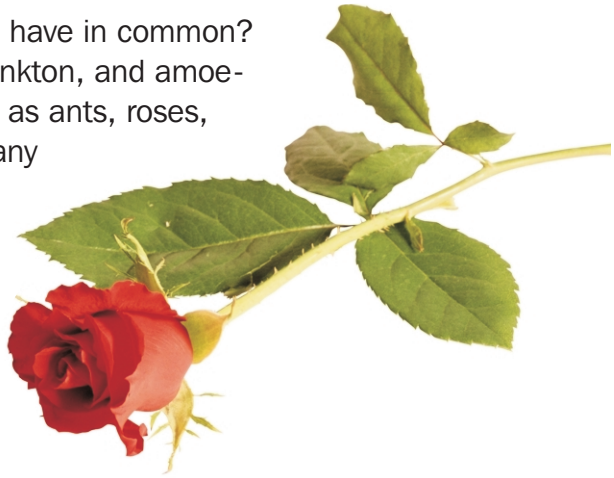
Plant Cell Structures



WHAT do bacteria, plankton, and amoebas have in common? Simple organisms, such as bacteria, plankton, and amoebas, are single cells. Complex organisms, such as ants, roses, redwood trees, and people, are made up of many cells. Most cells cannot be seen with the naked eye. Who can say how many cells make up your body or a large tree? Yet, despite the cells' small size, life's important activities take place within them.

Cells are remarkable microcosms of life. They convert energy from one form to another. They use energy to synthesize chemicals for growth and development and for mechanical activities. Cells are the building blocks for plants and animals.

Objective:

Identify the structures of a plant cell and their functions

Key Terms:

cell
cellulose
cell wall
chloroplast
chromatin
chromosome
cytoplasm
endoplasmic reticulum
gene
Golgi complex
mitochondrion
nucleolus

nucleus
organelle
plasma membrane
ribosome
rough endoplasmic reticulum
smooth endoplasmic reticulum
vacuole

Plant Cell Structures and Their Functions

The **cell** is the most basic unit of life. It is the smallest unit that can carry out functions of life. Plants have some different functions from animals, so it should come as no surprise that there are some structural differences at the cellular level. Three structural differences plant cells have from animal cells are cell walls, chloroplasts, and vacuoles. A discussion of these and other cell structures follows.

The feature that really defines a cell is the plasma membrane. A **plasma membrane** is a thin sheet that holds the contents of the cell together and serves as a protective barrier from the surrounding environment. While the plasma membrane restricts the movement of some mate-

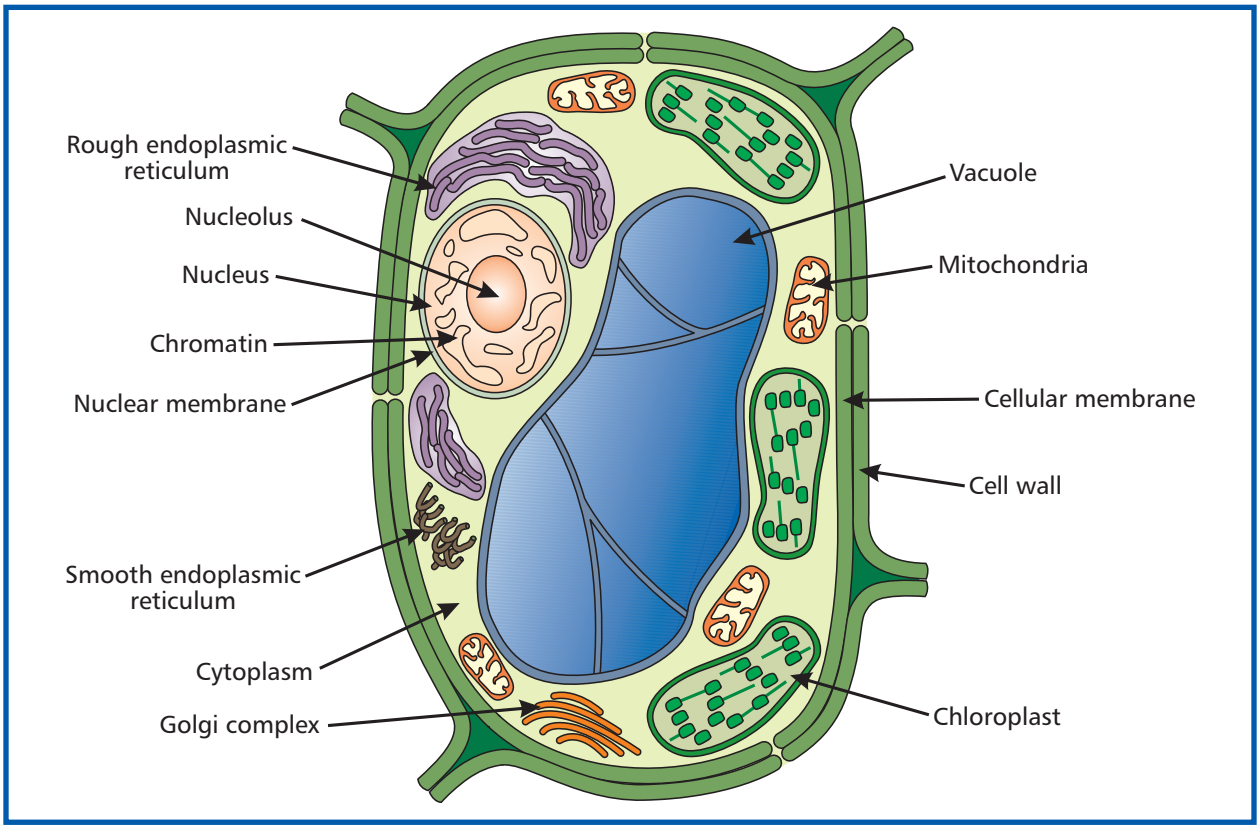


FIGURE 1. The plant cell and organelles.

rials, it allows and even initiates the movement of materials into and out of the cell. The plasma membrane also communicates with nearby cells.

A plant cell differs from an animal cell in that it has a **cell wall** on the outside of a plasma membrane. The cell wall is made of multiple layers of cellulose. **Cellulose** is a polysaccharide, or complex sugar molecule. The layers of cellulose offer great strength. Once a cell has stopped growing, the cell wall thickens and becomes rigid. It is the countless cell walls that provide the strength trees need to grow to great heights. The paper industry utilizes cellulose fibers from wood and fibrous crops in the making of paper.

Within the plasma membrane, the living material of the cell is found. This living material is referred to as the **cytoplasm**. Cytoplasm is the home to a number of specialized structures called **organelles**. Each organelle carries out an important duty for the cell.

A critical duty of a cell is the ability to control its functions and to determine its structures. This control and determination takes place in an organelle considered the command center of the cell, the **nucleus**. The nucleus holds the genetic information for a cell's activities within a nuclear envelope, or membrane. The genetic material is organized in structures called **chromosomes**. Chromosomes are made of chromatin. **Chromatin** is a complex of deoxyribonucleic acid, or DNA, molecules (35 percent), RNA (5 percent), and protein (60 percent). Segments of chromosomes, or **genes**, are units of hereditary data that dictate the activity and structure of a cell. Each chromosome contains thousands of genes. In addition, different types of plants have different numbers of chromosomes. For instance, corn has 20, wheat 42, cotton 52, potatoes 48, lettuce 18, alfalfa 32, and barley 14. A **nucleolus** is a specialized structure in a nucleus that is the site of ribosome synthesis.

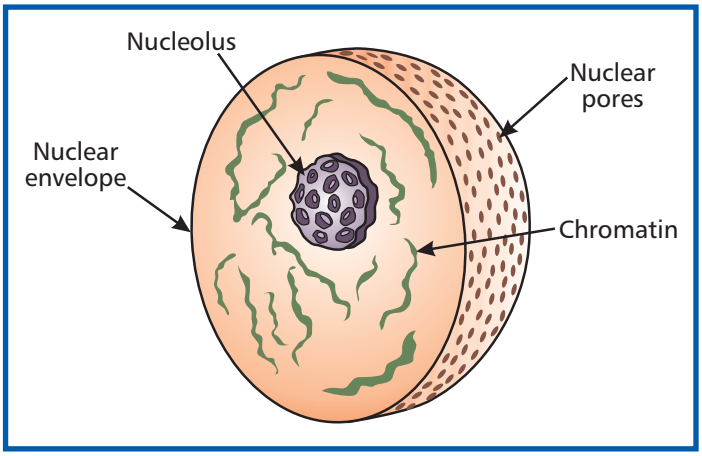


FIGURE 2. The nucleus is the command center of the cell.

UNDER INVESTIGATION...

LAB CONNECTION: Some Typical Plant Cells

It is easier to grasp the concept of cell organelles if you can actually see them. Prepared slides of plant cells can be obtained for viewing under a microscope. Look through the microscope. Begin with lowest power, increase to medium power, and then go to high power. Identify the different structures of the cells. Sketch your observations made with each power and label the cell parts. Some prepared slide sets are available that show the phases of cell division. View those and determine the stages of division.

Another option is to create your own slides by slicing thin layers of cells from plant tissue. Mount the tissue on slides for viewing. Onion epithelium works well. Experiment with different types of plant materials.

The life of the cell and the plant is dependent upon energy. Without energy to drive cell functions, life would cease to exist. **Chloroplasts** contain green pigments called chlorophyll that trap light energy for photosynthesis. Chloroplasts are found in cells exposed to light. They are abundant in leaf cells and absent from root cells. In the photosynthetic process, ATP and other compounds are made and then used to convert carbon dioxide to simple sugars. If signaled to do so by the nucleus of a cell, enzymes may convert the sugars to starches, lipids (fats), or other complex molecules.

Another type of organelle directly involved with the use of energy in the cell is the mitochondrion. **Mitochondria** convert sugars into energy through cellular respiration. It is with mitochondria that the plant is able to convert the food it has made and stored back into a form of energy. Glucose, starches, and lipids are transformed, releasing energy in the form of ATP.

The **endoplasmic reticulum** (ER) is an internal network of membranes extending throughout the cytoplasm. The endoplasmic reticulum contains many types of enzymes that catalyze different types of chemical reactions. There are two distinct forms of endoplasmic reticulum, the smooth and the rough. The **smooth endoplasmic reticulum** is the site for the production of lipids (fats) and hormones. It is also a site that breaks down toxic chemicals. The **rough endoplasmic reticulum** is the site that produces proteins for the cell secretion and cell membranes. The endoplasmic reticulum is studded with beadlike structures called **ribosomes**. The ribosomes are the major sites for the assembly and production of cell proteins.

Proteins are processed, sorted, or modified in the **Golgi complex**. The result is the complex molecules needed for plant growth. Many proteins manufactured in the ER pass through the Golgi complex. Frequently, the proteins are combined with carbohydrates and sugars.

A plant cell has an organelle called the vacuole. The **vacuole** is a large sac bound by a membrane. It may occupy up to 90 percent of the cell. It serves to transport and store water, foods, salts, minerals, pigments, and wastes.

Summary:

The cell is the most basic unit of life. It is the smallest unit that can carry out functions of life. Plant cells differ from animal cells in that they have cell walls, chloroplasts, and vacuoles. Within the cell wall, living material referred to as the cytoplasm is found. The cytoplasm contains a number of specialized structures called organelles. Each organelle carries out an important duty for the cell.

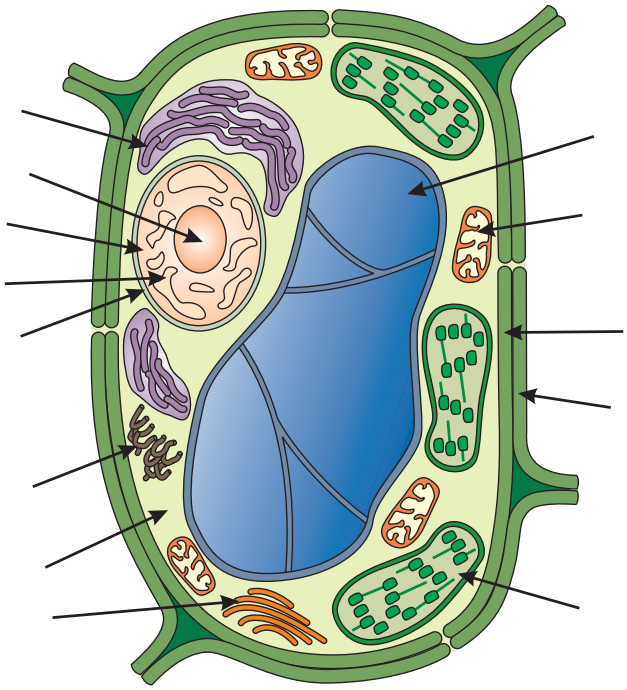
Molecular biology, the study of molecules related to genes and heredity, takes place in the cell. The command center of the cell is the nucleus. The nucleus holds the genetic information in structures called chromosomes. Chromosomes are made of chromatin. Chromatin consists of deoxyribonucleic acid, or DNA, molecules, RNA, and protein. Genes are segments of chromosomes that dictate the activity and structure of a cell.

Checking Your Knowledge:

1. What are the major organelles in a plant cell?
2. What are the functions of the organelles?
3. What is the difference between the nucleus and the nucleolus?

Expanding Your Knowledge:

Without looking at Figure 1, label the organelles of a plant cell on this drawing. Then, check your answers against Figure 1.



Web Links:

CellsAlive.com—Plant Cells

http://www.cellsalive.com/cells/plntcell.htm

Enchanted Learning—Plant Cell Anatomy

http://www.enchantedlearning.com/subjects/plants/cell/