

7.2 Cells: A Look Inside

Imagine a factory that makes thousands of cookies a day. Ingredients come into the factory, get mixed and baked, then the cookies are packaged. The factory has many parts that contribute to the process. Can you name some of those parts and their functions? A cell is a lot like a cookie factory. It too has many parts that contribute to its processes. Let's compare a cell to a cookie factory.

Comparing a cell to a cookie factory

Parts and functions A cookie factory has many parts. The cytoplasm of a cell has many *organelles*. Figure 7.6 shows a fictional cookie factory. A typical animal cell and its parts are shown on the next page. Table 7.1 compares a cookie factory to an animal cell. As you read this section, refer to the table to help you remember the cell parts and their functions.

Table 7.1: Comparing a cell and a cookie factory

Process	Cookie factory part	Cell part
Ingredients in/products out	Factory gate and doors	Cell membrane
Control center	Manager's office	Nucleus
Energy	Power plant	Mitochondria
Storage	Storage room	Vacuole
Making the product	Mixing/baking room	Ribosome
Transport of materials	Conveyer belts	Endoplasmic reticulum
Packaging and distribution	Shipping room	Golgi body
Clean up and recycling	Custodial staff	Lysosome
Structure/support	Walls and studs	Cytoskeleton

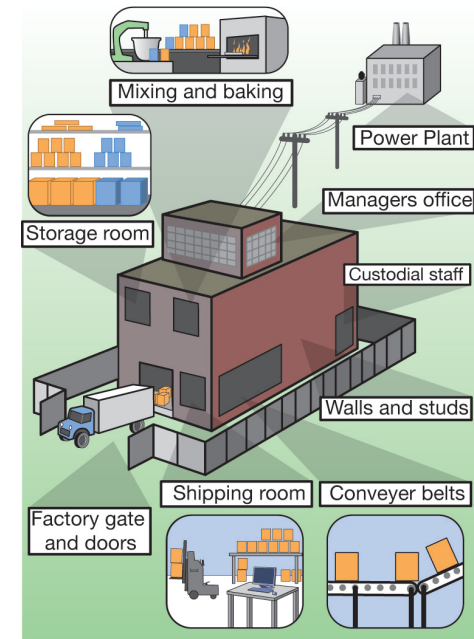


Figure 7.6: The parts of a cookie factory.

STUDY SKILLS

An **analogy** is a comparison of one thing to another different thing. The cookie factory is a good analogy for remembering cell parts and their functions. After reading this section, make another analogy comparing your school to a cell.

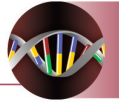
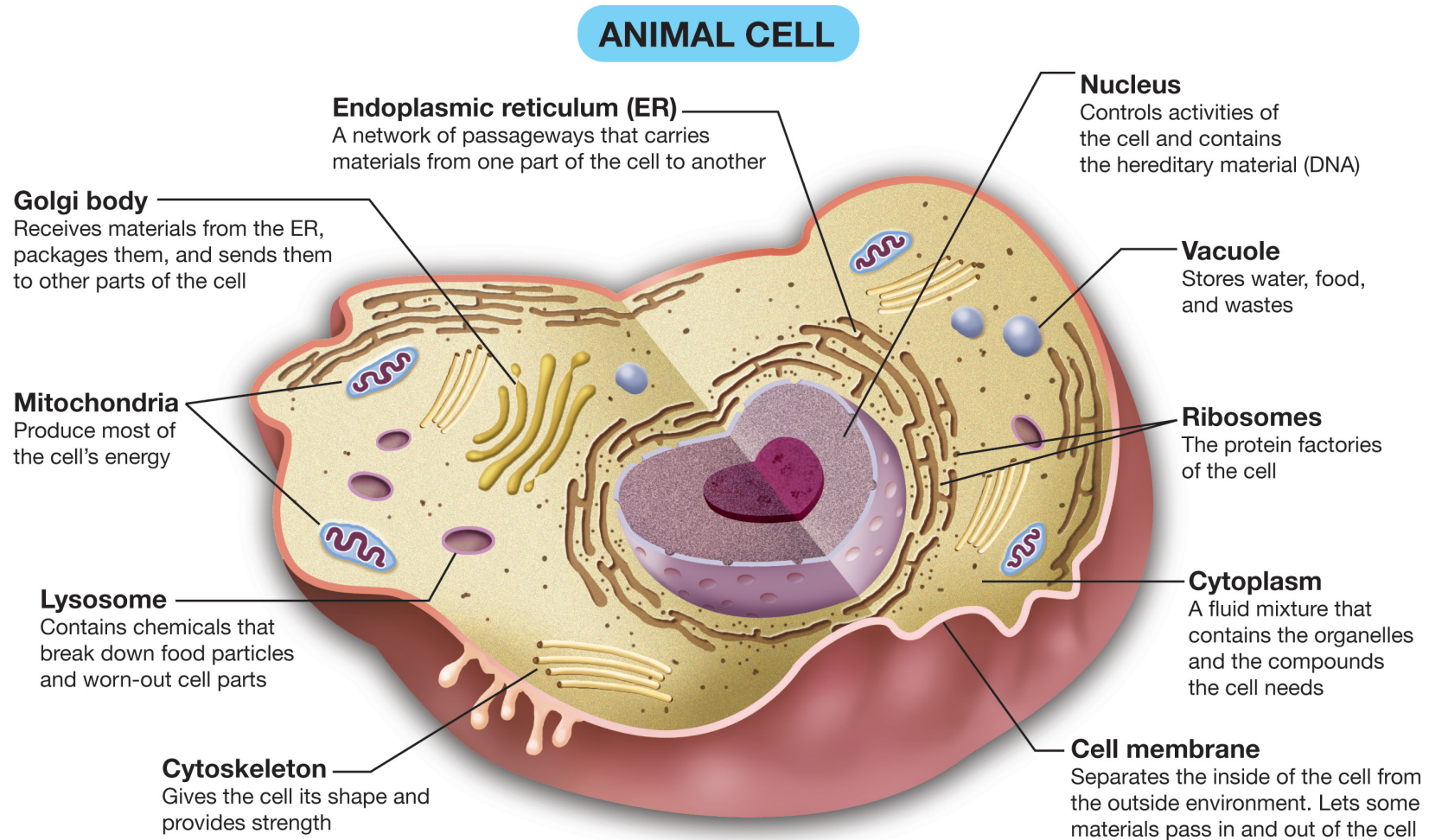


Diagram of an animal cell

The picture below is a schematic drawing of an animal cell. Under a microscope, you would not be able to see many of the organelles.



The cell membrane and nucleus

Looking at cells under a microscope To make cell parts visible under a microscope, you can apply a stain to the cells. A *stain* is a dye that binds to certain compounds in cells. Some stains bind to proteins while others bind to carbohydrates. Methylene blue is a stain often used to look at animal cells. It binds to proteins and makes the nucleus of the cell stand out. It also makes individual cells stand out by staining the cell membrane (Figure 7.7).

The cell membrane The cell membrane is a thin layer that separates the inside of the cell from its outside environment. It keeps the cytoplasm inside while letting waste products out. It also lets nutrients into the cell. It is made out of lipids and proteins.

The nucleus is the control center The most visible organelle in a eukaryotic cell is the nucleus. The nucleus is covered with a membrane that allows materials to pass in and out. It's often called the “control center” of the cell because it contains DNA. As you have learned, DNA is the hereditary material that carries all of the information on how to make the cell's proteins. You might say it's kind of like a recipe book.

The nucleolus If you look closely at the nucleus of a cell under a microscope, you may see an even darker spot. This spot is called the *nucleolus*. It acts as a storage area for materials that are used by other organelles.

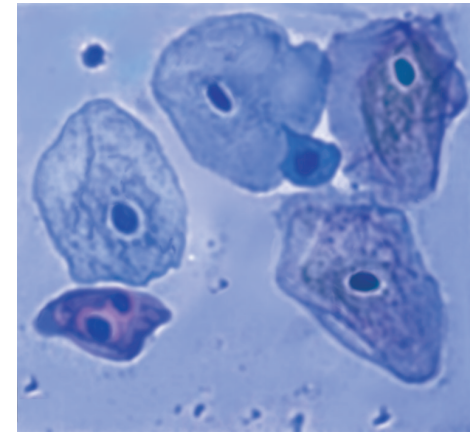
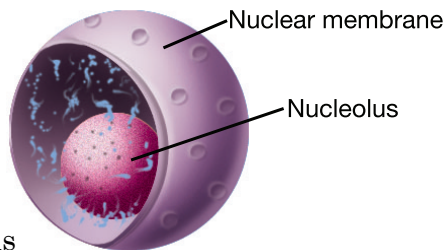
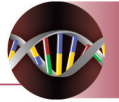


Figure 7.7: *These human cheek cells have been stained with methylene blue. How many cells do you see? Can you identify the nucleus in each cell?*

MY JOURNAL

Cells are not flat objects like they appear in this text. They are three-dimensional just like you are.

Find everyday objects that remind you of the different organelles inside of a cell. Collect those objects and make a table listing the object and the organelle it reminds you of.



Organelles and their functions

Seeing the other organelles Even with a powerful microscope, it's difficult to see organelles other than the nucleus. Scientists use different techniques like *fluorescence microscopy* to make organelles stand out. Figure 7.8 shows cells that have been treated to make the mitochondria stand out (the red dots).

Many discoveries about organelles were made using an *electron microscope*. This type of microscope uses tiny particles called *electrons*, instead of reflected light, to form images.

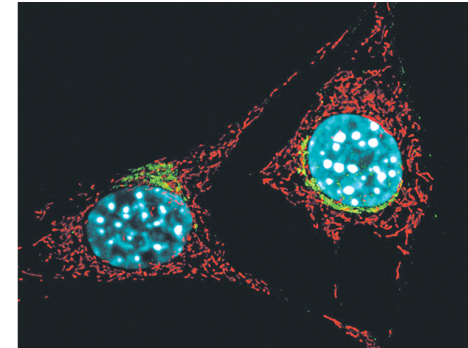
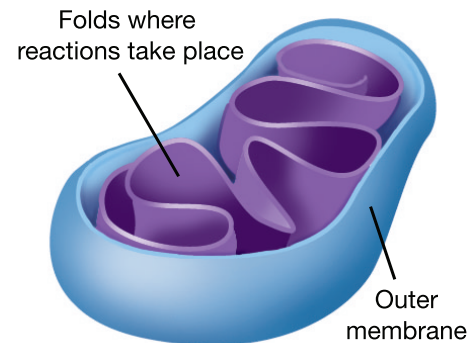


Figure 7.8: These mouse cells have been prepared to show mitochondria and the nucleus. The mitochondria appear as glowing red structures.

The mitochondria: powerhouses of the cell

The **mitochondria** are called the “powerhouses” of cells because they produce much of the energy a cell needs to carry out its functions. They are rod-shaped organelles surrounded by two membranes. The inner membrane contains many folds, where chemical reactions take place. Mitochondria can only work if they have oxygen. The reason you breathe air is to get enough oxygen for your mitochondria. Cells in active tissues—like muscle and liver cells—have the most mitochondria.



Mitochondria produce much of the energy a cell needs to carry out its functions.

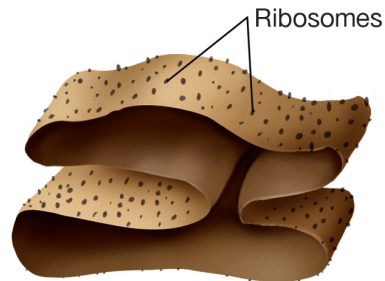
Vacuoles: storage areas of the cell In some animal cells, you will find small, fluid-filled sacs called vacuoles. A **vacuole** is the storage area of the cell. Vacuoles store water, food, and waste. Plant cells usually have one large vacuole that stores most of the water they need.

VOCABULARY

mitochondria - organelles that produces much of the energy a cell needs to carry out its functions.

vacuole - an organelle that stores food, water, and other materials needed by the cell.

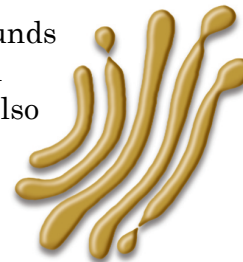
Endoplasmic reticulum The **endoplasmic reticulum** (ER) is a series of tunnels throughout the cytoplasm. They transport proteins from one part of the cell to another. You can think of the ER as a series of folded and connected tubes. There are different places to enter and exit in various locations.



Endoplasmic reticulum

Ribosomes If you look closely at the ER, you can sometimes see little round grains all around it. Each of those tiny grains is an individual ribosome. **Ribosomes** are the protein factories of the cell. When ribosomes make proteins, they release them into the ER. Some ribosomes are not attached to the ER, but float in the cytoplasm.

Golgi bodies **Golgi bodies** receive proteins and other compounds from the ER. They package these materials and distribute them to other parts of the cell. They also release materials outside of the cell. The number and size of Golgi bodies found in a cell depends on the quantity of compounds produced in the cell. The more compounds produced, the more and larger Golgi bodies there are. For example, a large number of Golgi bodies are found in cells that produce digestive enzymes.



Golgi body

Lysosomes **Lysosomes** contain enzymes that can break things down. Lysosomes pick up foreign invaders such as bacteria, food, and old organelles and break them into small pieces that can be reused.

Cytoskeleton The **cytoskeleton** is a series of fibers made from proteins. It provides structure to the cell and gives it its shape. Figure 7.9 shows a cell that has been treated so the cytoskeleton stands out.

VOCABULARY

endoplasmic reticulum - an organelle that transports proteins inside of the cell.

ribosome - an organelle that makes proteins.

Golgi body - an organelle that receives proteins, packages them, and distributes them.

lysosome - an organelle that contains enzymes that break things down to be reused by the cell.

cytoskeleton - a series of protein fibers inside of a cell that give structure and shape to the cell.

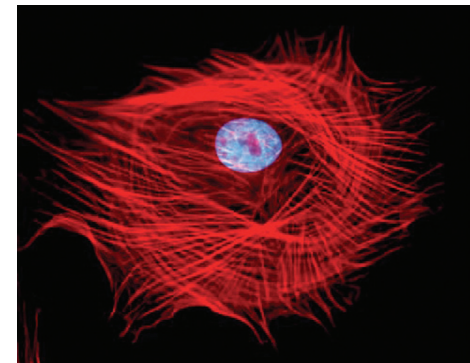


Figure 7.9: This cell was treated to make the cytoskeleton stand out.

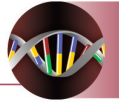
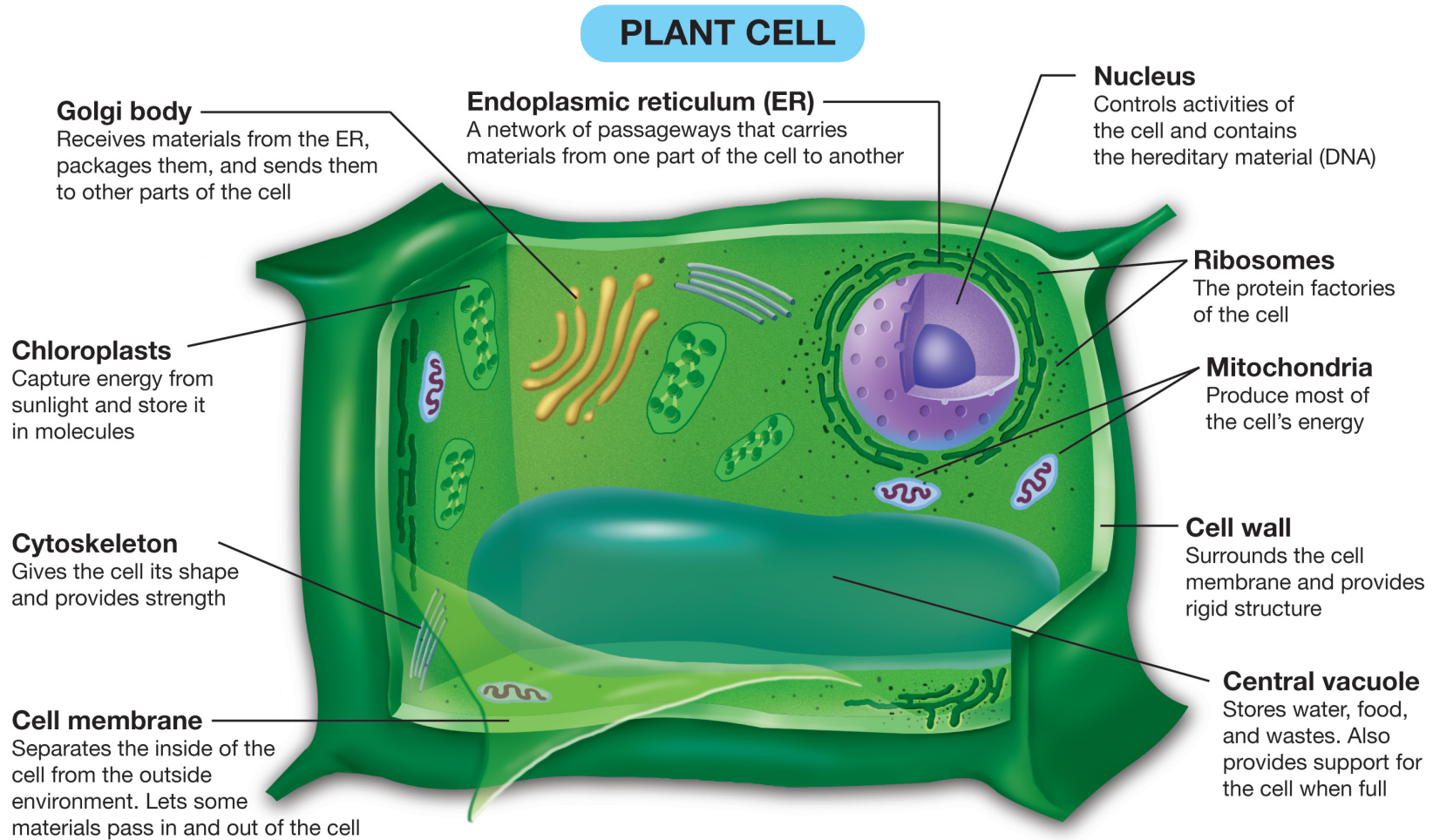


Diagram of a plant cell

Plant cells are different from animal cells. Here is a diagram of a typical plant cell.



How plant cells are different from animal cells

Figure 7.10 shows that plant and animal cells look very different. Their differences are described below.

Plant cells have chloroplasts Plant cells have chloroplasts, but animal cells do not. A **chloroplast** is an organelle that contains a pigment called *chlorophyll*. Chloroplasts are organelles that convert light energy into chemical energy in the form of molecules. This process is called *photosynthesis*.

Plant cells have a large, central vacuole Plant cells have a large central vacuole that stores *cell sap*. The major component of cell sap is water. Cell sap also consists of sugars, amino acids, and ions. When these vacuoles are full of cell sap, they help give plant cells their structure and rigidity.

Plant cells have a cell wall Plant cells have a cell wall, but animal cells do not. The **cell wall** is made of a carbohydrate called *cellulose*. Cell walls provide structure and support for the plant. Unlike the cell membrane, the cell wall is able to withstand high internal pressure. The buildup of water inside the central vacuole provides pressure against the cell wall. When a plant needs water it wilts because the central vacuoles in its cells are empty. They no longer push against the cell walls to keep the plant upright. Watering the plant restores water in the central vacuoles.

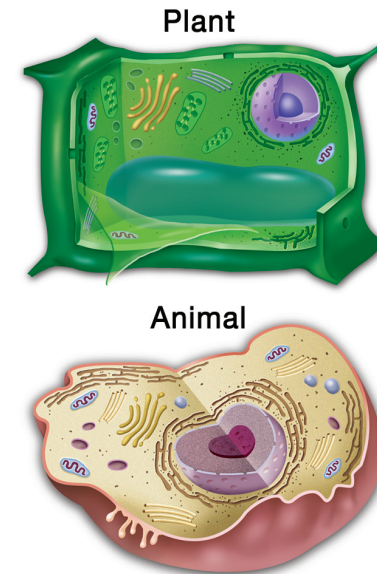
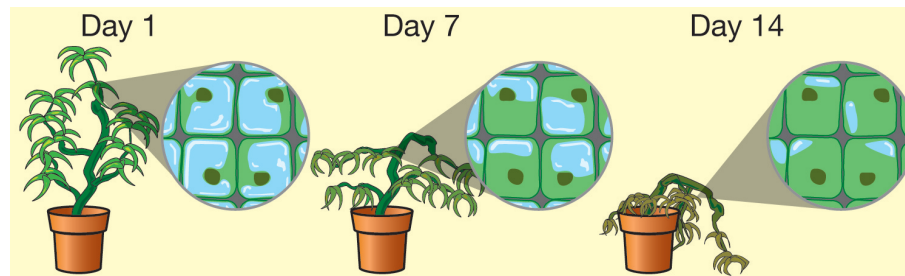


Figure 7.10: How are plant cells different from animal cells?

VOCABULARY

chloroplast - an organelle that converts light energy into chemical energy in the form of molecules.

cell wall - the outer layer of a plant cell that is made from cellulose and makes plant cells rigid.