Section 3

Domains and Kingdoms

Reading Preview

Key Concepts

- What characteristics are used to classify organisms?
- How do bacteria and archaea differ?
- What are the kingdoms within the domain Eukarya?

Key Terms

- prokaryote
- nucleus
- eukaryote

Target Reading Skill

Comparing and Contrasting As you read, compare and contrast the characteristics of organisms in domains Bacteria, Archaea, and Eukarya, by completing a table like the one below.

Characteristics of Organisms

Domain or Kingdom	Cell Type and Number	Able to Make Food?
Bacteria	Prokaryote; unicellular	
Archaea		
Eukarya: Protists		
Fungi		
Plants		
Animals		

Lab zone Discover Activity

Which Organism Goes Where?

1. Your teacher will give you some organisms to observe. Two of the organisms are classified in the same kingdom.
2. Observe the organisms. Decide which organisms might belong in the same kingdom. Write the reasons for your decision. Wash your hands after handling the organisms.
3. Discuss your decision and reasoning with your classmates.

Think It Over

Forming Operational Definitions What characteristics do you think define the kingdom into which you placed the two organisms together?

Suppose you were an apprentice helping Linnaeus classify organisms. You probably would have identified every organism as either a plant or an animal. That's because over 200 years ago, people could not see the tiny organisms that are known to exist today. When microscopes, which make small objects look larger, were invented, a whole new world was revealed. As more and more powerful microscopes were developed, scientists discovered many new organisms and identified important differences among cells.

Today, a three-domain system of classification is commonly used. Shown in Figure 17, the three domains are Bacteria, Archaea, and Eukarya. Within the domains are kingdoms. **Organisms are placed into domains and kingdoms based on their cell type, their ability to make food, and the number of cells in their bodies.**

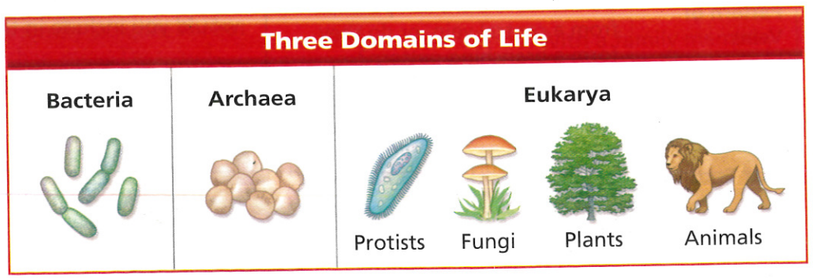


FIGURE 17
In the three-domain system of classification, all known organisms belong to one of three domains—Bacteria, Archaea, or Eukarya.

Domain Bacteria

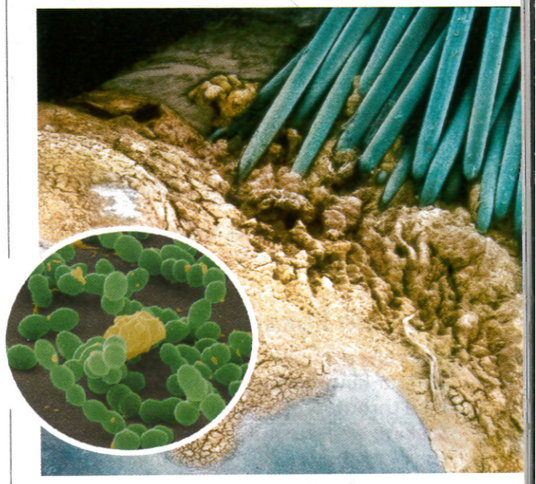
Although you may not know it, members of the domain Bacteria are all around you. You can find them in the yogurt you eat, on every surface you touch, and inside your body, both when you are healthy and sick.

Members of the domain Bacteria are prokaryotes (proh KA ree ohtz). **Prokaryotes** are organisms whose cells lack a nucleus. A **nucleus** (NOO klee us) (plural *nuclei*) is a dense area in a cell that contains nucleic acids—the chemical instructions that direct the cell's activities. In prokaryotes, nucleic acids are not contained within a nucleus.

Some bacteria are autotrophs, while others are heterotrophs. Bacteria may be harmful, such as those that cause strep throat. However, most bacteria are helpful. Some produce vitamins and foods like yogurt, and some recycle essential chemicals, such as nitrogen.

Reading Checkpoint **What is a nucleus?**

FIGURE 18
Domain Bacteria
The bristles of a toothbrush (blue) scrub away at a film of bacteria (yellow) on a tooth. The bacteria in the inset are responsible for causing cavities.



Domain Archaea

Deep in the Pacific Ocean, hot gases and molten rock spew out from a vent in the ocean floor. It is hard to imagine that any living thing could exist in such harsh conditions. Surprisingly, a group of tiny organisms thrives in such places. They are members of the domain Archaea (ahr KEE uh), whose name comes from the Greek word for "ancient."

Archaea can be found in some of the most extreme environments on Earth, including hot springs, very salty water, swamps, and the intestines of cows! Scientists think that the harsh conditions in which archaea live are similar to those of ancient Earth.

Like bacteria, archaea are unicellular prokaryotes. And like bacteria, some archaea are autotrophs while others are heterotrophs. Archaea are classified in their own domain, however, because their chemical makeup differs from that of bacteria. **Although bacteria and archaea are similar in some ways, there are important differences in the structure and chemical makeup of their cells.**

Reading Checkpoint **Where can archaea be found?**

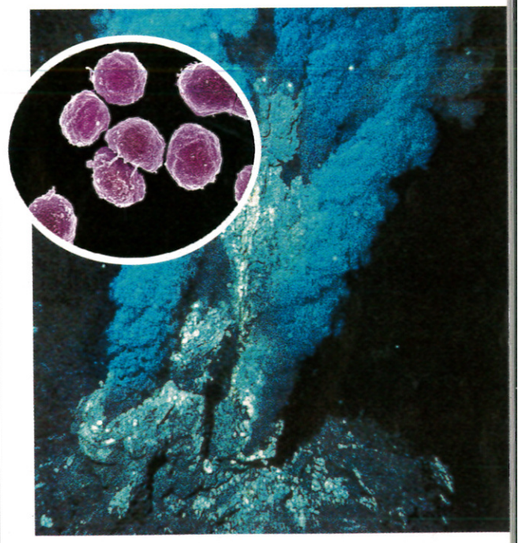


FIGURE 19
Domain Archaea
Heat-loving archaea (inset) thrive in deep-sea vents like these.
Classifying *What characteristics do archaea and bacteria share?*

▲ **Protists:** Paramecium

▲ **Fungi:** Mushrooms

▲ **Plants:** Moss

▲ **Animals:** Salamander

FIGURE 20
Domain Eukarya
You can encounter organisms from all four kingdoms of Eukarya on a hike through the woods.
Making Generalizations *What characteristic do all Eukarya share?*

Domain Eukarya

What do seaweeds, mushrooms, tomatoes, and dogs have in common? They are all members of the domain Eukarya. Organisms in this domain are **eukaryotes** (yoo KA ree ohtz)—organisms with cells that contain nuclei. **Scientists classify organisms in the domain Eukarya into one of four kingdoms: protists, fungi, plants, or animals.**

Protists A protist (PROH tist) is any eukaryotic organism that cannot be classifed as an animal, plant, or fungus. Because its members are so different from one another, the protist kingdom is sometimes called the "odds and ends" kingdom. For example, some protists are autotrophs, while others are heterotrophs. Most protists are unicellular, but some, such as seaweeds, are large multicellular organisms.

Fungi If you have eaten mushrooms, then you have eaten fungi (FUN jy). Mushrooms, molds, and mildew are all fungi. Most fungi are multicellular eukaryotes. A few, such as the yeast you use for baking, are unicellular eukaryotes. Fungi are found almost everywhere on land, but only a few live in fresh water. All fungi are heterotrophs. Most fungi feed by absorbing nutrients from dead or decaying organisms.

Plants Dandelions on a lawn, mosses in a forest, and peas in a garden are familiar members of the plant kingdom. Plants are all multicellular eukaryotes and most live on land. In addition, plants are autotrophs that make their own food. Plants provide food for most of the heterotrophs on land.

The plant kingdom includes a great variety of organisms. Some plants produce flowers, while others do not. Some plants, such as giant redwood trees, can grow very tall. Others, like mosses, never grow taller than a few centimeters.

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Animals A dog, a flea on the dog's ear, and a cat that the dog chases have much in common because all are animals. All animals are multicellular eukaryotes. In addition, all animals are heterotrophs. Animals have different adaptations that allow them to locate food, capture it, eat it, and digest it. Members of the animal kingdom live in diverse environments throughout Earth. Animals can be found from ocean depths to mountaintops, from hot, scalding deserts to cold, icy landscapes.

Reading Checkpoint **Which two kingdoms consist only of heterotrophs?**

Section 3 Assessment

Target Reading Skill **Comparing and Contrasting** Use the information in your table about Bacteria, Archaea, and Eukarya to help you answer the questions below.

Reviewing Key Concepts

1. a. **Listing** What are the three domains into which organisms are classified?
   b. **Classifying** What information do you need to know to determine the domain to which an organism belongs?
2. a. **Defining** What is a prokaryote?
   b. **Classifying** Which two domains include only organisms that are prokaryotes?
   c. **Comparing and Contrasting** How do the members of the two domains of prokaryotes differ?
3. a. **Reviewing** What do the cells of protists, fungi, plants, and animals have in common?
   b. **Comparing and Contrasting** How are protists and plants similar? How are they different?
   c. **Inferring** You learn that the Venus flytrap is in the same kingdom as pine trees. What characteristics do these organisms share?

Writing in Science

Detailed Observation Study a photo of an animal. Then write a detailed description of the animal without naming it. Describe the animal so that an artistic friend could paint it in detail without seeing it. Use adjectives that clearly and vividly describe the animal.