

AP Environmental Science Sample Syllabus

Topics and Timelines (Modified Block Schedule of four blocks per week=1-50 min, 2-80 min, 3-80 min, 4-50 min)

Textbook: Cunningham, *Environmental Science: A Global Concern* 14e (AP Edition)

Unit 1: Waste Management using Scientific Principles

Chapters:

- 2 – Principles of Science and Systems
- 21 – Solid, Toxic, and Hazardous Waste

Curriculum Coverage:

Scientific Method and Process Skills

Note: The following components are from the College Board requirements for AP Environmental Science Lab and Field Investigations. These components should be seamlessly added to every unit. All lab and field investigations should be rich, diverse, hands-on, inquiry-based, and apply to real world applications.

- Critically observe environmental systems
- Develop and conduct well-designed experiments
- Utilize appropriate techniques and instrumentation
- Analyze and interpret data, including appropriate statistical and graphical presentations
- Think analytically and apply concepts to the solution of environmental problems
- Make conclusions and evaluate their quality and validity
- Propose further questions for study
- Communicate accurately and meaningfully about observations and conclusions

Course Topics correlated with AP Course Outline:

VI. Pollution

A. Pollution Types

4. Solid waste: Types, disposal; reduction

B. Impacts on Environmental and Human Health

1. Hazards to Human Health: Environmental risk analysis, chronic and acute effects; dose-response relationships; air pollutants; smoking and other risks
2. Hazardous chemicals in the environment: types of hazardous wastes; treatment and disposal; biomagnification; relevant laws

C. Economic Impacts: Cost-benefit analysis; externalities; marginal costs; sustainability

Lecture and Discussion Topics:

The lecture and discussion topics can be addressed using traditional lecture with question and answer sessions during class, student-directed readings, or student-viewed video lecture (flipped classroom). All lecture and discussion topics should be reinforced with daily activities, hands-on activities, inquiry-based experiments and field investigations. It is encouraged that students participate in field trips to use their classroom knowledge in the field or industry.

Unit Topics:

Scientific Method and Process Skills

- Steps of the Scientific Method and its application.
- Define, describe and provide examples of positive and negative feedback mechanisms differentiate between precision and accuracy.
- Graph independent and dependent variables on graphing paper.

Municipal Solid Waste Management and its Effects

- Define and provide examples of MSW.
- Explain the benefits and drawbacks of sanitary landfill disposal and incinerators.
- Define and discuss the benefits and drawbacks of recycling, reusing, reducing, and composting. Categorize hazardous wastes and their disposal methods.
- Discuss how e-waste can be disposed of.
- Explain brownfields; define the terms bioremediation and phytoremediation.
- Identify chief legislation which regulates the disposal and cleanup of hazardous wastes and its history.
- Explain how a cost-benefit analysis may be applied to determine if pollution clean-up or pollution abatement is more feasible for a company.

Lecture Notes and AP Style Questions

Chapter 2 and 21 Lecture Powerpoint

Chapter 2 and 21 AP Teacher's Manual

Assessment: Exam consisting of 40 Multiple-choice questions with five answer choices, one free-response question emphasizing the AP style which includes a document based, data-set, and two evaluation questions. Appropriate questions can be found in the Test Bank, textbook Section Reviews, and the College Board.

Activities:

Student Preparation

1. Students should read Chapters 2 and 21 to become familiar with topics for the unit. By reviewing and answering questions from Chapter 2 and 21 Self Study and the Questions Bank, students will gain a strong understanding of potential test questions. The Self-Study also guides students through the more pertinent information that may appear on the AP exam.
2. Students can be assigned to read the *Case Study: Love Canal: The Forgotten Wastes*, and *Radioactive Decay* to gain a strong understanding of historical events that have led the US to specific legislative acts.
3. Students should complete the Section Reviews at the end of each section and AP Connections Review questions at the end of each Chapter. The questions will assist students to focus on the more pertinent topics. Completion of the Free-Response Questions is a superior method of preparing for the AP Exam. The answers can be peer-reviewed or scored to stress how point distribution is scored for each question.
4. Students should focus on the question stem. For example, using the terms define, describe, discuss, identify, explain, evaluate, compare, and contrast. The understanding of how to use these stems to answer questions will demonstrate how to write an effective response.
5. Know how to answer the descriptors within a question stem such as economic, ecological, biological, chemical, and ecosystem services.

Instructional Activities

1. Using *Lab: Exercise 22. Solid Waste Assessment from Field & Laboratory Exercises* 8th ed., students will collect their own municipal solid waste for a 24-hour period. Once all the MSW is collected, students will sort their waste into categories of waste and weigh out each category. The activity will also focus on analysis of how much waste each student would generate in one week, a month, and a year. In order to differentiate between plastic resin codes, students can also sort based on the various codes. Students should determine how closely their daily MSW compares to the nation.
2. *Decomposition Rates of Landfill Components*. Students create a model landfill to observe the decomposition rates of organic materials. Students are provided with a clear plastic cup to represent a model landfill. Each group uses a variety of organic materials to place in the model landfill is covered with soil. Everyday students measure the area of each material and record data in order to graph the rate of decomposition. Note: This lab should be set forth as an example to understanding the basic steps of the scientific method. A focus on how to create a hypothesis, tables, and graphs should be explored in order to develop basic process skills for future labs.
3. *Video*: Students can view the video Garbage “The Works” to better understand the steps of curbside pickup of MSW to its final stage of incineration.
4. *Video*: Students can also view the short called “Story of Stuff” from the website <http://storyofstuff.org/>. The video conveys how society has become a throwaway society and attempts to focus on how to become sustainable in the choices we make with regard to our purchases.
5. *Upcycling Project*: As a project, students can up-cycle items at home to demonstrate the repurposing of resources.

Unit 2: Terrestrial Ecology

Chapters:

- 3 – Matter, Energy and Life

Curriculum Coverage:

Course Topics correlated with AP Course Outline:

II. The Living World

- B. Energy Flow: photosynthesis and cellular respiration; food webs and trophic levels; ecological pyramids
- E. Natural Biogeochemical Cycles: Carbon, nitrogen, phosphorus, sulfur, water, conservation of matter

Lecture and Discussion Topics:

The lecture and discussion topics can be addressed using traditional lecture with question and answer sessions during class, student-directed readings, or student-viewed video lecture (flipped classroom). All lecture and discussion topics should be reinforced with daily activities, hands-on activities, inquiry-based experiments and field investigations. It is encouraged that students participate in field trips to use their classroom knowledge in the field or industry.

Unit Topics:

Matter, Energy, and Life

Diagram and explain the natural processes that occur in the hydrologic, carbon, nitrogen, phosphorus, and sulfur cycle.

- Discuss the how humans impact each cycle and the environmental impacts on each.
- Explain how the laws of conservation of matter applies to each cycle.
- Give examples of the four major organic molecules as they apply to each cycle.
- Analyze the significance of food chains, food webs, and ecological pyramids.
- Explain how the laws of thermodynamics applies to each in terms of energy flow and the 10% rule.
- Explain how photosynthesis and cellular respiration play a role in the flow of energy and matter in a food chain, food web, and ecological pyramids.
- Elaborate on the differences of gross and net productivity rates in various ecosystems. Calculate for the GPP and NPP of an ecosystem.
- Define the terms: matter, atoms, molecules, ions, and isotopes.
- Differentiate between potential, kinetic, chemical, and thermal (heat) energy.

Chapter 3 Lecture Powerpoint

Chapter 3 AP Teacher's Manual

Assessment: Exam consisting of 40 Multiple-choice questions with five answer choices, one free-response question emphasizing the AP style which includes a document based, data-set, and two evaluation questions. Appropriate questions can be found in the Test Bank, textbook Section Reviews, and the College Board.

Activities:

Student Preparation

1. Students should read Chapter 3 to become familiar with topics for the unit. By reviewing and answering questions from Chapter 3 Self Study and the Questions Bank, students will gain a strong understanding of potential test questions. The Self-Study also guides students through the more pertinent information that may appear on the AP exam.
2. Students can be assigned to read the *Case Study: Chesapeake Bay: How Do We Improve on a C* found on pp 50-51 of the textbook.
3. Students should complete the Section Reviews at the end of each section and AP Connections Review questions at the end of each Chapter. The questions will assist students to focus on the more pertinent topics. Completion of the Free-Response Questions is a superior method of preparing for the AP Exam. The answers can be peer-reviewed or scored to stress how point distribution is scored for each question.

Instructional Activities

1. *Food Chain Building.* Using sidewalk or marker chalk, students build a food chain with five trophic levels illustrating the change in energy flow from producer to top consumer.
2. *Relay Rice.* Students simulate the movement of energy by using rice as an energy source. Divide students into two groups. Organized groups from tallest to the shortest and spread out arms' length. The first person of each team receives a hand-full of rice. Each group represents a food chain. Measure the volume of rice before the race and record the data. Students will pass the rice to the next person until it reaches the last person in the food chain. Record volume of rice from the last person. Calculate the net loss or rice/energy for each food chain. Discuss how the laws of thermodynamics can

be applied to each simulated food chain.

3. Students work on *Lab Exercise 1 Primary Productivity from Lab and Field Exercises 8th ed.* Students will determine how light and temperature directly impact the amount of dissolved oxygen in an aquatic system. Once data has been collected, students will calculate the net primary productivity of aquatic producers in the various manipulated variable and compare their results. The results should be related to how human activities can impact the productivity rates of producers.
4. *Chalk Cycles.* Using sidewalk or marker chalk, student diagram the steps of the major biogeochemical cycles with focus on the natural and anthropogenic sources, processes, and negative impacts of each nutrient.

Unit 3: Populations, Communities, and Evolution

Chapters:

- 4 – Evolution, Biological Communities, and Species Interactions

Curriculum Coverage:

Course Topics correlated with AP Course Outline:

I. Earth Systems and Resources

- A. Earth Science Concepts: Geological Time Scale

II. The Living World

- A. Ecosystem Structure: Biological populations and communities, ecological niches, interactions among species; keystone species; species diversity and edge effects
- C. Ecosystem Diversity: Biodiversity, natural selection; evolution; ecosystem services
- D. Natural Ecosystem Change: Climate shifts; species movement, ecological succession

Lecture and Discussion Topics:

The lecture and discussion topics can be addressed using traditional lecture with question and answer sessions during class, student-directed readings, or student-viewed video lecture (flipped classroom). All lecture and discussion topics should be reinforced with daily activities, hands-on activities, inquiry-based experiments and field investigations. It is encouraged that students participate in field trips to use their classroom knowledge in the field or industry.

Unit Topics:

Populations, Communities, and Evolution

- Describe the level of ecological hierarchy using the terms: species, population, community, ecosystem, and biome.
- Discuss the difference between habitat and niche.
- Describe types of competition and purposes of inter and intraspecific competition and how this applies to generalized and realized niches.
- Analyze the role of and provide examples of keystone, invasive, and indicator species in an ecosystem.
- Categorize organisms' symbiotic relationships as parasitism, mutualism, and/or commensalism

- Contrast and compare the stages of primary and secondary succession using examples in terrestrial ecosystems. Explain how climax communities form in an ecosystem.
- Provide evidence of evolution and the process of evolution.
- Explain how natural selection, gene flow, mutation, and genetic drift can contribute to the evolution of a species.

Lecture Notes and AP Style Questions

Chapter 4 Lecture Powerpoint

Chapter 4 AP Teacher's Manual

Assessment: Exam consisting of 40 Multiple-choice questions with five answer choices, one free-response question emphasizing the AP style which includes a document based, data-set, and two evaluation questions. Appropriate questions can be found in the Test Bank, textbook Section Reviews, and the College Board.

Activities:

Student Preparation

1. Students should read Chapter 4 to become familiar with topics for the unit. By reviewing and answering questions from Chapter 4 Self Study and the Questions Bank, students will gain a strong understanding of potential test questions. The Self-Study also guides students through the more pertinent information that may appear on the AP exam.
2. Students can be assigned to read the *Case Study: Natural Selection in the Galapagos Islands* found on pp 73-74 in the textbook.
3. Students should complete the Section Reviews at the end of each section and AP Connections Review questions at the end of each Chapter. The questions will assist students to focus on the more pertinent topics. Completion of the Free-Response Questions is a superior method of preparing for the AP Exam. The answers can be peer-reviewed or scored to stress how point distribution is scored for each question.

Instructional Activities

1. Students work on *Lab Exercise 2 Habitat and Niche from Lab and Field Exercises 8th ed.* to describe how species live in various niches and provide examples of terrestrial organisms. To identify various abiotic and biotic factors that may limit the distribution of a species. Apply the terms generalist and specialist species to collected data sets.
2. Students work on *Lab Exercise 3 Community Structure from Lab and Field Exercises 8th ed.* to use quadrant sampling methods to study communities. Students will calculate for density, frequency, and relative frequencies of species in each community to determine which species of plants are dominant in a community. Using their quadrants, students will identify each community as clumped, random, or uniformly distributed.
3. *Mark and Recapture Simulation.* Using M&Ms or cracker goldfish, students use random sampling and mark and recapture methods to estimate the size of a population. Discuss the benefits and drawbacks of using these population sampling methods such as estimate only, lost marker, death/birth and migration.
4. *Succession at the High School.* Students take photographs of the stages of primary and secondary succession from their school grounds to create a storyboard or video of the stages of succession. A brief summary of the characteristics of each stage should be provided with each storyboard or video.

5. *Video Clips.* View clips from National Geographic “Invaders” that provides examples of how invasive species are introduced and can harm natural ecosystems. As an extension, students can research an invasive species to identify the biological, ecological, and economical impacts on the environment. Students can present their findings with a Most Wanted format.
6. *Geologic Timeline.* Students create a Timeline of Geological Events by labeling each era, events, and organisms found in each era. The work can be done as a group with students organizing tasks to be accomplished by individual members. The timeline should include when the major categories of life appeared with reference to the major eons/ eras (archaeon, Proterozoic, Paleozoic, Mesozoic, and Cenozoic eons).
7. *Natural Selection with Beans.* To demonstrate natural selection, students can use a variety of beans and tools to determine which bean species is more successful based on its selection pressure after several generations.

Unit 4: Biomes, Biodiversity, and Land Management

Chapters:

- 3 – Matter, Energy, and Life
- 11 – Biodiversity: Preserving Species
- 12 – Biodiversity: Preserving Landscapes
- 13 – Restoration Ecology

Curriculum Coverage:

Course Topics correlated with AP Course Outline:

I. Earth Systems and Resources

- A. Earth Science Concepts: Seasons; solar intensity; and latitude
- B. The Atmosphere: atmospheric circulation and the Coriolis effect; atmosphere and ocean interactions; ENSO

II. The Living World

- A. Ecosystem Structure: Species diversity and edge effects; major terrestrial biomes

IV. Land and Water Use

- A. Forestry: Tree plantations; old growth forests; forest fires; forest management, national forests
- C. Rangelands: Overgrazing; deforestation; desertification; rangeland management; federal rangelands
- D. Other Land Use
 3. Public and federal lands: management; wilderness areas; national parks; wildlife refuges; forests; wetlands
 4. Land conservation options: Preservation; remediation; mitigation; restoration
 5. Sustainable land-use strategies
- G. Global Economics: Tragedy of the Commons, relevant laws and treaties

VII. Global Change

- C. Loss of Biodiversity
 1. Habitat loss; overuse; pollution; introduced species; endangered and extinct species;
 2. Maintenance through conservation
 3. Relevant laws and treaties

Lecture and Discussion Topics:

The lecture and discussion topics can be addressed using traditional lecture with question and answer sessions during class, student-directed readings, or student-viewed video lecture (flipped classroom). All lecture and discussion topics should be reinforced with daily activities, hands-on activities, inquiry-based experiments and field investigations. It is encouraged that students participate in field trips to use their classroom knowledge in the field or industry.

Unit Topics:

Terrestrial Biomes and Adaptations

- Characterize terrestrial biomes based on their abiotic and biotic factors.
- Use a global map and air circulation patterns to locate these terrestrial biomes.
- Discuss significant environmental threats for each terrestrial biome based on its individual resources.
- Create a climatogram of the major terrestrial biomes and identify the biome indicative precipitation and temperatures.
- Provide reasons why plants and animals have specific adaptations for each biome.

Biodiversity and Sustainability

- Describe biodiversity and differentiate between the terms: genetic, biological, and ecological diversity.
- Evaluate the significance of protecting biodiversity for humans.
- Describe the major threats to the world's biodiversity using the acronym, HIPPCO.
- Identify national and global legislation set forth to protect biodiversity. Express challenges in upholding these laws.
- Provide examples of endangered species, their decline, and recovery.

Forest Harvesting and Management

- Describe types of forests within each biome and where there are 'hot spots' of biodiversity. Differentiate between the various logging methods used to harvest timber.
- Discuss how habitat fragmentation can lead to the endangerment or loss of a species.
- Explain steps the US has taken to preserve these environments.
- Provide significant historical evidence of US ecological restoration.
- Differentiate between restoration, reclamation, recreation, rehabilitation, and remediation. Discuss how the following biomes have been restored: prairies, forests, chaparrals or fire-based, wetlands, and streams.
- Provide specific examples of how humans have destroyed these environments and how they have been protected or restored.

Lecture Notes and AP Style Questions

Chapters 3, 11, 12, and 13 Lecture Powerpoint

Chapters 3, 11, 12, and 13 Teacher's Manual

Assessment: Exam consisting of 40 Multiple-choice questions with five answer choices, one free-response question emphasizing the AP style which includes a document based, data-set, and two evaluation questions. Appropriate questions can be found in the Test Bank, textbook Section Reviews, and the College Board.

Activities:

Student Preparation

1. Students should read Chapter 3, 11, 12, and 13 to become familiar with topics for the unit. By reviewing and answering questions from Chapter 3, 11, 12, and 13 Self Study and the Questions Bank, students will gain a strong understanding of potential test questions. The Self-Study also guides students through the more pertinent information that may appear on the AP exam.
2. Students can be assigned to read the *Case Study: Restoring Coral Reefs and Case Study: Palm Oil and Endangered Species* found on pp 226 and 250 respectively.
3. Students should complete the Section Reviews at the end of each section and AP Connections Review questions at the end of each Chapter. The questions will assist students to focus on the more pertinent topics. Completion of the Free-Response Questions is a superior method of preparing for the AP Exam. The answers can be peer-reviewed or scored to stress how point distribution is scored for each question.

Instructional Activities

1. *Sell Your Biome Travel Package.* Using various presentation methods, students can organize a travel package for each terrestrial biome. For each travel package, students should include the types of animals and plants found within each biome, location, climate data, endangered species, human impacts, and resources. Presentations will convey all the material for the major terrestrial biomes and endangered species. Students can vote for the travel package they desire to attend. Note: this project can be extensive and cover most of the topics addressed from the Lecture and Discussion Topics.
2. *Biome Plant Adaptation Activity.* Provide students with indicative plants from each terrestrial biome. Students will illustrate the plants in a journal and describe the plant adaptations which are characterized by the terrestrial biome.
3. *Forest Biodiversity.* Pass out two set of Biodiversity Cards. The first set (Forest A) will contain the names of different tree pine species to represent a polyculture. Distribute one card to each student, and have the students introduce themselves to three tree species, and each student should write down his/her name on the card when introduced. The teacher will announce which tree species is diseased and identify the trees that have now become diseased. The second set (Forest B) of cards will contain a monoculture of trees. Repeat the same procedure except select a different tree species to be infected. Discuss the significance of biodiversity in an ecosystem and how pesticides would impact Forest A and Forest B.
4. *Habitat Fragmentation.* Provide students with one white board cut 2ft x 2ft. Students create two habitats by dividing the board into two habitats A and B. For Forest A, students will make one clear cut representing an area of 9 squared cm, while Forest B receives nine 1 cm cuts. Students will outline each clear-cut and illustrate the edge effect for each forest. Once the clear-cuts have been made, students will calculate the area of land impacted by the clear-cuts. A discussion should lead into habitat fragmentation, edge effect, and loss of biodiversity.
5. *Video.* Students should view Dr. Seuss' "The Lorax" to discuss the impact of clear-cutting a forest. Discuss the concept of Tragedy of the Commons and how a public resource can be exploited if it is not protected.
6. *Tragedy of the Commons.* To further expand the idea of Tragedy of the Commons, a simulation using goldfish can be conducted with students. Place students in groups of four. Each student represents the head of their fish family and must capture at least two fish to survive. After each generation of fishing, fish will repopulate. During each fishing

round, students take turns fishing but during the entire activity, students are not allowed to communicate. Students will quickly realize that they must only catch the minimum in order to sustain the fish population for future generations.

Unit 5: Aquatic Ecosystems

Chapters:

- 5 – Biome: Global Patterns of Life

Curriculum Coverage:

Course Topics correlated with AP Course Outline:

I. Earth Systems and Resources

- B. The Atmosphere: atmospheric circulation and the Coriolis effect; atmosphere and ocean interactions; ENSO

II. The Living World

- A. Ecosystem Structure: Aquatic biomes

V. Energy Resources and Consumption, Hydroelectric Power (dam; flood control; salmon; silting and other impacts)

Lecture and Discussion Topics:

The lecture and discussion topics can be addressed using traditional lecture with question and answer sessions during class, student-directed readings, or student-viewed video lecture (flipped classroom). All lecture and discussion topics should be reinforced with daily activities, hands-on activities, inquiry-based experiments and field investigations. It is encouraged that students participate in field trips to use their classroom knowledge in the field or industry.

Unit Topics:

Aquatic Biomes and Adaptations

- Identify and characterize the zones of the ocean, including the abiotic and biotic factors that exist in each zone.
- Discuss the types of coastal zones, their economic and environmental significance, and human disturbances.
- Relate specific historical changes that have occurred with these aquatic environments, such as the Everglades, Coral Reefs, and Garbage Patch of the Pacific Ocean, and dead zones.
- Compare the seasonal changes of a lake and pond when a spring turnover or thermal stratification event occurs.

Lecture Notes and AP Style Questions

Chapter 5 Lecture Powerpoint

Chapter 5 AP Teacher's Manual

Assessment: Exam consisting of 40 Multiple-choice questions with five answer choices, one free-response question emphasizing the AP style which includes a document based, data-set, and two evaluation questions. Appropriate questions can be found in the Test Bank, textbook Section Reviews, and the College Board.

Activities:**Student Preparation**

1. Students should read Chapter 5 to become familiar with topics for the unit. By reviewing and answering questions from Chapter 5 Self Study and the Questions Bank, students will gain a strong understanding of potential test questions. The Self-Study also guides students through the more pertinent information that may appear on the AP exam.
2. Students can be assigned to read the *Case Study: A Blue Revolution* to gain an understanding of how the introduction of PCBs has had a negative effect on aquaculture.
3. Students should complete the Section Reviews at the end of each section and AP Connections Review questions at the end of each Chapter. The questions will assist students to focus on the more pertinent topics. Completion of the Free-Response Questions is a superior method of preparing for the AP Exam. The answers can be peer-reviewed or scored to stress how point distribution is scored for each question.

Instructional Activities

1. Using *Lab Exercise 10 Stream Ecology and Assessment from Lab and Field Exercises 8th ed.*, students will use population sampling methods to collect aquatic invertebrates. Using this technique, students will describe the physical and chemical characteristics of a stream. The sample invertebrates will provide evidence of the effects of water quality on aquatic life.
2. *Aquatic Biome WebQuest*. Using the website <https://www.epa.gov/oceans-and-coasts>, students can read about the importance of coastal zones, sources of pollution, and the management of these areas.
3. *Video*. Students watch video clips of [BBC: Blue Planet Series](#) which targets many of the coastal zones such as Tidal Seas, Coral Reefs, The Deep, and Coasts. Students should record adaptations of the organisms that exist in each of the aquatic biomes.

Unit 6: Water Pollution**Chapters:**

- 17 – Water Use and Management
- 18 – Water Pollution

Curriculum Coverage:

Course Topics correlated with AP Course Outline:

I. Earth Systems and Resources

- C. Global Water Resources and Use: Freshwater/saltwater; agricultural; industrial; and domestic use; surface and groundwater issues; global problems; conservation

IV. Land and Water Use

- F. Fishing: Fishing techniques; overfishing; aquaculture; relevant laws and treaties

VI. Pollution**A. Pollution Types**

3. Water pollution: Types, sources, effects; cultural eutrophication; groundwater pollution; maintaining water quality; water purification; sewage treatment/septic systems; Clean Water Act and other relevant laws

B. Impacts on Environmental and Human Health

- C. Economic Impacts: Cost-benefit analysis; externalities; marginal costs; sustainability

Lecture and Discussion Topics:

The lecture and discussion topics can be addressed using traditional lecture with question and answer sessions during class, student-directed readings, or student-viewed video lecture (flipped classroom). All lecture and discussion topics should be reinforced with daily activities, hands-on activities, inquiry-based experiments and field investigations. It is encouraged that students participate in field trips to use their classroom knowledge in the field or industry.

Unit Topics:

Surface and Groundwater Structure Composition and Water Distribution

- Identify major sources of freshwater and saltwater on a map.
- Explain the components of an aquifer and movement of water during a recharge.
- Explain the economic and ecological benefits of a reservoir.
- Determine the impact of overdrawing resources from surface or groundwater.
- Provide historical events of water diversion projects and their environmental consequences. Express how saltwater intrusion may occur near a coastal region when an excess of water is withdrawn.

Water Pollution Types, Sources, Effects, and Prevention

- Describe types of water pollutants, their natural and anthropogenic sources, human and environmental effects.
- Differentiate between point and nonpoint sources of water pollution.
- Describe how water quality indicators change naturally and their anthropogenic effects.
- Identify examples of water pollutants that enter groundwater and marine zones.
- Illustrate how dissolved oxygen and BOD levels are correlated.
- Identify chief legislation that protects watersheds and is responsible for cleanup and disposal of water pollutants; and describe the components of sewage treatment.

Water Quality and Fishing Methods

- Identify the major zones of the ocean based on depth, light, and open water.
- Discuss marine adaptations of species in each zone.
- Relate water quality such as dissolved oxygen, nutrients, and temperature to the various marine zones.
- Describe fishing techniques and discuss the benefits and costs of each technique.
- Provide solutions to preventing overfishing by discussing sustainable fishing methods.

Lecture Notes and AP Style Questions

Chapters 17 and 18 Lecture Powerpoint

Chapters 17 and 18 AP Teacher's Manual

Assessment: Exam consisting of 40 Multiple-choice questions with five answer choices, one free-response question emphasizing the AP style which includes a document based, data-set, and two evaluation questions. Appropriate questions can be found in the Test Bank, textbook Section Reviews, and the College Board.

Activities:

Student Preparation

1. Students should read Chapters 17 and 18 to become familiar with topics for the unit. By reviewing and answering questions from Chapters 17 and 18 Self Study and the Questions Bank, students will gain a strong understanding of potential test questions. The Self-Study also guides students through the more pertinent information that may appear on the AP exam.
2. Students can be assigned to read the *Case Study: Studying the Dead Zone* to analyze the consequence of nitrogen enrichment in a body of water in a real world event.
3. Students should complete the Section Reviews at the end of each section and AP Connections Review questions at the end of each Chapter. The questions will assist students to focus on the more pertinent topics. Completion of the Free-Response Questions is a superior method of preparing for the AP Exam. The answers can be peer-reviewed or scored to stress how point distribution is scored for each question.

Instructional Activities

1. *Watershed in Your Hand*. Students create a Watershed in their Hand by crumpling a sheet of paper, label the highest points to separate the divides and their water flow. Students predict the movement of water flow in each watershed and indicate the best locations for industry, recreation, and residential areas.
2. *Water Pollutant Pictorial Map*. Create a pictorial concept map of the major water pollutant types, their sources, examples, and human/environmental effects as study aide.
3. *Effects of Thermal Pollution on Goldfish*. Students create an experiment to determine the effects of varying water temperature on the respiration of fish. The experiment should include groups of fish exposed to a control and experimental temperatures (ice bath and warm water). Students will become familiar with effects of thermal pollution on living environments.
4. Students work on *Exercise 17. Dissolved Oxygen and Biochemical Oxygen Demand Field & Laboratory Exercises 8th ed*. In this lab activity, students will measure the amount oxygen present in water, determine percent saturation and determine the biological oxygen demand of a sample of water.
5. *Video*. Using a graphic organizer, students watch the National Geographic video "Troubled Waters". Students should be able to identify the source and effect of five major water pollutants discussed in the video.
6. *Fishing Method WebQuest*. Using the website <http://www.seafoodwatch.org/ocean-issues/fishing-and-farming-methods>, students view short video clips of fishing and farming methods. Students create a graphic organizer that includes a description or diagram of the method, the type of fish harvested, and the environmental costs of each method. Students also create a graphic organizer that includes sustainable fishing methods.

Unit 7: Human Population

Chapters:

- 7 – Human Populations
- 9 – Food and Hunger
- 22 – Urbanization and Sustainable Cities
- 23 – Ecological Economics

Curriculum Coverage:

Course Topics correlated with AP Course Outline:

III. Population

- A. Population Biology Concepts: Population ecology; carrying capacity; reproductive strategies; survivorship
- B. Human Population
 - 1. Human population dynamics: Historical population sizes; distribution; fertility rates; growth rates and doubling times; demographic transition; age-structure diagrams
 - 2. Population size: Strategies for sustainability; case studies; national policies
 - 3. Impacts of population growth: Hunger; disease; economic effects; resource use; habitat destruction

IV. Land and Water Use

- A. Agriculture:
 - 1. Feeding a growing population: Human nutritional requirements; types of agriculture; Green Revolution; genetic engineering and crop production; irrigation; sustainable agriculture
 - 2. Controlling Pests: Types of pesticides; costs and benefits of pesticide use; integrated pest control management; relevant laws
- D. Other Land use
 - 1. Urban land development: Planned development; suburban sprawl; urbanization
 - 2. Transportation infrastructure: Federal highway system; canals and channels; roadless areas; ecosystem impacts
- G. Global Economics: Globalization; World Bank; Tragedy of the Commons; relevant laws and treaties

V. Energy Resources and Consumption

- B. Energy Consumption
 - 1. History: Industrial Revolution; exponential growth; energy crisis
 - 2. Present global energy use
 - 3. Future energy needs
- C. Fossil Fuel Resources and Use: World Reserves and global demand
- F. Energy Conservation: Energy efficiency, CAFE standards; mass transit

VI. Pollution

- A. Pollution Types - Generalizations about quantities for different countries
- B. Impacts on Environmental and Human Health - Generalizations for different countries
- C. Economic Impacts: Cost-benefit analysis; externalities; marginal costs; sustainability

Lecture and Discussion Topics:

The lecture and discussion topics can be addressed using traditional lecture with question and answer sessions during class, student-directed readings, or student-viewed video lecture (flipped classroom). All lecture and discussion topics should be reinforced with daily activities, hands-on activities, inquiry-based experiments and field investigations. It is encouraged that students participate in field trips to use their classroom knowledge in the field or industry.

Unit Topics:

Human Population Dynamics and its Impacts

- Identify factors that contribute to population growth and how they are impacted by culture, economics, and society.
- Know the components of the IPAT model.
- Describe how these factors have changed historically using the demographic transition model. Discuss how women empowerment and technology play a role in population factors.
- Calculate for population growth rates (natural and unnatural) and doubling time.
- Relate diseases associated with malnutrition or undernutrition.
- Describe hunger patterns with various countries.
- Explain how strategies on reducing hunger.
- Explain the green revolution, GMOs and its impact on world hunger.

Lecture Notes and AP Style Questions

Chapters 7, 9, 22, and 23 Lecture Powerpoints

Chapters 7 and 9 AP Teacher Manual

Chapters 22 AP Teacher Manual Urbanization concepts

Chapters 23 AP Teacher Manual Economics and GDP

Assessment: Exam consisting of 40 Multiple-choice questions with five answer choices, one free-response question emphasizing the AP style which includes a document based, data-set, and two evaluation questions. Appropriate questions can be found in the Test Bank, textbook Section Reviews, and the College Board.

Activities:

Student Preparation

1. Students should read Chapter 7, 9, 22, and 23 to become familiar with topics for the unit. By reviewing and answering questions from Chapter 7, 9, 22 and 23 Self Study and the Questions Bank, students will gain a strong understanding of potential test questions. The Self-Study also guides students through the more pertinent information that may appear on the AP exam.
2. Students can be assigned to read the *Case Study: India Passes 1 Billion and Family Planning in Thailand*. Each case study provides how economics and culture play an important role in demographic transition of a population and how population control methods may or may not be implemented.
3. Students should complete the Section Reviews at the end of each section and AP Connections Review questions at the end of each Chapter. The questions will assist students to focus on the more pertinent topics. Completion of the Free-Response Questions is a superior method of preparing for the AP Exam. The answers can be peer-reviewed or scored to stress how point distribution is scored for each question.

Instructional Activities

1. *Video.* As a quick introduction to the unit, students should view the World Population simulation from YouTube at <https://www.youtube.com/watch?v=4BbkQiQyaYc>.
2. *Lab: Exercise 5 Population Dynamics* focuses on exploring factors that affect population size, composition, and distribution. Students will use *Lemna Minor* to observe what type of growth curve is exhibited after a two week period.
3. *Lab: Exercise 6 Historical Changes in Human Population* uses data from cemetery records and obituaries to describe how mortality and survivorship has changed from past and modern times. Students will also state how each population factor has influenced population growth. The final end product will be a survivorship curve for their given population.
4. *Lab: Exercise 7 Human Population Dynamics in Field and Laboratory Exercises 8th ed.* uses the US Census Bureau demographic data to compare three different countries from past to modern times. Once the data has been collected, students will calculate for population growth rate using birth and death rates and doubling time. A comparison of each country's resource consumption can be related to each society's sustainability. Students will view country's histograms and how each change as time passes.
5. *Building a DTM.* Students should construct a demographic transition model to include countries in each phase, characteristics of each country, and the representative stage of growth.
6. *Smart Growth in Town.* Students should take photographs of smart growth or sustainable development in their community to understand how urbanization impacts their community and how the local government may be creating a more sustainable or economically-charged community.
7. *Video.* Use the video "World in Balance" to further support concepts within the Human Population Unit. Students should be able to describe the population growth rates, pyramids, cultural significance, demographic transition, and sustainability strategies of the countries addressed.

Unit 8: Air Pollution

Chapters:

- 3 – Matter, Energy, and Life
- 15 – Climate Change
- 16 – Air Pollution

Curriculum Coverage:

Course Topics correlated with AP Course Outline:

- I. Earth Systems and Resources
 - B. The Atmosphere: Composition; structure; weather and climate
- II. The Living World
 - F. Natural Biogeochemical Cycles: carbon, nitrogen, sulfur, water
- V. Energy Resources and Consumption
 - F. Energy Conservation: energy efficiency; CAFE standards; hybrid electric vehicles; mass transit

VI. Pollution

A. Pollution Types

1. Air pollution: Sources - primary and secondary; major air pollutants; measurement units; smog; acid deposition - causes and effects; heat islands and temperature inversions; indoor air pollution; remediation and reduction strategies; Clean Air Act and other relevant laws
2. Noise pollution: sources, effects, control measures

B. Impacts on Environmental and Human Health

C. Economic Impacts: Cost-benefit analysis; externalities; marginal costs; sustainability

VII. Global Change

C. Loss of Biodiversity

Lecture and Discussion Topics:

The lecture and discussion topics can be addressed using traditional lecture with question and answer sessions during class, student-directed readings, or student-viewed video lecture (flipped classroom). All lecture and discussion topics should be reinforced with daily activities, hands-on activities, inquiry-based experiments and field investigations. It is encouraged that students participate in field trips to use their classroom knowledge in the field or industry.

Unit Topics:

Air Pollution

- Introduce the unit with describing the composition of the atmosphere.
- Identify and describe natural and anthropogenic air pollutants.
- Define, provide examples and differentiate between primary and secondary air pollutants. Identify the six major air criteria pollutants characterized by the EPA.
- For all major air pollutants, discuss the human and environmental impact.
- Explain how topography and urban climate can impact air pollutant events.
- Describe pollution control methods are utilized to prevent or limit air pollution for primary and secondary air pollutants.
- Identify chief national and global legislation created to control air pollution.
- Provide examples of how cap and trade approaches have been used to control air pollutants.

Chapters 15 and 16 Lecture Powerpoint

Chapters 15 and 16 AP Teacher's Manual

Assessment: Exam consisting of 40 Multiple-choice questions with five answer choices, one free-response question emphasizing the AP style which includes a document based, data-set, and two evaluation questions. Appropriate questions can be found in the Test Bank, textbook Section Reviews, and the College Board.

Activities:

Student Preparation

1. Students should read Chapter 15 and 16 to become familiar with topics for the unit. By reviewing and answering questions from Chapter 15 and 16 Self Study and the Questions Bank, students will gain a strong understanding of potential test questions. The Self-Study also guides students through the more pertinent information that may appear on the AP exam.
2. Students can be assigned to read the *Case Study: Beijing Looks for Answers to Air Pollution* found on pp 350-351 in the textbook.
3. Students should complete the Section Reviews at the end of each section and AP Connections Review questions at the end of each Chapter. The questions will assist students to focus on the more pertinent topics. Completion of the Free-Response Questions is a superior method of preparing for the AP Exam. The answers can be peer-reviewed or scored to stress how point distribution is scored for each question.

Instructional Activities

1. *Atmosphere Foldable.* Use two pages in a journal or a sheet of paper to illustrate the four major atmospheric layers. Create a line graph that illustrates the temperature and atmospheric pressure changes of the four different atmospheric layers. Students will characterize each atmospheric layer by drawing emogees or representative art for each layer. For instance, hot air balloons, clouds, and greenhouse gases in the troposphere; jet planes and ozone molecules in the stratosphere; meteorites in the mesosphere; and satellites in the thermosphere.
2. *Particulate Lab.* Using Particulate Collecting samples, students will compare the deposition rate and average particulate density collected from their school. Particulates can be collected using Petri dishes and petroleum jelly. Each particulate sampling dish can be collected in various areas of the school and collected within a 24-48 hour period for analysis using a stereomicroscope.
3. Using *Exercise 18 Air Pollution in Lab and Field Exercises 8th ed*, students will measure the concentration of CO, CO₂, NO, and SO₂ released from motor vehicles. Using their findings, students will analyze the combustion efficiency of motor vehicles and how this leads to the formation of tropospheric pollutants. Students will also record ozone levels and evaluate their significance on human health by using the EPA's Air Quality Index.
4. *Acid Rain Simulation and its Effects.* Compare the impact of acid rain on various aquatic ecosystems such as oceans, lakes, and buffered ponds. Applying acid to various materials like shells, metals, and rocks/minerals can also be used to analyze the effects of acid rain.
5. *Air Pollutant House Schematic.* Students diagram a house schematic to include all the various types of indoor and outdoor air pollutants. Each schematic should include sources, human and environmental effects of each pollutant.
6. *Urban Heat Island in Town.* Students record air temperatures from different location in their community to compare how an urban heat island can be created. Students report their findings as a class to create a surface temperature map of their community. Data analysis and discussion should lead to how the surfaces impact surface temperatures.

Unit 9: Global Change

Chapters:

- 15 – Climate Change
- 23 – Ecological Economics

Curriculum Coverage:

Course Topics correlated with AP Course Outline:

I. Earth Systems and Resources

- A. Earth Science Concepts: Seasons; solar intensity; and latitude
- B. The Atmosphere: Weather and climate; atmospheric circulation and the Coriolis effect; atmosphere and ocean interactions; ENSO

II. The Living World

- D. Natural Ecosystem Change: Climate shifts; species movement
- F. Natural Biogeochemical Cycles: carbon, nitrogen, sulfur, water

V. Energy Resources and Consumption

- F. Energy Conservation: energy efficiency; CAFE standards; hybrid electric vehicles; mass transit

IV. Land and Water Use

- B. Agriculture:
 - 3. Feeding a growing population; sustainable agriculture

VII. Global Change

- A. Stratospheric Ozone: Formation of stratospheric ozone; ultraviolet radiation; causes of ozone depletion; effects of ozone depletion; strategies for reducing ozone depletion; relevant laws and treaties
- B. Global Warming: Greenhouse gases and the greenhouse effect; impacts and consequences of global warming; reducing climate change; relevant laws and treaties
- C. Loss of Biodiversity
 - 1. Habitat loss; pollution; endangered and extinct species
 - 2. Maintenance through conservation
 - 3. Relevant laws and treaties

Lecture and Discussion Topics:

The lecture and discussion topics can be addressed using traditional lecture with question and answer sessions during class, student-directed readings, or student-viewed video lecture (flipped classroom). All lecture and discussion topics should be reinforced with daily activities, hands-on activities, inquiry-based experiments and field investigations. It is encouraged that students participate in field trips to use their classroom knowledge in the field or industry.

Unit Topics:

Climate Change

- Differentiate between weather and climate.
- Discuss global air circulation patterns and convection cells.
- Describe the abiotic factors of an El Niño versus La Niña.
- Indicate the type of atmospheric and oceanic changes that occur during each of these events. Identify the major greenhouse gases and their natural and anthropogenic sources.
- Describe how these greenhouse gases play a significant role in global climate change.
- Discuss the environmental effects and consequences of climate change.
- Provide evidence of global climate change and discuss the processes.
- Identify the chief global legislation which oversees the reduction or prevention of global change. Explain how a cost-benefit analysis may be applied to determine if pollution clean-up or pollution abatement is more feasible for a company.

Ozone Depletion and its Effects

- Describe how ozone formation occurs and how CFCs destroy the ozone layer.
- Identify strategies to reduce CFC emission locally, nationally, and globally.

Lecture Notes and AP Style Questions

Chapters 15 and 23 Lecture Powerpoint

Chapters 15 and 23 AP Teacher's Manual

Assessment: Exam consisting of 40 Multiple-choice questions with five answer choices, one free-response question emphasizing the AP style which includes a document based, data-set, and two evaluation questions. Appropriate questions can be found in the Test Bank, textbook Section Reviews, and the College Board.

Activities:

Student Preparation

1. Students should read Chapter 15 and 23 to become familiar with topics for the unit. By reviewing and answering questions from Chapter 15 and 23 Self Study and the Questions Bank, students will gain a strong understanding of potential test questions. The Self-Study also guides students through the more pertinent information that may appear on the AP exam.
2. Students can be assigned to read the *Case Study: Melting Glaciers in Antarctica*.
3. Students should complete the Section Reviews at the end of each section and AP Connections Review questions at the end of each Chapter. The questions will assist students to focus on the more pertinent topics. Completion of the Free-Response Questions is a superior method of preparing for the AP Exam. The answers can be peer-reviewed or scored to stress how point distribution is scored for each question.

Instructional Activities

1. Using *Lab 19 Global Indicators of Climate Change from Lab and Field Exercises 8th ed.*, students identify the major greenhouse gases and explain how they contribute to global climate change. Using the websites listed, students will analyze graphical representations of evidence of global climate change such as surface temperatures, sea level, and land and sea ice concentrations in order to make conclusions about the

trends. Students can also evaluate their own personal habits to make changes to reduce greenhouse gas emission.

2. *Greenhouse Effect Lab.* A greenhouse simulation can be conducted using a container with a lid and varying surfaces such as dark and light sands; and thermometer to simulate the effects of albedo on various surfaces. Students will record temperatures changes over a given period of time in order to make conclusions on the effects of radiation and albedo.
3. *Greenhouse Gas Simulation.* Students visit <https://phet.colorado.edu/en/simulation/greenhouse> to observe how what happens to light and infrared photons, experiment with how cloud cover impacts the absorption of photons, and how greenhouse gases absorb photos differently.
4. *El Nino Surface Maps.* Students compare surface temperatures maps during an El Nino and La Nina to determine how changes in wind currents can lead to upwellings or downwellings and impact the fishing community.
5. *Ozone Gumdrops.* Students build models of ozone molecules and chlorofluorocarbons (CFCs) using gum drops. Using the gumdrops, students demonstrate how UV radiation can lead to the breakdown of ozone molecules. The demonstration should lead to a discussion to the sources of CFCs, the effects of ozone depletion, and relevant global laws to reduce CFC emission.

Unit 10: Energy

- **Chapters:**
 - 14 – Geology and Earth Resources
 - 19 – Conventional Energy
 - 20 – Sustainable Energy

Curriculum Coverage:

Course Topics correlated with AP Course Outline

IV. Land and Water Use

D. Other Land Use

3. Public and federal lands: management; wilderness areas; national parks; wildlife refuges; forests; wetlands
4. Land conservation options: Preservation; remediation; mitigation; restoration
5. Sustainable land-use strategies

E. Mining: Extraction; global reserves, relevant laws and treaties

G. Global Economics: Tragedy of the Commons, relevant laws and treaties

V. Energy Resources and Consumption

A. Energy Concepts: Energy forms; power; units; conversions; Laws of Thermodynamics

B. Energy Consumption

4. History: Industrial Revolution; exponential growth; energy crisis
5. Present global energy use
6. Future energy needs

C. Fossil Fuel Resource: Formation of coal, oil, and natural gas; extraction/purification methods; world reserves and global demand; synfuels; environmental advantages/disadvantages of sources

D. Nuclear Energy: Nuclear fission process; nuclear fuel; electricity production; nuclear reactor types; environmental advantages/disadvantages; safety issues; radiation and human health; radioactive wastes; nuclear fusion

- E. Hydroelectric Power (dam; flood control; salmon; silting and other impacts)
- F. Energy Conservation: energy efficiency; CAFE standards; hybrid electric vehicles; mass transit
- G. Renewable Energy: solar energy; solar electricity; hydrogen fuel cells; biomass; wind energy small scale hydroelectric; ocean waves, and tidal energy; geothermal; environmental advantages/disadvantages

Lecture and Discussion Topics:

The lecture and discussion topics can be addressed using traditional lecture with question and answer sessions during class, student-directed readings, or student-viewed video lecture (flipped classroom). All lecture and discussion topics should be reinforced with daily activities, hands-on activities, inquiry-based experiments and field investigations. It is encouraged that students participate in field trips to use their classroom knowledge in the field or industry.

Unit Topics:

Energy Concepts

- Discuss the advantages and disadvantages of using various fossil fuels.
- Define and calculate power, energy, work, and energy efficiencies for fossil fuels.

Fossil Fuel Resource and Use

- Provide the benefits and costs of using surface versus subsurface mining.
- Discuss the human and environmental impacts of mining.
- Explain the type ore removed for each type of mining method.
- Thoroughly explain the process of mining with the terms: overburden, tailings, smelting, reclamation, external and internal costs.
- Discuss the advantages and disadvantages of using coal as a source of electricity.
- Summarize the chief components of a nuclear power plant, the advantages, and disadvantages of using nuclear as a source of electricity.
- Identify legislation created to protect geological and earth resources.

Renewable Fuel Resources and Use

- Discuss how active and passive solar energy may be used to generate electricity in domestic and industrial processes.
- Provide examples on how the average consumer can reduce energy usage at home.
- Provide the advantages and disadvantages of using sustainable energy such as fuel cells, hydrogen cells, hydroelectric, solar, geothermal, tidal/wave, biomass and wind.
- For each method, thoroughly describe the process of generating electricity.

Lecture Notes and AP Style Questions

Chapters 14, 19, and 20 Lecture Powerpoint

Chapters 14, 19, and 20 AP Teacher's Manual

Assessment: Exam consisting of 40 Multiple-choice questions with five answer choices, one free-response question emphasizing the AP style which includes a document based, data-set, and two evaluation questions. Appropriate questions can be found in the Test Bank, textbook Section Reviews, and the College Board.

Activities:

Student Preparation

1. Students should read Chapter 19 and 20 to become familiar with topics for the unit. By reviewing and answering questions from Chapter 19 and 20 Self Study and the Questions Bank, students will gain a strong understanding of potential test questions. The Self-Study also guides students through the more pertinent information that may appear on the AP exam.
2. Students can be assigned to read the *Case Study: The End of Coal* and *Case Study: A Renewable Transition* found on pp 427 and pp 450-451 respectively in the textbook.
3. Students should complete the Section Reviews at the end of each section and AP Connections Review questions at the end of each Chapter. The questions will assist students to focus on the more pertinent topics. Completion of the Free-Response Questions is a superior method of preparing for the AP Exam. The answers can be peer-reviewed or scored to stress how point distribution is scored for each question.

Instructional Activities

1. Using *Exercise 11 Personal Energy Consumption in Lab and Field Exercises 8th ed*, students will calculate for their personal footprint on energy. Students will calculate energy savings from reducing the size of a window, to changing the type of window, or changing the climate in a building. Students will calculate for the efficiency of different kinds of light bulbs. Using energy consumption labels provided by consumers, students will determine the amount of energy used by specific electrical appliances. A cost evaluation of energy consuming products will also be done.
2. *Solar Cooker*. Students design a solar cooker that will heat to a temperature of 70 degrees Celsius. Students can experiment with various shapes of solar cookers and materials to investigate the most efficient method to heat the provided temperature.
3. *Energy Speed Dating*. As a project, student are assigned a given nonrenewable or renewable energy source to 'speed date'. Each student creates an energy profile indicating the benefits and costs, how the energy is harnessed, energy efficiency, location of energy, and new developments. Each student shares his/her profile with all students during a dating rotation.
4. *Cooking Mining Simulation*. Students use various chocolate chip cookies to mine for profitable chocolate chips (ore/coal) using toothpicks and paper clips. Students are charged for each minute they mine to simulate daily ownership costs. Students summarize the mining process using mining and economic terms such as aforementioned in the lecture component. Note: this activity can also be completed in Unit 12.
5. *Video Clips*. To review various nonrenewable and renewable energy resources, students can view videos from the Switch website, <http://www.switchenergyproject.com/>.

Unit 11: Toxicology and Pest Control

Chapters:

- 8 – Environmental Health and Toxicology
- 10 – Farming: Conventional and Sustainable Practices

Curriculum Coverage:

Course Topics correlated with AP Course Outline:

I. Earth Systems and Resources

- D. Soil and Soil Dynamics: Soil erosion and other soil problems; soil conservation

IV. Land and Water Use

C. Agriculture:

4. Feeding a growing population: Human nutritional requirements; types of agriculture; Green Revolution; genetic engineering and crop production; irrigation; sustainable agriculture
5. Controlling Pests: Types of pesticides; costs and benefits of pesticide use; integrated pest control management; relevant laws

VI. Pollution

A. Pollution Types

3. Water pollution: Types; sources; and effects; ground water pollution; maintaining water quality; water purification; Clean Water Act, and other relevant laws

B. Impacts on Environmental and Human Health

3. Hazards to Human Health: Environmental risk analysis, chronic and acute effects; dose-response relationships; air pollutants; smoking and other risks
4. Hazardous chemicals in the environment: types of hazardous wastes; treatment and disposal; biomagnification; relevant laws

C. Economic Impacts: Cost-benefit analysis; externalities; marginal costs; sustainability

VII. Global Change

C. Loss of Biodiversity:

1. Pollution; endangered and extinct species
3. Relevant laws and treaties

Lecture and Discussion Topics:

The lecture and discussion topics can be addressed using traditional lecture with question and answer sessions during class, student-directed readings, or student-viewed video lecture (flipped classroom). All lecture and discussion topics should be reinforced with daily activities, hands-on activities, inquiry-based experiments and field investigations. It is encouraged that students participate in field trips to use their classroom knowledge in the field or industry.

Unit Topics:

Toxicology Concepts and Legislation

Classify toxins based on their origin, environmental effects, and human health. Provide specific

examples of toxins and their physiological effects on humans.

- Discuss how toxins are classified as hazardous, flammable, mutagenic, and corrosive.
- Analyze LD50, LC50, the threshold, and NOEL for toxins using a toxicology graph.
- Describe how fat-soluble toxins are bioaccumulated and biomagnified in an organism.
- Explain how a cost-benefit analysis and risk assessment can be utilized when determining a hazards degree of risk.
- Identify categories of infectious and noninfectious disease by vector and mode of transmission. Identify chief legislation in the US that protects human and environmental health.

Pest Control and Legislation

- Describe the history of the development of chemical pesticides from natural to anthropogenic. Summarize the benefits and costs of using chemical pesticides when eliminating disease carrying vectors and crop-damaging organisms.
- Discuss alternative methods to using chemical pesticides and their benefits and drawbacks. Describe how DDT was introduced into the US, its impact, and its removal in the US.
- Provide examples of how IPM has been successful and controlling pest infestation on crops. Discuss the how organic foods applies to food production and agriculture.
- Identify chief legislation in the US developed to protect human and environmental health.

Lecture Notes and AP Style Questions

Chapters 8 and 10 Lecture Powerpoint

Chapters 8 and 10 AP Teacher's Manual

Assessment: Exam consisting of 40 Multiple-choice questions with five answer choices, one free-response question emphasizing the AP style which includes a document based, data-set, and two evaluation questions. Appropriate questions can be found in the Test Bank, textbook Section Reviews, and the College Board.

Activities:

Student Preparation

1. Students should read Chapter 8 and 10 to become familiar with topics for the unit. By reviewing and answering questions from Chapter 8 and 10 Self Study and the Questions Bank, students will gain a strong understanding of potential test questions. The Self-Study also guides students through the more pertinent information that may appear on the AP exam.
2. Students can be assigned to read the *Case Study: The Chemical War on Columbian Coca*. This case study focuses on the environmental consequences of spraying herbicides to treat the coca industry. Students can also read the Case Study: Arsenic in Drinking Water to evaluate cost versus health.
3. Students should complete the Section Reviews at the end of each section and AP Connections Review questions at the end of each Chapter. The questions will assist students to focus on the more pertinent topics. Completion of the Free-Response Questions is a superior method of preparing for the AP Exam. The answers can be peer-reviewed or scored to stress how point distribution is scored for each question.

Instructional Activities

1. *Toxicology WebQuest*. Students use the following website to complete an introduction to Toxicology http://www.biology.arizona.edu/chh/problem_sets/toxicology/toxicology.html. Based on previous knowledge, students answer a problem set and will be directed to correct answers and their explanations.
2. *MSDS Conversions*. Students use Material Safety Data Sheets to identify LD50s for various chemicals. Each student uses his/her weight to calculate the LD50 for their body weight using the LD50 from the MSDS. Students will need to convert kilograms to grams and grams to kilograms based on each LD50.
3. *Lab: Exercise 15 Field and Laboratory Exercises 8th ed. Toxicity Testing LD50*. This lab will demonstrate the effects of various toxic materials on brine shrimp. Students will calculate the LD50 for a variety of toxic materials by creating LD50 graphs.
4. *School Risk Assessment*. Students survey the student body and rank students assessment of different types of risks. A Google survey can be created by the individual students and shared to other students to create a risk assessment. An evaluation of student responses can be compared to the actual degree of risk for each hazard.
5. *Interpreting Pesticide Label*. Provide students with various chemical pesticides. Students create a table identifying the types of chemical pesticides (herbicide, rodenticide, insecticide, etc.), potential environmental and human health hazards, target organism, and key hazardous terms. Students will also research the label requirements determined by the EPA and legislation.
6. *Pest Control Skits*. Students create Pest Control skits that convey the definition, example, advantages, disadvantages, and target organism or their selected method. Pest Control methods can include: biological control, integrated pest management, crop rotation, genetic engineering, organic methods, and physical.

Unit 12: Geology, Soil, and Agriculture

Chapters:

- 10 – Farming: Conventional and Sustainable Practices
- 14 – Geology and Earth Resources
- 23 – Ecological Economics

Curriculum Coverage:

Course Topics correlated with AP Course Outline:

- I. Earth Systems and Resources
 - A. Earth Science Concepts: Plate tectonics; earthquakes, volcanism
 - D. Soil and Soil Dynamics: Rock cycle; formation; composition; physical and chemical properties; main soil types; erosion and other soil problems; soil conservation
- IV. Land and Water Use
 - D. Agriculture:
 1. Feeding a growing population: Human nutritional requirements; types of agriculture; Green Revolution; genetic engineering and crop production; irrigation; sustainable agriculture
 - C. Rangelands: Overgrazing; deforestation; desertification; rangeland management
 - E. Mining: Mineral formation

Lecture and Discussion Topics:

The lecture and discussion topics can be addressed using traditional lecture with question and answer sessions during class, student-directed readings, or student-viewed video lecture (flipped classroom). All lecture and discussion topics should be reinforced with daily activities, hands-on activities, inquiry-based experiments and field investigations. It is encouraged that students participate in field trips to use their classroom knowledge in the field or industry.

Unit Topics:

Soil Properties

- Describe abiotic and biotic components of soil, evaluate the physical and chemical properties of soil, and their implications on agriculture.
- Create a soil profile of a stable soil horizon ecosystem and characterize each soil horizon with abiotic and biotic factors.
- Use a soil triangle to determine the soil texture given the soil components.
- Discuss how soil texture correlates with agriculture fertilizers and irrigation techniques.

Soil Erosion and Conservation Efforts

- Explain the types of soil erosion and types of agricultural methods implemented to reduce soil erosion.
- Identify specific areas in the world that are prone to soil erosion and their soil conservation efforts.
- Differentiate between desertification, waterlogging, and soil salinization.

Geology and the Rock Cycle

- Describe the rock cycle with a focus on how soil forms and weathers.
- Compare physical and chemical weathering of rock to form soils and its components. Differentiate between a rock and mineral.
- Differentiate between renewable, potentially renewable, and nonrenewable resources.

Plate Boundary Movements and its Formations

- Evaluate the geological features formed during convergent, divergent, and transform plate boundary movements.
- Discuss potential geological hazards for each plate boundary.
- Provide historical hazards associated with each plate boundary such as earthquakes, volcanoes, tsunamis, trench formation, arc islands, and ridges.

Lecture Notes and AP Style Questions

Chapters 10, 14, and 23 Lecture Powerpoint

Chapters 10, 23, and 24 AP Teacher's Manual

Assessment: Exam consisting of 40 Multiple-choice questions with five answer choices, one free-response question emphasizing the AP style which includes a document based, data-set, and two evaluation questions. Appropriate questions can be found in the Test Bank, textbook Section Reviews, and the College Board.

Activities:

Student Preparation

1. Students should read Chapters 10, 14, and 23 to become familiar with topics for the unit. By reviewing and answering questions from Chapter 10, 14, and 23 Self Study and the Questions Bank, students will gain a strong understanding of potential test questions. The Self-Study also guides students through the more pertinent information that may appear on the AP exam.
2. Students can be assigned to read the *Case Study: Indonesian Tsunami* in order to understand the intensity and impact of a tsunami.
3. Students should complete the Section Reviews at the end of each section and AP Connections Review questions at the end of each Chapter. The questions will assist students to focus on the more pertinent topics. Completion of the Free-Response Questions is a superior method of preparing for the AP Exam. The answers can be peer-reviewed or scored to stress how point distribution is scored for each question.

Instructional Activities

1. *Arable Soil Lab*. As an introduction, provide groups of students with an apple. Each apple represents the Earth. Students cut the apple into four $\frac{1}{4}$ slices, then record the percentage of water and land. Taking only one of the $\frac{1}{4}$ slices, students cut the $\frac{1}{4}$ into two more slices. Students will describe why only one of the $\frac{1}{8}$ slices is used to represent soil. Lastly, cut the $\frac{1}{8}$ slice into four slices. The last piece represents the amount of arable soil available for human consumption. This leads into a discussion of why soil is lost in a high abundance, and where the deposition is occurring. Further discussion should lead into methods of soil conservation.
2. *Lab: Exercise 16 ects of Salinization on Plants*. Students will describe the effects of saline soils on plants and explain how the salt exposure will cause physiological stress on the plant population. Different salt concentrations should be assigned to students. Students will also recommend mitigation and management strategies on reducing the risk of soil salinization.
3. *Soil Porosity and Permeability Lab*. Measuring pore space and permeability of various soils can be completed by students using different soil textures, soda bottles, collecting equipment, and water.
4. *Soil Chemistry*. Provide students with various soils from local or nearby areas to measure the soil pH, NPK, and soil texture. Kits can be purchased either at a home garden supply store or biological catalog.
5. *Edible Soil Profile*. Students create an Edible Soil Profile with all five horizons. Students can use different foods to demonstrate each soil horizon and its characteristics.
6. *Virtual Earthquake Simulation*. To predict the location of the epicenter of an earthquake, students can access the Virtual Earthquake simulation found at <http://www.sciencecourseware.org/GLOL/>. Students will be able to predict the time travel distance between P and S waves in order to triangulate the location of an earthquake.
7. *Video*. To further enhance greater understanding of how tsunami formation occurs, students may view the *Nova Video: The Day the Earth Shook*. The video focused on the structure of a tsunami wave, earthquake formation, and seismograph readings of P, S, and surface waves.