CONCEPT 1

Scientists classify cells into two types based on the presence or absence of a nucleus.

Activity

Asking Questions About Cells

As a scientist, you observe the two cells shown in **Figure 1.10**. Record at least three observations you can make. What questions can you ask based on your observations? What hypothesis would you state based on your observations and questions? How would you test your hypothesis?

As scientists have studied millions of cells, they have developed criteria that let them classify all cells into two main types. These two types—prokaryotic cells and eukaryotic cells—are compared in **Figure 1.10**.

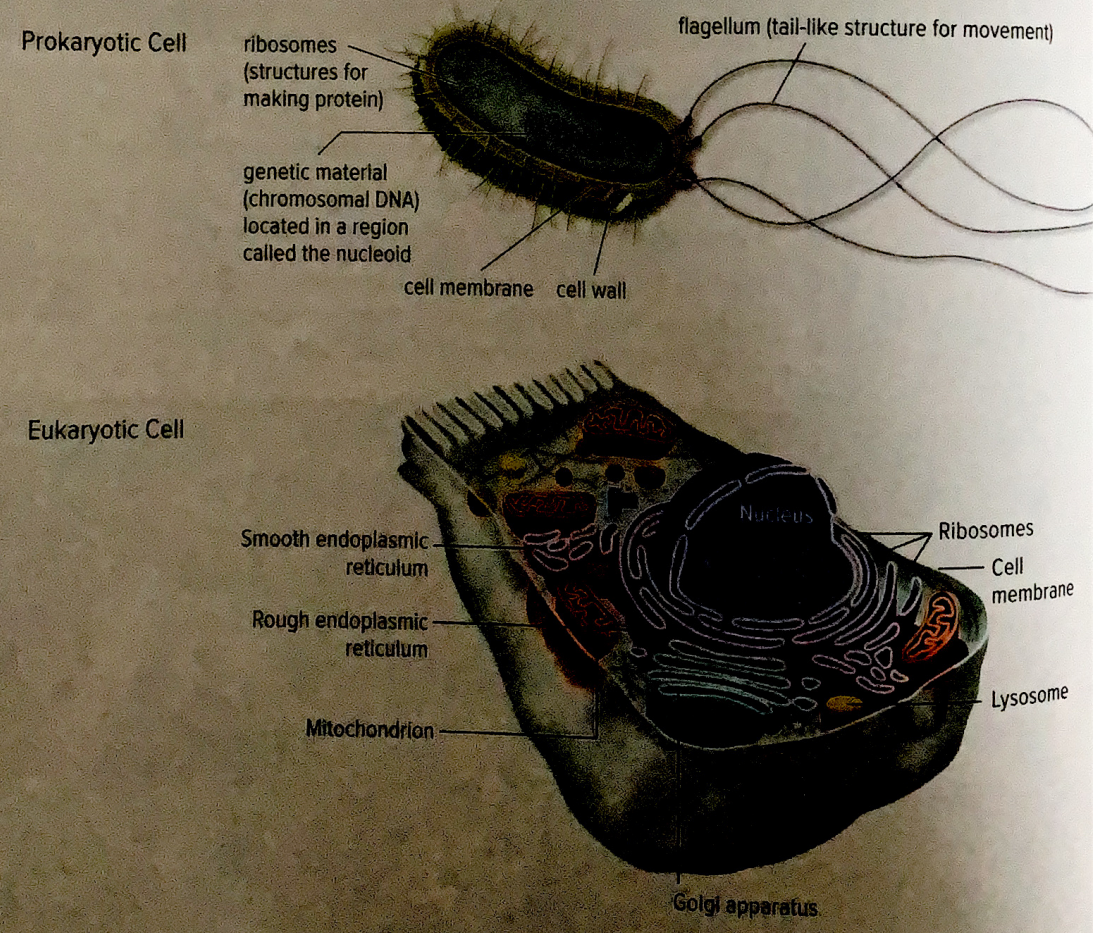


Figure 1.10 The two main types of cells

Prokaryotic Cells

A **prokaryotic cell** does not have a separate nucleus. In fact, the word prokaryotic comes from the words *pro-*, which means before, and *karyon*, which means nucleus. In addition to lacking a nucleus, prokaryotic cells are simpler than the other type of cells. They have fewer internal structures.

prokaryotic cell a type of cell without a nucleus and whose internal parts are not surrounded by membranes

Eukaryotic Cells

A **eukaryotic cell** has a nucleus, which contains the cell's genetic material. The nucleus is surrounded by a membrane. The *eu-* part of the word means proper, so a eukaryotic cell is one that has a proper or actual nucleus. Eukaryotic cells also contain other internal structures called organelles, which carry out cell processes. Eukaryotic cells are about 10 times as large as prokaryotic cells, and they are more complex. Table 1.2 compares these two types of cells.

eukaryotic cell a type of cell whose nucleus and other internal parts are surrounded by membranes

Table 1.2 Comparison of Prokaryotic and Eukaryotic Cells

Characteristic	Prokaryotic Cell	Eukaryotic Cell
Genetic material contained in nucleus surrounded by a membrane	no	yes
Organelles surrounded by membranes	no	yes
Size and complexity	smaller and less complex	about 10 times as large and more complex
Can carry out all processes needed to stay alive	yes	yes
Example	bacterium	liver cell of an animal

Activity

Cell Models

Build a model of an organism that either is or contains prokaryotic or eukaryotic cells. Use materials you bring from home, those provided by your teacher, or computer software to make your model. How can you connect the components of your model to the processes of life?

Before you leave this page . . .

1. Use a Venn diagram to compare and contrast prokaryotic and eukaryotic cells.
2. Write three statements that are true of both prokaryotic and eukaryotic cells.

CONCEPT 2

Bacteria are prokaryotic cells.

Activity

Describing Bacteria

Observe the different types of bacteria cells shown below. How would you describe each cell? How are they similar? How are they different?



Could you live in boiling water or super–salty lakes? You could if you belonged to the archaea. These prokaryotic organisms live in extreme environments. You may be more familiar with the other group of prokaryotic organisms: bacteria.

Bacteria

A typical bacterial cell looks like the prokaryotic cell in **Figure 1.10** (on page 24). It has a cell wall and a cell membrane that surround its jelly-like cytoplasm. Genetic material and protein-making structures called ribosomes float within the cytoplasm. Some bacteria have whip-like flagella for movement.

Archaea

Like bacteria, archaea lack a nucleus and have a cell wall. But there are some important differences between them. Molecules found in archaea are more like the molecules found in eukaryotic cells than those of bacterial cells. Archaea also have molecules in their cytoplasm that are not found in any other type of organism.

Before you leave this page . . .

1. Make a T-chart to compare and contrast bacteria and archaea.
2. What new questions do you have about bacteria and archaea?

CONCEPT 3

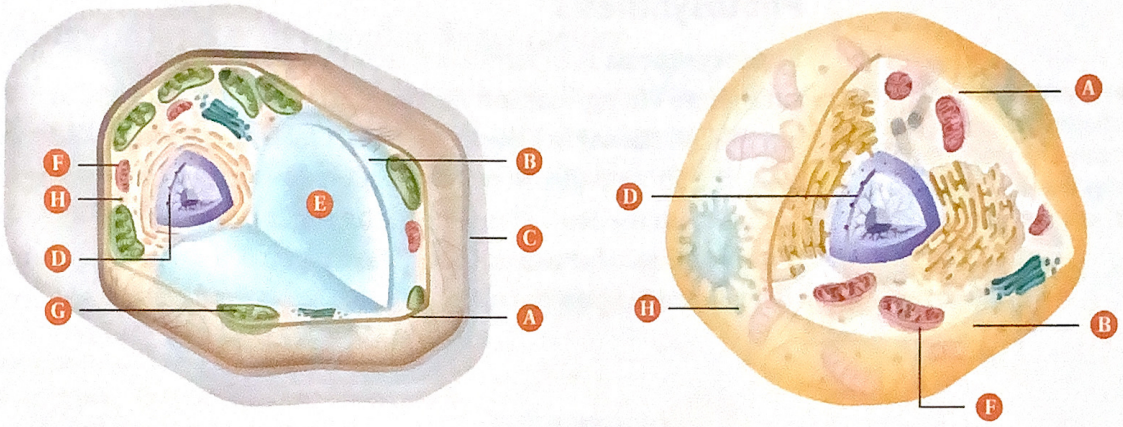
Plant and animal cells are eukaryotic cells.

Activity

Considering Plant and Animal Cells

Observe the plant and animal cells in **Figure 1.11**. Look at all the labelled features. Summarize the key similarities and differences.

Figure 1.11 shows the two main types of eukaryotic cells.



Cell Organelle	Structure and Function
A cell membrane	• surrounds and protects the contents of the cell • helps to control the movement of foods, wastes, and other substances into and out of the cell
B cytoplasm	• jelly-like fluid in which internal organelles float
C cell wall	• tough, rigid structure surrounding the cell membrane, giving plant cells a regular, box-like shape
D nucleus	• large, often round structure containing the genetic material that controls a cell's growth, reproduction, and other life-sustaining activities
E vacuoles	• balloon-like spaces within the cytoplasm to store wastes, food, and substances the cell cannot use right away • smaller and more numerous in animal cells
F mitochondria	• bean-shaped structures that release energy from food molecules to power cell processes
G chloroplasts	• structures containing chlorophyll (a green substance), which captures energy from the Sun to produce food (sugars) in the leaves and green stems of plants
H vesicles	• small sacs that transport materials and sometimes help materials enter and leave the cell

Figure 1.11 Some common organelles of plant and animal cells. Organelles help cells carry out their life processes.

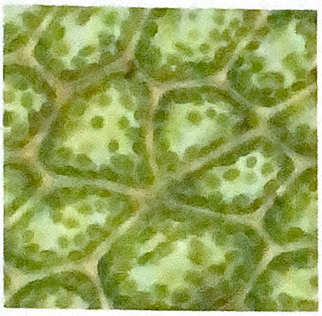


Figure 1.12 Chloroplasts are green-coloured structures in plant cells.

Plant Cells

Plant cells have organelles that carry out all of the processes needed for the whole plant to survive. Plant cells also have some structures that animal cells don't. Plant cells have thick, rigid cell walls to provide support. They also have a large vacuole, which is a structure that stores water and other substances.

Plant cells have a type of organelle that animal cells do not: the chloroplast. Chloroplasts, like the ones shown in **Figure 1.12**, capture the energy in sunlight. This energy is needed to power a process that takes place in chloroplasts: photosynthesis.

Photosynthesis

photosynthesis a chemical reaction in the cells of plants that converts the Sun's light energy into chemical energy that organisms can use

Photosynthesis is a chemical reaction that uses the energy of sunlight to change carbon dioxide and water into sugar and oxygen. As shown in **Figure 1.13**, plants take in carbon dioxide from the air and absorb water through their roots. Light energy comes from the Sun. Plants need the sugar produced by photosynthesis for use as food. The oxygen is a waste by-product that is released into the air.

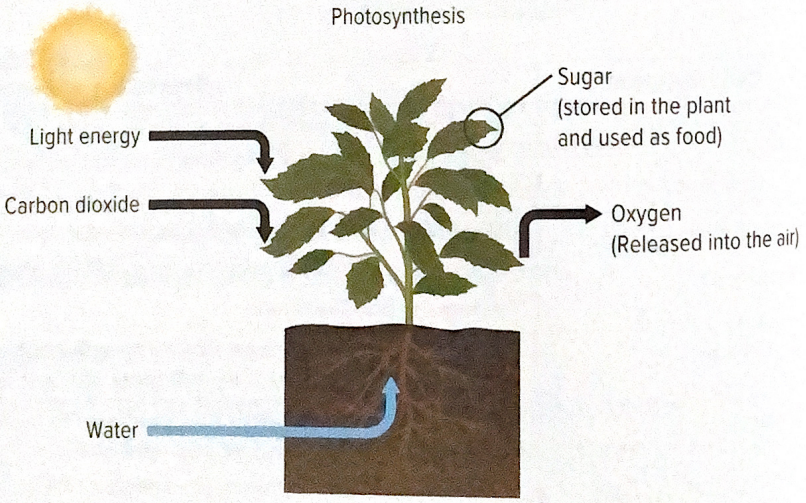


Figure 1.13 Photosynthesis converts the energy of sunlight into chemical energy (in the form of sugar).

Animal Cells

Animal cells have organelles that carry out all of the processes needed for the whole animal to survive. Animal cells have a cell membrane that controls the movement of substances into and out of a cell. Vesicles break down waste materials, which may be recycled or moved out of the cell.

In plant and animal cells, the nucleus directs cell activities and contains genetic material for reproduction. Plant and animal cells also have mitochondria. These organelles play a key role in another important life process called cellular respiration.

Connect to Investigation 1-B on Pages 34–35

Connect to Investigation 1-C on pages 36–37

Cellular Respiration

Cellular respiration is a chemical reaction in which sugar and oxygen in cells are changed into carbon dioxide and water. As part of this reaction, energy is released. The energy produced from cellular respiration is used by organisms to carry out life functions. Carbon dioxide and water are waste by-products.

cellular respiration a chemical reaction in the cells of most organisms that releases the energy needed to carry out life processes

Photosynthesis and Cellular Respiration

Figure 1.14 shows the relationship between photosynthesis and cellular respiration. These two processes function together as part of an important cycle. Most living things depend on this cycle to survive.

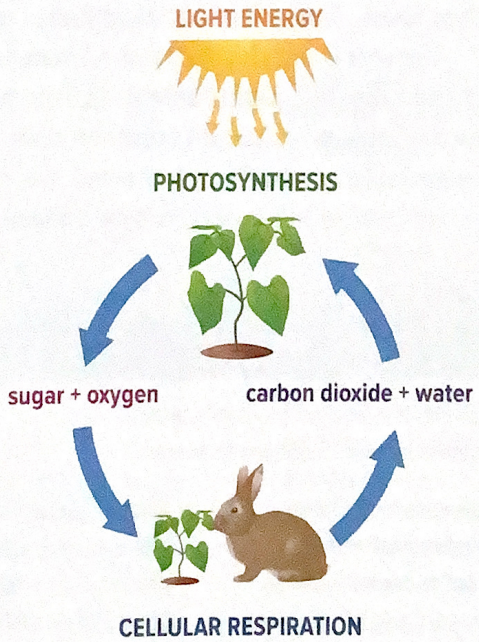


Figure 1.14 Photosynthesis stores energy, and cellular respiration releases energy. As well, each process makes the raw materials that the other process needs to store or release energy.

Plants and other organisms use the carbon dioxide and water produced by cellular respiration as part of photosynthesis.

Plants, animals, and other organisms use the sugar and oxygen produced by photosynthesis as part of cellular respiration.

Before you leave this page . . .

1. Identify and describe the key similarities and differences of plant and animal cells.
2. Explain how chloroplasts are related to cellular processes.
3. Some people describe photosynthesis and cellular respiration as the reverse of each other. Use well-reasoned arguments to explain why you agree or disagree with this idea.