SECTION 1

Sorting It All Out

Key Concept An eight-level classification system and branching diagrams are two basic tools that scientists use to study living and extinct organisms.

What You Will Learn

- Scientists use classification to study organisms and how organisms are related to each other.
- The eight levels of classification are domain, kingdom, phylum, class, order, family, genus, and species.
- Each organism that has been described is given a scientific name.
- Branching diagrams show the relatedness between living and extinct organisms over time.

Why It Matters

Classifying organisms will help you identify how living and extinct organisms are related.

Vocabulary

- classification
- taxonomy

READING STRATEGY

Graphic Organizer In your **Science Journal,** make a Pyramid Chart that follows a general note-taking structure. At the top, write the topic of this section. In the next level down, ask two questions about the topic. In the next level, answer the questions. In the bottom level, add more details to your answers.

Imagine that you live in a tropical rain forest and must get your own food, shelter, and clothing from the forest. What do you need to know to survive in the forest? You need to know which plants are safe to eat and which are not. You need to know which animals you can eat and which animals might eat you. In other words, you need to study the organisms around you and organize them into categories, or classify them. **Classification** is putting things into orderly groups based on similar characteristics.

Why Classify?

For thousands of years, humans have classified organisms based on usefulness. The Chácabo people of Bolivia know of 360 kinds of plants in the forest where they live. Of these 360 plant types, 305 types are useful to the Chácabo.

Some biologists, such as those shown in **Figure 1,** classify living and extinct organisms. Scientists classify organisms to help make sense and order of the many kinds of organisms in the world. Biologists use a system to classify organisms. This system is a tool to group organisms according to the characteristics that they share. The classification of organisms allows biologists to answer many important questions, such as the following:

- What are the defining characteristics of each species?
- When did the characteristics of an organism evolve?
- What are the relationships between various species?

Standards Check **What are three questions that classifying organisms can help answer?** 7.3.d

Figure 1 *These biologists are sorting rain-forest plant material.*

7.3.d Students know how to construct a simple branching diagram to classify living groups of organisms by shared derived characteristics and how to expand the diagram to include fossil organisms.

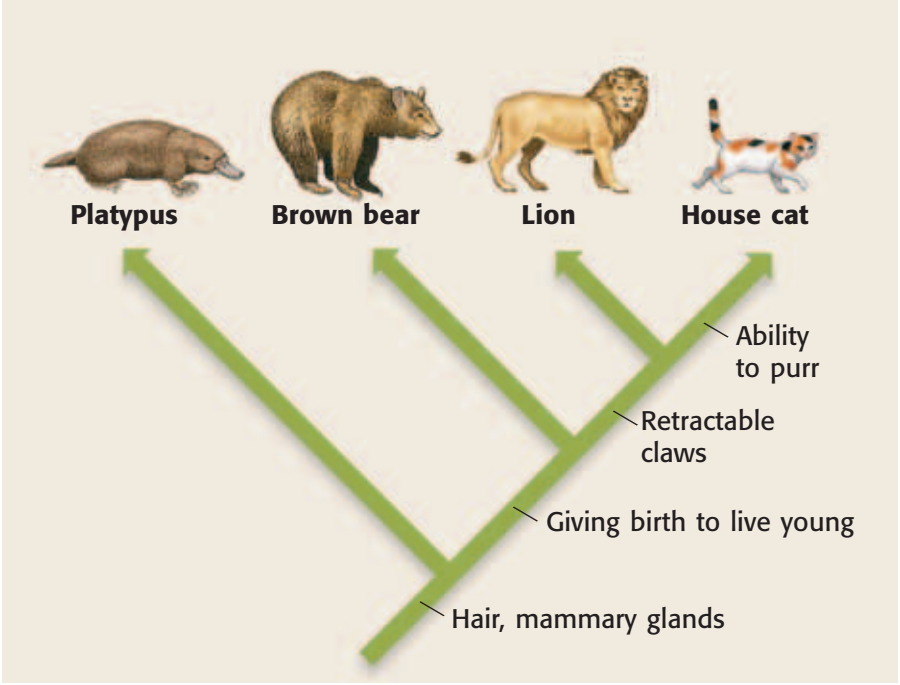


Figure 2 *This branching diagram shows the similarities and differences between four mammals. The bottom of the branching diagram begins in the past, and the tips of the branches end in the present day.*

How Do Scientists Classify Organisms?

In the 1700s, Carolus Linnaeus (KAR uh luhs li NAY uhs), a Swedish scientist, founded modern taxonomy. **Taxonomy** is the science of describing, classifying, and naming organisms. Linnaeus classified organisms based on their structure or characteristics. Classifying organisms by their characteristics is called *systematics*. The classification system used today is based on the one that Linnaeus developed.

classification (KLAS uh fi KAY shuhn) the division of organisms into groups, or classes, based on specific characteristics

taxonomy (taks AHN uh mee) the science of describing, naming, and classifying organisms

Wordwise The root *tax-* means "to arrange" or "to put in order." The suffix *-nomy* means "the science of."

Classification Today

Taxonomists use an eight-level system to classify organisms by their *shared derived characteristics*. A shared derived characteristic is a characteristic that two or more kinds of organisms share with their most recent common ancestor. Scientists use these characteristics to hypothesize how closely related organisms are. The more derived characteristics organisms share, the more closely related the organisms probably are. For example, the platypus, brown bear, lion, and house cat all have hair and mammary glands. Therefore, they are grouped together as mammals.

Branching Diagrams

Branching diagrams show which characteristics organisms share and when these organisms evolved. In **Figure 2,** each characteristic listed on the branching diagram is only shared by the animals above it. All of the animals shown have hair and mammary glands. But only the bear, lion, and house cat give birth to live young. Characteristics shown higher on the diagram are more recent than the characteristics below them. Therefore, more-recent organisms are at the ends of branches that begin higher on the diagram. For example, the house cat evolved more recently than the platypus.

Quick Lab

Constructing a Branching Diagram

7.3.d
7.7.d

1. Construct a diagram similar to the one in **Figure 2.** On the diagram, write "frog", "snake", "kangaroo", and "rabbit" in this order, from left to right.
2. Think of one major change that happened before the frog evolved.
3. For the last three organisms, write a change that happened between one of these organisms and the other two in your diagram.
4. How does this diagram show that the organisms are related?

15 min

Levels of Classification

Every living thing is classified into one of three domains. Domains are the largest, most general groups. All organisms in a domain are sorted into kingdoms. The members of one kingdom are more like each other than they are like the members of another kingdom. All organisms in a kingdom are further sorted into phyla (singular, *phylum*). The members of a phylum are sorted into classes. Each class includes one or more orders. Orders are separated into families. Families are sorted into genera (singular, *genus*). And genera are sorted into species. A species is a group of organisms that are closely related and that can mate to produce fertile offspring. **Figure 3** shows the classification of a house cat in the domain Eukarya, from the level of kingdom Animalia to the species *Felis catus*.

INTERNET ACTIVITY

Kingdom Competition!

Do you have a favorite kingdom? Choose one, and write which of its characteristics you most like. Create an advertisement for your favorite kingdom! Go to **go.hrw.com,** and type in the keyword HY7CLSW.

Scientific Names

By classifying organisms, biologists can give organisms scientific names. A scientific name remains the same for a specific kind of organism even if the organism has many common names. Before Linnaeus's time, scholars used names that were as long as 12 words to identify species. This system was hard to work with because the names were so long. The system was also hard to use because different scientists named organisms differently, so an organism could have more than one name.

Kingdom Animalia	Phylum Chordata	Class Mammalia
All animals are in the **kingdom Animalia.**	All animals in the **phylum Chordata** have a hollow nerve cord. Most have a backbone.	Animals in the **class Mammalia** have a backbone. They also nurse their young.
		

Figure 3 *Levels of classification begin with domain, followed by kingdom, phylum, class, order, family, genus, and species. This diagram shows the levels of classification of the house cat, in domain Eukarya.*

Two-Part Names

Linnaeus simplified the naming of living things by giving each species a two-part scientific name. For example, the scientific name for the Asian elephant is *Elephas maximus* (EL uh fuhs MAK suh muhs). The first part of the name, *Elephas,* is the genus name. The second part, *maximus,* is the specific name. No other species has the name *Elephas maximus*. Naming rules help scientists communicate clearly about living things.

All genus names begin with a capital letter. All specific names begin with a lowercase letter. Usually, both words are underlined or italicized. But if the surrounding text is italicized, the scientific name is not, as **Figure 4** shows. These printing styles show a reader which words are genus names and specific names.

Scientific names, which are usually Latin or Greek, contain information about an organism. The name of the animal shown in **Figure 4** is *Tyrannosaurus rex*. *Tyrannosaurus* is a combination of two Greek words and means "tyrant lizard." The word *rex* is Latin for "king." The name tells you that this animal was probably not a passive grass eater! *Tyrannosaurus rex* can also be referred to as *T. rex*. A correct scientific name consists of the genus name (or its abbreviation) and the specific name.

Figure 4 *You would never call* Tyrannosaurus rex *just* rex!

Standards Check **What are the two parts of a scientific name?** 7.3.d

Order Carnivora	Family Felidae	Genus *Felis*	Species *Felis catus*
Animals in the **order Carnivora** have a backbone and nurse their young. They also have special teeth for tearing meat.	Animals in the **family Felidae** are cats. They have a backbone, nurse their young, have special teeth for tearing meat, and have retractable claws.	Animals in the **genus *Felis*** share traits with other animals in the same family. However, these cats cannot roar; they can only purr.	The **species *Felis catus*** is the common house cat. The house cat shares traits with all of the organisms in the levels above the species level, but it also has unique traits.
			

Extinct Organisms and Living Organisms

Extinct organisms can also be placed in a branching diagram with living organisms. Scientists identify the characteristics of an extinct organism from fossils of that organism. The more shared derived characteristics that an extinct organism has in common with a living organism, the more closely related these organisms probably are. By studying fossils scientists can better understand the evolutionary relationships between organisms or how organisms have evolved. **Figure 5** shows a branching diagram that has extinct and living genera. Notice that extinct genera never appear at the tips of branches that reach the top of the diagram.

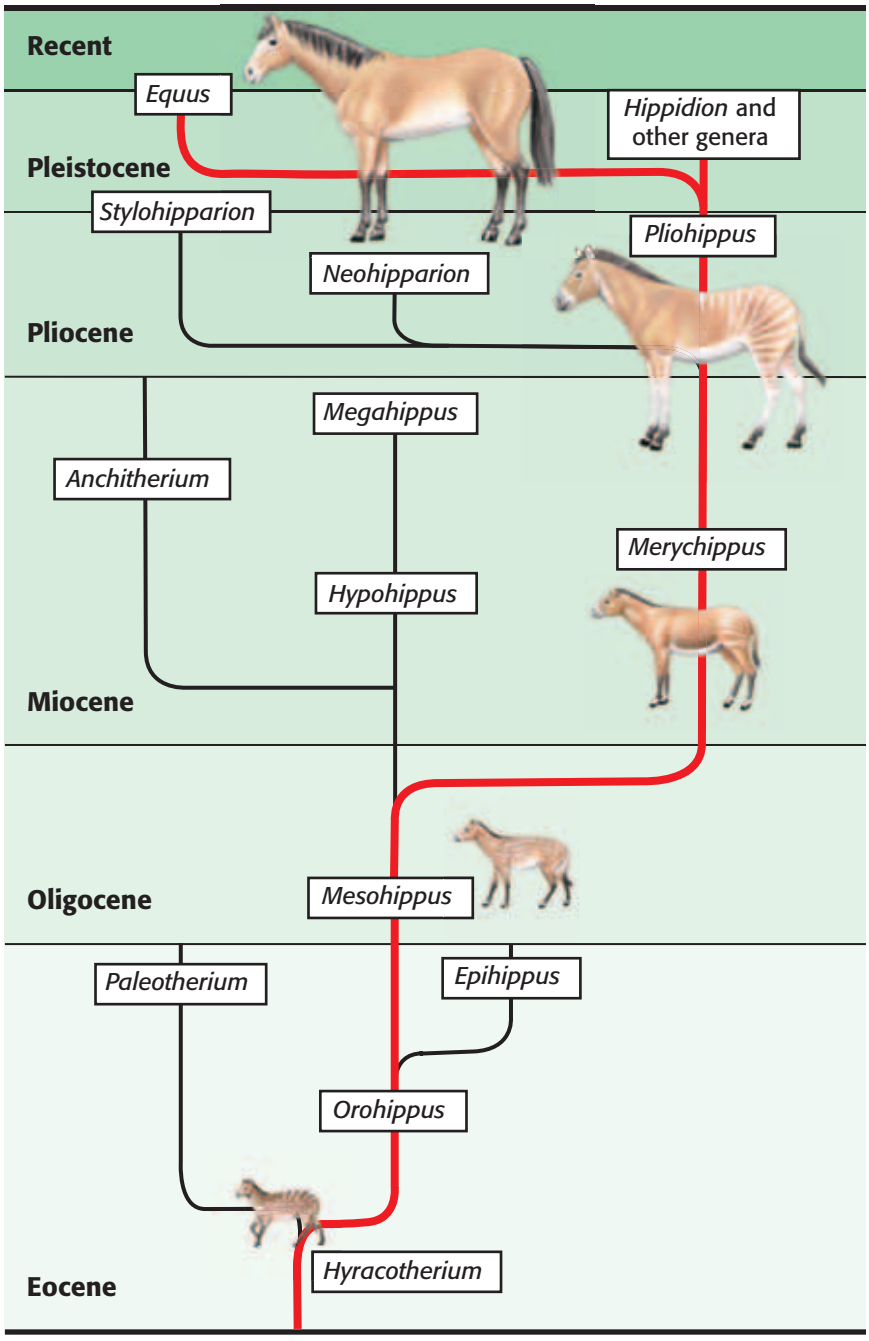


Figure 5 *This branching diagram shows the modern horse, and other related genera. The diagram also shows how these genera have probably evolved from currently extinct genera through the epochs of the Cenozoic era.* ***List all the genera that evolved from the genus* Mesohippus, *according to this diagram.***

SCHOOL to HOME

A Changing Classification System

Scientists are still discovering and classifying new organisms. What happens when newly discovered organisms do not fit into any existing groups? Use the Internet to find out about *Symbion pandora* (SIM bee ahn pan DAWR uh). When was *S. pandora* discovered? How did scientists fit this organism into the current system of classification? Write a paragraph on your findings in your **Science Journal.**

ACTIVITY

Fossils and Branching Diagrams

Branching diagrams that include fossils of extinct organisms show when the extinct organisms evolved and when those organisms became extinct. For example, as **Figure 5** shows that the members of the genus *Neohipparion* appeared near the beginning of the Pliocene Epoch and became extinct near the end of the Pliocene Epoch. In some cases, extinct organisms are on a branch that is on a direct line to other organisms. For example, the genus *Mesohippus* appeared in the Oligocene Epoch and is on a direct line to the genera *Hypohippus* and *Merychippus*.

Standards Check **How are fossils of extinct organisms included in branching diagrams?** 7.3.d

SECTION Review

7.3.d

Summary

- Classification groups organisms based on their shared derived characteristics.
- Classification is a tool that helps us understand the relationships between organisms.
- The are eight levels of classification.
- The scientific name of an organism has two parts.
- Branching diagrams show evolutionary relationships between extinct and living organisms.

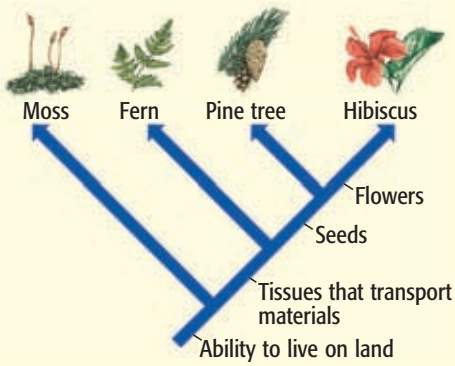
Using Vocabulary

1. Write an original definition for *classification* and *taxonomy.*

Understanding Concepts

2. **Analyzing** Why do scientists use scientific names for organisms?
3. **Listing** What are the eight levels of classification?

INTERPRETING GRAPHICS Use the branching diagram below to answer the next two questions.



4. **Identifying** Which kind of organism evolved earliest? Which kind of organism evolved most recently?
5. **Inferring** Which organisms have tissues that transport materials?

Critical Thinking

6. **Analyzing Processes** You have found a fossil of an organism. The organism has characteristics that have never been described. What would you have to do to identify this fossil?
7. **Making Inferences** What is the difference between organisms that share many derived characteristics and organisms that do not?
8. **Applying Concepts** There is an organism halfway up a branch in a branching diagram, and a different organism at the tip of the branch. What can you infer about these organisms?
9. **Making Inferences** In branching diagrams, what can you infer about the organisms at the tips of the branches that do not reach the tops of the diagrams?

Internet Resources

For a variety of links related to this chapter, go to www.scilinks.org

Topic: Basis for Classification; Levels of Classification

SciLinks code: HY70138; HY70870