**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 “Zoonotic Disease” module explores the concepts of taxonomy and symbiotic relationships through the lens of disease causing agents. Students will learn the definition of zoonotic disease and discover specific diseases of particular importance to humans and animals. 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:** archaebacteria, autotroph,commensalism, domain, eubacteria, eukaryote, fungi, heterotroph, host, kingdom, mutualism, parasite, photosynthesis, prokaryote, protist, symbiosis, taxonomy, vector, zoonoses

**Subject TEKS:**

* 6.(12) Organisms and environments. The student knows all organisms are classified into domains and kingdoms. Organisms within these taxonomic groups share similar characteristics that allow them to interact with the living and nonliving parts of their ecosystem. The student is expected to:
	+ (C) recognize that the broadest taxonomic classification of living organisms is divided into currently recognized domains;
	+ (D) identify the basic characteristics of organisms, including prokaryotic or eukaryotic, unicellular or multicellular, autotrophic or heterotrophic, and mode of reproduction, that further classify them in the currently recognized kingdoms;
* Biology (8) Science concepts. The student knows that taxonomy is a branching classification based on the shared characteristics of organisms and can change as new discoveries are made. The student is expected to:
	+ (A) define taxonomy and recognize the importance of a standardized taxonomic system to the scientific community;
	+ (B) categorize organisms using a hierarchical classification system based on similarities and differences shared among groups; and
	+ (C) compare characteristics of taxonomic groups, including archaea, bacteria, protists, fungi, plants, and animals.
* Biology (12) Science concepts. The student knows that interdependence and interactions occur within an environmental system. The student is expected to:
	+ interpret relationships, including predation, parasitism, commensalism, mutualism, and competition, among organisms

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

**Learning Objectives:**

1. Define taxonomy
2. Describe the importance of having a standardized system for classifying organisms.
3. Identify the domains of the modern taxonomic system.
4. Identify the kingdoms of the modern taxonomic system.
5. Describe characteristics of organisms which determine how they are classified into domains and kingdoms.
6. Define symbiosis and describe commensalism, mutualism, and parasitism.
7. Determine if organisms have a commensalistic, mutualistic, or parasitic. relationship.
8. Define zoonotic disease.
9. Give examples of common zoonoses.

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

**Materials:**

* Devices with internet access

**Background and Concepts for Teachers:**

Classification of Living Things

The science of classifying living things is called taxonomy. Scientists classify living things in order to organize and make sense of the incredible diversity of life. Modern scientists base their classifications mainly on molecular similarities. They group together organisms that have similar proteins and DNA.

The eight levels of classification from broadest to most specific are: Domain, Kingdom, Phylum, Class, Order, Family, Genus, and Species. Domains include archaebacteria, bacteria, and eukaryote

The Archaea and Bacteria Domains contain only single-celled organisms. Both Archaea and Bacteria have cells walls, but their cell walls are made of different materials. The cells of Archaea and Bacteria lack a nucleus. Some Eukarya are also single-celled, but many are multicellular. Some have a cell wall; others do not. However, the cells of all Eukarya have a nucleus and other organelles. Eukayota are further divided into the Kingdoms: Protista, Fungi, Plantae, and Animalia.

 Organisms in Kingdom Protista include all eukaryotes that are neither animals, nor plants, nor fungi. Most, but not all, are unicellular and all prefer moist or aquatic environments. Scientists divide protists into three groups: animal-like, plant-like, and fungi-like.

Unlike plants, Fungi are heterotrophs, which means that they obtain their "food" from outside of themselves. They do this by absorbing their nutrients through decomposition of organic matter. In addition, most fungi are multicellular, have cell walls, and are non-motile.

Organisms in Kingdom Plantae, have three main features. They are all: eukaryotic, photosynthetic, and multicellular. Photosynthesis is the process by which plants capture the energy of sunlight and use carbon dioxide from the air (and water) to make their own food, the carbohydrate glucose. Plants have chloroplasts, the organelle of photosynthesis, and are known as producers and autotrophs.

Kingdom Animalia members are eukaryotic, multicellular organisms, and most have complex tissue structure with differentiated and specialized tissue. Animals are heterotrophs; they must consume living or dead organisms since they cannot synthesize their own food and can be carnivores, herbivores, omnivores, or parasites. Most animals are motile for at least some stages of their lives, and most animals reproduce sexually.

Symbiotic Relationships

Symbiosis describes a close and long-term relationship between different species in which at least one species benefits. These symbiotic relationships often dictate the survival of one or both organisms. There are three types of symbiotic relationships: mutualism, commensalism, and parasitism.

Mutualism is a symbiotic relationship in which both species benefit. An example of a mutualistic relationship is between herbivores and gut bacteria. The bacteria help the herbivore digest food and utilize the intestines and its content as food and shelter. Since both species benefit, it is a mutualistic relationship. Clownfish and sea anemones also have a mutualistic relationship. The clownfish protects the anemone from anemone-eating fish, and the stinging tentacles of the anemone protect the clownfish from predators; mutual protection! The relationship between the plover bird and the African crocodile is another example of this type of symbiotic relationship. The tiny blackbird helps the crocodile by removing morsels of food that are stuck between the crocodile's teeth. These food remains are the source of food for the bird.

Commensalism is a symbiotic relationship in which one species benefits while the other is not affected. Commensal relationships may involve an organism using another for transportation or housing. For example, spiders build their webs on trees. The spider gets to live in the tree, but the tree is unaffected. Cattle egrets and livestock also have a commensal relationship. Cattle egrets are often found in grasslands near cattle, horses, or other livestock. These birds feed on the insects that are disturbed due to the movement of the animals.

Parasitism is a symbiotic relationship in which the parasitic species benefits while the host species is harmed. Parasites may live either inside or on the surface of their host. An example of a parasite is a hookworm. Hookworms affect the small intestine and lungs of a host organism. They must live inside of a host in order to survive. Some parasites may kill their host but most do not. It's easy to see why; if a parasite kills its host, the parasite is also likely to die. Parasites are found in animals, plants, and fungi.

Zoonotic Disease

 Zoonotic disease (plural, zoonoses) is an infectious disease caused by a pathogen (an infectious agent, such as a bacterium, virus, parasite or prion) that has jumped from an animal (usually a vertebrate) to a human. These pathogens can cause many different types of illnesses in people and animals, ranging from mild to serious illness and even death. Zoonoses have different modes of transmission including direct contact or through food, water or the environment.. In direct zoonosis the disease is directly transmitted from animals to humans through media such as air (influenza) or through bites and saliva (rabies). In contrast, transmission can also occur via an intermediate species (referred to as a vector), which carry the disease pathogen without getting sick. When humans infect animals, it is called reverse zoonosis or anthroponosis.

**Vocabulary / Definitions:**

* **Archaebacteria** - any of a group of single-celled prokaryotic organisms that have distinct molecular characteristics separating them from bacteria as well as from eukaryotes
* **Autotroph** - An autotroph is an organism that can produce its own food using light, water, carbon dioxide, or other chemicals; also producer
* **Commensalism –** an association between two organisms in which one benefits and the other derives neither benefit nor harm.
* **Domain** - the highest taxonomic rank in the hierarchical biological classification system, above the kingdom level.
* **Eubacteria** - simple celled organisms with rigid cell walls and often flagella for movement; “true” bacteria distinct from archaebacteria.
* **Eukaryote** - any cell or organism that possesses a clearly defined nucleus
* **Fungi** - any of a group of spore-producing organisms feeding on organic matter, including molds, yeast, mushrooms, and toadstools
* **Heterotroph** - an organism that eats other plants or animals for energy and nutrients; also consumer
* **Host** - an organism that harbors another organism inside or near their body in a symbiotic relationship
* **Kingdom** - the second highest taxonomic rank, just below domain
* **Mutualism** - an association between two organisms in which both organisms benefit
* **Parasite** - relationship between two species of plants or animals in which one benefits at the expense of the other
* **Photosynthesis** - the process by which green plants and some other organisms use sunlight to synthesize foods from carbon dioxide and water
* **Prokaryote** - a single-celled organism that lacks a distinct nucleus and specialized organelles
* **Protist** - unicellular eukaryotic organisms that are not plants, animals or fungi.
* **Symbiosis** - a close living relationship between organisms from different species, usually with benefits to one or both of the individuals
* **Taxonomy** - the scientific study of naming, defining, and classifying groups of organisms based on shared characteristics
* **Vector** - An organism or vehicle that transmits the causative agent or disease-causing organism from the reservoir to the host
* **Zoonosis -** diseases caused by germs that spread between animals and people

**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 genetics 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 watching the “Zombees” Science Friday video (<https://youtu.be/prtOM9LOz7U> ). After watching have students discuss the relationship witnessed between the flies and bees. Ask if all relationships between organisms are harmful. Have them brainstorm other relationships between organisms.

**Exploration/Explanation:**
Students should next examine the required concepts (standards) related to zoonotic disease (taxonomy and symbiosis). 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 zoonotic disease. 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 zoonotic disease. They will then answer questions relating to the scientist and his 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 zoonotic disease after reading about the scientist’s work.
* *Scientist Videos* – students learn how real scientists study zoonotic disease 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 zoonotic disease (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 taxonomy and symbiosis. 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:**

* Symbiosis Flow Chart – Students will create a flow chart to describe the relationships found in a mutualistic, commensalistic, and parasitic relationship. They will identify the domain and kingdom to which the organisms belong as well as the benefit or harm incurred by the organisms.

**Assessment/Evaluation:**

The Zoonotic Disease 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.