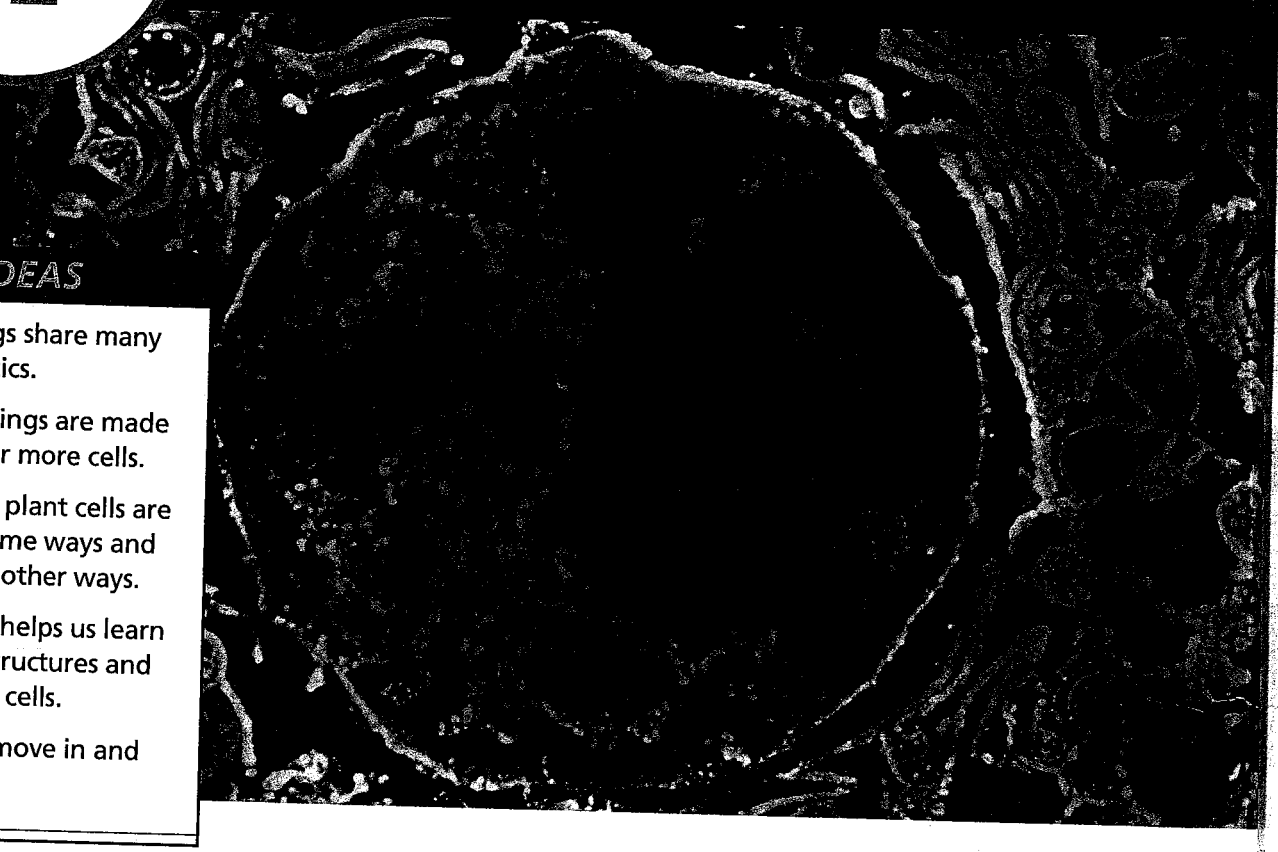
CHAPTER 1

Cells



KEY IDEAS

- Living things share many characteristics.
- All living things are made up of one or more cells.
- Animal and plant cells are similar in some ways and different in other ways.
- Technology helps us learn about the structures and functions of cells.
- Substances move in and out of cells.

You have no difficulty distinguishing one friend from another. But imagine how different the world would look if you could magnify with your eyes the way microscopes do. Could you tell the difference between a cell from one friend's arm and a cell from another friend's arm? What if you could see a cell from a fish's fin, a cell from a lettuce leaf, and a cell from a friend's arm—could you tell which was which?

The invention of the microscope and advances in technology mean that we can observe what is inside a cell and understand much of what goes on in there. Scientists continue to study cells because there are still many things we do not know.

In this chapter, you will learn about the characteristics, structures, and functions of cells, the building blocks of all living things.

Characteristics of Living Things 1.1

How do you know if something is alive? What do you look for in living things that tells you they are alive? For example, is the volcano in **Figure 1** alive? You would probably say "no," but why?

The lava flowing down the sides of a volcano moves, just as some living things do. Is movement alone enough to identify a living thing?

In time, the volcano may get larger. Is this growth? Is change in size enough to identify a living thing?

Humans breathe out gases. Similarly, gases burst from the top of the volcano. Does this "breathing out" of gases mean that the volcano is alive?

Examine the characteristics of living things (**Table 1**), and then try to answer the questions about the volcano. Many non-living things show one characteristic of living things. Some non-living things, like the volcano, show several. Living things are often referred to as **organisms**. Before something can be classified as an organism, it must show *all* the characteristics of living things.

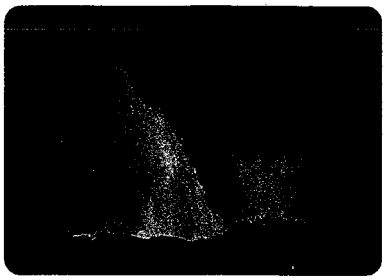
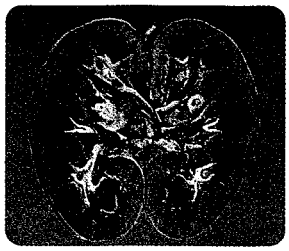


Figure 1
Volcanoes seem to grow and breathe. Are they alive?

LEARNING TIP

Photographs play an important role in reader comprehension. As you study **Table 1**, ask yourself, "What does this show?" Then move on and look at each part.

Table 1 Characteristics of Living Things

Living things are composed of cells. All cells are similar. This plant cell has features similar to other plant cells. 	Living things respond to the environment. Their response might be to another organism or to many other factors. 
Living things reproduce, grow, and repair themselves. Cells reproduce by dividing in two. New cells are needed for growth and repair. 	Living things have a life span. They exist for only a limited period of time.  
Living things require energy. Almost all plants get the energy they need from the Sun. Animals get the energy they need by eating plants, or by eating other animals that got their energy from plants. 	Living things produce waste. Your kidneys filter waste from your blood. 

Cell Theory

Cells are the basic unit of all living things. By looking closely at living things over the centuries, scientists have gathered a great deal of evidence to support what they call the **cell theory**. There are two main ideas in the cell theory:

- All living things are composed of one or more cells.
- All new cells arise only from cells that already exist.

The cell theory has proven very powerful for helping scientists understand the workings of the human body and the bodies of other animals and plants (**Figure 2**).

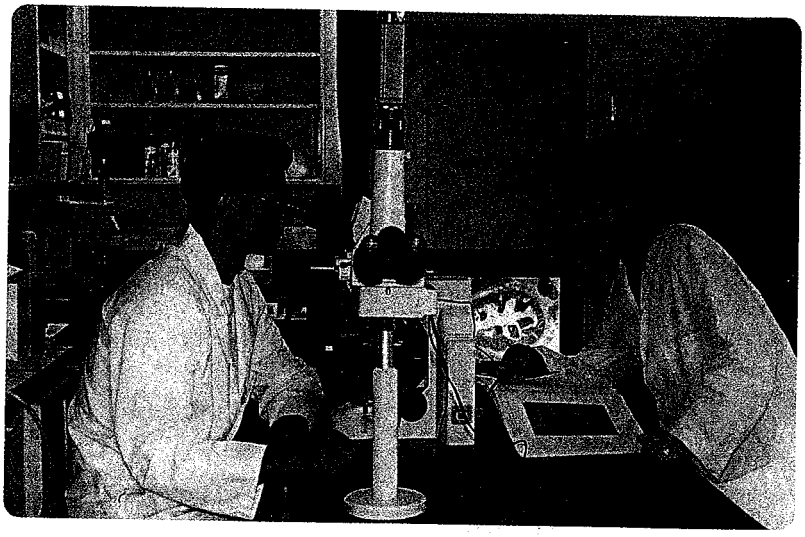


Figure 2
Scientists study cells to help them understand the human body, animals, and plants.

1.1 CHECK YOUR UNDERSTANDING

1. Are volcanoes living things? Explain.
2. Make a table listing the six characteristics of living things in one column. In the second column, next to each characteristic, suggest a non-living thing that shows the characteristic.
3. What are the important differences between living and non-living things?
4. Name at least one characteristic of living things that is shown in each of the following examples.
   (a) A plant bends toward the light.
   (b) A tadpole develops into a frog.
   (c) Human lungs breathe out carbon dioxide.
   (d) A blue jay feeds on sunflower seeds.
   (e) A cat gives birth to kittens.

PERFORMANCE TASK

In the Performance Task, you will create a model to represent a living cell or a group of living cells that work together. How might knowing the characteristics of living things help you to create models?

1.3 Plant and Animal Cells

"Because there are so many different kinds of organisms, there must be at least as many different kinds of cells." Do you agree with this hypothesis? Surprisingly, there are more similarities than differences among cells. The cells of all plants and the cells of all animals have many structures in common.

Using a microscope, it is quite easy to tell plant cells from animal cells, as you will discover. It is difficult to tell which plant cell came from which plant, however, and which animal cell came from which animal. It is much easier to tell what the cell does, and in what part of the animal or plant it is found.

Animal Cell Structures

Most animal cells have these structures.

The Nucleus

The **nucleus** is the control centre. It directs all of the cell's activities. In plant and animal cells, the nucleus is surrounded by a membrane. Cells with a nuclear membrane are known as **eukaryotic cells.** In some one-celled organisms, such as bacteria, the nucleus is not surrounded by a membrane. These cells are known as **prokaryotic cells.**

Chromosomes

Chromosomes are found inside the nucleus. **Chromosomes** contain DNA or genetic information, which holds "construction plans" for all the pieces of the cell. This genetic information is duplicated and passed on to other identical cells.

The Cell Membrane

The **cell membrane** holds the contents of the cell in place and acts like a gatekeeper, controlling the movement of materials, such as nutrients and waste, into and out of the cell. The cell membrane consists of a double layer of fat molecules.

The Cytoplasm

Most of the cell is **cytoplasm,** a watery fluid that contains everything inside the cell membrane and outside the nucleus. Many of the cell's chemical activities take place in the cytoplasm. The cytoplasm allows

materials to be transported quickly between the structures in the cell. The cytoplasm also stores wastes until they can be disposed of.

The Vacuole

Each vacuole is filled with fluid. A **vacuole** is used to store water and nutrients, such as sugar and minerals. A vacuole is also used to store waste and to move waste and excess water out of the cell.

The features of animal cells that you can see through a light microscope are shown in **Figure 1**.

LEARNING TIP

New vocabulary are often illustrated. When you come across a term you do not know, examine the pictures and diagrams, along with the captions.

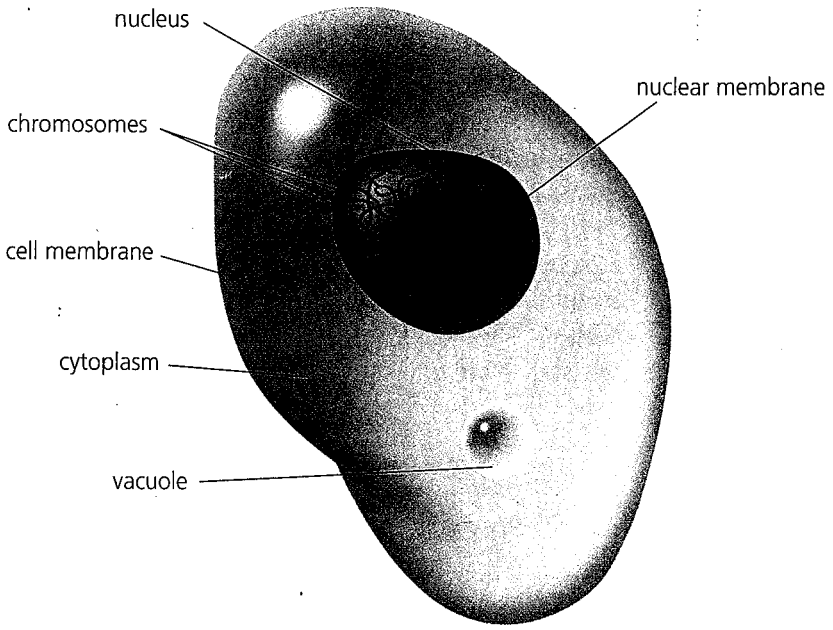


Figure 1
The structures of most animal cells that can be seen using a light microscope

Some animal cells must move or move their surrounding environment. They may have special structures that help them do this (**Figure 2**).

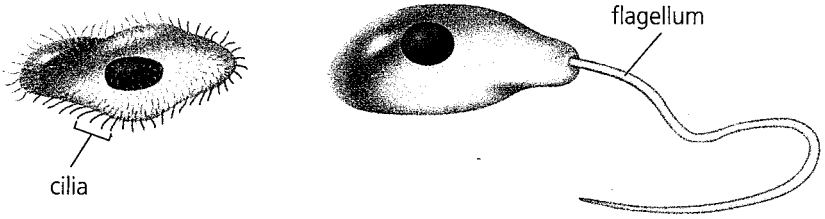


Figure 2
Some cells have structures that enable them to move or to move the environment around them.

The Flagellum

Some animal cells have a **flagellum**, or whip-like tail, that helps the cells to move. A flagellum is not found on all cells.

Cilia

Some special cells have **cilia**, or tiny hairs that work together to move a cell or to move the fluid surrounding the cell. Cilia are not found on all cells.

Plant Cell Structures

Plant cells contain the same features as animal cells, but they also have some special structures that are not found in animal cells (**Figure 3**). (As you look at a plant cell, it may appear that the cell does not have a cell membrane. The cell membrane is just hard to see.)

The Vacuole

Just as in animal cells, the vacuole is filled with water and nutrients. In a plant cell, however, the vacuole takes up a much larger part of the cytoplasm. The vacuole is used to store waste that is produced or absorbed by the plant.

▷ LEARNING TIP

Graphics help readers visualize the text. As you study **Figure 3**, ask yourself, "What is the purpose of the graphic? What am I supposed to notice and remember?"

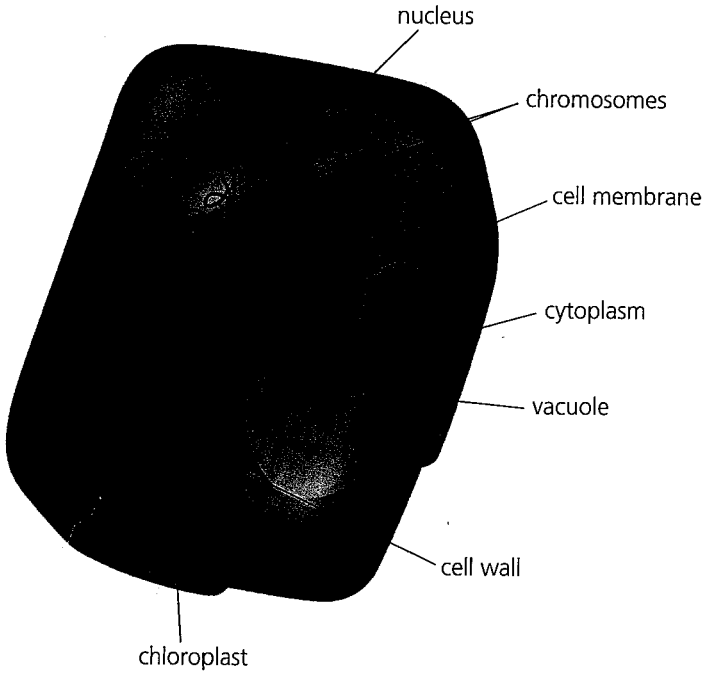


Figure 3
The structures of plant cells that can be seen using a light microscope

The Cell Wall

The **cell wall** protects and supports the plant cell. Some plant cells have a single cell wall, but others have a secondary cell wall that provides extra support and strength. Gases, water, and some minerals can pass through small pores (openings) in the cell wall.

Chloroplasts

Chloroplasts are the food factories of the plant cell. They contain many molecules of a green chemical called chlorophyll. Chlorophyll allows plant cells to make their own food, using light from the Sun, carbon dioxide, and water. Animal cells cannot do this.

1.3 CHECK YOUR UNDERSTANDING

1. Copy **Table 1** into your notebook. Fill in the function of each structure, and use a check mark to indicate which features are present in plant cells, animal cells, or both.

Structure	Function	Animal cell	Plant cell
nucleus	• control centre • directs cell activities		
chromosome			
cell membrane			
cytoplasm			
vacuole			
cell wall			
chloroplast			
flagellum			
cilia			

2. List the similarities and differences between plant and animal cell structures.
3. Where in a cell would you find genetic information?
4. A biologist finds a cell that appears to have two nuclei (plural of *nucleus*). What conclusion might you make about why this cell appears to have two nuclei?
5. Predict what might happen to a cell if the cell membrane was replaced by a plastic covering that prevented molecules from entering or leaving the cell.
6. Cilia also function to remove dirt and debris. Where in the human body might you find cells with cilia? Explain your answer.

LEARNING TIP

Do not guess. Look back through the section to find the answers. Even if you remember the answer, it is a good idea to go back and check it.

PERFORMANCE TASK

When you are building your model cell, what structures will you have to include? How can you represent these structures in your model?