SECTION 3

# The Organization of Living Things

**Key Concept** As multicellular organisms develop, their cells differentiate and form levels of organization.

### What You Will Learn

- Unicellular organisms are made up of one cell, and multicellular organisms are made up of many cells.
- The cells of multicellular organisms can differentiate to become specialized types of cells.
- The levels of organization in multicellular organisms are cells, tissues, organs, and organ systems.

### Why It Matters

Because cells can differentiate, multicellular organisms, such as humans, can have different kinds of cells, tissues, organs, and organ systems.

### Vocabulary

- organism
- function
- structure
- tissue
- organ
- organ system

**READING STRATEGY**

**Graphic Organizer** In your **Science Journal,** make a Comparison Table that compares various characteristics of unicellular and multicellular organisms.

In some ways, organisms are like machines. Some machines have just one part. But most machines have many parts. Some organisms exist as a single cell. Other organisms have many cells—trillions in some cases.

Anything that can perform life processes by itself is an **organism.** There are two types of organisms: unicellular organisms and multicellular organisms.

## Unicellular Organisms

Organisms that are made up of one cell are called *unicellular.* Prokaryotes, such as bacteria and archaea, are unicellular organisms. Eukaryotes such as yeasts, some algae, and some protists are also unicellular. A unicellular organism performs all of the necessary functions to stay alive. Unicellular organisms need fewer resources and can live in harsher conditions than organisms that have many cells.

## Multicellular Organisms

Organisms that are made up of many cells are called *multicellular.* Plants, animals, some protists, and many fungi are multicellular organisms. A multicellular organism starts as a single cell, such as the fertilized egg shown in **Figure 1.** As the single cell develops into many cells, the cells become *differentiated,* or fixed, into different types of cells.

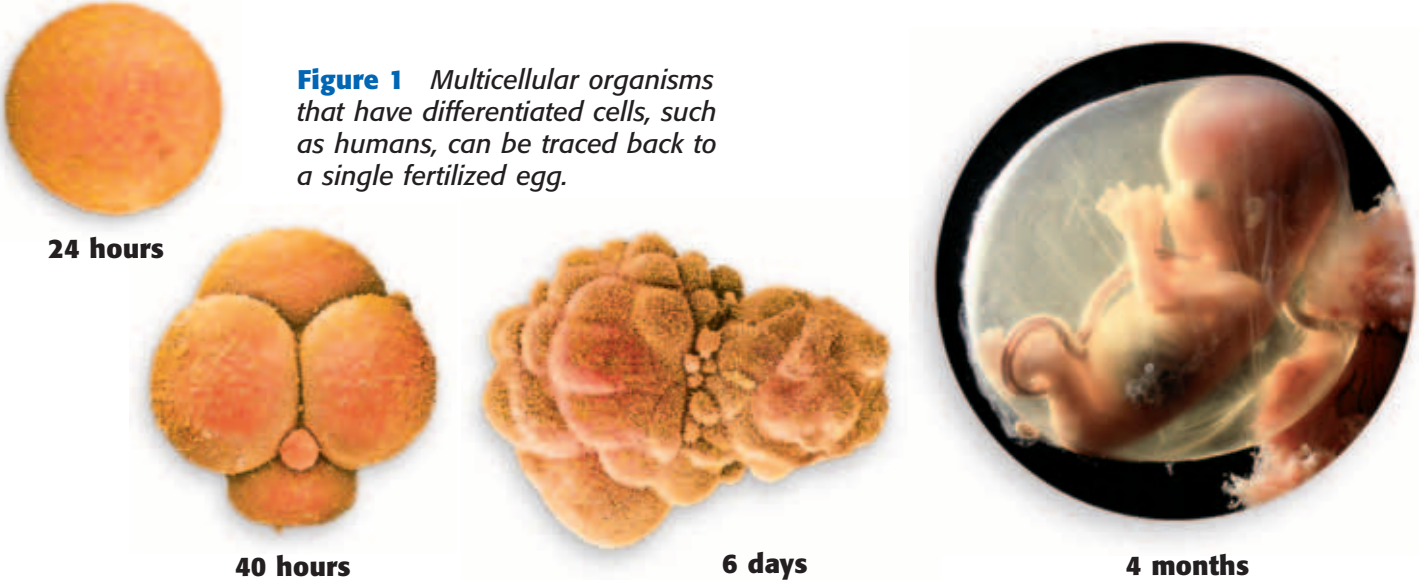



**Figure 1** *Multicellular organisms that have differentiated cells, such as humans, can be traced back to a single fertilized egg.*

## The Characteristics of Being Multicellular

Multicellular organisms differ from unicellular organisms in many ways. Characteristics of multicellular organisms include the following:

- **Larger Size** Many multicellular organisms are small. But usually they are larger than unicellular organisms. Multicellular organisms grow by making more small cells, not by making their cells larger. Being large can be an advantage. Large organisms are prey for fewer predators. Large predators can eat a wider variety of prey.
- **Longer Life** A unicellular organism dies if its cell dies. But if a single cell in a multicellular organism dies, the organism continues to live.
- **Specialization** Each type of cell has a particular job. Specialization makes the organism more efficient than a unicellular organism. In some ways, having specialized cells is similar to having an assembly line at a factory. The assembly line allows the factory to produce more products in less time than a single individual could.

**7.1.f** Students know that as multicellular organisms develop, their cells differentiate.
**7.5.a** Students know plants and animals have levels of organization for structure and function, including cells, tissues, organs, organ systems, and the whole organism.

**organism** (AWR guh NIZ uhm) a living thing; anything that can carry out life processes independently

***Standards Check*** **How are multicellular organisms more efficient than unicellular organisms?** **7.1.f**

## Quick Lab

### A Division of Labor

**7.1.f**

In this activity, your teacher will ask you to model a unicellular organism or a multicellular organism. You will make paper chains according to the steps at right. The steps represent how organisms do work, such as making cell parts.

1. If you are a unicellular organism, you must complete all of the steps before you start over.
2. If you are a cell in a multicellular organism, you will be a member of a team. Each team will work together in an assembly line. Each team member represents a cell that completes only one step. Each team member will receive the product from the previous team member, complete the step, and pass the product to the next team member.
3. Listen for your teacher's directions about when to start and stop.
4. Who made longer chains: the multicellular organisms or the unicellular organisms?
5. How does this activity relate to cell specialization?

**How to Make a Paper Chain**

1. Use **scissors** to cut one 8 in. strip of paper.
2. Use a **marker** to draw a line down the middle of the length of one strip of paper.
3. Use a **marker of a different color** to draw three circles on the line.
4. Walk to a desk in the front of the classroom. For the first strip, tape the two ends together to form a loop. For the rest of the strips, thread one end of the strip through the previous loop, and tape the ends of the strip to form another loop.

15 min

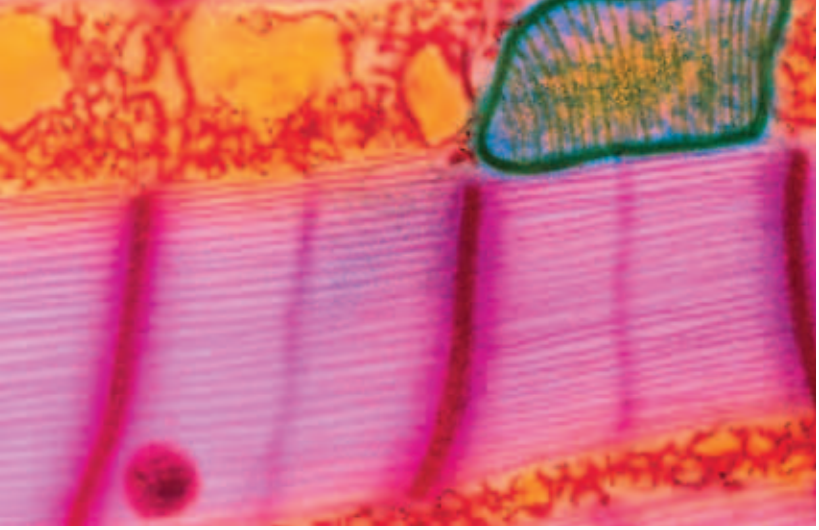


**Figure 2** *This photomicrograph shows a small part of one heart muscle cell. The green line surrounds one of many mitochondria, the powerhouses of the cell. The pink areas are muscle filaments.*

## From Cells to Organisms

In a multicellular organism, such as a human, different kinds of cells perform different functions. These cells rely on each other and work together to do all of the activities needed for the organism to live. Such cells must be well organized in an organism. A multicellular organism can have four levels of organization: cells, tissues, organs, and organ systems.

### Cells: The First Level of Organization

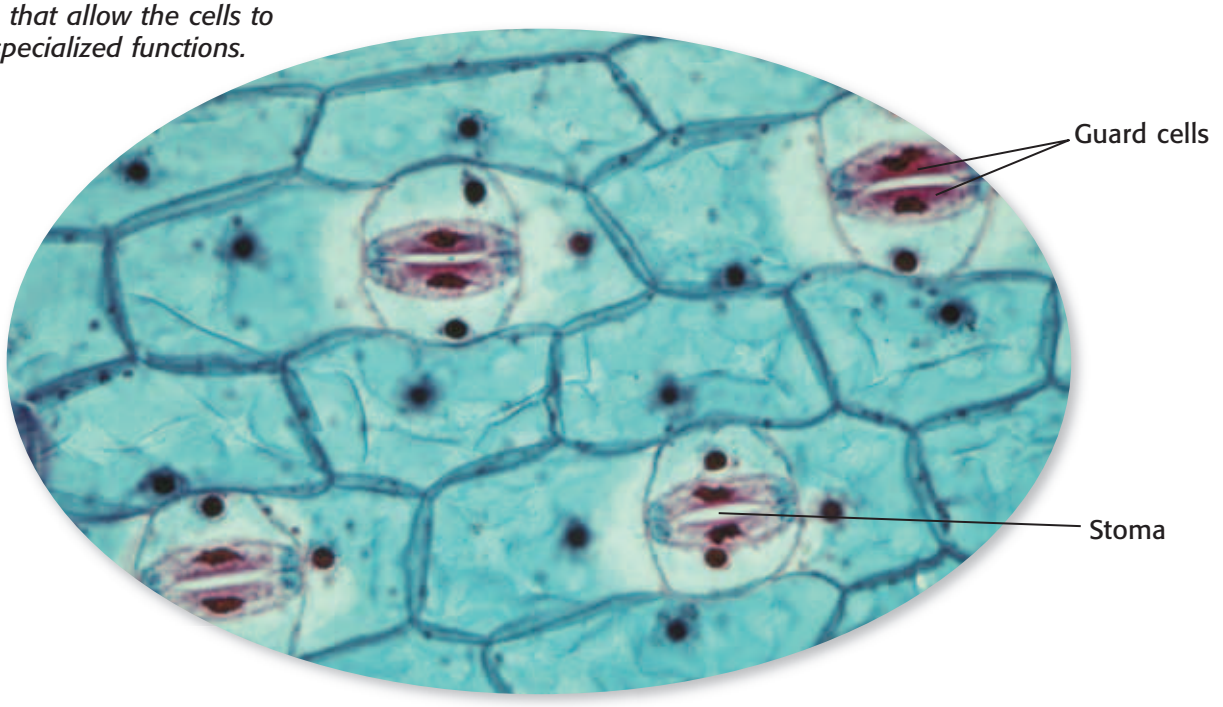
Cells in a multicellular organism can be specialized. A *specialized* cell performs a specific function. The **function** of a cell is the activity that the cell performs. The function of a specialized cell relates to the cell's structure. **Structure** is the arrangement of parts in an organism. It includes the shape of a part and the material of which the part is made. For example, the cardiac muscle cell in **Figure 2** is a specialized muscle cell. Heart muscle cells have internal structures that contract and that make the heart pump blood.

**function** (FUHNGK shuhn) the special, normal, or proper activity of an organ or part

**structure** (STRUHK shuhr) the arrangement of parts in an organism

Plants also have cells that perform specific functions. For example, a special type of cell is found in the layer between the inside of a plant and the outside of the plant. These cells are shaped like sausages, as **Figure 3** shows. Pairs of these sausage-shaped cells, which are called *guard cells,* control the size of openings called *stoma.* The stoma allow gases, such as carbon dioxide and oxygen, to move into and out of a leaf.

**Figure 3** *Some plant cells have structures that allow the cells to perform specialized functions.*



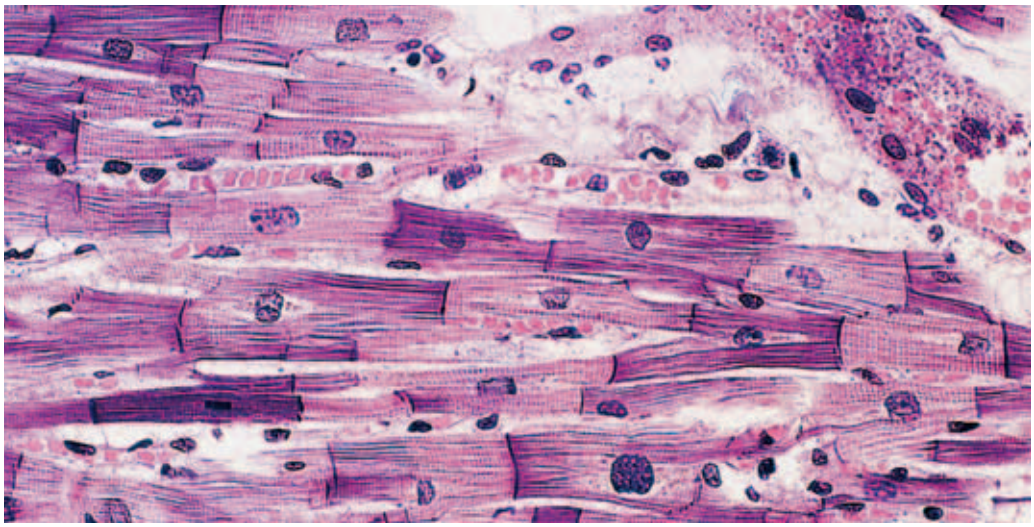


**Figure 4** *This photomicrograph shows cardiac muscle tissue. Cardiac muscle tissue is made up of many cardiac cells.*

## Tissues: The Second Level of Organization

A **tissue** is a group of cells that work together to perform a specific job. The material around and between the cells is also part of the tissue. The cardiac muscle tissue, shown in **Figure 4,** is made of many cardiac muscle cells. Cardiac muscle tissue is just one type of tissue in a heart.

Animals have four basic types of tissues: nerve tissue, muscle tissue, connective tissue, and protective tissue. In contrast, plants have three types of tissues: transport tissue, protective tissue, and ground tissue. Transport tissue moves water and nutrients through a plant. Protective tissue covers the plant. It helps the plant retain water and protects the plant from damage. Photosynthesis takes place in ground tissue.

**tissue** (TISH oo) a group of similar cells that perform a common function

**organ** (AWR guhn) a collection of tissues that carry out a specialized function of the body

## Organs: The Third Level of Organization

A structure that is made up of two or more tissues working together to perform a specific function is called an **organ.** For example, your heart is an organ. It is made mostly of cardiac muscle tissue. But your heart also has nerve tissue and tissues of the blood vessels that work together to make your heart the powerful pump that it is.

Another organ is your stomach. It also has several kinds of tissues. Muscle tissue in the stomach makes food move in and through the stomach. Special tissues make chemicals that help digest your food. Connective tissue holds the stomach together, and nervous tissue carries messages back and forth between the stomach and the brain. Other organs include the intestines, brain, and lungs.

Plants also have different kinds of tissues that work together as organs. The leaf of a plant is an organ that contains tissue that traps sunlight energy to make food. Other examples of organs in plants are stems and roots.

**Standards Check** What is an organ? 7.5.a

MATH PRACTICE

### A Pet Protist

Imagine that you have a tiny, box-shaped protist for a pet. To care for your pet protist properly, you have to figure out how much to feed it. The dimensions of your protist are roughly 25 µm × 20 µm × 2 µm. If seven food particles can enter through each square micrometer of surface area per second, how many particles can your protist eat in 1 min? Record you work in your **Science Journal.**

## Organ Systems: The Fourth Level of Organization

A group of organs working together to perform a particular function is called an **organ system.** Each organ system has a specific job to do in the body. The cardiovascular system, shown in **Figure 5,** includes organs and tissues, such as the heart and blood vessels. The job of the cardiovascular system is to transport blood throughout the body.

The digestive system is an organ system made up of several organs, including the stomach and intestines. The digestive system's job is to break down food into small particles. Other parts of the body then use these small particles as fuel. In turn, the digestive system depends on the respiratory and cardiovascular systems for oxygen.

Plants also have organ systems. They include leaf systems, root systems, and stem systems.

**Figure 5** *The cardiovascular system carries blood to every cell in your body.*

**organ system** (AWR guhn SIS tuhm) a group of organs that work together to perform body functions

# Organisms

Multicellular organisms, such as plants and animals, have levels of organization. Cells form the tissues, the tissues form the organs, and the organs form the organ systems of a multicellular organism. The levels of organization in a multicellular organism are shown in **Figure 6.**

***Standards Check*** **List the four levels of organization in multicellular organisms.** 7.5.a

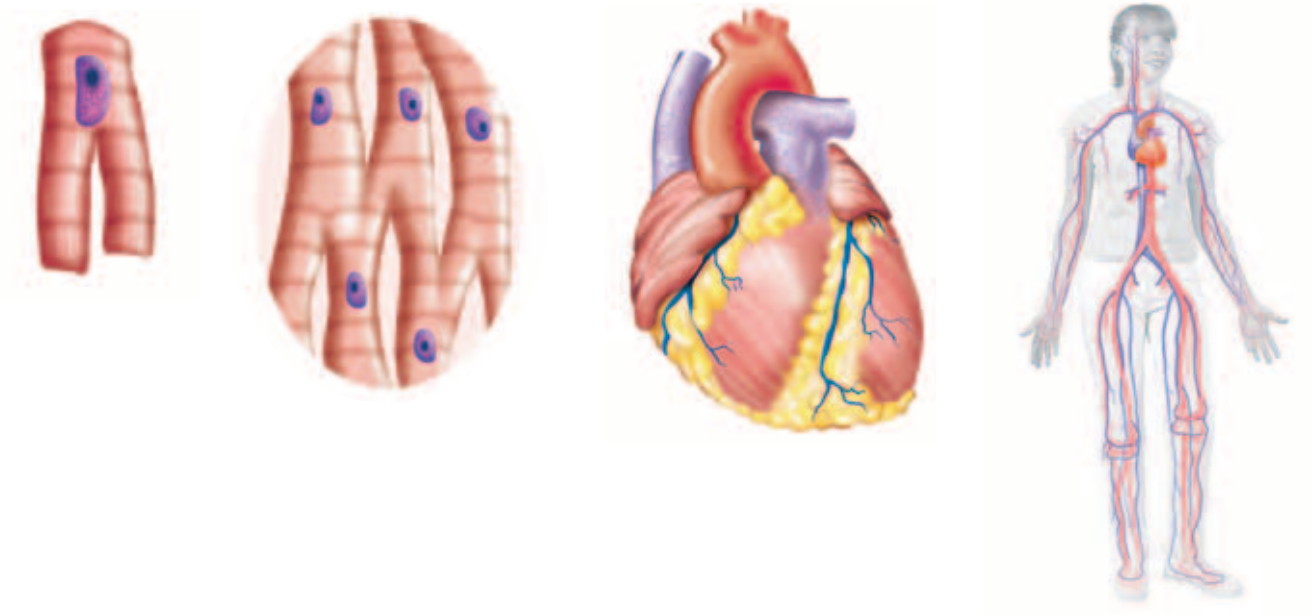
**Figure 6** **Levels of Organization**

**Cell**
Cells form tissues.

**Tissue**
Tissues form organs.

**Organ**
Organs form organ systems.

**Organ system**
And organ systems form organisms, such as you!



## Unicellular Organization

Prokaryotes, most protists, and some kinds of fungi are unicellular. Although some of these organisms live in colonies, they are still unicellular. These unicellular organisms live together, and each cell in the colony is the same. However, each cell must carry out all life processes in order for that cell to survive. In contrast, even the simplest multicellular organism has specialized cells that depend on each other in order to survive.

A slime mold is shown in **Figure 7.** A slime mold is a unicellular organism in which individual cells can come together to form a large group.

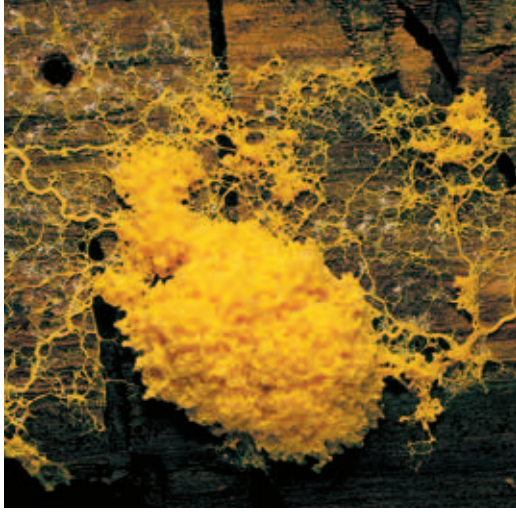


**Figure 7** *Slime molds eat small organisms and break down organic matter.*

# SECTION Review

7.1.f, 7.5.a

## Summary

- Unicellular organisms have only one cell.
- As a multicellular organism develops, its cells differentiate into specialized cells.
- Multicellular organisms are made up of one or many cells and can have a larger size and a longer life than unicellular organisms.
- The four levels of organization in multicellular organisms are cells, tissues, organs, and organ systems.
- A tissue is a group of cells working together. An organ is made up of two or more tissues working together. An organ system is made up of two or more organs working together.

### Using Vocabulary

1 Use *tissue, organ,* and *multicellular* in separate sentences.

### Understanding Concepts

2 **Describing** Describe the four levels of organization in multicellular organisms.

3 **Applying** Explain how different types of tissues work together in the heart, an organ.

4 **Demonstrating** The layer between the outside of a plant leaf and the inside of the leaf contains specialized cells called *guard cells.* How does the structure of guard cells relate to the function of guard cells?

### Critical Thinking

5 **Predicting Consequences** What would happen if the cells of a developing plant did not differentiate into guard cells?

6 **Making Inferences** Why can multicellular organisms be more complex than unicellular organisms?

7 **Making Comparisons** Organisms need to perform life functions. How do the ways in which a multicellular organism and a unicellular organism perform life functions differ?

### Math Skills

8 **Analyzing Shapes** Multicellular organism A is a cube. Each of its sides is 3 cm long. The volume of each of its cells is 1 $cm^3$. How many cells does the organism have?

### Challenge

9 **Applying Concepts** Think of an environment on Earth in which you would expect to find unicellular organisms but no multicellular organisms. Why are unicellular organisms able to survive in this environment?

### Internet Resources

For a variety of links related to this chapter, go to www.scilinks.org

Topic: Organization of Life

SciLinks code: HY71080