section 4

Benchmarks—SC.G.1.3.3: understands that the classification of living things is based on a given set of criteria and is a tool for understanding biodiversity and interrelationships

Also covers: SC.F.1.3.2; SC.F.1.3.3; SC.F.1.3.4; SC.F.1.3.5; SC.F.1.3.6; SC.F.1.3.7; SC.F.2.3.4; SC.H.1.3.2; **AA:** SC.D.1.3.2; SC.D.2.3.2; SC.F.1.3.1; SC.G.1.3.4; SC.G.1.3.5; SC.H.1.3.1; SC.H.1.3.4

How are living things classified?

as you read

What You'll Learn

- **Describe** how early scientists classified living things.
- **Explain** how similarities are used to classify organisms.
- **Explain** the system of binomial nomenclature.
- **Demonstrate** how to use a dichotomous key.

Why It's Important

Knowing how living things are classified will help you understand the relationships that exist among all living things.

Review Vocabulary

common name: a nonscientific term that may vary from region to region

New Vocabulary

- phylogeny
- kingdom
- binomial nomenclature
- genus

Classification

If you go to a library to find a book about the life of Louis Pasteur, where do you look? Do you look for it among the mystery or sports books? You expect to find a book about Pasteur's life with other biography books. Libraries group similar types of books together. When you place similar items together, you classify them. Organisms also are classified into groups.

History of Classification When did people begin to group similar organisms together? Early classifications included grouping plants that were used in medicines. Animals were often classified by human traits such as courageous—for lions—or wise—for owls.

More than 2,000 years ago, a Greek named Aristotle observed living things. He decided that any organism could be classified as either a plant or an animal. Then he broke these two groups into smaller groups. For example, animal categories included hair or no hair, four legs or fewer legs, and blood or no blood. **Figure 15** shows some of the organisms Aristotle would have grouped together. For hundreds of years after Aristotle, no one way of classifying was accepted by everyone.

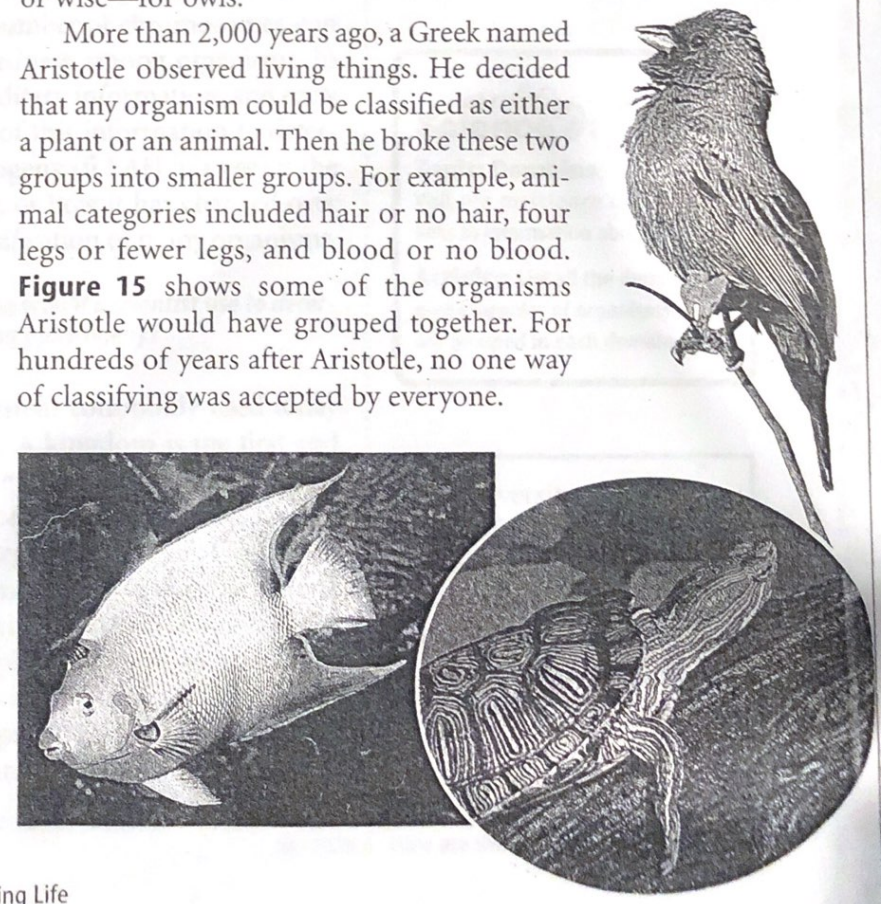

Figure 15 Using Aristotle's classification system, all animals without hair would be grouped together.

ist *other animals without hair* *nat Aristotle would have put in this group.*

Kingdom — Animalia
Phylum — Chordata
Class — Mammalia
Order — Cetacea
Family — Delphinidae
Genus — *Tursiops*
Species – *Tursiops truncatus*

Figure 16 The classification of the bottle-nosed dolphin shows that it is in the order Cetacea. This order includes whales and porpoises.

Linnaeus In the late eighteenth century, Carolus Linnaeus, a Swedish naturalist, developed a new system of grouping organisms. His classification system was based on looking for organisms with similar structures. For example, plants that had similar flower structure were grouped together. Linnaeus's system eventually was accepted and used by most other scientists.

Modern Classification Like Linnaeus, modern scientists use similarities in structure to classify organisms. They also use similiarities in both external and internal features. Specific characteristics at the cellular level, such as the number of chromosomes, can be used to infer the degree of relatedness among organisms. In addition, scientists study fossils, hereditary information, and early stages of development. They use all of this information to determine an organism's phylogeny. **Phylogeny** (fi LAH juh nee) is the evolutionary history of an organism, or how it has changed over time. Today, it is the basis for the classification of many organisms.

Reading Check *What information would a scientist use to determine an organism's phylogeny?*

Six Kingdoms A classification system commonly used today groups organisms into six kingdoms. A **kingdom** is the first and largest category. Organisms are placed into kingdoms based on various characteristics. Kingdoms can be divided into smaller groups. The smallest classification category is a species. Organisms that belong to the same species can mate and produce fertile offspring. To understand how an organism is classified, look at the classification of the bottle-nosed dolphin in **Figure 16.** Some scientists propose that before organisms are grouped into kingdoms, they should be placed in larger groups called domains. One proposed system groups all organisms into three domains.

Science Online

Topic: Domains

Visit life.msscience.com for Web links to information about domains.

Activity List all the domains and give examples of organisms that are grouped in each domain.

See Diversity of Life: Classification of Living Organisms on pages 848–851 for a survey of the six kingdoms.

Scientific Names

Using common names can cause confusion. Suppose that Diego is visiting Jamaal. Jamaal asks Diego if he would like a soda. Diego is confused until Jamaal hands him a soft drink. At Diego's house, a soft drink is called pop. Jamaal's grandmother, listening from the living room, thought that Jamaal was offering Diego an ice-cream soda.

What would happen if life scientists used only common names of organisms when they communicated with other scientists? Many misunderstandings would occur, and sometimes health and safety are involved. In **Figure 17,** you see examples of animals with common names that can be misleading. A naming system developed by Linnaeus helped solve this problem. It gave each species a unique, two-word scientific name.

Figure 17 Common names can be misleading.

Sea lions are more closely related to seals than to lions. **Identify** *another misleading common name.*

Jellyfish are neither fish nor jelly.

Binomial Nomenclature The two-word naming system that Linnaeus used to name the various species is called **binomial nomenclature** (bi NOH mee ul • NOH mun klay chur). It is the system used by modern scientists to name organisms. The first word of the two-word name identifies the genus of the organism. A **genus** is a group of similar species. The second word of the name might tell you something about the organism—what it looks like, where it is found, or who discovered it.

In this system, the tree species commonly known as red maple has been given the name *Acer rubrum.* The maple genus is *Acer.* The word *rubrum* is Latin for red, which is the color of a red maple's leaves in the fall. The scientific name of another maple is *Acer saccharum.* The Latin word for sugar is *saccharum.* In the spring, the sap of this tree is sweet.

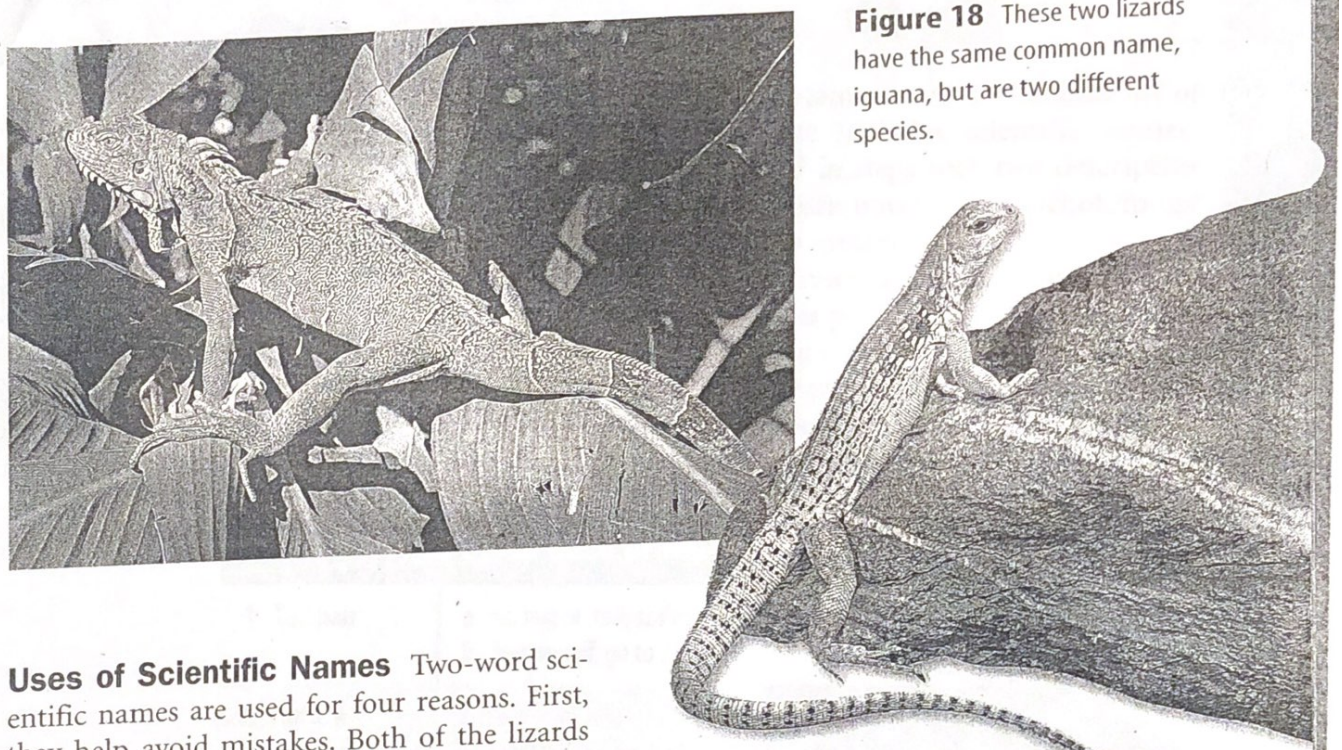

Figure 18 These two lizards have the same common name, iguana, but are two different species.

Uses of Scientific Names Two-word scientific names are used for four reasons. First, they help avoid mistakes. Both of the lizards shown in **Figure 18** have the name *iguana.* Using binomial nomenclature, the green iguana is named *Iguana iguana.* Someone who studied this *iguana,* shown in the left photo, would not be confused by information he or she read about *Dispsosaurus dorsalis,* the desert iguana, shown in the right photo. Second, organisms with similar evolutionary histories are classified together. Because of this, you know that organisms in the same genus are related. Third, scientific names give descriptive information about the species, like the maples mentioned earlier. Fourth, scientific names allow information about organisms to be organized easily and efficiently. Such information may be found in a book or a pamphlet that lists related organisms and gives their scientific names.

Reading Check *What are four functions of scientific names?*

Tools for Identifying Organisms

Tools used to identify organisms include field guides and dichotomous (di KAH tuh mus) keys. Using these tools is one way you and scientists solve problems scientifically.

Many different field guides are available. You will find some field guides at the back of this book. Most have descriptions and illustrations of organisms and information about where each organism lives. You can identify species from around the world using the appropriate field guide.

Mini LAB

Communicating Ideas

Procedure

1. Find a **magazine picture of a piece of furniture** that can be used as a place to sit and to lie down.
2. Show the picture to ten people and ask them to tell you what word they use for this piece of furniture.
3. Keep a record of the answers in your **Science Journal.**

Analysis

1. In your Science Journal, infer how using common names can be confusing.
2. How do scientific names make communication among scientists easier?

Try at Home

Dichotomous Keys A dichotomous key is a detailed list of identifying characteristics that includes scientific names. Dichotomous keys are arranged in steps with two descriptive statements at each step. If you learn how to use a dichotomous key, you can identify and name a species.

Did you know many types of mice exist? You can use **Table 2** to find out what type of mouse is pictured to the left. Start by choosing between the first pair of descriptions. The mouse has hair on its tail, so you go to 2. The ears of the mouse are small, so you go on to 3. The tail of the mouse is less that 25 mm. What is the name of this mouse according to the key?

Table 2 Key to Some Mice of North America

1. Tail hair	a. no hair on tail; scales show plainly; house mouse, *Mus musculus* b. hair on tail, go to 2
2. Ear size	a. ears small and nearly hidden in fur, go to 3 b. ears large and not hidden in fur, go to 4
3. Tail length	a. less than 25 mm; woodland vole, *Microtus pinetorum* b. more than 25 mm; prairie vole, *Microtus ochrogaster*
4. Tail coloration	a. sharply bicolor, white beneath and dark above; deer mouse, *Peromyscus maniculatus* b. darker above than below but not sharply bicolor; white-footed mouse, *Peromyscus leucopus*

section 4 review

Summary

Classification

- Organisms are classified into groups based on their similarities.
- Scientists today classify organisms into six kingdoms.
- Species is the smallest classification category.

Scientific Names

- Binomial nomenclature is the two-word naming system that gives organisms their scientific names.

Tools for Identifying Organisms

- Field guides and dichotomous keys are used to identify organisms.

Self Check

1. **State** Aristotle's and Linnaeus' contributions to classifying living things.
2. **Identify** a specific characteristic used to classify organisms.
3. **Describe** what each of the two words identifies in binomial nomenclature.
4. **Think Critically** Would you expect a field guide to have common names as well as scientific names? Why or why not?

Applying Skills

5. **Classify** Create a dichotomous key that identifies types of cars.