AP ENVIRONMENTAL SCIENCE

UNIT 4

Earth Systems and Resources

10–15%
AP EXAM WEIGHTING

~11–12
CLASS PERIODS

Remember to go to **AP Classroom** to assign students the online **Personal Progress Check** for this unit.

Whether assigned as homework or completed in class, the **Personal Progress Check** provides each student with immediate feedback related to this unit's topics and skills.

Personal Progress Check 4

Multiple-choice: ~25 questions
Free-response: 1 question

- Design an investigation

UNIT 4

10–15% AP EXAM WEIGHTING | **~11–12** CLASS PERIODS

Earth Systems and Resources

BIG IDEA 1
Energy Transfer ENG
- How does energy from the sun influence the weather?

BIG IDEA 2
Interactions Between Earth Systems ERT
- How can earthquakes be predicted?

Developing Understanding

This unit explores earth systems and its resources that support life. Geological changes that occur to earth systems at convergent and divergent boundaries can result in the creation of mountains, island arcs, earthquakes, volcanoes, and seafloor spreading. Soils are a resource, formed when parent material is weathered, transported, and deposited. The atmosphere is another resource, composed of certain percentages of major gases. Climate is influenced by the sun's energy, Earth's geography, and the movement of air and water. In subsequent units, students will examine how humans use natural resources and the impact on the environment.

Building the Science Practices

1.C 2.A 2.B

In this unit, students can practice analyzing and interpreting qualitative models and representations of environmental issues. The ability to describe global maps and maps of plate boundaries is key to explaining the global changes that occur at plate boundaries. Climatograms may also be introduced in this unit. To develop an understanding of the relationship between the geography of the earth and climate, students may benefit from describing the impact of El Niño on marine food chains, and other specific examples.

Students should be able to identify and describe environmental processes displayed visually. They can also practice explaining the meaning of a diagram or infographic, ultimately building to the ability to explain the consequences of a change in an environmental process (i.e., "What would happen if …") in later units. To help students build understanding in this area, it may be useful for them to perform a soil/water capacity lab.

Preparing for the AP Exam

On the AP Exam, students must be able to explain representations of convergent, divergent, and transform boundaries present on a global map. To practice this, students can examine global maps to identify the distribution of global plate boundaries. Students should also practice analyzing characteristics of soil. They can perform guided inquiry labs related to soil analysis and formation. Data show a strong correlation between the strength of students' conceptual understanding and their experience performing hands-on labs.

Students can also practice identifying how climate factors influence the rate of soil formation. They should indicate if that factor speeds up or slows down the rate of formation. Students may benefit from connecting visual representations with explanations of the Earth's atmosphere/geography, climate, global wind patterns, solar radiation, and the Earth's seasons.

UNIT AT A GLANCE

Enduring Understanding	Topic	Suggested Skill	Class Periods ~11–12 CLASS PERIODS
ERT-4	**4.1 Plate Tectonics**	2.C Explain how environmental concepts and processes represented visually relate to broader environmental issues.	
	4.2 Soil Formation and Erosion	4.B Identify a research method, design, and/or measure used.	
	4.3 Soil Composition and Properties	4.C Describe an aspect of a research method, design, and/or measure used.	
	4.4 Earth's Atmosphere	2.A Describe characteristics of an environmental concept, process, or model represented visually.	
	4.5 Global Wind Patterns	2.B Explain relationships between different characteristics of environmental concepts, processes, or models represented visually: ▪ In theoretical contexts ▪ In applied contexts	
	4.6 Watersheds	1.C Explain environmental concepts, processes, or models in applied contexts.	
ENG-2	**4.7 Solar Radiation and Earth's Seasons**	2.A Describe characteristics of an environmental concept, process, or model represented visually.	
	4.8 Earth's Geography and Climate	2.B Explain relationships between different characteristics of environmental concepts, processes, or models represented visually: ▪ In theoretical contexts ▪ In applied contexts	
	4.9 El Niño and La Niña	7.A Describe environmental problems.	
	Go to **AP Classroom** to assign the **Personal Progress Check** for Unit 4. Review the results in class to identify and address any student misunderstandings.		

SAMPLE INSTRUCTIONAL ACTIVITIES

The sample activities on this page are optional and are offered to provide possible ways to incorporate various instructional approaches into the classroom. They were developed in partnership with teachers from the AP community to share ways that they approach teaching some of the topics in this unit. Please refer to the Instructional Approaches section beginning on p. 201 for more examples of activities and strategies.

Activity	Topic	Sample Activity
1	4.1	**Construct an Argument** Provide students with a map and coordinates for earthquakes and volcanoes. Have them plot the location of these events and then compare their map to a map where the major plate boundaries are drawn. Then ask them to explain why these activities occur at plate boundaries.
2	4.4	**One-Minute Essay** Ask students to identify the four major layers of the atmosphere and describe the general temperature profile for each layer. They should also explain briefly why the troposphere and the stratosphere are impacted by air pollution.
3	4.9	**Ask the Expert** Divide the class into two groups that represent El Niño experts and two others that represent La Niña experts. Have students rotate through the groups with index cards. As they rotate, have them collect information on El Niño and La Niña and their impact on global weather pattern.

Unit Planning Notes

Use the space below to plan your approach to the unit.

SUGGESTED SKILL

Visual Representations

2.C

Explain how environmental concepts and processes represented visually relate to broader environmental issues.

AVAILABLE RESOURCES

- Classroom Resource > **Understanding Topographic Maps and Their Construction**
- The Exam > **Student Performance Q&A 2014, Q3**
- The Exam > **Samples and Commentary 2014, Q3**

TOPIC 4.1
Plate Tectonics

Required Course Content

ENDURING UNDERSTANDING

ERT-4

Earth's systems interact, resulting in a state of balance over time.

LEARNING OBJECTIVE

ERT-4.A

Describe the geological changes and events that occur at convergent, divergent, and transform plate boundaries.

ESSENTIAL KNOWLEDGE

ERT-4.A.1

Convergent boundaries can result in the creation of mountains, island arcs, earthquakes, and volcanoes.

ERT-4.A.2

Divergent boundaries can result in seafloor spreading, rift valleys, volcanoes, and earthquakes.

ERT-4.A.3

Transform boundaries can result in earthquakes.

ERT-4.A.4

Maps that show the global distribution of plate boundaries can be used to determine the location of volcanoes, island arcs, earthquakes, hot spots, and faults.

ERT-4.A.5

An earthquake occurs when stress overcomes a locked fault, releasing stored energy.

TOPIC 4.2
Soil Formation and Erosion

Required Course Content

ENDURING UNDERSTANDING

ERT-4

Earth's systems interact, resulting in a state of balance over time.

LEARNING OBJECTIVE

ERT-4.B

Describe the characteristics and formation of soil.

ESSENTIAL KNOWLEDGE

ERT-4.B.1

Soils are formed when parent material is weathered, transported, and deposited.

ERT-4.B.2

Soils are generally categorized by horizons based on their composition and organic material.

ERT-4.B.3

Soils can be eroded by winds or water. Protecting soils can protect water quality as soils effectively filter and clean water that moves through them.

SUGGESTED SKILL

Scientific Experiments

4.B

Identify a research method, design, and/or measure used.

AVAILABLE RESOURCES

- External Resource > **Environmental Literacy Council's AP Environmental Science Course Material**
- The Exam > Chief Reader Report (**2018 Q2 & Q4**, **2017, Q1, Q3, & Q4**)
- The Exam > Samples and Commentary (**2018, Q2**, **2018, Q4**, **2017, Q3**, **2017, Q4**)

SUGGESTED SKILL

Scientific Experiments

4.C

Describe an aspect of a research method, design, and/or measure used.

AVAILABLE RESOURCES

- External Resource > **Environmental Literacy Council's AP Environmental Science Course Material**

TOPIC 4.3
Soil Composition and Properties

Required Course Content

ENDURING UNDERSTANDING

ERT-4

Earth's systems interact, resulting in a state of balance over time.

LEARNING OBJECTIVE

ERT-4.C

Describe similarities and differences between properties of different soil types.

ESSENTIAL KNOWLEDGE

ERT-4.C.1

Water holding capacity—the total amount of water soil can hold—varies with different soil types. Water retention contributes to land productivity and fertility of soils.

ERT-4.C.2

The particle size and composition of each soil horizon can affect the porosity, permeability, and fertility of the soil.

ERT-4.C.3

There are a variety of methods to test the chemical, physical, and biological properties of soil that can aid in a variety of decisions, such as irrigation and fertilizer requirements.

ERT-4.C.4

A soil texture triangle is a diagram that allows for the identification and comparison of soil types based on their percentage of clay, silt, and sand.

TOPIC 4.4
Earth's Atmosphere

Required Course Content

ENDURING UNDERSTANDING

ERT-4

Earth's systems interact, resulting in a state of balance over time.

LEARNING OBJECTIVE

ERT-4.D

Describe the structure and composition of the Earth's atmosphere.

ESSENTIAL KNOWLEDGE

ERT-4.D.1

The atmosphere is made up of major gases, each with its own relative abundance.

ERT-4.D.2

The layers of the atmosphere are based on temperature gradients and include the troposphere, stratosphere, mesosphere, thermosphere, and exosphere.

SUGGESTED SKILL

Visual Representations

2.A

Describe characteristics of an environmental concept, process, or model represented visually.

AVAILABLE RESOURCES

- Classroom Resource > **"Weather or Not": AP Environmental Science and the Atmosphere**
- Classroom Resource > **Introductory Concepts for Understanding Climate**
- The Exam > **Chief Reader Report 2018, Q4**
- The Exam > **Samples and Commentary 2018, Q4**

SUGGESTED SKILL

Visual Representations

2.B

Explain relationships between different characteristics of environmental concepts, processes, or models represented visually:

- In theoretical contexts
- In applied contexts

AVAILABLE RESOURCES

- Classroom Resource > **"Weather or Not": AP Environmental Science and the Atmosphere**
- Classroom Resource > **Introductory Concepts for Understanding Climate**
- The Exam > **Chief Reader Report 2018, Q2**
- The Exam > **Samples and Commentary 2018, Q2**

TOPIC 4.5
Global Wind Patterns

Required Course Content

ENDURING UNDERSTANDING

ERT-4

Earth's systems interact, resulting in a state of balance over time.

LEARNING OBJECTIVE

ERT-4.E

Explain how environmental factors can result in atmospheric circulation.

ESSENTIAL KNOWLEDGE

ERT-4.E.1

Global wind patterns primarily result from the most intense solar radiation arriving at the equator, resulting in density differences and the Coriolis effect.

TOPIC 4.6
Watersheds

Required Course Content

ENDURING UNDERSTANDING

ERT-4

Earth's systems interact, resulting in a state of balance over time.

LEARNING OBJECTIVE

ERT-4.F

Describe the characteristics of a watershed.

ESSENTIAL KNOWLEDGE

ERT-4.F.1

Characteristics of a given watershed include its area, length, slope, soil, vegetation types, and divides with adjoining watersheds.

SUGGESTED SKILL

Concept Explanation

1.C

Explain environmental concepts, processes, or models in applied contexts.

AVAILABLE RESOURCES

- Classroom Resource > **AP Environmental Science Teacher's Guide**
- The Exam > **Chief Reader Report 2017, Q3**
- The Exam > **Samples and Commentary 2017, Q3**

SUGGESTED SKILL

Visual Representations

2.A

Describe characteristics of an environmental concept, process, or model represented visually.

AVAILABLE RESOURCES

- Classroom Resource > **AP Environmental Science Teacher's Guide**
- Classroom Resource > **Energy and Climate Change**
- The Exam > **Chief Reader Report 2017, Q3**
- The Exam > **Student Performance Q&A 2014, Q2**
- The Exam > Samples and Commentary (**2017, Q3, 2014, Q2**)

TOPIC 4.7
Solar Radiation and Earth's Seasons

Required Course Content

ENDURING UNDERSTANDING

ENG-2

Most of the Earth's atmospheric processes are driven by input of energy from the sun.

LEARNING OBJECTIVE

ENG-2.A

Explain how the sun's energy affects the Earth's surface.

ESSENTIAL KNOWLEDGE

ENG-2.A.1

Incoming solar radiation (insolation) is the Earth's main source of energy and is dependent on season and latitude.

ENG-2.A.2

The angle of the sun's rays determines the intensity of the solar radiation. Due to the shape of the Earth, the latitude that is directly horizontal to the solar radiation receives the most intensity.

ENG-2.A.3

The highest solar radiation per unit area is received at the equator and decreases toward the poles.

ENG-2.A.4

The solar radiation received at a location on the Earth's surface varies seasonally, with the most radiation received during the location's longest summer day and the least on the shortest winter day.

ENG-2.A.5

The tilt of Earth's axis of rotation causes the Earth's seasons and the number of hours of daylight in a particular location on the Earth's surface.

TOPIC 4.8
Earth's Geography and Climate

Required Course Content

ENDURING UNDERSTANDING

ENG-2

Most of the Earth's atmospheric processes are driven by input of energy from the sun.

LEARNING OBJECTIVE

ENG-2.B

Describe how the Earth's geography affects weather and climate.

ESSENTIAL KNOWLEDGE

ENG-2.B.1

Weather and climate are affected not only by the sun's energy but by geologic and geographic factors, such as mountains and ocean temperature.

ENG-2.B.2

A rain shadow is a region of land that has become drier because a higher elevation area blocks precipitation from reaching the land.

SUGGESTED SKILL

Visual Representations

2.B

Explain relationships between different characteristics of environmental concepts, processes, or models represented visually:

- In theoretical contexts
- In applied contexts

AVAILABLE RESOURCES

- Classroom Resource > **AP Environmental Science Teacher's Guide**
- Classroom Resource > **Introductory Concepts for Understanding Climate**
- The Exam > **Chief Reader Report, 2017 Q3**
- The Exam > **Student Performance Q&A 2016, Q1 & Q4**
- The Exam > Samples and Commentary (**2017 Q3**, **2016, Q1**, **2016, Q4**)

SUGGESTED SKILL

Environmental Solutions

7.A

Describe environmental problems.

AVAILABLE RESOURCES

- Classroom Resource > **AP Environmental Science Teacher's Guide**
- Classroom Resource > **Introductory Concepts for Understanding Climate**

TOPIC 4.9
El Niño and La Niña

Required Course Content

ENDURING UNDERSTANDING

ENG-2

Most of the Earth's atmospheric processes are driven by input of energy from the sun.

LEARNING OBJECTIVE

ENG-2.C

Describe the environmental changes and effects that result from El Niño or La Niña events (El Niño–Southern Oscillation).

ESSENTIAL KNOWLEDGE

ENG-2.C.1

El Niño and La Niña are phenomena associated with changing ocean surface temperatures in the Pacific Ocean. These phenomena can cause global changes to rainfall, wind, and ocean circulation patterns.

ENG-2.C.2

El Niño and La Niña are influenced by geological and geographic factors and can affect different locations in different ways.