

AP[®] Environmental Science

Syllabus 2

The goal of this course is to provide students with the scientific principles, concepts, and methodologies to understand the interrelationships of the natural world, to identify and analyze environmental problems both natural and human-made, and to evaluate the risks associated with these problems and examine alternative solutions for resolving and/or preventing them.

Text

Living in the Environment, 12th Ed., by G. Tyler Miller.

Methods

Instruction consists mostly of lectures, discussions, demonstrations, and written assignments—including research projects, in-class assignments, and homework. Approximately one period per week is devoted to hands-on laboratory experiences or fieldwork. All lab and fieldwork requires a written report. [C11]

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

Unit 1

Chapter 1

Topic: Environmental Issues, Their Causes, and Sustainability

General overview of the topics covered throughout the year

- Lab: Exponential Growth—A Toss of the Dice: Using random throws of dice, this activity simulates 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. [C3]
- Video: *The Lorax*

C3— The course provides instruction in each of the seven content areas outlined in the Course Description: Population

Chapter 2

Topic: Environmental History

- A. How humans have adapted to and modified the environment
- B. Environmental history of the United States
 - 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 in a pond. [C3]
 - Internet Activity: Top Environmental Stories, 1970-2000
 - Video: *Race to Save the Planet: The Environmental Revolution*

Test: Chapters 1 & 2

Unit 2

Chapter 3

Topic: Science Systems, Matter, and Energy

- A. The scientific method
- B. Nature's building blocks—a review of general chemistry
- C. Different forms of energy and their importance in environmental science
- D. Laws of matter and energy
 - Lab: Effects of Radiation on Seed Germination and Growth—Students measure, over a series of days, the effects of three types of radiation on the germination and subsequent growth of the irradiated seeds. They then treat their data to statistical analysis in order to draw conclusions. [C9]

C9—The course includes methods for analyzing and interpreting information and experimental data, including mathematical calculations.

Chapter 4

Topic: Ecosystems: Components, Energy Flow, and Matter Cycling

- A. Populations, communities, food chains, and webs [C2]
- B. Ecological pyramids and productivity
- C. Biogeochemical cycles [C1]
 - Lab: What's in an Owl Pellet? Students gain insight into the habits and adaptations (such as sources and preferences of prey) of an apex predator by examining owl pellets.

C2— The course provides instruction in each of the seven content areas outlined in the Course Description: The Living World

C1— The course provides instruction in each of the seven content areas outlined in the Course Description: Earth Systems and Resources

Test: Chapters 3 and 4

Unit 3

Chapter 5

Topic: Evolution and Biodiversity: Origins, Niches, and Adaptation

- A. Micro- and macroevolution
- B. Niches—fundamental and realized, generalists and specialists
- C. Theories and misconceptions about evolution
 - Lab: Biodiversity in Leaf Litter: A Berlese funnel is used to collect organisms from leaf litter. Biodiversity is calculated using the Shannon-Weiner Diversity Index. [C9]

Chapter 6

Topic: Biogeography, Climate, Biomes, and Terrestrial Biodiversity [C1]

- A. Weather and climate

B. What are biomes and how do they differ?

- Internet Activity: Creating and Understanding Climatograms
- Project: Biomes
- Video: *The Rainforest* (National Geographic)

Test: Chapters 5 & 6

Unit 4

Chapter 7

Topic: Aquatic Ecology: Biodiversity in Aquatic Ecosystems [C1]

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

C1— The course provides instruction in each of the seven content areas outlined in the Course Description: Earth Systems and Resources

Chapter 8

Topic: Community Ecology, Structure, Species Interaction, Succession, and Sustainability [C1]

- A. Nonnative or exotic species
- B. Indicator species and keystone species
- C. Interspecific and intraspecific competition
- D. Competition and symbiosis
- E. Succession
 - Lab: Inter- and Intraspecific Competition: Students analyze the effects of population density on the growth of two plant species (radishes and collards) growing alone and in mixed species groups. Density and species composition are manipulated. The resulting biomasses of the two species are statistically analyzed. [C8]
 - Video: *Cane Toads*

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.

Test: Chapters 7 & 8

Unit 5

Chapter 9

Topic: Population Dynamics, Carrying Capacity, and Conservation Biology [C3]

- A. Exponential versus logistic growth
- B. Biotic potential and environmental resistance
- C. Characteristics of r-strategists and K-strategists

C3— The course provides instruction in each of the seven content areas outlined in the Course Description: Population

D. Survivorship curves

- Lab: Duckweed Population Growth Lab: Students observe the growth of duckweed, an aquatic floating plant, and how its growth rate yields a logistic curve, illustrating concepts of population growth rates, carrying capacity, and limiting factors (such as light, pH, etc.).

Chapter 11

Topic: The Human Population: Growth, Demography, and Carrying Capacity

[C3]

- Zero population growth
- Fertility and death rates
- Age structure histograms
- Factors affecting population size
- The demographic transition

- Lab: Power of the Pyramids—Constructing Age-Sex Histograms: Students use census data to construct age-sex population pyramids. Such pyramids, representing several countries in various stages of development, are discussed and compared. Students then explore and discuss how the population would be affected by factors such as natural and human-made disasters as well as social, economic, and political changes. [C10]
- Video: *The People Bomb*
- Video: *World Population (Zero Population Growth)*

C3—The course provides instruction in each of the seven content areas outlined in the Course Description: Population

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.

Test: Chapters 9 & 11

Unit 6

Chapter 22

Topic: Sustaining Wild Species [C10]

- Effect of humans on biodiversity
- Estimation of extinction risks
- Instrumental, ecological, economic, and intrinsic values of biodiversity
- Causes of extinction
- Laws and treaties to prevent extinction of species (national and international)
- Wildlife management
 - Project: Endangered Species
 - Video: *NOAH'S: Keepers of the Ark*

Chapter 23

Topic: Sustaining Terrestrial Biodiversity: The Ecosystem Approach

- A. Land use in the United States and the world, including laws to manage public lands [C4]
- B. Managing forests sustainably
 - 1. Types of tree harvesting [C10]
 - 2. Importance of fires
- C. Managing tropical forests
- D. Sustaining national parks
- E. Gap analysis and ecological restoration
 - Lab: Invertebrate Behavior

C4— The course provides instruction in each of the seven content areas outlined in the Course Description: Land and Water Use

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.

Test: Chapters 22 and 23

Unit 7

Chapter 10

Topic: Geology: Processes, Hazards, and Soils [C1]

- 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 [C4]
 - Lab: Soil Labs
 - Lab: Rocks and the Rock Cycle
 - Video: *Weathering and Soils: Earth Revealed*

C1— The course provides instruction in each of the seven content areas outlined in the Course Description: Earth Systems and Resources

Chapter 12

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 [C4]

Test: Chapters 10 and 12

Unit 8

Chapter 13

Topic: Water Resources [C4]

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

C4— The course provides instruction in each of the seven content areas outlined in the Course Description: Land and Water Use

Chapter 19

Topic: Water Pollution [C6]

- A. Main types of water pollutants and how they are measured
- B. Point and nonpoint sources of pollution
- C. Stream pollution and oxygen-sag curves
- D. Groundwater pollution
- E. Ocean pollution
- F. Wastewater treatment
 - Lab: Measuring Water Quality
 - Video: *Race to Save the Planet: Do We Really Want to Live This Way?*
 - Video: *Land of the Alligator* (National Geographic)
 - Field trip: Wastewater treatment plant
 - Field Trip: Okefenokee Swamp
 - APES, AP® Biology, Environmental Science

C6— The course provides instruction in each of the seven content areas outlined in the Course Description: Pollution

Chapter 24

Topic: Sustaining Aquatic Biodiversity [C1]

- A. Importance and human impact on marine and aquatic biodiversity
- B. Protecting and sustaining marine biodiversity
 - Lab: Macroinvertebrates as a Measurement of Water Quality: Students assess the health of local surface water samples by conducting an analysis of macroinvertebrate diversity.

C1— The course provides instruction in each of the seven content areas outlined in the Course Description: Earth Systems and Resources

Test: Chapters 13, 19, and 24

Unit 9

Chapter 14

Topic: Geologic Resources: Nonrenewable Mineral & Energy Resources [C5]

- 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

C5— The course provides instruction in each of the seven content areas outlined in the Course Description: Energy Resources and Consumption

Chapter 15

Topic: Energy Efficiency and Renewable Energy [C5]

- A. Energy efficiency and how to improve it
- B. Solar energy
 - 1. Passive solar energy
 - 2. Active solar energy
- C. Hydroelectricity
- D. Wind power
- E. Biomass
- F. Solar-hydrogen
- G. Geothermal energy
- H. Micropower
- I. Sustainable energy use
 - Lab: Fossil Fuel lab—Personal Energy Audit
 - Project: Renewable and Nonrenewable Energy Sources—Pros and Cons

Test: Chapters 14 and 15

Unit 10

Chapter 17

Topic: Air and Air Pollution [C3]

- A. Outdoor air pollution
 - 1. Photochemical and industrial smog

C3— The course provides instruction in each of the seven content areas outlined in the Course Description: Population

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: Measuring Automobile Pollutants

Chapter 18

Topic: Climate Change and Ozone Loss [C7]

- A. Natural greenhouse effect
- B. Global climate change
- C. Possible solutions
- D. Ozone depletion
 1. Causes and chemical reactions
 2. Effects on human health
 - Lab: Field Testing for Ozone: Schoenbein paper and a relative humidity Schoenbein scale are used to measure the concentration of ozone in the air. This is then compared to concentrations in other time periods and in other parts of the world's atmosphere.

C7— The course provides instruction in each of the seven content areas outlined in the Course Description: Global Change

Test: Chapters 17 and 18

Unit 11

Chapter 16

Topic: Risk, Toxicology, and Human Health

- A. Risks and hazards
- B. Toxicology
 1. Bioaccumulation and biomagnification
 2. Poisons
- C. Chemical hazards
- D. Transmissible diseases
- E. Risk analysis
 - Lab: Toxicology—Testing LD-50: Four kinds of cleaning solutions (sodium hypochlorite, quaternary ammonium compounds, vinegar, and borates), are analyzed to determine the lethal dose 50 percent for yeast. Students produce a dose-response curve as part of their report.

Chapter 20

Topic: Pesticides and Pest Control [C6]

- A. Types of pesticides
- B. Pros and cons of pesticide use
- C. Pesticide treadmill and circle of poison
- D. Pesticide regulations in the United States
- E. Alternatives to the use of pesticides
- F. Integrated pest management
 - Lab: Herbicide Toxicity: Students determine the toxic dose for the plant *Brassica rapa*.

C6— The course provides instruction in each of the seven content areas outlined in the Course Description: Pollution

Chapter 21

Topic: Solid and Hazardous Waste [C6]

- A. Municipal Solid Waste (MSW)
- B. Hazardous waste
- C. Reduce, reuse, recycle
- D. Detoxifying, burning, burying, and exporting waste
- E. Land disposal
- F. Laws regarding hazardous waste in the United States
 - Video: *Endangered Planet*

Test: Chapters 16, 20, and 21

Unit 13

Chapters 26, 27 And 28

Topic: Environment and Society

- Worked throughout the year as other topics are covered

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