



# **ENVIRONMENTAL SCIENCE**

Course Description

**MAY 2008, MAY 2009**

## **The College Board: Connecting Students to College Success**

The College Board is a not-for-profit membership association whose mission is to connect students to college success and opportunity. Founded in 1900, the association is composed of more than 5,000 schools, colleges, universities, and other educational organizations. Each year, the College Board serves seven million students and their parents, 23,000 high schools, and 3,500 colleges through major programs and services in college admissions, guidance, assessment, financial aid, enrollment, and teaching and learning. Among its best-known programs are the SAT<sup>®</sup>, the PSAT/NMSQT<sup>®</sup>, and the Advanced Placement Program<sup>®</sup> (AP<sup>®</sup>). The College Board is committed to the principles of excellence and equity, and that commitment is embodied in all of its programs, services, activities, and concerns.

For further information, visit [www.collegeboard.com](http://www.collegeboard.com).

The College Board and the Advanced Placement Program encourage teachers, AP Coordinators, and school administrators to make equitable access a guiding principle for their AP programs. The College Board is committed to the principle that all students deserve an opportunity to participate in rigorous and academically challenging courses and programs. All students who are willing to accept the challenge of a rigorous academic curriculum should be considered for admission to AP courses. The Board encourages the elimination of barriers that restrict access to AP courses for students from ethnic, racial, and socioeconomic groups that have been traditionally underrepresented in the AP Program. Schools should make every effort to ensure that their AP classes reflect the diversity of their student population.

Dear Colleagues:

The College Board has pledged to become a stronger advocate in improving education for America's children. Our nation's college graduation rate is not what it should be and, with your help, we can do something about that. One of the best predictors of college performance is success in an AP<sup>®</sup> course in high school. A study published by the National Center for Educational Accountability has shown that students who succeed on AP Exams benefit academically with better college graduation rates than their fellows.

In 2006, more than 16,000 schools offered high school students the opportunity to take AP courses, and over 1.3 million students then took the challenging AP Exams. These students felt the power of learning come alive in the classroom, and many earned college credit and placement while still in high school. Behind these students were talented, hardworking teachers who are the heart and soul of the Advanced Placement Program<sup>®</sup>.

This AP Course Description summarizes the variety of approaches and curricula used in college courses corresponding to the AP course. Teachers have the flexibility to develop their own syllabi and lesson plans, and to bring their individual creativity to the AP classroom. In fact, AP Exams are designed around this flexibility and allow students whose courses vary significantly equal opportunities to demonstrate college-level achievement. Finally, this curricular flexibility is reflected in the AP Course Audit, which identifies elements considered by higher education as essential to a college-level course, providing a consistent standard for disparate AP classes across the world, while not setting forth a mandated AP curriculum.

The College Board is committed to supporting the work of AP teachers. AP workshops and summer institutes, held around the globe, provide stimulating professional development for tens of thousands of teachers each year. The College Board Fellows scholarships provide funds to support many teachers' attendance at these institutes. Teachers and administrators can also visit AP Central, the College Board's online home for AP professionals, at [apcentral.collegeboard.com](http://apcentral.collegeboard.com). Here, teachers have access to a growing set of resources, information, and tools, from textbook reviews and lesson plans to electronic discussion groups (EDGs) and the most up-to-date exam information. I invite all teachers, particularly those who are new to the AP Program, to take advantage of these resources.

As we look to the future, the College Board's goal is to broaden access to AP classes while maintaining high academic standards. Reaching this goal will require a lot of hard work. We encourage you to connect students to college and opportunity not only by providing them with the challenges and rewards of rigorous academic programs like AP but also by preparing them in the years leading up to AP courses.

Sincerely,

A handwritten signature in black ink that reads "Gaston Caperton". The signature is written in a cursive, flowing style.

Gaston Caperton  
President  
The College Board



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## **Welcome to the AP® Program**

The Advanced Placement Program (AP) is a collaborative effort among motivated students; dedicated teachers; and committed high schools, colleges, and universities. Since its inception in 1955, the Program has enabled millions of students to take college-level courses and exams, and to earn college credit or placement, while still in high school.

Most colleges and universities in the United States, as well as colleges and universities in more than 40 other countries, have an AP policy granting incoming students credit, placement, or both on the basis of their AP Exam grades. Many of these institutions grant up to a full year of college credit (sophomore standing) to students who earn a sufficient number of qualifying AP grades.

Each year, an increasing number of parents, students, teachers, high schools, and colleges and universities turn to the AP Program as a model of educational excellence.

More information about the AP Program is available at the back of this Course Description and at AP Central, the College Board's online home for AP professionals ([apcentral.collegeboard.com](http://apcentral.collegeboard.com)). Students can find more information at the AP student site ([www.collegeboard.com/apstudents](http://www.collegeboard.com/apstudents)).

### **AP Courses**

Thirty-seven AP courses in a wide variety of subject areas are available now. A committee of college faculty and master AP teachers designs each AP course to cover the information, skills, and assignments found in the corresponding college course. See page 2 for a complete list of AP courses and exams.

### **AP Exams**

Each AP course has a corresponding exam that participating schools worldwide administer in May (except for AP Studio Art, which is a portfolio assessment). AP Exams contain multiple-choice questions and a free-response section (either essay or problem solving).

AP Exams are a culminating assessment in all AP courses and are thus an integral part of the Program. As a result, many schools foster the expectation that students who enroll in an AP course will take the corresponding AP Exam. Because the College Board is committed to providing access to AP Exams for homeschooled students and students whose schools do not offer AP courses, it does not require students to take an AP course prior to taking an AP Exam.

### **AP Course Audit**

The AP Course Audit was created at the request of secondary school and college and university members of the College Board who sought a means to provide teachers and administrators with clear guidelines on the curricular and resource requirements that must be in place for AP courses. The AP Course Audit also helps colleges and universities better interpret secondary school courses marked "AP" on students' transcripts. To receive authorization from the College Board to label a course "AP," schools must demonstrate how their courses meet or exceed these requirements, which colleges and universities expect to see within a college-level curriculum.

The AP Program unequivocally supports the principle that each individual school must develop its own curriculum for courses labeled “AP.” Rather than mandating any one curriculum for AP courses, the AP Course Audit instead provides each AP teacher with a set of expectations that college and secondary school faculty nationwide have established for college-level courses. AP teachers are encouraged to develop or maintain their own curriculum that either includes or exceeds each of these expectations; such courses will be authorized to use the “AP” designation. Credit for the success of AP courses belongs to the individual schools and teachers that create powerful, locally designed AP curricula.

Complete information about the AP Course Audit is available at AP Central.

## **AP Courses and Exams**

### **Art**

Art History  
Studio Art: 2-D Design  
Studio Art: 3-D Design  
Studio Art: Drawing

### **Biology**

### **Calculus**

Calculus AB  
Calculus BC

### **Chemistry**

### **Chinese Language and Culture**

### **Computer Science**

Computer Science A  
Computer Science AB

### **Economics**

Macroeconomics  
Microeconomics

### **English**

English Language and Composition  
English Literature and Composition

### **Environmental Science**

### **French**

French Language  
French Literature

### **German Language**

### **Government and Politics**

Comparative Government and Politics  
United States Government and Politics

### **History**

European History  
United States History  
World History

### **Human Geography**

### **Italian Language and Culture**

### **Japanese Language and Culture**

### **Latin**

Latin Literature  
Latin: Vergil

### **Music Theory**

### **Physics**

Physics B  
Physics C: Electricity and Magnetism  
Physics C: Mechanics

### **Psychology**

### **Spanish**

Spanish Language  
Spanish Literature

### **Statistics**



# AP Environmental Science

## INTRODUCTION

The AP Environmental Science course is designed to be the equivalent of a one-semester, introductory college course in environmental science. Unlike most other introductory-level college science courses, environmental science is offered from a wide variety of departments, including geology, biology, environmental studies, environmental science, chemistry, and geography. Depending on the department offering the course, different emphases are placed on various topics. Some courses are rigorous science courses that stress scientific principles and analysis and that often include a laboratory component; other courses emphasize the study of environmental issues from a sociological or political perspective rather than a scientific one. The AP Environmental Science course has been developed to be most like the former; as such, it is intended to enable students to undertake, as first-year college students, a more advanced study of topics in environmental science or, alternatively, to fulfill a basic requirement for a laboratory science and thus free time for taking other courses.

The AP Course Description and AP Exam have been prepared by environmental scientists and educators who serve as members of the AP Environmental Science Development Committee. In both breadth and level of detail, the content of the course reflects what is found in many introductory college courses in environmental science. The exam is representative of such a course and therefore is considered appropriate for the measurement of skills and knowledge in the field of environmental science.

## THE COURSE

The goal of the AP Environmental Science course is to provide students with the scientific principles, concepts, and methodologies required to understand the interrelationships of the natural world, to identify and analyze environmental problems both natural and human-made, to evaluate the relative risks associated with these problems, and to examine alternative solutions for resolving or preventing them.

Environmental science is interdisciplinary; it embraces a wide variety of topics from different areas of study. Yet there are several major unifying constructs, or themes, that cut across the many topics included in the study of environmental science. The following themes provide a foundation for the structure of the AP Environmental Science course.

1. Science is a process.
  - Science is a method of learning more about the world.
  - Science constantly changes the way we understand the world.
2. Energy conversions underlie all ecological processes.
  - Energy cannot be created; it must come from somewhere.
  - As energy flows through systems, at each step more of it becomes unusable.

3. The Earth itself is one interconnected system.
  - Natural systems change over time and space.
  - Biogeochemical systems vary in ability to recover from disturbances.
4. Humans alter natural systems.
  - Humans have had an impact on the environment for millions of years.
  - Technology and population growth have enabled humans to increase both the rate and scale of their impact on the environment.
5. Environmental problems have a cultural and social context.
  - Understanding the role of cultural, social, and economic factors is vital to the development of solutions.
6. Human survival depends on developing practices that will achieve sustainable systems.
  - A suitable combination of conservation and development is required.
  - Management of common resources is essential.

## Prerequisites

The AP Environmental Science course is an excellent option for any interested student who has completed two years of high school laboratory science—one year of life science and one year of physical science (for example, a year of biology and a year of chemistry). Due to the quantitative analysis that is required in the course, students should also have taken at least one year of algebra. Also desirable (but not necessary) is a course in earth science. Because of the prerequisites, AP Environmental Science will usually be taken in either the junior or senior year.

## Textbooks

A number of recently published textbooks are appropriate for college students enrolled in introductory courses in environmental science. Reviews of many such textbooks can be found by clicking on the Teachers' Resources tab on the AP Central home page ([apcentral.collegeboard.com](http://apcentral.collegeboard.com)). The AP Environmental Science teacher should examine a variety of textbooks and use one that will adequately cover the suggested syllabus in a manner and style satisfactory to the teacher and the students. Among the major considerations to be used in choosing a text are depth and breadth of coverage, quality of illustrations, readability, clarity of presentation, value of end-of-chapter questions, availability of other teaching aids, and the capacity to stimulate student interest. A recently published textbook should be chosen so as to ensure that the information it contains is current and accurate.

School systems should recognize that the rapidly changing nature of environmental science requires regular updating of textbooks. While textbooks serve as valuable references, they cannot be exhaustive. Professional development—especially remaining current with new discoveries, events, and conceptual trends—is one responsibility of any AP teacher.

## Topic Outline

The following outline of major topics serves to describe the scope of the AP Environmental Science course and exam. The Development Committee has reorganized the outline in order to better present the course content in terms of major concept areas. However, it is important to note that this reorganized outline does **NOT** represent a change in the content of the course or the exam. The order of topics in the outline holds no special significance, since there are many different sequences in which the topics can be appropriately addressed in the course. The percentage after each major topic heading shows the approximate proportion of multiple-choice questions on the exam that pertain to that heading; thus the percentage also indicates the relative emphasis that should be placed on the topics in the course.

### I. Earth Systems and Resources (10–15%)

- A. Earth Science Concepts  
(Geologic time scale; plate tectonics, earthquakes, volcanism; seasons; solar intensity and latitude)
- B. The Atmosphere  
(Composition; structure; weather and climate; atmospheric circulation and the Coriolis Effect; atmosphere–ocean interactions; ENSO)
- C. Global Water Resources and Use  
(Freshwater/saltwater; ocean circulation; agricultural, industrial, and domestic use; surface and groundwater issues; global problems; conservation)
- D. Soil and Soil Dynamics  
(Rock cycle; formation; composition; physical and chemical properties; main soil types; erosion and other soil problems; soil conservation)

### II. The Living World (10–15%)

- A. Ecosystem Structure  
(Biological populations and communities; ecological niches; interactions among species; keystone species; species diversity and edge effects; major terrestrial and aquatic biomes)
- B. Energy Flow  
(Photosynthesis and cellular respiration; food webs and trophic levels; ecological pyramids)
- C. Ecosystem Diversity  
(Biodiversity; natural selection; evolution; ecosystem services)
- D. Natural Ecosystem Change  
(Climate shifts; species movement; ecological succession)
- E. Natural Biogeochemical Cycles  
(Carbon, nitrogen, phosphorus, sulfur, water, conservation of matter)

### III. Population (10–15%)

- A. Population Biology Concepts  
(Population ecology; carrying capacity; reproductive strategies; survivorship)
- B. Human Population
  - 1. Human population dynamics  
(Historical population sizes; distribution; fertility rates; growth rates and doubling times; demographic transition; age-structure diagrams)
  - 2. Population size  
(Strategies for sustainability; case studies; national policies)
  - 3. Impacts of population growth  
(Hunger; disease; economic effects; resource use; habitat destruction)

### IV. Land and Water Use (10–15%)

- A. Agriculture
  - 1. Feeding a growing population  
(Human nutritional requirements; types of agriculture; Green Revolution; genetic engineering and crop production; deforestation; irrigation; sustainable agriculture)
  - 2. Controlling pests  
(Types of pesticides; costs and benefits of pesticide use; integrated pest management; relevant laws)
- B. Forestry  
(Tree plantations; old growth forests; forest fires; forest management; national forests)
- C. Rangelands  
(Overgrazing; deforestation; desertification; rangeland management; federal rangelands)
- D. Other Land Use
  - 1. Urban land development  
(Planned development; suburban sprawl; urbanization)
  - 2. Transportation infrastructure  
(Federal highway system; canals and channels; roadless areas; ecosystem impacts)
  - 3. Public and federal lands  
(Management; wilderness areas; national parks; wildlife refuges; forests; wetlands)
  - 4. Land conservation options  
(Preservation; remediation; mitigation; restoration)
  - 5. Sustainable land-use strategies
- E. Mining  
(Mineral formation; extraction; global reserves; relevant laws and treaties)

- F. Fishing  
(Fishing techniques; overfishing; aquaculture; relevant laws and treaties)
- G. Global Economics  
(Globalization; World Bank; Tragedy of the Commons; relevant laws and treaties)

**V. Energy Resources and Consumption (10–15%)**

- A. Energy Concepts  
(Energy forms; power; units; conversions; Laws of Thermodynamics)
- B. Energy Consumption
  - 1. History  
(Industrial Revolution; exponential growth; energy crisis)
  - 2. Present global energy use
  - 3. Future energy needs
- C. Fossil Fuel Resources and Use  
(Formation of coal, oil, and natural gas; extraction/purification methods; world reserves and global demand; synfuels; environmental advantages/disadvantages of sources)
- D. Nuclear Energy  
(Nuclear fission process; nuclear fuel; electricity production; nuclear reactor types; environmental advantages/disadvantages; safety issues; radiation and human health; radioactive wastes; nuclear fusion)
- E. Hydroelectric Power  
(Dams; flood control; salmon; silting; other impacts)
- F. Energy Conservation  
(Energy efficiency; CAFE standards; hybrid electric vehicles; mass transit)
- G. Renewable Energy  
(Solar energy; solar electricity; hydrogen fuel cells; biomass; wind energy; small-scale hydroelectric; ocean waves and tidal energy; geothermal; environmental advantages/disadvantages)

**VI. Pollution (25–30%)**

- A. Pollution Types
  - 1. Air pollution  
(Sources—primary and secondary; major air pollutants; measurement units; smog; acid deposition—causes and effects; heat islands and temperature inversions; indoor air pollution; remediation and reduction strategies; Clean Air Act and other relevant laws)
  - 2. Noise pollution  
(Sources; effects; control measures)
  - 3. Water pollution  
(Types; sources, causes, and effects; cultural eutrophication; ground-water pollution; maintaining water quality; water purification; sewage treatment/septic systems; Clean Water Act and other relevant laws)

4. Solid waste  
(Types; disposal; reduction)
- B. Impacts on the Environment and Human Health
  1. Hazards to human health  
(Environmental risk analysis; acute and chronic effects; dose-response relationships; air pollutants; smoking and other risks)
  2. Hazardous chemicals in the environment  
(Types of hazardous waste; treatment/disposal of hazardous waste; cleanup of contaminated sites; biomagnification; relevant laws)
- C. Economic Impacts  
(Cost-benefit analysis; externalities; marginal costs; sustainability)

## VII. Global Change (10–15%)

- A. Stratospheric Ozone  
(Formation of stratospheric ozone; ultraviolet radiation; causes of ozone depletion; effects of ozone depletion; strategies for reducing ozone depletion; relevant laws and treaties)
- B. Global Warming  
(Greenhouse gases and the greenhouse effect; impacts and consequences of global warming; reducing climate change; relevant laws and treaties)
- C. Loss of Biodiversity
  1. Habitat loss; overuse; pollution; introduced species; endangered and extinct species
  2. Maintenance through conservation
  3. Relevant laws and treaties

## LABORATORY AND FIELD INVESTIGATION

Because it is designed to be a course in environmental *science* rather than environmental studies, the AP Environmental Science course must include a strong laboratory and field investigation component. The goal of this component is to complement the classroom portion of the course by allowing students to learn about the environment through firsthand observation. Experiences both in the laboratory and in the field provide students with important opportunities to test concepts and principles that are introduced in the classroom, explore specific problems with a depth not easily achieved otherwise, and gain an awareness of the importance of confounding variables that exist in the “real world.” In these experiences students can employ alternative learning styles to reinforce fundamental concepts and principles. Because all students have a stake in the future of their environment, such activities can motivate students to study environmental science in greater depth. **Colleges often require students to present their laboratory materials from AP science courses before granting college credit for laboratory, so students should be encouraged to retain their laboratory notebooks, reports, and other materials.**

Laboratory and field investigation activities in the course should be diverse. As examples, students can acquire skills in specific techniques and procedures (such as collecting and analyzing water samples), conduct a long-term study of some local system or environmental problem (such as the pollution of a nearby stream), analyze a real data set (such as mean global temperatures over the past 100 years), and visit a local public facility (such as a water-treatment plant).

Although there is a great diversity in the laboratory and field activities that would be appropriate for the course, activities should:

- always be linked to a major concept in science and to one or more areas of the course outline
- allow students to have direct experience with an organism or system in the environment
- involve observation of phenomena or systems, the collection and analysis of data and/or other information, and the communication of observations and/or results

The relative magnitudes of these elements may vary from activity to activity. As a whole, the course's laboratory and field investigation component should encompass all of the elements.

The laboratory and field investigation component of the AP Environmental Science course should challenge the students' abilities to:

- critically observe environmental systems
- develop and conduct well-designed experiments
- utilize appropriate techniques and instrumentation
- analyze and interpret data, including appropriate statistical and graphical presentations
- think analytically and apply concepts to the solution of environmental problems
- make conclusions and evaluate their quality and validity
- propose further questions for study
- communicate accurately and meaningfully about observations and conclusions

It is expected that students will perform as many labs/field investigations as possible; these investigations should fulfill the criteria outlined above. There are no specific AP Environmental Science classroom labs or field investigations required for the course; thus teachers have greater flexibility when it comes to the types of labs, field investigations, and field trips that are undertaken in their courses. Depending on location, students could perform water tests on a freshwater pond, a river, or an estuary/marine environment. Every teacher should provide students with opportunities to perform experiments and analyses involving the study of air, water, and soil qualities as an essential core for the lab/field investigation activities.

The *AP Environmental Science Teacher's Guide* provides many resources for lab/field investigation activities from both college and high school AP teachers. This publication is available in the College Board Store at AP Central ([store.collegeboard.com](http://store.collegeboard.com)). AP Central and the Environmental Literacy Council ([enviroliteracy.org](http://enviroliteracy.org)) also

have a collection of inquiry-based environmental science labs and field investigations that have been produced by a group of college and high school teachers and that are suitable for an AP Environmental Science course. In addition, ideas for labs and other activities can be exchanged on the moderated AP Environmental Science electronic discussion group (EDG) for teachers on AP Central.

## **INSTRUCTIONAL ISSUES: TRAINING, FUNDING, AND SCHEDULING**

An AP course is a college course, and the resources and time allotted should be similar to those in a college course. Because AP Environmental Science includes substantial material from both the life sciences and the physical sciences, it is likely that many schools will not have a single teacher whose background is adequate preparation to teach the entire course. In these situations, teachers should seek the expertise of their colleagues, by either team teaching, using guest lecturers, or having frequent consultations with colleagues and outside experts.

School administrators should be aware that an AP college-level science course is significantly more expensive to operate than a typical high school course and requires more scheduled time than courses without laboratory work. The introductory-level college science course typically consists of between 40 and 50 hours of lecture and between 30 and 40 hours of laboratory work per quarter or semester. Proportional allocations of time for class and laboratory work should be accorded to an AP Environmental Science course. School administrators should provide the equivalent of two double periods a week to allow for laboratory/field work.

Some of the laboratory/field investigations will require equipment the school may not already have. Schools may find it possible to share equipment that belongs to other high schools or to community colleges but should plan to purchase college-level laboratory equipment eventually.

## **THE EXAM**

The AP Environmental Science Exam is three hours long and is divided equally in time between a multiple-choice section and a free-response section. The multiple-choice section, which constitutes 60 percent of the final grade, consists of 100 multiple-choice questions that are designed to cover the breadth of the students' knowledge and understanding of environmental science. Thought-provoking problems and questions based on fundamental ideas from environmental science are included along with questions based on the recall of basic facts and major concepts. The number of multiple-choice questions taken from each major topic area is reflected in the percentage of the course as designated in the topic outline (see pages 5–8).

The free-response section emphasizes the application of principles in greater depth. In this section, students must organize answers to broad questions, thereby demonstrating reasoning and analytical skills, as well as the ability to synthesize material from several sources into cogent and coherent essays. Four free-response questions are included in this section, which constitutes 40 percent of the final grade: 1 data-set question, 1 document-based question, and 2 synthesis and evaluation questions. Questions from the 2006 exam appear on pages 16–19.



To provide maximum information about differences in students' achievements in environmental science, the exam is designed to yield average scores of about 50 percent of the maximum possible scores for both the multiple-choice and free-response sections. Thus, students should be aware that they may find the AP Exam more difficult than most classroom exams. However, it is possible for students who have studied most but not all topics in the outline to obtain acceptable grades.

The use of calculators is not allowed on either section of the exam.

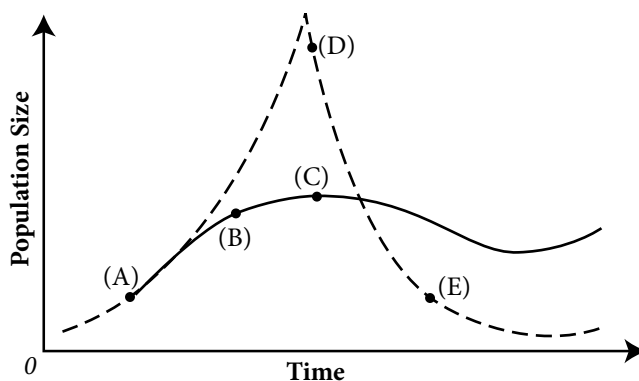
### Sample Multiple-Choice Questions

The following are examples of the kinds of multiple-choice questions found on the AP Environmental Science Exam. Students should spend an average time of less than 1 minute on each multiple-choice question, since 90 minutes are allotted for answering 100 questions.

Students often ask whether they should guess on multiple-choice questions. Haphazard or random guessing is unlikely to improve scores because one-fourth of the number of questions answered incorrectly will be subtracted from the number of questions answered correctly. However, candidates who have some knowledge of a question and can eliminate one or more answer choices will usually find it advantageous to guess from among the remaining choices. An answer key to the multiple-choice questions can be found on page 15.

*Directions:* The lettered choices on the graph below refer to the numbered statements immediately following it. Select the one lettered choice that best fits each statement. Each choice may be used once, more than once, or not at all in each set.

Questions 1–3 refer to the lettered points of the curves plotted on the graph below. The curves show two possible patterns of change in population size over time for a certain species of small mammal in an ecosystem.

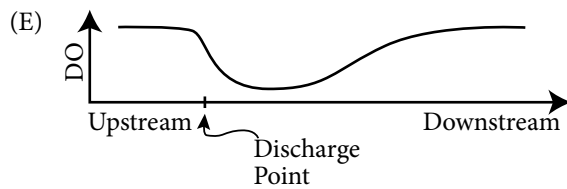
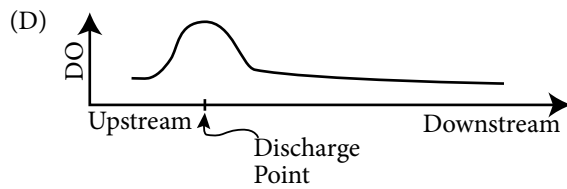
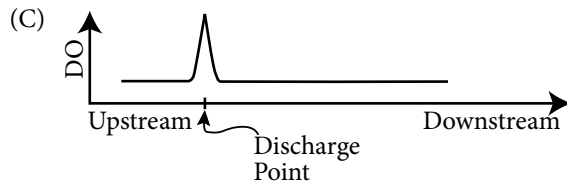
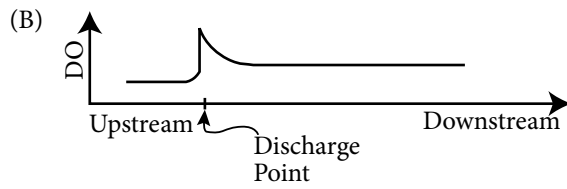
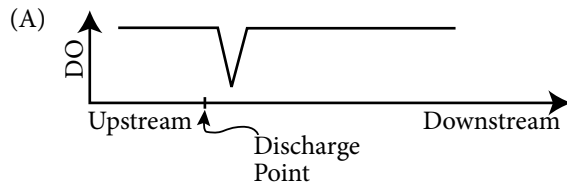


1. Population growing exponentially
2. Population decreasing at greatest rate
3. Population growing at a decreasing rate

*Directions:* Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case.

4. Which of the following is LEAST likely to be an effect of global warming?
- (A) Loss of fertile delta regions for agriculture
  - (B) Change in global patterns of precipitation
  - (C) Extinction of some species that have narrow temperature requirements
  - (D) Decreased rate of photosynthesis in vegetation
  - (E) Increased frequency of hurricanes
5. When  $X$  joules of nuclear energy is used to produce  $Y$  joules of electrical energy, which of the following is true?
- (A) In every case,  $X > Y$
  - (B) In every case,  $X = Y$
  - (C) In every case,  $X < Y$
  - (D) Either  $X < Y$  or  $X > Y$ , depending on the efficiency of the generator
  - (E) Either  $X < Y$  or  $X > Y$ , depending on the amount of heat produced

6. A point source discharges organic waste into a stream. Which of the following graphs best depicts the expected pattern for dissolved oxygen (DO) in this stream as a function of distance from the discharge point?



7. Of the following, which has the greatest permeability?
- (A) Clay
  - (B) Loam
  - (C) Sand
  - (D) Silt
  - (E) Humus
8. Reasons that the population size of an exotic species often grows rapidly when the species is introduced in a new environment include which of the following?
- I. The exotic species is resistant to pesticides.
  - II. There is a large, underutilized food source in the new environment.
  - III. The exotic species has few natural predators in the new environment.
- (A) I only
  - (B) II only
  - (C) I and III only
  - (D) II and III only
  - (E) I, II, and III
9. Most of the Earth's deserts are at approximately 30° latitude, north and south, because these latitudes are characterized by
- (A) generally warm ocean currents
  - (B) predominantly low atmospheric pressure
  - (C) descending dry air currents
  - (D) slow-moving jet streams
  - (E) enhanced solar radiation
10. The presence of which of the following contaminants would be the strongest reason for judging municipal sewage sludge unfit for use as fertilizer?
- (A) Human feces
  - (B) Ammonia
  - (C) Phosphates
  - (D) Nitrates
  - (E) Heavy metals
11. Which of the following is the best example of environmental remediation?
- (A) A species of trout becomes extinct in a eutrophic lake.
  - (B) The annual volume of sewage flowing into a stream is decreased by one half.
  - (C) The height of a factory smokestack is increased.
  - (D) A parcel of forest land is declared a state park.
  - (E) PCB-consuming bacteria are sprayed on an area that has soil contaminated with PCB's.
12. The CITES treaty has been helpful in protecting endangered animals and plants by
- (A) listing all species that can be hunted, traded, and used commercially
  - (B) listing those species and products whose international trade is controlled
  - (C) funding projects for breeding endangered plants and animals
  - (D) preventing the hunting of whales and dolphins
  - (E) specifying prices for certain plant and animal products

13. A country currently has a population of 100 million and an annual growth rate of 3.5 percent. If the growth rate remains constant, what will be the population of this country in 40 years?
- (A) 150 million
  - (B) 200 million
  - (C) 300 million
  - (D) 400 million
  - (E) 800 million
14. The dangers of disposing of toxic chemicals underground came to public attention in which of the following locations?
- (A) Bhopal, India
  - (B) Chernobyl, Ukraine
  - (C) Love Canal, New York
  - (D) Minamata, Japan
  - (E) Three Mile Island, Pennsylvania
15. Which type of electricity-generating power plant releases radioactive materials as well as toxic metals such as lead and arsenic under normal operating conditions?
- (A) Nuclear
  - (B) Hydroelectric
  - (C) Solar
  - (D) Coal-burning
  - (E) Geothermal
16. Which of the following greenhouse gases has the greatest heat-trapping ability per molecule?
- (A) Carbon dioxide
  - (B) Carbon monoxide
  - (C) Chlorofluorocarbon
  - (D) Methane
  - (E) Nitrous oxide
17. Of the following, the greatest threat to populations of migratory North American songbirds is
- (A) predation by raptors
  - (B) clearing of tropical forests
  - (C) disease from polluted waters
  - (D) sport hunting
  - (E) international trade in pets

**Answers to Multiple-Choice Questions**

1 – A	4 – D	7 – C	10 – E	13 – D	16 – C
2 – D	5 – A	8 – D	11 – E	14 – C	17 – B
3 – B	6 – E	9 – C	12 – B	15 – D	

## Sample Free-Response Questions

The free-response section of the exam consists of four required questions: one data-set question, one document-based question, and two synthesis and evaluation questions. The following questions appeared on the 2006 exam. Additional sample questions can be found at AP Central.

1. Upon receiving notice from their electric utility that customers with solar power systems are permitted to sell excess power back to the utility, an Arizona family is considering the purchase of a photovoltaic solar energy system for their 2,700-square-foot suburban home. The initial costs of the systems they are considering range from \$7,000 to \$30,000. While gathering information prior to making a decision, the homeowners find the following information at the Web site of the United States Department of Energy.

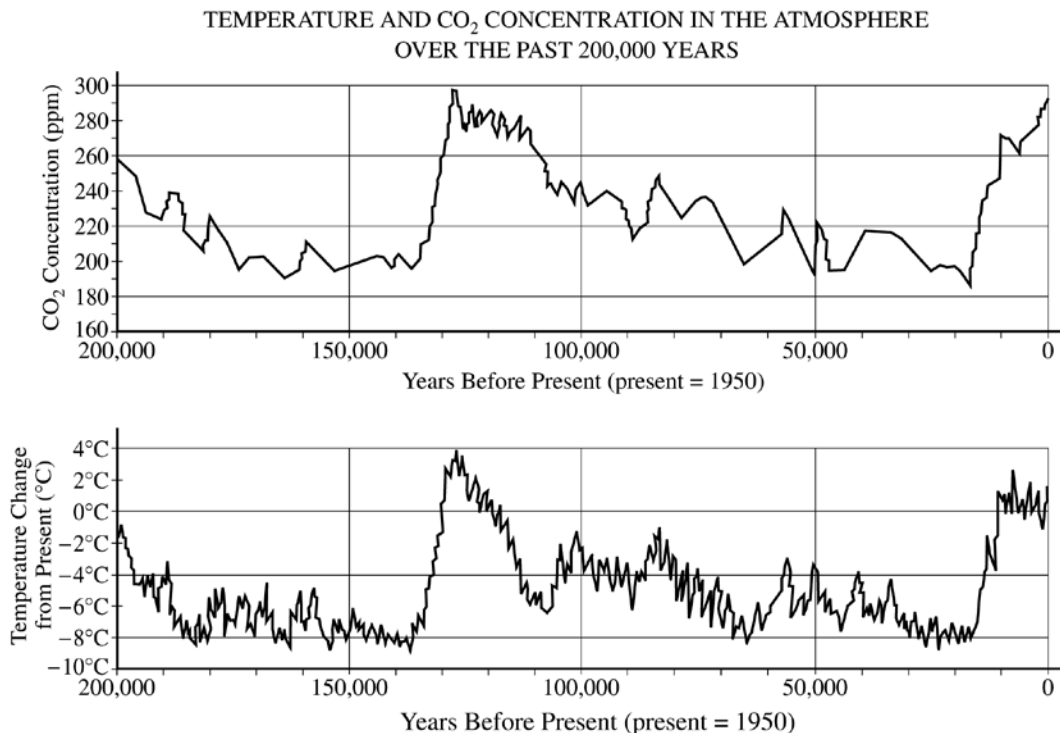
### Stand-Alone vs. Grid-Connected Systems

Stand-alone systems produce power independently of the utility grid. In some off-the-grid locations as near as one-quarter mile from the power lines, stand-alone photovoltaic systems can be more cost-effective than extending power lines. Direct-coupled systems need no electrical storage because they operate only during daylight hours, but most systems rely on battery storage so that energy produced during the day can be used at night. Some systems, called hybrid systems, combine solar power with additional power sources such as wind or diesel.

Grid-connected photovoltaic systems supply surplus power back through the grid to the utility and take from the utility grid when the home system's power supply is low. These systems remove the need for battery storage, although arranging for the grid interconnection can be difficult. In some cases, utilities allow net metering, which allows the owner to sell excess power back to the utility.

- (a) Describe one environmental benefit and one environmental cost of photovoltaic systems.
- (b) From the two types of solar systems described on the government Web site, select the system (either stand-alone or grid-connected) that you think best meets the needs of the homeowners. Write an argument to persuade them to purchase the system you selected. Include the pros and cons of each system in your argument.
- (c) Describe TWO ways that government or industry could promote the use of photovoltaic power systems for homeowners in the future.
- (d) Describe TWO ways that homeowners could use passive solar designs and/or systems and, for each way, explain how it would reduce the homeowners' energy costs.

2. According to atmospheric temperature and CO<sub>2</sub> concentration records derived from Antarctic ice cores, Earth's climate has undergone significant changes over the past 200,000 years. Two graphs are shown below. The upper graph shows the variation in atmospheric CO<sub>2</sub> concentration, and the lower graph shows the variation in air temperature. Both graphs cover the same time period from approximately 200,000 years ago up until the year 1950, which is represented as year 0 on the graphs.

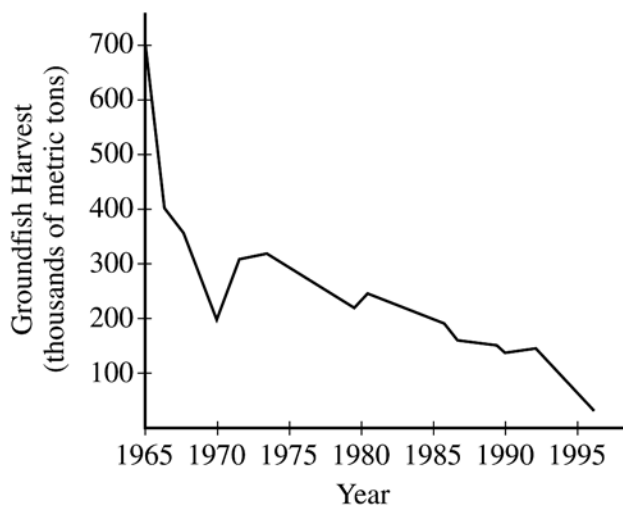


- (a) Answer the following questions that relate to the graphs above. Remember that for any calculations you must clearly indicate how you arrived at your answer. Answers must also include appropriate units.
- (i) Determine the net change in atmospheric CO<sub>2</sub> concentration between 140,000 years ago and 125,000 years ago.
  - (ii) Calculate the ratio of the change in mean global temperature to the change in atmospheric CO<sub>2</sub> concentration between 140,000 years ago and 125,000 years ago.
  - (iii) Scientists predict that between 1950 and 2050, the atmospheric CO<sub>2</sub> concentration will increase by 200 ppm. Predict the change in mean global temperature between 1950 and 2050 using the ratio that you calculated in part (ii).
  - (iv) Describe one major assumption that was necessary to make the prediction in part (iii) above. Discuss the validity of the assumption.

- (b) Identify and describe TWO major causes for the predicted 200 ppm increase in atmospheric  $\text{CO}_2$  concentration between 1950 and 2050.
  - (c) Identify TWO gases other than  $\text{CO}_2$  that contribute to the anthropogenic increase in mean global temperature. For each gas, describe a major human activity that leads to its release.
3. The city of Fremont has a large brownfield located along the Fremont River. The brownfield is a former industrial site where contamination by hazardous chemicals impedes redevelopment. The city council is considering two options for reclaiming the brownfield. The first option is to excavate and remove the contaminated soil, and the second option is to decontaminate the soil on the site using vegetation.
- (a) Assume that the city council chooses the first option. Describe TWO problems that result from removing the contaminated soil from the brownfield.
  - (b) Assume that the city council chooses the second option. Explain how vegetation could be used to decontaminate the soil. Discuss one advantage and one disadvantage of using this reclamation method.
  - (c) Describe and explain one environmental benefit and one societal benefit of brownfield reclamation.
  - (d) Identify and describe
    - (i) one method currently used to reduce the production of hazardous waste and
    - (ii) one method of legally disposing of hazardous waste.



GEORGES BANK GROUND FISH HARVEST



4. The graph above shows the decline in the catch of groundfish (such as cod, haddock, and flounder) from Georges Bank from 1965 to 1995. This decline in the fish harvest resulted in the closure of large portions of the fishery.
- Identify the five-year period during which the greatest rate of decline in the fish harvest took place. For that five-year period, calculate the rate of decline in the fish harvest, in metric tons per year. Show clearly how you determined your answer.
  - Choose any TWO commercial fishing practices from the list below. For each of your choices, describe the practice and explain the role it plays in the depletion of marine organisms.
    - Bottom trawling
    - Long-line fishing
    - Using drift nets/gill nets/purse seines
    - Using sonar
  - Identify one international regulation or United States federal law that applies to the harvesting of marine food resources and explain how that regulation or law helps to manage marine species.
  - The oceans of the world are often referred to as a commons. Give an example of one other such commons, explain how human activities affect that commons, and suggest one practical method for managing that commons.

# AP<sup>®</sup> Program Essentials

## The AP Reading

Each year in June, the free-response section of the exams, as well as the AP Studio Art portfolios, are scored by college faculty and secondary school AP teachers at the AP Reading. Thousands of Readers participate, under the direction of a Chief Reader (a college professor) in each AP subject. The experience offers both significant professional development and the opportunity to network with like-minded educators.

If you are an AP teacher or a college faculty member and would like to serve as a Reader, you can apply online at [apcentral.collegeboard.com/readers](http://apcentral.collegeboard.com/readers). Alternatively, you can send an e-mail to [apreader@ets.org](mailto:apreader@ets.org) or call Performance Assessment Scoring Services at 609 406-5384.

## AP Grades

The Readers' scores on the essay and problem-solving questions are combined with the results of the computer-scored multiple-choice questions, and the total raw scores are converted to a composite score on AP's 5-point scale:

AP GRADE	QUALIFICATION
5	Extremely well qualified
4	Well qualified
3	Qualified
2	Possibly qualified
1	No recommendation

## Grade Distributions

Many teachers want to compare their students' grades with national percentiles. Grade distribution charts are available at AP Central, as is information on how the grade boundaries for each AP grade are established. Grade distribution charts are also available on the AP student site at [www.collegeboard.com/apstudents](http://www.collegeboard.com/apstudents).

## Why Colleges Grant Credit, Placement, or Both for AP Grades

Colleges know that the AP grades of incoming students represent a level of achievement equivalent to that of students who take the same course in the colleges' own classrooms. That equivalency is ensured through several AP Program processes:

- College faculty serve on the committees that develop the Course Descriptions and exams in each AP course.
- College faculty are responsible for standard setting and are involved in the evaluation of student responses at the AP Reading.
- AP courses and exams are reviewed and updated regularly based on the results of curriculum surveys at up to 200 colleges and universities, collaborations among the College Board and key educational and disciplinary organizations, and the interactions of committee members with professional organizations in their discipline.

- Periodic college comparability studies are undertaken in which the performance of college students on AP Exams is compared with that of AP students to confirm that the AP grade scale of 1 to 5 is properly aligned with current college standards.

In addition, the College Board has commissioned studies that use a “bottom-line” approach to validating AP Exam grades by comparing the achievement of AP students with non-AP students in higher level college courses. For example, in the 1998 Morgan and Ramist “21-College” study, AP students who were exempted from introductory courses and who completed a higher level course in college compared favorably, on the basis of their college grades, with students who completed the prerequisite first course in college, then took the second, higher level course in the subject area. Such studies answer the question of greatest concern to colleges: Are AP students who are exempted from introductory courses as well prepared to continue in a subject area as students who took their first course in college? To see the results of several college validity studies, visit [apcentral.collegeboard.com/colleges/research](http://apcentral.collegeboard.com/colleges/research). (The complete Morgan and Ramist study can be downloaded from the site.)

### **Guidelines on Setting Credit and Placement Policies for AP Grades**

The College Board has created two useful resources for admissions administrators and academic faculty who need guidance on setting an AP policy for their college or university. The printed guide *AP and Higher Education* provides guidance for colleges and universities in setting AP credit and placement policies. The booklet details how to set an AP policy, summarizes AP research studies, and describes in detail course and exam development and the exam scoring process. AP Central has a section geared toward colleges and universities that provides similar information and additional resources, including links to all AP research studies, Released Exam questions, and sample student responses at varying levels of achievement for each AP Exam. Visit [apcentral.collegeboard.com/highered](http://apcentral.collegeboard.com/highered).

The *Advanced Placement Policy Guide* for each AP subject is designed for college faculty responsible for setting their department’s AP policy. These folios provide content specific to each AP Exam, including validity research studies and a description of the AP course curriculum. Ordering information for these and other publications can be found in the AP Publications and Other Resources section of this Course Description.

### **College and University AP Credit and Placement Policies**

Each college and university sets its own AP credit and placement policies. The AP Program has created an online search tool, AP Credit Policy Info, that provides links to credit and placement policies at hundreds of colleges and universities. The tool helps students find the credit hours and advanced placement they can receive for qualifying exam scores within each AP subject. AP Credit Policy Info is available at [www.collegeboard.com/ap/creditpolicy](http://www.collegeboard.com/ap/creditpolicy).

## AP Scholar Awards

The AP Program offers a number of AP Scholar Awards to recognize high school students who have demonstrated college-level achievement through consistently high performance on AP Exams. Although there is no monetary award, students receive an award certificate, and the achievement is acknowledged on grade reports sent to colleges following the announcement of the awards. For detailed information about AP Scholar Awards (including qualification criteria), visit AP Central or contact the College Board's national office. Students can find this information at [www.collegeboard.com/apstudents](http://www.collegeboard.com/apstudents).

## AP Calendar

The *AP Program Guide* for education professionals and the *Bulletin for AP Students and Parents* provide important Program information and details on the key events in the AP calendar. Information on ordering or downloading these publications can be found at the back of this book.

## Exam Security

All parts of every AP Exam must be kept secure at all times. Forty-eight hours after the exam has been administered, the inserts containing the free-response questions (Section II) can be made available for teacher and student review.\* **However, the multiple-choice section (Section I) must remain secure both before and after the exam administration.** No one other than students taking the exam can ever have access to or see the questions contained in Section I—this includes AP Coordinators and all teachers. The multiple-choice section must never be shared, copied in any manner, or reconstructed by teachers and students after the exam. **Schools that knowingly or unknowingly violate these policies will not be permitted to administer AP Exams in the future and may be held responsible for any damages or losses the College Board and/or ETS incur in the event of a security breach.**

Selected multiple-choice questions are reused from year to year to provide an essential method of establishing high exam reliability, controlled levels of difficulty, and comparability with earlier exams. These goals can be attained only when the multiple-choice questions remain secure. This is why teachers cannot view the questions, and students cannot share information about these questions with anyone following the exam administration.

To ensure that all students have an equal opportunity to demonstrate their abilities on the exam, AP Exams must be administered in a uniform manner. **It is extremely important to follow the administration schedule and all procedures outlined in detail in the most recent *AP Coordinator's Manual*.** Please note that AP Studio Art portfolios and their contents are not considered secure testing materials; see the *AP Coordinator's Manual* and the appropriate *AP Examination Instructions* book for further information. The *Manual* also includes directions on how to handle misconduct and other security problems. All schools participating in AP automatically

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\*The free-response section of the alternate form (used for late testing administration) is NOT released.

receive printed copies of the *Manual*. It is also available in PDF format at [apcentral.collegeboard.com/coordinators](http://apcentral.collegeboard.com/coordinators). Any breach of security should be reported to the Office of Testing Integrity immediately (call 800 353-8570 or 609 406-5427, fax 609 406-9709, or e-mail [tsreturns@ets.org](mailto:tsreturns@ets.org)).

## Teacher Support

### AP Central® ([apcentral.collegeboard.com](http://apcentral.collegeboard.com))

You can find the following Web resources at AP Central (free registration required):

- AP Course Descriptions, AP Exam questions and scoring guidelines, sample syllabi, research reports, and feature articles.
- A searchable Institutes and Workshops database, providing information about professional development events. AP Central offers online events that participants can access from their home or school computers.
- The Course Home Pages ([apcentral.collegeboard.com/coursehomepages](http://apcentral.collegeboard.com/coursehomepages)), which contain insightful articles, teaching tips, activities, lab ideas, and other course-specific content contributed by colleagues in the AP community.
- In-depth FAQs, including brief responses to frequently asked questions about AP courses and exams, the AP Program, and other topics of interest.
- Links to AP publications and products (some available for immediate download) that can be purchased online at the College Board Store ([store.collegeboard.com](http://store.collegeboard.com)).
- Moderated electronic discussion groups (EDGs) for each AP course to facilitate the exchange of ideas and practices.
- Teachers' Resources database—click on the “Teachers' Resources” tab to search for reviews of textbooks, reference books, documents, Web sites, software, videos, and more. College and high school faculty write the reviews with specific reference to the value of the resources in teaching AP courses.

### Online Workshops and Events

College Board online events and workshops are designed to help support and expand the high level of professional development currently offered to teachers in Pre-AP and AP workshops and AP Summer Institutes. Because of budgetary, geographical, and time constraints, not all teachers and administrators are able to take advantage of live, face-to-face workshops. The College Board develops and offers both standard and customized online events and workshops for schools, districts, and states in both live and recorded formats. Online events and workshops are developed and presented by experienced College Board consultants and college faculty. Full-day online workshops are equivalent to one-day, face-to-face workshops and participants can earn CEU credits. For more information, visit [apcentral.collegeboard.com/onlineevents](http://apcentral.collegeboard.com/onlineevents).

## Pre-AP<sup>®</sup>

Pre-AP<sup>®</sup> is a suite of K–12 professional development resources and services designed to help equip middle school and high school teachers with the strategies and tools they need to engage their students in high-level learning, thereby ensuring that every middle school and high school student has the opportunity to acquire a deep understanding of the skills, habits of mind, and concepts they need to succeed in college.

Pre-AP is based on the following premises. The first is the expectation that all students can perform at rigorous academic levels. This expectation should be reflected in the curriculum and instruction throughout the school so that all students are consistently being challenged to bring their knowledge and skills to the next level.

The second important premise of Pre-AP is the belief that educators can prepare every student for higher intellectual engagement by starting the development of skills and the acquisition of knowledge as early as possible. When addressed effectively, the middle school and high school years can provide a powerful opportunity to help all students acquire the knowledge, concepts, and skills needed to engage in a higher level of learning.

Pre-AP teacher professional development explicitly supports the goal of college as an option for every student. It is important to have a recognized standard for college-level academic work. The AP Program provides these standards for Pre-AP. Pre-AP professional development resources reflect the topics, concepts, and skills taught in AP courses and assessed in AP Exams.

The College Board does not design, develop, or assess courses or examinations labeled “Pre-AP.” The College Board discourages the labeling of courses as “Pre-AP.” Typically, such courses create a track, thereby limiting access to AP classes. The College Board supports the assertion that all students should have access to preparation for AP and other challenging courses. Courses labeled “Pre-AP” can inappropriately restrict access to AP and other college-level work and, as such, are inconsistent with the fundamental purpose of the College Board’s Pre-AP initiatives.

### Pre-AP Professional Development

Pre-AP professional development is available through workshops and conferences coordinated by the College Board’s regional offices. Pre-AP professional development is divided into three categories:

1. **Vertical Teaming**—Articulation of content and pedagogy across the middle school and high school years. The emphasis is on aligning curricula and improving teacher communication. The intended outcome is a coordinated program of teaching skills and concepts over several years.
2. **Classroom Strategies**—Content-specific classroom strategies for middle school and high school teachers. Various approaches, techniques, and ideas are emphasized.

3. **Instructional Leadership**—Administrators and other instructional leaders examine how to use Pre-AP professional development—especially AP Vertical Teams®—to create a system that challenges all students to perform at rigorous academic levels.


For a complete list of Pre-AP professional development offerings, please contact your regional office or visit [apcentral.collegeboard.com/pre-ap](http://apcentral.collegeboard.com/pre-ap).

## AP Publications and Other Resources

A number of AP resources are available to help students, parents, AP Coordinators, and high school and college faculty learn more about the AP Program and its courses and exams. To identify resources that may be of particular use to you, refer to the following key.

AP Coordinators and Administrators . . . . .	A
College Faculty . . . . .	C
Students and Parents . . . . .	SP
Teachers . . . . .	T

### Free Resources

Copies of the following items can be ordered free of charge at [apcentral.collegeboard.com/freepubs](http://apcentral.collegeboard.com/freepubs). Items marked with a computer mouse icon  can be downloaded for free from AP Central.

 **The Value of AP Courses and Exams** A, SP, T

This brochure, available in English and Spanish, can be used by school counselors and administrators to provide parents and students with information about the many benefits of participation in AP courses and exams.

**AP Tools for Schools Resource Kit** A

This complimentary resource assists schools in building their AP programs. The kit includes the video *Experience College Success*, the brochure *The Value of AP Courses and Exams*, and brief descriptions of the AP Credit Policy Info search tool and the Parent’s Night *PowerPoint* presentation.


*Experience College Success* is a six-minute video that provides a short overview of the AP Program, with commentary from admissions officers, college students, and high school faculty about the benefits of participation in AP courses. Each videotape includes both an English and Spanish version.

 **Bulletin for AP Students and Parents** SP

This bulletin provides a general description of the AP Program, including information on the policies and procedures related to taking the exams. It describes each AP Exam, lists the advantages of taking the exams, describes the grade reporting process, and includes the upcoming exam schedule. The *Bulletin* is available in both English and Spanish.

 **Get with the Program** **SP**

All students, especially those from underserved backgrounds, should understand the value of a high-quality education. Written especially for students and their families, this bilingual (Spanish/English) brochure highlights the benefits of participation in the AP Program. (The brochure can be ordered in large quantities for students in grades 8–12.)

 **AP Program Guide** **A**

This guide takes the AP Coordinator through the school year step-by-step—organizing an AP program, ordering and administering the AP Exams, AP Exam payment, and grade reporting. It also includes information on teacher professional development, AP resources, and exam schedules.

 **AP and Higher Education** **A, C, T**

This publication is intended to inform and help educational professionals at the secondary and postsecondary levels understand the benefits of having a coherent, equitable AP credit and placement policy. Topics included are development of AP courses and exams, grading of AP Exams, exam validation, research studies comparing the performance of AP students with non-AP students, uses of AP Exams by students in college, and how faculty can get involved in the AP Program.

 **Advanced Placement Policy Guides** **A, C, T**

These policy guides are designed for college faculty responsible for setting their department's AP policy, and provide, in a subject-specific context, information about AP validity studies, college faculty involvement, and AP course curricular content. There are separate guides for each AP subject field.

### **Priced Publications**

The following items can be ordered through the College Board Store at [store.collegeboard.com](http://store.collegeboard.com). Alternatively, you can download an AP Order Form from AP Central at [apcentral.collegeboard.com/documentlibrary](http://apcentral.collegeboard.com/documentlibrary).

 **Course Descriptions** **A, C, SP, T**

Course Descriptions are available for each AP subject. They provide an outline of each AP course's content, explain the kinds of skills students are expected to demonstrate in the corresponding introductory college-level course, and describe the AP Exam. Sample multiple-choice questions with an answer key and sample free-response questions are included.

Note: PDF versions of current AP Course Descriptions for each AP subject may be downloaded free of charge from AP Central and the College Board's Web site for students. Follow the above instructions to purchase printed copies. (The Course Description for AP Computer Science is available in electronic format only.)



## Released Exams

C, T

Periodically the AP Program releases a complete copy of each exam. In addition to providing the multiple-choice questions and answers, the publication describes the process of scoring the free-response questions and includes examples of students' actual responses, the scoring standards, and commentary that explains why the responses received the scores they did.

## Teacher's Guides

T

For those about to teach an AP course for the first time, or for experienced AP teachers who would like to get some fresh ideas for the classroom, the *Teacher's Guide* is an excellent resource. Each *Teacher's Guide* contains syllabi developed by high school teachers currently teaching the AP course and college faculty who teach the equivalent course at colleges and universities. Along with detailed course outlines and innovative teaching tips, you'll also find extensive lists of suggested teaching resources.

## AP Vertical Team Guides

A, T

AP Vertical Teams (APVT) are made up of teachers from different grade levels who work together to develop and implement a sequential curriculum in a given discipline. Teams help students acquire the skills necessary for success in AP courses. To assist teachers and administrators who are interested in establishing an APVT at their school, the College Board has published these guides: *AP Vertical Teams Guide for English*; *AP Vertical Teams Guide for Mathematics and Statistics*; *AP Vertical Teams Guide for Science*; *AP Vertical Teams Guide for Social Studies*; *AP Vertical Teams Guide for World Languages and Cultures*; *AP Vertical Teams Guide for Fine Arts, Vol. 1: Studio Art*; *AP Vertical Teams Guide for Fine Arts, Vol. 2: Music Theory*; and *AP Vertical Teams Guide for Fine Arts, Vols. 1 and 2 (set)*.

## Multimedia

### APCD® (home version), (multinetwork site license)

SP, T

These CD-ROMs are available for AP Calculus AB, AP English Literature, AP European History, and AP U.S. History. They each include actual AP Exams, interactive tutorials, exam descriptions, answers to frequently asked questions, and test-taking strategies. Also included are a listing of resources for further study and a planner to help students schedule and organize their study time.

The teacher version of each CD, which can be licensed for up to 50 workstations, enables you to monitor student progress and provide individual feedback. Included is a Teacher's Manual that gives full explanations along with suggestions for utilizing the APCD in the classroom.

## **Electronic Publications**

Additional supplemental publications are available in electronic format to be purchased and downloaded from the College Board Store. These include a collection of 13 AP World History Teaching Units, AP Calculus free-response questions and solutions from 1969 to 1997, and the *Physics Lab Guide*.

Announcements of new electronic publications can be found on the AP Course Home Pages on AP Central ([apcentral.collegeboard.com/coursehomepages](http://apcentral.collegeboard.com/coursehomepages)).

# Contact Us

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212 713-8066  
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## **AP Services**

P.O. Box 6671  
Princeton, NJ 08541-6671  
609 771-7300  
877 274-6474 (toll free in the U.S.  
and Canada)  
E-mail: [apexams@info.collegeboard.org](mailto:apexams@info.collegeboard.org)

## **AP Canada Office**

2950 Douglas Street, Suite 550  
Victoria, BC, Canada V8T 4N4  
250 472-8561  
800 667-4548 (toll free in Canada only)  
E-mail: [gewonus@ap.ca](mailto:gewonus@ap.ca)

## **AP International Office**

*Serving all countries outside the U.S. and Canada*  
45 Columbus Avenue  
New York, NY 10023-6992  
212 373-8738  
E-mail: [apintl@collegeboard.org](mailto:apintl@collegeboard.org)

## **Middle States Regional Office**

*Serving Delaware, District of Columbia, Maryland,  
New Jersey, New York, Pennsylvania,  
Puerto Rico, and the U.S. Virgin Islands*  
Two Bala Plaza, Suite 900  
Bala Cynwyd, PA 19004-1501  
866 392-3019  
E-mail: [msro@collegeboard.org](mailto:msro@collegeboard.org)

## **Midwestern Regional Office**

*Serving Illinois, Indiana, Iowa, Kansas,  
Michigan, Minnesota, Missouri,  
Nebraska, North Dakota, Ohio, South Dakota,  
West Virginia, and Wisconsin*  
6111 N. River Road, Suite 550  
Rosemont, IL 60018-5158  
866 392-4086  
E-mail: [mro@collegeboard.org](mailto:mro@collegeboard.org)

## **New England Regional Office**

*Serving Connecticut, Maine, Massachusetts, New  
Hampshire, Rhode Island, and Vermont*  
470 Totten Pond Road  
Waltham, MA 02451-1982  
866 392-4089  
E-mail: [nero@collegeboard.org](mailto:nero@collegeboard.org)

## **Southern Regional Office**

*Serving Alabama, Florida, Georgia, Kentucky,  
Louisiana, Mississippi, North Carolina, South Carolina,  
Tennessee, and Virginia*  
3700 Crestwood Parkway NW, Suite 700  
Duluth, GA 30096-7155  
866 392-4088  
E-mail: [sro@collegeboard.org](mailto:sro@collegeboard.org)

## **Southwestern Regional Office**

*Serving Arkansas, New Mexico, Oklahoma, and Texas*  
4330 South MoPac Expressway, Suite 200  
Austin, TX 78735-6735  
866 392-3017  
E-mail: [swro@collegeboard.org](mailto:swro@collegeboard.org)

## **Western Regional Office**

*Serving Alaska, Arizona, California, Colorado, Hawaii,  
Idaho, Montana, Nevada, Oregon, Utah, Washington,  
and Wyoming*  
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