**Summary:**
The curricula developed for use with the StepStone software provides a motivating and engaging learning environment. Specific details for using the software are provided in an accompanying “StepStone How-To” document.

The ecology module covers the concepts of ecosystem components and organization, energy flow through living systems, biodiversity, and ecological succession. Students will have the opportunity to guide their own learning through a variety of “learning objects” intended to provide critical thinking about and application of required science standards.

**Keywords:** abiotic, biodiversity, biome, biotic, carnivore, carrying capacity, community, competition, consumer, decomposer, ecology, ecosystems, energy pyramid, food chain, food web, herbivore, limiting factor, omnivore, organism, photosynthesis, pioneer species, population, primary succession, producer, secondary succession

**Subject TEKS:**

* 6.12 (E) describe biotic and abiotic parts of an ecosystem in which organisms interact;
	+ (F) diagram the levels of organization within an ecosystem, including organism, population, community, and ecosystem.
* 7.5 (B) diagram the flow of energy through living systems, including food chains, food webs, and energy pyramids.
* 7.8 (A) predict and describe how catastrophic events such as floods, hurricanes, or tornadoes impact ecosystems;
* 7.10 (A) observe and describe how different environments, including microhabitats in schoolyards and biomes, support different varieties of organisms;
	+ (B) describe how biodiversity contributes to the sustainability of an ecosystem
	+ (C) observe, record, and describe the role of ecological succession such as in a microhabitat of a garden with weeds.

**NGSS Science and Engineering Practices:**

* MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
* MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
* MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

**Grade Level:** 6th - 9th

**Learning Objectives:**

1. Describe and differentiate between abiotic and biotic factors in an ecosystem.
2. Describe the levels of organization in an ecosystem.
3. Define competition as it relates to individuals within an ecosystem.
4. Identify limiting factors and describe how they impact population size.
5. Create food chain and food web diagrams to accurately describe the flow of energy in an ecosystem.
6. Analyze energy pyramids to determine the energy available at each level of a food chain.
7. Explain the importance of biodiversity to an ecosystem and distinguish between areas of high and low biodiversity.
8. Describe the characteristics of earth’s major biomes.
9. Differentiate between primary and secondary succession and describe how each one affects an ecosystem.

**Time Required:** will vary depending on lesson implementation and learning objectives chosen

**Materials:**

* Devices with internet access

**Background and Concepts for Teachers:**

Levels of Organization in an Ecosystem

An ecosystem consists of all the living (biotic) organisms in an area and the nonliving (abiotic) features of their environment. Ecology is the study of the interactions that occur among organisms and their environment. An organism is a single individual from a population. A population is made up of all the organisms in an ecosystem that belong to the same species. A community refers to all the populations in an ecosystem. All of the communities in an area and the abiotic factors that affect them make up an ecosystem. A biome is a large region with plants and animals well adapted to the soil and climate of the region. The level of biological organization that is made up of all the ecosystems on Earth is the biosphere.

 All ecosystems have a limited amount of food, water, living space, mates, and other resources. Any biotic or abiotic factor that limits the number of individuals in a population is a limiting factor. When two or more organisms seek the same resource at the same time, competition occurs. Competition also limits population size. If resources become so scarce that individuals can no longer survive or reproduce, the ecosystem has reached its carrying capacity. Carrying capacity is the largest number of individuals of a species that an environment can support for a long period of time.

Energy Flow in an Ecosystem

In nature, energy in food passes from one organism to another in a sequence known as a food chain. Food chains consist of producers, consumers, and decomposers. Producers are organisms that take in and use energy from the sun to produce food. Consumers are organisms that take in energy when they feed on producers or other consumers. When organisms die other organisms called decomposers take in energy as they break down the remains.

A food web is a series of overlapping food chains that exist in an ecosystem. It provides a more complete model of the many interactions among organisms and the way energy moves through an ecosystem.

An energy pyramid compares the energy available at each level of the food chain in an ecosystem. Only about ten percent of the energy at each level of the pyramid is available to the next level.

Biodiversity

 Large geographic areas that have similar climates and ecosystems are called biomes. Earth is divided into seven major biomes: tundra, taiga, deciduous forests, rain forests, grasslands, deserts, and aquatic. The habitats provided by each biome support the biodiversity of animal and plant species. Biodiversity is the variety of organisms living in a given area. Biodiversity contributes to the sustainability of an ecosystem by providing resiliency should a particular species be impacted by disease or disaster.

Ecological Succession

 Succession refers to the normal, gradual changes that occur in the types of species that live in an area. Primary succession begins in a place without any soil. Pioneer species, hardy organisms such as lichen, do not need soil to survive and can begin building the soil in an area by breaking down rock. Secondary succession occurs in a place that already has soil and was once the home of living organisms. The previous inhabitants may have been destroyed or displaced due to disaster or disease. Because soil is already present, secondary succession occurs faster than primary succession.

 A community that has reached a stable stage of ecological succession is called a climax community. This type of community consists of a combination of plants and animals that use the available resources most efficiently.

**Vocabulary / Definitions:**

* **Abiotic** – any nonliving part of the environment
* **Biodiversity** – the variety of living things in a given space
* **Biome** – a large geographic area with similar climates and ecosystems
* **Biotic** – any living or once living organism in the environment
* **Carnivore –** an organism the eats the flesh of other animals
* **Carrying capacity** – largest number of individuals of a particular species that an ecosystem can support over time
* **Community –** all the populations of different species that live in an ecosystem
* **Competition -** when living organisms need the same limited resources to thrive in their shared environment
* **Consumer-** an organism that cannot produce its own food and must eat other organisms to obtain energy
* **Decomposer –** an organism that breaks down organic (once living) matter
* **Ecology –** study of the interactions that take place among organisms and their environment
* **Ecosystem –** all of the living and non-living things that interact in a specific area
* **Energy pyramid -** a graphical representation, showing the flow of energy at each trophic level in an ecosystem
* **Food chain –** model that describes how energy in the form of food passes from one organism to another
* **Food web –** model that describes how energy in the form of food moves through a community; a series of overlapping food chains
* **Herbivore -** an animal that gets its energy from eating plants alone
* **Limiting factor** – anything that can restrict the size of a population, including living and nonliving features of an ecosystem
* **Omnivore -** an organism that gets its energy from eating both plant and animal sources
* **Organism –** any living thing; the simplest level of an ecosystem
* **Photosynthesis - t**he process by which green plants and certain other organisms transform light energy into chemical energy (food)
* **Pioneer species** – a group of hardy organisms, such as lichens, found in the primary stage of succession and that begin an area’s soil building process
* **Population**- a group of organisms of the same species, all living in the same area and interacting with each other
* **Primary succession** - succession that begins in essentially lifeless areas, such as regions in which there is no soil or where the soil is incapable of sustaining life
* **Producer** - organisms that make their own food using an outside source of energy like the sun
* **Succession -** the normal, gradual changes that occur in the types of species that live in an area
* **Secondary succession** - succession that occurs in areas where a community existed but has been removed by disturbances that did not eliminate all life and nutrients from the environment

**Lesson Introduction/Motivation:**
Students begin by taking the “pre-test” in order to assess their current knowledge and understanding. This may also enable students to recognize concepts about which they would like to learn more or to which they need to pay particular attention.

The student-centered design of this module allows for multiple introduction/motivation activities. Students may begin the unit on their own by reading the “Meet a Scientist” biography or “Backpack Adventure” stories or by watching one or more “Scientist Videos”. Each of these learning objects provide students with insights into the history or application of ecology and should motivate students to dig deeper into the required standards presented/studied later. These learning objects also contain processing questions that can be answered and shared in class or in an on-line portfolio such as Google docs.

Alternately, teachers could introduce the module to their classes by having small groups of students explore a habitat. The habitat may be virtual (on-line images or from books/magazines) or physical (school grounds, garden, park, class aquarium, pond water sample under a microscope, etc.). Students will observe and record (with words or images) all of the living and non-living things they discover in the habitat. After recording their information ask students to explain, using evidence from their observations, whether they believe the habitat to be health or unhealthy. Allow each group to share a brief summary of their findings with the class.

**Exploration/Explanation:**
Students should next examine the required concepts (standards) of ecology. Setting up classroom stations can promote student collaboration, problem solving, and critical thinking. Stations also provide students with a common base of experiences. These stations may include any or all of the following learning objects:

* *Essential Knowledge* – students use various types of note outlines to record information about required content from an interactive video presentation. Students can then compare and discuss their notes to ensure the acquisition of key concepts.
* *Backpack Adventures* – students read (independently or as a read aloud) a fictional story with factual content about key concepts and individuals related to ecology. Students can then answer questions, create timelines, compare fact vs. fiction, or perform other related activities to reinforce required concepts.
* *Meet a Scientist* – students read (independently or as a read aloud) a short biography about a scientist instrumental to the field of ecology. They will then answer questions relating to the scientist and her work. Students could also role-play and describe how they would have solved the problem/answered the question facing the scientist. Additionally, students could ask additional questions they have about ecosystem organization after reading about the scientist’s work.
* *Scientist Videos* – students learn how real scientists study ecology in various short videos describing research, careers, or other aspects of the field. Students will then answer questions and/or discuss how the concepts they learn in class are applied in the real world.
* *Real Science Review* – students read an actual research article related to ecology (edited to middle school readability) and then review it using the scientific method as scaffolding. For instance, students will identify the hypothesis, data collection methods, relevance, etc.
* *Practice* – students can choose various on-line activities to gain or reinforce knowledge about ecosystems. Activities include videos, matching/labeling games, flashcards, mnemonics, quizzes, etc.

Another option for utilizing this module is to have students choose either “Backpack Adventures”, “Meet a Scientist”, “Scientist Videos”, or “Real Science Review” and complete (read/watch and answer questions) accompanying activities at home. They would journal on paper or through an on-line portfolio such as Google Docs about three main ideas, provide three vocabulary words and definitions, and/or construct three questions. As a class or in small groups students would share information and use it to complete note outlines, practice activities, or other class activities (see “Elaborate” section).

**Elaborate:**

* Ecosystem Observation Research Poster – students will answer a research question related to the health and sustainability of an ecosystem through observation and data collection. An accompanying teacher instruction page provides activity details.
* Oh Deer! Ecosystem Simulation – students will model population changes in ecosystems through a simulation activity. They will collect and analyze data to determine how abiotic and biotic components of an ecosystem affect populations. An accompanying teacher instruction page provides activity details.

**Assessment/Evaluation:**

The Ecology Module includes a post-test, which can be used for an overall learning assessment. Other opportunities for assessment include student output at any of the learning object stations, journaling requirements as detailed in the “Explore/Explain” section above and/or any of the “Elaborate” activities.

Please email us your comments on this lesson: cvmpeer@cvm.tamu.edu.
In your email, please include the title of the lesson and the grade level to which the lesson was applied.