Objective 2

The student will demonstrate an understanding of the life sciences.

From your studies in science, you should be able to show an understanding of the life sciences.

Life science? That's the study of living things, right?

Right! Life science is the study of *organisms*. Organisms are living things, such as plants and animals, including people. In life science we learn how different species meet their needs and how species adapt to their surroundings. A *species* is a group of organisms that have similar traits and can breed with one another. A *population* is a group of organisms that live in the same area and belong to the same species.

Adapt? What does that mean?

Good question. I'll answer it in a minute, but let me explain a few things first. All organisms have traits, or characteristics. For example, some human traits might include having black hair or being left-handed or having freckles.

Many of an organism's traits are *inherited*. Inherited traits are controlled by genes. Because genes are passed from parents to offspring, so are inherited traits.

Now I can answer your question. An *adaptation* is an inherited trait that helps an organism meet its needs. An organism is adapted to an environment when its inherited traits help it survive there. For example, polar bears have very thick coats. This adaptation helps them stay warm in a cold environment.

What are some other adaptations?

Here are just a few types of adaptations.

Purpose of Adaptation	Examples
Getting food	• Eagles have sharp beaks that they use to tear apart small animals. • Female mosquitoes use their straw-like mouthparts to suck blood.
Protection	• Rosebushes have thorns that help protect them from plant-eating animals. • When skunks are threatened, they can spray a bad-smelling liquid onto their enemies.
Reproduction	• The seeds of coconut palm trees float on water and can be carried from one island to another by the ocean. • The shells around bird eggs help protect their young until they are ready to hatch.
Water conservation	• Lizards have scaly skin that prevents water loss. • Some plants have small leaves to prevent water loss.
Getting oxygen	• Fish have gills that they use to take oxygen from the water in which they live. • A dolphin breathes air through a single nostril on top of its head when it comes to the ocean's surface.

So far you've mostly just talked about things that organisms have, like seeds or wings. What about things that organisms do, like drinking or breathing? Are those inherited traits?

Drinking and breathing are types of *behavior*. Behavior is the way an organism acts or what it does. And yes, some types of behavior are inherited. Inherited behavior is sometimes called *instinctive behavior*.

Animals don't have to learn instinctive behaviors. Animals are born knowing how to do them. No one has to teach a spider how to spin a web, and no one has to teach a lizard to lie in the sun to stay warm. These are instinctive behaviors.

My mom knows how to drive a car. Does that mean I inherited this behavior? Maybe I won't have to take a driving class when I get older!

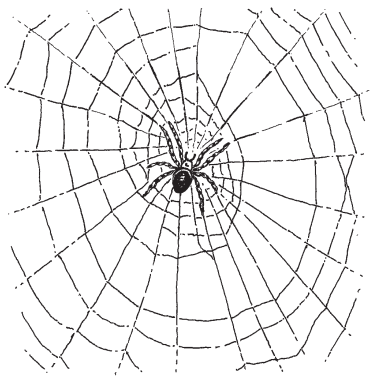
Hold it! Some behaviors are inherited, but many aren't. Driving a car is a learned behavior. You aren't born knowing how to do it, even if both your parents can drive. Someone has to teach you to drive before you can do it.

What about animals? Can they learn things?

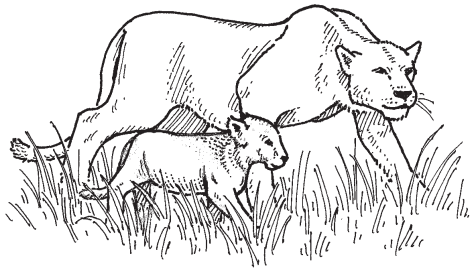
Yes! People aren't the only ones who have learned behaviors. Other animals do, too. A blue jay is a type of bird that eats insects. If a blue jay eats a monarch butterfly, the blue jay will get sick. But young blue jays don't know this. They have to learn it.

How do they learn it? They learn by experience. The first time a young blue jay eats a monarch butterfly, it gets sick and throws up. After that the blue jay knows not to eat any more monarch butterflies.

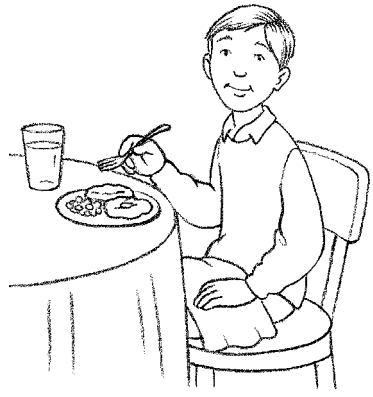
Other behaviors are a mixture of instinctive and learned behaviors. A lion cub is born with the instinct to hunt, but its mother teaches it how and where to hunt.



Web spinning is instinctive behavior.



For a lion cub, hunting is both an instinctive and a learned behavior.

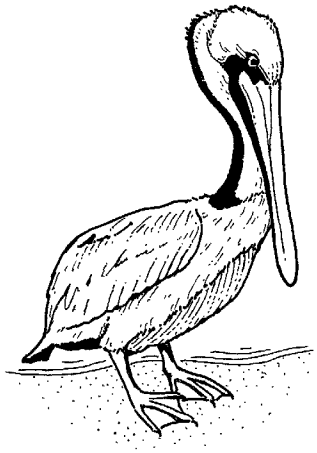


Good manners are learned behaviors.

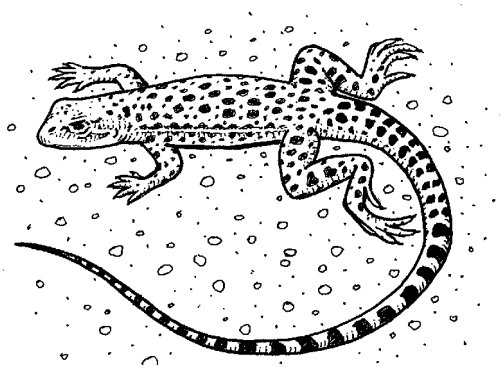
Now I understand more about animal behavior. Can you tell me about the places where animals live?

You bet. The place where an animal or a species lives is called its *habitat*. Dolphins live in the ocean, so the ocean is their habitat. A habitat usually contains all the things a species needs in order to live, such as food, shelter, water, and oxygen.

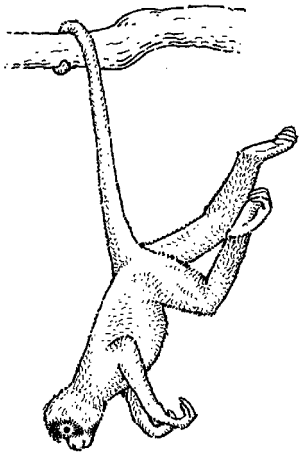
Every living thing has a habitat, even you. Your habitat is the neighborhood where you live, play, and go to school.



This bird is adapted to its habitat beside the water. It scoops fish out of the water with its large bill.



Some lizards live in hot, dry habitats. They have thick, scaly skin that keeps them from drying out.



This monkey has a tail that can grasp tree limbs. The tail is an adaptation that helps the monkey live and climb in trees.

Remember!

If a species isn't well adapted to its habitat, the species could become extinct, or die out.

What will happen if an organism or a species isn't adapted to its habitat?

Let me give you an example. Suppose two light-brown jackrabbits have several baby jackrabbits. The jackrabbits live in a dry habitat among sand, rocks, and spots of dry grass.

All the babies are light brown except one that is white. The white rabbit had a difference in its genes that makes its fur color different from that of its parents.

Which of the babies will a fox see best when it hunts for dinner? You guessed it! The white jackrabbit. The baby jackrabbit with white fur is not as well adapted to its habitat as its brothers and sisters. Chances are, the white jackrabbit will not live to pass on its genes for white fur.

Light-brown fur is an adaptation that helps jackrabbits live in a dry habitat. They are able to blend in with their environment because they are about the same color as their surroundings. Their fur color helps protect them from their enemies.

Jackrabbit

A jackrabbit's light-brown color helps it blend into its surroundings. If jackrabbits were white, they would be more visible to predators and less adapted to their environment.

What about a niche? Is that the same thing as a habitat?

No. An organism's habitat is related to its niche, but it isn't the same thing. Many species can share a habitat. A seashore is a habitat that is home to many kinds of plants, animals, and other organisms.

Only one species can occupy a *niche*. A niche is what a species does in its habitat. A niche describes how the species meets its needs and how it affects other organisms.

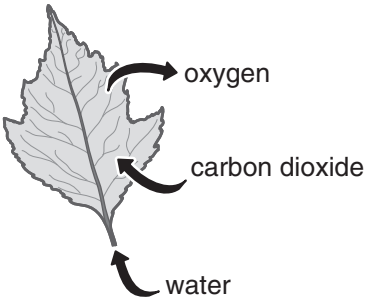
Salt Grass Marsh

Salt grass is adapted to living in shallow salty water where the ocean tides come in and out very gently. This type of habitat is called a salt marsh.

Take the niche of a plant such as salt grass. Salt grass provides a home for snails on its leaves. It also provides protection for baby fish and shrimp among its underwater stems. Salt grass makes its own food by using the sun's energy, and it is eaten by snails and other animals in its habitat. When salt grass dies, it becomes food for organisms in the water and adds to the rich soil in the marsh. All the ways salt grass depends on and adds to the marsh is its niche.

You said salt grass makes its own food. How does it do that?

Salt grass is a green plant. All green plants produce sugar by using carbon dioxide gas, water, and energy from the sun. This process, which is called *photosynthesis*, takes place inside a plant's leaves and stems. Green plants are called *producers* because they produce their own food.



But animals don't make their own food. They have to find and eat food, right?

Right! An animal gets food and energy by eating other organisms. A species that eats, or consumes, other organisms is called a *consumer*.

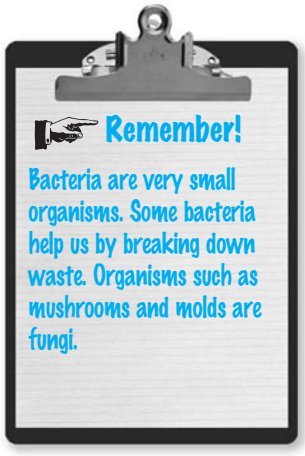
Some consumers eat only plants. These consumers are called *herbivores*. Grasshoppers, rabbits, and cows feed only on plants, so these animals are herbivores.

What about animals that don't eat plants, like lions?

They are consumers, too. But instead of eating plants, lions eat other animals. A consumer that eats other consumers is called a *carnivore*. Other examples of carnivores are rattlesnakes, eagles, and wolves.

I had a salad and a slice of sausage pizza for lunch. I ate part of a plant (the lettuce) and part of an animal (the sausage). What type of consumer does that make me?

That makes you an *omnivore*. An omnivore is a third type of consumer. Omnivores eat both producers and other consumers. Raccoons are another type of omnivore. They eat small animals, such as mice and frogs, as well as fruit and berries. Raccoons can even find a meal in the garbage.



The pizza that I had for lunch also had mushrooms on it. I know that mushrooms aren't plants, and they aren't animals, either. How do they get food?

You're right. Mushrooms are neither plants nor animals. They're fungi. Fungi and some types of bacteria are *decomposers*. Decomposers get their energy by breaking down dead organisms and the wastes of living organisms.

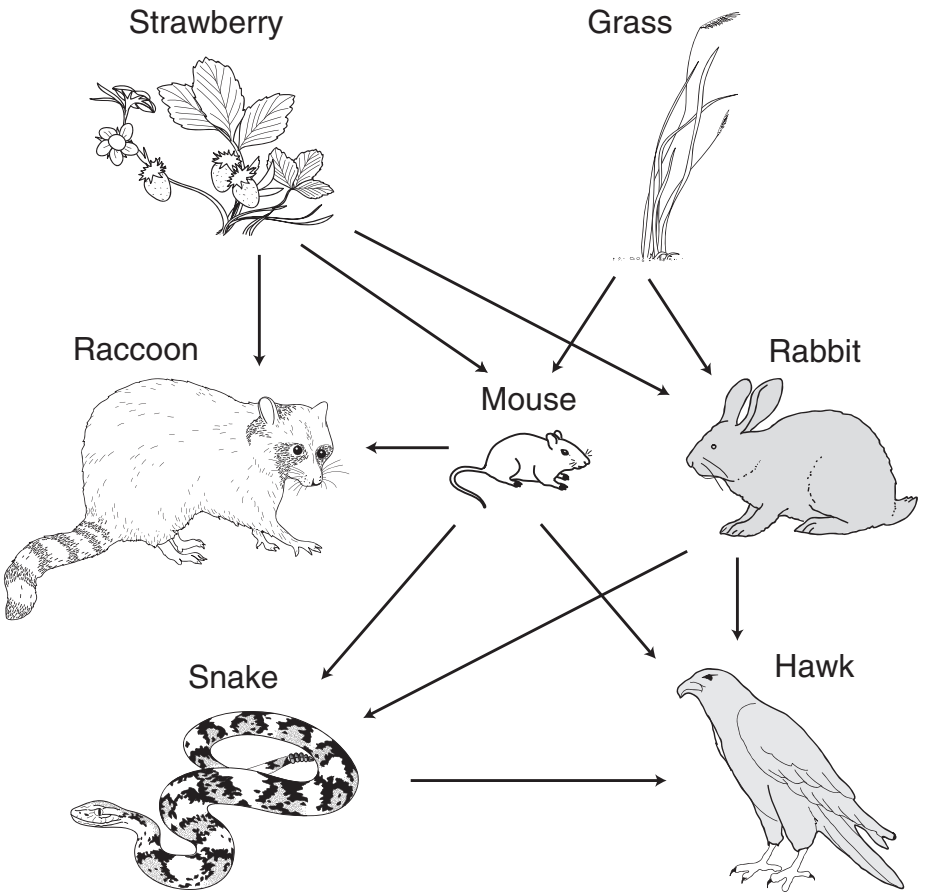
As decomposers break down wastes and dead organisms, they return nutrients to the soil. Plants need these nutrients in order to grow. One of these nutrients is nitrogen. Remind me to tell you more about nitrogen when we talk about cycles.

So we have producers, consumers, and decomposers. Is there a way to keep track of what eats what in an ecosystem?

Yes, there is. It's called a *food web*. A food web is a diagram that shows how energy moves from one organism to another in an *ecosystem*. An ecosystem includes all of the living and nonliving parts of a place and the relationships among these parts.

The arrows in a food web point in the direction that energy moves. In other words, the arrows point from the organism being eaten to the organism that does the eating. To show that snakes eat (or get energy from) mice, you would draw an arrow from the mice to the snakes.

Look at this simple food web.



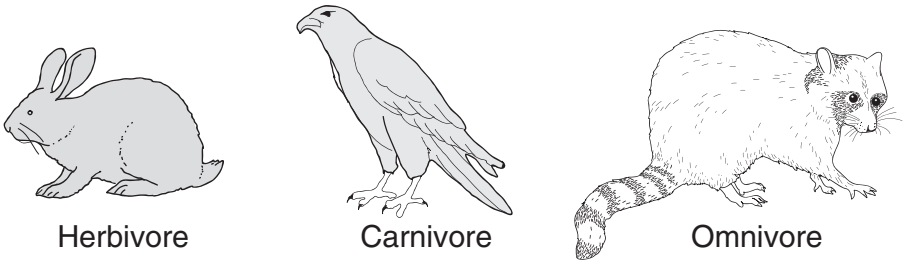
Arrows show the direction that energy moves through the food web.

Look at the mouse in the center of the food web. The arrows that point to the mouse show how the mouse gets its energy. The mouse gets energy by eating strawberries and grass seeds.

The arrows that point away from the mouse show the organisms that get energy from the mouse. Raccoons, snakes, and hawks can get energy by eating the mouse.

What are the producers and consumers in this food web?

The producers in this food web are the plants: strawberries and grasses. The producers get their energy from the sun. The rest of the organisms in the food web are consumers. They get their energy by eating other organisms.



Mice and rabbits are herbivores. Snakes and hawks are carnivores. Raccoons are omnivores.

What if you added decomposers to this food web? Where would they go?

Decomposers break down both plants and animals when they die. Decomposers can get energy from any of the organisms in this food web. If you added decomposers, you would have to draw an arrow pointing from each of the other organisms to the decomposers.

What would happen if all the herbivores were taken out of an ecosystem?

That would leave just omnivores, carnivores, producers, and decomposers. Without herbivores, there would be fewer animals to eat the plants. More plants would have a chance to grow bigger and taller. After a while the plants might run out of room to grow.

Without herbivores, carnivores would have fewer animals to eat. Some carnivores would probably starve. Herbivores are a necessary link in the flow of energy in an ecosystem.

What do you think might happen if the producers were removed from an ecosystem?

Probably nothing else could live there, right?

Right. Producers form the base of any food web. Without producers, energy from the sun would not be able to enter the food web. Herbivores would starve because they wouldn't have plants to eat. And once the herbivores died, carnivores and omnivores would begin to starve as well.

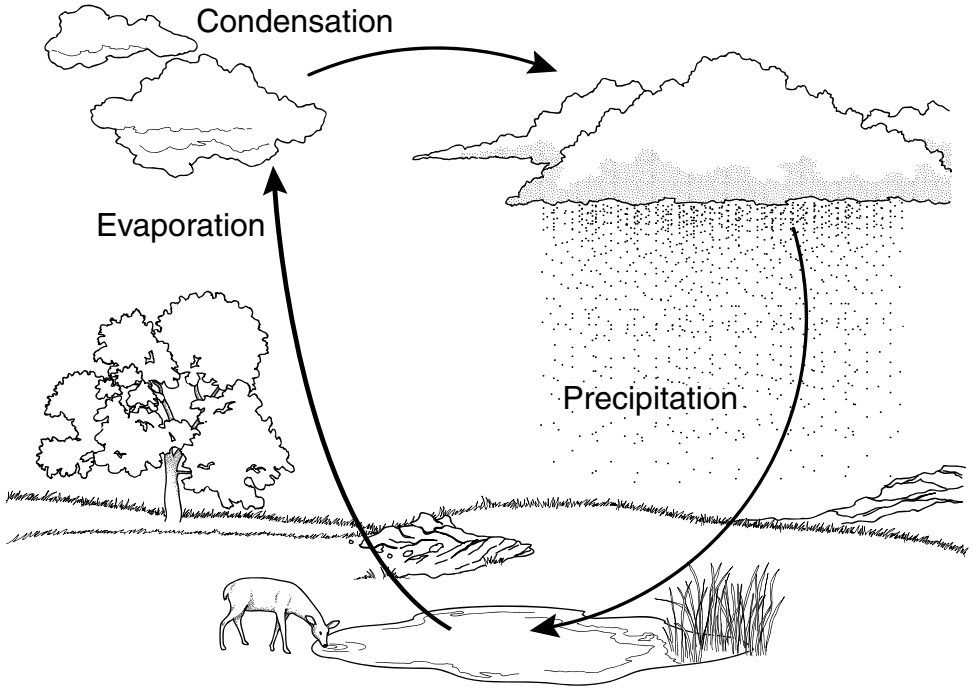
O.K., so I'm a consumer, and I get energy from my food. Is that all I need to stay alive?

No, you need air to breathe, water to drink, and vitamins and minerals from a nutritious diet. Most organisms need other things too.

Wow! So now you're going to tell me that besides a food web, there's a water web and an air web?

You're getting too smart! But we don't call them webs. We call them cycles because water and air are used over and over again. They cycle through the atmosphere, the soil, and living things and then back again. Take water, for example.

The Water Cycle



Animals take in water when they drink and return it to the environment as waste. Plants take in water through their roots. They lose water from their leaves.

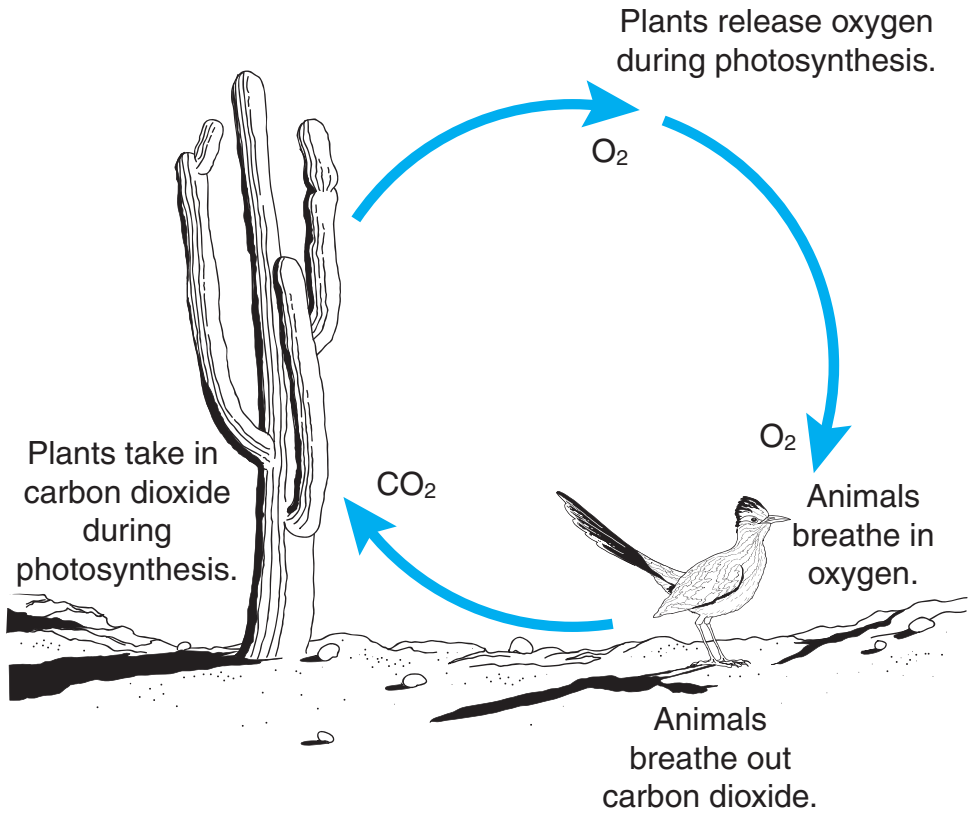
Water at Earth's surface evaporates into the air. Once in the air, water condenses into clouds and then falls back to the ground as precipitation (rain, snow, sleet, hail).

Objective 2

What about air?

Two important gases in air are oxygen and carbon dioxide. These two gases cycle through the ecosystem.

The Carbon Dioxide–Oxygen Cycle



Many animals get the oxygen they need in order to live by breathing air. They breathe out another gas as a waste. This waste gas is called carbon dioxide. But guess what? Green plants need carbon dioxide! They take in carbon dioxide and use it to make food during photosynthesis. Green plants also release oxygen during photosynthesis. In this way both gases are cycled through the atmosphere and through living things. Pretty neat system, huh?

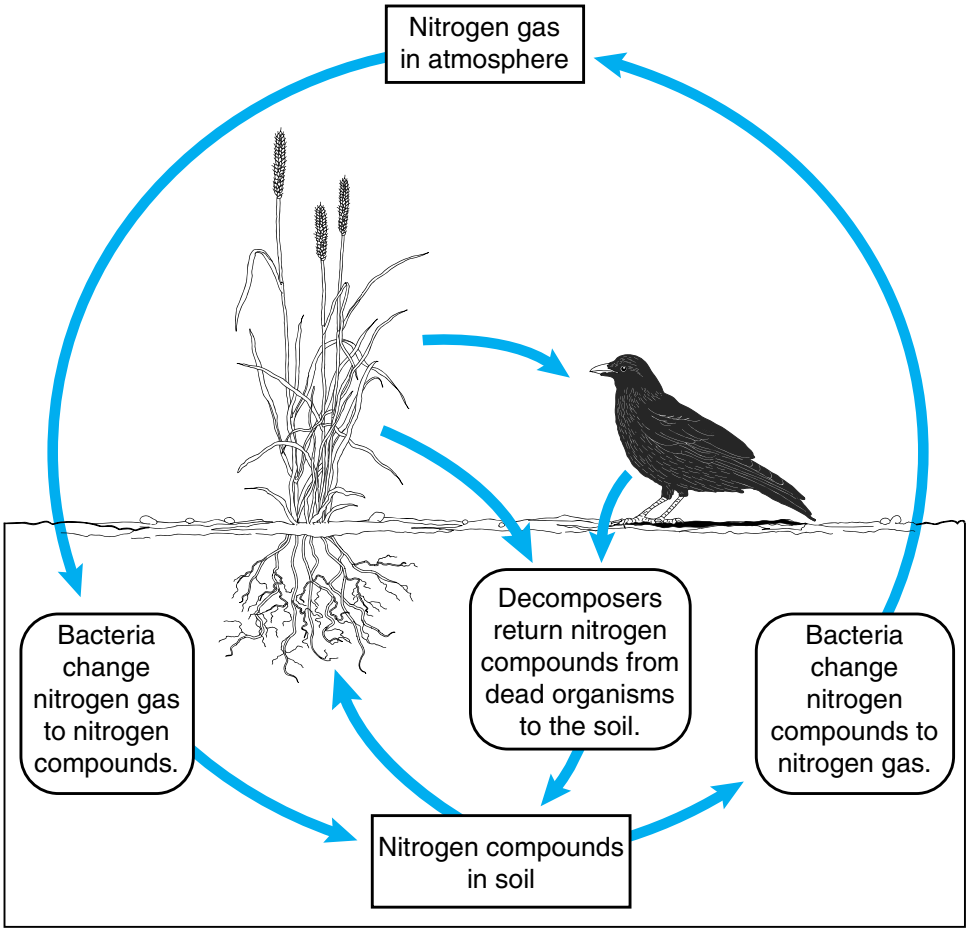
Is that all? Is there another cycle that I should know about?

I'll tell you about one more—the nitrogen cycle. Many of the chemicals in your body contain nitrogen. The proteins in your body, for example, contain nitrogen. Nitrogen is a basic need of every living thing. Nitrogen moves in a cycle, too!

Remember!

Proteins are chemicals that are needed for growth. Proteins make up a large part of your body, such as your muscles and bones.

The Nitrogen Cycle



Air contains lots of nitrogen gas, but most organisms can't use nitrogen in this form. However, there are some types of soil bacteria that can use nitrogen gas. They change nitrogen gas into compounds that plants can use.

Plants take in these nitrogen compounds through their roots. Animals take in nitrogen compounds by eating plants or other animals. When plants and animals die, their nitrogen compounds are returned to the soil by decomposers. Other types of soil bacteria change nitrogen compounds back into nitrogen gas.

See how everything is connected? Every living thing depends in some way on the living and nonliving parts of an ecosystem.