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 Web page (apcentral.collegeboard.org). 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 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; groundwater 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.**