

AP ENVIRONMENTAL SCIENCE SYLLABUS

COURSE DESCRIPTION: This course is designed to be the equivalent of a one-semester introductory college course in environmental science. The goal of the course is to provide students with scientific principles, concepts and methodologies required to understand the interrelationships of the natural world, to identify and analyze environmental problems both natural and man-made, to evaluate the relative risks associated with these problems and to examine alternative solutions for resolving and/or preventing them. The course integrates laboratory work and fieldwork within the course content, and requires students to submit written laboratory reports that analyze and interpret data which is collected.

COURSE PREREQUISITES: Pass Biology with at least a B, pass Chemistry or take Chemistry concurrently; pass Algebra II and get approval from a Science teacher.

CLASS PROFILE: The maximum number of students enrolled in a section is 24. The class meets for 8 periods per week, with each period running for 45 minutes. There is a double laboratory period 3 times per week.

TEXT & RESOURCES:

Wright, Richard T. Environmental Science: Toward a Sustainable Future, (10th ed.). Upper Saddle River, NJ: Pearson Prentice Hall, 2008

Molnar, William. Apadvantage Laboratory Investigations: AP Environmental Science. Saddle Brook, NJ: People's Education, 2005.

Companion website: www.prenhall.com/wright

METHODS: Instruction consists of lectures, discussion, written assignments, cooperative group projects, Webquests, presentations with visual aids, web explorations, laboratory experiments and fieldwork. Written assignments include in-class responses, homework, research projects, laboratory reports and personal reflections. Students are expected to connect the recurring themes of sustainability, stewardship, sound science, ecosystem capital, public policies/politics, and globalization to content covered in each chapter.

ON-GOING PROJECTS:

1. Environmental Issues Journal is collected five times a year. Students read, summarize and respond to ten articles of their choice which relate to environmental science issues.
2. Participation in Project SEARCH. Students learn fundamentals of water quality monitoring and aquatic studies. Students utilize standard field techniques to collect and interpret data from a local river. Student data is submitted to the state's Department of Environmental Protection. Students visit a local river in the fall and spring, analyzing water on site and collecting benthic macro-invertebrates for analysis in the classroom laboratory. Students will analyze data collected to assess the water quality of the river.
3. Participation in the Connecticut River Salmon Association's project to restore Atlantic salmon populations in the Connecticut River basin. Students raise salmon eggs in a temperature-controlled environment beginning

mid-January. Each student creates a Microsoft Excel spreadsheet to record daily data, calculate cumulative developmental indices, and predict hatching and stocking dates for the salmon. Students collaborate to manipulate temperature setting(s) to best establish hatching and stocking dates that coincide with our academic calendar. Salmon are stocked in a tributary of the Connecticut River in late April. In addition to using technology and analyzing data to predict and manipulate hatch and release dates, students also use this project as a case study of issues associated with water diversion, species restoration and pros and cons of aquaculture.

TIMELINE FOR CONTENT:

Week 1	<u>Chapter 1</u>	<p>Introduction: Toward a Sustainable Future</p> <ul style="list-style-type: none"> a. Major global environmental trends of concern b. Strategic themes: sustainability, stewardship, sound science c. Integrative themes: ecosystem capital, policy/politics, globalization d. Summer assignment review <p><u>SCIENTIFIC METHOD LAB</u>: students will design and conduct an experiment using the scientific method</p> <p><u>TRAGEDY OF THE COMMONS LAB</u>: students perform a simulation about over-fishing to illustrate and analyze this concept</p>
Weeks 2 & 3	<u>Chapter 2</u>	<p>Ecosystems: What They Are</p> <ul style="list-style-type: none"> a. Ecosystem structure b. Global biomes c. Historical progression of human impact on ecosystems <p><u>ROCKY INTERTIDAL TRANSECT SURVEY</u>: students perform a field investigation using transect sampling methods and statistical analysis to calculate population diversity and to identify interactions amongst organisms within a community</p> <p><u>OWL PELLET DISSECTION LAB</u>: students will dissect owl pellets to identify different organisms consumed by this predator; students will use class data to construct a food web, to calculate the biomass contributed by each type of prey, and to perform a diversity analysis of the owl's habitat</p> <p><u>BIOME PROJECT</u>: students will research one specific biome and will present their findings to the class</p>
Weeks 4 & 5	<u>Chapter 3</u>	<p>Ecosystems: How They Work</p> <ul style="list-style-type: none"> a. Laws of thermodynamics b. Energy flow c. Biogeochemical cycles d. Human impact on cycles and energy flow <p><u>AQUATIC PRIMARY PRODUCTIVITY LAB</u>: students will examine the primary productivity in a pond-water ecosystem, over a series of days, and relate it to the metabolism of organisms within such a system</p> <p><u>BIOGEOCHEMICAL CYCLES DIAGRAMS</u>: students will diagram and explain the nitrogen, phosphorus, sulfur and carbon cycles</p>

Weeks 6 & 7

Chapter 4

Ecosystems: How They Change

- a. Population biology concepts
- b. Mechanisms of population equilibrium
- c. Evolution (natural selection, plate tectonics)
- d. Ecological succession
- e. Invasive species

PREDATOR-PREY POPULATIONS LAB: students simulate the capture of mice by predators to examine the population dynamics of predator-prey relationships

NATURAL SELECTION LAB: students simulate natural selection of the peppered moth population

PLATE TECTONICS ACTIVITY: students will plot key geologic events and correlate them to tectonic plate boundaries

Week 8

Chapter 5

The Human Population: Demographics

- a. Human population expansion and its cause
- b. Developed vs. developing nations
- c. Environmental and social impacts of population growth
- d. Human population dynamics

FIELDWORK: students will make their first visit to a local river for Project SEARCH; students will collect benthic macro-invertebrates, water samples for 5-day BOD, and measure abiotic factors to analyze water quality (DO, pH, temperature, turbidity, TDS, nutrients, etc.)

HUMAN POPULATION LAB: students use information from a local cemetery to collect, graph and analyze data on human life expectancy from 1880-1900 and from 1985-2005

VIDEO: *World in the Balance – The People Paradox*

Week 9

Chapter 6

Population and Development

- a. Demographic transition
- b. Factors affecting family size
- c. Strategies for development
- d. Social modernization and population size
- e. Cairo Conference

POWER OF THE PYRAMIDS WEB-BASED LAB: students will research, evaluate, compare and contrast population profiles in a developed and a developing nation of their choice; students will identify reasons the populations may change and how social and technological advances may help stabilize a growing population

ECOLOGICAL FOOTPRINT ACTIVITY: students will use a web-based survey to determine their ecological footprint, and then compare that to the footprint of a person living in a developing nation

VIDEO: *World in the Balance – China Revs Up*

Weeks 10 & 11

Chapter 7

Water: Hydrologic Cycle and Human Use

- a. Hydrologic cycle
- b. Human impact on hydrologic cycle
- c. Sources and uses of water
- d. Surface and groundwater issues

e. Water conservation and public policy

BENTHIC MACRO-INVERTEBRATE BIODIVERSITY LAB:

students use a taxonomic key to identify macro-invertebrates collected for Project SEARCH and use this data to calculate the Hilsenhoff Biotic Index of a river to determine its health

DISSOLVED OXYGEN AND WATER TEMPERATURE LAB:

students use the Winkler method to determine the amount of dissolved oxygen present in water samples of varying temperatures

HYDROLOGIC CYCLE DIAGRAM: students diagram and explain the hydrologic cycle

Weeks 12 & 13

Chapter 8

Soil: Foundation for Land Ecosystems

- a. Soil characteristics
- b. Formation of soil
- c. Degradation of soil
- d. Soil conservation

PHYSICAL AND CHEMICAL CHARACTERISTICS OF SOIL

LAB: students analyze, over a series of days, a soil sample from a residential vegetable garden to identify its physical and chemical characteristics; students will include organic methods and solutions for improving the quality of the soil in their formal laboratory report

Week 14

Chapter 9

The Production and Distribution of Food

- a. Major patterns of food production
- b. Genetic engineering of crops
- c. Patterns in food trade
- d. Hunger, malnutrition, and famine

COMPOSTING LAB: students set up a miniature compost pile and, over a series of weeks, examine the effect of different independent variables on its rate of decomposition

SALINIZATION LAB: students will design an experiment to investigate the effects of salt on seed germination

Week 15

Chapter 10

Wild Species and Biodiversity

- a. Value of wild species
- b. Saving wild species
- c. Biodiversity and its decline
- d. Public policy and protecting biodiversity

ENDANGERED SPECIES PROJECT: students research one endangered species and present their findings to the class

Week 16

Chapter 11

Ecosystem Capital: Use and Restoration

- a. Major systems and their value
- b. Ecosystems as natural resources
- c. Land conservation options
- d. Land use
- e. Biomes and ecosystems under pressure (forests, oceans, etc.)
- f. Public and private lands

CAPTURE-MARK-RECAPTURE LAB: students capture, mark, release and recapture organisms from a sample population to calculate the estimated population in a given area using the Lincoln-Peterson method; students then relate this to the concepts of fisheries and over-fishing

MINING SIMULATION LAB: students operate a simulated mine in order to make a profit while also protecting the environment; students then investigate and submit a report on economic, environmental and political issues associated with mining

Week 17 & 18

Chapter 12

Energy From Fossil Fuels

- a. Energy concepts
- b. Electrical power production
- c. Energy consumption
- d. Fossil fuel resources, exploitation and use
- e. Energy conservation and public policy

FOSSIL FUEL ENERGY LAB ACTIVITY: students perform a virtual lab which requires them to explore a site and drill for oil, while remaining within a predetermined budget

PERSONAL ENERGY AUDIT: students will calculate the amount of electricity that they use in their homes and design a plan to reduce their consumption; students will also investigate the links between electricity use and the effects on the environment

Weeks 19 & 20

Chapter 13

Energy from Nuclear Power

- a. How nuclear power works
- b. Advantages/disadvantages of nuclear power
- c. Reactor types
- d. Human health and radiation

EFFECTS OF RADIATION ON PLANT GROWTH LAB: students measure, over a series of days, the effects of ionizing radiation on the germination and growth of seedlings

DIAGRAM A NUCLEAR POWER PLANT: students draw a labeled diagram of a nuclear power plant and explain the functions of each structure found in the power plant

BEGIN ATLANTIC SALMON PROJECT

Week 21 & 23

Chapter 14

Renewable Energy

- a. Solar energy
- b. Indirect solar energy sources
- c. Renewable energy for transportation
- d. Additional renewable energy sources
- e. Advantages/disadvantages of each energy source
- f. Policies for a sustainable energy future

SOLAR COOKER LAB: students will design and conduct an experiment to investigate variables that contribute to the effectiveness of a solar cooker; variables include the shape of the collector, the shape of the food container, orientation of the collector, and surface area or color of the container

RENEWABLE ENERGY PROJECT: students research different types of renewable energy (including alternative transportation) and present their findings to the class

Week 22

MID-TERM EXAMS

Week 24

Chapter 15 Environmental Hazards and Human Health

- a. Hazards to human health
- b. Pathways of risk
- c. Risk analysis
- d. Risk assessment

EXAMINING LD-50 TOXICOLOGY LAB: students expose a living organism to different levels of various compounds to determine and graph the dose-response curve for each compound

Week 25 & 26

Chapter 16 Pests and Pest Control

- a. Chemical approach
- b. Alternative methods of pest control
- c. Socioeconomic issues in pest management
- d. Pesticides and public policy

PEST SIMULATION LAB: colored dots on cubes represent different pests and their allele genotypes; a percentage of the pest population is killed with a pesticide; students collect and analyze data for several generations as pests develop resistance and resurge; secondary pest outbreaks are also introduced

PEST PROJECT: students research one pesticide, its effects, case studies, and present their findings to the class

VIDEO: *Race to Save the Planet: Save the Earth—Feed the World*

Week 27 & 28

Chapter 17 Water Pollution and Its Prevention

- a. Water pollution: sources, types, criteria
- b. Eutrophication
- c. Wastewater management and treatment
- d. Public policy

WASTEWATER TREATMENT LAB: students purify a water sample using a miniature water treatment apparatus and analyze data to determine the effectiveness of their design

THERMAL AND CHEMICAL POLLUTION LAB: students will measure the population of algae as it is exposed to different chemicals and changes in temperature

COLIFORM IN WATER LAB: students will perform an experiment that tests for water pollution due to the presence of sewage or fecal waste, as indicated by the presence of *E. coli*; a variety of water sources will be tested

Week 29

Chapter 18 Municipal Solid Waste: Disposal and Recovery

- a. Types of MSW
- b. Waste to energy
- c. Disposal and reduction of MSW
- d. Public policy and waste management

SOLID WASTE AND RECYCLING LAB: students

create miniature landfills and, over a series of weeks, collect and analyze data to determine which solid waste materials are biodegradable, and to test the microbial degrading process
VIDEO: *Race to Save the Planet: Waste Not, Want Not*

Week 30

Chapter 19

Hazardous Chemicals: Pollution and Prevention

- a. Types of hazardous wastes
- b. Involvement with food chains
- c. Methods of treatment/disposal
- d. Cleanup of contaminated sites
- e. Pollution avoidance
- f. Public policy

CLEANING UP OIL SPILLS LAB: students use microbes to simulate biodegradation of an oil slick
SUPERFUND RESEARCH PROJECT: students research different Superfund sites and present their findings to the class

Week 31 & 32

Chapter 20

The Atmosphere: Climate, Climate Change, and Ozone Depletion

- a. Atmosphere, weather, latitude, and seasons
- b. Climate
- c. Global climate change
- d. Depletion of the ozone layer
- e. ENSO
- f. Public policy

GLOBAL WARMING AND GREENHOUSE EFFECT LAB: students will assemble miniature greenhouses to re-create possible causes and effects of global warming; students will investigate the effect of different surfaces on heat absorption and greenhouse gases and suggest possible solutions to reducing the greenhouse effect on our planet

VIDEO: *An Inconvenient Truth*: students will analyze information presented and determine scientific accuracy of the documentary

Week 33

Chapter 21

Atmospheric Pollution

- a. Major air pollutants and their sources
- b. Smog
- c. Acid deposition
- d. Indoor air pollution and noise pollution
- e. Control strategies
- f. Public policy

ACID RAIN AND ALGAE LAB: students measure the effect of acid rain on lake ecosystems by studying changes in algal diversity in “lakes” exposed to acid rain

ESTIMATING AIR POLLUTION GENERATED BY EVERYDAY ACTIVITIES LAB: students measure the concentration of several air pollutants found in the exhaust streams of cars using syringe pumps and professional gas detector tubes; students use data to calculate the mass of each air pollutant added to the atmosphere by each point source and identify the source that produces the most air pollution

Week 34 **Chapter 22 Economics, Public Policy, and Environment (VACATION)**

- a. Economics and public policy
- b. Resources and wealth of nations
- c. Pollution and public policy development
- d. Cost-benefit analysis
- e. Politics, the public, and public policy

Week 35 **Chapter 23 Sustainable Communities & Lifestyles**

- a. Urban sprawl
- b. Urban blight
- c. Transportation infrastructure
- d. Sustainable communities
- e. Lifestyle changes

FIELDWORK: students will release Atlantic salmon fry into a tributary of the Connecticut River; students will also measure abiotic factors of the tributary to analyze its water quality (DO, pH, temperature, turbidity, TDS, nutrients, etc.) and compare these results to field data collected for Project SEARCH

Week 36 **REVIEW FOR APES EXAM**

Week 37 **APES EXAM ON MORNING OF TUESDAY, MAY 13th**

Weeks 38, 39 & 40 **AFTER THE EXAM**

FIELDWORK: students will make their second visit to a local river for Project SEARCH

BENTHIC MACRO-INVERTEBRATE BIODIVERSITY LAB: students use a taxonomic key to identify macro-invertebrates collected from the second visit for Project SEARCH and use this data to calculate the Hilsenhoff Biotic Index of a river to determine its health; once students have completed this analysis, they will then compile their data from the fall and spring visits to determine the overall water quality of the river, and they will submit a written report to the state's DEP to communicate their findings

ECO-EVALUATION:

Part 1: each student will rely upon content learned and the recurring themes of this course to write a reflection paper that details the five environmental concepts/issues that interested the student most; for each concept/issue, the student will summarize what they learned, why it interested them, and how each has or will influence the decisions they make

Part 2: students will design and present a PowerPoint presentation that communicates three of the five concepts/issues they reflected upon in their paper