

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.

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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.

SUGGESTED SKILL

 *Concept Explanation*

1.B

Explain environmental concepts and processes.



AVAILABLE RESOURCES

- Classroom Resource > [AP Environmental Science Teacher's Guide](#)
- External Resource > [Environmental Literacy Council's AP Environmental Science Course Material](#)
- External Source > [GLOBE for the Environmental Science Classroom](#)

TOPIC 9.3

The Greenhouse Effect

Required Course Content

ENDURING UNDERSTANDING

STB-4

Local and regional human activities can have impacts at the global level.

LEARNING OBJECTIVE

STB-4.C

Identify the greenhouse gases.

STB-4.D

Identify the sources and potency of the greenhouse gases.

ESSENTIAL KNOWLEDGE

STB-4.C.1

The principal greenhouse gases are carbon dioxide, methane, water vapor, nitrous oxide, and chlorofluorocarbons (CFCs).

STB-4.C.2

While water vapor is a greenhouse gas, it doesn't contribute significantly to global climate change because it has a short residence time in the atmosphere.

STB-4.C.3

The greenhouse effect results in the surface temperature necessary for life on Earth to exist.

STB-4.D.1

Carbon dioxide, which has a global warming potential (GWP) of 1, is used as a reference point for the comparison of different greenhouse gases and their impacts on global climate change. Chlorofluorocarbons (CFCs) have the highest GWP, followed by nitrous oxide, then methane.

TOPIC 9.4

Increases in the Greenhouse Gases

Required Course Content

ENDURING UNDERSTANDING

STB-4

Local and regional human activities can have impacts at the global level.

LEARNING OBJECTIVE

STB-4.E


Identify the threats to human health and the environment posed by an increase in greenhouse gases.

ESSENTIAL KNOWLEDGE

STB-4.E.1

Global climate change, caused by excess greenhouse gases in the atmosphere, can lead to a variety of environmental problems including rising sea levels resulting from melting ice sheets and ocean water expansion, and disease vectors spreading from the tropics toward the poles. These problems can lead to changes in population dynamics and population movements in response.

SUGGESTED SKILL

 *Visual Representations*

2.C

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



AVAILABLE RESOURCES

- Classroom Resource > [AP Environmental Science Teacher's Guide](#)
- External Resource > [Environmental Literacy Council's AP Environmental Science Course Material](#)
- External Source > [GLOBE for the Environmental Science Classroom](#)

SUGGESTED SKILL

 Data Analysis

5.D

Interpret experimental data and results in relation to a given hypothesis.



AVAILABLE RESOURCES

- Classroom Resource > [AP Environmental Science Teacher's Guide](#)
- External Resource > [Environmental Literacy Council's AP Environmental Science Course Material](#)
- External Source > [GLOBE for the Environmental Science Classroom](#)
- The Exam > [Student Performance Q&A 2014, Q4](#)
- The Exam > [Samples and Commentary 2014, Q4](#)

TOPIC 9.5

Global Climate Change

Required Course Content

ENDURING UNDERSTANDING

STB-4

Local and regional human activities can have impacts at the global level.

LEARNING OBJECTIVE

STB-4.F

Explain how changes in climate, both short- and long-term, impact ecosystems.

ESSENTIAL KNOWLEDGE

STB-4.F.1

The Earth has undergone climate change throughout geologic time, with major shifts in global temperatures causing periods of warming and cooling as recorded with CO₂ data and ice cores.

STB-4.F.2

Effects of climate change include rising temperatures, melting permafrost and sea ice, rising sea levels, and displacement of coastal populations.

STB-4.F.3

Marine ecosystems are affected by changes in sea level, some positively, such as in newly created habitats on now-flooded continental shelves, and some negatively, such as deeper communities that may no longer be in the photic zone of seawater.

STB-4.F.4

Winds generated by atmospheric circulation help transport heat throughout the Earth. Climate change may change circulation patterns, as temperature changes may impact Hadley cells and the jet stream.

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LEARNING OBJECTIVE**STB-4.F**

Explain how changes in climate, both short- and long-term, impact ecosystems.

ESSENTIAL KNOWLEDGE**STB-4.F.5**

Oceanic currents, or the ocean conveyor belt, carry heat throughout the world. When these currents change, it can have a big impact on global climate, especially in coastal regions.

STB-4.F.6

Climate change can affect soil through changes in temperature and rainfall, which can impact soil's viability and potentially increase erosion.

STB-4.F.7

Earth's polar regions are showing faster response times to global climate change because ice and snow in these regions reflect the most energy back out to space, leading to a positive feedback loop.

STB-4.F.8

As the Earth warms, this ice and snow melts, meaning less solar energy is radiated back into space and instead is absorbed by the Earth's surface. This in turn causes more warming of the polar regions.


STB-4.F.9

Global climate change response time in the Arctic is due to positive feedback loops involving melting sea ice and thawing tundra, and the subsequent release of greenhouse gases like methane.

STB-4.F.10

One consequence of the loss of ice and snow in polar regions is the effect on species that depend on the ice for habitat and food.

SUGGESTED SKILL

 *Environmental Solutions*

7.A

Describe environmental problems.



AVAILABLE RESOURCES

- Classroom Resource > [AP Environmental Science Teacher's Guide](#)
- External Resource > [Environmental Literacy Council's AP Environmental Science Course Material](#)

TOPIC 9.6

Ocean Warming

Required Course Content

ENDURING UNDERSTANDING

STB-4

Local and regional human activities can have impacts at the global level.

LEARNING OBJECTIVE

STB-4.G

Explain the causes and effects of ocean warming.

ESSENTIAL KNOWLEDGE

STB-4.G.1

Ocean warming is caused by the increase in greenhouse gases in the atmosphere.

STB-4.G.2

Ocean warming can affect marine species in a variety of ways, including loss of habitat, and metabolic and reproductive changes.

STB-4.G.3

Ocean warming is causing coral bleaching, which occurs when the loss of algae within corals cause the corals to bleach white. Some corals recover and some die.

TOPIC 9.7

Ocean Acidification

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](#)
- External Resource > [Environmental Literacy Council's AP Environmental Science Course Material](#)

Required Course Content

ENDURING UNDERSTANDING

STB-4

Local and regional human activities can have impacts at the global level.

LEARNING OBJECTIVE

STB-4.H

Explain the causes and effects of ocean acidification.

ESSENTIAL KNOWLEDGE

STB-4.H.1

Ocean acidification is the decrease in pH of the oceans, primarily due to increased CO₂ concentrations in the atmosphere, and can be expressed as chemical equations.

STB-4.H.2

As more CO₂ is released into the atmosphere, the oceans, which absorb a large part of that CO₂, become more acidic.

STB-4.H.3

Anthropogenic activities that contribute to ocean acidification are those that lead to increased CO₂ concentrations in the atmosphere: burning of fossil fuels, vehicle emissions, and deforestation.

STB-4.H.4

Ocean acidification damages coral because acidification makes it difficult for them to form shells, due to the loss of calcium carbonate.