

# 7.2

## KEY CONCEPT

# Biologists use seven levels of classification.



### BEFORE, you learned

- Classification is a system of organization
- Evidence is used to classify organisms



### NOW, you will learn

- About scientific names
- About seven levels of classification
- How to use a dichotomous key

## VOCABULARY

genus p. 212

binomial nomenclature

p. 212

dichotomous key p. 216

## EXPLORE Classification

### What data do you need to identify objects?

#### PROCEDURE

- 1 Have one student in your group think of a secret object. The student should then tell the group one characteristic (shape, color, size, type, and so on) of that object.
- 2 The rest of the group guesses the object's identity. Each time someone guesses incorrectly, another characteristic of the object should be given. Record the characteristics and guesses as you go.
- 3 When the secret object is guessed correctly, begin again with a different student picking a different secret object.

#### WHAT DO YOU THINK?

- How many characteristics did it usually take to guess an object's identity?
- How does this exercise relate to identifying organisms?

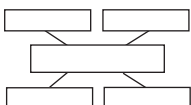


## Linnaeus named about 4000 species.

Scientists name species and arrange them into groups. One scientist named Carolus Linnaeus developed systems for both naming species and organizing them into groups. All 4000 species that Linnaeus named were plants or animals. Today, scientists have named over a million species. Linnaeus used appearance to group species. As you have read, modern scientists also use appearance, along with other types of evidence, to arrange species into groups.

### SUPPORTING MAIN IDEAS

Make a chart to show information that supports the first main idea presented: *Linnaeus named about 4000 species.*



## Naming Species

Sometimes using only one word to name an organism isn't specific enough. If you are telling a friend about your favorite writer, you might name Mary Oliver or Mary Whitebird or Mary Shelley. Using only "Mary" won't help your friend know the author you name, so you use two words. In a similar way, scientists use two words to name organisms.

A **genus** (JEE-nuhs) is a group of species that have similar characteristics. For example, the genus *Ursus* groups all of the animals known as bears. Included in this genus are *Ursus arctos* (grizzly bears), and *Ursus maritimus* (polar bears). Members of the same genus are closely related.

The system for naming species developed by Linnaeus is the basis of modern taxonomy. We call this system **binomial nomenclature** (by-NOH-mee-uhl NOH-muhn-KLAY-chuhr). *Binomial* means "two names" and *nomenclature* means "list of names." So binomial nomenclature describes a system of naming something using two names, or words. Most scientific names are Latin terms.

## INVESTIGATE Binomial Nomenclature

### How do you assign names?

#### PROCEDURE

- 1 Place ten objects on a table where everybody in the class can see them.
- 2 Give each object a genus name. Use a dictionary to come up with names that sound scientific. You may use only three genus names for the ten objects, so some names must apply to more than one objects.
- 3 Give each object a species name, using the dictionary again if you wish.
- 4 Write each object's full scientific name on an index card.
- 5 Trade your index cards with those of another group. Try to match their cards with the ten objects.

#### WHAT DO YOU THINK?

- How did the other group arrange the objects into genus names? How was their arrangement different from your group's?
- Why is it important for the names to be as descriptive as possible?

**CHALLENGE** Repeat the exercise, but now give each object a one-word name. Does this limitation make coming up with names easier or harder?

#### SKILL FOCUS

Classifying

#### MATERIALS

- objects
- dictionary
- 10 index cards

**TIME**  
30 minutes



## Binomial Nomenclature

All organisms are given a unique two-part name. Some organisms have the same species names: *gracilis* means “slender” or “graceful.” Without the genus name, the species name is unclear.



*Aubrieta gracilis*  
(false rockcress)



*Chameleo gracilis*  
(gracile chameleon)



*Mammillaria gracilis*  
(thimble cactus)

## Using Scientific Names

Linnaeus’s system of binomial nomenclature made communication about certain species much easier. When naming an organism, the use of a genus name as well as a species name is necessary.

If the genus name is not included in the scientific name, the identity of a species can be a mystery. For example, the species name of the three different species shown above is *gracilis*. The word *gracilis* means “graceful” or “slender” in Latin.

- *Aubrieta gracilis* is a type of flower found in a rock garden.
- *Chameleo gracilis* is a type of lizard called a chameleon.
- *Mammillaria gracilis* is a type of cactus.

People follow certain rules when they write scientific names. The genus name comes first; the first letter is capitalized and the entire name is in italics. The species name is also written in italics, it follows the genus name, and the first letter is lowercased.



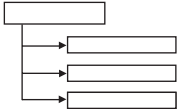
What is the difference between a genus and a species?

In addition to species and genus, the classification system includes several larger groups. Each larger group includes one or more smaller groups. Turn to page 214 to read about the larger groups in our modern system of classification.

## Organisms can be classified into seven levels.

### SUPPORTING MAIN IDEAS

Make a chart to show information that supports the main idea that *organisms can be classified into seven levels*.



### READING TIP

*Phyla* is the plural form of *phylum*.

You've read about species and genus, the most specific levels of the classification system most scientists use today. There are seven levels that describe a species. The largest level is the kingdom, the group containing the most species. The seven levels of classification for a spotted turtle and a housecat are listed below.

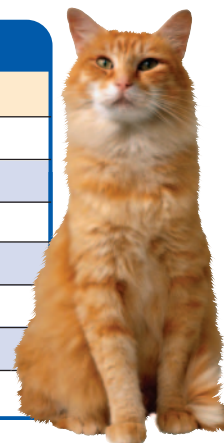
- 1 Kingdom (Animalia—the animals)
- 2 Phylum (Chordata—animals with backbones)
- 3 Class (Mammalia—mammals, or furry animals that nurse their young)
- 4 Order (Carnivora—carnivores, or animals that kill and eat other animals)
- 5 Family (Felidae—the cat family)
- 6 Genus (*Felis*—housecats, cougars, and many others)
- 7 Species (*catus*—all housecats, no matter what their breed)

Like the cat, the turtle is also classified into seven levels. However, only the two largest levels, Animalia and Chordata, are the same as the classification for a housecat. The more names an organism shares with another organism, the more closely related the two organisms are. Cats and turtles are both animals with backbones, but are otherwise different. Spotted turtles have more traits in common with snakes and lizards than with cats. Lizards, snakes, and turtles all belong in the class Reptilia. Phyla are more specific than kingdoms, classes are more specific than phyla, and so on. The illustration on page 215 shows how kingdom is the broadest grouping of organisms, and species is the most specific.

*Clemmys guttata*



Classification Hierarchy		
	Spotted turtle	Cat
Kingdom	Animalia	Animalia
Phylum	Chordata	Chordata
Class	Reptilia	Mammalia
Order	Testudines	Carnivora
Family	Emydidae	Felidae
Genus	<i>Clemmys</i>	<i>Felis</i>
Species	<i>guttata</i>	<i>catus</i>



*Felis catus*



## Classifying Organisms

Moving from kingdom to species, each level includes a smaller set of organisms.

**1 Kingdom**

Animalia:  
Animals



**2 Phylum**

Chordata:  
With backbone or  
similar structure



**3 Class**

Reptilia:  
Reptiles



**4 Order**

Testudines:  
Turtles



**5 Family**

Emydidae:  
Water turtles



**6 Genus**

*Clemmys*:  
North American  
pond turtles



**7 Species**

*guttata*:  
Spotted turtle



Spotted turtle  
*Clemmys guttata*



Scientists can compare very broad categories of organisms, such as kingdoms and phyla. Or they can compare very specific categories, such as species. If scientists wish to compare all the different types of turtles to one another, then they will compare the organisms in the order Testudines. But if scientists want to compare turtles that live in or near water, then they will compare only organisms in the family Emydidae.

You can remember the classification levels and their order with this memory aid: Kings Play Chess On Fat Green Stools. The first letter of each word is the same as the first letter in each level of classification: *kingdom*, *phylum*, *class*, *order*, *family*, *genus*, and *species*. A complete classification of humans goes like this: kingdom Animalia, phylum Chordata, class Mammalia, order Primates, family Hominidae, genus *Homo*, species *sapiens*.



Which level of classification in the seven-level system includes the most species?

## Dichotomous keys and field guides help people identify organisms.

With millions of organisms on Earth, how could a specific one be identified? Even if you know some of the larger categories, it can be difficult to find the species, genus, or even family name of many organisms from a long list of possibilities.

Take a beetle, for example. Even if you knew that it is in the kingdom Animalia, phylum Arthropoda (animals with jointed legs), class Insecta (insects), and order Coleoptera (hard-winged insects), you'd still have to choose among 300,000 known species of beetles that have been discovered around the world.

Taxonomists have come up with a tool to identify organisms such as this beetle. A **dichotomous key** (dy-KAHT-uh-muhs) asks a series of questions that can be answered in only two ways. Your answer to each question leads you to another question with only two choices. After a number of such questions, you will identify the organism. One example of a dichotomous key for trees is shown on page 217.

The questions in a dichotomous key gradually narrow down the list of possible organisms. The questions can ask about any trait. The idea is simply to make identifying an organism as easy as possible. The dichotomous key for trees, for example, asks a set of questions that only ask about the traits of the leaves. Leaves are usually easy to get from a tree that needs to be identified, and they include many characteristics that can be used to tell different trees apart.

### READING TIP

The prefix *di-* means "two."

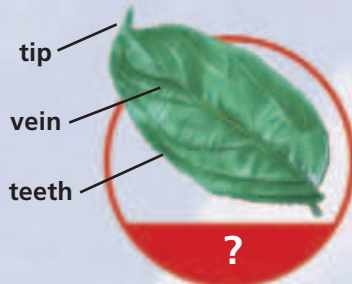


Use an interactive dichotomous key.



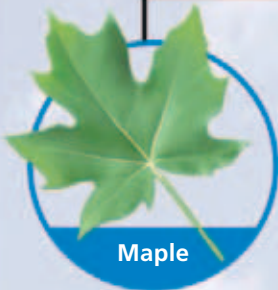
## Dichotomous Key

Use the dichotomous key below to discover on what tree the circled leaf is found.



☐ Leaf has three or more main veins

☒ Leaf has single main vein



☐ Leaf has no teeth, no lobes

☒ Leaf has teeth or lobes

☐ Leaf is somewhat lobed

☒ Leaf is not lobed



☐ Leaf has veins that end in teeth

☒ Leaf has more teeth than side veins



☐ Leaf has a bristle on its tip

☐ Leaf has no bristle



☐ Leaf tapers at both ends

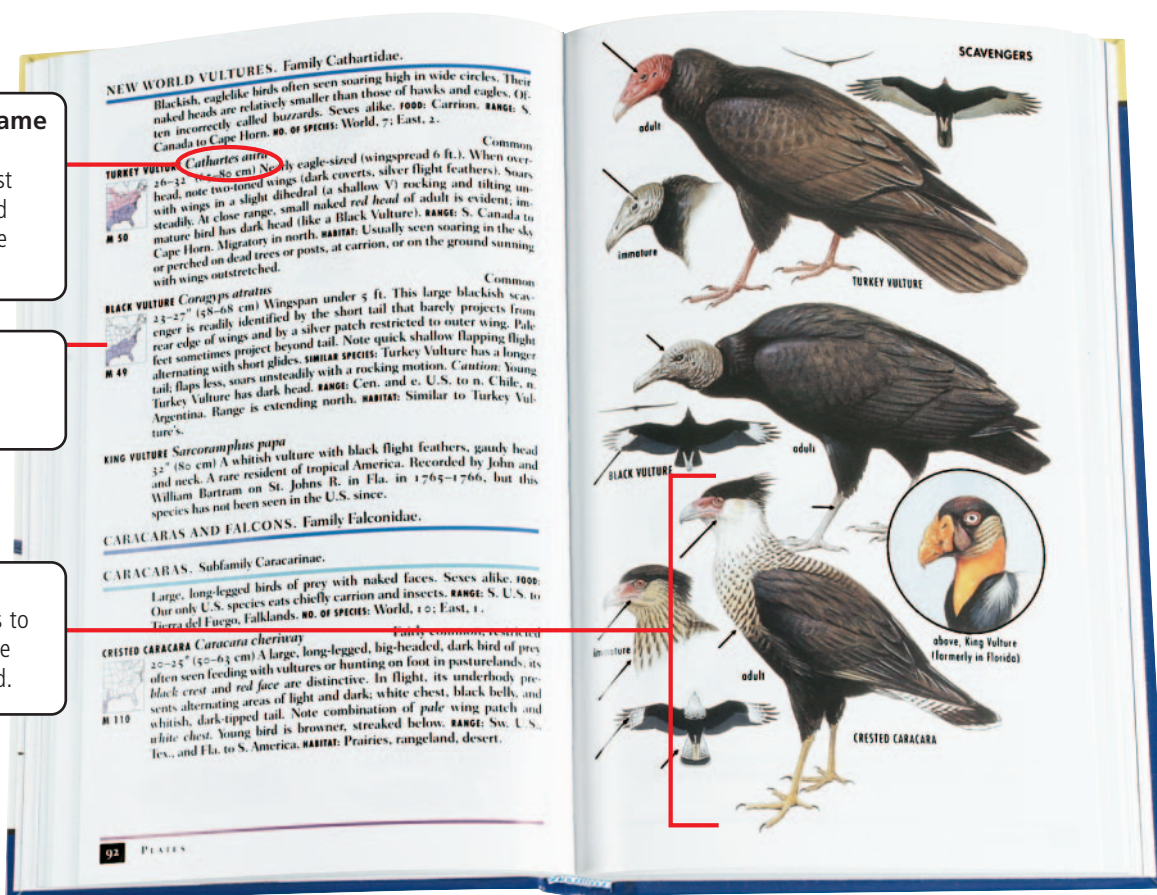
☐ Leaf is heart shaped



A bird's **scientific name** is shown next to its common name. The first name is the genus, and the second name is the species.

**Range maps** show where a bird can be found in each season.

**Body shape and body size** give clues to determining if you have identified the right bird.



Another tool for identifying organisms is a field guide. Field guides include paintings or photographs of familiar species. Flower guides may start with the flower's color. Bird guides are arranged by orders and families. Field guides also include maps showing where organisms live.



**CHECK YOUR  
READING**

What two tools have taxonomists developed to identify organisms?

## 7.2 Review

### KEY CONCEPTS

1. What is binomial nomenclature?
2. Write the names of the seven levels of classification. Which level contains the most organisms?
3. What makes a dichotomous key easy to use?

### CRITICAL THINKING

4. **Summarize** What were Carolus Linnaeus's main contributions to taxonomy?
5. **Compare and Contrast** Compare a dichotomous key with a typical field guide. What are the strengths and weaknesses of each?

### CHALLENGE

6. **Synthesize** Predict what differences you might find among organisms in the same species.