

## **Cell Theory**

The cell theory was proposed by two scientists- **Schleiden (1838) and Schwann (1839)**. It says that all the plants and animals are composed of cells and the cell is the basic unit of life. The cell theory was further expanded by **Virchow (1855)** by suggesting that all cells arise from pre-existing cells. The cell theory states that:

- All living species on Earth are composed of cells.
- A cell is the basic unit of life.
- All cells arise from pre-existing cells.

A **modern version of the cell theory** was eventually formulated, and it contains the following postulates:

- Energy flows within the cells.
- Genetic information is passed on from one cell to the other.
- The chemical composition of all the cells is the same.

## **Functions of Cell**

A cell performs major functions essential for the growth and development of an organism. Important functions of cell are as follows:

### **a. Provides Support and Structure**

All the organisms are made up of cells. They form the structural basis of all the organisms. The cell wall and the cell membrane are the main components that function to provide support and structure to the organism. For eg., the skin is made up of a large number of cells. Xylem present in the vascular plants is made of cells that provide structural support to the plants.

### **b. Facilitate Growth Mitosis**

In the process of mitosis, the parent cell divides into the daughter cells. Thus, the cells multiply and facilitate the growth in an organism.

### **c. Allows Transport of Substances**

Various nutrients are imported by the cells to carry out various chemical processes going on inside the cells. The waste produced by the chemical processes is eliminated from the cells by active and passive transport. Small molecules such as oxygen, carbon dioxide, and ethanol diffuse across the cell membrane along the concentration gradient. This is known as passive transport. The larger molecules diffuse across the cell membrane through active transport where the cells require a lot of energy to transport the substances.

### **d. Energy Production**

Cells require energy to carry out various chemical processes. This energy is produced by the cells through a process called photosynthesis in plants and respiration in animals.

### **e. Aids in Reproduction**

A cell aids in reproduction through the processes called mitosis and meiosis. Mitosis is termed as the asexual reproduction where the parent cell divides to form daughter cells. Meiosis causes the daughter cells to be genetically different from the parent cells.

Thus, we can understand why cells are known as the structural and functional unit of life. This is because they are responsible for providing structure to the organisms and perform several functions necessary for carrying out life's processes.

## **CELL WALL**

First discovered by –Robert Hooke

Thickness ranges from 0.1  $\mu\text{m}$  to 10  $\mu\text{m}$

A cell wall is defined as the **non-living component**, covering the **outmost layer of a cell**. Its composition varies according to the organism and is permeable in nature. The cell wall separates the interior contents of the cell from the exterior environment. It also provides shape, support, and protection to the cell and its organelles. However, this cellular component is present exclusively in **eukaryotic plants, fungi, and a few prokaryotic organisms**.

As stated above, **fungi also possess cell walls**, but they are made up of **chitin**, a derivative of glucose which is also found in the exoskeletons of arthropods. And just like the cell walls in plants, they provide structural support and prevent desiccation.

Prokaryotic organisms such as **bacteria** also contain cell walls. However, they are chemically different from the cell wall found in plants and fungi. The prokaryotic cell walls are composed of large polymers known as **peptidoglycans**. Cell walls in prokaryotes serve as a form of protection and prevent lysis (bursting of the cell and expulsion of cellular contents). Structurally, prokaryotic cell walls consist of two layers:

1. An **inner layer** that is made up of peptidoglycans
2. An **outer layer** that is composed of lipoproteins and lipopolysaccharides

Eukaryotic cells possess a definite nucleus along with a distinct nuclear membrane. It also contains membrane-bound organelles not found in prokaryotic cells. Another important point to note is that the cell wall is absent in other eukaryotic organisms such as animals, **only plants possess cell walls**.

### **Chemical composition of plant cell wall**

Cellulose- 10-15 %

Hemicellulose – 5-10 %

Water- 60 %

Pectic substances – 2-8 %

Protein – 1-2 %

Lipids – 0.5 -3 %

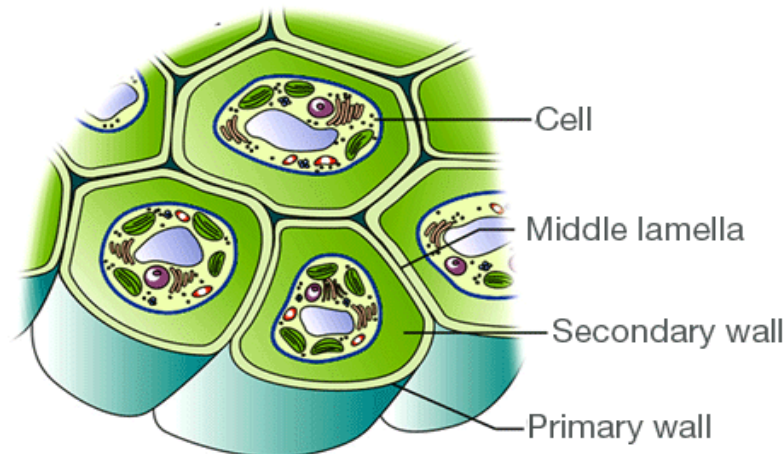
### **Cell Wall Structure**

The cell wall is the outer covering of a cell, present adjacent to the cell membrane, which is also called the plasma membrane. As mentioned earlier, the cell wall is present in all plant cells, fungi, bacteria, algae, and some archaea. An animal cell is irregular in its shape and this is mainly due to the lack of cell wall. The compositions of the cell wall usually vary along with organisms.

The plant cell wall is generally arranged in **3 layers and composed of carbohydrates, like pectin, cellulose, hemicellulose and other smaller amounts of minerals**, which form a network along with structural proteins to form the cell wall. The three major layers are:

1. Primary Cell Wall
2. The Middle Lamella

### 3. The Secondary Cell Wall



**Fig:** A plant cell showing the primary cell wall, middle lamella, and the secondary cell wall

#### **Primary Cell Wall**

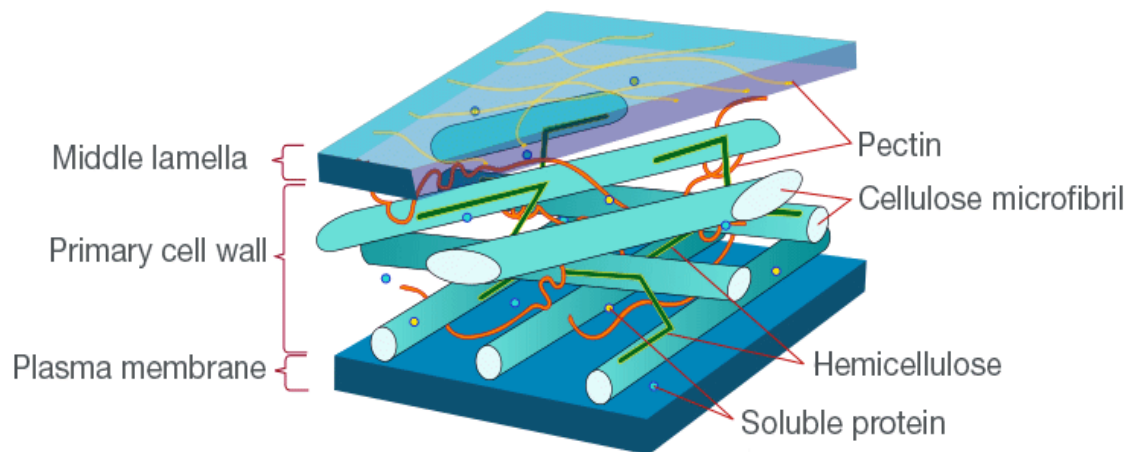
The primary cell wall is situated closest to the inside of the cell and is the first-formed cell wall. It is mainly made up of **cellulose**, allowing the wall to stretch for the purpose of growth. Several primary cells contain **pectic polysaccharides and structural proteins**. It is also comparatively permeable and thinner than the other layers.

#### **Middle Lamella**

The middle lamella is also the **outermost layer** and **it acts as an interface between the other neighbouring cells and glues them together**. This layer primarily consists of pectins. However, other substances such as lignin and proteins can also be found.

#### **Secondary Cell Wall**

The secondary cell wall is formed inside the primary cell wall once the cell is completely grown. Some types of cells (especially the cells of xylem tissues) consist of cellulose and lignin and these provide additional rigidity and waterproofing. Also, this layer provides the characteristic rectangular or square shape to a cell. It is also the **thickest layer and permits permeability**.



**Fig:** The above illustration shows the various components of a plant cell wall

### **Function of the Cell Wall**

The cell wall is an integral component of the plant cell and it performs many essential functions. Following are some of the major cell wall functions observed:

- The plant cell wall provides definite shape, strength, and rigidity
- It also provides protection against mechanical stress and physical shocks
- It helps to control cell expansion due to the intake of water
- It helps in preventing water loss from the cell
- It is responsible for transporting substances between and across the cell
- It acts as a barrier between the interior cellular components and the external environment