

# AP Environmental Science Syllabus

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The goal of the course is to help students develop an understanding of the natural world with particular attention to interactions and relationships between its components and human impact on them. Scientific principles, concepts and methodologies will be used to identify and analyze environmental problems, risks developing as a result of these problems, and possible solutions or prevention strategies. After taking this course, students should be equipped to make independent and informed decisions about the consequences of their actions on the environment, both as a citizen and a consumer.

**Textbook:** *Environment*, 5<sup>th</sup> Ed. by Raven and Berg, Harcourt College Publishers, 2006

## Unit 1 – Course Introduction and Sustainability

Students will learn the definition and importance of Environmental Science, sustainability, the Tragedy of the Commons, and the Scientific Method. They will begin to learn how to identify and analyze environmental problems, evaluate ecological and human health risks associated with these problems, and critically examine various solutions for resolving or preventing them. We will also discuss local plant and animal life, invasive species, personal, municipal, and non-municipal waste habits.

Videos, Activities and In-Class Assignments:

- Review of Summer Assignment (book reviews, find local plants and animals new to you, TED Talks and podcasts)
- Poverty – Hunger Banquet Activity
- What is THEORY (Darwin exhibit video)
- The Lorax
- Ecological Footprint
- Do Americans Use Too Much?
- The Story of Stuff
- Cane Toads video
- Experimental design activity - <http://www.thirteen.org/edonline/lessons/experiments/>

Labs, Simulations, and Field Activities:

- Grow Something You Can Eat (long term assignment)
- Tragedy of the Commons Sustainable Fishing Simulation
- Risk Perception
- Solid Waste Collection – *Students will quantify and analyze household solid waste and propose general strategies for reduction and recycling of solid waste.* [Molnar's Laboratory Investigations]
- Invasive Species walk

## Unit 2 – The Living World

### A. Ecosystems and Energy

Students will define ecology, describe ecosystems, and explain how energy is cycled through them.

Videos, Activities and In-Class Assignments:

- Ocean Food Webs
- Wolves: A Legend Returns to Yellowstone video
- Planet Earth: Pole to Pole video
- Case Study: "The Effects of Coyote Removal in Texas: A Case Study in Conservation Biology" - Helps students understand trophic level relationships and the role of keystone species. Students are required to interpret data that

are presented graphically and to predict how changes at one trophic level may affect populations and communities at other trophic levels. [[http://ublib.buffalo.edu/libraries/projects/cases/coyotes/coyotes\\_notes.html](http://ublib.buffalo.edu/libraries/projects/cases/coyotes/coyotes_notes.html)]

- Quantitative Analysis: Eating at a Lower Trophic Level – Students will calculate and compare human food needs at different trophic levels, using the data to construct a biomass pyramid and analyze the benefits and drawbacks of eating at lower trophic Levels on a global scale. [Molnar’s Laboratory Investigations]

Labs, Simulations, and Field Activities:

- Owl Pellet Dissection and Trophic Level Analysis

## B. Ecosystems and Living Organisms

Students will explain evolution by natural selection, distinguish between primary and secondary succession, and determine the importance of keystone species as ecological stabilizers. They will also explain symbiosis and distinguish among mutualism, commensalism, and parasitism and summarize the main determinants of species richness.

Videos, Activities and In-Class Assignments:

- CNN Planet in Peril video

Labs, Simulations, and Field Activities:

- Succession Analysis of Science Courtyard

## C. Biodiversity and Endangered/Threatened Species

Students will define and discuss the importance of biodiversity. They will contrast threatened, endangered, and extinct species, and list four characteristics common to many endangered species, describe four human causes of species endangerment and extinction and explain how invasive species endanger native species, and distinguish between conservation biology and wildlife management.

Videos, Activities and In-Class Assignments:

- CNN Planet in Peril video
- Endangered Species Flyer

Labs, Simulations, and Field Activities:

- Biodiversity – Why is it Important? Simulation
- Parking Lot Diversity (Shannon-Weiner Diversity Index)
- Leaf Litter Biodiversity (Berlese Funnels)

## D. Biogeochemical Cycles

Students will study the carbon, nitrogen, phosphorus, and hydrologic cycles and human effect on them.

Videos, Activities and In-Class Assignments:

- POGIL Nutrient Cycles Packet
- Robert Krulwich Carbon Cartoons
- Nitrogen Cycle Game

## E. Biomes

Students will define biome, briefly describe the nine major terrestrial biomes, and discuss human effects on each type. They will describe different types of aquatic ecosystems and the environmental factors and human behavior affecting them.

Videos, Activities and In-Class Assignments:

- Biome Book

- Biome Video Project

## Unit 3 – Agriculture

### A. Food

Students will contrast industrialized agriculture with subsistence agriculture and describe three kinds of subsistence agriculture. They will describe current food safety issues and describe the environmental impacts of industrialized agriculture and identify the potential benefits and problems with genetic engineering. They will contrast fishing and aquaculture and relate the environmental challenges of each activity.

Videos, Activities and In-Class Assignments:

- Organic Feud - *In this lesson, students examine possible pesticide exposure in their fruit and vegetable consumption. They then compile fact sheets exploring various organic food issues, interview their parents about the food choices they make for their children, and create and analyze a graph with the data from Pan UK's Pesticides News that describes a global increase in the use of pesticides and on what types of products the most pesticides are being used.* [<http://www.nytimes.com/learning/teachers/lessons/20030325tuesday.html>]
- Fresh the Movie
- Eyes of Nye GMO video
- Interactive Farming
- Case Study: “Farmville Future? CAFOs and Contamination” [National Center for Case Study Teaching in Science]

Labs, Simulations, and Field Activities:

- Grow Something You Can Eat (long term assignment)
- Supermarket Scavenger Hunt

### B. Pesticides

Students will distinguish among various types of pesticides, summarize the problems associated with pesticide use, including development of genetic resistance; creation of imbalances in the ecosystem; persistence, bioaccumulation, and biological magnification; and mobility in the environment, describe alternative ways to control pests, including cultivation methods, biological controls, reproductive controls, pheromones and hormones, genetic controls, quarantine, integrated pest management and irradiating foods, and briefly summarize the three U.S. laws that regulate pesticides.

Videos, Activities and In-Class Assignments:

- Case Study: “The Buzz about Colony Collapse Disorder: Causes, Effects, and Cures” [National Center for Case Study Teaching in Science]
- Case Study: “Kermit to Kermette? Does the Herbicide Atrazine Feminize Male Frogs?” [National Center for Case Study Teaching in Science]
- Case Study: “Pesticides: Can we do without them?” [National Center for Case Study Teaching in Science]

### C. Soil

Students will discuss the nature and properties of soil. They will examine its role in the environment and what can happen to plants and water resources if erosion or mineral depletion occurs, and define and describe sustainable soil use.

Labs, Simulations, and Field Activities:

- Soil Analysis – *Students will analyze a soil sample and remediate soil based on analysis. They will compare growth rate, taste, and other factors in crop samples from remediated and non-remediated soils.* [Molnar’s Laboratory Investigations]

## Unit 4 – Population

Students will explain the four factors that produce changes in population size and solve simple problems involving these changes and define biotic potential (intrinsic rate of increase) and carrying capacity and explain the differences between J-shaped and S-shaped growth curves. They will distinguish between density-dependent and density-independent factors that affect population size and give examples of Type I, Type II, and Type III survivorship curves and explain how highly developed and developing countries differ in population characteristics such as infant mortality rate, total fertility rate, replacement-level fertility, and age structure.

Videos, Activities and In-Class Assignments:

- Exponential Growth
- Examination of Population Reference Bureau's World Population Data Sheets
- Doubling Time
- World Population Growth – *Students will graph and mathematically analyze the rates of human population growth through history and project human populations into the future based on generalizations from various data sources for modern times.* [Molnar's Laboratory Investigations]

Labs, Simulations, and Field Activities:

- Bubble or Cemetery Data Survivorship – *Students will collect data to develop survivorship curves and age-sex population pyramids and predict characteristics of future populations based on sex, age, fertility, species life cycle, and other factors.* [Molnar's Laboratory Investigations]

Students will examine the effects of population size to hunger, natural resources, the environment, and economics, describe trends in the distribution of people in rural and urban areas, compare methods of several governments to slow population growth, and outline some of the steps governments and individuals can take to achieve global population stabilization.

Videos, Activities and In-Class Assignments:

- National Geographic: China's Lost Girls video
- Wide Angle: Time for School video
- Population Growth – *Students will complete a series of activities exploring the mathematical and environmental aspects of population growth. Using archived census and demographic data as well as up-to-the-minute population estimates from the U.S. Census Bureau, students will learn how to model population growth and study the implications of a changing population.*

## Unit 5 – Energy

### A. Fossil Fuels

Students will compare per-capita energy consumption in highly developed and developing areas, discuss the advantages, disadvantages, and environmental problems associated with coal, oil, and natural gas use, consider synfuels, and relate reasons for the US to develop a comprehensive national energy strategy.

Videos, Activities and In-Class Assignments:

- Personal Energy Use Audit – *Students will record and calculate approximate personal energy use in the home today and compare amounts, by-products, and dollar costs of competing fuels that are necessary to support personal energy consumption.* [Molnar's Laboratory Investigations]
- Kliowatt Ours video
- Who Killed the Electric Car? Video
- Energy Debate

### B. Nuclear Energy

Students will gain a comprehensive knowledge of nuclear power, including nuclear processes in general, specifically how mined uranium is used inside the reactor to produce heat and then electricity, how clean the process is compared to coal, how much it costs, and safety concerns associated with it.

Videos, Activities and In-Class Assignments:

- Energy Debate
- Nuclear Reactor Diagram

Labs, Simulations, and Field Activities:

- Pennium-123 – *Students simulate and plot radioactive decay.*  
[[http://www.ocrwm.doe.gov/info\\_library/program\\_docs/curriculum/unit\\_2\\_toc/15.pdf](http://www.ocrwm.doe.gov/info_library/program_docs/curriculum/unit_2_toc/15.pdf)]

### C. Renewable Energy and Conservation

Students will distinguish between active and passive solar energy and describe how each is used. They will contrast the advantages and disadvantages of solar thermal electric generation and photovoltaic solar cells in converting solar energy into electricity, describe two renewable energy sources that are not direct or indirect results of solar energy, and distinguish between energy conservation and energy efficiency and give examples of each.

Labs, Simulations, and Field Activities:

- Solar Absorption – *Students will design an experiment to calculate and compare the heat-absorbing capacities of various fluids under solar radiation, determine efficient applications and models for fluid solar-energy collectors based on experimental results, and compute heat absorption rates for passive solar materials.* [Molnar’s Laboratory Investigations]

## Unit 6 –Water Resources

Students will review the chemistry of a water molecule, describe the water cycle, identify problems due to flooding, lack of water, study both sides of water supply issues, and suggest conservation strategies. They will discuss how sewage is related to eutrophication, biochemical oxygen demand (BOD), and dissolved oxygen. They will contrast point source pollution and nonpoint source pollution and distinguish among primary, secondary, and tertiary treatments for wastewater and compare the goals of the Safe Drinking Water Act and the Clean Water Act. Finally, they will define soil pollution and briefly discuss the specific problem of salinization.

Videos, Activities and In-Class Assignments:

- Water Loss Drop by Drop – *Students will estimate household water loss from common leaks and extrapolate water loss to the surrounding community.* [Molnar’s Laboratory Investigations]
- Water Diversions – *Students will research the internet and other sources to analyze the effects of water diversions on surrounding ecosystems and human communities, then compare and contrast the problems and successes of various water diversions and describe possible remediation.* [Molnar’s Laboratory Investigations]
- Flow (video)
- A Civil Action

Labs, Simulations, and Field Activities:

- Water Quality Index – *Students will perform tests to determine the Water Quality Index (WQI) of a local body of water and perform follow-up WQI tests to establish an ongoing record and basis for possible water remediation.* [Molnar’s Laboratory Investigations]
- Tap Water Testing
- Eutrophication Lab

## Unit 6 – Land Resources and Use

### A. Minerals

Students will learn about the properties of minerals – types of ores, how they form, and how deposits are discovered and harvested. They will also consider the environmental impact of mining, global consumption patterns, and conservation strategies.

## B. Land Use and Urbanization

Students will review trends in land use across the United States. They will categorize and characterize natural areas, federal lands, wetlands, and agricultural lands. They will study deforestation, desertification, and threats to wetlands. They will define urbanization and describe trends in the distribution of people in rural and urban areas, describe some of the problems associated with the rapid growth rates of large urban areas and explain how cities are analyzed from an ecosystem perspective. They will describe brownfields, define suburban sprawl, and identify characteristics of an ideal sustainable city.

Videos, Activities and In-Class Assignments:  
Design a Sustainable City

## Unit 7 – Earth Science

Students will examine solar energy and its role in climate and atmospheric circulation, patterns of ocean circulation and its interaction with the atmosphere, weather versus climate, and plate tectonics.

Videos, Activities and In-Class Assignments:

- Atmospheric Structure
- Earth Science Fact Sheets
- Fundamental Topics in Meteorology – *Students complete a series of questions relating to pressure, air masses, and precipitation along fronts. At the end of each section students label weather maps illustrating each topic.*  
[[http://ww2010.atmos.uiuc.edu/\(Gh\)/guides/crclm/act/prs.xml](http://ww2010.atmos.uiuc.edu/(Gh)/guides/crclm/act/prs.xml)]

Labs, Simulations, and Field Activities:

- Specific Heat and Climate – *Compare the energy required to heat up water versus soil, relate collected data to climatic phenomena.* [Molnar’s Laboratory Investigations]

## Unit 8 – The Atmosphere

### A. Air Pollution

Students will list the major classes of air pollutants and describe their characteristics and effects. They will examine adverse health effects of specific air pollutants, summarize the effects of the Clean Air Act on air pollution, and contrast air pollution conditions in less developed countries.

Labs, Simulations, and Field Activities:

- Particulate Air Pollution – *Students will measure particulate matter locally and evaluate the data by EPA standards.*  
[Molnar’s Laboratory Investigations]

### B. Atmospheric Changes

Students will describe the greenhouse effect, list the five main greenhouse gases and discuss the ramifications of some of the potential effects of global warming, including rising sea level, changes in precipitation patterns, effects on organisms, effects on human health, and effects on agriculture. They will give examples of ways to alleviate and adapt to global warming. They will describe the different parts of the ozone layer, explain how ozone depletion takes place and relate some of the potential effects of ozone depletion.

Videos, Activities and In-Class Assignments:

- An Inconvenient Truth
- Evidence of Climate Change

Labs, Simulations, and Field Activities:

- CO<sub>2</sub> and Temperature
- Melting Sea Ice vs. Land Ice

- Expanding Oceans

## Unit 9 – Human Health & Environmental Toxicology

Students will examine the use of chemicals hazardous to human health

Videos, Activities and In-Class Assignments:

- Toxins in your home

Labs, Simulations, and Field Activities:

- Bloassay