KEY CONCEPT

1.3 Different cells perform various functions.

BEFORE, you learned

- Modern microscopes reveal details of cell structures
- Some cells are prokaryotic and some are eukaryotic
- Plant and animal cells have similarities and differences

NOW, you will learn

- How organisms are classified into three domains
- About specialization in multicellular organisms
- How cells, tissues, and organs are organized

VOCABULARY

specialization p. 28
tissue p. 29
organ p. 30

EXPLORE Specialization

How do roots differ from leaves?

PROCEDURE

1. Soak the grass plant in a cup of water to clean away any dirt.
2. Compare the color of the roots with the color of the blades or leaves. Record your observations.
3. Wash your hands when you have finished.

MATERIALS

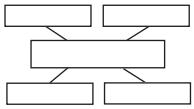
- grass plants
- cup
- water

WHAT DO YOU THINK?

- How does the color of the grass roots compare with that of the grass blades?
- Chloroplasts contain a chemical that gives leaves their green color. What does this suggest to you about the functions of the grass blades and roots?

Organisms can be classified by their cell type.

MAIN IDEA WEB
Make a web of the important terms and details about the main idea: *Organisms can be classified by their cell type.*



Look around you at this moment. The living organisms you see may number 10, 20, 100, or 1000, depending on where you are. What you are not seeing, but what is also there, is a huge number of unicellular organisms. For example, there are at least 2–3 million bacteria living on each square centimeter of your skin.

Most of the organisms alive on Earth today are made of a single cell. One of the most interesting scientific discoveries made recently had to do with a group of unicellular organisms. These organisms were found living where no one expected to find any life at all.

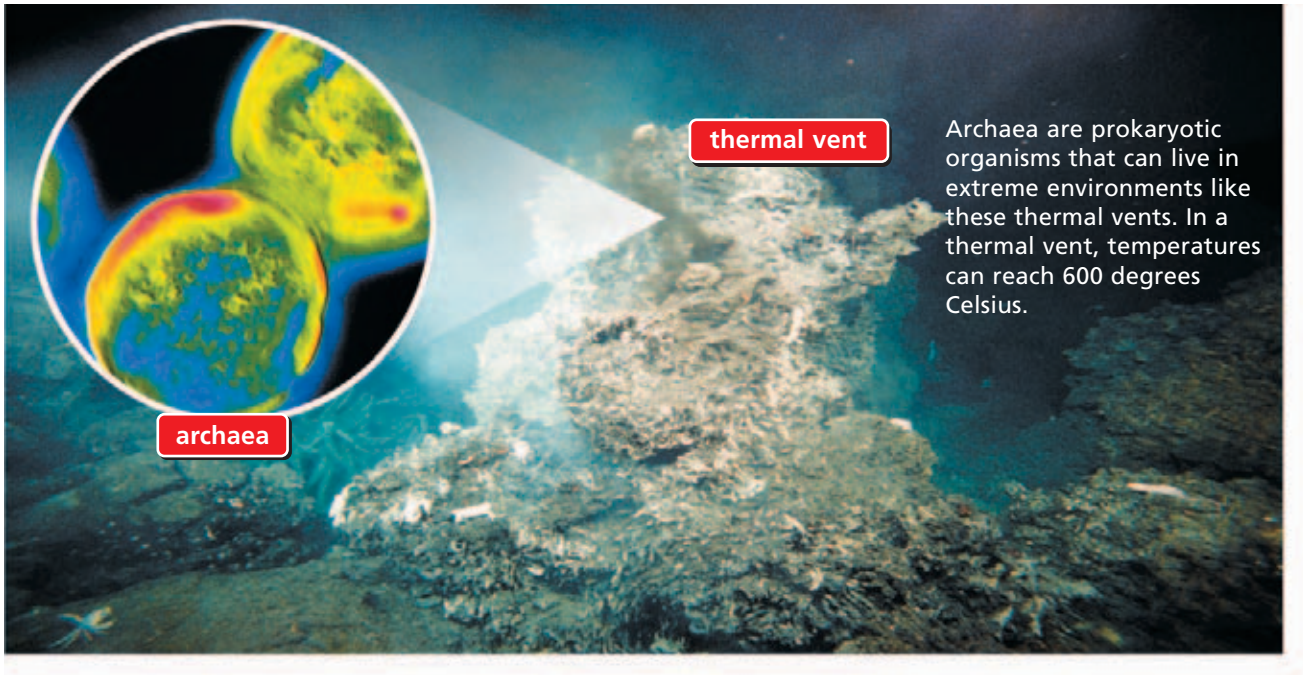
Archaea and Bacteria

In the early 1980s, scientists discovered unicellular organisms living in rather extreme environments. Some were living deep in the ocean, at thermal vents where there is extreme heat and little oxygen. Others were found in the salty waters of the Great Salt Lake and in the hot sulfur springs of Yellowstone Park.

REMINDER

The genetic material in a prokaryotic cell is not enclosed in a nucleus. In eukaryotic cells genetic material is stored in a nucleus.

At first, these organisms were referred to as archaebacteria. The organisms were similar in appearance to bacteria. The prefix *archae* comes from a Greek word that means "ancient." Many of these organisms live in environments that scientists think are like the environments of ancient Earth.



Archaea are prokaryotic organisms that can live in extreme environments like these thermal vents. In a thermal vent, temperatures can reach 600 degrees Celsius.

It took a while for scientists to realize that these organisms that looked like bacteria were genetically very different from bacteria. Scientists decided to establish a separate category for them, a domain called Archaea (AHR-kee-uh). A domain is a broad category of living things that is based on characteristics of their cells. Scientists have identified three domains. Bacteria are classified in the domain Bacteria. A third domain includes organisms with eukaryotic cells.

Organisms that belong to the domains Bacteria and Archaea are similar in some important ways. They are prokaryotes, which are unicellular organisms with prokaryotic cells. Their cytoplasm contains ribosomes but no organelles, so the structure of a prokaryote is simple. Another feature of a prokaryote is a tough cell wall that protects the organism.

RESOURCE CENTER
CLASSZONE.COM
Learn more about unicellular organisms.

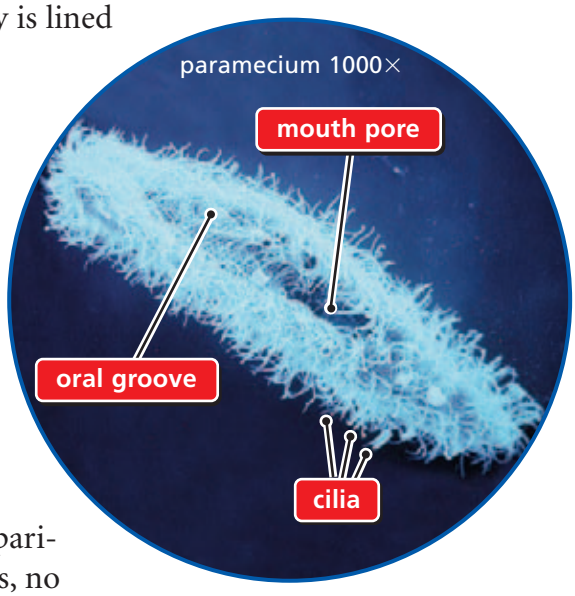
CHECK YOUR READING Why did scientists decide to establish separate domains for archaea and bacteria?

Eukarya

The third domain is the domain Eukarya. Organisms in this domain have cells with a nucleus. This domain includes almost all the multicellular organisms on Earth: plants, animals, and fungi. It also includes many unicellular organisms called protists. The cells of unicellular eukaryotes are more complex in structure and larger than the cells of prokaryotes.

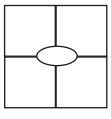
CHECK YOUR READING How are eukaryotes different from prokaryotes?

The paramecium is one of the most complex of all unicellular eukaryotes. Its body is lined with hairlike strands, called cilia (SIHL-ee-uh), that allow it to move. It has dartlike structures that carry a substance used in healing and, perhaps, defense. Along the outside of the cell is a long oral groove lined with cilia that leads to a mouth pore. In addition to a nucleus, the cell of a paramecium has organelles that enable it to digest food and remove water and wastes. The paramecium has all it needs to live as a single cell. By comparison, in most multicellular eukaryotes, no individual cell can survive on its own.



Cells in multicellular organisms specialize.

VOCABULARY
Remember to add a four square for *specialization* to your notebook.

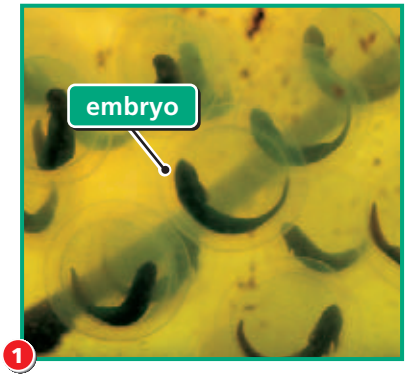


Most multicellular organisms consist of many different types of cells that do different jobs. For example, most animals have blood cells, nerve cells, and muscle cells. The cells are specialized. **Specialization** of cells means that specific cells perform specific functions. This specialization is why a single cell from a multicellular organism cannot survive on its own. A blood cell can help you fight infection or deliver oxygen to your muscles, but it cannot cause your body to move as a muscle cell can. Plants have cells that function in photosynthesis, and other cells that draw water from the soil, and still others that function mainly to support the plant's weight.

CHECK YOUR READING What does it mean for a cell to be specialized?

Specialization

A fully grown salamander has many specialized cells.



1 A salamander, like all multicellular organisms, begins life as an egg. After fertilization, the egg develops into an embryo.

2 As the cells divide, they begin to specialize. The amount of specialization depends on the complexity of the organism.

3 A salamander's body has many specialized cells. These include skin cells, blood cells, bone cells, muscle cells, and nerve cells.

A multicellular organism is a community of cells.

Cells in a multicellular organism are specialized. The ways in which the cells work together and interact depend on the organism. You can think of the cells of an organism as members of a community. The size and complexity of the community differ from organism to organism.

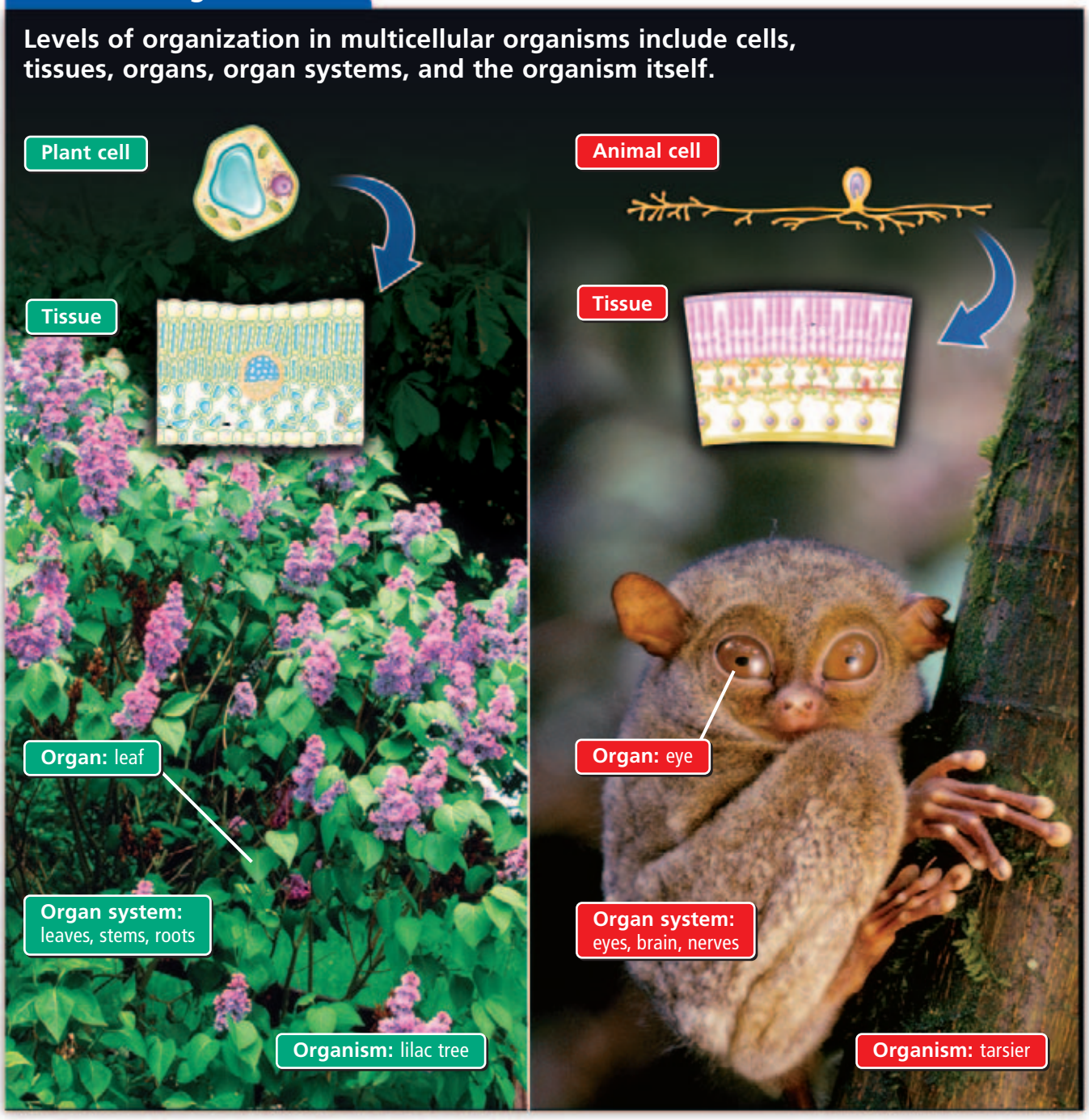
A sponge is an animal that is fairly simple in its organization. It spends its life attached to the ocean floor, filtering food and other nutrients from the water. Like all animals, the sponge is organized at a cellular level. Different types of cells in its body perform different functions. For example, certain cells take in food, and other cells digest it. However, cells in a sponge are not very highly specialized. A piece broken from a living sponge will actually regenerate itself as new cells replace the lost ones.

In more complex organisms, such as plants and animals, cells are not only specialized but grouped together in tissues. A **tissue** is a group of similar cells that are organized to do a specific job. If you look at your hand, you will see the top layer of tissue in your skin. Humans have two layers of skin tissue, layered one on top of the other. Together these skin tissues provide protection and support.

CHECK YOUR READING In what way is a tissue an organization of cells?

Levels of Organization

Levels of organization in multicellular organisms include cells, tissues, organs, organ systems, and the organism itself.



Different tissues working together to perform a particular function represent another level of organization, the **organ.** The eye is an organ that functions with the tarsier's brain to allow sight. A leaf is an organ that provides a plant with energy and materials. It has tissue that brings in water and nutrients, tissue that uses the Sun's energy to make sugar, and tissue that moves sugar to other parts of the plant.

CHECK YOUR READING What is the relationship between tissues and organs?

Different organs and tissues working together form an organ system. An organism may have only a few organ systems. The organ systems of plants include roots, stems, and leaves. Other organisms have many organ systems. Humans have 11 major organ systems, made up of about 40 organs and over 200 types of tissue. The human nervous system, for example, includes the brain, the spinal cord, nerves, and sensory organs, such as the ears and eyes.

An organism itself represents the highest level of organization. It is at this level that we see all the characteristics we associate with life. If an organism is a complex organism—a human, for example—it will consist of trillions of cells grouped into tissues, organs, and organ systems. However, a simple organism, like a sponge, meets its needs with a body made up of only a few types of specialized cells.

CHECK YOUR READING What level of organization is an organism? What do we see at this level of organization?

INVESTIGATE Cell Models

What are some of the limitations of using a model to represent a cell?

SKILL FOCUS
Making models

MATERIALS
- craft supplies
- scissors
- glue
- poster board
- markers

TIME
30 minutes

PROCEDURE

1. Work with a partner to choose a type of cell to model and to determine the types of organelles to include.
2. Using the poster board as a base, construct the model from available supplies. Make the model as accurate as you can.
3. Use a marker to label each organelle, and include a description of its function.
4. Compare your cell model with those made by your classmates.

WHAT DO YOU THINK?

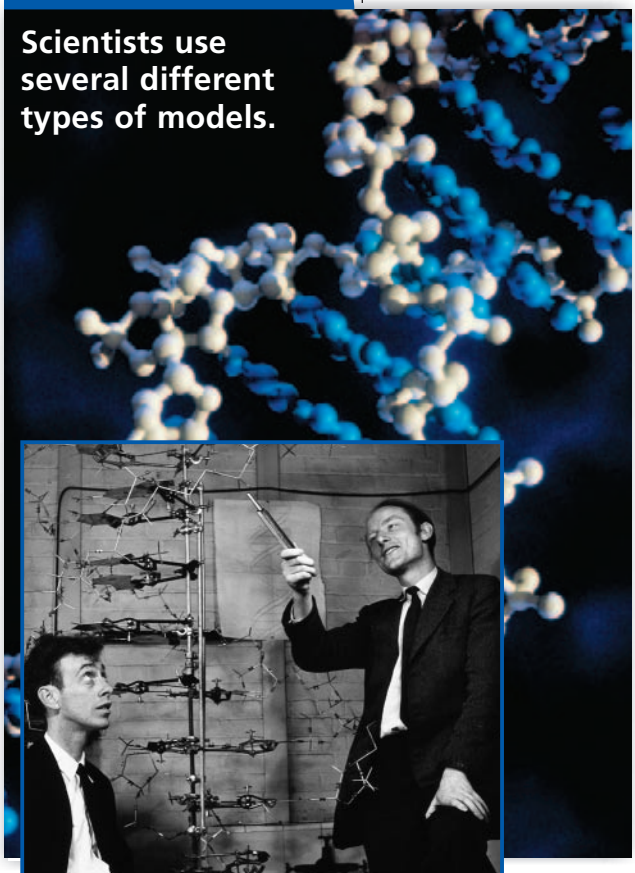
- What are some of the limitations of using a model to represent a cell?
- What are some of the benefits of making a three-dimensional model of a cell?

CHALLENGE Think of something to which you might compare the activities of a cell—perhaps the activities of a factory or a school. Add labels to your model to show how the comparison applies to each of the cell's structures.

Scientists use models to study cells.

Any drawing or photograph on a flat page is two-dimensional. In addition, diagrams of cells are often simplified to make them easier to understand. If you look at plant or animal cells under a microscope, you will notice some differences between real cells and the diagrams on page 22. In order to study cell structures and their functions, scientists use many types of models, including three-dimensional models. One of the most important discoveries in science involved the use of models.

Scientific Models



Scientists use several different types of models.

Watson and Crick used a model made from wire and tin.

DNA is the genetic material common to all cells. (You will read more about the structure and function of DNA later in this unit.) In the early 1950s, scientists had a good idea what DNA was made up of. The problem was that they could not figure out how all the pieces of the molecule fit together.

A scientist named Rosalind Franklin used x-rays to produce images of DNA. The x-ray provided an important clue as to the shape of the molecule. Two other scientists, James Watson and Francis Crick, were then able to put together a three-dimensional model of DNA and present it to the world in 1953.

Today's scientists have many different tools for making models. The images at the left show a computer model of DNA along with Watson and Crick's famous model.

1.3 Review

KEY CONCEPTS

1. What are the three domains, and what type of cells do the organisms in each domain have?
2. Define specialization in your own words.
3. Describe the levels of organization in a tree.

CRITICAL THINKING

4. **Synthesize** In what way does a specialized cell in a multicellular organism differ from the cell of a unicellular organism?
5. **Compare and Contrast** How is a model similar to the real object it represents? How is it different?

CHALLENGE

6. **Evaluate** The organism below is called *Chlamydomonas*. What domain does it belong to, and what do the internal structures tell you about it?