AP Environmental Science
Syllabus

Curricular Requirements

CR 1	The students and teachers have access to college-level resources including a recently published (within the last 10 years) college-level textbook and reference materials in print or electronic format.	*See page:* 2
CR 2	The course includes the required environmental legislation and policies.	*See page:* 6
CR 3	The course is structured to incorporate the big ideas and required content outlined in the AP Course and Exam Description.	*See pages:* 3-4
CR 4	The course provides opportunities for students to develop the skills related to Science Practice 1: Concept Explanation.	*See page:* 4
CR 5	The course provides opportunities for students to develop the skills related to Science Practice 2: Visual Representations.	*See pages:* 4-5
CR 6	The course provides opportunities for students to develop the skills related to Science Practice 3: Text Analysis.	*See page:* 5
CR 7	The course provides opportunities for students to develop the skills related to Science Practice 4: Scientific Analysis	*See page:* 5
CR 8	The course provides opportunities for students to develop the skills related to Science Practice 5: Data Analysis.	*See page:* 5
CR 9	The course provides opportunities for students to develop the skills related to Science Practice 6: Mathematical Routines.	*See pages:* 5-6
CR 10	The course provides opportunities for students to develop the skills related to Science Practice 7: Environmental Solutions.	*See page:* 6
CR 11	Students spend a minimum of 25% of instructional time engaged in a wide range of hands-on, inquiry-based laboratory investigations and/or field work to support the learning of required content and development of science practice skills throughout the course.	*See pages:* 6-7
CR 12	The course provides opportunities for students to record evidence of their scientific investigations. Evidence can be recorded in lab reports, mini-posters, or another appropriate formal manner for inclusion in lab reports/notebooks (print or digital format).	*See pages:* 6-7

Course Overview

AP Environmental Science is a laboratory and field-based course designed to provide students with the content and skills needed to understand the various interrelationships in the natural world, to identify and analyze environmental problems and to propose and examine solutions to these problems. Since this is an online course the laboratory and field-based activities will be done virtually and via experiments that students can easily perform at home with common materials. The course is intended to be the equivalent of a one-semester college ecology course, which is taught over an entire year in high school.

The course encompasses human population dynamics, interrelationships in nature, energy flow, resources, environmental quality, human impact on environmental systems, and environmental law. (PLEASE NOTE: Chemistry and Biology are prerequisites for this course).

Big Ideas and Science Practices

Throughout the course, students are exposed to the four big ideas that were used to design the AP Environmental course.

- Big Idea 1: Energy Transfer (ENG)
- Big Idea 2: Interactions Between Earth Systems (ERT)
- Big Idea 3: Interactions Between Different Species and the Environment (EIN)
- Big Idea 4: Sustainability (STB)

To better understand the big ideas and concepts of the course, students are given opportunities to conduct scientific inquiry using science practices and skills.

- Science Practice 1: Concept Evaluation
- Science Practice 2: Visual Representations
- Science Practice 3: Text Analysis
- Science Practice 4: Scientific Experiments
- Science Practice 5: Data Analysis
- Science Practice 6: Mathematical Routines
- Science Practice 7: Environmental Solutions

Instructional Resources

Textbook [CR1]

Teachers and students of the AP Environmental course are required to have a copy of the textbook below.

Botkin, Daniel B. and Edward A. Keller. *Environmental Science: Earth as a Living Planet*, 9th ed. Hoboken: Wiley, 2014.

Other Instructional Resources

Students are directed use college-level articles created based on information/data from government agencies. Example readings are listed below. The source of information/data is indicated in the parenthesis when applicable.

Supplementary Readings and Materials

The course includes a variety of supplementary readings from newspapers, magazines, and journals to expand upon textbook readings. These supplements highlight real-life examples of geographic concepts while providing greater depth of inquiry. Additional materials, including case studies, videos, and aerial photos, will be used to supplement primary course materials.

- Rachel Carson Biography (U.S. Fish & Wildlife Service)
- Ecosystem Services and Society
- Urbanization and the Environment
- The Sulfur Cycle and Methylation (EPA)
- Boreal Forests: Carbon Sinks or Sources? (NASA)
- The Effect of Phosphorus on Plants
- Heating Imbalances (NASA)
- How are conservation values identified? (Australian Government: Department of the Environment and Energy)
- Riparian Areas Environmental Uniqueness, Functions, and Values (United States Department of Agriculture)
- Population Genetics
- Size, Samples, and the **Lincoln Index**
- The Value of Honeybees (United States Department of Agriculture)
- Exploring Evidence for Global Climate Change

AP Environmental Science Course and Topic Outline

Four Big Ideas

The AP Environmental Science course is designed to expose students to four big ideas and the statements that represent the enduring understanding and knowledge that is essential to the understanding of the four big ideas. The course consists of eleven units. The table below outlines the Units and the Topics of the AP Environmental Science course and the corresponding AP Units and Big Ideas as described in the AP Environmental Science Course and Exam Description document by the College Board. **[CR 3]**

Unit and Topics (with Sample Activities)	AP Unit/s	Big Ideas
Unit 1: Scientific Method and Introduction to Environmental Science 1.1 Scientific Method, Practices, and Careers − Students analyze the impact of Rachel Carson's work on society. [STB] − Students complete a laboratory investigation on primary productivity. [ENG] 1.2 Introduction to Environmental Science − Students investigate the relationship between snails and elodea. [EIN]	2, 8, 5	ENG, STB, EIN
Unit 2: Life on Earth − Ecology, Habitats, and Biodiversity 2.1 Introduction to Ecology − Students conduct an investigation into the energy flow in a food chain. [ENG] − Students analyze the relationship between seed germination and environmental conditions. [ERT] 2.2 Habitats and Biodiversity − Students evaluate the impact of invasive species on the environment. [STB] − Students conduct a natural selection investigation in order to analyze the interaction between species and their environment. [EIN]	1, 2, 8, 9	ERT, ENG, STB, EIN

Unit 3: Life on Earth − Cycles and Systems 3.1 Earth's Cycles − Students evaluate the impact of the environment on net productivity. [ENG] 3.2 Earth's Systems − Students model Earth's cycles in a skills lesson. [ERT] 3.3 Shaping Earth − Students make connections between recycling and sustainability in a global connection lesson. [STB]	1, 2, 4, 5, 8	ERT, ENG, STB
Unit 4: Life on Earth − Biomes and Ecosystems − Students investigate Earth's biomes in a variety of lessons. [ERT] 4.1 Arid and Semi-Arid Biomes 4.2 Temperate, Wet, and Aquatic Biomes − Students explore and apply the Tragedy of the Commons to global environmental issues and suggest solutions. [STB] 4.3 Freshwater Ecosystems 4.4 Marine Ecosystems	1, 2, 8	ERT, STB
Unit 5: Populations and Environments 5.1 Population Dynamics − Students design and conduct an experiment on the growth rate of bread mold in different environmental conditions. [ERT] 5.2 Human Populations and Urban Environments − Students analyze the role of sustainability through lessons, journals, and discussions. [STB] 5.3 The Environmental Impact of Humans and Technology − Students explain how migratory patterns change in response to alterations in an ecosystem. [EIN]	3, 5, 8	ERT, EIN, STB
Unit 6: Soil, Food, and Agriculture 6.1 Soil − Students perform a lab investigation on the porosity of soil. [ERT] − Students complete a lesson and journal entry on waste disposal and management. [STB] 6.2 Food and Agriculture − Students complete an activity to evaluate the relationship between microflora and microfauna. [EIN]	4, 8	ERT, EIN, STB
Unit 7: Wildlife and Land Management 7.1 Wildlife Management − Students complete a lesson on wildlife management through land sustainability.[STB] 7.2 Land Use − Students analyze the causes and impacts of the Newfoundland cod fishery collapse. [EIN]	3, 5, 9	EIN, STB
Unit 8: Human, Risk, and Toxicology 8.1 Human Health − Students complete lessons on the effects and implications of environmental health. [EIN] 8.2 Environmental Hazards − Students complete discussion questions regarding sustainability and environmental health. [STB]	7, 8	EIN, STB
Unit 9: Energy Resources and Energy Use 9.1 Energy Resources − Students complete investigations into renewable resource use. [STB] 9.2 Renewable Energy Sources	6	STB

Unit 10: Water Resources and Water Pollution 10.1 Water Resources − Students complete a lab investigation on the water cycle. [ERT] 10.2 Water Pollution − Students analyze the impact of nonnative species in aquatic ecosystems.[EIN] − Students complete lessons on water policy and water management. [STB]	1, 4, 5, 8	ERT, EIN, STB
Unit 11: Atmospheric Dynamics, Climate Change, and Air Pollution 11.1 The Climate of the Earth − Students complete a journal entry on the environmental impacts of climate change. [ERT] − Students investigate energy transfer in the atmosphere. [ENG] 11.2 Air Pollution − Students complete lessons on air quality and atmospheric pollution. [STB]	4, 7, 9	ERT, ENG, STB

Science Practices

Listed below are examples of activities within the course that give students the opportunity to develop the seven science practices outlined in the AP Environmental Science Course and Exam Description document.

Science Practice 1: Concept Explanation (Explain environmental concepts, processes, and models presented in written format.) [CR 4]

- Students read the chapter on systems and cycles in the textbook. They explain how the principle of uniformitarianism helps answer questions about environmental changes.
- Students interact with material about ground water and groundwater depletion. They explain how groundwater can be classified a nonrenewable resource based on the relationship between the rate of pumping of groundwater and the rate of infiltration.
- Students read an article about carbon sinks and sources. They explain the steps and interactions in the carbon cycle.
- As a journal activity, students are asked to describe the results and the possible future effects of nuclear accidents.

Science Practice 2: Visual Representations (Analyze visual representations of environmental concepts and processes.) [CR 5]

- Students read an article about the Sulfur Cycle and Methylation where they analyze a generic visual representation of biomagnification. Students are then asked to apply what they learned from the visual representation to answer a question about a real-world scenario.
- Students use a graph of data obtained in the Seed Germination lab to describe the relationship between temperature, light, and water and seed germination.
- Students create a food web using printed out pictures and yarn. They explain energy flow in the food web and the ecosystem.

Science Practice 3: Text Analysis (Analyze sources of information about environmental issues.) [CR 6]

- Students read an article about the Historical Impacts of Environmental Science. They capture a summary of the work of each of the five scientists featured in the article by using a keywords.
- Students read an article about fracking from a scientific journal. They identify the claims made in the article and describe the evidence that supports the claim. Students present their arguments through a debate.
- Students read an article about Covid-19. Students identify biases of the author and determine how these biases may have affected the article's accuracy.

Science Practice 4: Scientific Experiments (Analyze research studies that test environmental principles.) [CR 7]

- Students will design an experiment to determine the effect of salinization on plant germination. They will draw conclusions based on the results of their investigation.
- Students collect data from a computer simulation to determine the relationship between permeability and grain size of sediments. They explain why permeability is an important factor in deciding location of wells.
- Students analyze a scientific study about how carbon in the oceans affects fish size. Students identify the hypothesis being tested in the experiment and experimental design components described in the article.

Science Practice 5: Data Analysis (Analyze and interpret quantitative data represented in tables, charts, and graphs.) [CR 8]

- Students determine the effect of temperature, water, and light on the germination rate of three different types of seeds. After gathering number of sprouts data based on different conditions, students analyze their data and conclude which combination of conditions germinate the most seeds.
- Students analyze quantitate data on the effects of a natural event in their area. The data are represented in charts, graphs, and tables. They create a storyboard on how that natural event affects the environment.
- Students conduct research to find data on the effect of human activities on climate change. They describe changes over time and explain the impacts of these changes on living things and the environment.

Science Practice 6: Mathematical Routines (Apply quantitative methods to address environmental concepts.) [CR 9]

- Students calculate the primary productivity of grass growth using data obtained from a laboratory activity.
- Students use the 10% rule to calculate how much energy is transferred from one trophic level to another.
- Students use statistical analysis in the Population Growth laboratory investigation to determine if the differences between the two treatments in the investigation are significant.
- Students use ratio and proportion to estimate population size of fish. Students calculate percent error in the investigation to determine the reliability of sampling methods.

Science Practice 7: Environmental Solutions (Propose and justify solutions to environmental problems) [CR 10]

- Students read about the effect of mold on indoor quality. They are then asked to propose and justify solutions to a hypothetical mold problem in their school.
- Students are taught about minerals and mining and read about the importance of mining for humans. They describe the environmental effects of open pit mining.
- Students create a poster that highlights the effects of urbanization on Earth's cycles. Students will propose and justify ways to minimize the negative effects of urbanization on these cycles.
- Students design and implement a campaign to recycle e-technology.

Legislation covered in the Course

Embedded in the units of instructions are the legislation listed below. Inclusion of these legislations will help students appreciate how policies enacted help to ensure that the environment and its resources are preserved for present and future populations. **[CR 2]**

- Clean Air Act (Unit 11, Topics 2.1 and 2.2)
- Clean Water Act (Unit 1, Topic 1.5; Unit 10, Topic 2.1)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Unit 4, Topic 4.3)
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (Unit 6, Topic 10.4)
- Montreal Protocol (Unit 11, Topic 2.3)
- Kyoto Protocol (Unit 7, Topic 2.2)
- Endangered Species Act (Unit 1, Topic 1.5; Unit 7, Topic 1.3)
- Safe Drinking Water Act (SDWA) (Unit 10, Topic 2.1)
- Delaney Clause of Food, Drug and Cosmetic Act
- Resource Conservations and Recovery Act (RCRA) – Unit 6, Topic 1.4

Labs

Students spend a minimum of 25% of instructional time engaged in scientific inquiry through hands-on wet labs and field work or through gizmos or computer simulations **[CR 11].** These activities are designed to help students understand required content and develop science practices. To practice scientific writing and reflect on what they learned after the lab activity, students are required to submit a lab report after each investigation. Lab reports include the following major components in the order shown **[CR 12].**

- Part 1: Introduction (Title, purpose, question, hypothesis, variables) Background Observations and Information
- Part 2: Materials and Procedure
- Part 3: Data Collection and Organization

- Part 4: Analysis and Conclusion

Students are required to compile their lab reports in a lab portfolio which will be submitted after the last laboratory activity in the course **[CR 12]**.

Listed are the lab/field work activities included in the course. Included is a brief description of each activity. **[CR 11]**

Lab/Fieldwork Title	**Description**
Triple Beam Balance	Students practice using a triple beam balance to determine the mass of different objects. Students practice using significant figures in measurements.
Primary Productivity	Students grow plants and use plant weight data to calculate productivity rates.
Interdependence of Plants and Animals	Students investigate the relationship between cellular respiration and photosynthesis by using Elodia plants and snails.
Seed Germination	Students determine the effect of temperature, water, and light on the germination rate of three different types of seeds.
Food Chain	Students examine the energy contribution of organisms within a food chain.
Natural Selection	Students explore how two moth populations are affected by changing environmental conditions.
Cell Energy Cycle	Students learn about energy transformation by investigating the relationship between cellular respiration and photosynthesis.
Plate Tectonics	Students will use a simulation to understand and describe what occurs on each of the plate boundaries and to locate each type of plate boundary on a world map.
The Rock Cycle	Students explore how sedimentary, igneous, and metamorphic rocks are formed using a computer simulation.
The Tragedy of the Commons	Students use a simulation to investigate how the common use of a resource can lead to the exploitation of that resource.
Rabbit Population by Season	Students examine how limiting factors affect a population and understand the effects of density-dependent and density-independent limiting factors by observing the changes in a rabbit population by season.
Population Growth	Students design and perform an experiment to determine the effect of environmental conditions on the growth rate of bread mold.
Estimating Population Size	Students use a simulation to estimate the total number of fish in a pond through the capture/recapture method.
Salinization	Students design and conduct an experiment to determine the effect of salinization on plant germination.
Porosity	Students investigate the relationship between the permeability of sediments to their grain size and the porosity of sediments to their macroscopic structure.
Solar House	Students design, build, and test the efficiency of a model solar house.
The Water Cycle	Students describe the different paths that water can travel on Earth's surface and compare the amounts of water in different reservoirs (oceans, ice, soil, etc.) using a simulation.

Watershed Assessment	Students assess the health of a watershed in their area using data obtained from different quality tests. Students present management recommendations based on their data.
Greenhouse effect	Students determine the relationship between the concentration of greenhouse gases and the rate heat flows out of the atmosphere using a simulation.
Monitoring Air Quality	Students design, build, and test a sulfur emissions scrubber. Students will determine the air quality in a certain area using features of that area.