Section 2

Classifying Organisms

Objectives

After completing the lesson, students will be able to

A.1.2.1 Explain why biologists classify organisms.

A.1.2.2 Relate the levels of classification to the relationships between organisms.

A.1.2.3 Explain how taxonomic keys are useful.

A.1.2.4 Explain the relationship between classification and evolution.

Target Reading Skill

Asking Questions Explain that changing a head into a question helps students anticipate the ideas, facts, and events they are about to read.

Answers

Possible questions and answers include: **Why do scientists classify?** *(Scientists classify because they want to organize living things into groups so they are easier to study.)* **What system did Linnaeus use to name organisms?** *(He used a system called binomial nomenclature.)* **What are the levels of classification?** *(Domain, kingdom, phylum, class, order, family, genus, species)*

All in One Teaching Resources

- Transparency A4

Preteach

Build Background Knowledge

L2

How Libraries Are Organized

Ask: **How do libraries organize their books?** *(First by whether they are fiction or nonfiction, then by subject matter, then in alphabetical order by author's last name, first name, and finally title)* Discuss with students how difficult it would be to find a book in the library without an organizing system.

Section 2

Classifying Organisms

Reading Preview

Key Concepts

- Why do biologists organize living things into groups?
- What do the levels of classification indicate about the relationship between organisms?
- How are taxonomic keys useful?
- What is the relationship between classification and evolution?

Key Terms

- classification
- taxonomy
- binomial nomenclature
- genus
- species
- evolution

Target Reading Skill

Asking Questions Before you read, preview the red headings. In a graphic organizer like the one below, ask a *what*, *why*, or *how* question for each heading. As you read, write the answers to your questions.

Classifying Organisms

Question	Answer
Why do scientists classify?	Scientists classify because . . .

Lab zone Discover Activity

Can You Organize a Junk Drawer?

1. Your teacher will give you some items that you might find in the junk drawer of a desk. Your job is to organize the items.
2. Examine the objects and decide on three groups into which you can sort them.
3. Place each object into one of the groups, based on how the item's features match the characteristics of the group.
4. Compare your grouping system with those of your classmates.

Think It Over

Classifying Which of your classmates' grouping systems seemed most useful? Why?

Suppose you had only ten minutes to run into a supermarket to get what you needed—milk and tomatoes. Could you do it? In most supermarkets this would be an easy task. You'd probably find out where the dairy and produce sections are, and head straight to those areas. Now imagine if you had to shop for these same items in a market where things were randomly placed throughout the store. Where would you begin? You'd have to search through a lot of things before you found what you needed. You could be there for a long time!

FIGURE 9
Classifying Vegetables
Vegetables in the produce section of a supermarket are neatly organized.

Lab zone Discover Activity

Skills Focus Classifying

L1

Materials items such as envelopes, erasers, paper, paper clips, pencils, rubber bands, stamps, tape

Time 15 minutes

Tips Avoid using sharp objects. Stress that items in a set must share at least one common trait.

Expected Outcome Students may group the items in a number of ways, such as by function (items you write with) or by shape (round).

Think It Over Each grouping system will have strengths and weaknesses. Criteria for usefulness will vary. Possibilities include systems that emphasize similar functions or that allow objects to be found quickly.

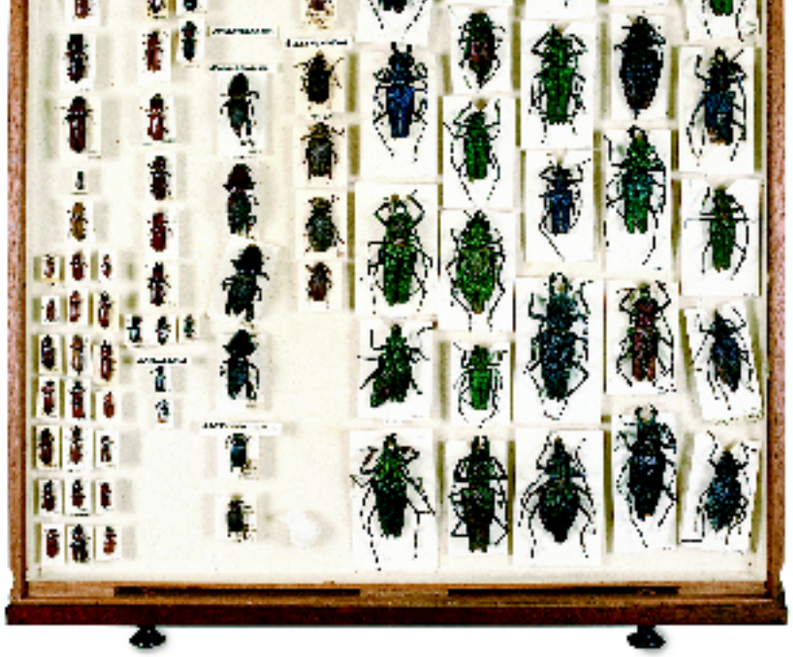


FIGURE 10
Classifying Beetles
These beetles belong to a large insect collection in a natural history museum. They have been classified according to characteristics they share. **Observing** *What characteristics may have been used to group these beetles?*

Why Do Scientists Classify?

Just as shopping can be a problem in a disorganized store, finding information about a specific organism can also be a problem. So far, scientists have identified more than one million kinds of organisms on Earth. That's a large number, and it is continually growing as scientists discover new organisms. Imagine how difficult it would be to find information about one particular organism if you had no idea even where to begin. It would be a lot easier if similar organisms were placed into groups.

Organizing living things into groups is exactly what biologists have done. Biologists group organisms based on similarities, just as grocers group milk with dairy products and tomatoes with produce. **Classification** is the process of grouping things based on their similarities.

Biologists use classification to organize living things into groups so that the organisms are easier to study. The scientific study of how living things are classified is called **taxonomy** (tak SAHN uh mee). Taxonomy is useful because once an organism is classified, a scientist knows a lot about that organism. For example, if you know that a crow is classified as a bird, then you know that a crow has wings, feathers, and a beak.

Reading Checkpoint **What is the scientific study of how living things are classified called?**

Differentiated Instruction

Special Needs L2

Classifying Help students understand the concept of classification by discussing classification of rocks. Give students samples of igneous, metamorphic, and sedimentary rocks. Display a sample of each rock type in front of a labeled box. Ask students to classify their rock samples. **learning modality: kinesthetic**

Instruct

Why Do Scientists Classify?

Teach Key Concepts L2

Organisms Are Organized into Groups

Focus Tell students that like organisms are grouped together. This makes it easier to study them.

Teach Write *kaz* on the board. Tell students this organism is a fish. Ask students to list what they know about *kaz* based on its classification.

Apply Ask: **How might you classify a sunflower, a robin, a lizard, a blue jay, and a tree?** *(Possible answers: sunflower and tree as plants; robin, lizard, and blue jay as animals; robin and blue jay as birds)* **learning modality: logical/mathematical**

Independent Practice L2

All in One Teaching Resources

- Guided Reading and Study Worksheet: *Classifying Organisms*

Student Edition on Audio CD

Living Things

Show the Video Field Trip to help students understand the classification of organisms. Discussion question: **What is the broadest level of classification?** *(Domain)*

Monitor Progress L2

Writing Have students describe the difference between classification and taxonomy.

Answer

Reading Checkpoint Taxonomy

The Naming System of Linnaeus

Teach Key Concepts L2

Scientific Names Have Two Parts

Focus Write these scientific names on the board: *Perognathus californicus, Perognathus nelsoni, Perognathus spinatus*.

Teach Explain that these animals are North American field pocket mice. Ask: **What genus/genera do these animals belong to?** *(Perognathus)* **What are the species of these mice?** *(Perognathus californicus, Perognathus nelsoni, and Perognathus spinatus)* Stress to students that both terms of the scientific name must be used to indicate an organism's species. The first term, the genus, can be used alone, while the second term (known as the specific epithet) cannot.

Extend Challenge students to see how much information they can infer about these animals from their names. *(Possible answers: They are different species, but all belong to the same genus. Mating among them would not produce fertile offspring. Students might infer that* P. nelsoni *was discovered by someone named Nelson,* P. californicus *is found in California, and* P. spinatus *has prickly fur.)* **learning modality: verbal**

Help Students Read L2

Analyze the Parts of Binomial

Word Part Analysis/Build Vocabulary

Write the term *binomial nomenclature* on the board. Tell students that *bi-* means "two" and *nomen* means "name." Ask: **What does the term *binomial* mean?** *(Two names)*

The Naming System of Linnaeus

Taxonomy also involves naming organisms. In the 1750s, the Swedish naturalist Carolus Linnaeus devised a system of naming organisms that is still used today. Linnaeus placed organisms in groups based on their observable features. Based on his observations, Linnaeus gave each organism a unique, two-part scientific name. This naming system Linnaeus used is called **binomial nomenclature** (by NOH mee ul NOH men klay chur). The word *binomial* means "two names."

Genus and Species The first word in an organism's scientific name is its genus. A **genus** (JEE nus) (plural *genera*) is a classification grouping that contains similar, closely related organisms. For example, pumas, marbled cats, and house cats are all classified in the genus *Felis*. Organisms that are classified in the genus *Felis* share characteristics such as sharp, retractable claws and behaviors such as hunting other animals.

The second word in a scientific name often describes a distinctive feature of an organism, such as where it lives or its appearance. Together, the two words indicate a unique species. A **species** (SPEE sheez) is a group of similar organisms that can mate with each other and produce offspring that can also mate and reproduce.

FIGURE 11

Binomial Nomenclature

These three different species of cats belong to the same genus. Their scientific names share the same first word, *Felis*. The second word of their names describes a feature of the animal.

Felis concolor
(Puma)
Concolor means "the same color" in Latin. Notice that this animal's coat is mostly the same color.

Felis marmorata
(Marbled cat)
Notice the marbled pattern of this animal's coat. *Marmorata* means "marble" in Latin.

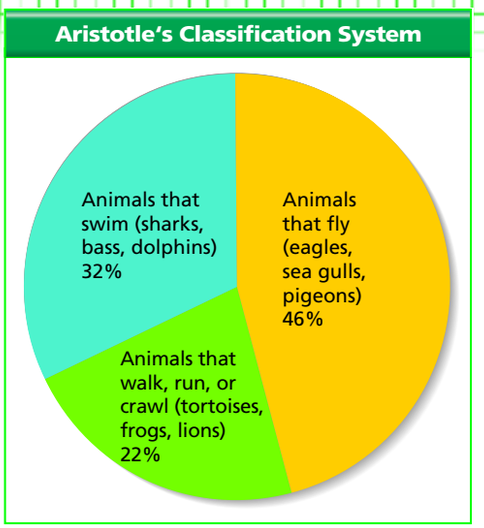
Felis domesticus
(House cat)
Domesticus means "of the house" in Latin.

Math Analyzing Data

Aristotle and Classification

Many hundreds of years before Linnaeus, a Greek scholar named Aristotle developed a classification system for animals. Aristotle first divided animals into those he considered to have blood and those he did not. This graph shows Aristotle's classification system for "animals with blood."

1. **Reading Graphs** Into how many groups were these animals classified?
2. **Interpreting Data** Which group made up the largest percentage of animals?
3. **Calculating** What percentage of these animals either fly or swim?
4. **Inferring** In Aristotle's classification system, where would a cow be classified? A whale?
5. **Predicting** Would Aristotle's classification system be useful today? Explain.



Using Binomial Nomenclature Notice in Figure 11 that a complete scientific name is written in italics. Only the first letter of the first word in a scientific name is capitalized. Notice also that scientific names contain Latin words. Linnaeus used Latin words in his naming system because Latin was the language that scientists used during that time.

Binomial nomenclature makes it easy for scientists to communicate about an organism because everyone uses the same scientific name for the same organism. Using different names for the same organism can get very confusing. For instance, look at the animal in Figure 12. People call it by a variety of names. Depending on where you live, you might call this animal a woodchuck, groundhog, or whistlepig. Fortunately, it has only one scientific name—*Marmota monax*.

Reading Checkpoint **How is a scientific name written?**

FIGURE 12
Marmota monax
Although there are many common names for this animal, it has only one scientific name, *Marmota monax*.
Making Generalizations *What is the advantage of scientific names?*

Differentiated Instruction

Less Proficient Readers L1
Communicating Have students use sketches, photographs, and short captions to create a visual display that compares common names and scientific names. Students can stick to the general concept or use a specific example. A specific example would be a pill bug/wood louse/roly poly/*Porcellio scaber*. **learning modality: visual**

Math Analyzing Data

Math Skill Interpreting graphs

Focus Tell students that circle graphs show how the parts of a whole are related.

Teach Ask: **What does the whole circle represent?** *(All of the animals with blood classified by Aristotle's system)* **What does each wedge represent?** *(A smaller group of animals)*

Answers
1. 3
2. animals that fly
3. 78%
4. cow—animals that walk, run, or crawl; whale—animals that swim
5. Possible answer: This system includes only three categories, so it may not be very useful today. It also does not match that of modern scientists, who use characteristics other than movement to classify animals. For example, frogs and lions belong to very different groups.

Monitor Progress L2

Skills Check Have each student choose one living thing and explain how he or she knows it is alive.

Students can save their drawings in their portfolios. Portfolio

Answers
Figure 12 Using scientific names makes it easy for scientists to communicate about organisms because everyone uses the same name for the same organism.

Reading Checkpoint In italics

Levels of Classification

Teach Key Concepts L2

Organisms Are Grouped into General and Specific Groups

Focus Draw a series of eight concentric circles on the board. Label the outermost circle "Domain." Label the innermost circle "Species."

Teach Correlate the remaining circles with their corresponding classification level. Point out that the broadest group is the domain. Ask: **Which is the most specific group?** *(Species)*

Extend Ask: **Which animals will share the same innermost circle?** *(Only those of the same species)* **Which animals will share the circle around the species circle?** *(Those of the same genus)* **Which animals will share the same kingdom circle?** *(All animals)* **learning modality: logical/mathematical**

All in One Teaching Resources

- Transparency A5

Lab zone Skills Activity

Observing

Test your observational skills using Figure 13. Look carefully at the organisms pictured together at the kingdom level. Make a list of the characteristics that the organisms share. Then make two more lists of shared characteristics—one for the organisms at the class level and the other for those at the genus level. How does the number of shared characteristics on your lists change at each level?

Levels of Classification

The classification system that scientists use today is based on the contributions of Linnaeus. But today's classification system uses a series of many levels to classify organisms.

To help you understand the levels in classification, imagine a room filled with everybody who lives in your state. First, all of the people who live in your town raise their hands. Then, those who live in your neighborhood raise their hands. Then, those who live on your street raise their hands. Finally, those who live in your house raise their hands. Each time, fewer people raise their hands. But you'd be in all of the groups. The most general group you belong to is the state. The most specific group is the house. The more levels you share with others, the more you have in common with them.

The Major Levels of Classification Most biologists today classify organisms into the levels shown in Figure 13. Of course, organisms are not grouped by where they live, but rather by their shared characteristics. First, an organism is placed in a broad group, which in turn is divided into more specific groups.

As Figure 13 shows, a domain is the highest level of organization. Within a domain, there are kingdoms. Within kingdoms, there are phyla (FY luh) (singular *phylum*). Within phyla are classes. Within classes are orders. Within orders are families. Each family contains one or more genera. Finally, each genus contains one or more species. **The more classification levels that two organisms share, the more characteristics they have in common.**

Classifying an Owl Take a closer look at Figure 13 to see how the levels of classification apply to the great horned owl. Look at the top row of the figure. As you can see, a wide variety of other organisms also belong to the same domain as the horned owl.

Next, look at the kingdom, phylum, class, and order levels. Notice that as you move down the levels in the figure, there are fewer kinds of organisms in each group. More importantly, the organisms in each group have more in common with each other. For example, the class Aves includes all birds, while the order Strigiformes includes only owls. Different owls have more in common with each other than they do with other types of birds.

Reading Checkpoint **Which is a broader classification level—a kingdom or a family?**

Lab zone Skills Activity

Skills Focus Observing L2

Time 10 minutes

Tips At the kingdom level, ask: **Are these animals unicellular or multicellular?** *(multicellular)* **Autotrophs or heterotrophs?** *(heterotrophs)* For the class and genus levels, point out that structural adaptations for movement and obtaining food can be used in classification. If students need more help, question them about adaptations that help birds fly, eat, perch.

Expected Outcome The closer to the species level, the longer the list of shared characteristics. *(Kingdom: multicellular heterotrophs; Class: multicellular heterotrophs with wings, feathers, a beak, feet that grip; Genus: similar body shape, tufts of feathers, hooked beak, flat, round face, forward facing eyes, talons)*

Extend Challenge students to describe some shared characteristics of humans. *(Possible answers: multicellular heterotroph, walks on two legs, has hair, opposable thumb, stands upright)* **learning modality: visual**

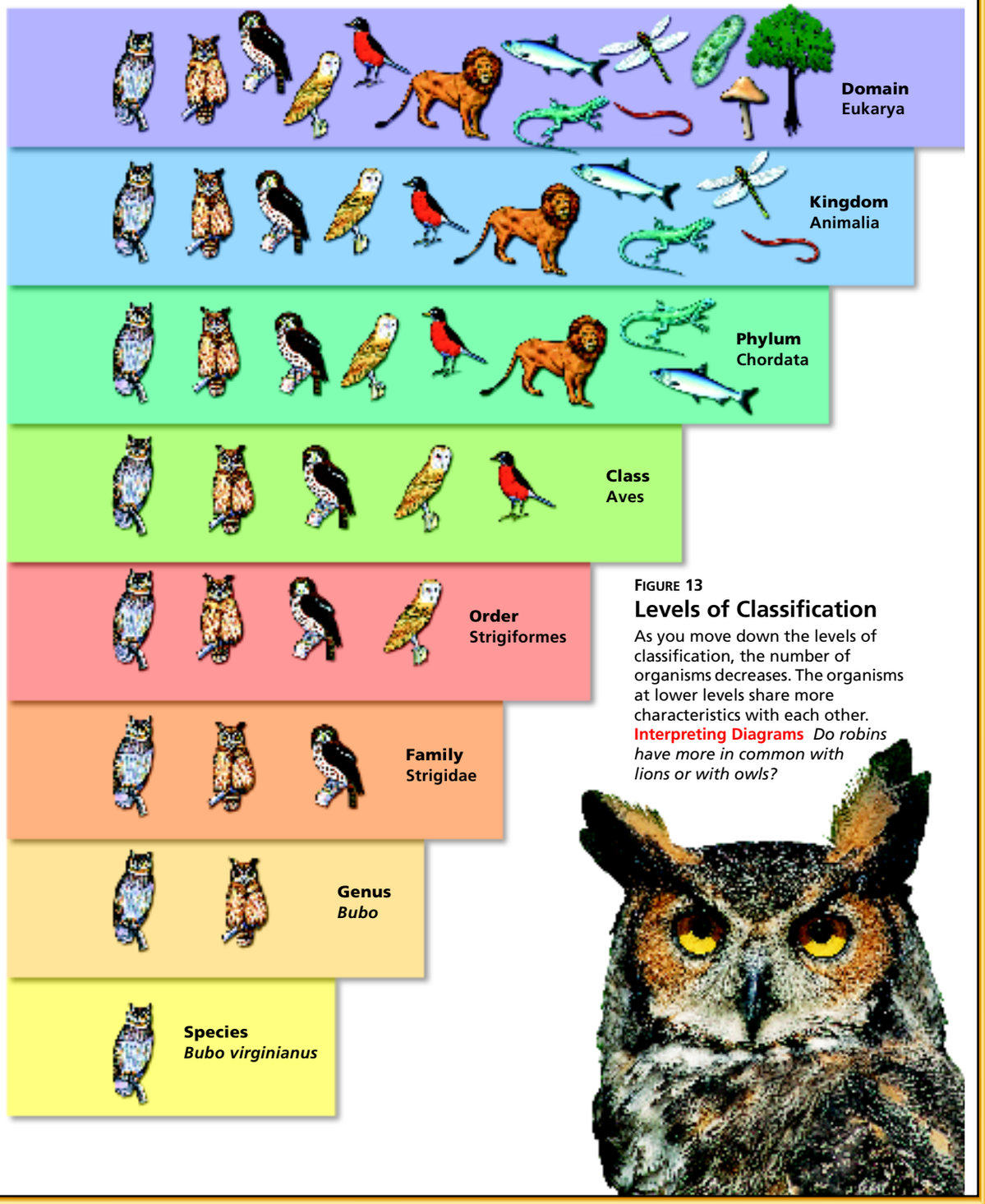


FIGURE 13

Levels of Classification

As you move down the levels of classification, the number of organisms decreases. The organisms at lower levels share more characteristics with each other. **Interpreting Diagrams** *Do robins have more in common with lions or with owls?*

Lab zone **Build Inquiry** L3

Make a Classification Chart

Materials colored pencils; dictionary; glue; list of class, order, and family of common pets; nature magazines; pen; poster board or heavyweight paper; ruler

Time 50 minutes

Focus Tell students to find the level in Figure 13 that would include a specific pet. Ask: **Which levels of Figure 13 would include a house cat?** *(Domain Eukarya; Kingdom Animalia; Phylum Chordata)*

Teach Direct students to create a model classification chart for a pet. Help students find the scientific name of their pet and determine its genus and species.

Apply Ask students how many classification levels the Magellan horned owl, *Bubo magellanicus* shares with *Bubo virginianus.* *(Seven)* **learning modality: visual**

Monitor Progress L2

Skills Check Ask students to explain which classification level will always have the most different kinds of organisms and which level will always have the fewest different kinds of organisms. *(Domain, species; because domains include some kingdoms, many phyla, classes, orders, families, genera, and species, while a species includes only one specific kind of organism)*

Answers

Figure 13 *Owls; robins and owls are birds, and so robins share many more levels of classification with owls than they do with lions.*

Reading Checkpoint Kingdom

Taxonomic Keys

Teach Key Concepts L2

How to Identify Organisms

Focus Show students a photo of a tick. Ask: **What is this organism called?**

Teach Show students how to read the taxonomic key in Figure 14. Point out that each step contains two statements. Find the statement that is true for the organism you are looking up and then follow the instructions.

Extend Show students examples of field guides. Ask students to find examples of organisms that look similar. **learning modality: visual**

Use Visuals: Figure 14 L2

Identifying Organisms

Focus Ask: **Which animals can you identify using the key?** *(Centipede, millipede, mite, tick, spider, scorpion, pseudoscorpion)*

Teach Have students draw a picture of each organism in the key then compare drawings.

Apply Ask: **What other information did you need to make the drawings?** *(Possible answers: organisms' color, kind of legs, location of eyes)* Ask: **Are these characteristics necessary in the key?** *(No, but a key that compares different animals might need this information.)* **learning modality: visual**

All in One Teaching Resources

- Transparency A6

Go Online PHSchool.com

For: More on classifying living things
Visit: PHSchool.com
Web Code: ced-1012

Taxonomic Keys

Why should you care about taxonomy? Suppose that you are watching television and feel something tickling your foot. Startled, you look down and see a tiny creature crawling across your toes. Although it's only the size of a small melon seed, you don't like the looks of its two claws waving at you. Then, in a flash, it's gone.

How could you find out what the creature was? You could use a field guide. Field guides are books with illustrations that highlight differences between similar-looking organisms. You could also use a taxonomic key. **Taxonomic keys are useful tools for determining the identity of organisms.** A taxonomic key consists of a series of paired statements that describe the physical characteristics of different organisms.

The taxonomic key in Figure 14 can help you identify the mysterious organism. To use the key, start by reading the pair of statements numbered 1a and 1b. Notice that the two statements are contrasting. Choose the one statement that applies to the organism. Follow the direction at the end of that statement. For example, if the organism has eight legs, follow the direction at the end of statement 1a, which says "Go to Step 2." Continue this process until the key leads you to the organism's identity.

Reading Checkpoint **What are field guides?**

FIGURE 14
Identifying Organisms
You can use a taxonomic key to identify this organism. The six paired statements in this key describe physical characteristics of different organisms.
Drawing Conclusions *What is this creature?*

Taxonomic Key

Step 1	**1a.**	Has 8 legs	Go to Step 2.
	1b.	Has more than 8 legs	Go to Step 3.
Step 2	**2a.**	Has one oval-shaped body region	Go to Step 4.
	2b.	Has two body regions	Go to Step 5.
Step 3	**3a.**	Has one pair of legs on each body segment	Centipede
	3b.	Has two pairs of legs on each body segment	Millipede
Step 4	**4a.**	Is less than 1 millimeter long	Mite
	4b.	Is more than 1 millimeter long	Tick
Step 5	**5a.**	Has clawlike pincers	Go to Step 6.
	5b.	Has no clawlike pincers	Spider
Step 6	**6a.**	Has a long tail with a stinger	Scorpion
	6b.	Has no tail or stinger	Pseudoscorpion

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Students can review classifying in an online interactivity.

Evolution and Classification

At the time that Linnaeus developed his classification system, people thought that species never change. In 1859, a British naturalist named Charles Darwin published a theory about how species can change over time. Darwin's theory has had a major impact on how species are classified.

Darwin's Theory Darwin collected data for his theory on the Galapagos Islands off the western coast of South America. As he studied the islands' finches, he observed that some species of finches were similar to each other but different from finches living in South America.

Darwin hypothesized that some members of a single species of finch flew from South America to the islands. Once on the islands, the species changed little by little over many generations until it was different from the species remaining in South America. After a while, the birds on the island could no longer mate and reproduce with those on the mainland. They had become a new species. In this way, two groups of a single species can accumulate enough differences over a very long time to become two separate species. This process by which species gradually change over time is called **evolution.**

Classification Today The theory of evolution has changed the way biologists think about classification. Scientists now understand that certain organisms are similar because they share a common ancestor. For example, Darwin hypothesized that the finches on the Galapagos Islands shared a common ancestor with the finches in South America. When organisms share a common ancestor, they share an evolutionary history. Today's system of classification considers the history of a species. **Species with similar evolutionary histories are classified more closely together.**

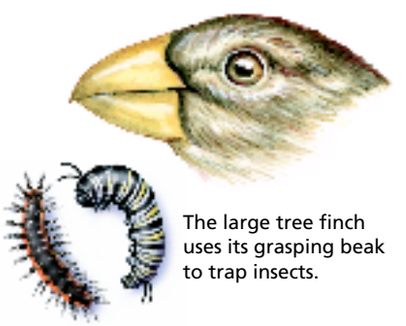
Determining Evolutionary History How do scientists determine the evolutionary history of a species? One way is to compare the structure of organisms. But today, scientists rely primarily on information about the chemical makeup of the organisms' cells. The more closely two species are related, the more similar the chemicals that make up their cells.

FIGURE 15

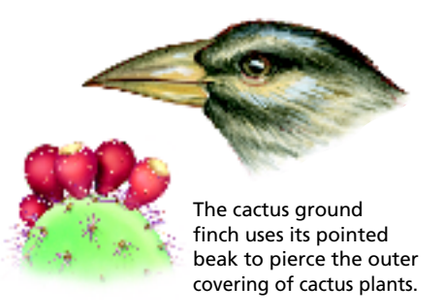
Galapagos Finches

These three species of finches that live on the Galapagos Islands may have arisen from a single species. Notice the differences in these birds' appearances, especially their beaks.

The large ground finch cracks open seeds with its strong, wide beak.



The large tree finch uses its grasping beak to trap insects.



The cactus ground finch uses its pointed beak to pierce the outer covering of cactus plants.

Evolution and Classification

Teach Key Concepts L2

Species Change Over Time

Focus Point out the Galapagos Islands on a globe or a map.

Teach Say: Darwin found finches on the Galapagos Islands that were different from South American finches. Ask: **Why do you think the finches on the Galapagos Islands differ from South American finches?** *(Possible answer: They are isolated and live in different environments, so they evolved differently.)*

Extend Challenge students to sketch beaks that might be used to eat burrowing insects, mice, sunflower seeds, and fruit. **learning modality: visual**

Classification Today

Teach Key Concepts L2

Classification is Based on Evolution

Focus Compare an organism's evolutionary history to a person's family tree. Ask: **How do you know who your ancestors are?** *(Possible answers: family records, family resemblance)*

Teach Ask: **How can you figure out the ancestors of an organism?** *(By studying their structures and chemical makeup)*

Extend Ask: **Why do we pay attention to theories about evolution when classifying organisms?** *(To group organisms that are related together)* **learning modality: verbal**

Monitor Progress L2

Skills Check Ask students to explain how evolution and classification are linked. *(Classification is guided by information about evolutionary history.)*

Answers

Figure 14 A pseudoscorpion

Reading Checkpoint Books with illustrations that highlight differences between similar-looking organisms

Monitor Progress L2

Answers

Reading Checkpoint Chemical makeup

Assess

Reviewing Key Concepts

1. a. To make studying organisms easier **b.** Possible answers: Four legs, fur, sharp, retractable claws, hunts other animals

2. a. Domain, kingdom, phylum, class, order, family, genus, species **b.** Squirrels, because organisms in the same family are more similar to each other than to those in different families

3. a. A series of paired statements that describe the physical characteristics of different organisms; used for identifying organisms **b.** Sample answer:

Step 1 1a. Red 1b. Not red	Go to Step 2. Go to Step 3.
Step 2 2a. Has smooth skin with seeds inside 2b. Has little seeds scattered all over the skin	Apple Strawberry
Step 3 3a. Yellow, elongated 3b. Orange, round	Banana Orange

4. a. Change in a species over time **b.** Organisms with similar evolutionary histories share a common ancestor and are therefore grouped together. **c.** They are similar.

Reteach L1

Have students list the levels of classification in order from broad to specific.

All in One Teaching Resources

- Section Summary: *Classifying Organisms*
- Review and Reinforcement: *Classifying Organisms*
- Enrich: *Classifying Organisms*

FIGURE 16
Classifying Skunks and Weasels
The skunk (bottom) and weasel (right) were once classified in the same family. Based on new chemical information, scientists reclassified skunks and weasels into different families.

New Information Sometimes, by studying the chemical makeup of organisms, scientists discover new information that changes what they had previously thought. For example, skunks and weasels were classified in the same family for 150 years. However, when scientists compared nucleic acids from the cells of skunks and weasels, they found many differences. These differences suggested that the two groups are not as closely related as previously thought. Some scientists proposed changing the classification of skunks. As a result, skunks were reclassified into their own family called Mephitidae, which means "noxious gas" in Latin.

Reading Checkpoint **What kind of information do scientists mainly rely on to determine evolutionary history?**

Section 2 Assessment

Target Reading Skill Asking Questions Use the answers to the questions you wrote about the headings to help you answer the questions below.

Reviewing Key Concepts

1. a. Reviewing Why do biologists classify?
b. Inferring Suppose someone tells you that a jaguarundi is classified in the same genus as house cats. What characteristics do you think a jaguarundi might have?

2. a. Listing List in order the levels of classification, beginning with domain.
b. Applying Concepts Woodchucks are classified in the same family as squirrels, but in a different family than mice. Do woodchucks have more characteristics in common with squirrels or mice? Explain.

3. a. Reviewing What is a taxonomic key?
b. Applying Concepts Create a taxonomic key that could help identify a piece of fruit as an apple, orange, strawberry, or banana.

4. a. Reviewing What is evolution?
b. Explaining How is knowing a species' evolutionary history important in its classification?
c. Predicting You discover a new organism that has a chemical makeup extremely similar to that of chickens. What is likely to be true about the evolutionary histories of your organism and chickens?

Lab zone At-Home Activity

Kitchen Classification With a family member, go on a "classification hunt" in the kitchen. Look in your refrigerator, cabinets, and drawers to discover what classification systems your family uses to organize items. Then explain to your family member the importance of classification in biology.

Lab zone At-Home Activity

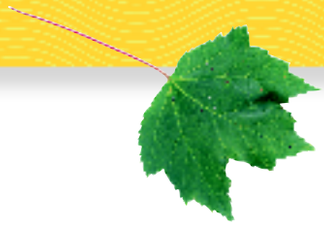
Kitchen Classification L1 Remind students to identify the criteria used to classify kitchen objects in their houses. Families may have organized items by size, function, or location. Ask students whether their family members agreed with their classification systems.

Lab zone Chapter Project

Keep Students on Track Encourage students to observe their object each day and record observations and drawings. If students seem bored because their object is not doing anything, encourage them to consider whether the inactivity shows that the object is not alive, or whether they should revise their methods of observation. For example, encourage students to explain how they could be sure that the object is not breathing or growing.

Lab zone Skills Lab

Living Mysteries



Problem

How can you create a taxonomic key to help identify tree leaves?

Skills Focus

observing, classifying, inferring

Materials

- a variety of leaves
- hand lens
- metric ruler

Procedure

1. Your teacher will give you five different tree leaves. Handle the leaves carefully.
2. Use a hand lens to examine each of the leaves. Look for characteristics such as those described in the table. Make a list of five or more identifying characteristics for each leaf.

Leaf Characteristics to Consider

Characteristic	Observations
Overall Shape	Is the leaf needlelike and narrow, or is it flat and wide? For a flat leaf, is it rounded, oblong, heart-shaped, or some other shape?
Simple vs. Compound	Is the leaf a single unit, or is it made up of individual leaflets? If it is made up of leaflets, how are they arranged on the leaf stalk?
Pattern of Veins	Do the leaf's veins run parallel from a central vein, or do they form a branching pattern?
Leaf Edges	Are the edges of the leaf jagged or smooth?
Leaf Texture	Is the leaf's surface fuzzy, shiny, or another texture?

3. Use your observations to create a taxonomic key for the leaves. In creating your taxonomic key, use the characteristics you listed along with any others that you observe. Remember that your taxonomic key should consist of paired statements, similar to the one shown in Figure 14 in this chapter.
4. Exchange your leaves and taxonomic key with a partner. If your partner cannot identify all of the leaves using your key, revise your key as necessary.

Analyze and Conclude

1. **Observing** How are your leaves similar or different from one another?
2. **Classifying** How did you decide which characteristics to use in your taxonomic key?
3. **Inferring** Choose one of your leaves and look back over the list of characteristics you used to classify it. Do you think every single leaf of the same type would share those characteristics? Explain.
4. **Communicating** Explain in your own words why a taxonomic key is helpful. Include in your explanation why it is important that the paired statements in a taxonomic key be contrasting statements.

More to Explore

Suppose you are hiking through the woods and see many flowers of different colors, shapes, and sizes. You decide to create a taxonomic key to help identify the flowers. What characteristics would you include in the key?

Lab zone Skills Lab

Living Mysteries

L2

Prepare for Inquiry

Skills Objective

After this lab, students will be able to

- observe and identify characteristics of leaves, such as pine, palm, cedar, maple, and orange
- classify organisms into one of the five leaf groups using a taxonomic key

Prep Time 30 minutes
Class Time 30 minutes

Advance Planning

Collect various leaves or photographs of leaves, such as pine, palm, cedar, maple, and orange.

Safety

Review the safety guidelines in Appendix A.

All in One Teaching Resources

- Lab Worksheet: *Living Mysteries*

Guide Inquiry

Introduce the Procedure

Suggest students try out the taxonomic key in Figure 14.

Expected Outcome

Student's keys will depend on the five leaves that they are given. The keys should follow the outline of the table of leaf characteristics provided, and lead to the correct identity of each leaf.

Analyze and Conclude

1. They differ in shape, number of leaves in a unit, pattern of veins, edges, and texture.
2. Answers will vary depending on leaves provided.
3. Yes, if they belong to the same species they share similar chacteristics.
4. The opposite statements are written so that organisms being classified match one choice or the other. Each pair is written to cover all possible choices and leads to either the correct name or the next step in the process.

Extend Inquiry

More to Explore Petal shape and arrangement, smell, number and size of flowers