# Unit 3 The Living World: Ecosystems

Content Area: **Science**
Course(s): **AP Environmental Science**
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## Transfer

This first unit sets the foundation for the course by examining the Earth as a system with interdependent components, processes, and relationships. In this unit, students will examine the distribution of resources in ecosystems and its influences on species interactions.

On the AP Exam, students must be able to explain trends in population data for organisms. To practice this, students can look at a variety of human population graphs from various countries and then explain the trends in the data to draw conclusions about changes in the populations. This is also an opportunity for students to explain population density and population growth.

## Enduring Understandings

ERT-1 Ecosystems are the result of biotic and abiotic interactions

ENG-1 Energy can be converted from one form to another

ERT-4 The health of a species is closely tied to its ecosystem, and minor environmental changes can have a large impact

## Essential Questions

How does energy change form within an ecosystem?
How does energy change form within an environment?
How old is the water you drink?

## Standards

**Ecosystem Interaction Standards:**

ERT-1.A.1 In a predator-prey relationship, the predator is an organism that eats another organism (the prey).

ERT-1.A.2 Symbiosis is a close and long-term interaction between two species in an ecosystem. Types of

symbiosis include mutualism, commensalism, and parasitism.

ERT-1.A.3 Competition can occur within or between species in an ecosystem where there are limited resources. Resource partitioning—using the resources in different ways, places, or at different times—can reduce the negative impact of competition on survival.

EIN-4.A.1 Invasive species are species that can live, and sometimes thrive, outside of their normal habitat. Invasive species can sometimes be beneficial, but they are considered invasive when they threaten native species.

EIN-4.A.2 Invasive species are often generalist, r-selected species and therefore may outcompete native species for resources.

EIN-4.A.3 Invasive species can be controlled through a variety of human interventions.

**Terrestrial Biome Standards:**

ERT-1.B.1 A biome contains characteristic communities of plants and animals that result from, and are adapted to, its climate.

ERT-1.B.2 Major terrestrial biomes include taiga, temperate rainforests, temperate seasonal forests, tropical rainforests, shrubland, temperate grassland, savanna, desert, and tundra.

ERT-1.B.3 The global distribution of nonmineral terrestrial natural resources, such as water and trees for lumber, varies because of some combination of climate, geography, latitude and altitude, nutrient availability, and soil.

ERT-1.B.4 The worldwide distribution of biomes is dynamic; the distribution has changed in the past and may again shift as a result of global climate changes.

**Aquatic Biomes Standards:**

ERT-1.C.1 Freshwater biomes include streams, rivers, ponds, and lakes. These freshwater biomes are a vital resource for drinking water.

ERT-1.C.2 Marine biomes include oceans, coral reefs, marshland, and estuaries. Algae in marine biomes supply a large portion of the Earth's oxygen, and also take in carbon dioxide from the atmosphere.

ERT-1.C.3 The global distribution of nonmineral marine natural resources, such as different types of fish, varies because of some combination of salinity, depth, turbidity, nutrient availability, and temperature.

**Biogeochemical Cycles Standards:**

ERT-1.D.1 The carbon cycle is the movement of atoms and molecules containing the element carbon between sources and sinks.
ERT-1.D.2 Some of the reservoirs in which carbon compounds occur in the carbon cycle hold those compounds for long periods of time, while some hold them for relatively short periods of time.
ERT-1.D.3 Carbon cycles between photosynthesis and cellular respiration in living things.

ERT-1.D.4 Plant and animal decomposition have led to the storage of carbon over millions of years. The burning of fossil fuels quickly moves that stored carbon into atmospheric carbon, in the form of carbon dioxide.

ERT-1.E.1The nitrogen cycle is the movement of atoms and molecules containing the element nitrogen between sources and sinks.
ERT-1.E.2 Most of the reservoirs in which nitrogen compounds occur in the nitrogen cycle hold those compounds for relatively short periods of time.
ERT-1.E.3 Nitrogen fixation is the process in which atmospheric nitrogen is converted into a form of nitrogen (primarily ammonia) that is available for uptake by plants and that can be synthesized into plant tissue.
ERT-1.E.4 The atmosphere is the major reservoir of nitrogen.

ERT-1.F.1 The phosphorus cycle is the movement of atoms and molecules containing the element phosphorus between sources and sinks.
ERT-1.F.2 The major reservoirs of phosphorus in the phosphorus cycle are rock and sediments that contain phosphorus-bearing minerals.
ERT-1.F.3 There is no atmospheric component in the phosphorus cycle, and the limitations this imposes on the return of phosphorus from the ocean to land make phosphorus naturally scarce in aquatic and many terrestrial ecosystems. In undisturbed ecosystems, phosphorus is the limiting factor in biological systems.

ERT-1.G.1 The hydrologic cycle, which is powered by the sun, is the movement of water in its various solid, liquid, and gaseous phases between sources and sinks.

ERT-1.G.2 All ecosystems depend on a continuous inflow of high-quality energy in order to maintain their structure and function of transferring matter between the environment and organisms via biogeochemical cycles. Biogeochemical cycles are essential for life and each cycle demonstrates the conservation of matter.

**Primary Productivity Standards:**

ENG-1.A.1 Primary productivity is the rate at which solar energy (sunlight) is converted into organic compounds via photosynthesis over a unit of time.
ENG-1.A.2 Gross primary productivity is the total rate of photosynthesis in a given area.
ENG-1.A.3 Net primary productivity is the rate of energy storage by photosynthesizers in a given area, after subtracting the energy lost to respiration.
ENG-1.A.4 Productivity is measured in units of energy per unit area per unit time (e.g., kcal/m2/yr).
ENG-1.A.5 Most red light is absorbed in the upper 1m of water, and blue light only penetrates deeper than 100m in the clearest water. This affects photosynthesis in aquatic ecosystems, whose photosynthesizers have adapted mechanisms to address the lack of visible light.

**Energy, Food Webs, Trophic Level and 10% Rule Standards:**

ENG-1.B.3 In terrestrial and near-surface marine communities, energy flows from the sun to producers in the lowest trophic levels and then upward to higher trophic levels.
ENG-1.C.1 The 10% rule approximates that in the transfer of energy from one trophic level to the next, only about 10% of the energy is passed on. The loss of energy that occurs when energy moves from lower to higher trophic levels can be explained through the laws ofthermodynamics.
ENG-1.D.1 A food web is a model of an interlocking pattern of food chains that depicts the flow of energy and nutrients in two or more food chains.
ENG-1.D.2 Positive and negative feedback loops can each play a role in food webs. When one species is

removed from or added to a specific food web, the rest of the food web can be affected.

## Assessments

Formative

- Reading Guide Checks
- Food Web Practice

Summative

Quiz

- Biomes Quiz
- Biogeochemical Cycles Quiz

Lab

- Predator- Prey interaction Lab

Test

- Unit 2 & 3 Test

## Resources

College Board AP Central : https://apcentral.collegeboard.org/courses/ap-environmental-science/course

College Board AP Environmental Science Course & Exam Description Manual https://apstudents.collegeboard.org/sites/default/files/2019-05/ap-environmental-science-course-and-exam-description.pdf

College Board AP Environmental Science "AP Classroom" https://apcentral.collegeboard.org/about-ap/news-changes/ap-2019?course=ap-environmental-science

AP Environmental Science Classroom Resources https://apcentral.collegeboard.org/courses/ap-environmental-science/classroom-resources

Khan Academy (Please look in AP Biology & Chemistry/Physics for all APES topics) https://www.khanacademy.org/science

Bozeman Science AP Environmental Science videos http://www.bozemanscience.com/ap-environmental-science

## Content

Predator-Prey Interactions

Symbiotic Relationships (Mutualism, Commensalism and Parasitism)

Invasive Species

Terrestrial and Aquatic Biomes

Carbon, Nitrogen, Phosphorus & Water Cycle

Primary Productivity

Energy flow, 10% Rule, Trophic Levels

Food Chains and Food Webs

## Learning Objective

ERT 1.A Describe the field of Environmental Science.
ERT 1.A Explain how the availability of resources influences species interactions
ERT- 1.B Describe the global distribution and principal environmental aspects of terrestrial biomes

ERT-1.C Describe the global distribution and principal environmental aspects of aquatic biomes.
ERT- 1.D, 1.G, 1.E, 1.F Explain the steps and reservior interactions in the carbon, nitrogen, phosphorus and water cycles

ENG-1.A Explain how solar energy is acquired and transferred by living organisms
ENG- 1.B Explain how energy flows and matter cycles through trophic levels
ENG - 1.CDetermine how the energy decreases as it flows through ecosystems.
ENG - 1.D Describe food chains and food webs and their consituenet members by trophic level

EIN-4.A Explain the environmental problems associated with invasive species and strategies to control them.