

# Structure and Function of the Cell

## 1: Introduction to the Cell

- **Cell**: the smallest unit that can carry on all the processes of life.
  - unicellular organisms & multicellular organisms
- **Discovery of the Cell**
  - Invention of the lens in the 1600s
  - Robert Hooke: In 1665, he observed a thin slice of cork (dead plant cells) with a microscope. He described what he observed as “little boxes” (cells).
  - Anton van Leeuwenhoek: In 1675, he was the first person to observe living cells.
- **Microscopes**: instruments that can form an enlarged image of the object or specimen being viewed
  - Magnification: refers to the microscope’s power to increase an object’s apparent size
  - Resolution: refers to the microscope’s power to show detail clearly
  - Three Types of Microscopes
    - Light Microscope: a beam of light passes through two lenses to produce an enlarged image of the object or specimen being viewed
      - The most powerful light microscopes can magnify an object about 2,000 times.
      - Scientists use light microscopes to observe living organisms and preserved cells
    - Transmission Electron Microscope (TEM): transmits a beam of electrons through a very thinly sliced specimen
      - TEMs can magnify objects up to 2,000,000 times.
    - Scanning Electron Microscope (SEM): scans the surface of an object with a beam of electrons
      - SEMs produce a 3-D image of the object.
      - SEMs can magnify objects up to 50,000 times.
- **The Cell Theory**
  - Matthias Schleiden (1838): concluded that all plants are composed of cells
  - Theodor Schwann (1839): concluded that all animals are composed of cells
  - Rudolph Virchow (1855): determined that cells come only from other cells
  - 1. All living things are composed of one or more cells
  - 2. Cells are organisms’ basic units of structure and function.
  - 3. Cells come only from existing cells.
- **Cell Diversity**
  - Size
    - Cells range in size from 2 m long (nerve cells that extend down a giraffe’s leg) to 0.2 micrometer ( $\mu\text{m}$ ) (some bacteria)
    - Most plant and animal cells are about 10 to 50  $\mu\text{m}$  in diameter.
    - ❖ Cell size is limited by two factors:
      - Surface Area to Volume Ratio (SA/V)
        - Cells are limited in size by the ratio between their volume and its outer surface area.
        - The food, oxygen, and other materials a cell requires must enter through its surface. Likewise, waste products must leave through its surface.
        - The larger the cell, the larger the surface area required to maintain it.
        - As a cell grows, its volume increases more rapidly than its surface area does.
        - As a cell grows larger, its surface area becomes too small to maintain life functions.
    - The distance of the nucleus from the cell membrane and the activity of the nucleus.

- Shape
  - Cells differ widely in shape.
  - Most cells are roughly cuboidal or spherical.
- Internal Organization
  - Nucleus: contains DNA which directs the activity of the cell
  - Organelle: a cell component that performs specific functions in the cell
  - Eukaryotes: cells that contain a nucleus and membrane-bound organelles
    - Examples: animals, plants, fungi, protozoa, and algae
  - Prokaryotes: cells that lack nuclei and membrane-bound organelles
    - Examples: bacteria and related microorganisms

## 2: Parts of the Cell

- Each living cell carries out the tasks of taking food, transforming food into energy, getting rid of wastes, and reproducing.
- Most eukaryotic cells have three main components:
  - The **cell membrane** is the outer boundary of the cell and separates the cell from its surroundings and other cells.
  - The **cytoplasm** lies inside the cell membrane, contains water and salts, and surrounds organelles.
  - The **nucleus** contains DNA and directs the activities of the cell.

### Cell Membrane

- The cell membrane is the structure that separates the cell from the external environment, and gives shape and flexibility to the cell.
- **selectively permeable**: the property of a membrane that allows some materials to pass through while preventing others
- **Fluid Mosaic Model**: like a mosaic, the cell membrane has a design consisting of a repetitive pattern, the phospholipid molecules in the lipid bilayer, interspersed with pieces of various shapes and styles, the proteins.
- The cell membrane is a **phospholipid bilayer**.
- Other components of the cell membrane:
  - cholesterol: provides some rigidity to the bilayer
  - proteins: function as channels, receptors, and markers
    - integral proteins (through membrane)
    - peripheral proteins (inside or outside membrane)

### **The Structure and Function of the following organelles will be discussed:**

Nucleus	Cell Wall	Cytoplasm
Cytoskeleton	Ribosomes	Endoplasmic Reticulum
Golgi Apparatus	Mitochondria	Lysosomes
Peroxisomes	Cilia and Flagella	Basal Bodies
Centrioles	Vacuoles	Plastids