

AP Environmental Science

Syllabus

The goal of this course is to provide students with the scientific principals, concepts, and methodologies to understand the interrelationships of the natural world, to identify and analyze environmental problems both natural and man-made, and to evaluate the risks associated with these problems and examine alternative solutions for resolving and/or preventing them. This syllabus is presented in the order it is taught.

Text

Living in the Environment, 14th Ed., by G. Tyler Miller, 2005

Supplemental Readings

The Cartoon Guide to the Environment by Larry Gonick and Alice Outwater

A Civil Action by Jonathan Harr

Encounters with the Archdruid by John McPhee

Ishmael by Daniel Quinn

Methods

Instruction consists mostly of discussions, demonstrations, lab work, lectures, and written assignments along with class projects and homework. Approximately one class period per week is devoted to hands-on lab experiments or real/virtual fieldwork. All lab and fieldwork activities require written lab reports. The students operate a for-profit school-wide recycling project throughout the year. They will also produce two movie reviews from an approved list of Environmental Science and Ecology commercial movies. Students participate in on-line activities associated with National Environmental Science Week and with Earth Day activities.

Unit 1--Humans and Sustainability: an overview

Chapter 1

Topic: Environmental Problems, their causes, and sustainability

General overview of the topics covered throughout the year.

- Group activity--What is Environmental Science? using the Hilda Taba model from the Joyce/Showers Models of Teaching
- Exponential Growth--A Toss of the Dice: Using random throws of the dice, students use this activity to simulate population growth of a species. Factors such as life span, birthrate, resource depletion, and population momentum are explored. Probability and statistics are introduced to the study of ecology. (30 minutes)
- Video: *The Lorax*
- Reading: *The Tragedy of the Commons* by Garrett Hardin. Class discussion and typed commentary on teacher-selected topics of the essay.

Chapter 2

Topic: Environmental History: Learning from the past

- A. How humans have adapted to and modified the environment
- B. Environmental History of the U.S.
 - Lab: Let's go fishing--Mark/Recapture Activity: Students sample, mark, and resample in order to use the Petersen Method to determine the fish population of a pond. (30 minutes)
 - Internet Activity: Top Environmental Concerns--Norman Mailer Study
 - Student Generated Timeline Presentations: Students work in small groups to produce an illustrated timeline that is then presented to the class with narration of why the group chose illustrations and icons as important benchmarks of the country's history. (out-of-class project with in-class presentation)

Test Chapters 1 and 2

UNIT 2--Science and Ecological Principals

Chapter 3

Topic: Science, Systems, Matter, and Energy

- A. The scientific method
- B. Nature's building blocks--a review of general Chemistry and Physics taught by the students using power point presentations.
- C. Different forms of energy and their importance in Environmental Science.
- D. Laws of matter and energy
 - Lab: Water Tension/Cohesion lab. Estimate the water capacity in a beaker by adding paper clips until the first drop of water spills over the side of the beaker. Students make estimates and then proceed to find the capacity at which beaker will hold volume by adding paperclips until the water spills. (20 minutes) Follow-up with full lab report.

Chapter 4

Topic: Ecosystems: What are they and how do they work?

- A. Populations, communities, food chains, and webs
- B. Ecological pyramids and productivity

C. Biogeochemical cycles--continuation of power point presentations from previous chapter adding the contents of this chapter.

- Lab: Build Chambered Biospheres using 2 liter soda bottles. Create living ecosystems with plants and animals to survive over the next three weeks as the chambers interact to simulate a complete ecosystem. (60-90 minutes)
- Reading/reaction paper: *The Value of Wildness* by Henry David Thoreau
- Lab: Predator/Prey lab--students use forks, knives and spoons to simulate the real world predator-prey phenomenon. The lab examines raw numbers as well as evolutionary adaptation. (30 minutes)

Test: Chapters 3 and 4

Chapter 5

Topic: Evolution and Biodiversity

- A. Micro and Macroevolution
- B. Niches--fundamental and realized, generalists and specialists
- C. Theories and misconceptions about evolution
 - Writing Lab--Students are taught the basics of editorial writing and use the writing process to produce an editorial on the origins of life.
 - Reading of the book *Ishmael* begins with six regularly scheduled chapter quizzes and a Socratic Seminar to culminate the novel study.

Chapter 6

Topic: Climate and Terrestrial Biodiversity

- A. Weather and climate--students interpret weather map prediction models and weather station data plot models to understand the recurring patterns of weather.
- B. Dynamics of the Atmosphere--composition and dynamics
- C. What are biomes and how do they differ?
 - Internet activity: Koppen's Climate Classifications related to species biomes (Homework)
 - Poster projects: biomes (out-of-class project)
 - Video: Biomes (United Streaming)

Chapter 7

Topic: Aquatic Biodiversity

- A. Saltwater life zones
- B. Freshwater life zones
 1. Eutrophication and overturn
 2. Characteristics of streams and rivers

Test: Chapters 6 and 7

Chapter 8

Topic: Community Ecology

- A. Nonnative or exotic species
- B. Indicator and keystone species
- C. Interspecific and intraspecific competition
- D. Competition and symbiosis
- E. Succession
 - Lab: Completion of the lab started in chapter 4 with the chambered biospheres with accompanying lab report. (students have been using the beginning of the class each period to record their data of the eco chambers.)
 - Lab: after school activity killing bush honeysuckle that has overrun our outdoor pond/ecology area. Required attendance on one of the days to chop (with chainsaw) the honeysuckle and paint the areas to prevent re-occurrence. (2 hours after school)
 - Video: *Cane Toads*
 - Computer Lab Activity: Keystone species assignment where students identify keystone species in each of the major biomes.

Chapter 9

Topic: Population Ecology

- A. Exponential versus logistical growth
- B. Biotic potential and environmental resistance
- C. Characteristics of r-strategists and k-strategists
- D. Survivorship curves
 - Lab: Computer Lab--students select 2 countries (one a developed and one a developing country) and compare their growth curves, reasons for growth, and problems associated with that growth. Students then explore and discuss how the populations are affected by natural and man-made disasters as well as social, economic and political changes. (45 minutes)
 - Reading/Reaction paper: *Native Americans Define the Natural Community* by Black Elk (homework)

Test: Chapters 8 and 9

Chapter 10

Topic: Applying population Ecology: The human population

- A. Zero population growth

- B. Fertility and death rates
- C. Age structure histograms
- D. Factors affecting population size, carrying capacity
- E. The demographic transition
 - Lab: Cemetery Demography. Using data from a local cemetery, students construct age-sex population pyramids and formulate ideas on factors that affected this particular sampling and how that may have related to the community or the country as a whole. (90-180 minutes)

Unit 3--Sustaining Biodiversity

Chapter 11

Topic: Sustaining Terrestrial Biodiversity: managing and protecting ecosystems

- A. Land use in the United States and the world, including laws to manage public lands
- B. Managing forests sustainability
- C. Managing tropical forests
- D. Sustaining national parks
- E. Gap analysis and ecological restoration
 - Reading: *Encounters with the Archdruid* accompanied by 3 quizzes and a summation paper at the end of the novel that compares the 3 subtexts and how the characters are portrayed in each.
 - Reading/Question Sheet: *The Value and Care of Parks* by Frederick Olmstead

Chapter 12

Topic: Sustaining Biodiversity: The species approach

- A. Effect of humans on biodiversity
- B. Estimation of extinction risks
- C. Instrumental ecological, economic, and intrinsic values of biodiversity
- D. Causes of extinction
- E. Laws and treaties to prevent extinction of species (national and international)
- F. Wildlife management
 - Video: NOAH's *Keepers of the Ark*
 - Lab: Species Extinction: A look at species that have recently become extinct, those on the endangered list, and what laws/practices are protecting them. (teacher generated lab--30 minutes)

Chapter 13

Topic: Sustaining Aquatic Biodiversity

- A. The Importance and human impact on marine and aquatic biodiversity
- B. Protecting and sustaining marine biodiversity

Test: Chapters 11, 12 and 13

Unit 4-Sustaining Environmental Quality and Energy Resources

Chapter 19

Topic: Risk, Toxicology, and Human Health

- A. Risks and hazards
- B. Toxicology
 - 1. Bioaccumulation and biomagnification
 - 2. Poisons
- C. Chemical Hazards
- D. Transmissible diseases
 - Special Project: After compiling the list of transmissible diseases from Miller and adding current diseases plaguing the population, students use a lottery to select "their" disease, research it thoroughly, and present a power point lesson to the class about the disease. The test on the material is taken entirely from the power point presentations (with teacher supplements)
- E. Risk Analysis
 - Parts per Million Lab: Students use watch glasses to dilute a toxic substance to acceptable parts per million (ppm) levels. Lab write-up required. (20 minutes)

Chapter 14

Topic: Food Resources

- A. Food production and nutrition
- B. Increasing Crop production
 - 1. Genetic Engineering
 - 2. Irrigation
- C. Meat Production --positive and negative effects
- D. Harvesting fish and shellfish
 - Virtual Computer Lab: Exploration of nutrition based on the USDA Web site. Also includes analysis of air born and food born pathogens. Extensive lab data sheet is required.
 - *Can the Growing Human Population Feed Itself* by John Bongaarts from Scientific American

Test: Test on chapter 19 and 14

Chapter 16

Topic: Geology and non-renewable mineral resources

- A. Geologic processes and plate tectonics
- B. Erosion and weathering
- C. Rocks, minerals and the rock cycle
- D. Soil formation and soil profiles
- E. Characteristics of soil and reading a soil triangle
- F. Soil erosion, desertification and salinization
 - Dry Lab: cut and paste map activity of the world plates, locations, fault lines and movement
 - Lab: rock specimens. Requirement to identify and categorize 24 hand specimens. Lab practical includes data sheet, classification of igneous, sedimentary and metamorphic rocks and a specimen quiz. (90 minutes)
 - Demonstration: soil samples/profiles/uses from Wards science lab kits
 - Virtual Computer Lab: Views the geologic process of convergent and divergent boundaries, subduction, transverse faults, convection currents, and geologic hot spots using the PBS online series *Savage Earth*, *The Earth at Work* by Kathy Svitil
 - Video: Rock Cycle (United Streaming)

Test: Chapter 16

Chapter 17

Topic: Nonrenewable energy resources

- A. Identifying, locating, and removing nonrenewable mineral resources
 - 1. Types of mining
 - 2. Environmental effects of mineral extraction
- B. Oil extraction, refining, and use
- C. Natural Gas
- D. Coal
- E. Nuclear energy
 - students (through a random draw) are assigned energy topic and make presentations to the class that cover the type of resource, its availability, cost factors, environmental impacts and outlook for the future. Many choose to use Power Point presentations with accompanying handouts, illustrations and graphics.
 - Video: *Nightline: ABC News*, Ted Koppel. Accountability of the Chernobyl disaster. Students then produce a typed paper answering five

questions pertinent to the video and European and world-wide impact of the disaster.

Chapter 18

Topic: Energy Efficiency and Renewable Energy

* student presentations on these topics continue as described in the previous chapter

- A. Energy efficiency and how to use it
- B. Solar Energy
 - 1. Passive Solar Energy
 - 2. Active Solar Energy
- C. Hydroelectricity
- D. Wind Power
- E. Biomass
- F. Solar-hydrogen
- G. Geothermal
- H. Micropower
 - Lab: Fossil Fuel lab--Personal Energy Audit and Energy Resource Comparison
 - Project: Renewable and Nonrenewable Energy Sources--Pros and Cons; benefits of attaining a national energy plan. (small groups/45 minutes)

Test: Chapter 17 and 18

Unit 5--Sustaining Environmental Quality and Natural Resources

Chapter 23

Topic: Pest Management

- A. Types of pesticides
- B. Pros and cons of pesticide use
- C. Pesticide treadmill and circle of poison
- D. Pesticide regulation in the United States
- E. Alternatives to the use of pesticides
- F. Integrated pest management
 - Reading and paper: Abstract from *Silent Spring* by Rachel Carson

Chapter 24

Topic: Solid and Hazardous Waste

- A. Municipal Solid Waste
- B. Hazardous Waste
- C. Reduce, reuse, recycle
- D. Detoxifying burning and exporting waste
- E. Land Disposal
- F. Laws regarding hazardous waste in the U.S.
 - Video: ABC News investigation into "midnight dumping" by Diane Sawyer
 - Field trip: Landfill and Solid Waste Management Facility (1/2 day)
 - Reading: *A Civil Action* by Jonathan Harr: book reading continues throughout the unit with chapter quizzes and Socratic Seminar as a culminating activity. Students are welcome to view the movie starring John Travolta on their own.
 - Take home lab: Toxins in the Home: a take-home inspection of toxic substances that may be avoided in the home. Information on proper disposal is included.

Test: Chapter 23 and 24

Chapter 20

Topic: Air Pollution

- A. Outdoor Air Pollution
 1. Photochemical smog
 2. Inversions
 3. Acid deposition
- B. Indoor air pollution
 1. Types and sources
 2. Effects on human health
- C. Solutions to air pollution
 - Video: *Race to Save the Planet: Only One Atmosphere*
 - Lab: Particulate Air Pollution: Students use Ward's kits to analyze outdoor air quality and petri dishes and Vaseline to search for indoor air particulates. (45 minutes)

Chapter 21

Topic: Climate change and Ozone loss

- A. Natural Greenhouse effect

- B. Global Climate change-global warming, El Nino, La Nina
- C. Possible solutions
- D. Ozone depletion
 - 1. Causes and chemical reactions
 - 2. Effects on human health
 - Lab: Heating and Cooling differences between land and water helps students understand the concept of sea breezes and land breezes and they affect climate and climate changes. (45 minutes) Full lab report write-up.
 - Video: *An Inconvenient Truth* by Al Gore followed by discussion and a written outline of the key points.

Test: Chapter 20 and 21

Chapter 15

Topic: Water resources

- A. Properties of water
- B. Types of fresh water
- C. Water Shortages
- D. Damming water and water transfer
- E. Desalination
- F. Irrigation
- G. Solutions to overuse of water
- H. Flooding and Floodplain management
 - Video: *The Power of Water* (National Geographic)

Chapter 22

Topic: Water Pollution

- A. Main types of water pollutants and how they are measured
- B. Point and non-point sources of pollution
- C. Stream pollution and oxygen-sag curves
- D. Groundwater pollution
- E. Ocean pollution
- F. Wastewater treatment
 - Lab: measuring water quality using Wards catalog water testing kits. Overall water quality is assessed. Complete lab report write-up required.
 - Field Trip: Wastewater treatment plant
 - Lab: Construction of wastewater treatment model and filtration and testing of wastewater
 - Field Trip: Okefenokee Swamp trip (optional) in conjunction with the AP Biology class

Test: Chapter 15 and 22
Unit 6--Sustaining Human Societies

Chapter 25

Topic: Sustainable Cities

- A. Urbanization and Urban Growth
- B. Urban Resources and Environmental problems
- C. Transportation
- D. Urban Land-Use planning and control
- E. Making urban areas more livable and sustainable

Chapter 26

Topic: Economics, Environment and sustainability

- A. Economic Resources and systems
- B. Pollution control and resource management
- C. Full-Cost pricing
- D. Reducing poverty to improve environmental quality

Chapter 27

Topic: Politics, Environment and Sustainability

- A. Political challenges for the 21st Century
- B. Developing environmental policy
- C. Environmental Law
 - Project: Political Activism project where students write letters to their congressmen about an environmental issue. Persuasive writing is taught in formatting the letters.
 - Case Study: National Resources Defense Council-U.S. law and policy on public lands and rivers, energy bills, and coastal areas

Chapter 28

Topic: Environmental Worldviews, ethics and sustainability

- A. Environmental worldviews in industrial societies
- B. Life-centered world views
- C. Living more sustainably

Test: Chapters 25-28

Review, practice and strategies for taking the AP Environmental Test