Reflect

For hundreds of millions of years, dinosaurs roamed the planet. Some weighed up to 80 tons. Some were taller than a 6-story building. Then, starting about 65 million years ago, the dinosaurs went **extinct**. Today not a single one remains. What killed off the dinosaurs? Scientists don't know for sure, but changing conditions on Earth probably played a big role. About 65 million years ago, a huge asteroid hit the planet. Also around this time, Earth was covered in volcanoes. Events like these—an asteroid impact and frequent volcanic eruptions—likely threw large clouds of dust and ash high into the air. These clouds could have blocked sunlight from reaching the planet's surface for months—possibly years. Temperatures would have dropped around the world. Many plants would have died, followed by plant-eating animals, followed by meat-eating animals. Could a chain of events like this have doomed the dinosaurs?

extinct: describes a species that has completely died out

As the dinosaurs died, however, another group thrived. These animals—the mammals—included the ancestors of modern cats, dogs, whales, elephants, and human beings. Why do you think some **organisms** survive changes to their environment, while others do not? What does this have to do with adaptations?

organism: a living thing

What are adaptations? How do they help organisms survive?

To scientists, an *adaptation* is any characteristic that helps an organism survive or reproduce. Adaptations can be physical as well as behavioral. Most adaptations happen slowly—they are **traits** that are inherited over many generations.

Examples of traits include the size and shape of a bird's beak. In any generation, some birds are born with more powerful beaks. Birds with stronger beaks can eat seeds with harder shells. These birds have access to more food than birds with weaker beaks. They are more likely to survive and reproduce, and some of their offspring will inherit stronger beaks. Like their parents, these birds will be more likely to survive and reproduce. In each generation, more birds will have stronger beaks. In this way, the adaptation spreads through the population.

trait: an internal or external characteristic or feature of an organism

What Do You Think?

Take a look at the following photographs. The picture on the right shows a cactus in an Arizona desert. The picture on the left shows two redwood trees in a California forest. How do you think each plant has adapted to survive in its environment?

Look Out!

Organisms inherit many traits from their parents. However, very few of these traits become adaptations. Changes to the environment may cause certain traits to be advantageous. Organisms with these traits are more likely to survive and reproduce. Changes to the environment can also make traits less advantageous. Organisms with these traits are less likely to survive and reproduce. For example, a rabbit born with a brown coat in a snowy environment will have trouble hiding from predators. Only traits that make organisms more likely to survive are truly adaptations.

It is important to remember that animals do not choose the traits they inherit. Birds cannot choose to have stronger beaks. Plants cannot choose to grow longer roots. Traits become adaptations only over many generations, as more and more offspring inherit advantageous traits.

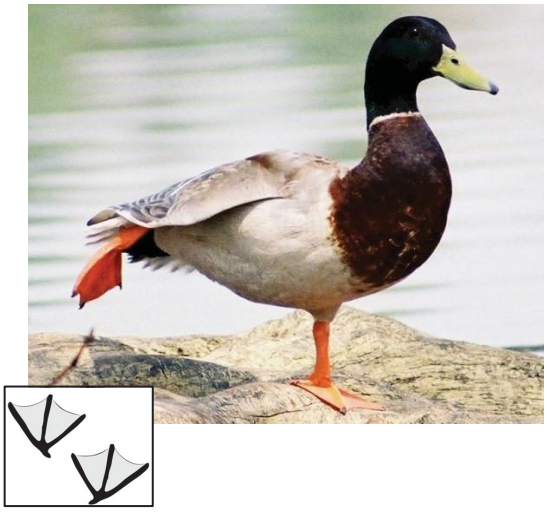
Look Out!

What are some examples of plant and animal adaptations?
Plants and animals have specific structures and functions that help them to survive in their environments. A *structure* is a body part—for example, a tail or a leaf. A *function* describes how something works or what it can do. For example, monkeys have tails that can grasp tree branches. Plants have leaves that can open to capture moisture from the air.

Let's take a closer look at a specific structure: the foot. How do foot adaptations help different animals to survive in their environments?

- **Bison:** Bison—also call American buffalo—can grow to weigh over 2,200 pounds. They need strong, sturdy feet to support their great bodies. But bison hooves have other uses. Bison live on the prairies of Midwestern America. In the winter, they use their hooves to clear snow from the ground. They can then eat the grasses underneath. Bison also use their hooves as weapons against predators. A swift kick can cripple or even kill a wolf or a bear.

- **Ducks:** Ducks—like other birds that swim—have webbed feet. If you've ever worn flippers while swimming, you understand the advantages of webbed feet. Thin flaps of skin connect a duck's front toes. This webbing helps the duck to propel itself through the water. Some ducks also spend time perched in trees. These ducks use their sharp claws to grip tree branches more securely. Have you ever wondered how ducks can walk on icy surfaces? Birds have very few blood vessels or nerves in their feet. So, their feet don't get as cold as human feet do.



Look Out!

- **Squirrels:** Squirrels spend much of their time in trees—searching for food and hiding from predators. They must be able to climb up and down quickly and to leap from branch to branch. Squirrels do these things with help from their feet. Squirrels have five claws on each hind foot. They also have very flexible ankles. A squirrel can press its hind feet flat against a tree trunk, digging its claws into the bark as it climbs. On each front foot, squirrels have four long fingers with claws and a short thumb. A squirrel uses its thumbs to hold nuts and other food as it eats.

Reflect

How are some organisms better adapted to live on land? How are some organisms better adapted to live in the water? (Think of structures such as lungs, gills, tails, and roots. Think of how different animals disguise, or camouflage, themselves and how different plants obtain water.)

Everyday Life: Why is the human thumb an important adaptation?
Human beings have opposable thumbs. What does this mean? The word opposable is related to the word opposite. As humans, we can move our thumbs in many directions. We can even press our thumbs against—or opposed to—our other fingers. Few other organisms have this ability. Apes do; however, their thumbs are smaller and cannot move over such a wide range. In fact, an opposable thumb is one of the most important human adaptations. It allows us to use tools and perform tasks with our hands that other animals cannot perform.

Reflect

Gibbons and other apes have opposable toes.

If humans had opposable toes, what activities could you perform more easily?

Try Now

Take a few minutes to explore the importance of opposable thumbs.

1. First, perform some or all of the following activities. Describe how your thumbs help you to perform each activity:
   - Write your name with a pencil or pen.
   - Tie your shoelaces.
   - Open a closed door, a jar, or a bottle.
   - Brush your teeth or hair.
   - Throw and catch a ball.
2. Next, have an adult tape your thumbs to your index fingers. Do not wrap the tape too tightly around your fingers. The tape should restrict your thumb's movements but not cause you any soreness or pain.
3. Perform each activity from Step 1 again. Is the activity more difficult when you can't use your thumbs? Explain.

What do you know?

An adaptation is a characteristic that helps an organism to survive in its environment. Study the photographs of the four environments below. Then, read the characteristics in the box. Decide which characteristics are common adaptations for plants or animals in each environment. Write your answers in the spaces beneath each photograph.

Try Now

Characteristics	
•Good sense of balance •Broad, flat leaves •Ability to absorb oxygen from fresh water •Leaves that remove excess salt	•Strong, sturdy roots and trunks •Thick, white fur •Ability to absorb oxygen from salt water •Roots that cling to narrow gaps in rocks

Arctic Forest		Pond	
			
Adaptations for Plants	*Adaptations for Animals*	*Adaptations for animals*	*Adaptations for Animals*

Mountain		Coral Reef	
			
Adaptations for Plants	*Adaptations for Animals*	*Adaptations for Plants*	*Adaptations for Animals*

Connecting With Your Child

Adaptations Close to Home

To help students learn more about adaptations, take them to a nearby ecosystem. Examples include a field, forest, pond, stream, or park. Instruct students to describe the nonliving parts that make up the ecosystem. (Nonliving parts of an ecosystem are called *abiotic features*.) For example, a stream is made up of water, rocks, soil, mud, sticks, and dead leaves. Encourage students to be specific and to describe as much of the ecosystem as they may safely explore. For example, students may note how quickly the water in a stream is flowing. They may also note how cool or warm the water feels to the touch.

Then, instruct students to describe all the plants that they can see and to *hypothesize*, or guess, how the plants are adapted to survive in the ecosystem. Finally, instruct students to hypothesize what kinds of animals live in the ecosystem and how these animals are adapted to survive there. (Plants, animals, and other living parts of an ecosystem are called *biotic features*.) If you see any animals while exploring, remind students not to approach or touch them. In addition, remind students not to disturb or change the ecosystem as they explore. Make sure they do not take anything home with them.

When you return home, research the ecosystem online to compare students' hypotheses to the plants and animals that actually live there. You may be able to find this information on the website of a local government or conservationist group.

Here are some questions to discuss with students:

- How are the plants that live in this ecosystem adapted to survive there?
- How are the animals that live in this ecosystem adapted to survive there?
- Select and adaptation that you observed. How long do you think it took for this adaptation to spread through the population of organisms?
- Imagine that the ecosystem changed in some way. (For example, suppose the water level fell in the stream or many trees
- in the forest were cut down.)
- What traits would make plants and animals more likely to survive in this changed environment? What traits would make plants and animals less likely to survive?