Cell and Molecular Biology

Lec: 2
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Cell structure

The **cell** (from Latin cella, meaning" small room) is the basic structural ، functional, and biological unit of all known organisms. A **cell** is the smallest unit of life .**Cells** are often called the" building blocks of life ." The study of **cells** is called **cell** biology, cellular biology, or cytology.

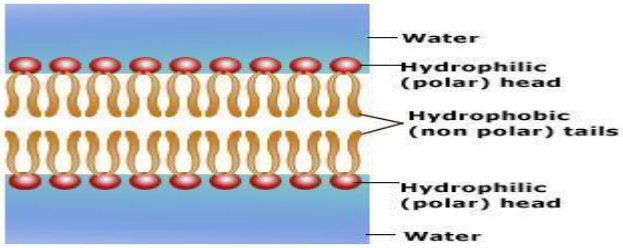
The human body is composed of trillions of **cells**. They provide structure for **the** body, take in nutrients from food, convert those nutrients into energy, and carry out specialized **functions**. ... **Cells** have many parts, each with a different **function**

1- cell membrane

According to **cell theory**, cells are the main unit of organization in biology. Whether you are a single cell or with trillions of cells. All cells are contained by a **cell membrane** (also known as the plasma membrane or cytoplasmic membrane) which is a biological membrane that separates the interior of all cells from the outside environment, in another words is a type of biological membranes which encloses the protoplasm (the nucleus and the cytoplasm with its organelles and inclusions) and separates one cell from other cells and from the external environment . The cell membrane is not a solid structure, it is made of millions of smaller molecules that create a flexible and porous container **(Proteins** and **phospholipids**).

Phospholipid molecules

are shaped with a head and a tail region. The head section of the molecule likes water (**hydrophilic**) while the tail does not (**hydrophobic**). Because the tails want to avoid water, they tend to stick to each other and let the heads face the watery areas inside and outside of the cell. The two surfaces of molecules create the **lipid bilayer**.



Proteins in Plasma Membrane

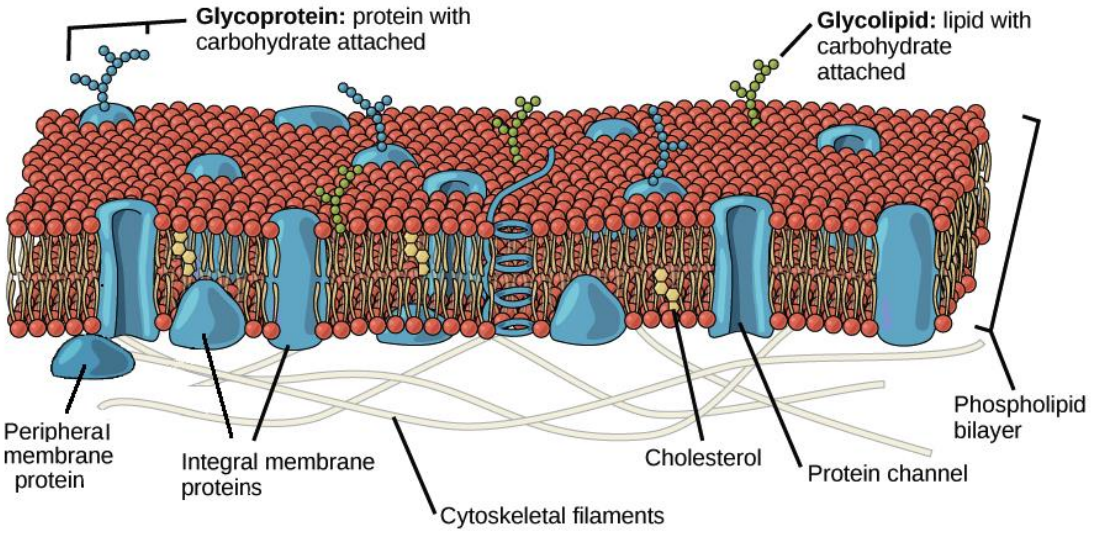
In plasma membrane, proteins perform various functions, and this diversity is reflected in the significantly different types of proteins associated with the lipid bilayer. There are three types of proteins in plasma membrane, which includes:

Integral proteins: are embedded within the lipid bilayer. They cannot easily be removed from the cell membrane, extending through the lipid bilayer so that one end contacts the interior of the cell and the other touches the exterior, are the only class of proteins that can perform functions both inside and outside of the cell.

Peripheral Proteins: Peripheral proteins are attached to the exterior of the lipid bilayer. They are easily separable from the lipid bilayer, able to be removed without harming the bilayer in any way

Lipid-Bound Proteins: Lipid-bound proteins are located entirely within the boundaries of the lipid bilayer.

Transport proteins(proteins channel)



Function of Plasma Membrane

- It separates the contents of the cell from its outside environment and it regulates what enters and exits the cell.
- Plasma membrane plays a vital role in protecting the integrity of the interior of the cell by allowing only selected substances into the cell and keeping other substances out.
- It also serves as a base of attachment for the cytoskeleton in some organisms and the cell wall in others. Thus the cell membrane supports the cell and helps in maintaining the shape of the cell.
- The cell membrane is primarily composed of proteins and lipids. While lipids help to give membranes their flexibility and proteins monitor and maintain the cell's chemical climate and assist in the transfer of molecules across the membrane.
- The lipid bilayer is semi-permeable, which allows only selected molecules to diffuse across the membrane.

Specialization of plasma membrane

In living organisms, most physiologically important events take place at cell surfaces or at interfaces between intracellular compartments. Plasma membrane may show a variety of specializations in its function. Such specializations are grouped in cell junctions and microvilli.

The plasma membranes of neighboring cells in a tissue frequently exhibit specialized junctional regions that play a role in cell-cell adhesion and in intercellular transport. The most common of these junctions are:

(1) Tight junctions

(2) Gap junctions

(3) Desmosomes

A- Cell junction

Most cells are in physical contact with other cells at all times. They form permanent connections with each other called cell

junctions.Cell junction are divided into three categories based on the functions they serve. These are:

1- Tight Junctions:

In tight junctions, the plasma membrane of neighboring epithelial cells fuse with one another at one or more points. Tight junction connects adjacent cells in a sheet in a way that prevents small molecules from leaking between the cells. In this junction, plasma membrane of the two adjacent cells are fused completely like a zipper and leave no space or gap. For example, nutrients that are absorbed from the food in the digestive tract must pass through the cells in the sheet before such nutrients can enter the extracellular fluid.

The main functions of the tight junction

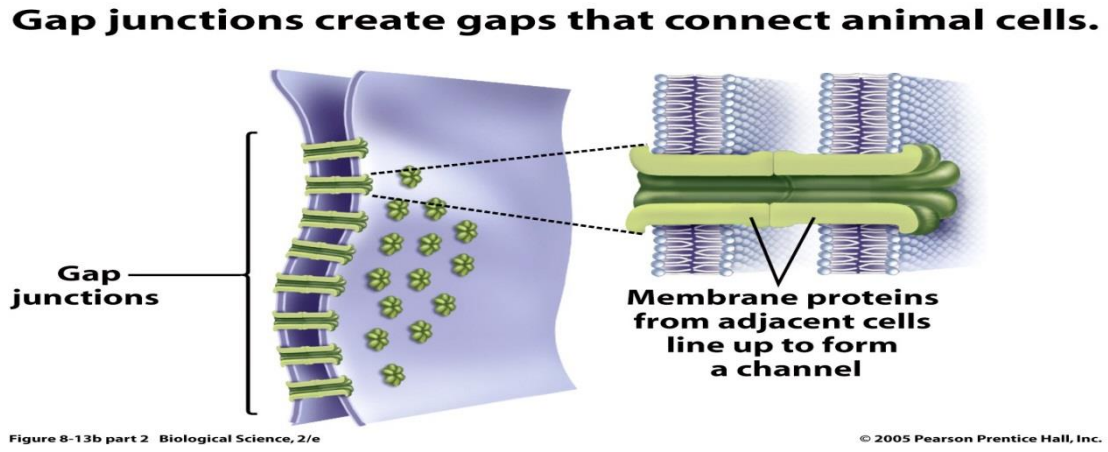
a- They hold cells together.

b- Blocks the lateral movement of integral proteins from the apical side (lumen side) to the basolateral side(extracellular side),This makes sure that the proper endocytosis and exocytosis processes occur on both sides.

c- Controls the movement of molecules and ions by only allowing a limited quantity to get into the cell on apical side and out on basolateral side for e.g. if a molecule such as water wants to get into the cell it must actually undergo membrane transport(passive diffusion) while if a large molecules such as sugar want to inter the cell it must pass through the integral proteins.This type of junction found in epithelia cell of lung , intestine, stomach and bladder.

2-Gap Junctions:

The gap junction or nexus is probably the most complex modification of adjacent plasma membranes. Gap junction are the connection tunnels that exist between adjacent cells, they allow molecules and ions up to a certain size to pass through from one cell to the next



Gap junction found in muscle tissue such as cardiac cell for e.g. allowing the passage of Ca+ from one cell to the other which enhance the action potential and finely cause the heart contraction of the heart.

Maine function of gap junction

1- Provides cytoplasmic channel from one cell to an adjacent cell

2- Allows for communication through exchange of material and transmission of electrical impulses

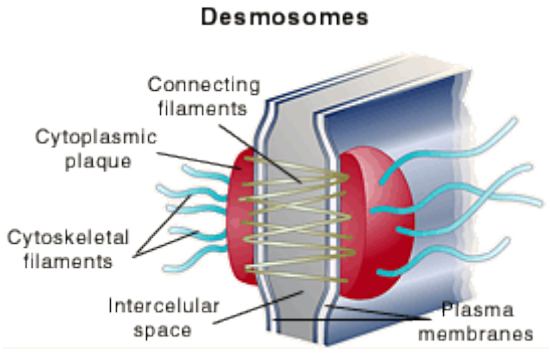
3- Desmosomes

Desmosomes are localized patches that hold two cells tightly together. They are common in epithelia (e.g., the skin). Desmosomes are attached to intermediate filament of keratin in the cytoplasm (connect the cytoskeletons of adjacent cells). Desmosomes do not prevent the movement of ions or molecules around the cell but they are usually found in combination with tight junction ,while hemidesmosomes anchor epithelial cells to a basement membrane

The main function of desmosomes

1- Fasten cells together into strong sheets

2-Attach muscle cells to each other



B- Microvilli

Microvilli (singular: **microvillus**) are microscopic cellular membrane protrusions that increase the surface area of cells and minimize any increase in volume, and are involved in a wide variety of functions, including absorption ,secretion , cellular adhesion.

Examples for microvilli location: 1-Thousands of microvilli form a structure called the brush border that is found on the apical surface of some epithelial cells, such as the small intestines .

2- Microvilli are observed on the plasma surface of eggs, aiding in the anchoring of sperm cells that have penetrated the extracellular coat of egg cells

3- Microvilli are also of importance on the cell surface of white blood cells , as they aid in the migration of white blood cells