Chapter 7

Cell Structure and Function

Section Objectives:

- Relate advances in microscope technology to discoveries about cells and cell structure.
- Compare the operation of a microscope with that of an electron microscope.
- Identify the main ideas of the cell theory.

The History of the Cell Theory

- Before microscopes were invented, people believed that diseases were caused by curses and supernatural spirits.
- As scientists began using microscopes, they quickly realized they were entering a new world–one of microorganisms.
- Microscopes enabled scientists to view and study cells, the basic units of living organisms.

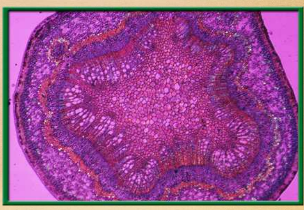
Development of Light Microscopes

- The first person to record looking at water under a microscope was Anton van ***Leeuwenhoek***.
- The microscope van Leeuwenhoek used is considered a simple light microscope because it contained one lens and used natural light to view objects.

Development of Light Microscopes

Compound light microscopes use a series of lenses to magnify objects in steps.

These microscopes can magnify objects up to 1 500 times.



Microscope Lab Techniques

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The Cell Theory

- Robert Hooke was an English scientist who lived at the same time as van Leeuwenhock.
- Hooke used a compound light microscope to study cork, the dead cells of oak bark.

Cells are the basic building blocks of all living things.

The cell theory is made up of three main ideas:

1. All organisms are composed of one or more cells.
2. The cell is the basic unit of organization of organisms.
3. All cells come from preexisting cells.

Development of Electron Microscopes

- The electron microscope was invented in the 1940s.
- This microscope uses a beam of electrons to magnify structures up to 500 000 times their actual size.

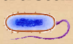
Development of Electron Microscopes

There are two basic types of electron microscopes.

1. The scanning electron microscope scans the surface of cells to learn their three dimensional shape.

2. The transmission electron microscope allows scientists to study the structures contained within a cell.

Two Basic Cell Types

Cells that do not contain internal membrane-bound structures are called **prokaryotic cells**. 

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- The cells of most unicellular organisms such as bacteria do not have membrane bound structures and are therefore called prokaryotes.

Two Basic Cell Types

Cells containing membrane-bound structures are called **eukaryotic cells**. 

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- Most of the multi-cellular plants and animals we know are made up of cells containing membrane-bound structures and are therefore called eukaryotes.

Two Basic Cell Types

The membrane-bound structures within eukaryotic cells are called **organelles**.

- Each organelle has a specific function that contributes to cell survival.

Two Basic Cell Types

- Separation of organelles into distinct compartments benefits the eukaryotic cells.

The **nucleus** is the central membrane-bound organelle that manages cellular functions.

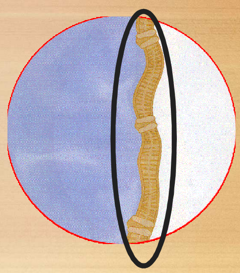
Section Objectives

- Explain how a cell’s plasma membrane functions.
- Relate the function of the plasma membrane to the fluid mosaic model.

All living cells must maintain a balance regardless of internal and external conditions. Survival depends on the cell's ability to maintain the proper conditions within itself.

Why cells must control materials

The **plasma membrane** is the boundary between the cell and its environment.

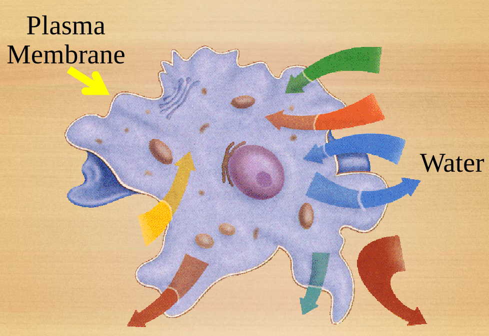


It is the plasma membrane's job to:

- allow a steady supply of glucose, amino acids, and lipids to come into the cell no matter what the external conditions are.
- remove excess amounts of these nutrients when levels get so high that they are harmful.
- allow waste and other products to leave the cell.

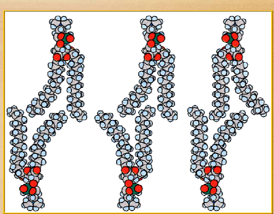
This process of maintaining the cell's environment is called homeostasis.

Selective permeability is a process used to maintain homeostasis in which the plasma membrane allows some molecules into the cell while keeping others out.



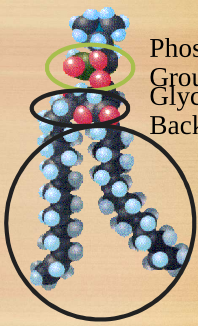
Structure of the Plasma Membrane

The plasma membrane is composed of two layers of phospholipids back-to-back.



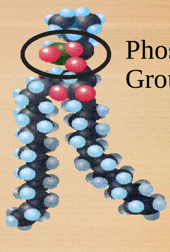
Phospholipids are lipids with a phosphate attached to them.

The lipids in a plasma membrane have a glycerol backbone, two fatty acid chains, and a phosphate group.



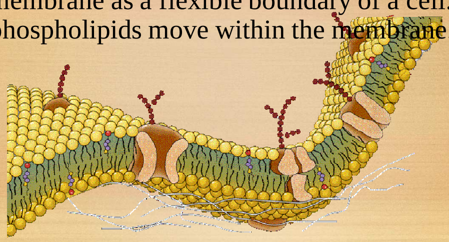
Makeup of the phospholipid bilayer

The phosphate group is critical for the formation and function of the plasma membrane.



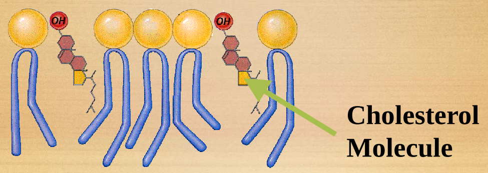
Makeup of the phospholipid bilayer

The **fluid mosaic model** describes the plasma membrane as a flexible boundary of a cell. The phospholipids move within the membrane.



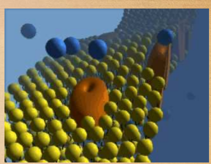
Other components of the plasma membrane:

Cholesterol plays the important role of preventing the fatty acid chains of the phospholipids from sticking together.



Other components of the plasma membrane:

Transport proteins allow needed substances or waste materials to move through the plasma membrane.



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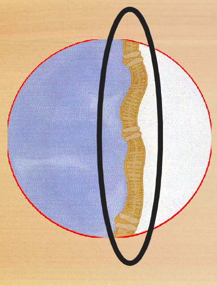
Section Objectives

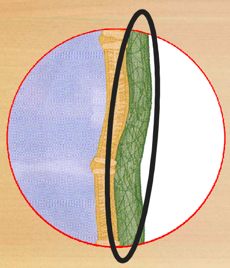
- Understand the structure and function of the parts of a typical eukaryotic cell.
- Explain the advantages of highly folded membranes.
- Compare and contrast the structures of plant and animal cells.

Cellular Boundaries



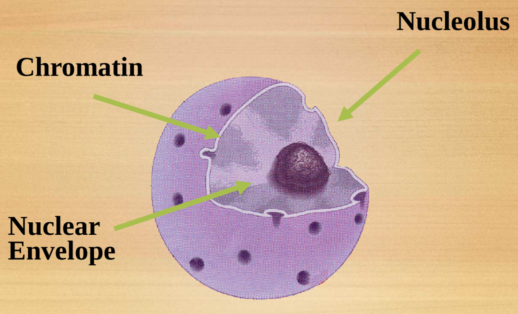
The plasma membrane acts as a selectively permeable membrane.

The cell wall



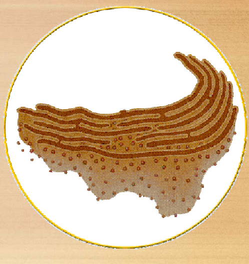
The **cell wall** is a fairly rigid structure located outside the plasma membrane that provides additional support and protection.

Nucleus and cell control

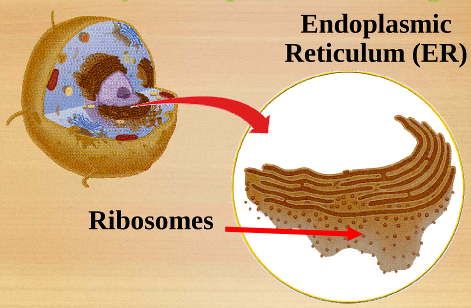


Assembly, Transport, and Storage

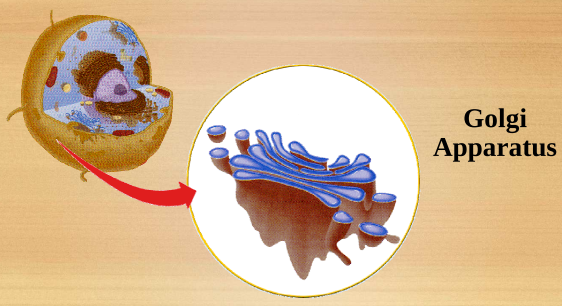
The **endoplasmic reticulum (ER)** is an organelle that is suspended in the cytoplasm and is the site of cellular chemical reactions.



Assembly, Transport, and Storage

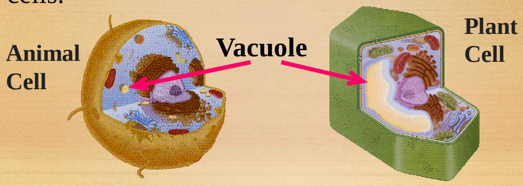


Assembly, Transport, and Storage



Vacuoles and storage

Vacuoles are membrane-bound spaces used for temporary storage of materials. Notice the difference between vacuoles in plant and animal cells.

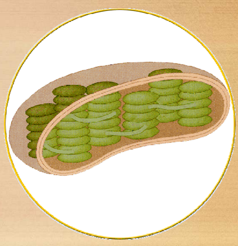


Lysosomes and recycling

Lysosomes are organelles that contain digestive enzymes. They digest excess or worn out organelles, food particles, and engulfed viruses or bacteria.

Energy Transformers: Chloroplasts and energy

Chloroplasts are cell organelles that capture light energy and produce food to store for a later time.



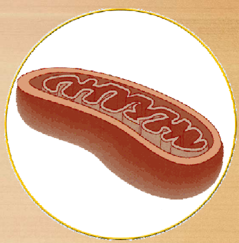
Chloroplasts and energy

The chloroplasts belongs to a group of plant organelles called **plastids**, which are used for storage.

Chloroplasts contain green pigment called chlorophyll. Chlorophyll traps light energy and gives leaves and stems their green color.

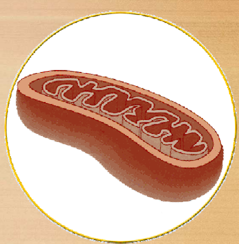
Mitochondria and energy

Mitochondria are membrane-bound organelles in plant and animal cells that transform energy for the cell.



Mitochondria and energy

A mitochondria, like the endoplasmic reticulum, has a highly folded inner membrane. Energy storing molecules are produced on inner folds.



Structures for Support and Locomotion

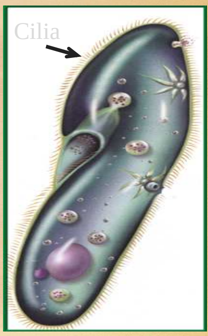
Cells have a support structure called the **cytoskeleton** within the cytoplasm. The cytoskeleton is composed of microtubules and microfilaments. Microtubules are thin, hollow cylinders made of protein and microfilaments are thin solid protein fibers.

Cilia and flagella

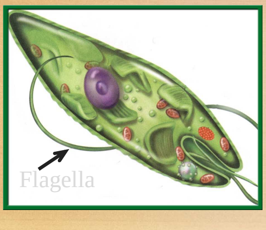
Some cell surfaces have cilia and flagella, which are structures that aid in locomotion or feeding. Cilia and flagella can be distinguished by their structure and by the nature of their action.

Cilia and flagella

Cilia are short, numerous, hair-like projections that move in a wavelike motion.



Cilia and flagella



Flagella are long projections that move in a whip-like motion. Flagella and cilia are the major means of locomotion in unicellular organisms.