Unit 03: Ecology

Content Area: **Science**
Course(s): **AP Biology**
Time Period: **October**
Length: **2 weeks**
Status: **Published**

Transfer Skills

This unit shows how an ecosystem's interactions are directly related to the system's available energy and its ability to respond to changes in its environment. When highly complex living systems interact, communities and ecosystems will change based on those interactions. The more biodiversity present in a system, the more likely that system is to maintain its health and success in the face of disruption. Matter cycles through systems and energy flows; the rate of flow determines the success of the species within the systems. A student should be able to accurately determine what happens within biological systems when disruptions occur.

Students should demonstrate understanding of the relationship between organisms and their environment by constructing and analyzing food chains and food webs and analyzing trophic diagrams. On past exams, when students have been asked to construct a food web from a data table, they have struggled with inferring the correct relationships between the organisms and with translating how a relationship between two organisms resulted in their placement on the food web. Another common error is the incorrect placement of the arrows that indicate energy flow. Students should use their knowledge from the cellular energetics unit (4) to explain how energy and carbon are transferred through an ecosystem so that they can predict how changes in the environment can impact an ecosystem, both positively and negatively. Throughout the course, students should practice providing support for their claims about biological systems. Connections to ecology throughout the course are fundamental and will help students to build this skill.

Enduring Understandings

The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.

Living systems are organized in a hierarchy of structural levels that interact.

Communities and ecosystems change on the basis of interactions among populations and disruptions to the environment.

Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

Competition and cooperation are important aspects of biological systems.

Essential Questions

How does the acquisition of energy relate to the health of a biological system?

How do communities and ecosystems change, for better or worse, due to biological disruption?

How does a disruption of a biological system affect genetic information storage and transmission?

How do species interactions affect the survival of an ecosystem?

Content

Ecosytems

Carbon and nitrogen cycles

Energy flow through ecosystems

Disruptions to ecosystems: invasive species, loss of biodiversity, loss of keystone species, etc...

Population growth models: exponential vs. logistic

Density dependent vs. density independent limits to population growth

Community interactions: predation, competition, symbiosis, etc...

Learning Objectives

ENE-1.M Describe the strategies organisms use to acquire and use energy.
ENE-1.N Explain how changes in energy availability affect populations and ecosystems.
ENE-1.O Explain how the activities of autotrophs and heterotrophs enable the flow of energy within an ecosystem.
SYI-1.G Describe factors that influence growth dynamics of populations.
SYI-1.H Explain how the density of a population affects and is determined by resource availability in the environment.
ENE-4.A Describe the structure of a community according to its species composition and diversity.
ENE-4.B Explain how interactions within and among populations influence community structure.
ENE-4.C Explain how community structure is related to energy availability in the environment.
SYI-3.F Describe the relationship between ecosystem diversity and its resilience to changes in the environment.
SYI-3.G Explain how the addition or removal of any component of an ecosystem will affect its overall short-term and longterm structure.
SYI-2.A Explain how invasive species affect ecosystem dynamics.
SYI-2.B Describe human activities that lead to changes in ecosystem structure and/ or dynamics.
SYI-2.C Explain how geological and meteorological activity leads to changes in ecosystem structure and/or dynamics

Standards

ENE-1.M.1 Organisms use energy to maintain organization, grow, and reproduce—

a. Organisms use different strategies to regulate body temperature and metabolism.

i. Endotherms use thermal energy generated by metabolism to maintain homeostatic body temperatures.

ii. Ectotherms lack efficient internal mechanisms for maintaining body temperature, though they may regulate their temperature behaviorally by moving into the sun or shade or by aggregating with other individuals.

b. Different organisms use various reproductive strategies in response to energy availability.

c. There is a relationship between metabolic rate per unit body mass and the size of multicellular organisms—generally, the smaller the organism, the higher the metabolic rate.

d. A net gain in energy results in energy storage or the growth of an organism.

e. A net loss of energy results in loss of mass and, ultimately, the death of an organism.

ENE-1.N.1 Changes in energy availability can result in changes in population size.

ENE.1.N.2 Changes in energy availability can result in disruptions to an ecosystem—

a. A change in energy resources such as sunlight can affect the number and size of the trophic levels.

b. A change in the producer level can affect the number and size of other trophic levels.

ENE-1.O.1 Autotrophs capture energy from physical or chemical sources in the environment—

a. Photosynthetic organisms capture energy present in sunlight.

b. Chemosynthetic organisms capture energy from small inorganic molecules present in their environment, and this process can occur in the absence of oxygen.

ENE-1. O.2 Heterotrophs capture energy present in carbon compounds produced by other organisms.

a. Heterotrophs may metabolize carbohydrates, lipids, and proteins as sources of energy by hydrolysis.

SYI-1.G.1 Populations comprise individual organisms that interact with one another and with the environment in complex ways.

SYI-1.G.2 Many adaptations in organisms are related to obtaining and using energy and matter in a particular environment—

a. Population growth dynamics depend on a number of factors.

i. Reproduction without constraints results in the exponential growth of a population.

SYI-1.H.1 A population can produce a density of individuals that exceeds the system's resource availability.

SYI-1.H.2 As limits to growth due to density-dependent and density-independent factors are imposed, a logistic growth model generally ensues.

ENE-4.A.1 The structure of a community is measured and described in terms of species composition and species diversity.

ENE-4.B.1 Communities change over time depending on interactions between populations.

ENE-4.B.2 Interactions among populations determine how they access energy and matter within a community.

ENE-4.B.3 Relationships among interacting populations can be characterized by positive and negative effects and can be modeled. Examples include predator/prey interactions, trophic cascades, and niche partitioning.

ENE-4.B.4 Competition, predation, and symbioses, including parasitism, mutualism, and commensalism, can drive population dynamics.

ENE-4.C.1 Cooperation or coordination between organisms, populations, and species can result in enhanced movement of, or access to, matter and energy.

SYI-3.F.1 Natural and artificial ecosystems with fewer component parts and with little diversity among the parts are often less resilient to changes in the environment.

SYI-3.F.2 Keystone species, producers, and essential abiotic and biotic factors contribute to maintaining the diversity of an ecosystem.

SYI-3.G.1 The diversity of species within an ecosystem may influence the organization of the ecosystem.

SYI-3.G.2 The effects of keystone species on the ecosystem are disproportionate relative to their abundance in the ecosystem, and when they are removed from the ecosystem, the ecosystem often collapses.

SYI-2.A.1 The intentional or unintentional introduction of an invasive species can allow the species to exploit a new niche free of predators or competitors or to outcompete other organisms for resources.
SYI-2.A.2 The availability of resources can result in uncontrolled population growth and ecological changes.
SYI-2.B.1 The distribution of local and global ecosystems changes over time. SYI-2.B.2 Human impact accelerates change at local and global levels—

a. The introduction of new diseases can devastate native species.
b. Habitat change can occur because of human activity

SYI-2.C.1 Geological and meteorological events affect habitat change and ecosystem distribution. Biogeographical studies illustrate these changes.

Resources

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

College Board AP Biology course and exam description manual: https://apcentral.collegeboard.org/pdf/ap-biology-course-and-exam-description-0.pdf

AP Biology Lab Manual:

https://apcentral.collegeboard.org/pdf/ap-biology-teacher-lab-manual-fall-2019.pdf?course=ap-biology

AP Biology Classroom Resources: https://apcentral.collegeboard.org/courses/ap-biology/classroom-resources?course=ap-biology

Khan Academy AP Biology: https://www.khanacademy.org/science/ap-biology

Bozeman Science AP Biology videos: http://www.bozemanscience.com/ap-biology

HHMI Biointeractive: https://www.biointeractive.org/