Cell – The Unit of Life

- Cytology → The branch of biology dealing with study of form, structure, and composition of cell.
- Cell is the fundamental, structural, and functional unit of life.
- Unicellular organisms (Amoeba, Paramecium, Yeast, Bacteria): A single cell performs all vital functions → respiration, digestion, reproduction, excretion.
- Multicellular organisms: Functions are divided among tissues and organs → division of labour.

History of Cell Discovery

1. Robert Hooke (1665)
    - First observed and described dead cells for the first time in his book ***Micrographia*** (1665) while observing thin slices of bottle cork using a self-designed compound microscope.
    - Coined the term "Cell" (looked like honeycomb chambers).
2. Anton van Leeuwenhoek (1674)
    - First to observe living free cells (bacteria, protozoa).
3. Robert Brown (1831)
    - Discovered nucleus in orchid cells.
4. J. E. Purkinje (1839)
    - Coined the term "Protoplasm" for the fluid substance inside the cell.
5. Matthias Schleiden (1838) – German Botanist
    - Examined many plant tissues → concluded all plants are composed of cells.
6. Theodor Schwann (1839) – German Zoologist
    - Studied animal cells, observed plasma membrane.
    - Stated: Animals and plants differ as animal cells lack cell wall.
    - Concluded: *All living beings are made of cells and cell products*.
7. Cell Theory (1838–1839) – Schleiden & Schwann
    - All living organisms are composed of cells.
    - Cell is the basic unit of life.
    - Limitation: Did not explain origin of new cells.
8. Rudolf Virchow (1855)
    - Modified Cell Theory.
    - Proposed: "Omnis cellula e cellula" → new cells arise only from pre-existing cells.
    - Final cell theory:
        - Cell is the structural, functional, and genetic unit of life.
        - Cells arise from pre-existing cells.
        - Cells carry genetic information passed to next generation.

Microscopy & Advancements

Robert Hooke → first compound microscope & dead cell discovery (1665).

Anton van Leeuwenhoek **→ first simple microscope** & living cell discovery (1674).

Ernst Ruska → first electron microscope (1931/1938).

Fathers Related to Cell Biology & Microscopy

1. **Father of Cytology (Cell Biology) & Micrography:** Robert Hooke (1665)
2. **Father of Microbiology:** Anton van Leeuwenhoek
3. **Father of Modern Cell Theory:** Rudolf Virchow – "Omnis cellula e cellula."
4. **Father of Histology (study of tissues):** Marcello Malpighi.
5. **Father of Electron Microscopy:** Ernst Ruska – invented electron microscope (1931).

Cell Sizes

- Smallest cell: *Mycoplasma (PPLO)* (~0.1 µm).
- Largest cell: Ostrich egg (~170 mm × 130 mm).
- Longest cell: Human nerve cell (~1 m).
- Human RBC: ~7–8 µm, circular, biconcave, no nucleus.
- Viruses: 0.02–0.2 µm (acellular, not true cells).
- Bacteria: 1–2 µm.
- Eukaryotic cells: 10–100 µm.
- Multinucleated cells: Muscle fibers, some fungi.

Cell Shapes

- Cuboidal → lining of kidney tubules.
- Columnar → intestinal lining.
- Polygonal → epithelial cells.
- Thread-like → muscle fibers.
- Irregular → amoeba, WBCs.
- Biconcave → RBCs.

Functional Characteristics of Cells

1. Metabolism
    - Energy production, nutrient uptake, waste removal, growth.
2. Growth & Development
    - Cell enlargement, cell division, differentiation.
3. Reproduction
    - Ensures continuity of life (binary fission in prokaryotes, mitosis/meiosis in eukaryotes).
4. Responsiveness/Irritability
    - Ability to respond to stimuli (e.g., amoeba moving towards food).
5. Genetic Material
    - DNA stores hereditary information and transmits it to next generation.