AP Environmental Science Syllabus

Curricular Requirements

CR1	**The students and teacher 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.**
CR2	**The course includes the required environmental legislation and policies.**
CR3	**The course is structured to incorporate the big ideas and required content outlined in each of the units described in the AP Course and Exam Description (CED).**
CR4	**The course provides opportunities for students to develop the skills related to Science Practice 1: Concept Application**
CR5	**The course provides opportunities for students to develop the skills related to Science Practice 2: Visual Representations**
CR6	**The course provides opportunities for students to develop the skills related to Science Practice 3: Text Analysis**
CR7	**The course provides opportunities for students to develop the skills related to Science Practice 4: Scientific Experiments**
CR8	**The course provides opportunities for students to develop the skills related to Science Practice 5: Data Analysis**
CR9	**The course provides opportunities for students to develop the skills related to Science Practice 6: Mathematical Routines**
CR10	**The course provides opportunities for students to develop the skills related to Science Practice 7: Environmental Solutions**
CR11	**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 learning required content and developing science practices throughout the course.**
CR12	**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).**

Explore Curricular Requirement

In this course, students will explore the interrelationships within the natural world. Students will explore how energy is transferred, how the interactions of the earth's systems, interactions between species, interactions between species and the environment, and the process and actions that affect species, populations, biogeochemical cycle sustainability.

- Explain the balance of all of the earth's systems that maintain life.
- Identify their ecological footprint by analyzing their interactions within the biosphere.
- Identify sustainable practices to protect the environment.

Course Description

The AP Environmental Science course is designed to be the equivalent of a one-semester, introductory college course in environmental science.

AP Environmental Science engages students with the scientific principles, concepts, and methodologies required to understand the interrelationships in the natural world. Students will explore how energy is transferred, interactions of the Earth's systems, interactions between species, interactions between species and their environment, the process and actions that affect species, populations, and about biogeochemical cycle sustainability.

The course requires that students identify and analyze natural and human-made environmental problems, evaluate the relative risks associated with these problems, and examine alternative solutions for resolving or preventing them. Environmental science is interdisciplinary, embracing topics from geology, biology, environmental studies, environmental science, chemistry, and geography.

Course Objectives

Students will meet the following goals by taking this course:

- Explain the balance of all of Earth's systems that maintain life.
- Identify their ecological footprint by analyzing their interactions in the biosphere.
- Identify sustainable practices to protect the environment.

Prerequisites

Students should have completed two years of high school laboratory science—one year of life science and one year of physical science (e.g., a year of biology and a year of chemistry). Students should also have taken at least one year of algebra, given the quantitative analysis required in the course. Also desirable (but not necessary) is a course in earth science.

Lab Requirement

Although there are no specific AP Environmental Science labs or field investigations required for the course, it is required that students have the opportunity to spend a minimum of 25 percent of instructional time engaged in hands-on, inquiry-based laboratory and/or fieldwork investigations. In this course, students will complete **Laboratory Experiences*, equivalent to 25 percent of the course material**.

Big Ideas

This course introduces students to a broad set of big ideas, including:

BIG IDEA 1: ENERGY TRANSFER ENG

- Energy conversions underlie all ecological processes. Energy cannot be created; it must come from somewhere. As energy flows through systems, at each step, more of it becomes unusable.

BIG IDEA 2: INTERACTIONS BETWEEN EARTH SYSTEMS ERT

- Earth is one interconnected system. Natural systems change over time and space. Biogeochemical systems vary in their ability to recover from disturbances.

BIG IDEA 3: INTERACTIONS BETWEEN DIFFERENT SPECIES AND THE ENVIRONMENT EIN

- Humans alter natural systems and have had an impact on the environment for millions of years. Technology and population growth have enabled humans to increase both the rate and scale of their impact on the environment.

BIG IDEA 4: SUSTAINABILITY STB

- Human survival depends on developing practices that will achieve sustainable systems. A suitable combination of conservation and development is required. The management of resources is essential. Understanding the role of cultural, social, and economic factors is vital to the development of solutions.

In addition, this course emphasizes Science Practices:

- Concept Explanation 1
- Visual Representation 2
- Text Analysis 3
- Scientific Experiments 4
- Data Analysis 5
- Mathematical Routines 6
- Environmental Solutions 7

On the AP Exam, students must be able to describe and explain concepts related to the tragedy of the commons, clearcutting, agricultural practices, and mining. To practice this, case studies that represent real-world examples of human activities can be helpful, focusing on understanding concepts in applied contexts. Case studies can also be used to help students practice proposing solutions to environmental problems and describing the benefits or disadvantages of those solutions.

Resources CR1

- Botkin, Daniel. *Environmental Science: Earth as a Living Planet* (10th edition), Atlas Elite Publishing Partners, 2020. https://botkinlc.com
- Resource manuals for laboratory investigations
- Other resource publications
- Magazines
- Newspapers
- Television and radio
- Videos
- Interactive software
- Websites
- Equipment suppliers

Required Environmental Policies and Legislation CR2

Understanding the following environmental policies and legislation are required for the course as they relate to solutions to environmental problems. Teachers are encouraged to incorporate an understanding of legislation and policies and how they impact the environment

- Clean Air Act
- Clean Water Act
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
- Montreal Protocol
- Kyoto Protocol
- Endangered Species Act
- Safe Drinking Water Act (SDWA)
- Delaney Clause of Food, Drug, and Cosmetic Act
- Resource Conservation and Recovery Act (RCRA)

COURSE OUTLINE CR2

Unit 1: Introduction to Environmental Science

Students are introduced to the Big Ideas of the course as well as scientific methods.

Big Ideas: ENG EIN STB

Topics:	**Skill Pairing**
Energy Transfer	1.A
Interactions Among Living Things, Land, Water, and Air	1.A
Resource Availability, Human Consumption, and Population Growth: Impacts on Sustainability	1.A
Human Resource Use and Sustainability	1.A
Methods of Science	6.A
Accuracy, Precision, and Uncertainty	6.B 6.C
Data Analysis	5.E

Unit 2: The Living World: Ecosystems

Students explore a view of planet Earth as one system made up of regional ecosystems that are themselves composed of interdependent environmental features, processes, and relationships among species.

Big Ideas: ERT ENG

Topics:	**Skill Pairing**

- Predation 1.A
- Symbiosis, Mutualism, Commensalism, and Parasitism 1.A
- Interspecific and Intraspecific Competition 1.A
- Niches and Competitive Exclusion 1.A
- Trophic Levels 1.B
- Energy Flow in a Food Web 6.C
- Species Loss and Gain and Effect on Food Webs 2.A
- Introduction to Ecosystems 1.A
- Inputs, Outputs, and Cycling of Materials in Ecosystems 1.B
- Carbon Sources and Sinks 2.B
- Carbon Reservoirs and Holding Time 2.B
- Carbon Cycling in Producers, Consumers, and Decomposers 2.B
- Use of Fossil Fuels and the Carbon Cycle 2.B
- Nitrogen Sources and Sinks 2.B
- Nitrogen Reservoirs and Holding Times 2.B
- Nitrogen Fixation 2.B
- Phosphorus Sources and Sinks 2.B
- Phosphorus as a Limiting Factor in Aquatic and Terrestrial Ecosystems 2.B
- The Water Cycle 2.B
- Movement Between Sources and Sinks in the Water Cycle 2.B
- Climate Influence on Biome Distribution 1.B
- Characteristics of Terrestrial Biomes 1.B
- Characteristics of Aquatic Biomes 1.B
- Freshwater Biomes 1.B
- Saltwater Biomes 1.B
- Productivity and Change in Biomes 1.A
- Productivity in Aquatic and Terrestrial Biomes 1.A
- Climate Changes and Effects on Biome Distribution 1.A

Unit 3: The Living World: Biodiversity

In this unit, students learn about the importance of biodiversity in an ecosystem and the impact of outside factors on the evolution of organisms.

Big Ideas: ERT

Topics: **Skill Pairing**

- Genetic Diversity, Habitat Diversity, and Species Diversity 1.A
- Introduction to Biodiversity 1.A
- Population Bottlenecks and Genetic Diversity 1.A
- Disturbances and Ecosystems 1.A
- Introduction to Biodiversity: Part 2 1.A

- Ecosystem Services 1.B
- Human Activity and Disruptions on Ecosystem Services 1.B
- Island Biogeography 1.A
- Effects of Invasive Species on Island Ecosystems 1.A
- Disturbances in Ecosystems 5.A
- Specialist Versus Generalist Species 5.A
- Organisms and Adaptation to Their Environment 5.A
- Natural Disruptions and Their Impacts on Ecosystems 5.A
- Environmental Change and Natural Selection 5.A
- Ecological Succession 5.C
- Keystone Species 5.C
- Indicator Species and Ecosystem Health 5.C
- Pioneer Species and Ecological Succession 5.C
- Disturbances in Ecosystems: Part 2 5.C

Unit 4: Populations

In this unit, students examine how populations in ecosystems change over time and the factors that affect population growth.

Big Ideas: EIN ERT

Topics: **Skill Pairing**

- Life History Strategies 1.B
- Generalist and Specialist Species 1.B
- r and K-selected Species ` 1.B
- Life History Strategies 1.B
- Survivorship Curves 5.C
- Survivorship in r-selected and K-selected Species 5.C
- Population Abundance, Density, and Distribution 5.B
- Carrying Capacity 5.B
- Population Growth Rates and Carrying Capacity 5.B
- Human Population Growth 5.B
- Limiting Factors and Effects on Population Growth 7.A
- Doubling Time of a Human Population 7.A
- Population Growth Rates 1.C
- Demographic Transition 1.C
- Stages of Demographic Transition 1.C

Unit 5: Earth Systems and Resources

In this unit, students study the natural components that make up the environment, from geologic features to the atmosphere and climate.

Big Ideas: ERT ENG

Topics:	**Skill Pairing**
The Lithosphere	2.C
Convection and Plate Tectonics	2.C
Convergent and Divergent Boundaries	2.C
Transform Boundaries	2.C
Soil Formation	2.C
Soil Horizons	4.C
Soil Erosion	2.C
Soils and Water Quality	2.C
Effects on Soil Properties: Particle Size and Composition	4.C
Testing Methods for Soil Properties	4.C
Using a Soil Texture Triangle	2.B
Major Gases of Earth's Atmosphere	2.A
Layers of the Atmosphere	2.B
Global Wind Patterns	2.A
Coriolis Effect	2.A
Weather, Climate, and Geography	2.B
Rain Shadow and Effect on Local Climate	2.B
El Niño and La Niña	2.B
Seasons, Latitude, and Solar Radiation	2.B
Latitude and the Seasons	2.B
Seasons: Longest Summer and Shortest Winter Days	2.B
The Hydrosphere: Freshwater	7.C

Unit 6: Semester Review and Practice Exam

In this unit, students will review the previous five units.

Activities:

- Semester 1 Review
- Complete Unit 6 Exam

Unit 7: Land and Water Use

In this unit, students examine how humans use and consume natural resources and how we disrupt ecosystems, both positively and negatively.

Big Ideas: EIN STB

Topics:	**Skill Pairing**
The Tragedy of the Commons (CERCLA)	1.B
Clearcutting and the Environment	1.A
The Green Revolution and Global Agricultural Production	3.A 3.B 3.C 3.D 3.E

• Impacts of Agricultural Practices	1.A
• Irrigation Methods	7.C
• Pest Control Methods	7.E
• Meat Production Methods	5.E
• Impacts of Overfishing	7.B
• Impacts of Mining	7.B
• Impacts of Urbanization	7.E
• Ecological Footprints	5.E
• Introduction to Sustainability	5.E
• Methods to Reduce Urban Runoff	4.B
• Integrated Pest Management	7.D
• Sustainable Agriculture	7.E
• Aquaculture	7.C
• Sustainable Forestry	7.F

Unit 8: Energy Resources and Consumption

In this unit, students learn about renewable and nonrenewable sources of energy, where they're used, and their impact on the environment.

Big Ideas: ENG

Topics:	**Skill Pairing**
• Renewable and Nonrenewable Resources	1.C
• Global Energy Consumption	6.C
• Fuel Types and Uses	1.A
• Distribution of Natural Energy Resources	2.B
• Fossil Fuels	7.A
• Nuclear Power	2.B
• Energy from Biomass	7.B
• Solar Energy	5.C
• Hydroelectric Power	7.F
• Geothermal Energy	1.B
• Hydrogen Fuel Cell	1.C
• Wind Energy	7.B
• Energy Conservation	7.C

Unit 9: Energy Resources

In this unit, students learn more about air pollution, including how human actions can cause it. Students also analyze legislation intended to regulate emissions and improve air quality.

Big Ideas: STB

Topics:	Skill Pairing
• Introduction: Air Pollution Sources and Effects (Clean Air Act)	7.A
• Photochemical Smog	5.B
• Thermal Inversion and Pollution	2.C
• Atmospheric $C0_2$ and Particulates	1.A
• Indoor Air Pollution	5.C
• Acid Rain: Causes and Effects	1.A
• Noise Pollution	3.A 3.C 3.D 3.E

Unit 10: Aquatic and Terrestrial Pollution

In this unit, students examine the impact of pollution on ecosystems and learn how to determine its source.

Big Ideas: STB EIN

Topics:	Skill Pairing
• Sources of Pollution	1.A
• Human Impacts on Ecosystems (Clean Water Act, SDWA)	6.B
• Endocrine Disruptors	1.A
• Human Impacts on Wetlands and Mangroves	7.B
• Eutrophication	2.C
• Thermal Pollution	1.C
• Persistent Organic Pollutants (POPs)	1.B
• Impacts of Solid Waste Disposal in Aquatic Environments	7.D
○ Bioaccumulation and Biomagnification (RCRA)	
• Waste Reduction Methods	6.B
• Sewage Treatment	2.A
• Lethal Dose 50 (LD_{50})	6.A
• Dose Response Curve	5.E
• Pollution and Human Health (Delaney Clause of Food, Drug, and Cosmetic Act)	4.C
• Pathogens and Infectious Disease	2.B

Unit 11: Global Change

In this unit, students come to understand the global impact of local and regional human activities and evaluate and propose solutions.

Big Ideas: STB EIN

Topics:	Skill Pairing
• Stratospheric Ozone Depletion	1.A
• Reducing Ozone Depletion (Montreal Protocol)	7.B

- The Greenhouse Effect 1.B
- Increases in Greenhouse Gases (Kyoto Protocol) 2.C
- Global Climate Change 5.D
- Ocean Warming 7.A
- Ocean Acidification 1.C
- Invasive Species 7.E
- Endangered Species (CITES, Endangered Species Act) 7.D
- Human Impacts on Biodiversity 7.C

Unit 12: Exam Review and Practice Exam

In this unit, students review for and complete an AP Environmental Science Exam.

Labs and Activities

Lab Portfolio: Students are required to keep a lab portfolio that includes all lab reports completed throughout the course.

Lab Report Components:

- Title
- Essential Question with Answer
- Hypothesis
- Lab Procedure Summary
- Data
- Analysis Questions
- Application and Reflection Questions

Unit 1

Wet Lab: The Scientific Method 4.D

In this lab, students will review and begin applying the scientific method to inquiry-based labs. Students will use the scientific method to design their own experiments. They will develop an experiment consisting of two mini-experiments to: 1) determine how temperature affects the rate of dissolving an antacid tablet and 2) determine how changing the surface area affects the rate of dissolving an antacid tablet. *Science Practice 1: Concept Explanation* CR4

Unit 2

Wet Lab: Chemical Weathering: Carbonation vs. Hydrolysis 4.D

In this lab, students compare weak acids and water in the process of chemical weathering of rocks. Students will design an experiment to compare the effects of carbonation and hydrolysis on rocks. They will determine which type of weathering, carbonation (addition of acid) or hydrolysis (addition of water), breaks down chalk more rapidly. *Practice 4: Scientific Experiments* CR7

Wet Lab: Study Your Biome 4.D

In this lab, students will determine the biome that they live in by exploring the abiotic and biotic factors of their local environment.

Wet Lab: Primary Productivity of Grass 4.D

In this lab, students will discover primary productivity and how sunlight influences net productivity in an ecosystem.

Unit 3

Wet Lab: Modeling Species Abundance and Diversity of Pollinators 4.D

In this lab, students will model the diversity of pollinators and calculate the diversity index of two different sample groups.

Wet Lab: Island Biogeography 4.D

In this lab, students will observe the migration of species to islands from the mainland and model how this affects the islands' biogeography.

Interactive Simulation: Natural Selection 4.D

In this interactive simulation, students will experience natural selection by observing organisms and their adaptation to the environment through imagery and visual manipulation.

Virtual Lab: Evidence of Succession 4.D

In this virtual lab, students will examine ecological succession and its role in forming a climax community. Students will design a climax community by introducing plants and animals to an ecosystem in a specific order.

Unit 4

Virtual Lab: Effects of Limiting Factors on Population Growth 4.D

In this virtual lab, students analyze factors that limit population growth through land and resource allocation.

Activity: Can We Feed The Growing Population

In this activity, students will be challenged in a variety of ways to discover how humans have changed Earth. This data-driven activity will allow students to critically consider the uses and changes of land around the world and how population, climate, and resources play a role in those changes. *Science Practice 5: Data Analysis* CR8

Unit 5

Wet Lab: Climate Change and Cities Engineering Design 4.D

In this lab, students develop an engineering design solution using temperature data that they have collected to determine materials and landscaping that will help lower temperatures in their school building or home.

Unit 6

Semester 1 Review

Semester 1 Exam

Unit 7

Wet Lab: The Tragedy of the Commons 4.D

In this lab, students will analyze the tragedy of the commons and why it is important to manage shared resources sustainably. Students will simulate fishing over four fishing seasons while making sure that enough fish are remaining at the end of each season to replenish the fish caught. Each season, they will calculate the amount of money they earned through fishing. *Science Practice 7: Environmental Solutions* CR10

Virtual Lab: Genetically Modified Corn 4.D

In this virtual lab, students discover how genetically modified (GM) corn is created and how it compares to natural/organic corn.

Unit 8

Activity: A Tale of Two Watersheds

In this activity, students will explore and compare two unique watersheds. As they analyze the differences, they will predict how these watersheds would be different given different circumstances and decide what preventive measures could be taken to protect them. *Science Practice 2: Visual Representations* CR5

Unit 9

Interactive Simulation: Determining Sources of Air Pollution in an Industrialized Area 4.D 4.E

In this interactive simulation, students analyze and identify sources of air pollution and pollutant reduction in the vicinity of an industrialized city.

Wet Lab: Airborne Particulates 4.C 4.D

In this lab, students decipher how atmospheric particulates can affect our health and impact air quality.

Virtual Lab: Acid Rain and the Water Cycle 4.B 4.D

In this virtual lab, students determine the impact of acid rain on water pH levels and the effects on the environment. They also examine ways to prevent acid rain.

Noise Pollution Activity

In this activity, students will immerse themselves in the legislation known as the Clean Air Act Title IV—Noise Pollution. As they uncover the elements that make up this act, they are led to investigate its intentions, bias, accuracy, and credibility. Ultimately, students are tasked with expanding on the role of the EPA in its efforts to ensure the people are protected from violators and the impact that noise pollution has on the health and well-being of American citizens. *Science Practice 3: Text Analysis* CR6

Unit 10

Interactive Simulation: Nonpoint and Point Source Pollution Investigation 4.D 7.A

In this interactive simulation, students engage in a scenario focused on pollution to better understand where pollution originates.

Wet Lab: Bioaccumulation and Biomagnification 4.A 4.D

In this lab, students learn about how plastics in the ocean combine with persistent organic pollutants (POPs) and how they are passed up through a food web.

Activity: Lethal Dose 50 (LD_{50}) 4.E

In this activity, students will analyze a data set and work to discover how to assist Farmer Frank in the task of dosing his farm animals with medication they need to stay healthy. It is the student's job to ensure Farmer Frank takes the right approach while ensuring the animals' safety. *Science Practice 9: Mathematical Routines* **CR9**

Unit 11

Interactive Simulation: Ozone Depleting Chemicals **4.D** **7.B**

In this interactive simulation, students will recognize the ozone cycle and how ozone-depleting chemicals interfere with this process. Students will then model how CFCs interfere with the natural cycle of ozone reactions in the atmosphere.

Wet Lab: Climate Change Inquiry **4.D**

In this lab, students learn about climate change by performing three experiments that investigate indicators of climate change, including melting ice and sea-level rise, CO_2 and impacts on air temperature, and sea ice and its effect on water temperature.

Unit 12

Semester 2 Review

Semester 2 Exam

Two Practice Exams