

# Cell: The Unit of Life

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### What Makes Something Living?

- When we look around, we see both living and non-living things.
- A common question arises:
  - What is the fundamental difference between living and non-living things?
    - The answer lies in the presence of cells, which are found **only in living organisms**.

### The Cell – Basic Unit of Life

- The **cell** is the smallest unit that can carry out all the basic functions of life.
- It is considered the structural and functional unit of life.

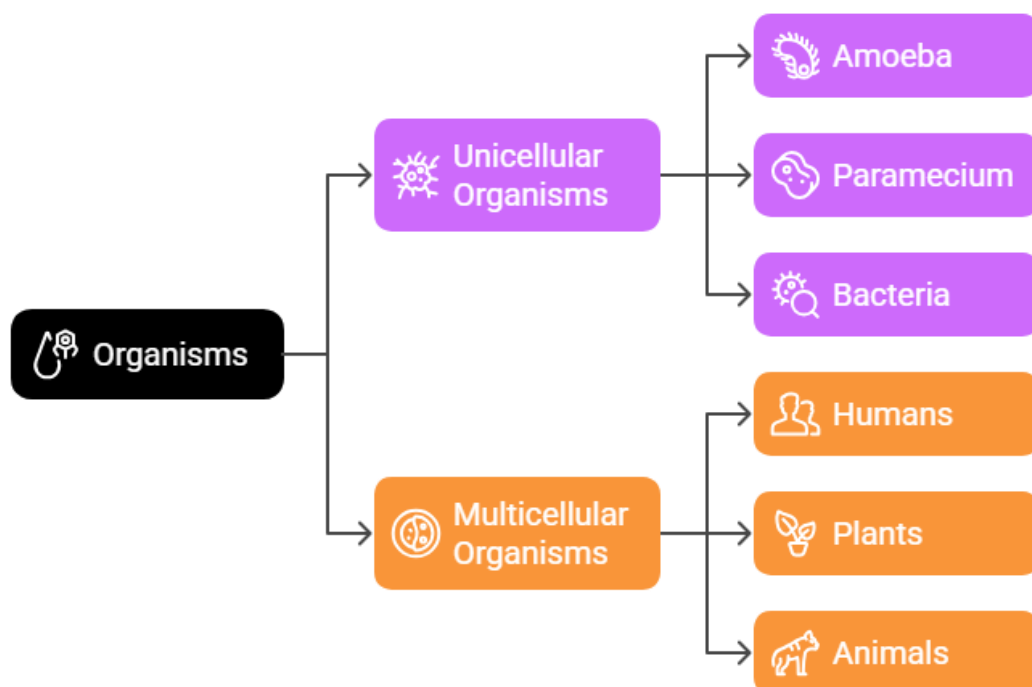
### Types of Organisms Based on Cell Number

#### A. Unicellular Organisms:

- Composed of a single cell.
- **Examples:** Amoeba, Paramecium, Bacteria

#### B. Multicellular Organisms:

- Composed of many cells working together.
- **Examples:** Humans, Plants, Animals



# The Cell and Cell Theory

## What is a Cell?

- A cell is the fundamental structural and functional unit of all living organisms.
- **Unicellular organisms:**
  - Are capable of independent existence.
  - Perform all essential life functions.
- Anything less than a complete cell cannot sustain an independent life.

### Historical Background:

#### Antonie van Leeuwenhoek:

- First observed and described a live cell.

#### Robert Brown:

- Discovered the nucleus.

#### Microscopy:

- The invention of the microscope enabled the observation of cells.
- Advancements (especially the electron microscope) revealed detailed cellular structures.

## Cell Theory

### Early Contributions

#### A. Matthias Schleiden (1838) – German Botanist

- Studied a large number of plants.
- Concluded that all plants are made up of different kinds of cells, which form **plant tissues**.

#### B. Theodor Schwann (1839) – German Zoologist

- Studied various animal cells.
- Observed that:
  - Animal cells have a thin outer layer, now called the **plasma membrane**.
  - Cell wall is a distinctive feature of plant cells.

#### C. Joint Contribution (Schleiden & Schwann)

- Proposed the original Cell Theory, which stated:
  - All living organisms (plants and animals) are composed of cells and cell products.

### Limitation of the Original Cell Theory

- The original theory did not explain how new cells are formed.

### Modification by Rudolf Virchow (1855)

- Introduced the concept:
  - "*Omnis cellula e cellula*" – **All cells arise from pre-existing cells.**
- Finalized the modern form of the Cell Theory.

### Modern Cell Theory – Key Points

- All living organisms are composed of cells and products of cells.
- All cells arise from pre-existing cells.

# An Overview of the Cell

## Basic Cell Structure

### Plant Cell (e.g., Onion Peel):

- A typical plant cell has a distinct cell wall as its outer boundary.
- Just beneath the cell wall lies the **cell membrane**.

### Animal Cell (e.g., Human Cheek Cell):

- Cell membrane forms the outer boundary of the human cheek cell.
- Cell wall is absent in animal cells like the **human cheek cell**.

### Common Feature:

- Both contain a nucleus, a dense membrane-bound structure.
- The nucleus houses chromosomes, which contain the **genetic material – DNA**.

## Types of Cells

### A. Eukaryotic Cells:

- Have a membrane-bound nucleus.
- Contain membrane-bound organelles such as:
  - Endoplasmic Reticulum (ER)
  - Golgi Complex
  - Lysosomes
  - Mitochondria
  - Microbodies
  - Vacuoles

### B. Prokaryotic Cells:

- **Lack** a membrane-bound nucleus and organelles.

## Cytoplasm

- A semi-fluid matrix that fills the cell.
- Present in both **prokaryotic** and **eukaryotic cells**.
- Acts as the main site of cellular activities and biochemical reactions that sustain life.

## Organelles

### A. Ribosomes:

- **Non-membrane-bound**
- Found in all cells (both eukaryotic and prokaryotic)
- Located in:
  - Cytoplasm
  - Mitochondria
  - Chloroplasts (in plant cells)
  - On rough endoplasmic reticulum (RER)

### **B. Centrosome:**

- Present in animal cells
- Non-membrane-bound
- Plays a key role in cell division

## **Diversity in Cells**

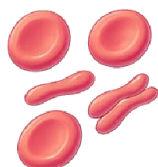
Cells show a wide range of sizes, shapes, and functions depending on the organism and the role they perform.

### **Variation in Cell Size:**

- The smallest known cells are ***Mycoplasmas***, measuring about 0.3  $\mu\text{m}$  in size.
- Bacteria are slightly larger, typically ranging from 3 to 5  $\mu\text{m}$ .
- The ostrich egg is the largest known **isolated single cell**.

### **Examples in Humans:**

- **Red Blood Cells (RBCs):** Approximately 7.0  $\mu\text{m}$  in diameter.
- **Nerve Cells:**
  - Among the longest cells in the human body.
  - In some animals, they can reach lengths of several meters.



Red blood cells



White blood cells



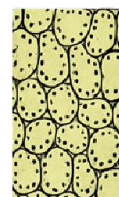
Columnar epithelial cells



Nerve cell (Branched and long)



A tracheid (elongated)



Mesophyll cells (round and oval)

**Diagram showing different shapes of the cells**



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