Current and Recent Members of the AP Environmental Science Development Committee

Myra Amodie
Mt. Lebanon High School
Pennsylvania

Nivedita M. Ganguly
Oak Ridge High School
Tennessee

Dean Goodwin*
Kimball Union Academy
New Hampshire

David Hong*
Diamond Bar High School
California

Henry S. Horn*
Princeton University
New Jersey

Hilary I. Inyang*
University of North Carolina, Charlotte
North Carolina

Fred M. Loxsom,* Chair
Eastern Connecticut State University
Connecticut

Alan W. McIntosh*
University of Vermont
Vermont

Thomas Mowbray, former Chief Reader
Salem College
North Carolina

Susan Postawko,* Chief Reader
University of Oklahoma
Oklahoma

Pamela J. Shlachtman*
Miami Palmetto High School
Florida

Benjamin J. Smith
Palos Verdes Peninsula High School
California

Mohan K. Wali
The Ohio State University
Ohio

* Current committee member

Setting a Policy for AP® Environmental Science

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

The Advanced Placement Program® (AP) provides motivated students with the opportunity to take college-level courses while still in high school. Students demonstrate their mastery of the curriculum by taking AP Exams—35 exams are available in 20 subject areas. In 2005, more than 1.2 million students took AP Exams worldwide. Of the 2.1 million AP Exams taken in 2005, more than 38,000 were in Environmental Science. More than 3,000 colleges and universities, including many international institutions, accept qualifying AP Exam scores for credit, placement, or both.

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

Environmental Science Faculty Involvement in AP

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

> "In my four years of involvement with the AP Environmental Science program, I have been very impressed by its coverage of both traditional and emerging environmental issues. Most of the free-response and multiple-choice questions posed to students place environmental issues within the context of sustainable development. My observation is that the program has enhanced the development of budding environmental scientists who are able to establish the interconnections among many sustainable development factors, some of which are nested in environmental issues."
>
> —Hilary Inyang, AP Environmental Science Development Committee
> Duke Energy Distinguished Professor
> Director of the Global Institute for Energy and Environmental Systems
> The University of North Carolina, Charlotte

The College Board publication *AP and Higher Education* discusses the following topics at greater length: how to set an AP policy, AP research studies, the development of AP courses and exams, and the AP Exam scoring. For more information or to request a copy of this publication, please go to **apcentral.collegeboard.com/highered.**

How to Set an AP Policy

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

Research on AP Student Performance

Research studies show that students who do well on an AP Exam are academically prepared to place out of a corresponding college course and move on to the next higher-level course in the discipline.

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

Research studies show that students who take the AP Exams are significantly more likely to take further course work in the same subject area than students who do not take the AP Exam. Higher scores on the AP Exam make this trend even more pronounced, with a greater likelihood of majoring or minoring in the discipline.

PDF copies of research studies on AP student performance can be found at apcentral.collegeboard.com/colleges/research.

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

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

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

AP Environmental Science Students, Course, and Exam

Participation and Performance Data for AP Environmental Science Students in 2005

Total Number of Schools Offering AP Environmental Science: 1,920

Table 1: AP Environmental Science Exam Score Distribution, 2005

EXAM GRADE	NUMBER OF EXAMINEES	% AT
Score of 5	3,551	9.3%
Score of 4	8,901	23.4%
Score of 3	7,204	18.9%
Score of 2	6,813	17.9%
Score of 1	11,635	30.5%
	38,104	100.0%

Figure 1: AP Environmental Science Examinees by Gender, 2005

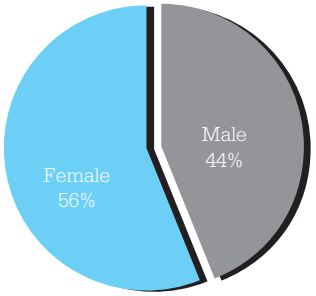
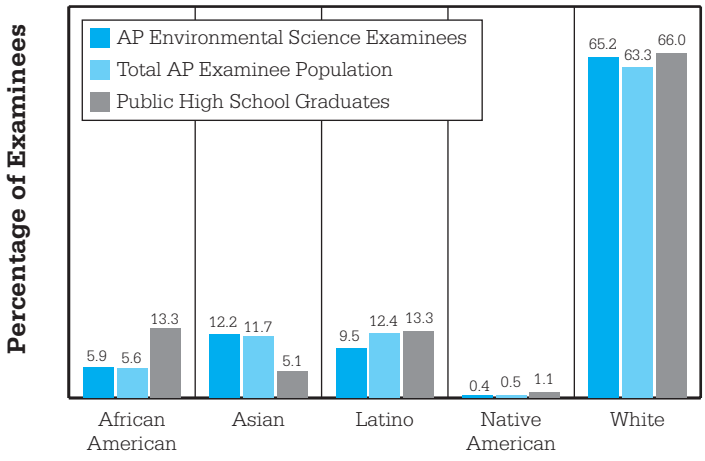


Figure 2: AP Environmental Science Examinees by Race and Ethnicity, 2005



AP Credit Policy Info on the Web

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

The AP Environmental Science Course

The AP Environmental Science course is designed to provide students with a learning experience equivalent to that of an introductory one-semester college course in environmental science. 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. The AP Environmental Science course requires the use of a college-level textbook and a significant laboratory and field investigation component. The course is based upon scientific principles and analyses from a variety of scientific fields and approaches.

> "The AP Environmental Science course should integrate classroom work with a variety of laboratory and field experiences for students. These experiences should include opportunities for students to participate in field studies, to perform laboratory experiments, to design and conduct their own research programs, and to visit environmentally significant local sites, such as water treatment plants."
>
> —Fred Loxsom
> AP Environmental Science Development Committee Chair
> Endowed Chair in Sustainable Energy Studies
> Eastern Connecticut State University

The Development Committee creates the guidelines for the AP Environmental Science course and designs the AP Exam. Periodically the Development Committee conducts curriculum surveys, sent to professors who teach the comparable college-level course, that help ensure that the AP Environmental Science course remains current with concepts and themes as taught in college and university classrooms.

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, 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.
2. Energy conversions underlie all ecological processes.
3. The Earth itself is one interconnected system.
4. Humans alter natural systems.
5. Environmental problems have a cultural and social context.
6. Human survival depends on developing practices that will achieve sustainable systems.

The Development Committee has created a topic outline that covers the main subject areas that should be taught, along with the relative weight to be assigned to each topic:

I. Earth Systems and Resources 10–15%
- A. Earth Science Concepts
- B. The Atmosphere
- C. Global Water Resources and Use
- D. Soil and Soil Dynamics

II. The Living World 10–15%
- A. Ecosystem Structure
- B. Energy Flow
- C. Ecosystem Diversity
- D. Natural Ecosystem Change
- E. Natural Biogeochemical Cycles

III. Population 10–15%
- A. Population Biology Concepts
- B. Human Population
  1. Human population dynamics
  2. Population size
  3. Impacts of population growth

IV. Land and Water Use 10–15%
- A. Agriculture
  1. Feeding a growing population
  2. Controlling pests
- B. Forestry
- C. Rangelands
- D. Other Land Use
  1. Urban land development
  2. Transportation infrastructure
  3. Public and federal lands
  4. Land conservation options
  5. Sustainable land-use strategies
- E. Mining
- F. Fishing
- G. Global Economics

V. Energy Resources and Consumption 10–15%
- A. Energy Concepts
- B. Energy Consumption
  1. History
  2. Present global energy use
  3. Future energy needs
- C. Fossil Fuel Resources and Use
- D. Nuclear Energy

E. Hydroelectric Power

F. Energy Conservation

G. Renewable Energy

VI. Pollution 25–30%

A. Pollution Types

1. Air pollution
2. Noise pollution
3. Water pollution
4. Solid waste

B. Impacts on the Environment and Human Health

1. Hazards to human health
2. Hazardous chemicals in the environment

C. Economic Impacts

VII. Global Change 10–15%

A. Stratospheric Ozone

B. Global Warming

C. Loss of Biodiversity

1. Habitat loss; overuse; pollution; introduced species; endangered and extinct species
2. Maintenance through conservation
3. Relevant laws and treaties

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

The AP Environmental Science Exam

The AP Environmental Science Exam consists of a multiple-choice and a free-response essay section. The total exam time is three hours, divided equally between the two sections. The multiple-choice section includes 100 questions and constitutes 60 percent of the final grade. It is 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 concepts. The free-response section emphasizes the application of principles in greater depth, requiring students to 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. The free-response section includes four essay questions constituting 40 percent of the final grade: one question is based upon a data set, one is a document-based question, and two are synthesis and evaluation questions.

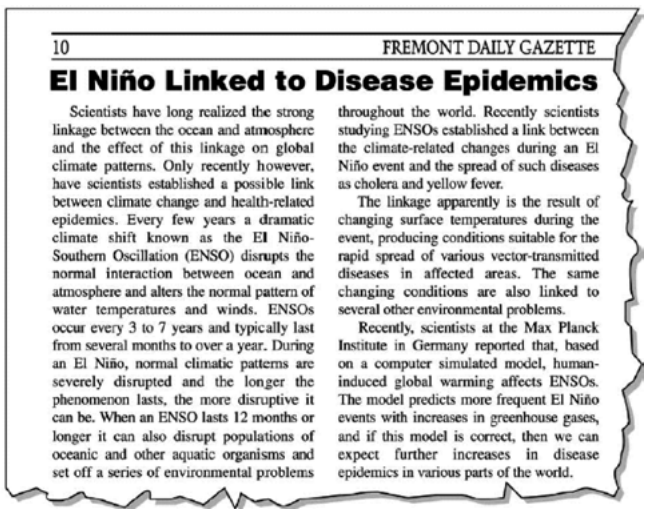
"Although the AP Environmental Science Development Committee believes that past exams have been effective assessment tools, the Committee decided a few years ago to begin writing tests that would more clearly emphasize conceptual understanding and would place less emphasis on the memorization of facts. We believe that we have been successful and that recent tests more accurately gauge the level of understanding expected of students in college courses."

—Fred Loxsom
AP Environmental Science Development Committee Chair
Endowed Chair in Sustainable Energy Studies
Eastern Connecticut State University

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

Question 1

Read the article below and answer the questions that follow.



10 FREMONT DAILY GAZETTE

El Niño Linked to Disease Epidemics

Scientists have long realized the strong linkage between the ocean and atmosphere and the effect of this linkage on global climate patterns. Only recently however, have scientists established a possible link between climate change and health-related epidemics. Every few years a dramatic climate shift known as the El Niño-Southern Oscillation (ENSO) disrupts the normal interaction between ocean and atmosphere and alters the normal pattern of water temperatures and winds. ENSOs occur every 3 to 7 years and typically last from several months to over a year. During an El Niño, normal climatic patterns are severely disrupted and the longer the phenomenon lasts, the more disruptive it can be. When an ENSO lasts 12 months or longer it can also disrupt populations of oceanic and other aquatic organisms and set off a series of environmental problems throughout the world. Recently scientists studying ENSOs established a link between the climate-related changes during an El Niño event and the spread of such diseases as cholera and yellow fever.

The linkage apparently is the result of changing surface temperatures during the event, producing conditions suitable for the rapid spread of various vector-transmitted diseases in affected areas. The same changing conditions are also linked to several other environmental problems.

Recently, scientists at the Max Planck Institute in Germany reported that, based on a computer simulated model, human-induced global warming affects ENSOs. The model predicts more frequent El Niño events with increases in greenhouse gases, and if this model is correct, then we can expect further increases in disease epidemics in various parts of the world.

(a) Describe what an El Niño is and clearly indicate where it occurs.

(b) Describe the connection between the climate change associated with an El Niño and the transmission of diseases. Explain whether the article is correct in its reporting of the various disease epidemics that occur in response to an El Niño.

(c) People in what part of the world would be most likely to be affected by this link between El Niño and disease?

(d) Clearly describe two other important environmental problems associated with ENSOs.

Question 2

Answer the questions below regarding the heating of a house in the Midwestern United States. Assume the following:

- The house has 2,000 square feet of living space.
- 80,000 BTUs of heat per square foot are required to heat the house for the winter.
- Natural gas is available at a cost of $5 per thousand cubic feet.
- One cubic foot of natural gas supplies 1,000 BTUs of heat energy.
- The furnace in the house is 80 percent efficient.

(a) Calculate the following, showing all the steps of your calculations, including units.

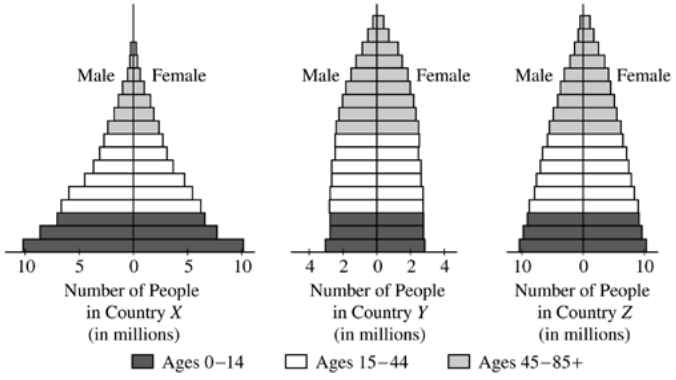
(i) The number of cubic feet of natural gas required to heat the house for one winter

(ii) The cost of heating the house for one winter

(b) Identify and describe three actions the residents of the house could take to conserve heat energy and lower the cost of heating the house.

(c) The residents decide to supplement the heating of the house by using a wood-burning stove. Discuss two environmental impacts, one positive and one negative, of using the wood-burning stove.

Question 3



The figures above show the age structures of human population in three countries, *X*, *Y*, and *Z*.

(a) Which of the three countries has the largest rate of population growth? Which has the smallest rate? Explain.

(b) Compare the infant mortality rates that are likely in Countries *X* and *Y*. Explain your reasoning.

(c) Describe the changes in both the birth rate and the death rate for a country making the transition from a preindustrial society to an industrial society.

(d) Describe one incentive that the government of a country could offer its citizens that would favor a reduction in the growth of its population. Explain how this incentive would work, and describe one possible drawback.

Question 4

Species such as the dusky seaside sparrow, the passenger pigeon, and the woolly mammoth are extinct. Populations of other species have declined to the point where they are designated as threatened or endangered.

(a) Identify one threatened or endangered species and explain why its population has declined.

(b) Describe three characteristics of organisms that would make them particularly vulnerable to extinction.

(c) Present three arguments in favor of the maintenance of biodiversity.

(d) Name and describe one United States federal law or one international treaty that is intended to prevent the extinction of species.

Question 5

Between 1950 and 2000, global meat production increased from 52 billion kilograms to 240 billion kilograms. During this period, the global human population increased from 2.6 billion to 6.0 billion.

(a) Calculate the per capita meat production in 1950 and 2000.

(b) Use the values from part (a) to calculate the change in global per capita meat production during this 50-year period as a percentage of the 1950 value.

(c) Discuss why it is more efficient to produce grain for human consumption than to produce meat for human consumption. In your answer, consider both land use and energy use.

(d) Describe TWO environmental consequences of the increase in production of meat for human consumption.

(e) Identify and explain one potential advantage and one potential disadvantage for human health of a diet that contains very little meat.

Question 6

Most of the coal mined in the United States today comes from surface (strip) mines. In surface mining, the vegetation, soil, and rock covering the coal (referred to as overburden) are removed and set aside. After the coal has been hauled away, good conservation practices require that the overburden be replaced and the surface be restored to its original condition. Land restoration may be diffi-

cult in some regions due to factors such as the local climate, the thickness of the coal seam, the extent of the overburden, and the sulfur content of the coal.

(a) Describe the steps that should be taken to restore the land after the overburden has been replaced.

(b) Explain why the restoration of the land would likely be more difficult in an arid climate (less than 10 inches of precipitation per year).

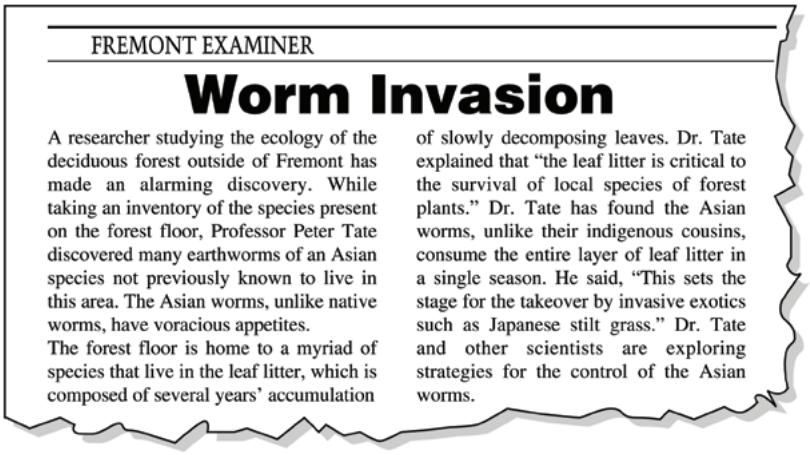
(c) Describe one environmental impact that the sulfur content of the remaining coal and the tailings would have on the reclamation process and suggest a possible remedy.

(d) Other than mining and reclamation, describe TWO environmental impacts of using coal for energy.

(e) Explain why per capita coal consumption in the United States is likely to increase.

Question 7

Read the article below and answer the questions that follow.



FREMONT EXAMINER

Worm Invasion

A researcher studying the ecology of the deciduous forest outside of Fremont has made an alarming discovery. While taking an inventory of the species present on the forest floor, Professor Peter Tate discovered many earthworms of an Asian species not previously known to live in this area. The Asian worms, unlike native worms, have voracious appetites.

The forest floor is home to a myriad of species that live in the leaf litter, which is composed of several years' accumulation of slowly decomposing leaves. Dr. Tate explained that "the leaf litter is critical to the survival of local species of forest plants." Dr. Tate has found the Asian worms, unlike their indigenous cousins, consume the entire layer of leaf litter in a single season. He said, "This sets the stage for the takeover by invasive exotics such as Japanese stilt grass." Dr. Tate and other scientists are exploring strategies for the control of the Asian worms.

(a) Support Dr. Tate's assertion that "the leaf litter is critical to the survival of local species of forest plants." Include in your discussion the roles of leaf litter in a deciduous forest ecosystem.

(b) Describe THREE abiotic changes that would be likely to result if the exotic worms consumed all the leaf litter in a single year.

(c) For one of the changes you identified in part (b), explain how the change could set the stage for the takeover of Japanese stilt grass or other exotic species.

(d) Design a controlled experiment to determine whether the worms, in fact, do change the forest ecosystem. Identify the environmental factor you will measure, and include the specific hypothesis you will test and the data you will collect.

How to Get Involved

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

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

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

Contact Us

National Office
Advanced Placement Program
45 Columbus Avenue
New York, NY 10023-6992
212 713-8066
E-mail: ap@collegeboard.org

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®, the PSAT/NMSQT®, and the Advanced Placement Program® (AP®). 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.

050081625