

# AP Environmental Science Syllabus

## Course Overview

The AP environmental Course is designed to be the equivalent of a one-semester, introductory college course in environmental science. The AP Environmental Course adheres to the objectives set forth in the *Course Description for AP Environmental Science* which are 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 and preventing them.

All students in the course are required to have successfully completed a minimum of two science laboratory courses. They must maintain an organized laboratory data notebook, conduct laboratory activities while adhering to all laboratory safety rules, and submit laboratory reports. [C11] The curriculum is delivered through the use of lectures, research, reading of current events, Socratic discussions, laboratory activities, and field experiences. The students are assigned readings from the textbook, as well as case studies and articles on topic related to current environmental issues. Student knowledge is evaluated through the use of chapter test and quizzes, as well as essays. The essays are from former AP Exams, as well as teacher created. There is a required mid-term exam and the AP Exam. Extensive reviews are conducted after school and on Fridays, beginning the month prior to the exam.

## Textbook

G. Tyler Miller Jr., and Scott E. Spoolman *Living in the Environment: Principles, Connections, and Solutions. 16<sup>th</sup> Edition* (Pacific Grove, Calif.: Brooks/Cole, 2005)

## Resources

- Laboratory equipment and materials needed to conduct laboratory activities. In addition, the students have access to materials such as binoculars, seines, dip nets, measuring tapes, field flags, etc., for field experiences.
- LaMotte Kits
- Books
  - A copy of the textbook
  - Instructor's Guide for Miller's *Living in the Environment, 14<sup>th</sup> Ed.*
  - *Principles of Environmental Science: Inquiry and Applications 2<sup>nd</sup> Ed.* by William P. Cunningham and Mary Ann Cunningham.
  - Laboratory Investigations for AP\* Environmental Science By William Molnar
- Technology
  - Probe ware for data collection and analysis (Vernier, Lab Pro)
  - Apple laptops with Internet access for research.

## Course Outline

Note: Weekly schedule can vary depending on the Broward County school calendar.

### Weeks 1 and 2

#### Chapter 1: Environmental Problems, Their Causes, and Sustainability

- Lecture over
- Environmental History
- An overview of environmental problems, possible cause, sustainability, and environmental history. [C7]
- Introduction to the creation of the National Parks, and reserves.
- Introduction to conservation laws
- Introduction of the Rule of 70 and population growth [C3]
- **Case study:** China's New Affluent Consumers [C7]
- **Case Study:** The Environmental Transformation of Chattanooga, Tennessee
- **Case Study:** Also Leopold's Environmental Ethics
- **Film:** *Planet In Peril*
- Socratic discussion
- **Activity: Biological Footprint** [C8], [C10], [C11]

### Week 3 and 4

#### Chapter 2: Science, Ecological Principles, and sustainability

- Overview of Scientific Method, its applications in Environmental Science [C9]
- Positive and negative feedback, synergy
- Overview of Chemistry- Inorganic and Organic. Biogeochemical cycles [C8]
- Overview of Energy – [C5]
  - Law of conservation of energy
  - Electromagnetic spectrum and wavelengths
  - Nuclear energy
  - **Lab: Ecological Impacts of Rice Farming: Nutrient Cycles (Miller)** [C7], [C8], [C9], [C11]
  - **Core Case Study** – Carrying out a controlled scientific experiment
  - **Science Focus:** Easter Island: Some Revisions to a Popular Environmental Story
  - **Science Focus:** The Scientific Consensus over Global arming

### Weeks 5 and 6

#### Chapter 3: Ecosystems: What are They and How Do They Work

- Students answer the Critical Thinking Questions
- Biotic components of ecosystems [C3]
  - Trophic levels (examples in different aquatic and terrestrial ecosystems)
  - Limiting factors
- Abiotic factors of an Ecosystem [C1], [C8]

- Soil types, composition, soil profiles
- Biogeochemical cycles – Rock cycle, water cycle, carbon cycle, nitrogen cycle, sulfur cycle. [C1]
- **Lab: Comparison of Soil Profiles** [C11]
- **Lab: Using Detritus to Determine Arthropod Biodiversity in relation to Ecosystem Type, Miller** [C3], [C8], [C9], [C11]

## Week 7

### Chapter 4: Biodiversity and Evolution

- Evolution
- Pangea, and geologic and biologic history of the Earth
- Speciation – (geographic isolation), keystone and foundation species
- Biodiversity
  - **Case Study:** Why are Amphibians Vanishing
- Extinctions – mass, background, mass depletions, biological extinction [C3]
- Artificial selection, genetic manipulation
- Students answer the Chapter Review Questions at the web site for the book <http://biology.brookscole.com/miller16>
- **Lab: Evolution and Adaptation: Using Woolly Worms and Other Creatures to Simulate Natural Selection (Miller Lab # 9)** [C11], [C9], [C8], [C3]

## Weeks 8 and 9

### Chapter 5: Biodiversity, Species Interactions, and Population Control [C8]

- Natural selection
  - Limiting Factors
  - Community structure and species diversity [C3]
  - Types of species – native, nonnative, indicator, keystone or foundation
  - Symbiotic relationships – mutualism, commensalisms, parasitism
  - Predator-prey interactions
    - Defense mechanisms of prey – camouflage, chemical warfare, warning coloration, mimicry, deceptive look, deceptive behavior
    - **Science Focus:** Why Should We Care About Kelp Forests?
    - **Case Study:** Exploding White-Tailed Deer in the United States
  - Ecological succession [C7]
    - Primary
    - Secondary
  - Interconnections of organisms, interdependence. Precautionary Principle [C10]
  - Woolly Worm Lab
  - Population Growth – Logistic, and Exponential Growth
- Population Change Formula** = (Births + Immigration) – (Deaths + Emigration)

$$\% \text{ Population Change} = \frac{(\text{Births} + \text{Immigration}) - (\text{Deaths} + \text{Emigration})}{\text{Population Size}} \times 100$$

- Doubling of a population – **Rule of 70** [C9]
- Reproductive Patterns – r-species and k-species
- Principles of sustainability
  - Solar energy
  - Population control
  - Biodiversity
  - Nutrient recycling
- Critical Thinking Questions

## 2<sup>nd</sup> Nine Weeks

### Weeks 11 and 12

#### Chapter 6: The Human Population and Its Impact [C3]

- Factors affecting human population size - Birth rate, Death rate – Mortality, Immigration, emigration
- **Population change** = (births + immigration) – (deaths + emigration) [C9]

$$\% \text{ Population Change} = \frac{(\text{Births} + \text{Immigration}) - (\text{Deaths} + \text{Emigration})}{\text{Population Size}} \times 100$$

- Doubling of a population – **Rule of 70** [C9]
- Population age structure
- **Lab:** World Population Growth (Molnar #19) [C11], [C3], [C9]
- **Lab:** Global Population Trends (Molnar # 21) [C11], [C3], [C9]

### Week 13

#### Chapter 7: Climate and Terrestrial Biodiversity [C8]

- Review of weather systems
- Climate – climatic zones of Earth [C1]
  - Topography effects on climate
- Wind – low and high pressure systems
  - El Nino and La Nina and the world climatic effects
- Activity: On-line El Nino research at <http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/enso.shtml>
- Biomes – climates and life on land [C1], [C2]
- Desert
- Grassland
- Tundra
- Chaparral
- Forests
  - Deciduous
  - Evergreen Coniferous
  - Rain forest
- **Lab: Formation of Deserts (Molnar # 4) [C11]**

- Critical Thinking Questions

## Week 14

### Chapter 8: Aquatic Biodiversity

- Types of Aquatic Life Zones in fresh and marine ecosystems
- Salt water life zones
  - Estuaries, coral reefs, open ocean
  - Aquatic Biodiversity [C2]
    - Plankton
    - Nekton
    - Benthos
- Freshwater life zones –
  - Lakes, wetlands, rivers
  - Biodiversity
- Impact of human activity on aquatic ecosystems [C10]
  - Water pollution [C6], [C10]
  - Use and abuse – recreational, commercial (dams, dikes) [C4]
- **Field Experience:** Field trip to an estuary (Ann Kolb Nature Center) [8], [9], [C11]
- **Lab: Water testing, species count and identification** [C11], [C2], [C4], [C7]
- **Film: *Aquatic Ecosystems***  
*Water's Journey: The Hidden Rivers of Florida*, Karts Productions

## Week 15 and 16

### Chapter 9: Sustaining Biodiversity: The Species Approach

- Species Extinction – causes, remediation [C8], [C10]
- Habitat loss and degradation; nonnative species; poaching and hunting [C10]
- **Case Study:** The passenger Pigeon: Gone Forever
- On-line research on nonnative species such as Kudzu, the Asian Eel, *Lygodium*, and other species of interest to our area.
- **Case Study:** What has the Endangered Species Act Accomplished?
- **Ch. 27 and 28:** Environmental Laws; Global Environmental Policy, Environmental Groups. Environmental ethics
- Reconciliation ecology

## Week 17

### Chapter 10: Sustaining Terrestrial Biodiversity: The Ecosystem Approach [C2], [C8], [C9]

### Chapter 25: Environmental Worldwide views, Ethics, and Sustainability

- Public Lands in the United States (Parks, forests, natural reserves, conservation areas)
- Laws that protect them (Ch. 27-4)
- Organizations – private, and public (Ch. 27-5, 27-6)
- **Case study:** How should U.S. National Forests be managed? [C1], [C9]

- Tropical deforestation. Studies of Brazil and Colombia.
- **Activity:** research on the European Union (EU) Web site; its environmental regulations. Chapter 28: Compare EU regulations to those of the United States. [C7], [C5]

### 3rd Nine Weeks

#### Weeks 19 and 20

##### Chapter 11: Sustaining Aquatic Biodiversity

- Review of aquatic biodiversity
- Global water resources and use
- Fishing – techniques, over-fishing, aquaculture,
- Laws and treaties
- Protecting, sustaining, and restoring wetlands, rivers, coral reefs
- **Case Study:** Restoring the Florida Everglades
- **Case Study:** Can the Great Lakes survive Repeated Invasions by alien Species?
- **Field Experience:** Field trip to the Everglades National Park [C9], [C10], [C11]
- **Lab:** Water testing, species count and identification.
- Socratic discussion on topics of the chapters 11 and 12.
- **Test** over Chapters 11, 12, and 13; AP-like essay based on subject matter of chapters 11,12, and 13.
- **Films:** *Water's Journey Everglades: Currents of Change*, Karst Productions  
*Water's Journey Everglades: Restoring Hope*, Karst productions

#### Week 21 and 22

##### Chapter 12: Food, Soil, and Pest Management[C10]

- Green revolution
- Growing techniques
- Soil erosion and degradation
- Desertification
- Soil conservation methods [C10]
- Fertilizers
- Environmental impact
- Irrigation methods
- Fishing, over-fishing, aquaculture [C8], [C10]
- Governmental policies
- Pesticides – types and uses
- Pros and cons of pesticide use
- Pesticide regulation
- **Case Study:** How Successful have Pesticides been in Reducing Crop Losses in the United States. [C7]
- **Case Study:** Revisiting DDT – from Riches to Rags [C7], [C10]
- **Lab: Soil Analysis**, Investigation # 9, Molnar [C4], [8], [C9], [C11]

## Week 23

### Chapter 13: Water Resources

- Water Properties
- Fresh water resources – surface water and ground water [C1]
- Dams, reservoirs, aquifers
- Water use and diversion [C4]
  - Human consumption
  - Irrigation
  - Conservation methods
- **Case Study:** The Colorado River Basin – An Over-tapped Resource
- **Case Study:** China's Three Gorges Dam – A Controversial Project
- **Lab:** Percent composition of water on Earth. [C8], [C11]
- **Activity: Water Loss Drop by Drop**, Investigation #13, Molner [C1], [11]

## Week 24

### Chapter 20: Water Pollution [C6]

- Types of water pollution
- Sources of water pollution of streams, lakes, surface water, and ground water.
- Ocean pollution
- Drinking water quality
- Research at [www.sfwmd.gov](http://www.sfwmd.gov)
- Preventing and reducing water pollution
- Remediation
- **Case Study:** India's Ganges River: Religion, Poverty, and Health [C7]
- **Case Study:** Pollution in the Great Lakes: Hopeful Progress [C7]
- Selected Review Questions
- **Lab: Water Quality Index**, Investigation # 12, Molnar [C9], [C10], [C11]  
**This lab will be conducted after the AP Exam, as I could not fit it in due to lack of time.** The concepts were discussed.
- **Test Chapters 15 and 22**

## Week 25 and 26

### Chapter 14: Geology and Nonrenewable Mineral Resources [C1], [C5]

- Geologic processes – internal and external
- Rock Cycle
- Extracting mineral resources and effects on the environment

## Week 27

### Chapter 15: Nonrenewable Energy Resources [C1], [C5]

- Oil –types, availability, distribution, extraction, environmental impact
- Coal – types, extraction, environmental impact.
  - Case study of China today
  - [www.npr.org](http://www.npr.org)
- Natural Gas – availability, environmental impact

- Nuclear Energy – availability, environmental impact and consequences
- **Case Study: How Much Oil Does the United States Have?**
- **Case Study: The Yucca Mountain Storage Site for High-Level Radioactive Wastes.**
- **Film: Living Under The Cloud (Chernobyl),** Bullfrog Films

## Week 28

### Chapter 16: Energy Efficiency and Renewable Energy [C1], [C5]

- Ways to improve energy efficiency
- Producing electricity from water, wind, biomass, geothermal, hydrogen
- Sustainable Energy strategy
- Test Chapters 16, 17, 18
- **Case Study:** The Coming Energy-Efficiency and renewable-energy revolution.

## Week 29

### Chapter 17: Environmental Hazards and Human Health [C10]

- Risk, probability, and hazards
- Assessing chemical hazards
- Chemical and biological hazards.
- Diseases
- **Case Study:** Are Hormonally active agents a human threat?
- **Case Study:** The Global Tuberculosis Epidemic
- **Case Study:** HIV and AIDS [C7]
- **Case Study:** Malaria: A deadly Parasitic Disease That is Making A Comeback [C7]

## 4<sup>th</sup> Nine Weeks

## Week 30

### Chapter 18: Air Pollution [C6], [C10]

- Structure of the Atmosphere
- Outdoor and indoor air pollution
- Causes of pollution – industry, automobiles, natural (Radon gas)
- Photochemical and industrial smog
- Effects of air pollution on living organisms [C10]
- Prevention and reduction of air pollution
- Acid deposition
- **Case Study:** South Asia's Massive Brown Cloud –Chocking in China and India
- **Internet reading at [www.npr.org](http://www.npr.org) Climate Connections**
- Selected Chapter Review Questions

## Week 31

### Chapter 19: Climate Change and Ozone Loss [C1]

- Past climate changes



- Climate change and human activities
- Factors affecting the Earth's temperature
- Dealing with the threat of global warming [C10]
- Ozone depletion in the stratosphere
- Protecting the Ozone layer
- **Case Study:** Warning Signals from the Earth's Ice and Snow: Meltdowns are Underway
- **Film:** *Ice Island*, Karst Productions (**Will be shown after the AP Exam**)
- Selected Chapter Review Questions
- Quiz over Chapters 20 and 21

### Week 32

#### Chapter 21: Solid and Hazardous Waste [C10]

- Producing less waste
- Reduce, reuse, recycle
- **Case Study:** Is it Feasible to Recycle Plastics?
- Burning and burying solid waste
- Hazardous waste
- **Case Study:** A Black Day in Bhopal, India
- **Case Study:** Lead, Mercury, and Dioxins [C10]
- Hazardous waste regulation in the United States and in the world.
- Research at [www.epa.org](http://www.epa.org) and [http://europa.eu/pol/env/index\\_en.htm](http://europa.eu/pol/env/index_en.htm)
- Select Chapter Review Questions

**Chapter 22, 23, 24, and 25** were integrated throughout the curriculum. At the end of the course, a Socratic discussion will be used as an evaluation tool to determine the students' ability to discuss and support their views of environmental issues. Students will use their knowledge base, but will also have to research to be able to substantiate their arguments. This will be used instead of a final exam.

### Content Areas

**The course provides instruction in each of the following seven content areas C1 – C7, outlined in the course description, as well as C8 –C11.**

- [C1] **Earth Systems and Resources**
- [C2] **The Living World**
- [C3] **Populations**
- [C4] **Land and Water Use**
- [C5] **Energy Resources and Consumption**
- [C6] **Pollution**
- [C7] **Global Change**

- [C8] The course provides students with the scientific principles, concepts, and methodologies required to understand the interrelationships of the natural world. The curriculum draws upon various scientific disciplines.
- [C9] The course includes methods for analyzing and interpreting information and experimental data, including mathematical calculations.
- [C10] The course teaches students how to identify and analyze environmental problems, to evaluate the ecological and human health risks associated with these problems, and to critically examine various solutions for resolving or preventing them.
- [C11] The course includes a laboratory and/or field investigation component. A minimum of one class period or its equivalent per week is spent engaged in laboratory and/or field work.

### **Laboratory Activities**

1. ***Ecological Impacts of Rice Farming: Nutrient Cycles (Miller)***  
*[2 class periods]*  
Students weighed rice (not enriched) samples from different areas of the world, dried them in an oven for a period of two days, and re-weighed them to determine the amount of water that was removed in the process. The students proceeded to incinerate the desiccated rice samples to determine carbon content. This lab allowed the students to observe that natural resources are removed from an area with every crop, and how elements move throughout the cycles, and from one place in the world to another.
2. ***Biological Footprint [1/2 a class period]***  
Students determine their biological footprint at the website. This helps the students to visualize the negative impact that one individual can have on the environment and that they have control of that.
3. ***Comparisons of Soil Profiles [1/2 a class period]***  
Students observed soil profiles prepared by the instructor, as well as the individual components of the profile. They compare and contrast the profiles and try to determine what type of ecosystem/biome they come from. This introduces the students to concept that soils are different and prepares them for further examination of the topic.
4. ***Evolution and Adaptation: Using Woolly Worms and Other Creatures to Simulate Natural Selection. [1 class period]***  
Students go out in a field to try to collect the woolly worms of different colors, previously dispersed by the teacher. This activity allows the student to see the importance of an adaptation like camouflage, and the student calculates mathematically the advantage of such camouflage.
5. ***Using Detritus to Determine Arthropod Biodiversity in Relation to Ecosystem type [2 class periods]***

- Students measured, and marked of an area of the school, and each group selected a specific part of the area to survey. They collected soil and detritus from the area, and examined it in the lab. This lab helped the students to recognize the relationship between organism type and abundance, to specific habitat. Some of the reinforced concepts were taxonomy, biodiversity, population dynamics, soil types, and forestry. Students also had to use laboratory skills in setting up their equipment and using microscopes. Mathematical skills were used in the application of the Shannon-Weiner Diversity Index.
6. ***Formation of Deserts, Molnar [1/2 class period]***  
Students researched this activity on the Internet in class and completed it at home. This activity allowed the students to identify desert formation, and the role that cold-water currents, as well as geographic location, play in this.
  7. ***Water testing, species count, and species identification [2 class periods]***  
Using LaMotte test kits, the students ran a variety of water tests in the field at an estuary, and collected muck samples for lab study. Some of the tests were run using LaMotte Test kits, such as Phosphates, Nitrates, Dissolved Oxygen. Salinity, pH, Temperature, and Turbidity (Secchi Dish) were also conducted. This reinforced laboratory skills, as well as observational skills.  
The same tests were conducted on a fieldtrip to the Everglades with a follow-up the next day in the lab. [2 class periods]
  8. ***World Population Growth (Molnar #19) [1class period]***  
[www.census.gov/ipc/www/worldpop.html](http://www.census.gov/ipc/www/worldpop.html)  
***Global Population Trends (Molnar # 21)***  
[www.census.gov/ipc/www/idbpyr.html](http://www.census.gov/ipc/www/idbpyr.html)  
The students researched these activities on the Internet in class and completed the assignment at home. This activity reinforced the students' research skills and the application of mathematics skills in science.
  9. ***Soil Analysis (Molner #9) [2 class periods]***  
Students run several soil tests such as soil texture, moisture, percolation rate, porosity, and micro-invertebrate count. The students use skills that were previously learned to carry out their procedures and analysis of the results.
  10. ***Water Quality Index (Molner #12) This lab will be conducted after the AP Exam because of lack of time. Next year, it will be incorporated into the field trips.***  
Students will collect samples of water from a near-by canal and run a series of tests such as Dissolved Oxygen, Nitrates, Phosphates, Turbidity, etc., using Vernier probes and LaMotte test kits, as well as conventional methods.