

## Revision Notes on The Fundamental Unit of Life

### Quick Review

- All living organisms in this universe are made up of cells.
- They either exist as a single cell or as a combination of multiple cells.

### Discoveries about Cells – The Fundamental Unit of Life

Discovered By	Period of time	What they discovered?
Robert Hooke	1665	noticed the presence of cells in a cork slice
Leeuwenhoek	1674	found the presence of living cells in the pond water
Robert Brown	1831	recognized the existence of a nucleus in the cell
Purkinje	1839	invented the term 'Protoplasm' which is the liquid present in a cell
Schleiden and Schwann	1838, 1839	presented the cell theory that all organisms are actually made up of cells
Virchow	1855	suggested that all cells come from cells that already exist in nature

### The Cell Theory

1. A cell is the structural and functional unit of all living organisms.
2. All the living organisms are made up of cells.
3. Cells are formed from pre-existing cells.
  - **Unicellular Organisms** – The organisms that consist of a single cell such as *Amoeba*.
  - **Multicellular Organisms** – The organisms which contain various cells that perform different functions in the organism such as plants fungi and animals

### How can multicellular organisms originate from a single cell?

A cell has the capability to divide itself into cells of its own type. Therefore, more cells can generate from an already existing cell.

### The Shape of the Cell

- The shape of the cell may vary depending upon the type of function they perform in an organism.
- Cells are capable of changing their shape. For example, the white blood cells and amoeba can change shapes on their own.

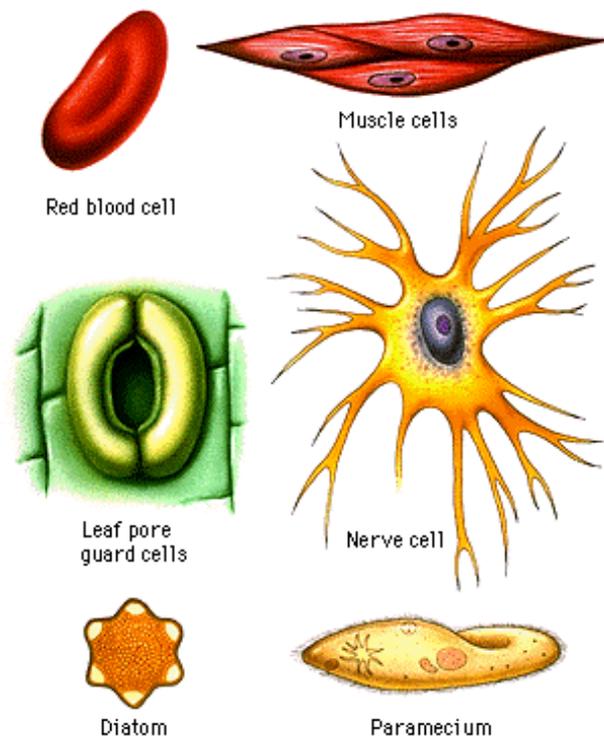


Figure 1 - Cells can have different Shapes and Sizes

**How can cells perform distinct functions in organisms?**

Cells are capable of performing multiple functions in an organism. A cell contains specific components which are called **Organelles**. Each organelle in the cell can perform different functions such as making new cells or clearing the waste of the cell. Thus, organelles allow a cell to perform several kinds of activities in an organism.

**The Organization of a Cell**

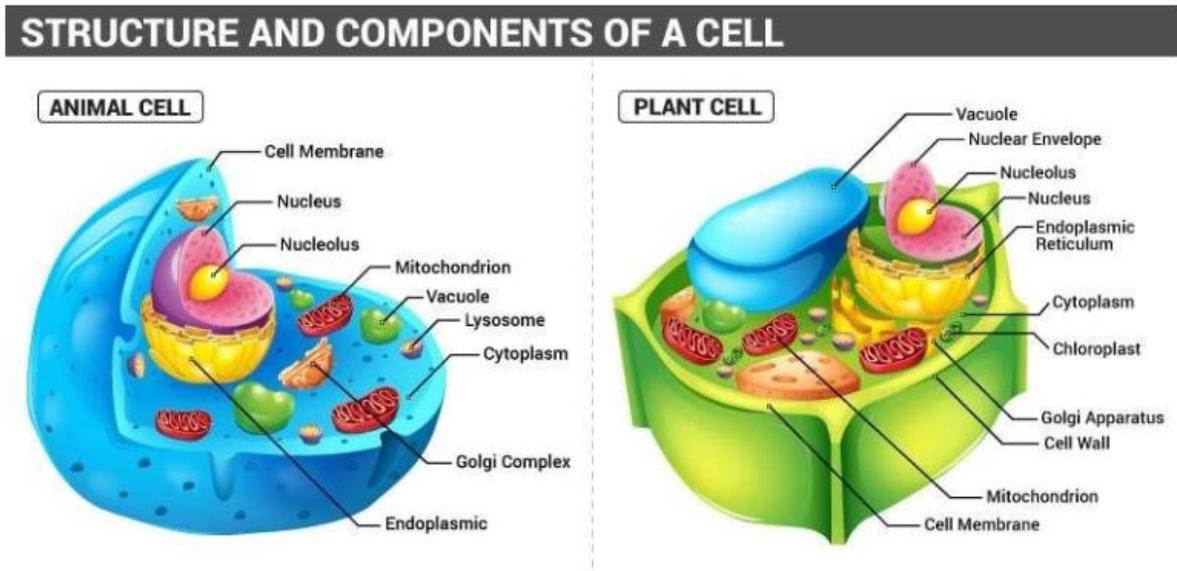


Figure 2 - The Structure of Cells in Plants and Animals

A cell contains three features –

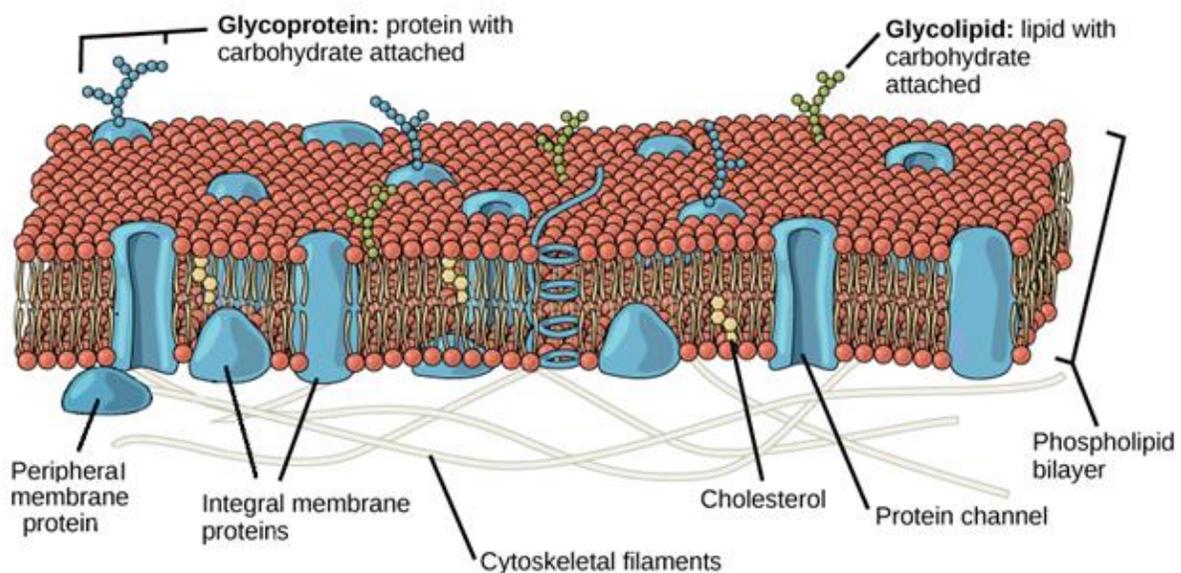
- The Plasma Membrane
- Nucleus
- Cytoplasm

### Plasma Membrane

- It is just like an envelope that covers the whole cell. Therefore, a cell gets separated from the external environment because it has a plasma membrane.
- The plasma membrane has the capability to decide which materials should enter or leave the cell and which should not. That is why it is also called as a '**Selectively Permeable Membrane**'.

### The Fluid Mosaic Model of Plasma Membrane

- The Fluid Mosaic model explains the structure of the plasma membrane. According to it, the plasma membrane comprises of 3 components - Lipids, Proteins and Carbohydrates. These components can flow freely and fluidly inside the plasma membrane.
- There are two types of lipids (fats) in the plasma membrane –
  - **Phospholipid** – It is a lipid made up of glycerol, two fatty acids, and phosphate. It creates a semi-permeable membrane which allows flow of only certain materials inside/ outside the cell
  - **Cholesterol** - It is a lipid which provides fluidity to the surface of plasma membrane.



## How can substances move in and out of a cell?

### Gaseous Exchange between the Cell and its External Environment –

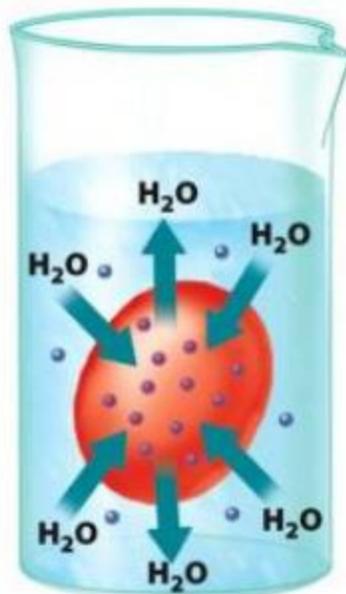
- Movement of Oxygen and Carbon dioxide to and from the cell is carried out by means of diffusion.
- Gaseous substances have a tendency to move to areas where their concentration is less from the areas where there is higher. This movement is defined as the process of **diffusion**. Diffusion can take place of solids, liquid, gases.

### Movement of Water between the Cell and its External Environment –

It is carried out by the means of osmosis. **Osmosis** is a process in which water moves from the region of high concentration to one where its concentration is low through a semi permeable membrane. Therefore we can say that Osmosis is just a special case of the process of diffusion.

### Hypotonic Solutions

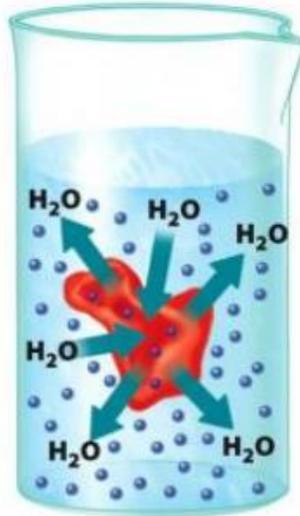
- If the concentration of water outside the cell is higher than the concentration of water inside the cell the cell gains water by the process of osmosis.
- Water can move into the cell from the cell membrane. In the case of hypotonic solutions, more amount of water enters the cells which results in swelling of the cells.



**Net water gain  
Cell swells**

## Isotonic Solutions

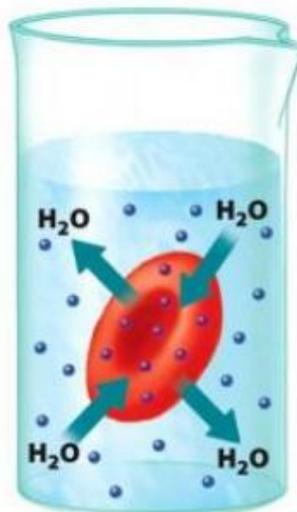
- If the cells are put in an environment which has similar concentration of water as present inside. This state allows for the free movement of water across the membrane without changing concentration of solutes on either side.
- Therefore, the size of the cell does not vary in an isotonic solution because there is no net movement of water.



**Net water loss  
Cell shrinks**

## Hypertonic Solutions

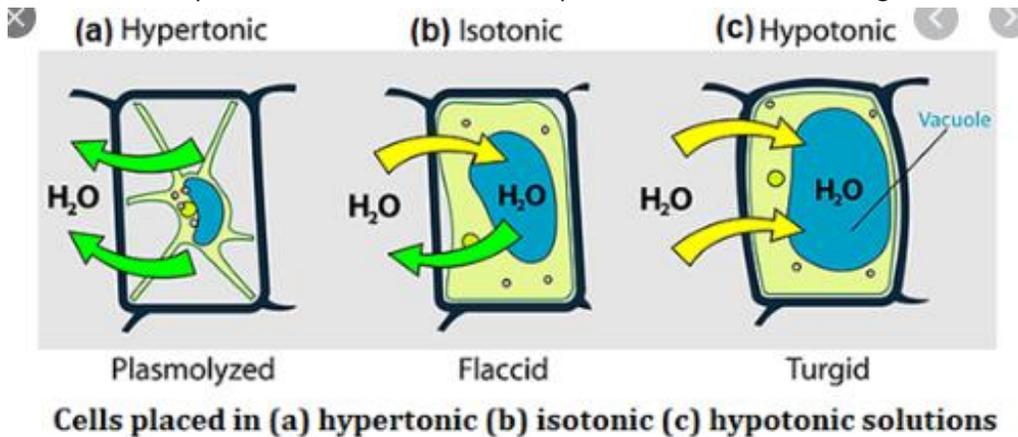
- If the cells are kept in an environment which has lower concentration of water than what is present inside the cells then due to the process of osmosis water moves out of the cells.
- This results in a decrease in size of the cells (they shrink) as more amount of water comes out of the cell.



**No net loss or gain**

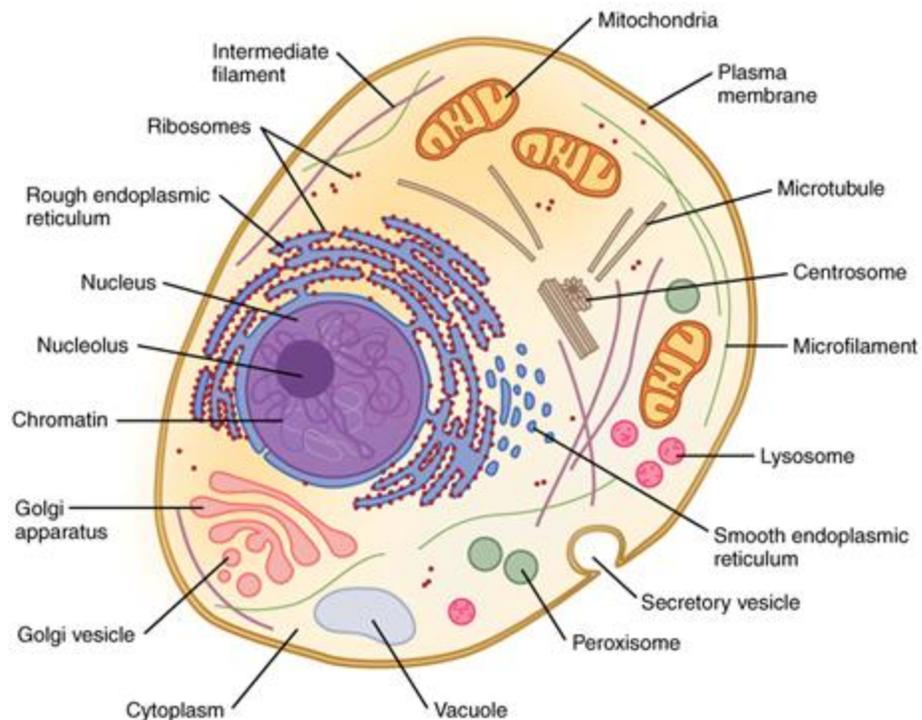
## Cell Wall

- The cell wall is a outer, hard covering of the cell which maintains the shape of the cell.
- The cell wall is generally made up of cellulose.
- **What is plasmolysis?**  
Plasmolysis is a process in which the contents of the cell that are away from the cell wall shrink or contract when a cell loses water due to Osmosis when it is kept in hypertonic solution.
- **Can dead cells absorb water?** No, dead cells cannot absorb water through osmosis.
- **How plants, fungi, and bacteria can exist in hypotonic medium?**  
Plants, fungi, and bacteria exist in such situations because of their rigid cell membranes. Even if the cells swell up the cell membrane is able to prevent them from bursting out.



## The Nucleus

Nucleus is a prominent, organelle present in cell which is the controlling centre of all activities of cell.



### The Structure of the Nucleus

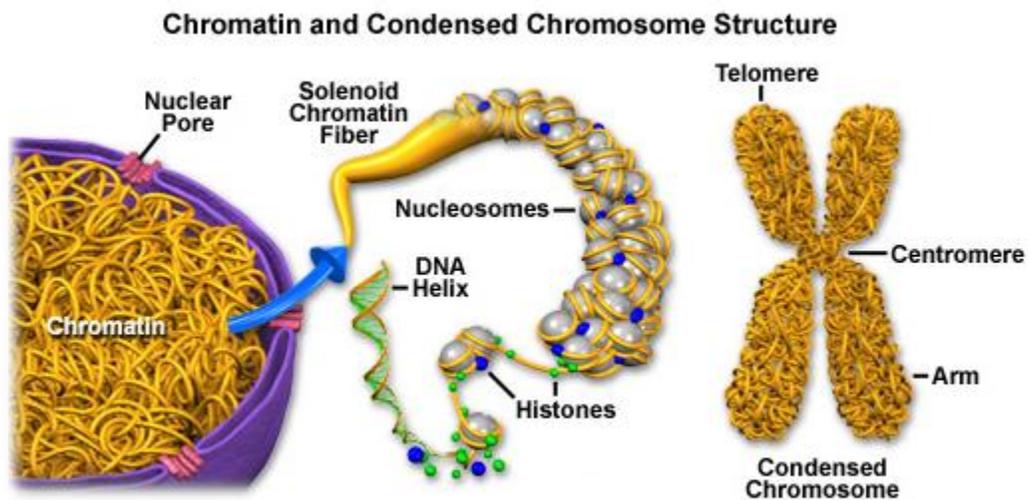
- A nucleus has a nuclear membrane which covers it all around.
- There are pores present on the nuclear membrane that allow movement of substances in and out of the nucleus.
- There are chromosomes, rod-shaped structures present in the nucleus which contain genetic information.

The chromosomes contain two types of things -

1. **DNA** - This is responsible for organizing and constructing new cells
2. **Proteins** - These help in packaging and condensation of DNA.

### Chromatin

Chromatin is thread-like material present in a cell. The chromatin organizes itself into chromosomes whenever the cell is about to divide.



### Nucleolus

It is called as the **Brain of the Nucleus**. It comprises of 25% of the volume of the nucleus. It consists of proteins and ribonucleic acids (RNA). It helps in formation of ribosomes which help in formation of proteins inside the cell.

### What is a nucleoid?

Sometimes cells do not have a well-defined nucleus because they lack a nuclear membrane. Such a nucleus with no definite nuclear boundaries is called a **Nucleoid**.

**What are the prokaryotes?**

Organisms whose cells do not have a definite cell membrane are called **Prokaryotes**.

**What are eukaryotes?**

Organisms whose cells contain a well-defined nuclear membrane are called **Eukaryotes**.

Prokaryotes	Eukaryotes
There is no presence of nucleus	The nucleus exists in the cells
A single chromosome is present	There are multiple chromosomes
They undergo asexual reproduction	They undergo sexual as well as a sexual reproduction
They are generally unicellular organisms	They are generally multicellular organisms
There are no membrane bound cell organelles	There are membrane bound cell organelles present inside the cells
<b>Example</b> – Bacteria, Blue green algae (Cyanobacteria)	<b>Example</b> – Fungi, Plants and Animals