FUNDAMENTAL UNIT OF LIFE – COMPLETE NOTES

1. CELL – BASIC CONCEPT

- The **cell** is the **smallest structural and functional unit of life**.
- All living organisms are made up of cells.
- Cells carry out all life processes like respiration, digestion, and reproduction.

2. HISTORY OF CELL DISCOVERY

Important Scientists & Contributions

- **Robert Hooke (1665)**
  - Discovered cells in cork using a microscope.
  - Coined the term "cell".
- **Anton van Leeuwenhoek (1674)**
  - First observed **living cells** (bacteria, protozoa).
- **Robert Brown (1831)**
  - Discovered the **nucleus**.
- **Matthias Schleiden (1838)**
  - Stated that **plants are made of cells**.
- **Theodor Schwann (1839)**
  - Stated that **animals are made of cells**.
- **Rudolf Virchow (1855)**
  - Proposed: **"All cells arise from pre-existing cells."**

3. CELL THEORY

1. All living organisms are made of cells.
2. Cell is the basic unit of life.
3. All cells arise from pre-existing cells.

4. TYPES OF ORGANISMS

Unicellular Organisms

- Made up of **one cell**.
- Example: Amoeba, Paramecium, Bacteria.
- One cell performs all functions.

Multicellular Organisms

- Made up of **many cells**.
- Cells specialize into tissues and organs.
- Example: Humans, plants.

5. STRUCTURE OF A TYPICAL CELL

Main Parts:

1. **Cell Membrane (Plasma Membrane)**
   - Outer boundary of the cell.
   - Selectively permeable.
   - Controls entry and exit of substances.
2. **Cytoplasm**
   - Jelly-like fluid inside the cell.
   - Contains organelles.
3. **Nucleus**
   - Control center of the cell.
   - Contains DNA (genetic material)

6. CELL ORGANELLES & FUNCTIONS

Organelle	Function
Nucleus	Controls activities, stores DNA
Mitochondria	Powerhouse (energy production)
Ribosomes	Protein synthesis
Endoplasmic Reticulum (ER)	Transport system
Golgi Apparatus	Packaging and secretion
Lysosomes	Waste digestion
Vacuole	Storage
Chloroplast (plants only)	Photosynthesis

7. PLANT CELL vs ANIMAL CELL

Feature	Plant Cell	Animal Cell
Shape	Rectangular	Round/irregular
Cell Wall	Present	Absent
Chloroplast	Present	Absent
Vacuole	Large central	Small/absent
Plastids	Present	Absent
Centrosome	Absent	Present

8. PROKARYOTIC vs EUKARYOTIC CELLS

Feature	Prokaryotic	Eukaryotic
Nucleus	Absent	Present
Size	Small	Larger
Organelles	Absent	Present
Example	Bacteria	Plants, animals

9. CELL WALL (PLANT CELL)

Structure:

- Rigid outer layer outside the cell membrane.

Composition:

- Made mainly of **cellulose**.

Functions:

- Provides support and protection.
- Maintains shape.
- Prevents over-expansion.

CELL ORGANELLES – DETAILED NOTES

Cell organelles are **specialized structures** present in the cytoplasm that perform specific functions.

1. CYTOPLASM

- Jelly-like fluid inside the cell membrane.
- Contains all organelles.
- Site of many metabolic activities.

☞ **Function:**

- Supports organelles.
- Helps in transport of materials within the cell.

2. MITOCHONDRIA (Powerhouse of the Cell)

- Double membrane structure.
- Inner membrane forms folds called **cristae**.
- Contains its own DNA.

☞ **Function:**

- Produces energy in the form of **ATP** through respiration.

☞ **Special Fact:**

- Can replicate independently (semi-autonomous).

3. ENDOPLASMIC RETICULUM (ER)

Types:

1. **Rough ER (RER)**
    - Has ribosomes attached.
    - Helps in protein synthesis.
2. **Smooth ER (SER)**
    - No ribosomes.
    - Helps in lipid synthesis and detoxification.

☞ **Function:**

- Acts as a transport system within the cell.

4. RIBOSOMES

- Small granular structures.
- Found free in cytoplasm or attached to RER.

☞ **Function:**

- Site of **protein synthesis**.

☞ **Note:**

- Known as “protein factories”.

5. GOLGI APPARATUS

- Stack of flattened sacs (cisternae).

☞ **Function:**

- Modifies, packages, and transports proteins and lipids.
- Forms vesicles for secretion.

☞ **Simple idea:**

- “Post office of the cell”

6. LYSOSOMES

- Membrane-bound sacs filled with digestive enzymes.

☞ **Function:**

- Digests waste materials and dead organelles.

☞ **Special Name:**

- “Suicide bags” (can destroy the cell if they burst).

7. VACUOLES

- Fluid-filled sacs.

In Plant Cells:

- Large central vacuole.

In Animal Cells:

- Small or absent.

☞ **Function:**

- Storage of water, food, and waste.
- Maintains cell pressure (turgidity).

8. CHLOROPLASTS (Only in Plant Cells)

- Green plastids containing **chlorophyll**.
- Double membrane structure.

☞ **Function:**

- Site of **photosynthesis**.

☞ **Structure includes:**

- Grana (stacks)
- Stroma (fluid)

9. PLASTIDS (PLANT CELLS ONLY)

Types:

1. **Chloroplasts** – photosynthesis
2. **Chromoplasts** – give color (fruits/flowers)
3. **Leucoplasts** – store food (starch, oil, protein)

10. CELL MEMBRANE (PLASMA MEMBRANE)

- Thin, flexible boundary.

☞ **Structure:**

- Lipid bilayer with proteins.

☞ **Function:**

- Selectively permeable.
- Controls entry and exit of substances.

☞ **Transport Types:**

- Diffusion
- Osmosis
- Active transport

11. NUCLEUS (CONTROL CENTER)

- Surrounded by nuclear membrane.
- Contains chromosomes (DNA).

☞ **Parts:**

- Nuclear membrane
- Nucleolus
- Chromatin

☞ **Function:**

- Controls cell activities.
- Stores genetic information.

QUICK REVISION TABLE

Organelle	Function
Cytoplasm	Medium for reactions
Mitochondria	Energy production
ER	Transport system
Ribosomes	Protein synthesis
Golgi Apparatus	Packaging
Lysosomes	Digestion
Vacuole	Storage
Chloroplast	Photosynthesis
Nucleus	Control center

10. COMPOUND MICROSCOPE

Parts:

- Eyepiece (ocular lens)
- Objective lenses
- Stage
- Mirror/Light source
- Coarse adjustment knob
- Fine adjustment knob

Working:

- Magnifies small objects using lenses.

11. CELL DIVISION

1. MITOSIS (Equational Division)

- Occurs in body cells.
- Produces **2 identical cells**.
- Used for growth and repair.

Stages:

1. Prophase
2. Metaphase
3. Anaphase
4. Telophase

2. MEIOSIS (Reduction Division)

- Occurs in reproductive cells.
- Produces **4 non-identical cells**.
- Chromosome number is halved.

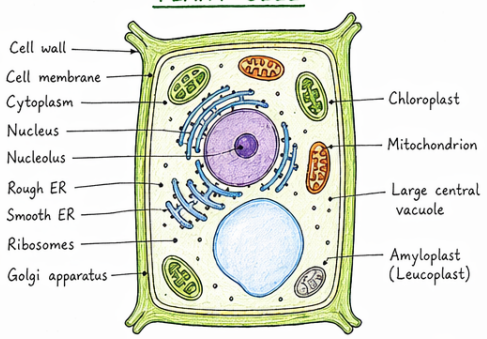
12. IMPORTANT DIFFERENCES: MITOSIS vs MEIOSIS

Feature	Mitosis	Meiosis
Cells Produced	2	4
Type	Identical	Different
Chromosomes	Same	Half
Occurs in	Body cells	Reproductive cells

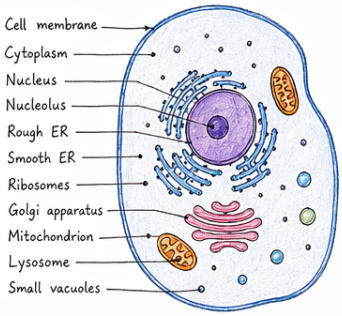
13. KEY POINTS TO REMEMBER

- Cell is the basic unit of life.
- All cells come from pre-existing cells.
- Plant cells have cell wall & chloroplasts.
- Mitochondria = powerhouse of the cell.
- Mitosis = growth, Meiosis = reproduction.

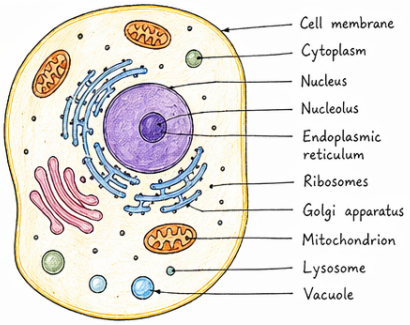
PLANT CELL



ANIMAL CELL



TYPICAL CELL (GENERALIZED)

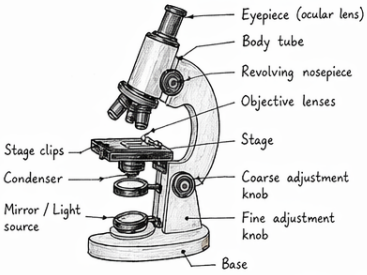


IMPORTANT CELL ORGANELLES

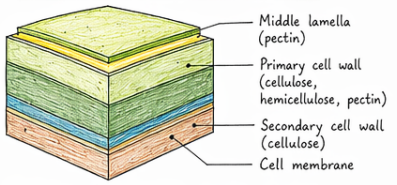
Mitochondrion	Endoplasmic Reticulum (ER)	Ribosomes	Golgi Apparatus	Lysosomes
Site of respiration. Produces energy (ATP).	Transport system in the cell. RER – with ribosomes SER – without ribosomes	Site of protein synthesis.	Modifies, packages and transports proteins and lipids.	Contain digestive enzymes. Break down waste materials.

Vacuole	Chloroplast	Nucleus
Stores water, food and waste. Maintains turgidity in plant cells.	Contains chlorophyll. Site of photosynthesis.	Control center of cell. Contains DNA (genetic material).

COMPOUND MICROSCOPE



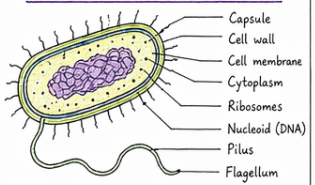
CELL WALL (PLANT CELL)



Functions : Provides shape, support, strength and protection. Freely permeable.

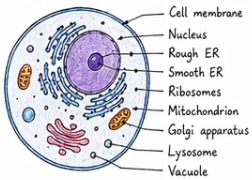
Composition : Mainly cellulose, hemicellulose, pectin and proteins.

PROKARYOTIC CELL (BACTERIA)



Example : Bacteria (E. coli)

EUKARYOTIC CELL

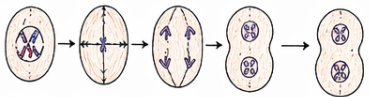


Example : Amoeba

CELL DIVISION

MITOSIS (Equational Division)

Produces two genetically identical daughter cells.



MEIOSIS (Reduction Division)

Produces four genetically different daughter cells.