

AP ENVIRONMENTAL SCIENCE

UNIT 6

Energy
Resources and
Consumption



10–15%
AP EXAM WEIGHTING



~16–17
CLASS PERIODS

The icon consists of a white circle containing a blue square with the letters 'AP' in white. Below the square are two short horizontal lines, suggesting a computer monitor or a screen.

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 6

Multiple-choice: ~35 questions

Free-response: 1 question

- Analyze an environmental problem and propose a solution doing calculations

Energy Resources and Consumption



Developing Understanding

BIG IDEA 1

Energy Transfer **ENG**

- Why are fossil fuels the most widely used energy resources if they are nonrenewable?

This unit examines human use of renewable and nonrenewable sources of energy and its impact on the environment. Energy consumption differs throughout the world and the availability of natural energy resources depends on the region's geologic history. Subsequent units will examine the impact of human activity on the atmosphere, land, and water.

Building the Science Practices

1.A 1.B 1.C

In this unit, students can practice identifying where natural energy resources occur (e.g., coal, crude oil, ores) on a global map. They can also practice describing other forms of energy and differentiating between nonrenewable and renewable forms of energy. Students may struggle with vocabulary related to this subject matter. Students also tend to misunderstand radioactivity and think that all radiation is bad.

Text analysis is also an important skill for students to build upon in this unit. When reading texts about topics in this unit, students can practice identifying the claims as well as describing the perspectives and assumptions of the author.

Preparing for the AP Exam

On the AP Exam, students must be able to explain concepts related to renewable and nonrenewable energy sources. They may benefit from in-class opportunities to practice comparing and contrasting different sources of fuel and how they are used, with an emphasis on the impacts of usage on the environment. Students often struggle with applying appropriate mathematical relationships to determine the amount of energy produced or used based on the given information. To combat this, teachers can provide multiple opportunities for students to manipulate formulae and use the data provided to solve a problem, especially problems that use dimensional analysis and multiple steps. They should provide a numerical answer and unit, if required.

Students will also need to explain environmental problems related to the use of different energy resources and propose solutions. To that end, students may benefit from multiple opportunities to propose realistic solutions to environmental problems related to the use of different energy sources.

UNIT AT A GLANCE

Enduring Understanding	Topic	Suggested Skill	Class Periods
			~16–17 CLASS PERIODS
ENG-3	6.1 Renewable and Nonrenewable Resources	1.C Explain environmental concepts, processes, or models in applied contexts.	
	6.2 Global Energy Consumption	6.C Calculate an accurate numeric answer with appropriate units.	
	6.3 Fuel Types and Uses	1.A Describe environmental concepts and processes.	
	6.4 Distribution of Natural Energy Resources	2.B Explain relationships between different characteristics of environmental concepts, processes, or models represented visually: <ul style="list-style-type: none"> ▪ In theoretical contexts ▪ In applied contexts 	
	6.5 Fossil Fuels	7.A Describe environmental problems.	
	6.6 Nuclear Power	2.B Explain relationships between different characteristics of environmental concepts, processes, or models represented visually: <ul style="list-style-type: none"> ▪ In theoretical contexts ▪ In applied contexts 	
	6.7 Energy from Biomass	7.B Describe potential responses or approaches to environmental problems.	
	6.8 Solar Energy	5.C Explain patterns and trends in data to draw conclusions.	
	6.9 Hydroelectric Power	7.F Justify a proposed solution, by explaining potential advantages.	
	6.10 Geothermal Energy	1.B Explain environmental concepts and processes.	
	6.11 Hydrogen Fuel Cell	1.C Explain environmental concepts, processes, or models in applied contexts.	
	6.12 Wind Energy	7.B Describe potential responses or approaches to environmental problems.	
	6.13 Energy Conservation	6.C Calculate an accurate numeric answer with appropriate units.	
	Go to AP Classroom to assign the Personal Progress Check for Unit 6. 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	6.1	Fishbowl Divide students into two groups and arrange them in an inner and outer circle. Assign students in the inner group a type of nonrenewable resource and assign the students in the outer group a type of renewable resource. Have them move through the circle reporting on one pro and one con for each resource. Then have them make a list summarizing the pros and cons of each resource.
2	6.9	Debate Divide the class into three groups. Assign one group to represent the pros of creating a dam for hydroelectric power. Assign the second group to represent the cons of creating a dam for hydroelectric power. Assign the third group to represent the panel of judges. Have students debate the merits of each side and allow the panel of judges to vote on the winner of the debate.



Unit Planning Notes

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

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 2018 Q1 & Q2](#)
- The Exam > Samples and Commentary ([2018 Q1](#), [2018, Q2](#))

TOPIC 6.1

Renewable and Nonrenewable Resources

Required Course Content

ENDURING UNDERSTANDING**ENG-3**

Humans use energy from a variety of sources, resulting in positive and negative consequences.

LEARNING OBJECTIVE**ENG-3.A**

Identify differences between nonrenewable and renewable energy sources.

ESSENTIAL KNOWLEDGE**ENG-3.A.1**

Nonrenewable energy sources are those that exist in a fixed amount and involve energy transformation that cannot be easily replaced.

ENG-3.A.2

Renewable energy sources are those that can be replenished naturally, at or near the rate of consumption, and reused.

TOPIC 6.2

Global Energy Consumption

SUGGESTED SKILL

 *Mathematical Routines*

6.C

Calculate an accurate numeric answer with appropriate units.



Required Course Content

ENDURING UNDERSTANDING

ENG-3

Humans use energy from a variety of sources, resulting in positive and negative consequences.

LEARNING OBJECTIVE

ENG-3.B

Describe trends in energy consumption.

ESSENTIAL KNOWLEDGE

ENG-3.B.1

The use of energy resources is not evenly distributed between developed and developing countries.

ENG-3.B.2

The most widely used sources of energy globally are fossil fuels.

ENG-3.B.3

As developing countries become more developed, their reliance on fossil fuels for energy increases.

ENG-3.B.4

As the world becomes more industrialized, the demand for energy increases.

ENG-3.B.5

Availability, price, and governmental regulations influence which energy sources people use and how they use them.

AVAILABLE RESOURCES

- Classroom Resource > [AP Environmental Science Teacher's Guide](#)
- Classroom Resource > [Quantitative Skills in the AP Sciences \(2018\)](#)
- The Exam > [Chief Reader Report 2018, Q1](#)
- The Exam > [Samples and Commentary 2018, Q1](#)

SUGGESTED SKILL

 *Concept Explanation***1.A**

Describe environmental concepts and processes.



AVAILABLE RESOURCES

- Classroom Resource > [AP Environmental Science Teacher's Guide](#)
- The Exam > Chief Reader Report (2018 Q1 & Q2, 2017, Q4)
- The Exam > Samples and Commentary (2018 Q1, 2018, Q2, 2017, Q4)

TOPIC 6.3

Fuel Types and Uses

Required Course Content

ENDURING UNDERSTANDING

ENG-3

Humans use energy from a variety of sources, resulting in positive and negative consequences.

LEARNING OBJECTIVE

ENG-3.C

Identify types of fuels and their uses.

ESSENTIAL KNOWLEDGE

ENG-3.C.1

Wood is commonly used as fuel in the forms of firewood and charcoal. It is often used in developing countries because it is easily accessible.

ENG-3.C.2

Peat is partially decomposed organic material that can be burned for fuel.

ENG-3.C.3

Three types of coal used for fuel are lignite, bituminous, and anthracite. Heat, pressure, and depth of burial contribute to the development of various coal types and their qualities.

ENG-3.C.4

Natural gas, the cleanest of the fossil fuels, is mostly methane.

ENG-3.C.5

Crude oil can be recovered from tar sands, which are a combination of clay, sand, water, and bitumen.

ENG-3.C.6

Fossil fuels can be made into specific fuel types for specialized uses (e.g., in motor vehicles).

ENG-3.C.7

Cogeneration occurs when a fuel source is used to generate both useful heat and electricity.

TOPIC 6.4

Distribution of Natural Energy Resources

Required Course Content

ENDURING UNDERSTANDING

ENG-3

Humans use energy from a variety of sources, resulting in positive and negative consequences.

LEARNING OBJECTIVE

ENG-3.D

Identify where natural energy resources occur.

ESSENTIAL KNOWLEDGE

ENG-3.D.1

The global distribution of natural energy resources, such as ores, coal, crude oil, and gas, is not uniform and depends on regions' geologic history.

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](#)

SUGGESTED SKILL

 Environmental Solutions

7.A

Describe environmental problems.



AVAILABLE RESOURCES

- Classroom Resource > [AP Environmental Science Teacher's Guide](#)
- The Exam > [Chief Reader Report 2018, Q1](#)
- The Exam > [Samples and Commentary 2018, Q1](#)

TOPIC 6.5

Fossil Fuels

Required Course Content

ENDURING UNDERSTANDING

ENG-3

Humans use energy from a variety of sources, resulting in positive and negative consequences.

LEARNING OBJECTIVE

ENG-3.E

Describe the use and methods of fossil fuels in power generation.

ENG-3.F

Describe the effects of fossil fuels on the environment.

ESSENTIAL KNOWLEDGE

ENG-3.E.1

The combustion of fossil fuels is a chemical reaction between the fuel and oxygen that yields carbon dioxide and water and releases energy.

ENG-3.E.2

Energy from fossil fuels is produced by burning those fuels to generate heat, which then turns water into steam. That steam turns a turbine, which generates electricity.

ENG-3.E.3

Humans use a variety of methods to extract fossil fuels from the earth for energy generation.

ENG-3.F.1

Hydrologic fracturing (fracking) can cause groundwater contamination and the release of volatile organic compounds.

TOPIC 6.6

Nuclear Power

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](#)
- The Exam > [Student Performance Q&A 2014, Q1](#)
- The Exam > [Samples and Commentary 2014, Q1](#)

Required Course Content

ENDURING UNDERSTANDING

ENG-3

Humans use energy from a variety of sources, resulting in positive and negative consequences.

LEARNING OBJECTIVE

ENG-3.G

Describe the use of nuclear energy in power generation.

ESSENTIAL KNOWLEDGE

ENG-3.G.1

Nuclear power is generated through fission, where atoms of Uranium-235, which are stored in fuel rods, are split into smaller parts after being struck by a neutron. Nuclear fission releases a large amount of heat, which is used to generate steam, which powers a turbine and generates electricity.

ENG-3.G.2

Radioactivity occurs when the nucleus of a radioactive isotope loses energy by emitting radiation.

ENG-3.G.3

Uranium-235 remains radioactive for a long time, which leads to the problems associated with the disposal of nuclear waste.

ENG-3.G.4

Nuclear power generation is a nonrenewable energy source. Nuclear power is considered a cleaner energy source because it does not produce air pollutants, but it does release thermal pollution and hazardous solid waste.

continued on next page

LEARNING OBJECTIVE**ENG-3.H**

Describe the effects of the use of nuclear energy on the environment.

ESSENTIAL KNOWLEDGE**ENG-3.H.1**

Three Mile Island, Chernobyl, and Fukushima are three cases where accidents or natural disasters led to the release of radiation. These releases have had short- and long-term impacts on the environment.

ENG-3.H.2

A radioactive element's half-life can be used to calculate a variety of things, including the rate of decay and the radioactivity level at specific points in time.

TOPIC 6.7

Energy from Biomass

SUGGESTED SKILL

 *Environmental Solutions***7.B**

Describe potential responses or approaches to environmental problems.



AVAILABLE RESOURCES

- Classroom Resource > [AP Environmental Science Teacher's Guide](#)
- The Exam > [Chief Reader Report 2018, Q4](#)
- The Exam > [Samples and Commentary 2018, Q4](#)

Required Course Content

ENDURING UNDERSTANDING

ENG-3

Humans use energy from a variety of sources, resulting in positive and negative consequences.

LEARNING OBJECTIVE

ENG-3.I

Describe the effects of the use of biomass in power generation on the environment.

ESSENTIAL KNOWLEDGE

ENG-3.I.1

Burning of biomass produces heat for energy at a relatively low cost, but it also produces carbon dioxide, carbon monoxide, nitrogen oxides, particulates, and volatile organic compounds. The overharvesting of trees for fuel also causes deforestation.

ENG-3.I.2

Ethanol can be used as a substitute for gasoline. Burning ethanol does not introduce additional carbon into the atmosphere via combustion, but the energy return on energy investment for ethanol is low.

SUGGESTED SKILL

 Data Analysis

5.C

Explain patterns and trends in data to draw conclusions.



AVAILABLE RESOURCES

- Classroom Resource > [AP Environmental Science Teacher's Guide](#)
- The Exam > [Chief Reader Report 2018, Q1](#)
- The Exam > [Student Performance Q&A 2014, Q2](#)
- The Exam > [Samples and Commentary \(2018, Q1, 2014, Q2\)](#)

TOPIC 6.8

Solar Energy

Required Course Content

ENDURING UNDERSTANDING

ENG-3

Humans use energy from a variety of sources, resulting in positive and negative consequences.

LEARNING OBJECTIVE

ENG-3.J

Describe the use of solar energy in power generation.

ENG-3.K

Describe the effects of the use of solar energy in power generation on the environment.

ESSENTIAL KNOWLEDGE

ENG-3.J.1

Photovoltaic solar cells capture light energy from the sun and transform it directly into electrical energy. Their use is limited by the availability of sunlight.

ENG-3.J.2

Active solar energy systems use solar energy to heat a liquid through mechanical and electric equipment to collect and store the energy captured from the sun.

ENG-3.J.3

Passive solar energy systems absorb heat directly from the sun without the use of mechanical and electric equipment, and energy cannot be collected or stored.


ENG-3.K.1

Solar energy systems have low environmental impact and produce clean energy, but they can be expensive. Large solar energy farms may negatively impact desert ecosystems.

TOPIC 6.9

Hydroelectric Power

SUGGESTED SKILL

 *Environmental Solutions*

7.F

Justify a proposed solution, by explaining potential advantages.

**AVAILABLE RESOURCES**

- Classroom Resource > [AP Environmental Science Teacher's Guide](#)
- The Exam > [Chief Reader Report 2018, Q1 & Q4](#)
- The Exam > Samples and Commentary ([2018, Q1, 2018, Q4](#))

Required Course Content

ENDURING UNDERSTANDING

ENG-3

Humans use energy from a variety of sources, resulting in positive and negative consequences.

LEARNING OBJECTIVE

ENG-3.L

Describe the use of hydroelectricity in power generation.

ENG-3.M

Describe the effects of the use of hydroelectricity in power generation on the environment.

ESSENTIAL KNOWLEDGE

ENG-3.L.1

Hydroelectric power can be generated in several ways. Dams built across rivers collect water in reservoirs. The moving water can be used to spin a turbine. Turbines can also be placed in small rivers, where the flowing water spins the turbine.

ENG-3.L.2

Tidal energy uses the energy produced by tidal flows to turn a turbine.

ENG-3.M.1

Hydroelectric power does not generate air pollution or waste, but construction of the power plants can be expensive, and there may be a loss of or change in habitats following the construction of dams.

SUGGESTED SKILL

 *Concept Explanation***1.B**

Explain environmental concepts and processes.



AVAILABLE RESOURCES

- Classroom Resource > [AP Environmental Science Teacher's Guide](#)

TOPIC 6.10

Geothermal Energy

Required Course Content

ENDURING UNDERSTANDING

ENG-3

Humans use energy from a variety of sources, resulting in positive and negative consequences.

LEARNING OBJECTIVE

ENG-3.N

Describe the use of geothermal energy in power generation.

ENG-3.O

Describe the effects of the use of geothermal energy in power generation on the environment.

ESSENTIAL KNOWLEDGE

ENG-3.N.1

Geothermal energy is obtained by using the heat stored in the Earth's interior to heat up water, which is brought back to the surface as steam. The steam is used to drive an electric generator.

ENG-3.O.1

The cost of accessing geothermal energy can be prohibitively expensive, as is not easily accessible in many parts of the world. In addition, it can cause the release of hydrogen sulfide.

TOPIC 6.11

Hydrogen Fuel Cell

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](#)

Required Course Content

ENDURING UNDERSTANDING

ENG-3

Humans use energy from a variety of sources, resulting in positive and negative consequences.

LEARNING OBJECTIVE

ENG-3.P

Describe the use of hydrogen fuel cells in power generation.

ENG-3.Q

Describe the effects of the use of hydrogen fuel cells in power generation on the environment.

ESSENTIAL KNOWLEDGE


ENG-3.P.1

Hydrogen fuel cells are an alternate to non-renewable fuel sources. They use hydrogen as fuel, combining the hydrogen and oxygen in the air to form water and release energy (electricity) in the process. Water is the product (emission) of a fuel cell.

ENG-3.Q.1

Hydrogen fuel cells have low environmental impact and produce no carbon dioxide when the hydrogen is produced from water. However, the technology is expensive and energy is still needed to create the hydrogen gas used in the fuel cell.

SUGGESTED SKILL

 Environmental Solutions

7.B

Describe potential responses or approaches to environmental problems.



AVAILABLE RESOURCES

- Classroom Resource > [AP Environmental Science Teacher's Guide](#)
- The Exam > [Chief Reader Report 2018, Q2](#)
- The Exam > [Samples and Commentary 2018, Q2](#)

TOPIC 6.12

Wind Energy

Required Course Content

ENDURING UNDERSTANDING

ENG-3

Humans use energy from a variety of sources, resulting in positive and negative consequences.

LEARNING OBJECTIVE

ENG-3.R

Describe the use of wind energy in power generation.

ENG-3.S

Describe the effects of the use of wind energy in power generation on the environment.

ESSENTIAL KNOWLEDGE

ENG-3.R.1

Wind turbines use the kinetic energy of moving air to spin a turbine, which in turn converts the mechanical energy of the turbine into electricity.

ENG-3.S.1

Wind energy is a renewable, clean source of energy. However, birds and bats may be killed if they fly into the spinning turbine blades.

TOPIC 6.13

Energy Conservation

SUGGESTED SKILL

 *Mathematical Routines***6.C**

Calculate an accurate numeric answer with appropriate units.



AVAILABLE RESOURCES

- Classroom Resource > [AP Environmental Science Teacher's Guide](#)
- The Exam > [Chief Reader Report 2018, Q1](#)
- The Exam > [Samples and Commentary 2018, Q1](#)
- Classroom Resource > [Quantitative Skills in the AP Sciences \(2018\)](#)

Required Course Content

ENDURING UNDERSTANDING

ENG-3

Humans use energy from a variety of sources, resulting in positive and negative consequences.

LEARNING OBJECTIVE

ENG-3.T

Describe methods for conserving energy.

ESSENTIAL KNOWLEDGE

ENG-3.T.1

Some of the methods for conserving energy around a home include adjusting the thermostat to reduce the use of heat and air conditioning, conserving water, use of energy-efficient appliances, and conservation landscaping.

ENG-3.T.2

Methods for conserving energy on a large scale include improving fuel economy for vehicles, using BEVs (battery electric vehicles) and hybrid vehicles, using public transportation, and implementing green building design features.

