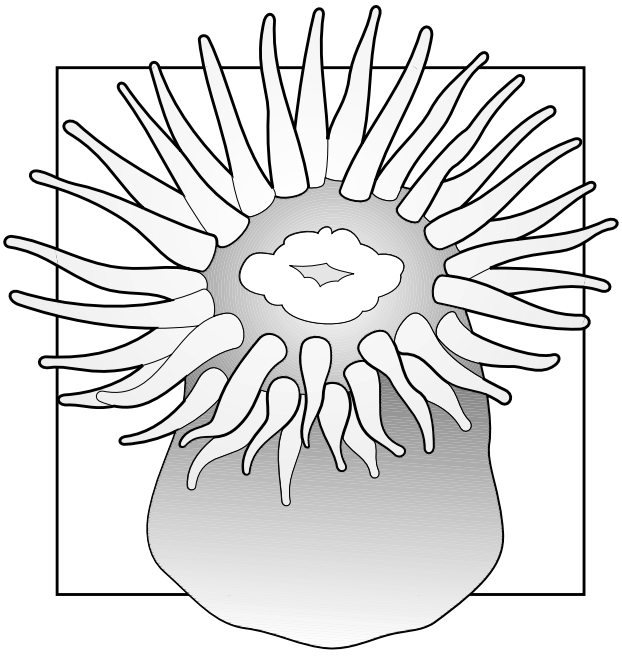
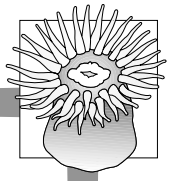
Unit 2: Identifying Living Things





Vocabulary

Study the vocabulary words and definitions below.

animal ..... a type of organism that is a consumer; can move about to get food; has more than one cell

bacteria ..... single-celled organisms that have no cell nucleus; most are consumers; share monera kingdom with blue-green bacteria

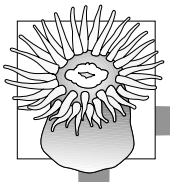
blue-green bacteria ..... single-celled organisms that have no cell nucleus; are producers; share monera kingdom with bacteria; also called cyanobacteria

cell ..... the basic unit of life

chlorophyll ..... a green pigment that plants and algae use to make food through photosynthesis

classification ..... a way to group things together based on likenesses

common name ..... the English name that we have given to a familiar animal or plant; not as precise as the scientific name and does not show the organism's relationship to other living things



consumers ..... organisms that must eat other living things to survive

decomposer ..... living things that eat dead organisms to survive

fungi ..... plantlike types of organisms that are consumers or decomposers; do not move from place to place; have more than one cell (*sing.* fungus)

kingdom ..... a large-scale division of all living things

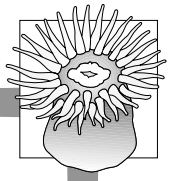
Carolus Linnaeus ..... a scientist of the 1700s who started the system of plant and animal classification we use today

monera ..... the kingdom of organisms that is microscopic, single-celled, and have no cell nucleus; includes bacteria and blue-green bacteria

organism ..... one individual living thing
Example: cat, oak tree, salamander

photosynthesis ..... the process plants and algae use to make the sugar glucose from water, carbon dioxide, and the energy in sunlight

plant ..... a type of organism that is a producer; does not move from place to place; has more than one cell



producers ..... organisms that can make their own food through photosynthesis

protist ..... a single-celled organism that has a cell nucleus

scientific name ..... the name scientists use to identify an organism; gives the organism's genus and species—the two most precise groups by which to classify the organism
Example: humans—*Homo sapiens*

species ..... the most precise grouping for an organism; directly identifies one particular type of living thing

virus ..... an extremely small infectious agent that only reproduces in living cells

Introduction

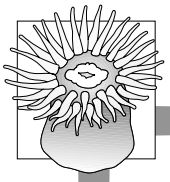
Have you ever awakened in an unfamiliar place—maybe when you were traveling or visiting relatives—and wondered where you were? At first there's a slight feeling of panic as you try to identify your surroundings. But as you identify the things around you—the night table, the lamp, the walls, the windows—you begin to remember where you are and to relax.

For thousands of years, human beings have tried to find their place in the living world. People have discovered that naming the **plants** and **animals** that surround them has been comforting and useful. Over time, we have identified so many plants and animals that we have had to *classify* them, or group them together in certain categories, so that we could keep them straight.

Classifying the things around us is a part of everyday life. When you clean up your room, you put clean clothes in one place, dirty clothes in another, garbage in the garbage can, and books in a stack. This is a process of *identifying* things and *grouping* them together. The grocery store groups types of food. The music store groups kinds of music. In this unit, we will see how biologists have grouped together things in the *living world* according to a system of scientific **classification**.

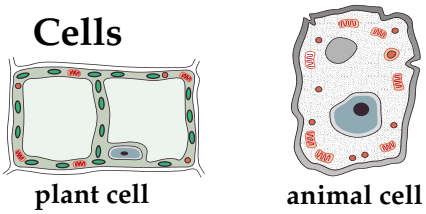
What Is Life?

This unit will discuss many of the ways biologists classify life. Before we can advance very far with that, though, we need to ask a question: "What is Life?" Off the top of your head, you can name many living things and probably as many nonliving things. Between all the things you identified, be it tree, bird, or sponge, we could find some common traits. Each living individual thing is an **organism**. An elm tree is an organism, as is a bluebird. No matter what the organisms are, they have traits in common. It is these traits, or characteristics, we will use to define life.



Characteristics of Living Organisms

- Organisms are organized into one or more **cells**. Cells are the smallest part of an organism that can be considered alive. (Cells are discussed in Unit 3.)
- Organisms use energy. It is because of this that a knowledge of energy is fundamental to not only biologists but other scientists.
- Organisms have a particular shape and a limit to their size. A fish can neither look like a tree nor grow to a size larger than the ocean.
- Organisms grow and change. The smallest single cell organism gets larger and changes in some way during its life.
- Organisms can reproduce. Whether they are horses or bacteria, living things can, through one means or more, reproduce more living organisms.
- Organisms die. No living thing has a life span that is without limit.

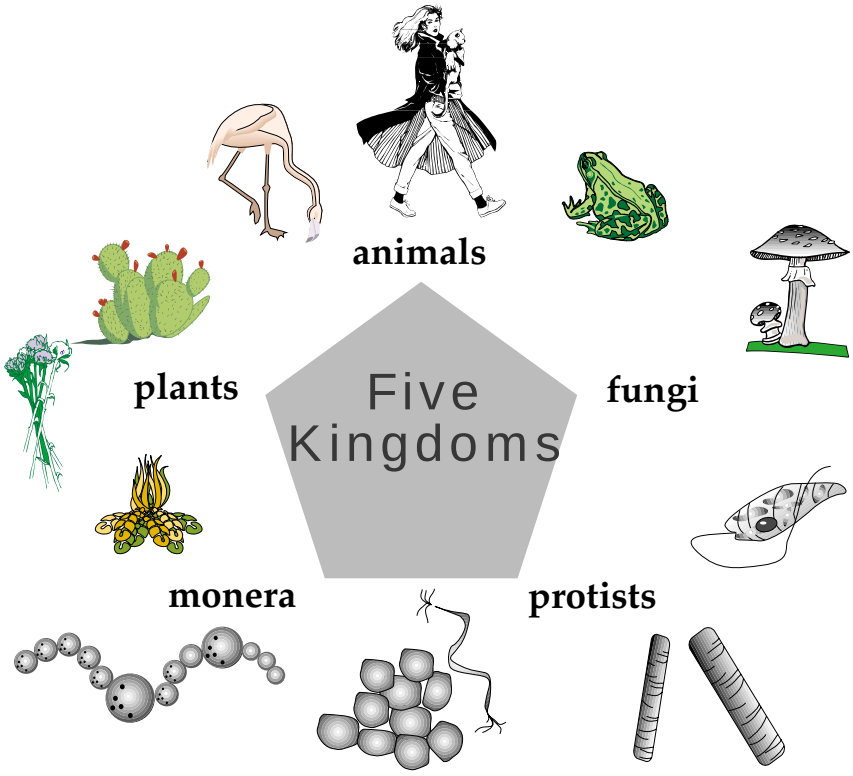


Cells are the smallest part of an organism that can be considered alive.

If you apply these characteristics to any nonliving thing, you may be surprised. A car can move, and it certainly uses energy, but it fails to have most of the characteristics of living organisms. As you can see, the job of deciding if something is alive is really the job of seeing how similar it is to other living things. That's how all of classification works.

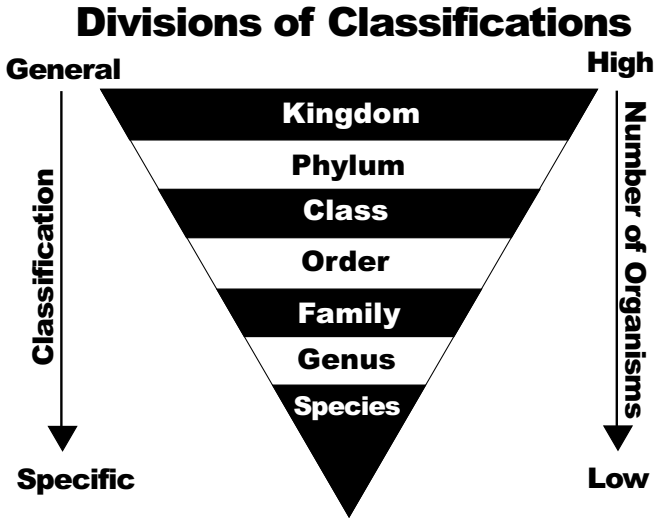
Scientific Classification

In 1735 a scientist named **Carolus Linnaeus** invented a system of classification which is the basis of the one we use today. This system starts out by dividing all organisms into separate **kingdoms**. A kingdom is a very broad, large-scale division of all living things. There are five kingdoms in most modern classification systems: animals, plants, **fungi**, **protists**, and **monera**.



We divided the kingdoms into smaller groups based on structural characteristics of the organisms. Now biologists have developed other means to classify organisms. Each kingdom is divided into several categories. Each level of categories has a unique name and within each are one or more smaller categories. As you move away from the category of kingdom, each group becomes more precise. This means each group is smaller. Within each kingdom are phyla; each phylum is divided into several classes; each class is divided into several orders; each order is

divided into several families; each family is divided into several genera (*sing.* genus); and, finally, each genus is divided into several **species**. Species is the most precise grouping of an organism. In a sense, it is the smallest "category" to which it belongs.



An organism is placed in a group according to a variety of specific traits it possesses. This is easy to see from examples.

Classification

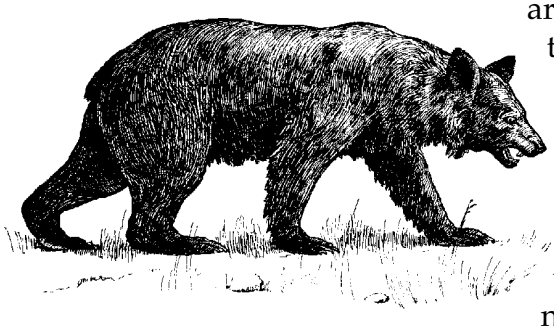
Group	Group Name		Comparison
	Black Bear	Grizzly Bear	
Kingdom	animal	animal	*same kingdom*
Phylum	chordate	chordate	*same phylum*
Class	mammal	mammal	*same class*
Order	carnivore	carnivore	*same order*
Family	Ursidae	Ursidae	*same family*
Genus	Ursus	Ursus	*same genus*
Species	americanus	horribilis	*different species*

These two organisms are placed in the same groups all the way through to the genus level. This means that they are closely related—that they have many of the same traits. For instance, they are both animals and they are both chordates, which means they have a spinal chord. They are both mammals; that is, they have hair and nurse their young. They are both

carnivores, which means they eat meat. Even before we find out what family these organisms are in, we know a lot about them from their classification.

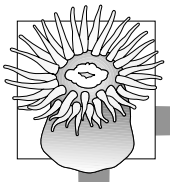
The family name, *Ursidae*, comes form the Latin word for bear, *ursus*. The genus name, *Ursus*, reflects this same word. And finally we come to the species name. The black bear is *americanus*. Its species name tells us it lives in America. The grizzly's species name, *horribilus*, tells us that it is—well—horrible, as in horribly fierce. The fact that these bears are different species shows that they do in fact differ in some traits. The adult grizzly bear is about a foot taller and about 300 pounds heavier than the adult black bear. Grizzlies also have a hump above their shoulders and look a bit dish-faced (that is, they have a short muzzle and a wide face) from the side.

As you can see, we've found out quite a bit about these two organisms just from knowing how they're classified. Their **scientific names** are the key to all this information. The scientific name includes the genus and the species names. Thus the black bear is *Ursus americanus* and the grizzly bear is *Ursus horribilis*. Their **common names**, "black bear" and "grizzly bear," aren't precise enough—for example, there are also black grizzly bears! Also, the common name doesn't show us how these bears are related to all other living things. Finally, the scientific name provides one common, universal term that scientists from all nationalities and cultures use.



The Five Kingdoms of Living Things

Living things are divided into five major kingdoms: *plants, fungi, animals, protists,* and *monera.* What follows is a description of each kingdom and the traits that place an organism in that kingdom. Some groups of living things are so familiar that they are difficult to define. Have you ever thought of how you would define a plant? An animal? Here are some scientific definitions of the five kingdoms of living things. They have been ordered, as closely as possible, from the simplest to the most complex.

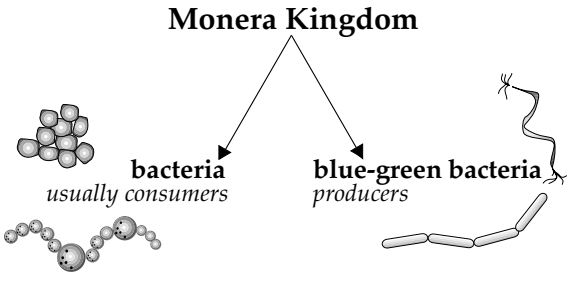


The Monera (Bacteria and Blue-Green Bacteria) Kingdom

Members of the monera (**bacteria** and **blue-green bacteria**) kingdom are the simplest organisms. These are microscopic, single-celled organisms that have *no cell nucleus.* There are two subgroups in this kingdom: bacteria, which are usually **consumers**, and blue-green bacteria, which are *producers*. Producers are organisms that do not have to eat other living organisms to survive. Instead, they use nonliving material to produce the energy they need. Consumers, however, do rely on consuming living organisms. Consumers rely on producers.

Beyond being very, very small—even smaller than members of the protist kingdom, which we will look at next—bacteria lack many cell parts. They are one of three shapes: round, rodlike, or spiral. They are everywhere. When you smell sour milk, you smell the by-products of the bacteria that are feeding on the milk. When you walk past the garbage, you may be nearly knocked down by the stench. This smell is caused by bacteria. People can control bacteria in food by heating or freezing it. We also use preparations called *antiseptics* to protect our cuts and injuries from infection by bacteria.

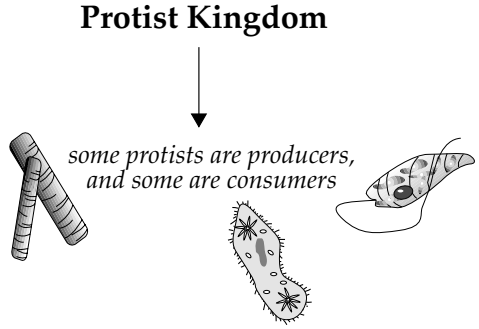
Like bacteria, blue-green algae are very simple and lack many cell parts. They contain the pigment chlorophyll and can feed themselves through photosynthesis. Photosynthesis is the process by which an organism stores the energy of the sun. This is done by combining carbon dioxide (a gas in the atmosphere), water, and the sun's energy to produce sugars. Sometimes they become obvious in polluted lakes where they receive many nutrients for carrying on photosynthesis. They reproduce very quickly and become so plentiful that they form a green scum on the surface of the water.



The Protist Kingdom

The protists are members of a kingdom that exists almost outside our awareness—they are microscopic organisms of fantastic forms and lifestyles. Each is only a single cell large, and each has a cell nucleus. A cell nucleus is a specialized part of a cell. It holds within it the information needed to reproduce the cell. The information also controls the way the cell functions or behaves. Some protists are *producers*, and some are *consumers*. If ever you magnify a drop of pond water with a microscope, you will see these tiny creatures spinning, swimming, and floating about.

Although protists are so small we cannot see them without a microscope, they perform important functions in our world. For one thing, they serve as food for larger organisms, such as fish or snails. Also, some protists are hosts for diseases. Yellow fever and malaria, for example, are spread by mosquitoes that have been infected with disease-carrying protists.



The Fungi Kingdom

The most familiar member of the fungi kingdom is probably the mushroom. Fungi (*sing*. fungus) often look similar to plants. But in fact, they are very different from plants in that they *do not* make their own food. Fungi either feed on living things or on the energy that remains in dead things. When fungi feed on dead things, they decompose or break down the chemical bonds that are still present in these dead organisms. Organisms that rely on energy stored in dead organisms are **decomposers**. For example, mildew feeds on the energy that is still present in the chemical bonds that hold leather together. Mushrooms often grow on cow manure where they can take in the nutrients that managed to pass

through the cow. If it weren't for fungi and other types of decomposers, we would live in a world piled high with dead animals, plants, and cow manure. Most fungi are made up of many cells, and each cell has a nucleus.

Fungi Kingdom

fungi often look similar to plants but are very different in that they do not make their own food

The Plant Kingdom

What is the most noticeable difference between plants and other types of living things? Plants are green. They are green for a very important reason: they contain the pigment **chlorophyll**. Plants, like blue-green bacteria, use **photosynthesis**. Chlorophyll makes it possible for plants to produce their own food from sunlight, carbon dioxide, and water. Because plants can produce their own food, they too are known as **producers**. When plants make sugar, they also produce something very important. They produce the gas oxygen. Without oxygen, the members of the next kingdom could not survive.

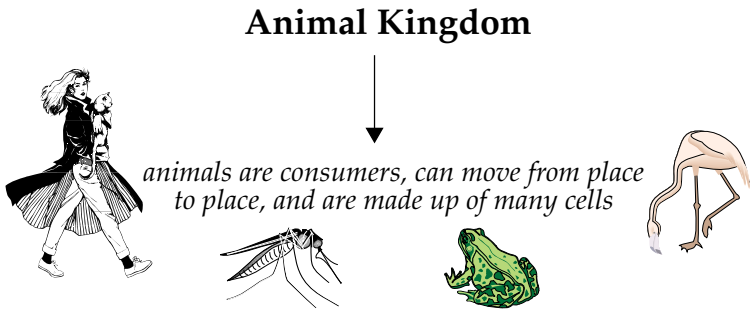
Besides photosynthesis, there are two other traits that define plants: 1) they are stationary—they don't move from place to place on their own; and 2) they are made of many cells.

Plant Kingdom

plants are stationary, are made of many cells, and use photosynthesis

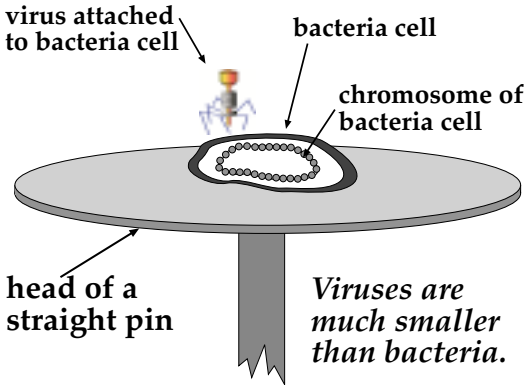
The Animal Kingdom

Think of all the animals you know. They are all so different. What features could they possibly have in common? The most obvious common trait is that animals *cannot* make their own food. They are *consumers*. Another trait you might notice is that most animals can move from place to place. Also, animals show a wide range of shapes and sizes, and most are fairly complex, with many different tissues and organs. Finally, all animals are made up of many cells. We will discuss more features of animals later.

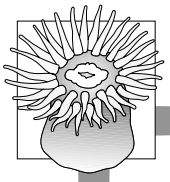


Are Viruses Living Things?

Viruses are strange little things that don't really fall into any category. In fact, scientists have long argued about whether or not viruses are even alive. They are not made of cells, the basic unit of all life. However, they do reproduce. Viruses reproduce by hijacking the equipment of living cells, basically taking over the cell and using its chemicals to make copies of themselves. As they reproduce, they kill the cell they have taken over. Obviously, viruses are *consumers*.



(This illustration is not to scale—the cell and virus are much smaller.)



If viruses aren't made of cells, what are they made of? Mostly, they're a bit of reproductive material inside a protective capsule. They are much smaller than bacteria and can only be seen with very specialized microscopes. A virus operates by somehow tricking a cell into allowing it inside. Then it sabotages the cell by substituting its own reproductive material for the cell's reproductive material. It *tricks* the cell's machinery into making virus copies instead of cell copies.

Viruses are very much in the news these days because of the human immunodeficiency virus (HIV), which attacks immune system cells and causes Acquired Immune Deficiency Syndrome (AIDS). Viruses are also responsible for other familiar sicknesses, such as the common cold. Although scientists have developed vaccines to protect us against some viruses, they have not been able to develop vaccines to keep us safe from all of them.

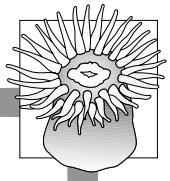
The Interconnectedness of Life

As we've seen, all living things rely on energy to stay alive. Those that are producers use the sun's energy. Consumers use energy from producers or other consumers. Lastly, decomposers use the energy left in any dead organism. How does this energy do all this? One way of looking at living organisms is to study how energy connects them to other organisms.

All Living Things Rely on Energy

producers	*use the sun's energy*
consumers	*use energy from producers or other consumers*
decomposers	*use the energy left in any dead organism*

The energy that connects the smallest bacteria with you originates in the sun. If we follow all the energy produced by the sun, we find only a small part of it reaches Earth. Much of the energy arrives as light; much of it arrives as heat. Producers use the light energy in photosynthesis. Although algae and plants use this energy, most of the energy from the sun is not used by producers. Where did the remaining energy go?



Living systems—that is, any groups of producers, consumers, and decomposers—obey all physical laws of science. One of these laws states that no matter what happens, we neither destroy or create matter or energy. So, now we know that the sun's energy has not been destroyed. Again we wonder where the energy went. The answer to our question is this: The energy has been changed to heat, another form of energy. Let's see what happens to the energy used by a producer.

A producer that is fairly common is grass. Grass takes a small part of the sun's light energy and makes sugars. The sugars are then consumed by any number of organisms. If a cow happens to be the consumer, the cow will only make use of a small part of the energy. Again, the rest of the energy will become heat. With so much energy being lost as heat, there are some interesting results.

One result is that organisms are very good at finding unused or seldom used sources of energy. This results in a high number of different organisms living together. Consider the example of cows and grass. In reality, many organisms besides the cow and the grass would live together. When a cow eats grass, not all the energy or material in the grass is used by the cow. Some energy is left over. It may be found in the manure produced by the cow. In this case, dung beetles may make use of this energy. Once the dung beetle has finished with the manure, there still may be material useful to some organisms. For instance, minerals may soak back into the ground and promote the growth of new grass or other plants. Alternatively, the cow may spread manure in an area the grass did not grow. Seeds from the grass may sprout and increase the amount of grass in the area.

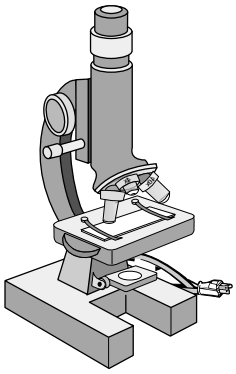
It's easy to see how the cow relies on the grass in its area, but now we see more. We see that the grass relies on the cow (and the dung beetle and other organisms) in order to survive and spread. Such connections are known as interdependence. The interdependence is based on the need for energy, and the result is a high variety of organisms. You've already seen this in our look at the different kingdoms. Later sections of this book will seek to further develop your knowledge of the diversity, complexity, similarities, and interconnectedness of organisms.

Summary

Throughout history, people have identified and named the living things around them. In 1735 the scientist Linnaeus invented a system of classification which is the basis by which we group all living things. The system places all living things in certain categories according to the traits they have. According to this system, each type of organism is identified by its genus and species name. These form its scientific name.

The largest-scale division of living things is division by kingdom. There are five kingdoms of living things: plants, fungi, animals, protists, and monera. Viruses, which are different from living things because they are not made of cells, have not been classified within any kingdom.

All living things share a common set of traits. Within this common pool there is a great diversity and interconnectedness of life. These result from the flow of energy from producers to consumers and to decomposers. Energy and matter are not destroyed in these changes, but energy is lost as unusable heat. A knowledge of the flow of energy is essential to all sciences.



Careers in Biology

Biology Teacher

Biology teachers help students understand important scientific concepts. These concepts relate to biology and science in general, and teachers help students see what relations these concepts have to our lives. Biology teachers prepare for their position by completing the work to earn a bachelor's degree from a college or university. Further, a teacher must be certified by the state in order to actually teach. Florida currently needs science teachers.