

17.1 The Linnaean System of Classification

VOCABULARY

taxonomy
taxon
binomial nomenclature
genus

KEY CONCEPT Organisms can be classified based on physical similarities.

MAIN IDEAS

- ▶ Linnaeus developed the scientific naming system still used today.
- ▶ Linnaeus' classification system has seven levels.
- ▶ The Linnaean classification system has limitations.

☀ Connect to Your World

The pangolin shown on the previous page may not look like any other animal that you are familiar with. However, scientists classify pangolins as mammals—the same group of animals that includes dogs, cats, mice, and humans. All female mammals have the ability to produce milk. Unlike pangolins, most mammals have hair. Scientists use key characteristics such as these to classify all living things.

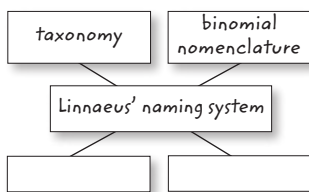
▶ MAIN IDEA

Linnaeus developed the scientific naming system still used today.

READING TOOLBOX

TAKING NOTES

Use a main idea web to take notes about the Linnaean system of classification.



Before Swedish botanist Carolus Linnaeus introduced his scientific naming system, naturalists named newly discovered organisms however they wanted. In fact, they often named organisms after themselves. Because they had no agreed-upon way to name living things, it was difficult for naturalists to talk about their findings with one another. This all changed in the 1750s, when Linnaeus devised a system that standardized the way organisms are classified and named.

Taxonomy

Taxonomy is the science of naming and classifying organisms. Taxonomy gives scientists a standard way to refer to species and organize the diversity of living things. Linnaean taxonomy classifies organisms based on their physical and structural similarities. Organisms are placed into different levels in a hierarchy—a multilevel scale in which each level is “nested” in the next-higher level. In other words, each level is included in a larger, more general level, which in turn is included in an even larger, more general level.

A group of organisms in a classification system is called a **taxon** (plural, *taxa*). The basic taxon in the Linnaean system is the species. In this system, species are most commonly defined as a group of organisms that can breed and produce offspring that can reproduce. Linnaeus' system gives each species a scientific name. With few changes, this method of naming is still used today.

READING TOOLBOX

VOCABULARY

Taxonomy comes from the Greek *taxis*, which means “arrangement,” and *nomie*, which means “method.”

Scientific Names

Binomial nomenclature (by-NOH-mee-uhl NOH-muhn-KLAY-chuhr) is a system that gives each species a two-part scientific name using Latin words.

The first part of the name is the genus. A **genus** (plural, *genera*) includes one or more physically similar species that are thought to be closely related. For example, the genus *Quercus* includes more than 500 species of oak trees. Genus names are always capitalized. They are written in italics or underlined.

The second part of the name is the species descriptor. It can refer to a trait of the species, the scientist who first described it, or its native location. Like the genus, the species descriptor is written in italics or underlined. However, it is always lowercase. The species descriptor is never written alone because, as **FIGURE 1.1** shows, the same word may be used in different genera. *Quercus alba* is the scientific name for white oak trees (*alba* means “white”), but *Tyto alba* is the scientific name for barn owls.

You may wonder why biologists use scientific names. It may seem easier to use terms such as *white oak* instead of remembering two-part Latin names. However, scientific names are helpful in a number of ways. First, genera such as *Quercus* contain hundreds of species. Many of these species have very similar common names. Scientific names allow scientists to talk about particular species without confusion. Also, remember that biology is studied all over the world. One species may have many different common names. In fact, a species may have several different common names within a single country. *Armadillidium vulgare* is the scientific name for pill bugs. However, this species is also called roly-poly, sow bug, and potato bug. Scientific names allow scientists around the world to communicate clearly about living things.

VISUAL VOCAB

Binomial nomenclature is a standard naming system that gives each species a two-part name using Latin words.

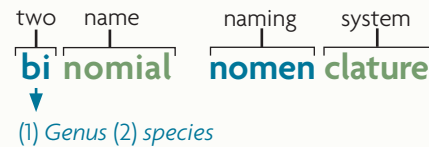


FIGURE 1.1 The white oak (*Quercus alba*) and the barn owl (*Tyto alba*) belong to different genera. The species parts of their scientific names are both *alba*, meaning “white.”



Contrast Describe the difference between a genus and a species.

FIGURE 1.2 SCIENTIFIC AND COMMON NAMES

COMMON NAMES	SCIENTIFIC NAME	
	Genus	species
Roly-poly, pill bug, sow bug, potato bug	<i>Armadillidium</i>	<i>vulgare</i>
Dandelion, Irish daisy, lion's tooth	<i>Taraxacum</i>	<i>officinale</i>
House sparrow, English sparrow	<i>Passer</i>	<i>domesticus</i>
Mountain lion, cougar, puma	<i>Puma</i>	<i>concolor</i>
Red maple, scarlet maple, swamp maple	<i>Acer</i>	<i>rubrum</i>

MAIN IDEA

Linnaeus' classification system has seven levels.

CONNECT TO

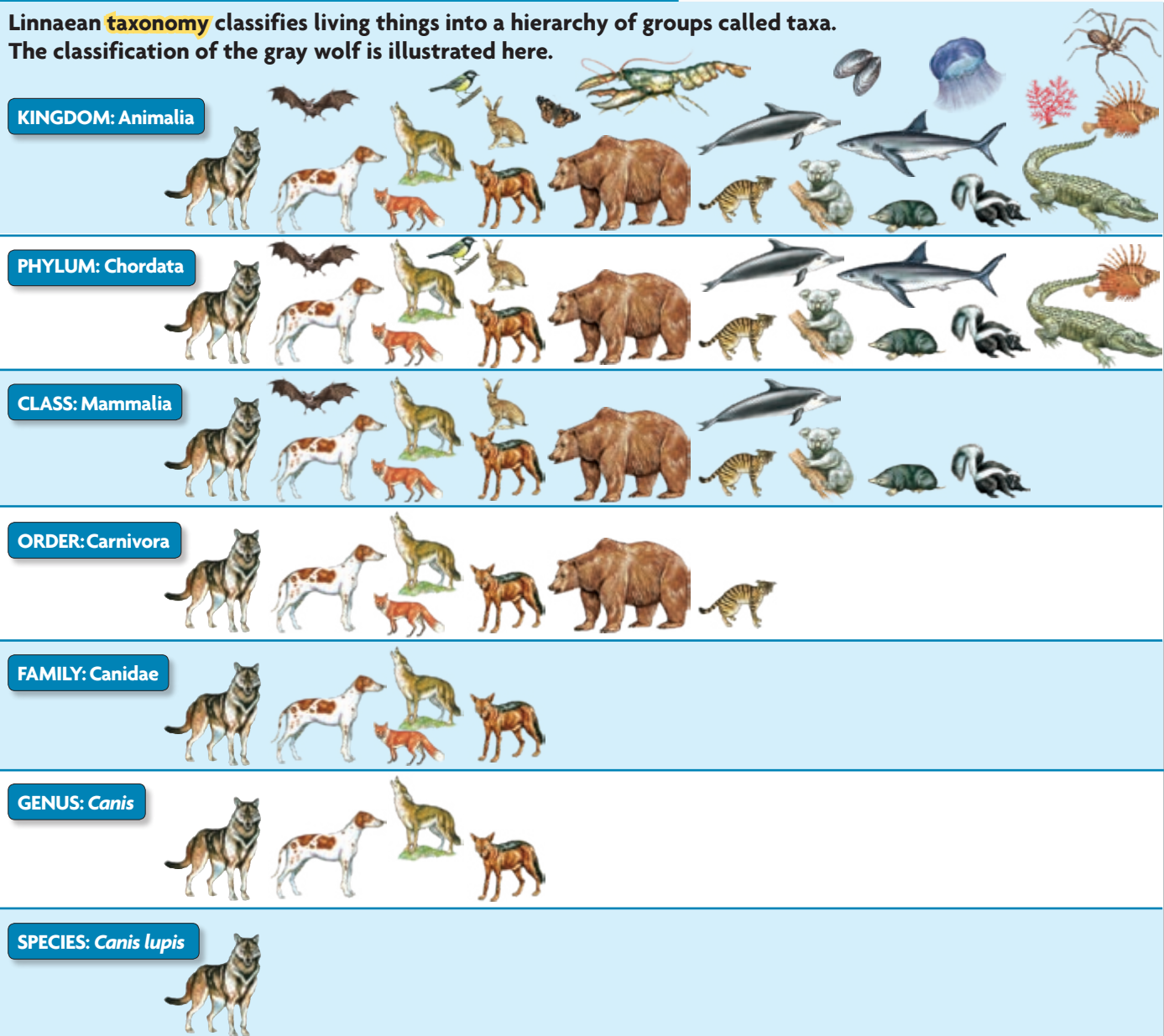
DOMAINS

The tree of life has been updated since Linnaeus' time. Scientists now classify organisms into an even broader category, called the domain, above the kingdom level. You will learn more about domains and kingdoms in **Section 4**.

The Linnaean system of classification has seven levels, or taxa. From the most general to the most specific, these levels are kingdom, phylum (the term *division* is often used instead of *phylum* for plants and fungi), class, order, family, genus, and species. Each level in Linnaeus' system is nested, or included, in the level above it. A kingdom contains one or more phyla, a phylum contains one or more classes, and so forth. The classification of the gray wolf, *Canis lupis*, is shown in **FIGURE 1.3**. Moving down, the levels represent taxa that become more and more specific, until you reach the species level at the bottom.

FIGURE 1.3 The Linnaean Classification System

Linnaean **taxonomy** classifies living things into a hierarchy of groups called taxa. The classification of the gray wolf is illustrated here.



Analyze Based on the taxonomy shown here, are bats or cats more closely related to gray wolves?

The top level represents all of the species in kingdom Animalia. As you move down, the levels show examples of species from phylum Chordata, class Mammalia, order Carnivora, family Canidae, genus *Canis*, and the species *Canis lupis*. Each level is included in all of the more general levels above it.

Notice that gray wolves are in the same genus, *Canis*, as dogs and coyotes. Because the Linnaean system is a nested hierarchy, wolves, dogs, and coyotes also belong to the same family, order, class, phylum, and kingdom. Foxes do not belong to the *Canis* genus, but they do belong to Canidae—the same family as wolves, dogs, and coyotes. Therefore, foxes also belong to the same order, class, phylum, and kingdom as wolves, dogs, and coyotes.

Apply If two species belong to the same order, what other levels in the Linnaean system must they have in common?

▶ MAIN IDEA

The Linnaean classification system has limitations.

Linnaeus created his classification system before technology allowed us to study organisms at the molecular level. His system focuses on physical similarities alone. Remember that physical similarities between two species are not always a result of the species' being closely related. Unrelated species can evolve similar traits through convergent evolution. Linnaeus' system does not account for similarities that evolved this way. So today, scientists use genetic research to help classify living things. Genetic similarities between two species are more likely than physical similarities to be due to a common ancestor.

For example, the giant panda and the raccoon have similar ears and snouts. Because of these similarities, they have been placed in the same family in the Linnaean system. However, molecular biologists have found that the giant panda is more closely related to members of the bear family than it is to raccoons. Furthermore, the red panda, shown in **FIGURE 1.4**, is more closely related to the raccoon than to the giant panda.

Infer Why is the common name *red panda* misleading in terms of classification based on relatedness?

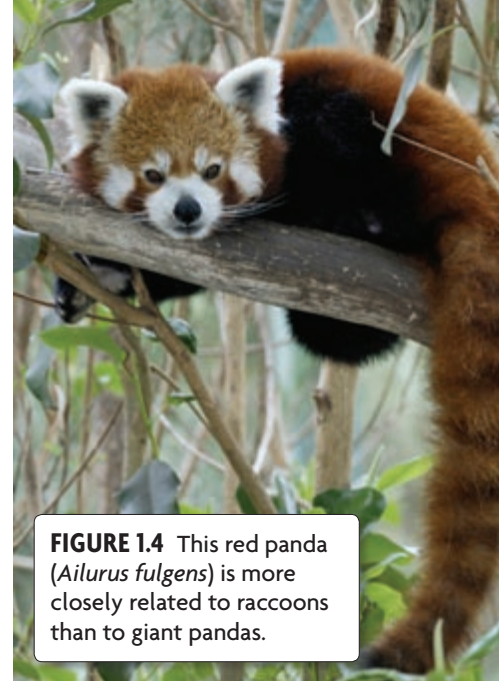


FIGURE 1.4 This red panda (*Ailurus fulgens*) is more closely related to raccoons than to giant pandas.

✦ CONNECT TO

CLASSIFICATION

Refer to **Appendix A** for a complete list of the kingdoms and their phyla.

17.1 Formative Assessment

REVIEWING ▶ MAIN IDEAS

1. What is **binomial nomenclature**?
2. Name each **taxon** in the Linnaean system of classification, from most general to most specific.
3. What are some limitations of the Linnaean classification system?

CRITICAL THINKING

4. **Compare** How is a scientific name similar to an address that includes city and state?
5. **Apply** Which two species are more closely related: *Ursus maritimus*, *Ursus americanus*, or *Bufo americanus*? Explain your answer



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PREMIUM CONTENT

✦ CONNECT TO

HISTORY OF SCIENCE

6. During his voyages, Darwin collected thousands of organisms, which he classified using the Linnaean classification system. How did this system help him share his findings with other naturalists?