Science Department
AP Environmental Science

Developed By: Michael Seeback, Supervisor of Secondary Science & Technology
Effective Date: September 2026

Scope and Sequence

Unit	Topic of Study	Duration (Weeks)
1	The Living World: Ecosystems	3
2	The Living World: Biodiversity	3
3	Populations	4
4	Earth Systems & Resources	3
5	Land & Water Use	6
6	Energy Resources & Consumption	6
7	Atmospheric Pollution	3
8	Aquatic & Terrestrial Pollution	6
9	Global Change	6

Unit 1

The Living World: Ecosystems

Summary and Rationale

The first unit sets the foundation for the course by examining the Earth as a system with interdependent components, processes, and relationships. Students will examine the distribution of resources in ecosystems and its influences on species interactions. There is a global distribution of terrestrial and aquatic biomes—regional ecosystems—that each have specific environmental features based on their shared climate. This distribution is dynamic, and it has changed due to global climate change. Each ecosystem relies on biogeochemical cycles for survival. These cycles facilitate the acquisition and transfer of energy into usable forms, and they can be altered by human activities. In subsequent units, students will apply their understanding of ecosystems to the living world and examine the importance of biodiversity

Recommended Pacing

3 weeks (~14-15 class periods - per AP recommendations in the CED)
Exam weight: 6-8%

Standards

HS-LS2-1: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
HS-LS2-6: Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms under stable conditions but changing conditions may result in a new ecosystem.
HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
HS-LS2-8: Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
HS-ESS2-2: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
HS-ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
HS-ESS2-6: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
HS-ESS2-7: Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.
HS-ESS3-3: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- How do biotic and abiotic factors interact to influence ecosystem structure and function?
- How do species interactions affect population dynamics and ecosystem stability?
- What factors determine the distribution of terrestrial and aquatic biomes?
- How does matter cycle through Earth's living and nonliving systems?
- How do the carbon, nitrogen, phosphorus, and hydrologic cycles sustain life on Earth?
- How does energy move through ecosystems?
- Why is energy transfer between trophic levels inefficient?
- How do productivity and energy availability influence ecosystem structure?
- How do food chains and food webs demonstrate ecosystem interdependence?
- How can disturbances to energy flow or matter cycling affect ecosystem sustainability?

Unit Enduring Understandings:

- Ecosystems consist of interacting biotic and abiotic components that influence the distribution and abundance of organisms.
- Resource availability shapes species interactions, including competition, predation, and symbiosis.
- Climate and environmental conditions determine the characteristics and distribution of terrestrial and aquatic biomes.
- Matter is continuously recycled through the biosphere via interconnected biogeochemical cycles.
- Carbon, nitrogen, phosphorus, and water cycle through Earth's systems and are essential for sustaining life.
- Energy enters ecosystems primarily through photosynthesis and flows through trophic levels.
- Only a small portion of energy is transferred between trophic levels, limiting ecosystem productivity.
- Primary productivity determines the amount of energy available to support organisms within an ecosystem.
- Food chains and food webs illustrate the complex interdependence of organisms within ecosystems.
- Changes to one component of an ecosystem can produce cascading effects throughout the system.
- Conservation of energy provides a framework for understanding pressure and fluid speed relationships.
- Changes in pressure, speed, and elevation are interconnected in flowing fluids.
- Fluid principles explain a wide range of phenomena, including transportation, engineering systems, weather processes, and biological systems.

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 1.1: Introduction to Ecosystems

- Explain the relationships among organisms, populations, communities, and ecosystems.
- Distinguish between biotic and abiotic components of ecosystems.
- Describe how resource availability influences species interactions.
- Compare predation, competition, and symbiotic relationships.
- Explain how ecosystem structure affects ecosystem function.

Topic 1.2: Terrestrial Biomes

- Identify major terrestrial biomes based on climate characteristics.
- Explain how temperature and precipitation influence biome distribution.
- Describe the characteristic vegetation and adaptations found within major biomes.
- Analyze relationships between climate patterns and ecosystem productivity.

Topic 1.3: Aquatic Biomes

- Differentiate between freshwater and marine biomes.
- Describe how salinity, depth, temperature, and nutrient availability influence aquatic ecosystems.
- Explain the distribution of organisms within aquatic environments.
- Compare major aquatic ecosystem types.

Topic 1.4: The Carbon Cycle

- Describe the movement of carbon through Earth's systems.
- Identify major carbon reservoirs and carbon sinks.
- Explain the roles of photosynthesis, respiration, decomposition, and combustion in carbon cycling.
- Analyze how human activities alter the carbon cycle.

Topic 1.5: The Nitrogen Cycle

- Describe the processes of nitrogen fixation, nitrification, assimilation, ammonification, and denitrification.
- Explain the role of bacteria in nitrogen cycling.
- Trace the movement of nitrogen through ecosystems.
- Evaluate how human activities influence nitrogen availability.

Topic 1.6: The Phosphorus Cycle

- Describe the movement of phosphorus through living and nonliving systems.
- Explain why phosphorus lacks a significant atmospheric phase.
- Identify major phosphorus reservoirs.
- Analyze the environmental impacts of excess phosphorus inputs.

Topic 1.7: The Hydrologic Cycle

- Describe the major processes of the water cycle.
- Explain how water moves among Earth's reservoirs.
- Analyze the influence of the hydrologic cycle on ecosystem processes.
- Evaluate factors that affect water availability.

Topic 1.8: Primary Productivity

- Differentiate between gross primary productivity (GPP) and net primary productivity (NPP).
- Apply the relationship NPP = GPP − Respiration.
- Explain factors affecting primary productivity.
- Compare productivity among ecosystem types.

Topic 1.9: Trophic Levels

- Identify organisms occupying different trophic levels.
- Explain the role of producers, consumers, and decomposers in ecosystems.
- Describe how energy and matter move through trophic levels.
- Interpret ecological pyramids.

Topic 1.10: Energy Flow and the 10% Rule

- Explain why energy decreases between trophic levels.
- Apply the 10% rule to energy-transfer calculations.
- Analyze the relationship between energy availability and food chain length.
- Explain how thermodynamic principles affect ecosystem energy flow.

Topic 1.11: Food Chains and Food Webs

- Construct and interpret food chains and food webs.
- Trace the movement of energy through ecosystems.
- Predict the effects of changes within food webs.
- Analyze ecosystem interactions using food-web models.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

● Allow additional time for skill mastery.
● Provide small group/ individualized instruction.
● Allow use of assistive technology.
● Anticipate needs; pre-teach if needed.
● Have student repeat directions to check for understanding.
● Highlight text/ visual presentation.
● Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .

ML-

● Provide additional wait time for student responses to questions
● Provide simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase.
● Speak clearly, using a normal tone and rate of speed, or slightly slower.
● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.

- Provide additional time for in-class assignments and assessments
- Allow for computer with voice output, spelling and grammar checker
- Offer individual help throughout the lesson
- Modify readings and primary source documents.

At Risk-

- Provide small group instruction for identified areas for growth
- Allow for alternate pathways for completion of assignments.
- Provide additional wait time for student responses to questions
- Pair oral instruction with visuals
- Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☑ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.
- ☑ Communicate clearly and effectively and with reason.
- ☑ Consider the environmental, social and economics impacts of decisions.
- ☑ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☐ Model integrity, ethical leadership, and effective management.
- ☑ Plan education and career paths aligned to personal goals.
- ☐ Use technology to enhance productivity.
- ☑ Work productively in teams while using cultural global competence.

Unit 2

The Living World: Biodiversity

Summary and Rationale

Biodiversity, which includes genetic, species, and habitat diversity, is critically important to ecosystems. Biodiversity in ecosystems is a key component to sustaining life within the living world. Natural and human disruptions have short- and long-term impacts on ecosystems. Ecological succession can occur in terrestrial and aquatic ecosystems in both developed and developing areas. Organisms within ecosystems must adapt to the changes created by these disruptions. In subsequent units, students will examine in greater detail how populations change over time.

Recommended Pacing

3 weeks (~11-12 class periods - per AP recommendations in the CED)
Exam weight: 6-8%

Standards

HS-LS2-1: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
HS-LS2-6: Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms under stable conditions but changing conditions may result in a new ecosystem.
HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
HS-LS4-2: Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
HS-LS4-5: Evaluate evidence supporting claims that changes in environmental conditions may result in increases in the number of individuals of some species, the emergence of new species over time, and the extinction of other species.
HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.
HS-ESS3-3: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- What is biodiversity and why is it essential to ecosystem stability?
- How do genetic, species, and ecosystem diversity contribute to ecosystem resilience?
- Why are some ecosystems more resistant to environmental disturbances than others?
- What benefits do humans receive from functioning ecosystems?
- How does island biogeography help explain patterns of biodiversity?
- How do environmental conditions limit the distribution of organisms?

- How do natural disturbances influence ecosystem structure and biodiversity?
- How do adaptations increase an organism's ability to survive and reproduce?
- How does ecological succession influence community development over time?
- How do changes in biodiversity affect ecosystem services and sustainability?

Unit Enduring Understandings:

- Biodiversity exists at genetic, species, and ecosystem levels and contributes to ecosystem stability.
- Greater biodiversity generally increases ecosystem resilience to environmental change and disturbance.
- Healthy ecosystems provide essential services that support both natural systems and human societies.
- Species richness and distribution are influenced by geographic isolation, habitat size, and environmental conditions.
- Every species has a range of environmental conditions within which it can survive and reproduce.
- Natural disturbances are important ecological processes that influence biodiversity and community structure.
- Adaptations arise through natural selection and increase an organism's fitness within its environment.
- Ecosystems are dynamic and continually change through ecological succession.
- Changes in biodiversity can alter ecosystem function and the availability of ecosystem services.
- The long-term sustainability of ecosystems depends on the maintenance of biodiversity.

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 2.1: Introduction to Biodiversity

- Define biodiversity at the genetic, species, and ecosystem levels.
- Differentiate between species richness and species evenness.
- Explain the relationship between biodiversity and ecosystem resilience.
- Describe the effects of population bottlenecks on genetic diversity.
- Evaluate the ecological importance of keystone species.

Topic 2.2: Ecosystem Services

- Define ecosystem services and explain their importance to human societies.
- Distinguish among provisioning, regulating, supporting, and cultural ecosystem services.
- Classify ecosystem services using real-world examples.
- Evaluate the ecological and economic value of ecosystem services.
- Explain how biodiversity supports ecosystem services.

Topic 2.3: Island Biogeography

- Explain the theory of island biogeography.
- Describe how island size influences species richness.
- Explain how geographic isolation affects immigration and extinction rates.

- Predict biodiversity patterns using island biogeography principles.
- Apply island biogeography concepts to habitat fragmentation and conservation efforts.

Topic 2.4: Ecological Tolerance

- Define ecological tolerance and range of tolerance.
- Interpret tolerance curves and identify optimal environmental conditions.
- Explain how limiting factors affect species distribution.
- Describe the effects of environmental stress on populations.
- Predict how changes in environmental conditions may affect biodiversity.

Topic 2.5: Natural Disruptions to Ecosystems

- Identify common natural disturbances that affect ecosystems.
- Explain the short-term and long-term impacts of disturbances on biodiversity.
- Compare ecosystem responses to different types of disturbances.
- Evaluate factors that contribute to ecosystem recovery.
- Analyze relationships between disturbances and ecological resilience.

Topic 2.6: Adaptations

- Define adaptation and explain its role in evolution.
- Differentiate among structural, physiological, and behavioral adaptations.
- Explain how natural selection contributes to adaptation.
- Evaluate how adaptations enhance survival and reproductive success.
- Analyze examples of species adaptations in various environments.

Topic 2.7: Ecological Succession

- Define ecological succession and explain its significance.
- Differentiate between primary and secondary succession.
- Identify characteristics of pioneer species.
- Describe changes in species composition during succession.
- Explain factors that influence ecosystem recovery after disturbance.
- Evaluate how succession contributes to biodiversity and ecosystem stability.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

- Allow additional time for skill mastery.
- Provide small group/ individualized instruction.
- Allow use of assistive technology.
- Anticipate needs; pre-teach if needed.
- Have student repeat directions to check for understanding.
- Highlight text/ visual presentation.
- Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .

ML-

- Provide additional wait time for student responses to questions

● Provide simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase.
● Speak clearly, using a normal tone and rate of speed, or slightly slower.
● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.

● Provide additional time for in-class assignments and assessments
● Allow for computer with voice output, spelling and grammar checker
● Offer individual help throughout the lesson
● Modify readings and primary source documents.

At Risk-

● Provide small group instruction for identified areas for growth
● Allow for alternate pathways for completion of assignments.
● Provide additional wait time for student responses to questions
● Pair oral instruction with visuals
● Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☑ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.
- ☑ Communicate clearly and effectively and with reason.
- ☑ Consider the environmental, social and economics impacts of decisions.
- ☑ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☐ Model integrity, ethical leadership, and effective management.
- ☑ Plan education and career paths aligned to personal goals.
- ☐ Use technology to enhance productivity.
- ☑ Work productively in teams while using cultural global competence.

Unit 3

Populations

Summary and Rationale

Populations within ecosystems change over time in response to a variety of factors. This unit examines the relationship between the type of species and the changes in a habitat over time. Specialist species are advantaged by habitats that remain constant, while generalist species tend to be advantaged by habitats that are changing. Different reproductive patterns, including those exhibited by K- and r-selected species, also impact changes to population. Population growth is limited by environmental factors, especially by the availability of resources and space. In subsequent units, students will explore how increases in populations affect earth systems and resources, land and water use, and energy resources.

Recommended Pacing

4 weeks (~12-13 class periods - per AP recommendations in the CED)
Exam weight: 10-15%

Standards

HS-LS2-1: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
HS-LS2-6: Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms under stable conditions, but changing conditions may result in a new ecosystem.
HS-LS4-2: Construct an explanation based on evidence that evolution primarily results from heritable genetic variation, competition for limited resources, and differential survival and reproduction.
HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
HS-LS4-5: Evaluate evidence supporting claims that changes in environmental conditions may result in increases in some species, the emergence of new species, or the extinction of other species.
HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.
HS-ESS3-3: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- What factors influence population growth and population size?
- How do environmental conditions affect species survival and reproductive success?
- How do reproductive strategies influence population dynamics?
- What factors determine carrying capacity within an ecosystem?
- How does resource availability regulate population growth?
- How can population growth be modeled and predicted?
- How do age structure diagrams provide insight into future population trends?
- How do fertility rates impact population growth and sustainability?
- How have human populations changed over time?
- How does the demographic transition model explain patterns of human population growth?
- What are the environmental implications of continued population growth?

Unit Enduring Understandings:

- Population size and growth are influenced by environmental conditions, resource availability, and reproductive strategies.
- Generalist and specialist species exhibit different adaptations that affect their success in changing environments.
- Organisms use different reproductive strategies that reflect tradeoffs between offspring quantity and parental investment.
- Carrying capacity represents the maximum population size that an environment can sustainably support.
- Population growth is limited by both density-dependent and density-independent factors.
- Human population growth follows predictable patterns that can be analyzed using demographic models.
- Age structure and fertility rates help predict future population growth and resource demand.
- Resource availability ultimately limits long-term population growth.
- Population trends influence environmental quality, resource consumption, and sustainability.
- Understanding population dynamics is essential for effective environmental management and planning.

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 3.1: Generalist and Specialist Species

- Differentiate between generalist and specialist species.
- Describe the ecological advantages and disadvantages of each strategy.
- Explain how habitat stability influences species success.
- Predict how environmental change may affect generalist and specialist populations.
- Analyze examples of species occupying broad and narrow ecological niches.

Topic 3.2: K-Selected and r-Selected Species

- Differentiate between K-selected and r-selected reproductive strategies.
- Compare life-history characteristics associated with each strategy.
- Explain how environmental conditions influence reproductive success.
- Evaluate tradeoffs between offspring quantity and parental investment.
- Relate reproductive strategies to population growth patterns.

Topic 3.3: Survivorship Curves

- Interpret Type I, Type II, and Type III survivorship curves.
- Relate survivorship patterns to reproductive strategies.
- Compare mortality rates among different populations.
- Analyze how survivorship influences population growth.
- Use survivorship data to evaluate population characteristics.

Topic 3.4: Carrying Capacity

- Define carrying capacity and explain its ecological significance.
- Identify factors that determine carrying capacity.
- Describe how limiting resources affect population size.
- Interpret population growth graphs that illustrate carrying capacity.
- Predict population responses when carrying capacity is exceeded.

Topic 3.5: Population Growth and Resource Availability

- Compare exponential and logistic population growth.
- Explain how resource availability influences population size.
- Identify factors that limit population growth.
- Analyze population growth curves.
- Evaluate the effects of resource scarcity on populations.
- Describe overshoot and dieback in natural populations.

Topic 3.6: Age Structure Diagrams

- Interpret age structure diagrams.
- Compare population structures representing rapid growth, slow growth, and population decline.
- Predict future population trends using age structure data.
- Explain how age distribution affects population growth rates.
- Evaluate demographic information using population pyramids.

Topic 3.7: Total Fertility Rate

- Define total fertility rate and replacement-level fertility.
- Explain factors that influence fertility rates.
- Compare fertility patterns among different populations.
- Analyze relationships between fertility rate and population growth.
- Evaluate social and economic factors that influence reproductive decisions.

Topic 3.8: Human Population Dynamics

- Describe factors that influence human population growth.
- Calculate and interpret population growth rates.
- Analyze trends in birth rates, death rates, immigration, and emigration.
- Explain how improvements in health care, sanitation, and technology affect population growth.

- Evaluate environmental impacts associated with human population growth.

Topic 3.9: Demographic Transition

- Describe the stages of the demographic transition model.
- Explain changes in birth rates and death rates throughout demographic development.
- Compare countries at different stages of demographic transition.
- Predict future population trends based on demographic data.
- Analyze relationships among industrialization, economic development, and population growth.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

● Allow additional time for skill mastery.
● Provide small group/ individualized instruction.
● Allow use of assistive technology.
● Anticipate needs; pre-teach if needed.
● Have student repeat directions to check for understanding.
● Highlight text/ visual presentation.
● Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .

ML-

● Provide additional wait time for student responses to questions
● Provide simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase.
● Speak clearly, using a normal tone and rate of speed, or slightly slower.
● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.

● Provide additional time for in-class assignments and assessments
● Allow for computer with voice output, spelling and grammar checker
● Offer individual help throughout the lesson
● Modify readings and primary source documents.

At Risk-

● Provide small group instruction for identified areas for growth
● Allow for alternate pathways for completion of assignments.
● Provide additional wait time for student responses to questions
● Pair oral instruction with visuals
● Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)
Please select all standards that apply to this unit of study: ☑ Act as a responsible and contributing citizen and employee. ☑ Apply appropriate academic and technical skills. ☐ Attend to personal health and financial well being. ☑ Communicate clearly and effectively and with reason. ☑ Consider the environmental, social and economics impacts of decisions. ☑ Demonstrate creativity and innovation. ☑ Employ valid and reliable research strategies. ☑ Utilize critical thinking to make sense of problems and persevere in solving them. ☐ Model integrity, ethical leadership, and effective management. ☑ Plan education and career paths aligned to personal goals. ☐ Use technology to enhance productivity. ☑ Work productively in teams while using cultural global competence.

Unit 4

Earth Systems and Resources

Summary and Rationale

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.

Recommended Pacing

3 weeks (~11-12 class periods - per AP recommendations in the CED)
Exam weight: 10-15%

Standards

HS-ESS2-1: Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
HS-ESS2-2: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
HS-ESS2-4: Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

HS-ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
HS-ESS2-6: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
HS-ESS2-7: Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.
HS-ESS3-2: Evaluate competing design solutions for developing, conserving, managing, and utilizing energy and mineral resources based on associated economic, social, environmental, and geopolitical costs, risks, and benefits.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- How do Earth's physical systems interact to shape the environment?
- How does plate tectonics influence Earth's surface features and natural hazards?
- What factors contribute to soil formation and soil fertility?
- How do soil properties influence ecosystem productivity?
- How does the structure of the atmosphere support life on Earth?
- What processes drive global wind patterns and weather systems?
- How do watersheds influence the movement and quality of water?
- How does solar energy drive climate and seasonal variations?
- How do geographic features influence regional climate patterns?
- How do El Niño and La Niña affect weather and climate around the world?
- How do changes in one Earth system affect other Earth systems?

Unit Enduring Understandings:

- Earth is composed of interconnected geologic, atmospheric, hydrologic, and climatic systems.
- Plate tectonics continuously reshapes Earth's surface and influences natural processes.
- Soil is a dynamic natural resource formed through interactions among rock, climate, organisms, topography, and time.
- Soil composition and texture influence water availability, fertility, and ecosystem productivity.
- The atmosphere regulates climate, weather, and the distribution of solar energy.
- Uneven heating of Earth drives atmospheric circulation and global wind patterns.
- Watersheds connect terrestrial and aquatic systems through the movement of water.
- Variations in solar radiation influence climate, seasons, and ecosystem distribution.

- Geographic features such as latitude, elevation, and mountain ranges affect regional climates.
- Ocean-atmosphere interactions, including El Niño and La Niña, influence global climate patterns.
- Changes within one Earth system can create cascading effects throughout other Earth systems.

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 4.1: Plate Tectonics

- Describe the structure of Earth's interior.
- Explain the theory of plate tectonics.
- Differentiate among convergent, divergent, and transform plate boundaries.
- Identify geologic features associated with each type of plate boundary.
- Explain how tectonic activity produces earthquakes, volcanoes, and mountain formation.

Topic 4.2: Soil Formation and Erosion

- Explain the processes involved in soil formation.
- Identify the factors that influence soil development.
- Describe the characteristics of soil horizons.
- Analyze natural and human causes of soil erosion.
- Evaluate the environmental impacts of soil erosion.

Topic 4.3: Soil Composition and Properties

- Identify the major components of soil.
- Differentiate among sand, silt, and clay particles.
- Explain how soil texture influences permeability, water retention, and fertility.
- Interpret soil texture classifications.
- Evaluate relationships between soil properties and land use.

Topic 4.4: Earth's Atmosphere

- Describe the composition of Earth's atmosphere.
- Identify the major atmospheric layers and their characteristics.
- Explain the ecological significance of the ozone layer.
- Analyze how atmospheric structure influences weather and climate.
- Describe the role of greenhouse gases in Earth's energy balance.

Topic 4.5: Global Wind Patterns

- Explain how unequal solar heating drives atmospheric circulation.
- Describe the formation of Hadley, Ferrel, and Polar cells.
- Identify major global wind belts.
- Explain the Coriolis effect and its influence on wind patterns.
- Analyze relationships between wind circulation and climate.

Topic 4.6: Watersheds

- Define a watershed and identify its components.
- Describe how water moves through a watershed.
- Analyze factors affecting watershed health.
- Explain connections between land use and water quality.
- Evaluate the importance of watersheds in environmental management.

Topic 4.7: Solar Radiation and Earth's Seasons

- Define insolation and explain its distribution across Earth's surface.
- Describe how Earth's axial tilt produces seasonal changes.
- Analyze relationships among latitude, solar angle, and climate.
- Explain variations in day length throughout the year.
- Predict seasonal patterns based on Earth's position relative to the Sun.

Topic 4.8: Earth's Geography and Climate

- Explain how latitude influences climate.
- Analyze the effects of elevation on temperature and precipitation.
- Describe the formation of rain shadows.
- Evaluate how geographic features influence local and regional climate patterns.
- Relate climate patterns to the distribution of ecosystems.

Topic 4.9: El Niño and La Niña

- Describe the processes that produce El Niño and La Niña events.
- Compare atmospheric and oceanic conditions associated with each phase.
- Explain how ENSO events influence global weather patterns.
- Predict environmental impacts resulting from El Niño and La Niña conditions.
- Analyze relationships among ocean circulation, atmospheric circulation, and climate.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

● Allow additional time for skill mastery.
● Provide small group/ individualized instruction.
● Allow use of assistive technology.
● Anticipate needs; pre-teach if needed.
● Have student repeat directions to check for understanding.
● Highlight text/ visual presentation.
● Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .

ML-

● Provide additional wait time for student responses to questions
● Provide simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase.
● Speak clearly, using a normal tone and rate of speed, or slightly slower.
● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.

● Provide additional time for in-class assignments and assessments
● Allow for computer with voice output, spelling and grammar checker
● Offer individual help throughout the lesson
● Modify readings and primary source documents.

At Risk-

● Provide small group instruction for identified areas for growth
● Allow for alternate pathways for completion of assignments.
● Provide additional wait time for student responses to questions
● Pair oral instruction with visuals
● Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☑ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.
- ☑ Communicate clearly and effectively and with reason.
- ☑ Consider the environmental, social and economics impacts of decisions.
- ☑ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☐ Model integrity, ethical leadership, and effective management.
- ☑ Plan education and career paths aligned to personal goals.
- ☐ Use technology to enhance productivity.
- ☑ Work productively in teams while using cultural global competence.

Unit 5

Land and Water Use

Summary and Rationale

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.

Recommended Pacing

6 weeks (~18-19 class periods - per AP recommendations in the CED)
Exam weight: 10-15%

Standards

HS-LS2-1: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
HS-LS2-6: Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms under stable conditions, but changing conditions may result in a new ecosystem.
HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
HS-ESS2-2: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
HS-ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.
HS-ESS3-2: Evaluate competing design solutions for developing, conserving, managing, and utilizing energy and mineral resources based on the associated economic, social, environmental, and geopolitical costs and risks, as well as benefits.
HS-ESS3-3: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- How do human activities affect land and water resources?
- Why do common resources become vulnerable to overuse?
- What are the environmental benefits and costs of modern agricultural practices?
- How do irrigation and pest-control methods affect environmental sustainability?
- What environmental impacts result from forestry, fishing, and mining practices?
- How does urbanization alter natural systems and resource availability?
- How can human environmental impacts be measured and evaluated?
- What indicators can be used to assess sustainability?
- How can sustainable land-use practices reduce environmental degradation?
- How can natural resources be managed to meet current needs while preserving future availability?
- What tradeoffs must societies consider when balancing resource use and environmental protection?

Unit Enduring Understandings:

- Human societies rely heavily on land and water resources to meet agricultural, economic, and developmental needs.
- Commonly shared resources are susceptible to depletion when individuals act in their own short-term interests.
- Agricultural practices can increase food production but may also contribute to soil degradation, water pollution, and habitat loss.
- Resource extraction and land-use practices often produce environmental consequences that extend beyond the immediate area of use.
- Urbanization alters ecosystem processes, hydrology, biodiversity, and resource consumption patterns.
- Ecological footprints and sustainability indicators provide tools for measuring human impacts on the environment.
- Sustainable resource management seeks to balance environmental, economic, and societal needs.
- Conservation practices can reduce environmental degradation while maintaining resource productivity.
- Long-term environmental sustainability depends on responsible stewardship of land and water resources.
- Effective resource management requires evaluating environmental tradeoffs and implementing sustainable practices.

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 5.1: The Tragedy of the Commons

- Define the tragedy of the commons.
- Explain why shared resources are vulnerable to overexploitation.
- Analyze the environmental consequences of resource depletion.
- Evaluate management strategies that promote sustainable resource use.
- Apply the concept to fisheries, forests, grazing lands, and freshwater resources.

Topic 5.2: Clearcutting

- Describe the process of clearcutting.
- Explain the economic benefits associated with clearcutting practices.
- Analyze environmental impacts including habitat fragmentation, erosion, and biodiversity loss.
- Evaluate sustainable forestry alternatives.
- Assess the role of forest management in ecosystem conservation.

Topic 5.3: The Green Revolution

- Describe the major innovations of the Green Revolution.
- Explain how agricultural productivity increased during the Green Revolution.
- Evaluate environmental and social consequences associated with high-input agriculture.
- Analyze the relationships among food production, technology, and sustainability.
- Assess the long-term impacts of intensive agricultural practices.

Topic 5.4: Impacts of Agricultural Practices

- Identify agricultural practices that contribute to environmental degradation.
- Explain the effects of soil erosion and nutrient depletion.
- Analyze how agricultural runoff affects water quality.
- Evaluate the environmental consequences of fertilizer and pesticide use.
- Compare conventional and sustainable farming approaches.

Topic 5.5: Irrigation Methods

- Describe common irrigation techniques.
- Compare irrigation methods based on water-use efficiency.
- Analyze environmental impacts associated with irrigation.
- Explain causes and consequences of salinization and waterlogging.
- Evaluate strategies for improving water conservation in agriculture.

Topic 5.6: Pest Control Methods

- Differentiate among chemical, biological, and integrated pest-management strategies.
- Explain how pesticide resistance develops.
- Analyze environmental impacts associated with pesticide use.
- Evaluate advantages and limitations of various pest-control approaches.
- Assess sustainable alternatives for managing agricultural pests.

Topic 5.7: Meat Production Methods

- Compare concentrated animal feeding operations (CAFOs) and free-range systems.
- Analyze environmental impacts associated with livestock production.
- Explain relationships among meat production, land use, water consumption, and greenhouse gas emissions.
- Evaluate sustainability tradeoffs among different production methods.

- Assess resource demands associated with animal agriculture.

Topic 5.8: Impacts of Overfishing

- Define overfishing and identify its causes.
- Explain how fishing practices affect marine ecosystems.
- Analyze factors contributing to fishery declines.
- Evaluate environmental consequences of bycatch and habitat destruction.
- Assess strategies that support sustainable fisheries management.

Topic 5.9: Impacts of Mining

- Describe major mining methods and practices.
- Explain how mining affects land, water, and ecosystems.
- Analyze the environmental impacts of mine waste and acid mine drainage.
- Evaluate tradeoffs associated with mineral resource extraction.
- Assess reclamation and mitigation strategies used in mining operations.

Topic 5.10: Impacts of Urbanization

- Describe patterns and causes of urban growth.
- Explain how urbanization affects hydrologic systems.
- Analyze the impacts of impervious surfaces on water quality and flooding.
- Evaluate environmental consequences of urban expansion.
- Assess relationships among urban development, resource use, and sustainability.

Topic 5.11: Ecological Footprints

- Define ecological footprint and explain its significance.
- Calculate and interpret ecological footprint data.
- Compare ecological footprints among populations and lifestyles.
- Analyze factors that contribute to resource consumption.
- Evaluate strategies for reducing ecological footprints.

Topic 5.12: Introduction to Sustainability

- Define sustainability and sustainable development.
- Identify indicators used to evaluate environmental sustainability.
- Explain relationships among environmental, economic, and social systems.
- Analyze trends that influence long-term sustainability.
- Evaluate approaches used to achieve sustainable resource management.

Topic 5.13: Methods to Reduce Urban Runoff

- Describe the causes of urban runoff.
- Evaluate green infrastructure practices that reduce runoff.
- Explain how permeable surfaces improve water infiltration.
- Analyze the effectiveness of stormwater management strategies.
- Assess the role of urban planning in protecting water resources.

Topic 5.14: Integrated Pest Management

- Describe the principles of integrated pest management (IPM).
- Compare IPM with conventional pesticide-based approaches.
- Evaluate how IPM reduces environmental impacts.
- Analyze the effectiveness of biological and cultural pest-control methods.

- Assess the role of IPM in sustainable agriculture.

Topic 5.15: Sustainable Agriculture

- Identify agricultural practices that promote sustainability.
- Explain how soil conservation techniques improve productivity.
- Analyze benefits of crop rotation, contour plowing, and cover cropping.
- Evaluate strategies that reduce environmental impacts of farming.
- Assess the relationship between sustainable agriculture and food security.

Topic 5.16: Sustainable Aquaculture

- Describe aquaculture systems and practices.
- Compare aquaculture and wild-capture fisheries.
- Analyze environmental challenges associated with aquaculture.
- Evaluate methods that improve aquaculture sustainability.
- Assess the role of aquaculture in meeting global food demands.

Topic 5.17: Sustainable Forestry

- Describe practices used in sustainable forest management.
- Explain the ecological benefits of reforestation and selective harvesting.
- Analyze methods for reducing wildfire risk and maintaining forest health.
- Evaluate tradeoffs between resource extraction and conservation.
- Assess the long-term importance of forests in supporting biodiversity and ecosystem services.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

● Allow additional time for skill mastery.
● Provide small group/ individualized instruction.
● Allow use of assistive technology.
● Anticipate needs; pre-teach if needed.
● Have student repeat directions to check for understanding.
● Highlight text/ visual presentation.
● Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .

ML-

● Provide additional wait time for student responses to questions
● Provide simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase.
● Speak clearly, using a normal tone and rate of speed, or slightly slower.
● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.
- Provide additional time for in-class assignments and assessments
- Allow for computer with voice output, spelling and grammar checker
- Offer individual help throughout the lesson
- Modify readings and primary source documents.

At Risk-
- Provide small group instruction for identified areas for growth
- Allow for alternate pathways for completion of assignments.
- Provide additional wait time for student responses to questions
- Pair oral instruction with visuals
- Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☑ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.
- ☑ Communicate clearly and effectively and with reason.
- ☑ Consider the environmental, social and economics impacts of decisions.
- ☑ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☐ Model integrity, ethical leadership, and effective management.
- ☑ Plan education and career paths aligned to personal goals.
- ☐ Use technology to enhance productivity.
- ☑ Work productively in teams while using cultural global competence.

Unit 6

Energy Resources & Consumption

Summary and Rationale

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

Recommended Pacing

6 weeks (~16-17 class periods - per AP recommendations in the CED)
Exam weight: 10-15%

Standards

HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
HS-PS3-4: Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system.
HS-PS3-5: Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.
HS-ESS3-2: Evaluate competing design solutions for developing, conserving, managing, and utilizing energy and mineral resources based on the associated economic, social, environmental, and geopolitical costs and risks, as well as benefits.
HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems.
HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems.
HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- How do renewable and nonrenewable energy resources differ?
- How does global energy consumption affect environmental sustainability?
- What factors influence energy demand around the world?
- How are fossil fuels formed, extracted, and used?
- What environmental and economic tradeoffs are associated with different energy sources?
- How does nuclear power compare with fossil fuel and renewable energy systems?
- What advantages and limitations exist for biomass, solar, hydroelectric, geothermal, hydrogen, and wind energy?
- How does the geographic distribution of resources influence energy production?
- How do energy choices affect ecosystems, climate, and human health?
- How can energy conservation reduce environmental impacts?

- What role will energy innovation play in achieving a sustainable future?

Unit Enduring Understandings:

- Modern societies depend on reliable energy resources to support economic development and human well-being.
- Energy resources vary in availability, renewability, efficiency, and environmental impact.
- Fossil fuels remain major global energy sources but contribute significantly to pollution and climate change.
- Renewable energy resources offer alternatives to fossil fuels but possess unique technological and environmental limitations.
- The distribution of natural energy resources influences economic, political, and environmental decision-making.
- No energy source is completely free of environmental impacts or tradeoffs.
- Energy production involves converting energy from one form to another through physical and technological processes.
- Conservation and efficiency are essential components of sustainable energy management.
- Energy choices have long-term consequences for ecosystems, human health, and climate stability.
- Evaluating energy systems requires balancing environmental, economic, and societal considerations.

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 6.1: Renewable and Nonrenewable Resources

- Differentiate between renewable and nonrenewable energy resources.
- Classify common energy resources according to their rate of replenishment.
- Explain the concepts of energy stocks and energy flows.
- Evaluate the sustainability of various energy resources.
- Analyze factors affecting energy availability.

Topic 6.2: Global Energy Consumption

- Describe patterns of global energy use.
- Compare energy consumption among developed and developing nations.
- Analyze factors that influence energy demand.
- Evaluate trends in energy production and consumption.
- Explain the relationship between economic development and energy use.

Topic 6.3: Fuel Types and Uses

- Identify major fuel types used throughout the word.
- Compare energy content and applications of various fuels.
- Explain how fuels are selected for specific purposes.
- Evaluate advantages and limitations of different fuel sources.
- Analyze environmental impacts associated with fuel use.

Topic 6.4: Distribution of Natural Energy Resources

- Describe the geographic distribution of major energy resources.
- Explain how geologic processes influence energy-resource availability.
- Analyze the economic implications of uneven resource distribution.
- Evaluate factors affecting energy-resource accessibility.
- Assess geopolitical considerations associated with resource distribution.

Topic 6.5: Fossil Fuels

- Describe the formation of coal, petroleum, and natural gas.
- Compare methods used to extract fossil fuels.
- Explain how fossil fuels are converted into usable energy.
- Analyze environmental impacts associated with extraction and combustion.
- Evaluate advantages and limitations of fossil fuel dependence.

Topic 6.6: Nuclear Power

- Describe the process of nuclear fission.
- Explain how nuclear power plants generate electricity.
- Compare benefits and risks associated with nuclear energy.
- Analyze issues related to radioactive waste management.
- Evaluate environmental and safety concerns associated with nuclear energy.

Topic 6.7: Energy from Biomass

- Identify major sources of biomass energy.
- Explain how biomass can be used to generate energy.
- Compare biomass with fossil fuels and other renewable resources.
- Analyze environmental impacts of biomass production and use.
- Evaluate the sustainability of biomass energy systems.

Topic 6.8: Solar Energy

- Describe technologies used to capture solar energy.
- Compare passive and active solar-energy systems.
- Explain how photovoltaic cells generate electricity.
- Analyze benefits and limitations of solar power.
- Evaluate factors affecting solar-energy production.

Topic 6.9: Hydroelectric Power

- Explain how hydroelectric facilities generate electricity.
- Compare different hydroelectric technologies.
- Analyze environmental impacts associated with dams and reservoirs.
- Evaluate advantages and disadvantages of hydroelectric power.
- Assess the role of hydropower in sustainable energy production.

Topic 6.10: Geothermal Energy

- Describe how geothermal energy is generated and utilized.
- Explain the geologic conditions necessary for geothermal power development.
- Analyze environmental impacts associated with geothermal systems.
- Compare geothermal energy with other renewable resources.
- Evaluate limitations affecting geothermal energy production.

Topic 6.11: Hydrogen Fuel Cells

- Explain how hydrogen fuel cells generate electricity.
- Describe methods used to produce hydrogen fuel.
- Compare hydrogen fuel cells with conventional combustion technologies.
- Analyze environmental benefits and challenges of hydrogen use.
- Evaluate the potential role of hydrogen in future energy systems.

Topic 6.12: Wind Energy

- Explain how wind turbines convert kinetic energy into electricity.
- Identify environmental and geographic factors affecting wind-energy production.
- Analyze advantages and limitations of wind power.
- Evaluate environmental impacts associated with wind-energy development.
- Assess the role of wind energy in reducing reliance on fossil fuels.

Topic 6.13: Energy Conservation

- Define energy conservation and energy efficiency
- Identify strategies that reduce energy consumption.
- Analyze economic and environmental benefits of conservation measures.
- Evaluate technologies that improve energy efficiency.
- Assess the role of conservation in achieving sustainable energy use.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

● Allow additional time for skill mastery.
● Provide small group/ individualized instruction.
● Allow use of assistive technology.
● Anticipate needs; pre-teach if needed.
● Have student repeat directions to check for understanding.
● Highlight text/ visual presentation.
● Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .

ML-

● Provide additional wait time for student responses to questions
● Provide simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase.
● Speak clearly, using a normal tone and rate of speed, or slightly slower.
● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.

● Provide additional time for in-class assignments and assessments
● Allow for computer with voice output, spelling and grammar checker
● Offer individual help throughout the lesson
● Modify readings and primary source documents.

At Risk-

● Provide small group instruction for identified areas for growth
● Allow for alternate pathways for completion of assignments.
● Provide additional wait time for student responses to questions
● Pair oral instruction with visuals
● Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☑ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.
- ☑ Communicate clearly and effectively and with reason.
- ☑ Consider the environmental, social and economics impacts of decisions.
- ☑ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☑ Model integrity, ethical leadership, and effective management.
- ☑ Plan education and career paths aligned to personal goals.
- ☑ Use technology to enhance productivity.
- ☑ Work productively in teams while using cultural global competence.

Unit 7

Atmospheric Pollution

Summary and Rationale

Air pollution has many sources and effects, both indoors and outdoors. Air is a natural resource that covers the Earth and crosses many system boundaries. Human activities affect the quality of the air both indoors and outdoors. Through legislation, the Clean Air Act regulates the emission of air pollutants that affect human health. The gases and particulates in the atmosphere come from both natural and human sources; once air pollution sources are identified, methods can be used to reduce it. Subsequent units will focus on pollution's impacts to land and water.

Recommended Pacing

3 weeks (~11-12 class periods - per AP recommendations in the CED)
Exam weight: 7-10%

Standards

HS-PS1-5: Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of reacting particles on the rate at which a reaction occurs.
HS-ESS2-2: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
HS-ESS2-4: Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.
HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems.
HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems.
HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- What are the major sources of atmospheric pollution?
- How do pollutants move through and interact with the atmosphere?
- What are the environmental and human health effects of air pollution?
- How do primary and secondary pollutants differ?
- How does photochemical smog develop?
- What factors contribute to acid deposition and its environmental consequences?
- How does indoor air pollution affect human health?
- What causes thermal inversions and how do they influence air quality?
- How do atmospheric pollutants affect ecosystems and natural resources?
- What technologies and policies can improve air quality?
- How can societies balance economic development with clean air initiatives?

Unit Enduring Understandings:

- Human activities release pollutants that alter atmospheric composition and affect environmental quality.
- Air pollutants can be transported, transformed, and concentrated through atmospheric processes.

- Primary pollutants are emitted directly into the atmosphere, while secondary pollutants form through chemical reactions.
- Air pollution can negatively impact human health, ecosystems, infrastructure, and climate.
- Weather conditions and atmospheric processes influence pollutant distribution and concentration.
- Photochemical smog forms through interactions among pollutants and sunlight.
- Acid deposition can alter soil chemistry, aquatic ecosystems, and vegetation health.
- Indoor air pollutants can present significant health risks due to prolonged exposure.
- Effective pollution-control technologies and regulations can significantly improve air quality.
- Reducing atmospheric pollution requires informed decision-making and sustainable resource management.

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 7.1: Introduction to Air Pollution

- Differentiate between primary and secondary air pollutants.
- Identify major pollutants released from fossil fuel combustion and other human activities.
- Explain the sources and environmental impacts of common atmospheric pollutants.
- Analyze relationships among pollutant sources, atmospheric processes, and air quality.
- Evaluate factors that influence pollutant concentrations in the atmosphere.

Topic 7.2: Photochemical Smog

- Explain the chemical processes involved in photochemical smog formation.
- Identify the roles of nitrogen oxides (NOx), volatile organic compounds (VOCs), and sunlight in smog production.
- Describe the formation of ground-level ozone.
- Analyze conditions that increase the likelihood of smog events.
- Evaluate the environmental and human health impacts of photochemical smog.

Topic 7.3: Thermal Inversion

- Define thermal inversion and describe how it develops.
- Explain how thermal inversions influence air quality.
- Analyze atmospheric conditions that promote inversion events.
- Assess the effects of trapped pollutants on human health and the environment.
- Interpret scenarios involving inversion-related air pollution.

Topic 7.4: Atmospheric CO_2 and Particulates

- Identify natural and anthropogenic sources of atmospheric carbon dioxide.
- Describe sources and characteristics of particulate matter.
- Explain how particulate matter affects environmental quality and human health.
- Analyze the role of atmospheric CO_2 in Earth's systems.

- Evaluate the impacts of increasing atmospheric concentrations of pollutants.

Topic 7.5: Indoor Air Pollutants

- Identify major indoor air pollutants and their sources.
- Explain health risks associated with exposure to indoor pollutants.
- Analyze factors that contribute to poor indoor air quality.
- Evaluate strategies for reducing indoor pollutant exposure.
- Assess the effectiveness of ventilation and pollutant-control measures.

Topic 7.6: Reduction of Air Pollutants

- Describe technologies used to reduce atmospheric pollution.
- Explain the operation of catalytic converters, scrubbers, electrostatic precipitators, and vapor recovery systems.
- Evaluate the effectiveness of air-pollution control technologies.
- Analyze the role of environmental regulations in improving air quality.
- Assess the benefits and limitations of pollution-reduction strategies.

Topic 7.7: Acid Rain

- Describe the formation of acid deposition.
- Explain how sulfur dioxide and nitrogen oxides contribute to acid rain.
- Analyze the impacts of acid deposition on aquatic ecosystems, soils, forests, and infrastructure.
- Evaluate factors that influence ecosystem susceptibility to acid deposition.
- Assess methods used to reduce emissions that contribute to acid rain.

Topic 7.8: Noise Pollution

- Define noise pollution and identify major sources.
- Explain the effects of excessive noise on human health.
- Analyze the impacts of noise pollution on wildlife populations and ecosystem function.
- Evaluate methods used to reduce noise pollution.
- Assess the role of planning and policy in managing noise-related environmental issues.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

● Allow additional time for skill mastery.
● Provide small group/ individualized instruction.
● Allow use of assistive technology.
● Anticipate needs; pre-teach if needed.
● Have student repeat directions to check for understanding.
● Highlight text/ visual presentation.
● Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .

ML-

● Provide additional wait time for student responses to questions
● Provide simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase.

● Speak clearly, using a normal tone and rate of speed, or slightly slower.
● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.

● Provide additional time for in-class assignments and assessments
● Allow for computer with voice output, spelling and grammar checker
● Offer individual help throughout the lesson
● Modify readings and primary source documents.

At Risk-

● Provide small group instruction for identified areas for growth
● Allow for alternate pathways for completion of assignments.
● Provide additional wait time for student responses to questions
● Pair oral instruction with visuals
● Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☑ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.
- ☑ Communicate clearly and effectively and with reason.
- ☑ Consider the environmental, social and economics impacts of decisions.
- ☑ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☑ Model integrity, ethical leadership, and effective management.
- ☑ Plan education and career paths aligned to personal goals.
- ☑ Use technology to enhance productivity.
- ☑ Work productively in teams while using cultural global competence.

Unit 8

Aquatic and Terrestrial Pollution

Summary and Rationale

Pollution created by human activities directly impacts ecosystems in the air, on land, and in water. The source of pollution can sometimes be easy to identify, but other times the source is diffused. There are many human health issues that can be linked to pollution. Legislation has been created to reduce discharges of pollution in water and regulate drinking water. Increases in waste cause global concerns for organisms that live on land and in water. In the final unit, students will explore how local and regional human activities can have a global impact.

Recommended Pacing

6 weeks (~19-20 class periods - per AP recommendations in the CED)
Exam weight: 7-10%

Standards

HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
HS-LS2-6: Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms under stable conditions, but changing conditions may result in a new ecosystem.
HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
HS-ESS2-2: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
HS-ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.
HS-ESS3-3: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems.
HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems.
HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- How do pollutants enter aquatic and terrestrial ecosystems?
- What are the differences between point-source and nonpoint-source pollution?
- How do pollutants affect ecosystem structure, function, and biodiversity?
- What environmental and health concerns are associated with toxic substances?
- How do pollutants accumulate and move through food webs?
- What causes eutrophication and other forms of water-quality degradation?
- How do waste-disposal practices affect environmental quality?
- How can wastewater and sewage be treated to reduce environmental impacts?
- How are toxicological risks evaluated and communicated?
- How do pollution-related health risks affect human populations?
- What strategies can reduce pollution and promote environmental sustainability?

Unit Enduring Understandings:

- Human activities introduce pollutants into aquatic and terrestrial environments through a variety of pathways.
- Pollution can alter ecosystem processes, reduce biodiversity, and impair environmental quality.
- The impacts of pollution depend on pollutant type, concentration, persistence, and environmental conditions.
- Toxic substances can accumulate within organisms and increase in concentration through food webs.
- Nutrient pollution can disrupt aquatic ecosystems through eutrophication and oxygen depletion.
- Waste generation and disposal practices influence environmental and public health.
- Effective treatment of wastewater can reduce pollution entering natural systems.
- Toxicological principles help scientists assess risk and understand pollutant effects on living organisms.
- Pollution can create significant human-health challenges through exposure to harmful substances and pathogens.
- Sustainable waste-management and pollution-prevention strategies can reduce environmental degradation.

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 8.1: Sources of Pollution

- Differentiate between point-source and nonpoint-source pollution.
- Identify common sources of pollutants entering terrestrial and aquatic systems.
- Explain how pollutants are transported through the environment.
- Analyze challenges associated with monitoring and controlling pollution sources.
- Evaluate human activities that contribute to environmental contamination.

Topic 8.2: Human Impacts on Ecosystems

- Explain how pollution affects ecosystem structure and function.
- Describe how pollutants alter environmental conditions beyond an organism's tolerance range.
- Analyze impacts of pollution on aquatic and terrestrial biodiversity.
- Evaluate the ecological consequences of oil spills, sedimentation, and other pollutants.
- Assess the role of indicator species in evaluating environmental quality.

Topic 8.3: Endocrine Disruptors

- Define endocrine disruptors and describe how they affect hormonal systems.
- Identify common endocrine-disrupting chemicals and their sources.
- Explain how endocrine disruptors affect organisms and populations.
- Analyze ecological and human-health impacts associated with endocrine disruption.
- Evaluate the environmental risks posed by these contaminants.

Topic 8.4: Human Impacts on Wetlands and Mangroves

- Describe the ecosystem services provided by wetlands and mangroves.
- Explain how development and pollution affect wetland and mangrove ecosystems.
- Analyze the consequences of habitat degradation and loss.
- Evaluate the ecological importance of wetlands and mangroves.
- Assess conservation strategies designed to protect these ecosystems.

Topic 8.5: Eutrophication

- Describe the causes of eutrophication.
- Explain the roles of nitrogen and phosphorus in nutrient pollution.
- Analyze the relationship between algal blooms and dissolved oxygen levels.
- Evaluate ecological consequences of hypoxia and dead zones.
- Assess strategies used to prevent nutrient pollution.

Topic 8.6: Thermal Pollution

- Define thermal pollution and identify its major sources.
- Explain how temperature changes affect aquatic ecosystems.
- Analyze relationships among temperature, dissolved oxygen, and aquatic life.
- Evaluate environmental consequences of thermal discharges.
- Assess methods used to reduce thermal pollution.

Topic 8.7: Persistent Organic Pollutants (POPs)

- Identify characteristics of persistent organic pollutants.
- Explain why POPs remain in the environment for long periods.
- Analyze pathways through which POPs move through ecosystems.
- Evaluate ecological and human-health risks associated with POP exposure.
- Assess challenges associated with managing persistent pollutants.

Topic 8.8: Bioaccumulation and Biomagnification

- Differentiate between bioaccumulation and biomagnification.
- Explain how contaminants move through food webs.
- Analyze factors that contribute to pollutant accumulation in organisms.
- Evaluate ecological consequences of biomagnification.
- Assess risks to top consumers and human populations.

Topic 8.9: Solid Waste Disposal

- Describe major methods of solid-waste disposal.
- Explain how sanitary landfills are designed to reduce environmental impacts.
- Analyze advantages and disadvantages of waste-disposal methods.
- Evaluate environmental concerns associated with landfills and incineration.
- Assess the effectiveness of modern waste-management systems.

Topic 8.10: Waste Reduction Methods

- Identify strategies used to reduce solid waste generation.
- Explain the principles of waste reduction, reuse, and recycling.
- Analyze environmental benefits of reducing waste production.
- Evaluate waste-management approaches used by communities.
- Assess the role of individual and societal actions in reducing waste.

Topic 8.11: Sewage Treatment

- Describe the stages of sewage treatment.
- Explain how treatment processes remove contaminants from wastewater.
- Analyze the role of wastewater treatment in protecting water quality.
- Evaluate limitations of wastewater-treatment systems.
- Assess environmental consequences of untreated sewage.

Topic 8.12: Lethal Dose 50% (LD_{50})

- Define LD_{50} and explain its use in toxicology.
- Interpret LD_{50} data for various substances.
- Compare toxicity levels using quantitative measures.
- Analyze factors influencing an organism's response to toxic substances.
- Evaluate the usefulness and limitations of LD_{50} testing.

Topic 8.13: Dose-Response Curve

- Interpret dose-response relationships.
- Explain how increasing exposure affects organismal responses.
- Identify threshold and non-threshold responses.
- Analyze toxicological data using dose-response curves.
- Evaluate the significance of dose-response analysis in environmental health.

Topic 8.14: Pollution and Human Health

- Identify major health risks associated with environmental pollutants.
- Explain exposure pathways for contaminants.
- Analyze relationships between pollutant exposure and disease.
- Evaluate factors affecting human vulnerability to pollutants.
- Assess strategies that reduce health risks associated with pollution.

Topic 8.15: Pathogens and Infectious Diseases

- Identify common waterborne and environmentally transmitted pathogens.
- Explain how pathogens spread through environmental systems.
- Analyze environmental conditions that promote disease transmission.
- Evaluate public-health measures used to reduce pathogen exposure.
- Assess the role of sanitation, treatment, and prevention programs in disease control.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

● Allow additional time for skill mastery.
● Provide small group/ individualized instruction.
● Allow use of assistive technology.
● Anticipate needs; pre-teach if needed.
● Have student repeat directions to check for understanding.
● Highlight text/ visual presentation.
● Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .

ML-

● Provide additional wait time for student responses to questions
● Provide simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase.
● Speak clearly, using a normal tone and rate of speed, or slightly slower.
● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.

● Provide additional time for in-class assignments and assessments
● Allow for computer with voice output, spelling and grammar checker
● Offer individual help throughout the lesson
● Modify readings and primary source documents.

At Risk-

● Provide small group instruction for identified areas for growth
● Allow for alternate pathways for completion of assignments.
● Provide additional wait time for student responses to questions
● Pair oral instruction with visuals
● Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☐ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☑ Attend to personal health and financial well being.
- ☑ Communicate clearly and effectively and with reason.
- ☑ Consider the environmental, social and economics impacts of decisions.
- ☑ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☑ Model integrity, ethical leadership, and effective management.
- ☑ Plan education and career paths aligned to personal goals.
- ☑ Use technology to enhance productivity.
- ☑ Work productively in teams while using cultural global competence.

Unit 9

Global Change

Summary and Rationale

A central aspect of environmental science is to understand the global impact of local and regional human activities. Humans can mitigate their impact through sustainable use of resources. Human activities can cause ozone depletion in the stratosphere and increases in the greenhouse gases in the atmosphere. Increases in greenhouse gases can cause human health and environmental problems. These environmental problems include global climate change, ocean warming, and endangered species. Overall, this course provides an opportunity to examine the interrelationships among the natural world and challenges students to evaluate and propose solutions to a variety of environmental problems.

Recommended Pacing

6 weeks (~19-20 class periods - per AP recommendations in the CED)
Exam weight: 15-20%

Standards

HS-LS2-6: Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms under stable conditions, but changing conditions may result in a new ecosystem.
HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
HS-LS4-5: Evaluate evidence supporting claims that changes in environmental conditions may result in increases in the number of individuals of some species, the emergence of new species over time, and the extinction of other species.

HS-ESS2-4: Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
HS-ESS2-6: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
HS-ESS2-7: Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.
HS-ESS3-3: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems.
HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems.
HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- How do human activities contribute to global environmental change?
- How does stratospheric ozone depletion affect living organisms and ecosystems?
- How have international efforts reduced ozone depletion?
- How does the greenhouse effect influence Earth's climate?
- What human activities contribute to rising greenhouse gas concentrations?
- What evidence supports the occurrence of global climate change?
- How does climate change affect Earth's oceans and ecosystems?
- How do ocean warming and ocean acidification affect marine life?
- Why do invasive species threaten ecosystem stability and biodiversity?
- What factors contribute to species endangerment and extinction?
- How do human activities influence biodiversity loss on a global scale?
- What strategies can mitigate the impacts of global environmental change?

Unit Enduring Understandings:

- Human activities can alter Earth's atmosphere, oceans, and ecosystems on a global scale.
- Stratospheric ozone protects life by absorbing harmful ultraviolet radiation.
- International cooperation can successfully address global environmental challenges.
- The greenhouse effect is a natural process that is being intensified by human activities.

- Increasing greenhouse gas concentrations contribute to changes in Earth's climate system.
- Climate change affects physical, biological, and ecological processes worldwide.
- Oceans are significantly affected by rising atmospheric carbon dioxide concentrations.
- Ocean warming and acidification threaten marine biodiversity and ecosystem function.
- Invasive species can alter ecosystem structure, reduce biodiversity, and disrupt ecological relationships.
- Species become endangered when environmental pressures exceed their ability to survive and reproduce.
- Human activities are a major driver of biodiversity loss worldwide.
- Scientific understanding and sustainable management practices can reduce the impacts of global change.

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 9.1: Stratospheric Ozone Depletion

- Describe the structure and function of the stratospheric ozone layer.
- Explain how ozone absorbs ultraviolet radiation.
- Identify ozone-depleting substances and their sources.
- Analyze the mechanisms responsible for ozone depletion.
- Evaluate environmental and human health impacts associated with ozone loss.

Topic 9.2: Reducing Ozone Depletion

- Describe strategies used to reduce ozone depletion.
- Explain the significance of international agreements such as the Montreal Protocol.
- Evaluate the effectiveness of policies regulating ozone-depleting substances.
- Analyze tradeoffs associated with replacement chemicals.
- Assess progress toward ozone-layer recovery.

Topic 9.3: The Greenhouse Effect

- Explain the natural greenhouse effect.
- Identify major greenhouse gases and their sources.
- Describe how greenhouse gases influence Earth's energy balance.
- Differentiate between the natural and enhanced greenhouse effects.
- Analyze relationships between atmospheric composition and climate.

Topic 9.4: Increases in Greenhouse Gases

- Identify major human activities that increase greenhouse gas concentrations.
- Analyze trends in atmospheric greenhouse gas levels.
- Explain how fossil-fuel combustion, agriculture, and land-use changes contribute to emissions.
- Evaluate the environmental implications of increasing greenhouse gas concentrations.
- Interpret data related to greenhouse gas trends.

Topic 9.5: Global Climate Change

- Describe evidence supporting global climate change.

- Explain causes of contemporary climate change.
- Analyze environmental impacts associated with changing climate patterns.
- Evaluate ecological and societal consequences of climate change.
- Assess potential mitigation and adaptation strategies.

Topic 9.6: Ocean Warming

- Explain how climate change contributes to ocean warming.
- Analyze the effects of increasing ocean temperatures on marine ecosystems.
- Describe the causes and consequences of coral bleaching.
- Evaluate impacts of ocean warming on biodiversity and ecosystem services.
- Interpret data related to changing ocean temperatures.

Topic 9.7: Ocean Acidification

- Describe the process of ocean acidification.
- Explain the relationship between atmospheric carbon dioxide and ocean chemistry.
- Analyze impacts of changing pH on marine organisms.
- Evaluate consequences for marine food webs and ecosystem stability.
- Interpret data related to ocean acidification trends.

Topic 9.8: Invasive Species

- Define invasive species and identify pathways of introduction.
- Explain characteristics that contribute to invasive species success.
- Analyze ecological impacts of invasive species.
- Evaluate management strategies used to control invasive populations.
- Assess the role of human activities in species introductions.

Topic 9.9: Endangered Species

- Identify factors that contribute to species endangerment.
- Analyze characteristics that increase extinction risk.
- Explain ecological consequences of species loss.
- Evaluate conservation strategies designed to protect endangered species.
- Assess the effectiveness of laws and policies that support species recovery.

Topic 9.10: Human Impacts on Biodiversity

- Explain major causes of biodiversity loss.
- Apply the HIPPCO framework to biodiversity challenges.
- Analyze relationships among habitat loss, invasive species, pollution, climate change, and overexploitation.
- Evaluate the ecological consequences of declining biodiversity.
- Assess strategies that conserve biodiversity and promote ecosystem resilience.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

- Allow additional time for skill mastery.

● Provide small group/ individualized instruction.
● Allow use of assistive technology.
● Anticipate needs; pre-teach if needed.
● Have student repeat directions to check for understanding.
● Highlight text/ visual presentation.
● Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .

ML-

● Provide additional wait time for student responses to questions
● Provide simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase.
● Speak clearly, using a normal tone and rate of speed, or slightly slower.
● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.

● Provide additional time for in-class assignments and assessments
● Allow for computer with voice output, spelling and grammar checker
● Offer individual help throughout the lesson
● Modify readings and primary source documents.

At Risk-

● Provide small group instruction for identified areas for growth
● Allow for alternate pathways for completion of assignments.
● Provide additional wait time for student responses to questions
● Pair oral instruction with visuals
● Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☑ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☑ Attend to personal health and financial well being.
- ☑ Communicate clearly and effectively and with reason.
- ☑ Consider the environmental, social and economics impacts of decisions.
- ☑ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☑ Model integrity, ethical leadership, and effective management.
- ☑ Plan education and career paths aligned to personal goals.
- ☑ Use technology to enhance productivity.
- ☑ Work productively in teams while using cultural global competence.