Introduction to Cells

- **Definition:** A cell is the basic structural, functional, and biological unit of all living organisms. It is the smallest unit of life that can replicate independently.
- **Discovery:** Robert Hooke first discovered cells in 1665 when he observed a slice of cork under a microscope.

Types of Cells:

1. **Prokaryotic Cells:**
   - Found in bacteria and archaea.
   - Lack a true nucleus and membrane-bound organelles.
   - Genetic material (DNA) is present in the nucleoid region.
2. **Eukaryotic Cells:**
   - Found in plants, animals, fungi, and protists.
   - Contain a nucleus and membrane-bound organelles.
   - Larger and more complex than prokaryotic cells.

Cell Structure and Organelles

Organelles are specialized structures within a cell that perform distinct processes. Let’s dive into each one:

1. Plasma Membrane (Cell Membrane):

- **Structure:** A semi-permeable lipid bilayer composed of phospholipids, proteins, and carbohydrates.
- **Function:** Regulates the entry and exit of substances, maintains homeostasis, and facilitates communication between cells.

2. Cytoplasm:

- **Structure:** A jelly-like fluid inside the cell, containing organelles and the cytoskeleton.
- **Function:** Supports and suspends organelles, assists in cellular processes like glycolysis.

3. Nucleus:

- **Structure:** Enclosed by a double membrane (nuclear envelope), contains nuclear pores for material exchange.
- **Function:** Houses DNA, controls cell activities like growth, metabolism, and reproduction.

4. Mitochondria:

- **Structure:** Double-membraned organelle; the inner membrane is folded into cristae.
- **Function:** Known as the powerhouse of the cell, it produces ATP (energy) through cellular respiration.

5. Endoplasmic Reticulum (ER):

- **Rough ER (RER):** Studded with ribosomes, involved in protein synthesis.
- **Smooth ER (SER):** Lacks ribosomes, synthesizes lipids and detoxifies drugs.

6. Ribosomes:

- **Structure:** Small, spherical structures composed of RNA and proteins.
- **Function:** Sites of protein synthesis, found floating in cytoplasm or attached to RER.

7. Golgi Apparatus (Golgi Complex):

- **Structure:** Stacked, flattened membrane-bound sacs.
- **Function:** Modifies, sorts, and packages proteins and lipids for storage or transport out of the cell.

8. Lysosomes:

- **Structure:** Membrane-bound sacs containing digestive enzymes.
- **Function:** Break down cellular waste, damaged organelles, and invading pathogens (the “suicide bags” of the cell).

9. Peroxisomes:

- **Structure:** Small vesicles containing oxidative enzymes.
- **Function:** Detoxify harmful substances (like hydrogen peroxide) and participate in lipid metabolism.

10. Cytoskeleton:

- **Structure:** Network of protein filaments (microtubules, microfilaments, intermediate filaments).
- **Function:** Maintains cell shape, aids in movement (cilia, flagella), and organizes cell

components.

11. Centrioles (in animal cells):

- **Structure:** Cylindrical structures made of microtubules.
- **Function:** Help organize spindle fibers during cell division (mitosis).

12. Vacuoles:

- **Structure:** Membrane-bound sacs (larger in plant cells).
- **Function:** Store nutrients, waste products, and water; maintain turgor pressure in plant cells.

13. Chloroplasts (in plant cells):

- **Structure:** Double-membraned organelle containing chlorophyll.
- **Function:** Conduct photosynthesis, converting solar energy into chemical energy (glucose).

14. Cell Wall (in plant cells, fungi, bacteria):

- **Structure:** Rigid layer made of cellulose (plants), chitin (fungi), or peptidoglycan (bacteria).
- **Function:** Provides protection, structural support, and prevents excessive water intake.

Key Differences Between Plant and Animal Cells:

Feature	Plant Cell	Animal Cell
Cell Wall	Present (cellulose)	Absent
Chloroplasts	Present (photosynthesis)	Absent
Vacuole	Large, central vacuole	Small, scattered vacuoles
Centrioles	Absent (except lower plants)	Present (help in mitosis)
Shape	Rectangular or square	Rounded or irregular

Conclusion:

Cells are the fundamental units of life, and their organelles work in harmony to ensure smooth cellular function — from energy production and protein synthesis to waste management and genetic information storage. Understanding cells helps us grasp the basics of biology and biotechnology, playing a crucial role in medical advancements and environmental science.