24.1

KEY CONCEPT

Scientists develop systems for classifying living things.

BEFORE, you learned

- Natural selection helps explain how new species develop
- Evidence indicates that species change over time
- New species develop from ancestral species

NOW, you will learn

- Why scientists classify living things
- That taxonomists study biological relationships
- About evidence used to classify organisms

VOCABULARY

classification p. 824
taxonomy p. 824

THINK ABOUT

How are these organisms similar?

Both a worm and a caterpillar share many characteristics. Both have long, skinny bodies that are divided into segments. But an earthworm moves underground, has no legs or eyes, and can grow back segments that are lost. A caterpillar crawls aboveground and is just one part of a butterfly's life cycle. As you read this chapter, think about whether you would classify these animals together or separately.

Scientists classify millions of species.

About 400 years ago, scientists who studied insects classified them based upon their appearance and behavior. If animals looked alike, researchers concluded that they were related. In the last few centuries scientists have realized that appearances can suggest false connections. Although caterpillars look like worms, they are actually an earlier stage of a butterfly's life.

For some people, the world seemed to grow larger during the 1600s. Travelers sailed to distant lands and oceans. Scientists went on many of these trips, observing and collecting samples of living things they had never seen before. In addition, the microscope allowed scientists to see tiny organisms that had been invisible before. But how could scientists organize and talk about this wonderful new knowledge?

Classification and Taxonomy

VOCABULARY
Add a description wheel for *classification* to your notebook. Include the word *group* in your diagram.

Two scientific processes deal with classifying and naming living things. **Classification** is the process of arranging organisms into groups based on similarities. **Taxonomy** is the science of naming and classifying organisms. A good system of classification allows you to organize a large amount of information so that it is easy to find and to understand. The system should provide a tool for comparing very large groups of organisms as well as smaller groups. Large groups might include all animals. Smaller groups might include birds, reptiles, or mammals.

A good system of taxonomy allows people to communicate about organisms. Before the 1700s, scientists had not agreed on a system of naming and grouping organisms. Take, for example, the common wild briar rose. Some scientists called it *Rosa sylvestris inodora seu canina* (odorless woodland dog rose). Others used the name *Rosa sylvestris alba cum rubore, folio glabro* (pinkish-white woodland rose with hairless leaves). Plus, any scientist studying a species could change the name.

These long Latin names may sound confusing, but even common names can be confusing. In England the bird called a robin—Britain's national bird—is only distantly related to the bird called a robin in the United States, even though they both have red feathers on their chests. A daddy longlegs could be either a long-legged relative of spiders (in the United States) or a long-legged relative of mosquitoes (in England).

British Daddy Longlegs

American Daddy Longlegs

RESOURCE CENTER
CLASSZONE.COM
Find out more about taxonomy.

Clearly, biologists need both a system for organizing and a system for naming. Each name should refer to one specific type of organism. That way, scientists can use the species name and be sure that everybody knows exactly which organism they are talking about.

CHECK YOUR READING What is the difference between classification and taxonomy?

Like other cats, a caracal has fur, sharp fangs, and is a meat eater.

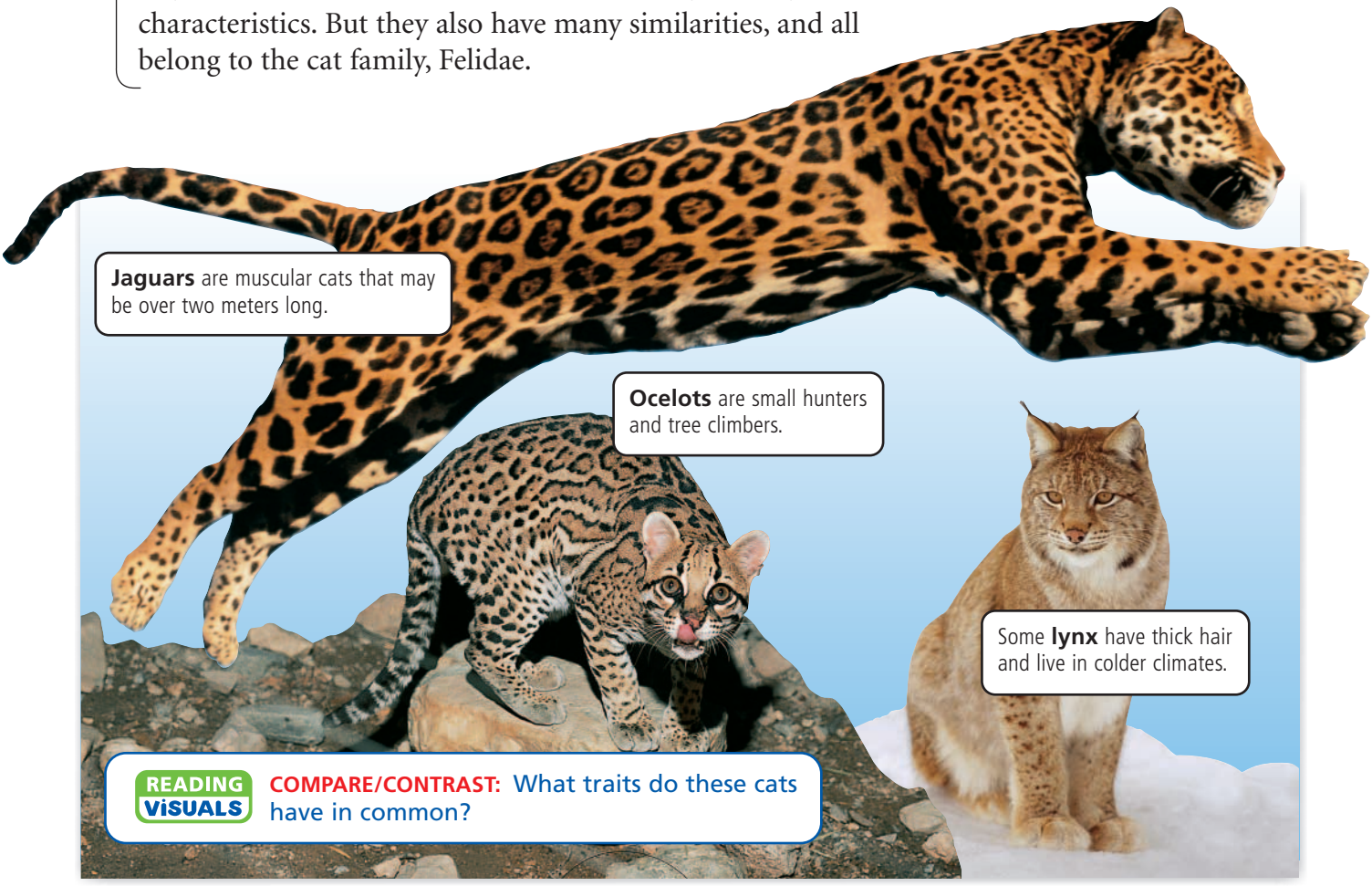
Using Classification

To classify organisms, scientists use similarities and differences among species. Sometimes these differences are easy to see, such as whether an animal has fur, feathers, or scales. Other times, seeing the differences requires special laboratory equipment, such as equipment to study DNA.

A classification system can help you identify unfamiliar organisms. For example, if you had never heard of a caracal but were told that it was a kind of cat, you already would know many things about it. It has fur, fangs, and sharp claws. It's a meat eater, not a plant eater. You would know these things because the caracal shares those characteristics with all of the members of the cat family.

If you looked up *caracal* in an encyclopedia, you'd find that your guesses were right. The caracal is a small wildcat native to Africa, the Middle East, and India. It weighs about 13 to 19 kilograms (29 to 42 pounds). The name *caracal* comes from a Turkish word meaning "black-eared."

The more characteristics two organisms share, the more similar their names should be in the classification system. The caracal, a pet cat, and all the cats below are different in size, habitat, and other characteristics. But they also have many similarities, and all belong to the cat family, Felidae.



Taxonomists study biological relationships.

READING TiP
Taxonomy, *taxonomist*, and *taxon* all share the same root.

Scientists need a simple, standard way of arranging all of the different species. The science of taxonomy is related to the Greek word *taxis*, which means "arrangement." Taxonomists are the scientists who classify and name organisms based on their similarities and differences. A taxon is a group of organisms that share certain traits. Taxons can be broad, like animals and plants, or more specific, like cats and roses.

As you learned in Chapter 23, living things evolve over time. A single species found in a fossil record might be the ancestor of many different species found on Earth today. Taxonomists study the relationships between species, trying to discover how one species evolved as compared with another species. Species that share ancestors are grouped together.

To determine how to classify organisms, scientists compare a variety of characteristics, or traits. A trait is a characteristic or behavior that can be used to tell two species apart, such as size or bone structure. If two organisms share a trait, taxonomists try to determine if they share the trait because they share an ancestor.

CHECK YOUR READING How do taxonomists use biological relationships to classify organisms?

INVESTIGATE Classifying Leaves

How can you classify leaves?

SKILL FOCUS
Classifying

MATERIALS
- leaves
- hand lens

TIME
20 minutes

PROCEDURE

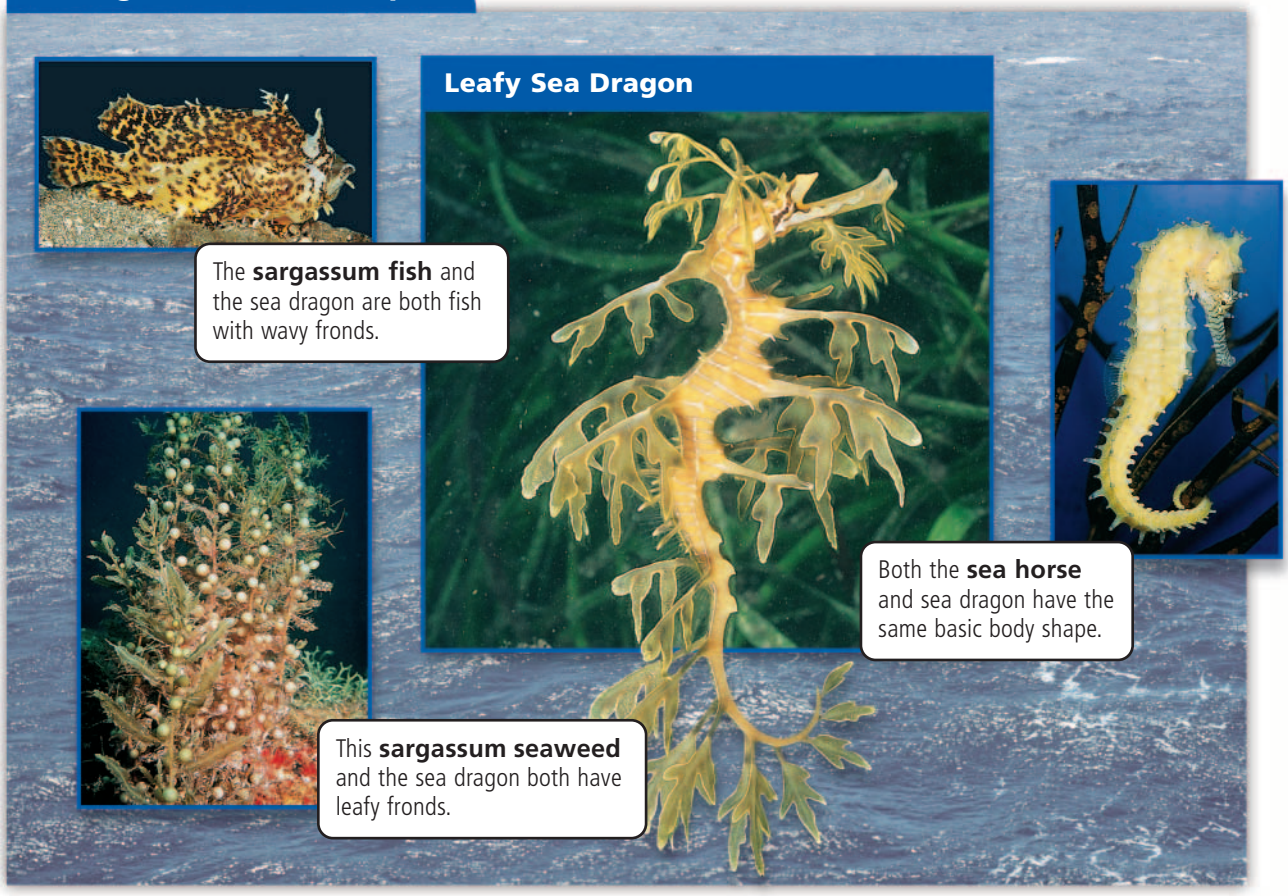
1. Decide, as a class, what traits you will use to classify leaves. You may use size, shape, color, vein patterns, texture, or anything else that you observe.
2. Work with a few classmates. Sort your leaves into four or five taxons, based on the characteristics chosen in step 1. Give each taxon a name that describes its common traits.
3. Compare your classification scheme with those of other groups.

WHAT DO YOU THINK?

- How did you arrange the leaves into groups?
- Did your methods of classifying leaves match those of other student groups?

CHALLENGE How does your group's classification scheme compare with the scheme scientists use for classification?

Biological Relationships



Look at the photographs and try to determine to which organism a leafy sea dragon is more closely related. The leafy sea dragon shares traits with all of the other organisms pictured. For example, the sea dragon and the sargassum seaweed look similar, with greenish wavy fronds. But the sea dragon is an animal that moves, gets food from other organisms, and breathes oxygen. The sargassum seaweed is not an animal, it is a type of algae.

The sargassum fish shares more traits with the sea dragon, but its body is a much different shape and has scales. In fact, the leafy sea dragon is an animal that is closely related to a sea horse. Both have heads and bodies with similar shapes, and neither has scales. The sea horse shares more traits with the leafy sea dragon than with the other two organisms.

Taxonomists take evidence and try to reconstruct the evolution of a species. Then they place the species in the classification system. Scientists use physical evidence, such as fur, bones, and teeth. They also use genetic evidence, which is found within an organism's DNA.

Physical Evidence

Physical Evidence

Steller's Jay
- Lives only west of the Rocky Mountains
- Has a solid black head and neck and almost no white feathers

Blue Jay
- Lives mostly east of the Rocky Mountains
- Has blue, black, and white feathers on its wings and neck

The primary tools early scientists used for taxonomy were their eyes and measuring devices. They collected examples of organisms and noted characteristics, such as color, size, weight, and how groups of organisms obtain energy. Scientists who studied animals observed the internal structure, as well as outward appearances. These physical features are still important today.

Individuals of two species, such as the two jays shown to the left, can have many similarities as well as some differences. One obvious difference is the color pattern. Another is the area of the world in which they live. Blue jays live east of the Rocky Mountains, and steller's jays live west of the Rockies. The common names and the scientific names reflect the differences and the common ancestor: blue jay, *Cyanocitta cristata* and steller's jay, *Cyanocitta stelleri.*

Skeletons, shells, and other hard parts of organisms become fossilized more easily than soft parts do. Scientists can observe and measure fossilized bones or pieces of bones and compare them with each other. They can also compare bones of species that are extinct with bones of modern species. From such studies, scientists can determine many things about the organism. Physical evidence provides clues about how an organism may have lived, how it moved, or what type of food it ate.

All of this physical evidence helps scientists see that all living organisms are related by evolution. Some are more closely related than others. This means they share a more recent ancestor.

CHECK YOUR READING How could comparing fossilized bones with a modern animal's bones help you see the modern animal's evolutionary history?

Genetic Evidence

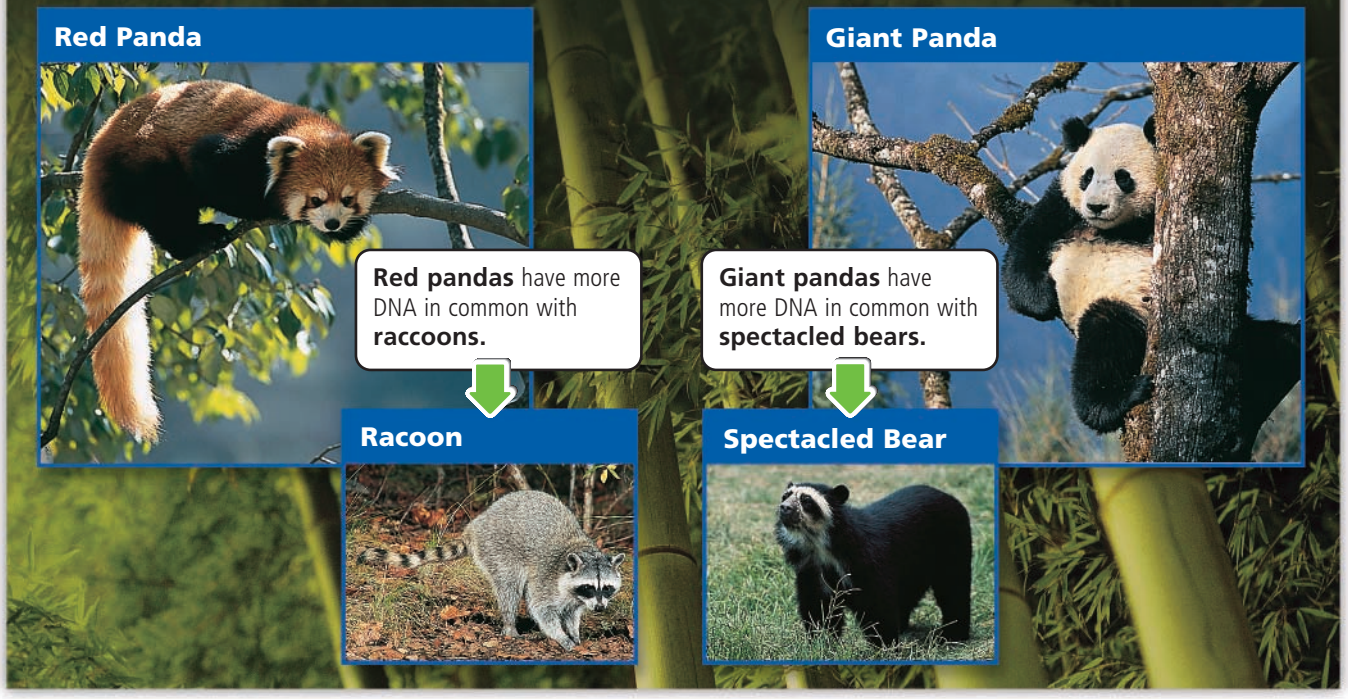
In the early 20th century scientists discovered that organisms inherit their traits through structures called genes. In the mid-1950s they observed that genes are made of DNA and that DNA stores coded information.

Today scientists can use laboratory machines to catalog each component of an organism's DNA. With that information stored on a computer, scientists can compare the components of a gene from one organism with the components of the same gene from another organism.

Genetic evidence usually supports physical evidence, but not always. Consider the example shown on page 829. For years, taxonomists argued about how to classify this small, reddish animal from China. Its scientific name is *Ailurus fulgens*, and the common name is red panda.

Genetic Evidence

Both of these pandas live in the same habitat, have similar faces, and eat bamboo. But genetic evidence shows that red pandas and giant pandas are only distant relatives.



Later, scientists discovered a larger, bearlike animal in China, which they called the giant panda. Both pandas ate only bamboo, shared a common name, and their faces looked similar. Scientists concluded they were related to each other and to raccoons. However, molecular evidence has shown that the red panda is more closely related to raccoons and the giant panda is more closely related to bears.

24.1 Review

KEY CONCEPTS

1. Describe the benefits of classifying species.
2. Why do taxonomists study biological relationships?
3. How do scientists use genetic evidence when classifying organisms?

CRITICAL THINKING

4. **Analyze** Why do people need a universal system of naming organisms?
5. **Predict** The animal called a marbled godwit is a bird. What traits would you predict it has?

CHALLENGE

6. **Synthesize** Suppose you found two species of cave-dwelling lizards without eyes living on opposite sides of the world. Explain how you would try to determine if the two species were closely related.