Biology Unit 4: Ecology

Unit #:	APSDO-00018815	Duration:	10.0 Week(s)	Date(s):	03-30-2015 to 06-12-2015

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Grades:
10
Subjects:
Science

Unit Focus

In this unit, students construct explanations for the role of energy in the cycling of matter in organisms and ecosystems. Students develop explanations for the role of energy in the cycling of matter in organisms utilizing photosynthesis and cellular respiration.They can support explanations of the interactions of photosynthesis and cellular respiration. Students understand organisms interactions with each other and their physical environment, how organisms obtain resources, change the environment, and how these changes affect both organisms and ecosystems. Students demonstrate an ability to investigate the role of biodiversity in ecosystems and the role of animal behavior on survival of individuals and species. Students have increased understanding of interactions among organisms and how those interactions influence the dynamics of ecosystems. Summative assessments may include: modeling to demonstrate the cycling of matter between photosynthetic and cellular respiration processes, modeling to demonstrate the transfer of matter and energy through trophic levels, analysis of data, application problems, laboratory practice, experimental design, and communication linking evidence to explanations about interactions and changes within ecosystems. Primary instructional materials may include: course textbook (Biology by Miller and Levine), supplemental print and online resources (e.g., POGILs (process oriented guided inquiry learning activities)), and related equipment and materials.

Stage 1: Desired Results - Key Understandings

Established Goals

Next Generation Science Standards (DCI)
Science: 10

- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem

Transfer

T1 (T3) Collect, analyze, and evaluate the quality of evidence in relation to a question.
T2 (T5) Communicate scientific information clearly, thoroughly, and accurately.
T3 (T2) Design an investigation or model using appropriate scientific tools, resources, and methods.
T4 (T4) Develop a valid scientific conclusion, assess its validity and limitations, and determine future course of actions to inspire further questions.
T5 (T1) Integrate knowledge from a variety of disciplines and apply it to new situations to make sense of information, formulate insightful questions, and/or solve problems.
T6 (T6) Use mathematics to represent physical variables and their relationships, to make

occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. *LS2.9.C1*

- As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. *LS1.9.C4*
- As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. *LS1.9.C3*
- Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. *PS3.9.B1*
- Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and

quantitative predictions, and to solve problems.

Meaning

Understandings

U1

LS4-D (9-12) Human activity such as habitat destruction, pollution, introduction of invasive species, etc. can disrupt an ecosystem and threaten the survival of some species.

U2

LS4-D (9-12) Humans positively impact ecosystems through varied conservation efforts such as habitat restoration, breeding programs, efforts to reduce pollution, etc.

U3 (U327) Energy transfers and matter cycles between producers, consumers, decomposers, and their environment.
U4 (U328) Plants and animals depend upon interactions with each other to survive (e.g., being part of a group).
U5 (U300) All animals need food, obtained from plants or other animals, in order to live and grow. Plants need water and light to live and grow.
U6 (U309) Photosynthesis provides a mechanism for converting light energy into chemical energy (sugars) while cellular respiration breaks down sugar to create a usable form of chemical energy.
U7 (U331) Ecosystems are dynamic and their characteristics and stability can vary over time.
U8 (U330) The carrying capacity of an ecosystem is determined by a variety of living and nonliving factors.

Essential Questions

Q1

LS2-A (9-12) What biotic (predation, competition, and disease) and abiotic factors influence the stability of an ecosystem?

Q2

LS2-A (9-12) How do environmental factors acting on a population affect whether the population is in an exponential or logistic growth pattern?

Q3

LS2-C (9-12) How do ecosystems recover through ecological succession following disturbances such as glacial retreat, forest fires, lava flows, and dune blow-outs?

Q4

LS2-D (9-12) How do interdependent interactions between and within populations of an ecosystem affect chances of survival?

Q5

LS4-D (9-12) How do human activities positively and negatively impact ecosystems?

Q6 (Q337) How do the processes of photosynthesis and cellular respiration provide and conserve most of the energy in an ecosystem?
Q7 (Q338) Why are populations smaller for organisms near the top of the trophic

resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. *LS2.9.A1*

- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. *PS3.9.B2*
- Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. *LS2.9.D1*
- Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. *ETS1.9.A2*
- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. *LS4.9.D2*
- Moreover, anthropogenic changes (induced by human activity) in the environment-including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change-can disrupt an ecosystem and threaten the survival of

structure?
Q8 (Q312) How are the processes of photosynthesis and cellular respiration connected in the cycling of matter and transfer of energy through different organizational levels of living system?

Acquisition of Knowledge and Skill

Knowledge

K1

Photosynthesis and cellular respiration are interdependent metabolic processes

K2

Interactions between organisms in a food web

K3

As biomass is recycled in a trophic structure, energy is transferred to different forms at a rate of 10% efficiency

K4

Law of conservation of matter and the cycling of carbon, nitrogen, phosphorous

K5

Symbiotic relationships can have beneficial, detrimental, and neutral affects on population dynamics

K6

Ecosystems change in predictable ways through primary and secondary succession

K7

Abiotic and biotic factors influence biomes

Skills

S1

Model interdependent relationships between producers, consumers, and decomposers (including, but not limited to, symbiotic relationships)

S2

Model interdependent relationship between photosynthesis and cellular respiration including the cycling of matter and energy

S3

Use analytical representations (logistic and exponential growth curves) to support explanations of factors that affect carrying capacity of ecosystems

S4

Predicting potential impacts of environmental changes (including biotechnology applications) to biodiversity

S5

Explaining changes in ecosystems as a result of succession

S6

Simulate changes in a biome based on varied environmental factors including human

some species. *LS2.9.C2* • Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. *LS2.9.B1* • Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. *LS2.9.B3* • Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. *LS2.9.B2* • The availability of energy limits what can occur in any system. *PS3.9.B4* • The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. *PS3.9.D3* • The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.	and their biodiversity **K8** Negative and positive human impacts on ecological systems	impacts

LS1.9.C1 • The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. *LS1.9.C2*		