AP ENVIRONMENTAL SCIENCE

UNIT 5

Land and Water Use

10–15%
AP EXAM WEIGHTING

~18–19
CLASS PERIODS

UNIT 5

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Land and Water Use

BIG IDEA 3
Interactions Between Different Species and the Environment EIN
- How does your use of natural resources impact the world?

BIG IDEA 4
Sustainability STB
- Why are sustainable practices difficult to implement?

Developing Understanding

This unit explores human activities that disrupt ecosystems both positively and negatively and the methods employed to reduce impact. It examines human use of natural resources through many means, including mining and clearcutting, and the impacts on the environment. Agricultural practices in particular can cause environmental disruption. For example, one of the largest uses of freshwater is for irrigation. Every irrigation method employed for agriculture has its own benefits and drawbacks. In subsequent units, students will examine different types of energy resources, the consumption of these resources, and the impact on the environment.

Building the Science Practices

7.B 7.C 7.D 7.E 7.F

In this unit, students can practice identifying environmental problems (e.g., pollution, depletion of the ozone layer, global climate change). They can also practice thinking critically about the problem, and when evaluating a given solution, articulating its benefits and drawbacks. The ability to describe and propose viable solutions for environmental problems is critical for this unit.

Students will benefit from opportunities to practice describing the development process for legislation enacted to mitigate environmental problems and the effects of the legislation on the various stakeholders. Most importantly, students should have many opportunities to evaluate a proposed solution to an environmental problem and/or the legislation that addresses it and then describe benefits and drawbacks to the solution.

Preparing for the AP Exam

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 within 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.

Students may benefit from opportunities to analyze text-based resources about environmental issues and the impact of human activities on the environment. Teachers can guide students in identifying the author's claim, perspective, and/or assumptions. It may be especially helpful to utilize sources of information that have quantitative data so that students can provide explanations that both describe the data and connect the data to an environmental issue.

TOPIC 5.1
The Tragedy of the Commons

SUGGESTED SKILL

Concept Explanation

1.B

Explain environmental concepts and processes.

AVAILABLE RESOURCES

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

Required Course Content

ENDURING UNDERSTANDING

EIN-2

When humans use natural resources, they alter natural systems.

LEARNING OBJECTIVE

EIN-2.A

Explain the concept of the tragedy of the commons.

ESSENTIAL KNOWLEDGE

EIN-2.A.1

The tragedy of the commons suggests that individuals will use shared resources in their own self-interest rather than in keeping with the common good, thereby depleting the resources.

SUGGESTED SKILL

Concept Explanation

1.A

Describe environmental concepts and processes.

AVAILABLE RESOURCES

- Classroom Resource > AP Environmental Science Teacher's Guide

TOPIC 5.2
Clearcutting

Required Course Content

ENDURING UNDERSTANDING

EIN-2

When humans use natural resources, they alter natural systems.

LEARNING OBJECTIVE

EIN-2.B

Describe the effect of clearcutting on forests.

ESSENTIAL KNOWLEDGE

EIN-2.B.1

Clearcutting can be economically advantageous but leads to soil erosion, increased soil and stream temperatures, and flooding.

EIN-2.B.2

Forests contain trees that absorb pollutants and store carbon dioxide. The cutting and burning of trees releases carbon dioxide and contributes to climate change.

TOPIC 5.3
The Green Revolution

SUGGESTED SKILL

Text Analysis

3.B

Describe the author's perspective and assumptions.

AVAILABLE RESOURCES

- Classroom Resource > AP Environmental Science Teacher's Guide

Required Course Content

ENDURING UNDERSTANDING

EIN-2

When humans use natural resources, they alter natural systems.

LEARNING OBJECTIVE

EIN-2.C

Describe changes in agricultural practices.

ESSENTIAL KNOWLEDGE

EIN-2.C.1

The Green Revolution started a shift to new agricultural strategies and practices in order to increase food production, with both positive and negative results. Some of these strategies and methods are mechanization, genetically modified organisms (GMOs), fertilization, irrigation, and the use of pesticides.

EIN-2.C.2

Mechanization of farming can increase profits and efficiency for farms. It can also increase reliance on fossil fuels.

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 2017, Q3
- The Exam > Samples and Commentary 2017, Q3

TOPIC 5.4
Impact of Agricultural Practices

Required Course Content

ENDURING UNDERSTANDING

EIN-2

When humans use natural resources, they alter natural systems.

LEARNING OBJECTIVE

EIN-2.D

Describe agricultural practices that cause environmental damage.

ESSENTIAL KNOWLEDGE

EIN-2.D.1

Agricultural practices that can cause environmental damage include tilling, slash-and-burn farming, and the use of fertilizers.

TOPIC 5.5 Irrigation Methods

SUGGESTED SKILL

Environmental Solutions

7.C

Describe disadvantages, advantages, or unintended consequences for potential solutions.

AVAILABLE RESOURCES

- Classroom Resource > **Agriculture and the Nitrogen Cycle**

Required Course Content

ENDURING UNDERSTANDING

EIN-2

When humans use natural resources, they alter natural systems.

LEARNING OBJECTIVE	ESSENTIAL KNOWLEDGE
EIN-2.E Describe different methods of irrigation.	**EIN-2.E.1** The largest human use of freshwater is for irrigation (70%). **EIN-2.E.2** Types of irrigation include drip irrigation, flood irrigation, furrow irrigation, drip irrigation, and spray irrigation.
EIN-2.F Describe the benefits and drawbacks of different methods of irrigation.	**EIN-2.F.1** Waterlogging occurs when too much water is left to sit in the soil, which raises the water table of groundwater and inhibits plants' ability to absorb oxygen through their roots. **EIN-2.F.2** Furrow irrigation involves cutting furrows between crop rows and filling them with water. This system is inexpensive, but about 1/3 of the water is lost to evaporation and runoff. **EIN-2.F.3** Flood irrigation involves flooding an agricultural field with water. This system sees about 20% of the water lost to evaporation and runoff. This can also lead to waterlogging of the soil.

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LEARNING OBJECTIVE

EIN-2.F

Describe the benefits and drawbacks of different methods of irrigation.

ESSENTIAL KNOWLEDGE

EIN-2.F.4

Spray irrigation involves pumping ground water into spray nozzles across an agricultural field. This system is more efficient than flood and furrow irrigation, with only 1/4 or less of the water lost to evaporation or runoff. However, spray systems are more expensive than flood and furrow irrigation, and also requires energy to run.

EIN-2.F.5

Drip irrigation uses perforated hoses to release small amounts of water to plant roots. This system is the most efficient, with only about 5% of water lost to evaporation and runoff. However, this system is expensive and so is not often used.

EIN-2.F.6

Salinization occurs when the salts in groundwater remain in the soil after the water evaporates. Over time, salinization can make soil toxic to plants.

EIN-2.F.7

Aquifers can be severely depleted if overused for agricultural irrigation, as has happened to the Ogallala Aquifer in the central United States.

TOPIC 5.6
Pest Control Methods

Required Course Content

ENDURING UNDERSTANDING

EIN-2

When humans use natural resources, they alter natural systems.

LEARNING OBJECTIVE

EIN-2.G

Describe the benefits and drawbacks of different methods of pest control.

ESSENTIAL KNOWLEDGE

EIN-2.G.1

One consequence of using common pest-control methods such as pesticides, herbicides, fungicides, rodenticides, and insecticides is that organisms can become resistant to them through artificial selection. Pest control decreases crop damage by pest and increases crop yields.

EIN-2.G.2

Crops can be genetically engineered to increase their resistance to pests and diseases. However, using genetically engineered crops in planting or other ways can lead to loss of genetic diversity of that particular crop.

SUGGESTED SKILL

Environmental Solutions

7.E

Make a claim that proposes a solution to an environmental problem in an applied context.

AVAILABLE RESOURCES

- Classroom Resource > **AP Environmental Science Teacher's Guide**
- The Exam > **Chief Reader Report 2018, Q1**
- The Exam > **Student Performance Q&A 2015, Q1**
- The Exam > Samples and Commentary (**2018, Q1**, **2015, Q1**)

SUGGESTED SKILL

Data Analysis

5.E

Explain what the data implies or illustrates about environmental issues.

AVAILABLE RESOURCES

- Classroom Resource > **AP Environmental Science Teacher's Guide**

TOPIC 5.7
Meat Production Methods

Required Course Content

ENDURING UNDERSTANDING

EIN-2

When humans use natural resources, they alter natural systems.

LEARNING OBJECTIVE

EIN-2.H

Identify different methods of meat production.

EIN-2.I

Describe the benefits and drawbacks of different methods of meat production.

ESSENTIAL KNOWLEDGE

EIN-2.H.1

Methods of meat production include concentrated animal feeding operations (CAFOs), also called feedlots, and free-range grazing.

EIN-2.I.1

Meat production is less efficient than agriculture; it takes approximately 20 times more land to produce the same amount of calories from meat as from plants.

EIN-2.1.2

Concentrated animal feeding operation (CAFOs) are used as a way to quickly get livestock ready for slaughter. They tend to be crowded, and animals are fed grains or feed that are not as suitable as grass. Additionally, feedlots generate a large amount of organic waste, which can contaminate ground and surface water. The use of feedlots are less expensive than other methods, which can keep costs to consumers down.

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LEARNING OBJECTIVE

EIN-2.I

Describe the benefits and drawbacks of different methods of meat production.

ESSENTIAL KNOWLEDGE

EIN-2.1.3

Free range grazing allows animals to graze on grass during their entire lifecycle. Meat from free range animals tends to be free from antibiotics and other chemicals used in feedlots. Organic waste from these animals acts as fertilizer. Free range grazing requires large areas of land and the meat produced is more expensive for consumers.

EIN-2.I.4

Overgrazing occurs when too many animals feed on a particular area of land. Overgrazing causes loss of vegetation, which leads to soil erosion.

EIN-2.I.5

Overgrazing can cause desertification. Desertification is the degradation of low precipitation regions toward being increasingly arid until they become deserts.

EIN-2.I.6

Less consumption of meat could reduce CO_2, methane, and N_2O emissions; conserve water; reduce the use of antibiotics and growth hormones; and improve topsoil.

SUGGESTED SKILL

Environmental Solutions

7.B

Describe potential responses or approaches to environmental problems.

AVAILABLE RESOURCES

- Classroom Resource > AP Environmental Science Teacher's Guide

TOPIC 5.8
Impacts of Overfishing

Required Course Content

ENDURING UNDERSTANDING

EIN-2

When humans use natural resources, they alter natural systems.

LEARNING OBJECTIVE

EIN-2.J

Describe causes of and problems related to overfishing.

ESSENTIAL KNOWLEDGE

EIN-2.J.1

Overfishing has led to the extreme scarcity of some fish species, which can lessen biodiversity in aquatic systems and harm people who depend on fishing for food and commerce.

TOPIC 5.9 Impacts of Mining

Required Course Content

ENDURING UNDERSTANDING

EIN-2

When humans use natural resources, they alter natural systems.

LEARNING OBJECTIVE	ESSENTIAL KNOWLEDGE
EIN-2.K Describe natural resource extraction through mining.	**EIN-2.K.1** As the more accessible ores are mined to depletion, mining operations are forced to access lower grade ores. Accessing these ores requires increased use of resources that can cause increased waste and pollution. **EIN-2.K.2** Surface mining is the removal of large portions of soil and rock, called overburden, in order to access the ore underneath. An example is strip mining, which removes the vegetation from an area, making the area more susceptible to erosion.
EIN-2.L Describe ecological and economic impacts of natural resource extraction through mining.	**EIN-2.L.1** Mining wastes include the soil and rocks that are moved to gain access to the ore and the waste, called slag and tailings that remain when the minerals have been removed from the ore. Mining helps to provide low cost energy and material necessary to make products. The mining of coal can destroy habitats, contaminate ground water, and release dust particles and methane. **EIN-2.L.2** As coal reserves get smaller, due to a lack of easily accessible reserves, it becomes necessary to access coal through subsurface mining, which is very expensive.

SUGGESTED SKILL

Environmental Solutions

7.E

Make a claim that proposes a solution to an environmental problem in an applied context.

AVAILABLE RESOURCES

- Classroom Resource > **AP Environmental Science Teacher's Guide**
- The Exam > **Chief Reader Report 2018, Q2**
- The Exam > **Student Performance Q&A 2016, Q2**
- The Exam > Samples and Commentary (**2018, Q2**, **2016, Q2**)

SUGGESTED SKILL

Environmental Solutions

7.C

Describe disadvantages, advantages, or unintended consequences for potential solutions.

AVAILABLE RESOURCES

- Classroom Resource > **AP Environmental Science Teacher's Guide**
- The Exam > **Student Performance Q&A 2015, Q4**
- The Exam > **Samples and Commentary 2015, Q4**

TOPIC 5.10
Impacts of Urbanization

Required Course Content

ENDURING UNDERSTANDING

EIN-2

When humans use natural resources, they alter natural systems.

LEARNING OBJECTIVE

EIN-2.M

Describe the effects of urbanization on the environment.

ESSENTIAL KNOWLEDGE

EIN-2.M.1

Urbanization can lead to depletion of resources and saltwater intrusion in the hydrologic cycle.

EIN-2.M.2

Urbanization, through the burning of fossil fuels and landfills, affects the carbon cycle by increasing the amount of carbon dioxide in the atmosphere.

EIN-2.M.3

Impervious surfaces are human-made structures—such as roads, buildings, sidewalks, and parking lots—that do not allow water to reach the soil, leading to flooding.

EIN-2.M.4

Urban sprawl is the change in population distribution from high population density areas to low density suburbs that spread into rural lands, leading to potential environmental problems.

TOPIC 5.11 Ecological Footprints

Required Course Content

ENDURING UNDERSTANDING

EIN-2

When humans use natural resources, they alter natural systems.

LEARNING OBJECTIVE

EIN-2.N

Explain the variables measured in an ecological footprint.

ESSENTIAL KNOWLEDGE

EIN-2.N.1

Ecological footprints compare resource demands and waste production required for an individual or a society.

SUGGESTED SKILL

Data Analysis

5.E

Explain what the data implies or illustrates about environmental issues.

AVAILABLE RESOURCES

- Classroom Resource > AP Environmental Science Teacher's Guide

SUGGESTED SKILL

Data Analysis

5.E

Explain what the data implies or illustrates about environmental issues.

AVAILABLE RESOURCES

- Classroom Resource > **AP Environmental Science Teacher's Guide**
- The Exam > Chief Reader Report (**2018 Q1**, **2017, Q3**)
- The Exam > Samples and Commentary (**2018, Q1**, **2017, Q3**)

TOPIC 5.12
Introduction to Sustainability

Required Course Content

ENDURING UNDERSTANDING

STB-1

Humans can mitigate their impact on land and water resources through sustainable use.

LEARNING OBJECTIVE

STB-1.A

Explain the concept of sustainability.

ESSENTIAL KNOWLEDGE

STB-1.A.1

Sustainability refers to humans living on Earth and their use of resources without depletion of the resources for future generations. Environmental indicators that can guide humans to sustainability include biological diversity, food production, average global surface temperatures and CO_2 concentrations, human population, and resource depletion.

STB-1.A.2

Sustainable yield is the amount of a renewable resource that can be taken without reducing the available supply.

TOPIC 5.13
Methods to Reduce Urban Runoff

Required Course Content

ENDURING UNDERSTANDING

STB-1

Humans can mitigate their impact on land and water resources through sustainable use.

LEARNING OBJECTIVE

STB-1.B

Describe methods for mitigating problems related to urban runoff.

ESSENTIAL KNOWLEDGE

STB-1.B.1

Methods to increase water infiltration include replacing traditional pavement with permeable pavement, planting trees, increased use of public transportation, and building up, not out.

SUGGESTED SKILL

Scientific Experiments

4.B

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

AVAILABLE RESOURCES

- Classroom Resource > AP Environmental Science Teacher's Guide

SUGGESTED SKILL

Environmental Solutions

7.D

Use data and evidence to support a potential solution.

AVAILABLE RESOURCES

- Classroom Resource > AP Environmental Science Teacher's Guide

TOPIC 5.14
Integrated Pest Management

Required Course Content

ENDURING UNDERSTANDING

STB-1

Humans can mitigate their impact on land and water resources through sustainable use.

LEARNING OBJECTIVE	ESSENTIAL KNOWLEDGE
STB-1.C Describe integrated pest management.	STB-1.C.1 Integrated pest management (IPM) is a combination of methods used to effectively control pest species while minimizing the disruption to the environment. These methods include biological, physical, and limited chemical methods such as biocontrol, intercropping, crop rotation, and natural predators of the pests.
STB-1.D Describe the benefits and drawbacks of integrated pest management (IPM).	STB-1.D.1 The use of integrated pest management (IPM) reduces the risk that pesticides pose to wildlife, water supplies, and human health. STB-1.D.2 Integrated pest management (IPM) minimizes disruptions to the environment and threats to human health but can be complex and expensive.

TOPIC 5.15
Sustainable Agriculture

Required Course Content

ENDURING UNDERSTANDING

STB-1

Humans can mitigate their impact on land and water resources through sustainable use.

LEARNING OBJECTIVE

STB-1.E

Describe sustainable agricultural and food production practices.

ESSENTIAL KNOWLEDGE

STB-1.E.1

The goal of soil conservation is to prevent soil erosion. Different methods of soil conservation include contour plowing, windbreaks, perennial crops, terracing, no-till agriculture, and strip cropping.

STB-1.E.2

Strategies to improve soil fertility include crop rotation and the addition of green manure and limestone.

STB-1.E.3

Rotational grazing is the regular rotation of livestock between different pastures in order to avoid overgrazing in a particular area.

SUGGESTED SKILL

Environmental Solutions

7.E

Make a claim that proposes a solution to an environmental problem in an applied context.

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

Environmental Solutions

7.C

Describe disadvantages, advantages, or unintended consequences for potential solutions.

AVAILABLE RESOURCES

- Classroom Resource > **AP Environmental Science Teacher's Guide**

TOPIC 5.16
Aquaculture

Required Course Content

ENDURING UNDERSTANDING

STB-1

Humans can mitigate their impact on land and water resources through sustainable use.

LEARNING OBJECTIVE

STB-1.F

Describe the benefits and drawbacks of aquaculture.

ESSENTIAL KNOWLEDGE

STB-1.F.1

Aquaculture has expanded because it is highly efficient, requires only small areas of water, and requires little fuel.

STB-1.F.2

Aquaculture can contaminate wastewater, and fish that escape may compete or breed with wild fish. The density of fish in aquaculture can lead to increases in disease incidences, which can be transmitted to wild fish.

TOPIC 5.17 Sustainable Forestry

Required Course Content

ENDURING UNDERSTANDING

STB-1

Humans can mitigate their impact on land and water resources through sustainable use.

LEARNING OBJECTIVE

STB-1.G

Describe methods for mitigating human impact on forests.

ESSENTIAL KNOWLEDGE

STB-1.G.1

Some of the methods for mitigating deforestation include reforestation, using and buying wood harvested by ecologically sustainable forestry techniques, and reusing wood.

STB-1.G.2

Methods to protect forests from pathogens and insects include integrated pest management (IPM) and the removal of affected trees.

STB-1.G.3

Prescribed burn is a method by which forests are set on fire under controlled conditions in order to reduce the occurrence of natural fires.

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 2017, Q1**
- The Exam > **Samples and Commentary 2017, Q1**