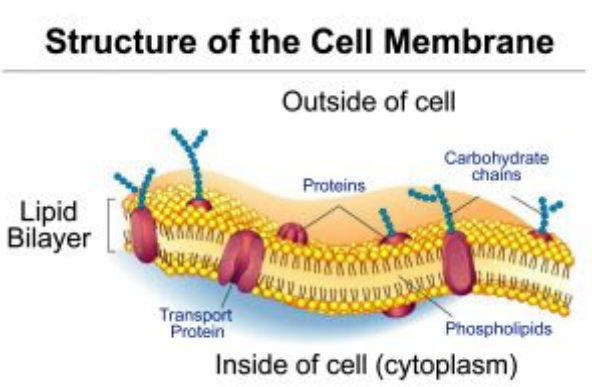
CAIE Biology A-level

Topic 4: Cell membranes and transport

Notes



All cells and organelles are surrounded by a **partially permeable membrane** composed of a sea of phospholipids with protein molecules between the phospholipid molecules. The main function of the membrane is **controlling the movement of substances in and out of the cell/organelle**. However, it also contains **receptors** for other molecules to allow signalling between cells. The fluidity of the membrane and the mosaic arrangement of the protein give the structure of the membrane its name – **fluid mosaic model**.

Structure and functions of the cell membrane:

- **Glycoproteins**- recognition sites, act as antigens.
- **Phospholipids**- form a bilayer, make membrane fluid. They have non-polar tails and hydrophilic heads, thus forming a barrier to most water soluble substances.
- **Cholesterol**- waterproof the membrane, control stability of membrane. They also have hydrophilic heads and hydrophobic tails.
- **Intrinsic proteins** - pass through membranes, some form channels or carriers for water soluble molecules.
    - **Channel proteins** - a hydrophobic channel where diffusion of polar molecules and ions happens
    - **Carrier proteins** - allow active and passive transport. They change shape when the molecule enters the protein.
- **Extrinsic proteins**- found on the surface only, some act as enzymes.
- **Glycolipids-** short carbohydrate chains that help make membranes stable by forming hydrogen bonds with H2O. Help cells attach to one another.

Cell signalling:
Specific **ligands** are released from the cell which are **transported to the target cell** where they **bind to specific receptors** on the cell surface membrane. This produces a **response** which may cause a cascade of more reactions.

Three factors affect the permeability of a cell membrane:

- **Heat**
- **Ethanol**
- **pH**

Movement across membranes:

The movement of molecules through cell membrane depends on the properties of the molecule as well as the requirements of the cell. There are several types of movement:

- **Diffusion** is the passive movement of small, non-polar lipid soluble molecules such as carbon dioxide and oxygen from an area of high concentration to an area of low concentration. The molecules move directly through the phospholipid bilayer.
- **Facilitated diffusion** requires a **channel protein** in the cell membrane to transport polar molecules, charged and water soluble molecules across the membrane.
- **Osmosis** is the net diffusion of water molecules from an area of low solute concentration to an area to high solute concentration through a partially permeable membrane.
- **Active transport** can transport all types of molecules through **carrier proteins** from an area of low concentration to an area of high concentration. However, this process requires energy in the form of ATP.
- **Cytosis** is a form of active transport where parts of the plasma membrane form infoldings or outfoldings. There are two types of cytosis - **exocytosis and endocytosis** which both transport large particles by enclosing them in vesicles made from the cell surface membrane. The vesicles are transported into the cell in endocytosis. In exocytosis, vesicles are fused with the cell surface membrane, releasing the contents outside of the cell.

The rate of **gas exchange** by diffusion becomes more rapid as:

- **Surface area** of the surface increases
- **Diffusion distance** decreases
- **Diffusion gradient** becomes more steep

Water potential is the **pressure exerted by water molecules that are free to move in a system**. It is measured in **kPa**. Pure water has a water potential of 0 pKa, the higher the water potential the larger the number of water molecules that are free to move. **A solution's water potential falls as solutes are added** as water molecules cluster around the solute. The contribution of solute to the water potential is called the **solute potential.**