Cell membrane

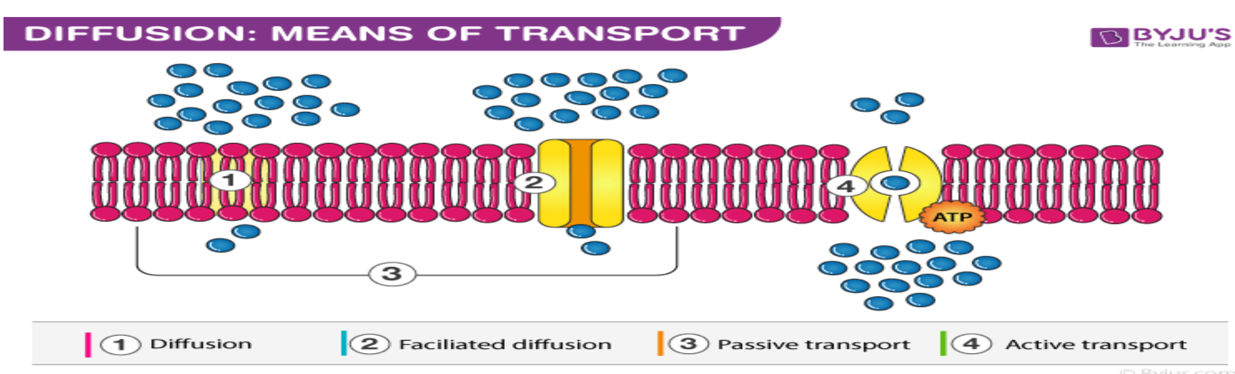
Cell membrane is a phospholipid bilayer that regulates the entry and exit of molecules. Diffusion, osmosis and active transport are some forms of transport seen across the cell membrane. Movement of Substances Across Cell Membrane

The contents of a cell are completely surrounded by its cell membrane or plasma membrane. Thus, any communication between the cell and the extracellular medium is mediated by the cell membranes. These cell membranes serve two important functions:

1. It must retain the dissolved materials of the cell so that they do not simply leak out into the environment.
2. It should also allow the necessary exchange of materials into and out of the cell.

There are two major methods for moving molecules across a membrane, and it is related to whether or not cell energy is used. Passive mechanisms, such as diffusion, require no energy to function, whereas active transport does. In passive transport, an ion or molecule crosses the membrane and moves down its concentration or electrochemical gradient. The different types of transport mechanisms across cell membranes are as follows:

1. Simple diffusion
2. Facilitated diffusion
3. Osmosis



Diffusion

Diffusion is a spontaneous process in which a substance moves from a region of high concentration to a region of low concentration, eventually eliminating the concentration difference between the two regions.

Simple Diffusion

Transport across the plasma membrane occurs unaided in simple diffusion, i.e., molecules of gases such as carbon dioxide and oxygen, as well as small molecules like ethanol, enter the cell by crossing the cell membrane without the assistance of any permease. A small molecule in an aqueous solution dissolves into the phospholipid bilayer, crosses it, and then dissolves into the aqueous solution on the opposite side during simple diffusion. The relative rate of molecule diffusion across the phospholipid bilayer is proportional to the concentration gradient across the membrane.

Facilitated Diffusion

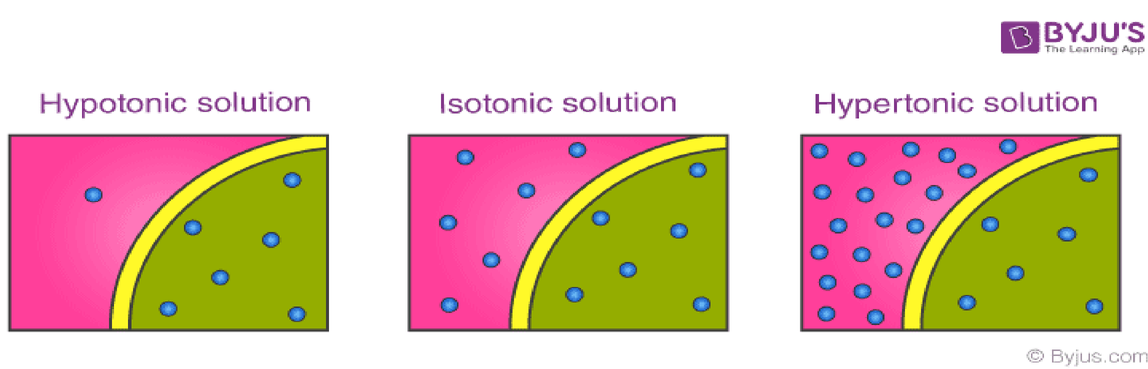
This is a type of passive transport in which molecules that cross the cell membrane move quickly due to the presence of specific permeases in the membrane. Facilitated diffusion occurs only in the direction of a concentration gradient and does not require metabolic energy. It is distinguished by the following characteristics:

- The rate of molecule transport across the membrane is much faster than would be expected from simple diffusion.
- This is a specific process; each facilitated diffusion protein transports only one type of molecule.
- There is a maximum rate of transport, which means that when the concentration gradient of molecules across the membrane is low, increasing the concentration gradient results in an increase in the rate of transport.

Osmosis

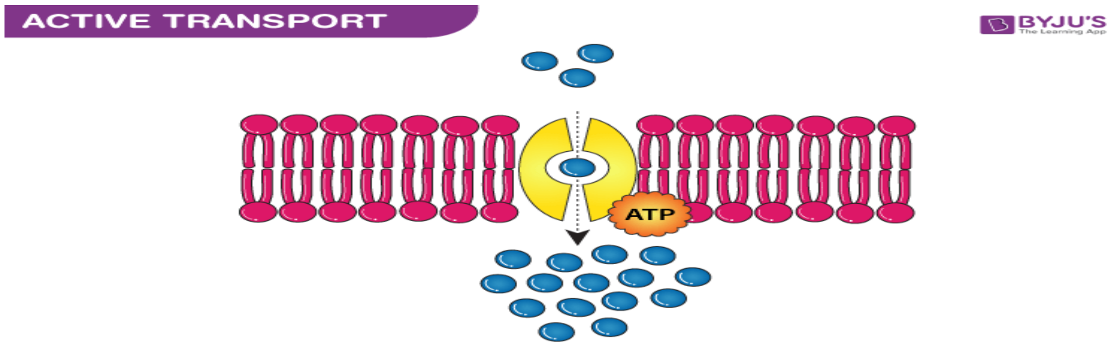
Water molecules can transport through the cell membrane. The movement of water molecules through the cell membrane is caused by differences in the concentration of the solute on its two sides. Osmosis is the process by which water molecules pass through a membrane from a region of higher water concentration to a region of lower water concentration.

- The process by which water molecules enter the cell is known as **endosmosis**, whereas the process by which water molecules exit the cell is known as **exosmosis**.
- Excessive exosmosis causes the cytoplasm and cell membrane in plant cells to shrink away from the cell wall. This is known as **plasmolysis**. It is due to plasmolysis that a plant loses its support and wilts.
- When two compartments of different solute concentrations are separated by a semipermeable membrane, the compartment with higher solute concentration is called **hypertonic** relative to the compartment of lower solute concentration, which is described as **hypotonic**.
- If a cell is placed in a hypotonic solution, it rapidly gains water by osmosis and swells. Conversely, a cell placed into a hypertonic solution rapidly loses water by osmosis and shrinks.
- When the internal solute concentration equals the external solute concentration, it is said to be **isotonic**. Here, no net movement of water in or out of the cells occurs.
- The amount of water contained within the cell creates a pressure termed hydrostatic pressure (osmotic pressure). The cell membrane regulates the osmotic pressures of intracellular and intercellular fluids.



Active Transport

Active transport is a kind of cellular transport in which substances like amino acids, glucose and ions are transported across cell membranes to a region that already has a high concentration of such substances. As a result, active transport employs chemical energy like ATP to move substances against their concentration gradient. This type of transport is commonly found in the small intestine wall and root hair cells.



Active transport is performed by a special type of protein molecules of the cell membrane called the transport proteins or pumps. They consume energy in the form of ATP molecules.

Primary Active Transport

Photon energy and redox energy are two sources of energy for primary active transport. The mitochondrial electron transport chain, which uses the reduction energy of NADH to transport protons across the inner membrane of mitochondria against their concentration gradient, is an example of primary active transport using redox energy. The proteins involved in photosynthesis are an example of primary active transport using photon or light energy.

Primary active transport is demonstrated by glucose uptake in the human intestine.

Secondary Active Transport

Secondary active transport allows one solute to move downward (along its electrochemical potential gradient) in order to generate enough entropic energy to drive the transport of the other solute upward (from a low concentration region to a high concentration region). This is also known as coupled transport. There are two types of coupled transport – antiport and symport. Antiport transport involves the movement of two ion or other solute species in opposite directions across a membrane, whereas symport transport involves the movement of two species in the same direction.