

AP Environmental Science Syllabus

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Course Description

The AP Environmental Science course is a 36-week course designed to be equivalent to one-semester of introductory college course in environmental science. This course is designed as a rigorous science course with a strong laboratory component. Environmental Science is interdisciplinary, embracing a wide variety of topics from multiple science fields. The goal of the course is to provide students with the methods and scientific principles to identify and analyze both natural and human-made problems. They will also be able to evaluate risks, propose alternative solutions to problems, and learn how to prevent future issues.

Class size and Scheduling

Class size is approximately 25 students. The class periods are 50 minutes long each day. On average, a minimum of one period per week is generally scheduled for lab activities. Each semester consists of two nine week periods.

AP Environmental Science is open to students who have taken Biology, Chemistry, and Algebra II or higher. Many of the students are taking AP Biology or AP Chemistry at the same time.

Text

Living in the Environment: Principles, Connections, and Solutions, 16th Edition, G. Tyler Miller (Thomson Learning – Brooks/Cole)

Introduction Unit

Topic 1: Environmental issues, their causes, and Sustainability (Chapter 1)

- Description:
 - A. Living more sustainably
 - B. Population and economic growth
 - C. Resources and pollution
 - D. Ecological Footprint
- Lab: What's Your Ecological Footprint?
 - Students will use two different methods to calculate their own ecological footprint based on personal resource consumption and waste. Students will compare and contrast results and determine ways they can personally reduce their impact on the environment.
- Video: Endangered Planet
 - Students will examine how population growth and politics have influenced environmental science over time.

Test: Introduction Unit Test

Unit 1: Earth Systems and Resources (10-15% of the AP test)

Topic 1: Earth Science (Chapter 14)

- Description:
 - A. Geological time scale
 - B. Plate tectonic movement – earthquakes, volcanoes, and tsunamis
 - C. Seasons, solar intensity, and latitude
- Video: Wave the Shook the Earth (Nova)
 - Students will examine the plate tectonic movement that causes tsunamis and the devastating impact they can have on humans and ecosystems.

Topic 2: Soil and Soil Dynamics (Chapter 12 and 14)

- Description:
 - A. Rock cycle, formation and composition of rock types
 - B. Physical and chemical properties
 - C. Main soil types (horizons) – erosion, weathering, and other soil problems
 - D. Soil conservation methods

Topic 3: Atmosphere (Chapter 18 and 7)

- Description:
 - A. Composition and atmospheric structure/layers
 - B. Weather and climate
 - C. Atmospheric circulation and the Coriolis Effect
 - D. Atmospheric-oceanic circulation – El Nino Southern Oscillation
- Lab: Convection Currents
 - Students will explore how changes in temperature, cause changes in density and creates differences in pressure that spur wind movement. Students will relate this to ocean current and plate tectonic movement, all caused by the process of convection.

Topic 4: Global Water and Resource Use (Chapter 13 and 7)

- Description:
 - A. Freshwater – global water use and availability
 - B. Saltwater
 - C. Ocean Circulation

Test: Unit 1 Test (covers all 4 topics of Unit 1)

Unit 2: The Living World (10-15% of the AP Test)

Topic 1: The Ecosystem Structure (Chapter 3, 4, 5 and 7)

- Description:
 - A. Biological Population and communities
 - B. Ecological niches
 - C. Interactions among species – symbiotic relationships, interspecific and intraspecific competition
 - D. Types of species – keystone, indicator, native, and invasive species
 - E. Species diversity and edge effects
 - F. Major terrestrial and aquatic biomes
- Lab: What's in an ecosystem?
 - Students will create a mini-ecosystem (5m x5m) outside. Students will investigate all biotic and abiotic factors of the ecosystem. They will explore the various population and communities while scientifically classifying the organisms in their ecosystem.
- Project: Biome Presentations
 - Students will work in small groups (2-3 students) to present an assigned biome. Students will explain the defining characteristics of the biome, adaptations of the plants and animals and anthropogenic threats to the biome.

Quiz: Biome Quiz

Topic 2: Energy Flow (Chapter 3)

- Description:
 - A. Photosynthesis and Cellular Respiration
 - B. Food chain, food webs and trophic levels
 - C. Ecological pyramids – first and second law of thermodynamics
- Lab: Net Primary Productivity
 - Students will measure an area in a field (10cm x 10cm square) and remove 15 blades of grass from the area and weigh. Dry plant material in a drying oven for 48 hrs and weigh

record your answer. After 5 days go back to the same area and remove the same number of grass, weigh and dry for 48 hrs; weigh the dry material and subtract this mass by the first dry mass. The result is the amount of carbon that accumulated over 5 days.

Topic 3: Ecosystem Diversity and Natural Ecosystem Change (Chapter 4)

- Description:
 - A. Natural selection and artificial selection
 - B. Macroevolution and microevolution
 - C. Ecosystem services
 - D. Climate shifts, species movement and extinction rates
 - E. Ecological succession – primary and secondary, climax community
- Lab: Natural Selection – For the birds
 - Students will simulate the process of natural selection in 5 different populations of birds with different beak type. All groups will start with the same number of organisms. Based on the amount of food they capture, their population will get larger (most food caught) or smaller (least food caught.) Based on the results after 4 generations, students will determine which beak type is most well adapted for the current environmental conditions.

Topic 4: Natural Biogeochemical Cycles (Chapter 3)

- Description:
 - A. Carbon cycle
 - B. Nitrogen cycle
 - C. Phosphorous cycle
 - D. Water cycle
 - E. Law of conservation of matter
- Lab: Carbon Cycle Game
 - Students will have a game board and a set of directions. Students will determine where to go on the game board by the random flipping of two coins. Students will trace 15 complete cycles that start in the atmosphere and return to the atmosphere. Upon completion of the game board, students should be able to understand the most common pathways in the carbon cycle and how humans are impacting them.

Test: Unit 2 Test (covers all 4 topics of Unit 2)

Unit 3: Populations (10-15% of the AP Test)

Topic 1: Population Biology Concepts (Chapter 3 and 5)

- Description:
 - A. Population dynamics and carrying capacity - exponential verses logistic growth
 - B. Biotic potential and environmental resistance
 - C. Characteristics of r-strategists and K-strategists
 - D. Reproductive patterns and survivorship curves
- Lab: Predator – Prey Simulation
 - Students will simulate and analyze the interactions between a predator population of lynx and a prey population of snowshoe hares. Students will record data in a table and graph the results to show patterns (cyclical) and make predictions over several generations.
- Video: National Geographic: Strange Days on Planet Earth, Episode – Predators
 - Students will examine some of the problems that can arise in an ecosystem when the top level predators are removed from the environment.

Quiz: Moose and Wolves of Isle Royale

Topic 2: Human Populations (Chapter 6)

- Description:
 - A. Historical population sizes and distribution

- B. Fertility rates – total fertility rate and replacement level fertility
- C. Growth rates and doubling time (math calculations)
- D. Demographic transition
- E. Age-structure diagrams
- F. Strategies of sustainability
- G. Case Studies – China and India (national policies)
- Lab: Power of the Pyramids
 - Students will research an assigned country and explore population trends using www.Census.gov. Students will create an age-structure diagram based on the most recent census. Students will analyze and research what may be causing the trends and make future predictions of what the country will look like in the next 50-100 years.

Topic 3: Impacts of Population Growth (Chapter 12, 17 and 9)

- Description:
 - A. Hunger – undernourishment, malnourishment, and the accompanying health problems
 - B. Disease – HIV, malaria, tuberculosis, and diseases from contaminated drinking water
 - C. Loss of Biodiversity (6 factors) – HIPPCO – habitat loss, invasive species, population growth, pollution, climate change, overconsumption of resources
- Video: National Geographic: Strange Days on Planet Earth, Episode - Invaders
 - Students will examine cases from all over the world where invasive species have been introduced and discover the havoc they are causing on the native species and ecosystems.

Test: Unit 3 Test (covers all 3 topics of Unit 3)

Unit 4: Land and Water Use (10-15% of the AP Test)

Topic 1: Agriculture (Chapter 12)

- Description:
 - A. Feeding a growing population – human nutritional requirements
 - B. Types of agriculture – first and second green revolution
 - C. Genetic engineering, crop production, and genetically modified organism
 - D. Irrigation and problems that arise – waterlogging, desertification, salinization
 - E. Sustainable agriculture and irrigation methods
 - F. Controlling pests – types of pesticides
 - G. Costs and benefits of pesticide use
 - H. Alternatives to conventional chemical pesticides – integrated pest management
- Lab: Town Simulation
 - Each group of students will represent the town council and are responsible for making decisions about resource use. The goal is to make decisions to sustainably survive for 10 generations. Decisions about agriculture, industry, water use and energy consumption will determine if they can be sustainable. As the population grows, towns will have to decide how to become more sustainable through implementing conservation laws.

Topic 2: Forestry (Chapter 10)

- Description:
 - A. Tree plantations and old-growth forests
 - B. Forest fires – crown, ground, and surface fires
 - C. Forest management and sustainable forestry techniques
 - D. Deforestation
 - E. National forests

Topic 3: Rangelands (Chapter 10 and 12)

- Description:
 - A. Overgrazing and desertification

B. Rangeland management and federal rangelands

Topic 4: Other Land Use (Chapter 10 and 22)

- Description:
 - A. Urban land development – urban sprawl, urbanization and planned development
 - B. Transportation infrastructure – federal highway system, canals, and road less areas
 - C. Public and federal lands – wilderness areas, national parks, and wildlife refuges
 - D. Land conservation options – preservation, mitigation, remediation, restoration

Topic 5: Mining (Chapter 14)

- Description:
 - A. Mineral formation
 - B. Extraction – subsurface and surface mining
 - C. Global reserves

Topic 6: Fishing (Chapter 11 and 12)

- Description:
 - A. Types of fishing techniques and the impacts
 - B. Overfishing
 - C. Aquaculture

Test: Unit 4 Test (covering all 6 topics of Unit 4)

Unit 5: Energy Resources and Consumption (10-15% of the AP Test)

Topic 1: Energy Concepts and Consumption (Chapter 2)

- Description:
 - A. Energy forms – kinetic, mechanical, and electrical
 - B. Units and conversions – megawatts, kilowatts, watts
 - C. Math calculations and examples
 - D. Laws of thermodynamics
 - E. History – Industrial Revolution and exponential growth
 - F. Energy Crisis – present global energy use and meeting future energy needs

Topic 2: Nonrenewable Resources (Chapter 15)

- Description:
 - A. Coal
 - B. Oil
 - C. Natural Gas
 - D. Nuclear
- Lab: Nuclear Waste
 - Students will calculate the amount of waste stored at the local nuclear waste facility. They will compare that to the amount that can be stored at Yucca Mountain. They will assess the possible risk in transporting nuclear waste and what types of health problems can arise in the event of a nuclear accident.

Topic 3: Renewable Resources (Chapter 16)

- Description:
 - A. The importance of improving energy efficiency – in homes and cars
 - B. Hydroelectric energy
 - C. Solar energy – passive and active
 - D. Wind Energy
 - E. Biomass – solid and liquid (biofuels)
 - F. Geothermal energy
 - G. Hydrogen fuel
 - H. Sustainable energy strategy

- Lab: Water Diversions
 - This is a research-based lab done with the use of the internet and the textbook. Students will explore three case studies – the Aral Sea, the Colorado River, and the Salton Sea. They will investigate the cause of the problem and determine how the environment and humans in the region are being affected. They will also propose possible solutions to the water diversion problem.
- Project: Resource Reports
 - Students will work in small groups (2-3 students) to present an assigned nonrenewable or renewable resource. Students will explain the primary ways the resource is used and discuss extraction methods and technologies necessary for utilization. Students will include all the advantages and disadvantages of using that resource for energy.

Unit 6: Pollution (20-30% of the AP Test)

Topic 1: Air Pollution (Chapter 18)

- Description:
 - A. Structure and science of the atmosphere
 - B. Outdoor air pollution – major criteria air pollutants
 - C. Photochemical and industrial smog
 - D. Acid deposition – causes and effects
 - E. Heat islands and temperature inversions
 - F. Indoor air pollution
 - G. Effects of air pollution on living organisms and materials
 - H. Preventing and reducing air pollution – relevant laws and technological devices
- Lab: Air Pollution
 - Students will graph the concentration of nitrogen dioxide, sulfur dioxide, and suspended particulate matter in the United States from 1940-2000. They will analyze the trends and determine what may have caused levels to increase or decrease over time. They will also discuss the environmental and health problems these pollutants can cause.

Quiz: Air Pollution Quiz

Topic 2: Noise Pollution (Chapter 22)

- Description:
 - A. Sources
 - B. Effects
 - C. Possible control measures

Topic 3: Water Pollution (Chapter 20)

- Description:
 - A. Main types and sources of water pollutants and how they are measured
 - B. Point and nonpoint sources of pollution
 - C. Stream pollution and oxygen – sag curves
 - D. Cultural eutrophication
 - E. Ground water pollution
 - F. Ocean pollution – oil spills and dead zones
 - G. Water purification – septic tanks and sewage treatment facilities
- Video: National Geographic - Strange Days on Planet Earth, Episode – Troubled Water
 - Students will examine some of the various types of water pollution that are occurring all over the world – eutrophication, pesticide runoff, biomagnifications of mercury, groundwater contamination and ocean pollution. Students will see several indicator species that are signs that water pollution is present.
- Field Trip/Lab: Everglades Holiday Park – Science Eye

- Students spend the day as wildlife biologists exploring every aspect of the Everglades. They will conduct biodiversity transects on common (native and exotic) aquatic plant species. They will complete a quantitative water quality assessment measuring levels of nitrates, phosphates, hardness, and pH at four different sites. They will compare the sites and the proximity to human development to determine the causes of the polluted water. They will collect macro-invertebrates and use them as indicator species to determine the health of the ecosystem.

Topic 4: Solid and Hazardous Waste (Chapter 21)

- Description:
 - Types of waste – municipal solid waste, industrial waste and hazardous waste
 - Types of disposal – open dump, sanitary landfill, incineration, ocean dumping
 - Wasting resources – priority should be given to producing less waste
 - Eco-industrial revolution and selling services
 - Reuse, recycle, and compost
 - Hazardous waste – surface impoundment, hazardous waste landfill, deep well disposal
 - Regulations in the United States
 - Achieving a low-waste society
- Video: National Geographic: Strange Days on Planet Earth, Episode – Dirty Secrets
 - Students will examine some of the risks of landfills and disposal of trash in the oceans and the problems it can cause for humans and the environment.

Topic 5: Hazards to Human Health (Chapter 17)

- Description:
 - Risk analysis and hazards
 - Toxicology – bioaccumulation and biomagnifications
 - Dose-response relationships (LD-50)
 - Chemical hazards – acute and chronic effects

Test: Unit 6 Test (covers all 5 topics in Unit 6)

Unit 7: Global Change (10-15% of the AP Test)

Topic 1: Stratospheric Ozone (Chapter 19)

- Description:
 - Formation of stratospheric ozone
 - Ultraviolet radiation
 - Causes and effects of ozone depletion
 - Strategies to reduce ozone depletion – laws and treaties

Topic 2: Climate Change (Chapter 19)

- Description:
 - Greenhouse effect and greenhouse gases
 - Impacts and consequences of global warming
 - Reducing climate change – laws and treaties
- Video: National Geographic: Strange Days on Planet Earth, Episode – One Degree
 - Students will examine some of the changes that are taking place on earth from just a one degree change in temperature. They will explore what else could happen on the planet if we do not slow down global warming and climate change.

Topic 3: Loss of Biodiversity (Chapter 9, 10 and 11)

- Description:
 - Six factors – HIPPCO – habitat loss, invasive species, population growth, pollution, climate change, overconsumption of resources

- B. Maintenance through conservation – the species approach (research and legal), the ecosystem approach (sanctuaries and protected areas), managing wild populations (case study – overfishing)
- C. Ecological restoration – repairing damage to forests, rangelands, wetlands, and oceans
- D. Reconciliation ecology – the sharing approach
- Video: National Geographic: Strange Days on Planet Earth - Episode: Dangerous Catch
 - Students will explore the wide-ranging effects that overfishing can have on both terrestrial and aquatic ecosystems. They will also examine the disadvantages of aquaculture and learn about some of the newest methods being employed to make aquaculture more sustainable.

Unit 8: Review, Practice and Projects

- Review Description:
 - A. Students will spend one class period reviewing each of the above seven units.
 - B. Each student will take two full-length (4 essays, 100 multiple choice) practice tests.
 - C. All tests will be graded AP style.
 - D. After each test, students will complete a diagnostic guide to analyze the questions they missed. This will help the students to identify areas of weakness to better focus study time.
- AP Test: First Monday of AP testing – morning exam
- Project Descriptions: to be completed after the AP Test
 - A. Exotic Species: Wanted Poster (Individual Project)
 - Students will select an exotic species to research and present. They will create a “wanted” poster that presents the exotic as a “criminal.” They will include the place they were last seen, where they are currently hiding, and the details as to the crimes they have committed. Students will turn in an outline with their sources and present their poster to the class.
 - B. Environmental Science Scavenger Hunt (Group Project, 2-4 students)
 - Students will be given a list of 50 environmental terms. We will travel around the campus as a class as they search for items on the list. When they find an item on the list, they will create a specimen card identifying the species and take a picture with a digital camera or video camera. Students can present their results in a video or a slideshow. They must find an example of all fifty items.
 - C. Green Houses (Individual or Group Project)
 - Students will design an environmentally-friendly house. They should consider things that reduce or eliminate waste, water-conservation measures, and energy consumption and efficiency. They must include the advantages and disadvantages of each device or technique they implement in the design of their house. Students will present their home to the class. (This project can be done as a research paper, PowerPoint presentation, poster presentation, or construct a model of the house.)

Other Topics

- Worked in throughout the year as other topics are covered
 - A. **Chapter 25: Sustainable Cities**
 - B. **Chapter 26: Economics, Environment, and Sustainability**
 - C. **Chapter 27: Politics, Environment, and Sustainability**
 - D. **Chapter 28: Environmental Worldviews, Ethics, and Sustainability**