01 The Living World Ecosystems

Content Area: **Science**
Course(s): **AP Environment**
Time Period: **Semester 1**
Length: **2 weeks**
Status: **Published**

Textbook Resource

Textbook: Environmental Science for the AP Course, 4th edition. Friedland and Relyea

Standards

CCC.1	Patterns.
CCC.2	Cause and effect: Mechanism and explanation.
CCC.4	Systems and system models.
SEP.2	Developing and Using Models
CCC.5	Energy and matter: Flows, cycles, and conservation.
CCC.7	Stability and change.
SEP.5	Using Mathematics and Computational Thinking
HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
LS1.C	Organization for Matter and Energy Flow in Organisms
HS-LS2-1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
LS2.A	Interdependent Relationships in Ecosystems
LS2.B	Cycles of Matter and Energy Transfer in Ecosystems
HS-LS2-4	Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
HS-LS2-5	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
LS4.C	Adaptation
ETS1.B	Developing Possible Solutions

Enduring Understandings

Ecosystems are complex, interactive systems that include both biological communities (biotic) and physical (abiotic) components of the environment. Ecosystems are dynamic, experiencing shifts in population composition and abundance and changes in the physical environment over time, which ultimately affects the stability and resilience of the entire system.

Essential Questions

How do matter and energy move and change forms through ecosystems?

How does the availability of resources influence species interactions?

What are the causes of change in boundaries of terrestrial/aquatic biomes?

What are the steps and reservoir interactions in the major biogeochemical cycles?

How does energy decrease as it flows through ecosystems?

Knowledge and Skills

Unit 1: The Living World: Ecosystems

Topic 1.1 Intro to Ecosystems

Knowledge

- In a predator-prey relationship, the predator is an organism that eats another organism (the prey).
- Symbiosis is a close and long-term interaction between two species in an ecosystem. Types of symbiosis include mutualism, commensalism, and parasitism.
- 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.

Skills

- Describe environmental concepts and processes

Topic 1.2 Terrestrial Biomes

Knowledge

- A biome contains characteristic communities of plants and animals that result from, and are adapted to, its climate.
- Major terrestrial biomes include taiga, temperate rainforests, temperate seasonal forests, tropical rainforests, shrubland, temperate grassland, savanna, desert, and tundra.
- 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.
- 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.

Skills

- Explain environmental concepts and processes.

Topic 1.3 Aquatic Biomes

Knowledge

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

Skills

- Explain environmental concepts and processes.

Topic 1.4 The Carbon Cycle

Knowledge

- The carbon cycle is the movement of atoms and molecules containing the element carbon between sources and sinks.
- 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.
- Carbon cycles between photosynthesis and cellular respiration in living things.
- 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.

Skills

- Explain relationships between different characteristics of environmental concepts, processes, or models represented visually:

Topic 1.5 The Nitrogen Cycle

Knowledge

- The nitrogen cycle is the movement of atoms and molecules containing the element nitrogen between sources and sinks.
- Most of the reservoirs in which nitrogen compounds occur in the nitrogen cycle hold those compounds for relatively short periods of time.
- 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
- The atmosphere is the major reservoir of nitrogen.

Skills

- Explain relationships between different characteristics of environmental concepts, processes, or models represented visually:

Topic 1.6 The Phosphorus Cycle

Knowledge

- The phosphorus cycle is the movement of atoms and molecules containing the element phosphorus between sources and sinks.
- The major reservoirs of phosphorus in the phosphorus cycle are rock and sediments that contain phosphorus-bearing minerals.
- 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.

Skills

- Explain relationships between different characteristics of environmental concepts, processes, or models represented visually:

Topic 1.7 The Water Cycle

Knowledge

- 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.
- The oceans are the primary reservoir of water at the Earth's surface, with ice caps and groundwater acting as much smaller reservoirs.

Skills

- Explain relationships between different characteristics of environmental concepts, processes, or models represented visually:

Topic 1.8 Primary Productivity

Knowledge

- Primary productivity is the rate at which solar energy (sunlight) is converted into organic compounds via photosynthesis over a unit of time.
- Gross primary productivity is the total rate of photosynthesis in a given area.
- Net primary productivity is the rate of energy storage by photosynthesizers in a given area, after subtracting the energy lost to respiration.
- Productivity is measured in units of energy per unit area per unit time (e.g., kcal/m2/yr).
- 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.

Skills

- Describe environmental concepts and processes.

Topic 1.9 Trophic Levels

Knowledge

- 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.
- 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.

Skills

- Explain environmental concepts and processes.

Topic 1.10 Energy Flow and the 10% Rule

Knowledge

- 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 of thermodynamics.

Skills

- Calculate an accurate numeric answer with appropriate units.

Topic 1.11 Food Chains and Food Webs

Knowledge

- 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.
- 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.

Skills

- Describe characteristics of an environmental concept, process, or model represented visually

Make connections to other units by considering:

Understanding ecosystems is the foundation for all other units. Ecosystems are the result of biotic and abiotic interactions, relying on the biogeochemical cycles, and facilitating the transfer of energy into usable forms that can be altered by humans.

Key vocabulary you need to know

Salinity	Hydrologic Cycle	Eutrophication	Temperature
Phytoplankton	Surface Water	Thermal Stratification	Precipitation

Littoral	Oligotrophic	Fall turnover	Latitude
Limnetic	Mesotrophic	Swamp	Biome
Profundal	Eutrophic	Marsh	Tundra
Benthic	Climate	Wetland	Permafrost
Intertidal zone	Grasslands: Temperate, Savanna, Chaparral	Estuary	Boreal Forest/Conifer Forest/Taiga
Temperate Rainforest	Desert	Tropical Rain Forest	
		Temperate Deciduous	

Figures/ Equations to know

- GPP= NPP-R
- 10% of all energy moves from one trophic level to the next

Transfer Goals

Apply computation to analyze environmental scenarios

Design an experiment and communicate the results

Explain environmental issues with respect to an ecosystem's characteristics

Modifications

https://docs.google.com/document/d/1ODqaPP69YkcFiyG72fIT8XsUIe3K1VSG7nxuc4CpCec/edit?usp=sharing

Assessments

https://docs.google.com/document/d/1wR7bQF-8AQoRrt0g4C3hKja0yjwDjC9_BiAmONWbTcI/edit?usp=sharing