

## What is cell?

The fundamental, structural and functional unit of life which consists of a mass of protoplast surrounded by a definite membrane- the plasma membrane. The plant cell has an extra envelope called cell wall.

## Discovery of cell

Cell was discovered by **Robert Hooke** (English mathematician and physicist) in 1665 in a thin slice of cork under his self designed primitive microscope.

Later, In the beginning of the 19<sup>th</sup> century, **Matthias Schleiden** (1838) and **Theodor Schwann** (1839) establish the theory of cell and Later, In 1885 **Rudolf Virchow** added some more principle in cell theory

## Tools for observing Cells

The most commonly used instrument to observe cellular organization of living organism is a **Microscope**. **Anton von Leeuwenhoek** improved the design of microscope to observe free living cells in pond water.

The microscope can be broadly divided into two group:-

(a) Simple microscope and (b) Compound microscope

**Simple microscope** are just magnifying glasses.

A **compound microscope** is one in which the magnifying takes place in two stages. It consists of two lens units- the first called 'objective', produces a primary magnified image and the second called '**eye piece**' or '**ocular**' magnified the first image.

### **Electron microscope**

Electron microscope use focused beam of electrons (instead of light) for illumination of object and to produce an enlarged image of an object. This microscope can be focused upto 2,00,000 times.

## What is Unicellular and Multicellular Organism?

The organism that is made up of single cell only is called **Unicellular Organism**(uni= single) ex- amoeba, paramecium, Chlamydomonas etc.. The organism that is made up of many cells are called **Multicellular organism**. Ex- birds, animals, human beings etc.

## What is Zygote?

Fertilisation of egg results in the formation of a single celled structure called Zygote.

## Shape and Size of Cells

Shapes of cells of multicellular organism, depends on their position in the body, specific function which they perform and their interaction with neighbouring cells.

For example:-

Smooth muscle fibres- spindle shaped

Erythrocytes- disc shaped

Nerve cells- elongated

Cells are vary in their sizes. Their dimensions are usually expressed in microns ( $\mu$ ) and angstrom ( $\text{\AA}$ ) (1 micron= $10^{-6}$  meters and 1 angstrom= $10^{-10}$  meters). The Average cell size varies from 0.5 micron to 20 micron in diameter.

*PPLO (pleura pneumonia-like organism) is the smallest cell while egg of an ostrich is the largest cell known so far.*

## What is cell Made up of?

Every living cell is made up of some special components called **Organelles**.

## Organelles

**1) Plasma membrane/ Cell membrane-** The thin surface membrane of cell that separates the cell contents from its external environment is called Cell membrane or Plasma membrane.

**Why it is called selectively permeable membrane?**

Cell membrane is called selectively permeable membrane because it allows only some substances to pass through it and prevents from some other substances.

**Fluid Mosaic Model**

It is most recent and accepted model of cell membrane. It was proposed by **Singer** and **Nicolson** in 1972.

According to this model, the cell membrane is made up of a lipid bilayer and two types of protein molecules. These proteins are- (i)intrinsic proteins which are embedded in the lipid bilayer, and (ii) extrinsic proteins which occur superficially.

**What is Diffusion and Osmosis?**

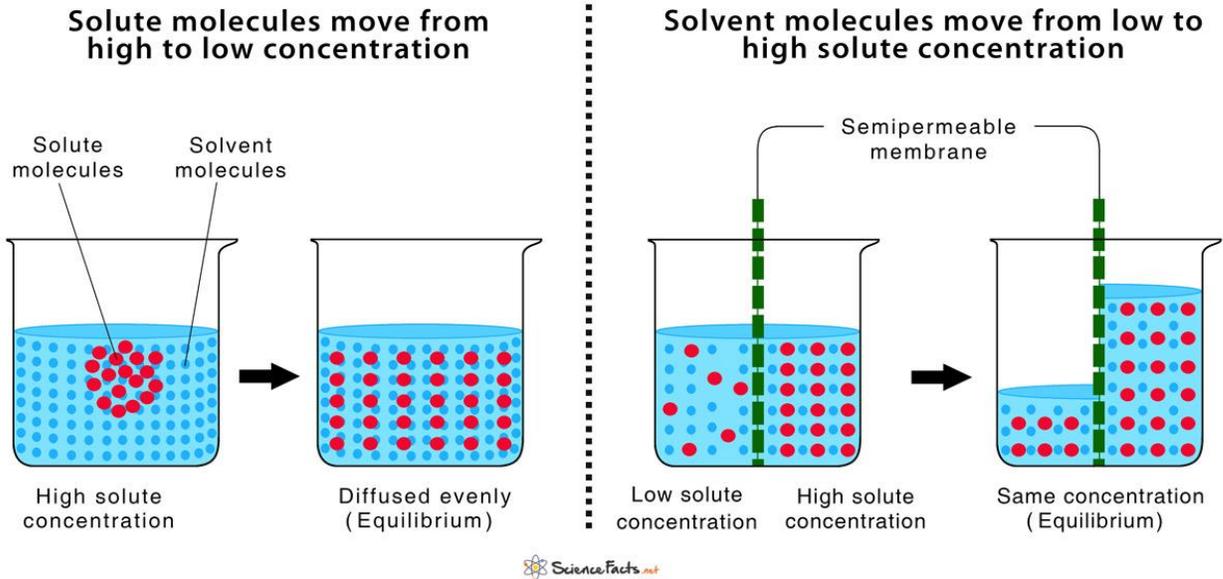
**Diffusion** is the movement of molecules of a substance (solid, liquid or gas) from a region of their high concentration to the region of their low concentration.

**Osmosis** is the passage of water (or solvent) from a region of its high concentration through a semipermeable membrane to a region of its low concentration.

# Diffusion

VS

# Osmosis



- When a cell is placed in a solution having lower concentration of solute and higher concentration of water as compared to the concentration of cell sap, the water molecules move from external solution into the cell. This solution called **hypotonic solution**. The water molecules move from external solution into the cell and cell swells up, this process called **endosmosis**.
- When a cell is placed in a solution having higher concentration of solute and lower concentration of water as compared to the concentration of cell sap, the water molecules move from cell sap to the external solution. This solution called **hypertonic solution**. The molecules move from cell sap to the external solution and cell shrinks, this process called **exosmosis**.
- When a cell is placed in a solution having exactly the same concentration as that of cell sap, there will be no net movement of water across the cell membrane. This solution called **isotonic solution**.

## Endocytosis

Endocytosis is a bulk transport in which a cell transport ( like proteins) into the cell by engulfing them in an energy using process.

When the substance engulfed is solid, the process is called phagocytosis while when the substance taken in is liquid, it is termed as pinocytosis.

## Exocytosis

It is the process by which the cell discharges its content to the outside of the cell. The process is also called cellular vomiting during which the exocytotic vesicles turn out the materials from interior of the cells.

## 2) Cell Wall

The plant cells as well as the cells of bacteria and fungi and some protists possess an additional layer outside the plasma membrane, called the Cell Wall. The plant cell wall is chiefly composed of **cellulose** ( carbohydrate).

- When a plant cell is placed in a hypertonic solution, the cytoplasm alongwith the plasma membrane shrinks and separates from the cell wall. This process of shrinkage of **protoplast (nucleus + cytoplasm + cell membrane)** from the cell wall due to exosmosis is called **plasmolysis**.

## 3) Nucleus

Each cell shows presence of a deeply stained rounded structure called **Nucleus**. It is mid point of the cell. It is located centrally in animal cells but pushed to one side due to the presence of large central vacuole in plant cells.

Chemically, the nucleus is composed of about 80% proteins, 12% DNA(deoxyribonucleic acid), 5% of RNA(ribonucleic acid) and 3% lipids.

## Structure

- **Nuclear Envelop-** Nucleus is surrounded by two nuclear membrane, together called **nuclear envelop**, enclose a fluid filled space called **intermembrane space** or **perinuclear space**. It has numerous minute, circular nuclear pores which allows movement of materials in and out of the nucleus.
- **Nuclear Sap or Nucleoplasm-** It is clear, fluid present in the nucleus. It contains raw materials, enzymes, proteins and metal ions for the synthesis of nucleic acids (DNA and RNAs).
- **Chromatin Material-** In a non-dividing cell, an entangled mass of thread-like structures is present in the nucleus called **Chromatin material**. At

the time of division chromatin material gets organized into rod-shaped structures called **Chromosomes**.

- **Nucleolus**- Usually one rounded body present in the nucleoplasm is called Nucleolus. It is not membrane bounded. It is rich in RNAs and proteins.
- **Nuclear Matrix**- Usually is a network of fine, criss-crossing fibrils which join the nuclear envelope by their ends. They maintain the shape of nucleus.

### Prokaryotic cells and Eucaryotic cells

**Prokaryotic cells**- The organism whose cells lack a nuclear membrane called Prokaryotes.

**Eucaryotic cells**- The cells possess true nucleus bounded by nuclear membrane are called **eukaryotic cells** and such organism which possess these cells are called **eucaryotes**.

**Cytoplasm**- The fluid content present between nuclear membrane and the cell membrane is called cytoplasm.

**Endoplasmic Reticulum**- The endoplasmic reticulum (ER) is an interconnected network of membrane-bound tubules, sacs and vesicles that occupies most of the cytoplasm in eukaryotic cells.

**It is of two types-**

**Rough Endoplasmic Reticulum (RER)**- These appear rough because of the presence of a large number of ribosomes over their surface. These ribosomes are site of protein synthesis.

**Smooth Endoplasmic Reticulum (SER)**- These appear smooth due to lack of ribosomes. It consists mainly of tubules and vesicles.

**Golgi Apparatus**- The Golgi apparatus was discovered by Camillo Golgi in 1898 in nerve cells of barn owl. It consists of smooth, flattened, membrane-bound (double walled) sac like structure called cisternae or Golgi apparatus.

**Lysosomes-** Lysosomes are dark spherical organelles bounded by single unit membrane. They are discovered by Christian de Duve in 1949, who named them lysosomes(Greek word-lysis= digestive; soma= body).

**Ribosomes-** Ribosomes are the smallest cell organelles. They are not bounded by a membrane. They are directly involved in the process of protein synthesis.

**Mitochondria-** Mitochondria are usually sausage-shaped, spherical, oval or cylindrical organelle found in cytoplasm. It generates ATP(adenosine triphosphate). ATP is called the energy currency of the cell.

**Plastids-** It is found only in plants and algae. They are the largest cytoplasmic organelle in plants. It is of three types- chromoplasts, chloroplast and leucoplasts.

**Chloroplast-** They are green colour plastid because of green chlorophyll pigment. They have chlorophyll, so they utilize solar energy and prepare food by the process of photosynthesis. Hence they are called 'kitchen of the cell'.

**Chromoplast-** They impart various colours to flowers and fruits.

**Leucoplast-** They store materials such as starch, oil and protein granules.

**Vacuoles-** Vacuoles are fluid-filled and membrane bound vacuoles are cell inclusion found in plants and fungal cells. The cell membrane of vacuoles are called tonoplast.