

Cell: The Unit of Life

WHAT IS A CELL ?

All living organisms have a basic feature in common they are made up of building blocks, called **cells**.

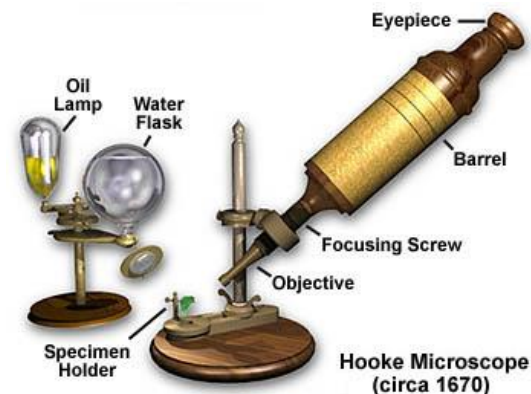
The cell is the fundamental structural and functional unit of all living beings. It is the smallest part of the body of an organism which is capable of independent existence and of performing the essential functions of life.

THE INVENTION OF THE MICROSCOPE AND THE DISCOVERY OF CELL

The first microscope was constructed by Dutch scientist **Antony van Leeuwenhoek**. He made **simple microscopes** because they consisted of a single biconvex lens.

Robert Hooke, an English scientist, developed a microscope by using two lenses known as **compound microscopes**.

Hooke examined a thin slice of cork under his microscope and observed that it was made of tiny "**box-like**" compartments piled up together he name it "Cell".



CELL THEORY

In 1838, Matthias Schleiden, a German Botanist, announced that **every plant is made up of a large number of cells**. A year later, Theodor Schwann, a German zoologist, made similar discoveries in animals. He declared that **all animals and plants are composed of cells, which serve as the units of structure and function**. Rudolf Virchow in 1858 made an addition to the cell theory by saying that **all cells arise from pre-existing cells**.

Cell Theory 3 Parts

1. All organisms are made up of one or more cells.
2. All cells arise from preexisting cells.
3. Cell is the structural and functional unit of life.



CELLS - HOW MANY ?

Single-celled: Many small plants and animals are made up of just one single cell.

Examples: Bacteria, yeast, amoeba

Few-celled: Some very small plants and animals are made up of a relatively fewer number of cells- just a few hundred or a few thousand cells.

Examples: Spirogyra, Volvox

Multi-celled: Most plants and animals we see around us including ourselves, are made up of millions and billions of cells.

Examples: Human beings, Mango trees.

CELLS - HOW SMALL?

Cells are very small and are seen only **with a microscope**.

- **Smallest cells** are the bacteria (0.3-5.0 micrometre), red blood cells (about 7 micrometre) in the human body.
- **Longest cells** are the nerve cells.

● **Largest cells** are the birds' eggs . Ostrich egg is the largest single cell of the living world today.

SMALLNESS OF CELLS: A GREATER EFFICIENCY

● Cells generally remain small in size and this is because of two main reasons.

(i) Different regions of a cell can communicate with each other rapidly for the cell to function effectively.

(ii) Cells have a large surface area / volume ratio for greater diffusion of substances in and out of the cell.

CELL SHAPES TO SUIT FUNCTIONAL REQUIREMENT

● **Human red blood cells** are circular and biconcave, to pass through narrow capillaries and transport oxygen.

● **White blood cells** are amoeboid that can squeeze out through capillary walls.

● **Nerve cells** are long to conduct "impulses" from distant parts of the body to the brain and vice-versa.

● **Muscle cells** are long and contractile to pull or squeeze the parts.

● **Guard cells** of stomatal pore in the leaves are bean-shaped to open and close the pore.

STRUCTURE OF A CELL

A generalised cell consists of three essential parts: (1) cell membrane (plasma membrane), (2) nucleus and (3) cytoplasm.

Cell organelles (the "little organs") : Most parts of a cell have a definite shape, a definite structure and a definite function. Such parts are called **organelles**.

Cell Membrane and Cell Wall

Each cell is surrounded by a cell membrane or plasma membrane.

- The cell membrane is living and has fine pores through which substances may enter or leave the cell.
- Cell membrane is composed of lipoproteins. The permeability of the cell membrane is selective, i.e. it allows only certain substances to pass through while it prevents others.
- Plant cells have a cell wall surrounding the cell membrane. The cell wall is made of cellulose, a non-living substance.
- The cell wall gives shape and a certain degree of rigidity to the cell without interfering with the functions of the cell membrane.
- The cell wall is freely permeable allowing the substances in solution to enter and leave the cell without hindrance.

Cytoplasm

Cytoplasm is a semi-liquid substance. It occupies most part of the cell within the cell membrane.

- Many chemical reactions take place in the cytoplasm.
- Living cytoplasm is always in a state of some movement.

The following are the cell organelles embedded in the cytoplasm :

1. Endoplasmic reticulum

The endoplasmic reticulum (ER) is an irregular network of double membranes distributed over the entire cytoplasm in a cell.

- At its outer end, endoplasmic reticulum is connected with the cell membrane.
- At its inner end it is connected with the nuclear membrane.
- It appears rough when small granules called **ribosomes** are attached to it and appears smooth without them.

- It forms the supporting framework of the cell and also serves as a pathway for the distribution of the materials from one part of the cell to the other.

2. Ribosomes - The sites of protein synthesis

The ribosomes are numerous small granules either scattered freely in the cytoplasm or attached to the membranes of the endoplasmic reticulum. These are the 'factories' for the synthesis of proteins.

3. Mitochondria - The cell's energy producers

The mitochondria are spherical or rod-shaped bodies. These are minute double-walled bags with their inner walls produced into finger-like processes projecting inwards (called cristae). Mitochondria are the sites where cell respiration occurs to release energy.

4. Golgi apparatus - The delivery system of the cell

These are very small vesicles of different shapes, and are generally located near the nucleus. The golgi complex consists of many small groups of hollow tubular structures with membranous walls, called cisternae, and is associated with some minute vesicles and vacuoles.

5. Lysosomes - The intracellular digestive centres

Lysosomes are small vesicles of different shapes containing some digestive enzymes.

- Their enzymes destroy and digest foreign substances around them.
- They digest the stored food during unfavourable conditions when food is unavailable to the cell.
- Many damaged cells are rapidly destroyed or dissolved by their own lysosomes and hence these are also called the "**suicide bags**".

6. Centrosome and centrioles

A centrosome is found only in an animal cell. During cell division spindle fibres develop from the centrosome.

The centrosome contains two centrioles which are short bundles of microfilaments arranged at right angles to each other .

7. Plastids

Plastids are found only in plant cells.

(a) Leucoplasts (leuco: white) are colourless plastids. They have no pigment. They store starch. Cells of a potato have lots of leucoplasts in them.

(b) Chromoplasts (chromo : colour) These are variously coloured plastids-yellow, orange and red. They are mostly present in petals of flowers and in fruits, and the colouring substances (pigments) associated with them are **xanthophyll (yellow)** and **carotene (orange-red)**.

(c) Chloroplasts (chloro: green). These are green-coloured plastids. They have a green-coloured pigment called chlorophyll. e.g. leaves.

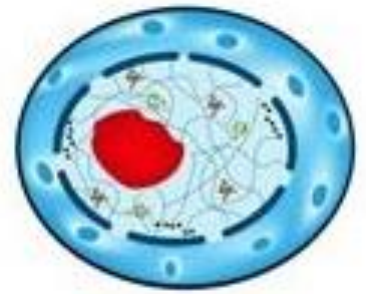
Non-living substances or Cell inclusions

1. Granules. These are many small particles in the cytoplasm and such particles are believed to contain food materials, such as starch, glycogen and fats.

2. Vacuoles. These are certain clear spaces in the cytoplasm. They are filled with water and various substances in solution. In plant cells, the vacuoles are usually quite large and the liquid which they contain is called **cell sap**. An animal cell does not have such prominent vacuoles, their vacuoles are smaller in size.

Nucleus

Nucleus is a small spherical mass located somewhat in the centre of the cytoplasm. In the nucleoplasm, there are certain thread-like structures called chromatin fibres.



Nucleus

Cells in which nuclear membrane is absent are called **prokaryotic cells**. They have nuclear material called chromatin fibres which occur freely in the central region of the cytoplasm called nucleoid, e.g. bacteria.

Cells in which double nuclear membrane is present are called **eukaryotic cells**. The nucleolus participates in protein synthesis of ribosomes.

The number of chromosomes is definite in each species. Every human body cell has **46** (23 pairs) chromosomes.

PROTOPLASM

Cytoplasm + Nucleus = Protoplasm. The living substances in an organism.