



Notes: Chapter 5 - The Fundamental Unit of Life

• Introduction to Cells

- **Cell:** The basic structural and functional unit of life.
 - **Discovery:** Robert Hooke discovered cells in 1665 while observing a cork slice under a microscope.
 - **Cell Theory:**
 - All living organisms are made up of cells.
 - The cell is the basic unit of life.
 - All cells arise from pre-existing cells (Virchow).

Practice Questions:

1. What is a cell? Who discovered it and how?
2. State the main points of the cell theory.
3. How did Robert Hooke's discovery contribute to biology?

Revision Points:

- Cells are the basic unit of structure and function in all living organisms.
- The cell theory states that all living things are made of cells, and new cells arise from existing cells.

• Types of Cells

◦ Prokaryotic Cells:

- **Definition:** Cells that lack a well-defined nucleus and membrane-bound organelles.
 - **Example:** Bacteria.
 - **Characteristics:**
 - Genetic material is not enclosed in a nuclear membrane.
 - No membrane-bound organelles like mitochondria or chloroplasts.
 - Generally smaller in size.

◦ Eukaryotic Cells:

- **Definition:** Cells with a well-defined nucleus and membrane-bound organelles.
 - **Example:** Plant and animal cells.
 - **Characteristics:**
 - Genetic material is enclosed within a nuclear membrane.
 - Presence of membrane-bound organelles like the nucleus, mitochondria, and Golgi apparatus.
 - Generally larger in size.

Practice Questions:

1. Differentiate between prokaryotic and eukaryotic cells.
2. Why are eukaryotic cells more complex than prokaryotic cells?
3. Give examples of organisms with prokaryotic and eukaryotic cells.

Revision Points:

- Prokaryotic cells lack a nucleus and membrane-bound organelles, while eukaryotic cells have a defined nucleus and organelles.
- Eukaryotic cells are more advanced and are found in plants, animals, and fungi.

• **Structure of a Cell**

◦ **Plasma Membrane (Cell Membrane):**

- **Definition:** The outermost membrane of the cell that separates the cell's contents from its surroundings.
 - **Functions:**
 - **Selective Permeability:** Regulates the entry and exit of substances.
 - **Example:** Allows nutrients in and wastes out.
 - **Process of Diffusion and Osmosis:**
 - **Diffusion:** Movement of substances from a region of higher concentration to lower concentration.
 - **Osmosis:** Movement of water molecules through a semi-permeable membrane from a region of higher water concentration to lower water concentration.

Practice Questions:

1. What is the plasma membrane? What are its functions?
2. Explain the difference between diffusion and osmosis.
3. Why is the plasma membrane called selectively permeable?

Revision Points:

- The plasma membrane controls the movement of substances in and out of the cell.
 - Diffusion and osmosis are crucial processes for the exchange of gases and water.
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○ Cell Wall (in Plant Cells):

- **Definition:** The outer rigid layer found in plant cells, made up of cellulose.
 - **Function:** Provides shape, support, and protection to plant cells.
 - **Example:** Cell wall in plant tissues like the stem.

Practice Questions:

1. What is the function of the cell wall in plant cells?
2. Why is the cell wall absent in animal cells?
3. How does the cell wall help in maintaining the shape of a plant cell?

Revision Points:

- The cell wall provides structural support and rigidity to plant cells, distinguishing them from animal cells.
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● Nucleus: The Control Center

- **Definition:** A large, membrane-bound organelle containing the cell's genetic material (DNA).
 - **Parts of the Nucleus:**
 - **Nuclear Membrane:** Encloses the nucleus.
 - **Nucleoplasm:** The fluid inside the nucleus.
 - **Chromosomes:** Thread-like structures containing DNA.
 - **Nucleolus:** Site of ribosome production.
 - **Functions:**
 - Controls cell activities.
 - Stores genetic information for inheritance.

Practice Questions:

1. What is the function of the nucleus in a cell?
2. Name the parts of the nucleus and describe their functions.
3. How do chromosomes carry genetic information?

Revision Points:

- The nucleus stores genetic material (DNA) and controls cellular activities.
 - Chromosomes within the nucleus are responsible for inheritance.
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● Cytoplasm and Organelles

○ Cytoplasm:

- **Definition:** The jelly-like fluid between the plasma membrane and the nucleus.
 - Contains organelles like mitochondria, Golgi bodies, and ribosomes.

Practice Questions:

1. What is the role of the cytoplasm in a cell?
2. How does the cytoplasm support cell organelles?
3. Describe the structure of cytoplasm.

Revision Points:

- The cytoplasm is the site for most cellular activities and contains organelles that perform specific functions.
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○ Endoplasmic Reticulum (ER):

- **Definition:** A network of membranes involved in the transport of substances.
 - **Types:**
 - **Rough ER:** Has ribosomes attached to it; involved in protein synthesis.
 - **Smooth ER:** Lacks ribosomes; involved in lipid synthesis.

Practice Questions:

1. Differentiate between rough and smooth endoplasmic reticulum.
2. What is the function of the rough ER in protein synthesis?
3. Why is the smooth ER important for lipid synthesis?

Revision Points:

- The rough ER synthesizes proteins, while the smooth ER is involved in lipid metabolism and detoxification.
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○ Mitochondria:

- **Definition:** The powerhouse of the cell that generates energy in the form of ATP through cellular respiration.
 - **Functions:**
 - Produces energy through the breakdown of glucose.
 - Site of aerobic respiration.

Practice Questions:

1. Why are mitochondria called the powerhouse of the cell?
2. Explain the process of energy production in mitochondria.
3. What is the role of ATP in cellular activities?

Revision Points:

- Mitochondria generate energy for the cell through cellular respiration and are critical for energy-dependent processes.

○ Golgi Apparatus:

- **Definition:** Stacks of membrane-bound vesicles that modify, sort, and package proteins and lipids.
 - **Functions:**
 - Modifies proteins made by the ER.
 - Packages proteins into vesicles for transport.

Practice Questions:

1. What is the function of the Golgi apparatus?
2. How does the Golgi apparatus interact with the ER in the cell?
3. Describe the role of the Golgi apparatus in protein modification.

Revision Points:

- The Golgi apparatus is involved in modifying, sorting, and packaging proteins and lipids for transport within and outside the cell.

○ Lysosomes:

- **Definition:** Membrane-bound vesicles containing digestive enzymes.
 - **Functions:**

- Break down waste materials and cellular debris.
- Involved in autolysis (self-digestion of damaged cells).

Practice Questions:

1. What is the function of lysosomes in a cell?
2. Why are lysosomes called the "suicidal bags" of the cell?
3. How do lysosomes help in maintaining cell health?

Revision Points:

- Lysosomes digest and recycle cellular waste, playing a crucial role in maintaining the health of the cell.
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● Plastids (in Plant Cells)**○ Types of Plastids:**

- **Chloroplasts:** Contain chlorophyll and are responsible for photosynthesis.
- **Leucoplasts:** Store starch, oil, and proteins.
- **Chromoplasts:** Contain pigments that give color to flowers and fruits.

Practice Questions:

1. Differentiate between chloroplasts, leucoplasts, and chromoplasts.
2. What is the role of chloroplasts in photosynthesis?
3. How do plastids help in plant functions?

Revision Points:

- Plastids are involved in photosynthesis (chloroplasts) and storage (leucoplasts), and give color to plant parts (chromoplasts).
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● Vacuoles

- **Definition:** Large, membrane-bound sacs that store water, nutrients, and waste.
 - **Functions:**
 - Store nutrients and waste products.
 - Provide turgidity and support to plant cells.

Practice Questions:

1. What is the role of vacuoles in plant cells?
2. How do vacuoles help maintain cell turgidity?
3. Why are vacuoles larger in plant cells compared to animal cells?

Revision Points:

- Vacuoles store essential substances and provide structural support, especially in plant cells.

• Summary and Revision Points

- Cells are the basic unit of life and can be prokaryotic (simple) or eukaryotic (complex).
 - The plasma membrane controls substance movement, while the cell wall provides rigidity in plant cells.
 - The nucleus controls cellular activities, and organelles like mitochondria and Golgi apparatus have specialized functions.
 - Cytoplasm supports organelles, while vacuoles and plastids are essential for storage and plant cell functions.
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