.

Specialized direction words are used for the laboratory essays. These words include *design* (an experiment), *calculate* (a value), and *construct* and *label* (a graph). These words have specific meanings for laboratory analyses and are discussed in the lab section later in this book.

Must-Know Essay Questions

Some AP Biology teachers try to predict which essay questions will be on the next AP test. For example, reviewing old AP exams might reveal some questions that haven't been asked in a while. A new scientific discovery or research that receives a Nobel Prize might suggest an AP question. Unfortunately, guessing questions in this way is very unreliable.

Here is a better way. Questions on the essay section of the AP exam generally address fundamental principles or processes in biology. Here is a list of the most important principles—the ones on which questions keep reappearing on AP exams. Being able to answer these questions is an absolute requirement for being prepared. So, at the very least, know this material. Sample responses to questions on these topics appear at the end of the appropriate subject area reviews and in the answer sections following each practice exam. Additional responses appear at the end of each practice exam in *CliffsAP: 5 Biology Practice Exams*, also published by Wiley.

1. Topic 2: Cells: Cell structure, especially structure and function of the plasma membrane
2. Topic 3: Respiration: Respiration and mitochondria
3. Topic 4: Photosynthesis: Photosynthesis and chloroplasts
4. Topic 5: Cell Division: Mitosis and meiosis
5. Topic 7: Molecular Genetics: DNA structure and replication
6. Topic 7: Molecular Genetics: Protein synthesis
7. Topic 8: Evolution: Natural selection
8. Topic 8: Evolution: Speciation
9. Topic 10: Plants: Reproduction in flowering plants
10. Topic 10: Plants: Plant tropisms and hormones (especially auxin)
11. Topic 11: Animal Structure and Function: Nerve transmission
12. Topic 11: Animal Structure and Function: Muscle contraction
13. Topic 12: Animal Reproduction and Development: Menstrual cycle
14. Topic 14: Ecology: Succession
15. Topic 14: Ecology: Biogeochemical cycles

There's no guarantee that questions on these topics will appear on your AP exam, but these topics appear so often that you should be prepared. In any case, the multiple-choice section of the exam will certainly include questions on these topics. So you can't lose by focusing on these areas.

Some Final Suggestions

For each of the practice tests, a scoring template is provided for the multiple-choice questions of the exam. The test is followed by an answer key for the multiple-choice questions, explanations for the multiple-choice questions, and scoring standards for the free-response questions (often called a rubric).

To get the full benefit of simulating a real AP exam, set aside at least three hours for each exam. Begin the multiple-choice section and after 80 minutes, stop and move on to the essay section. Spend 10 minutes outlining your answers to each essay question and then allow yourself 90 minutes to write out your full answers. By using the actual times that the real AP exam allows, you will learn whether the time you spend on each multiple-choice and each essay question is appropriate.

When you're done taking a practice exam, score your exam using the multiple-choice answers that follow the exam and the free-response scoring standards that follow the multiple-choice answer explanations. Then go back and answer any multiple-choice questions that you were unable to complete in the allotted 80 minutes. When you are done, read all the multiple-choice explanations, even those for questions you got right. The explanations are thorough and provide you with information and suggestions. Even if you know the answers, reviewing the provided explanations is good review.

Although you've heard it so many times, practice *will* improve your test performance (although it's unlikely to make you perfect). So be sure to complete both tests and review all the answers. Good luck.

