RAMA UNIVERSITY

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FACULTY OF ENGINEERING &TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY

Plasma (Cytoplasmic) membrane

The **plasma (cytoplasmic) membrane** (or *inner membrane*) is a thin structure (about 5 to 10 nm thick) lying inside the cell wall and enclosing the cytoplasm of the cell.

Bacterial plasma membrane contains both phospholipids and proteins.

The plasma membrane of bacterial cells contains pentacyclic sterol-like molecules called hopanoids whereas eukaryotic plasma membrane contains sterols such as cholestrol.

❖Cell membrane is one of a highly organized and asymmetric system, which also is flexible and dynamic.

❖The most widely accepted current model for membrane structure is the **fluid mosaic model** of S. Jonathan Singer and Garth Nicholson.

❖The membrane must be about as viscous as olive oil, which allows membrane proteins to move freely enough to perform their functions without destroying the structure of the membrane.

❖ This dynamic arrangement of phospholipids and proteins is referred to as the **fluid mosaic model. Fluid mosaic model distinguishes** between two types of membrane proteins.

❖ **Peripheral proteins** are loosely connected to the membrane and can be easily removed. They are soluble in aqueous solutions and make up about 20 to 30% of total membrane protein. About 70 to 80% of membrane proteins are **integral proteins.**

❖These are not easily extracted from membranes and are insoluble in aqueous solutions when freed of lipids.

Integral proteins, like membrane lipids, are amphipathic; their hydrophobic regions are buried in the lipid while the hydrophilic portions project from the membrane surface.

Some of these proteins even extend all the way through the lipid layer. Integral proteins can diffuse laterally around the surface to new locations, but do not flip-flop or rotate through the lipid layer.

Often carbohydrates are attached to the outer surface of plasma membrane proteins.

Proteins attached to carbohydrates are called **glycoproteins**, and lipids attached to carbohydrates are called **glycolipids**.

Both glycoproteins and glycolipids help protect and lubricate the cell and are involved in cell-to-cell interactions.

Asymmetry of cell membrane : The cell membrane is an asymmetric structure. That means that the two sides of membrane are structurally and functionally different.

This difference has to do with

(1) the difference in composition of lipids, proteins and carbohydrates

(2) the difference in the orientation and positioning of the proteins and

(3) the difference in the enzymatic activities of the two sides of the membrane.

The fluidity of plasma membrane is regulated by fatty acid and cholesterol.

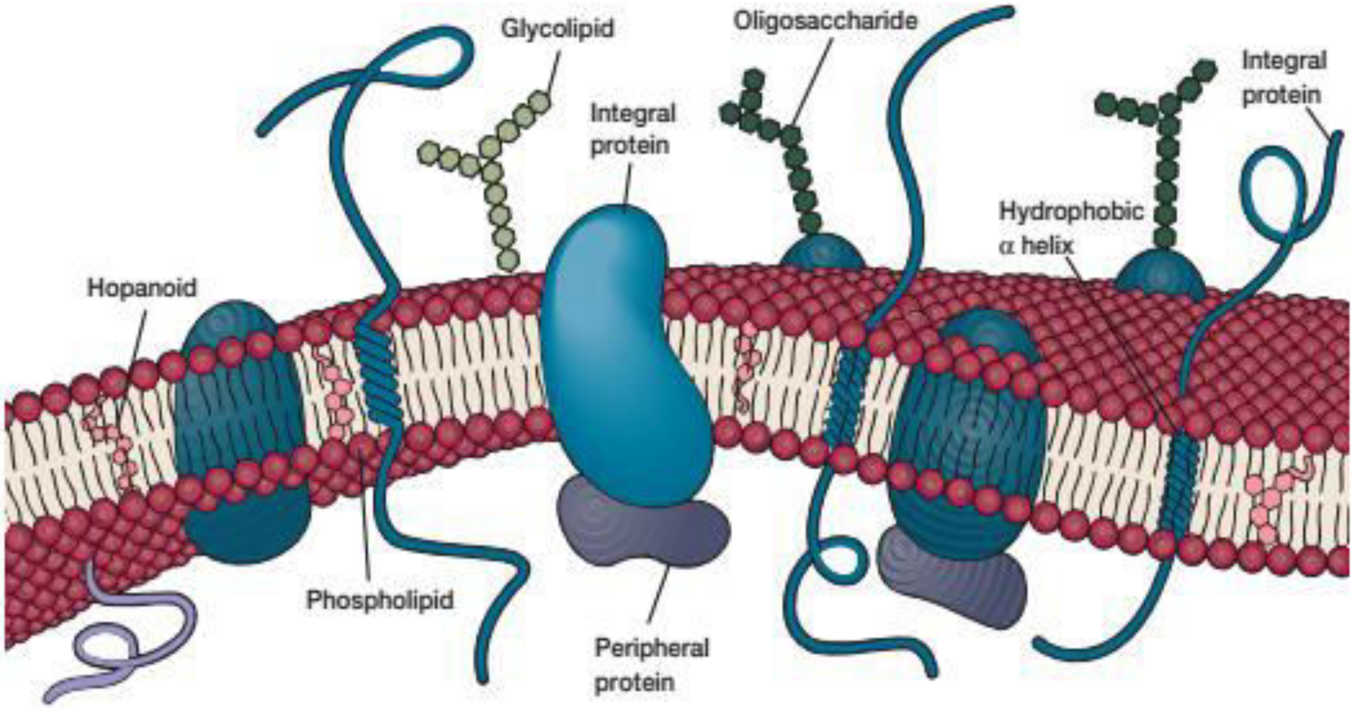

Figure : Fluid mosaic models of bacterial plasma membrane

Major function of plasma membrane

❖Plasma membrane acts as a selective semi permeable barrier which controls the entry and exit of ions and micromolecules across the membrane.

❖Plasma membranes are also important to the breakdown of nutrients and the production of energy for e.g. the plasma membranes of bacteria contains enzymes capable of catalyzing the chemical reactions that break down nutrients and produce ATP.

❖The important energy conversion process in biological systems are carried out by membrane system.

❖E.g. photosynthesis, oxidative phosphorylation which occour in inner membrane of chloroplast and mitochondria respectively.

Effect of isotonic, hypotonic and hypertonic solutions on plasma membrane of bacteria

When bacterial cells are kept in solutions, osmotic pressure is exerted on plasma membrane depending upon the concentration of solute in the solution. Relative to concentration of solutes outside the cells and interior of the cells, it can be categorized into following three types:

Isotonic solution: An **isotonic solution** is a medium in which the overall concentration of solutes equals that found inside a cell (*iso* means equal). Water leaves and enters the cell at the same rate (no net change); the cell's contents are in equilibrium with the solution outside the cytoplasmic membrane

Hypotonic solution:

It is a medium having lower concentration of solute outside the cell compared to interior of cells. In this solution bacteria with weak cell walls undergo osmotic lysis because water moves from ouside the cell to interior of cells and causing swelling of cells. Excessive swelling leads to rupture of plasma membrane.

Hypertonic solution:

A **hypertonic solution** is a medium having a higher concentration of solutes than that inside the cell (*hyper* means above or more). Most bacterial cells placed in a hypertonic solution shrink and collapse or *plasmolyze* because water leaves the cells by osmosis.

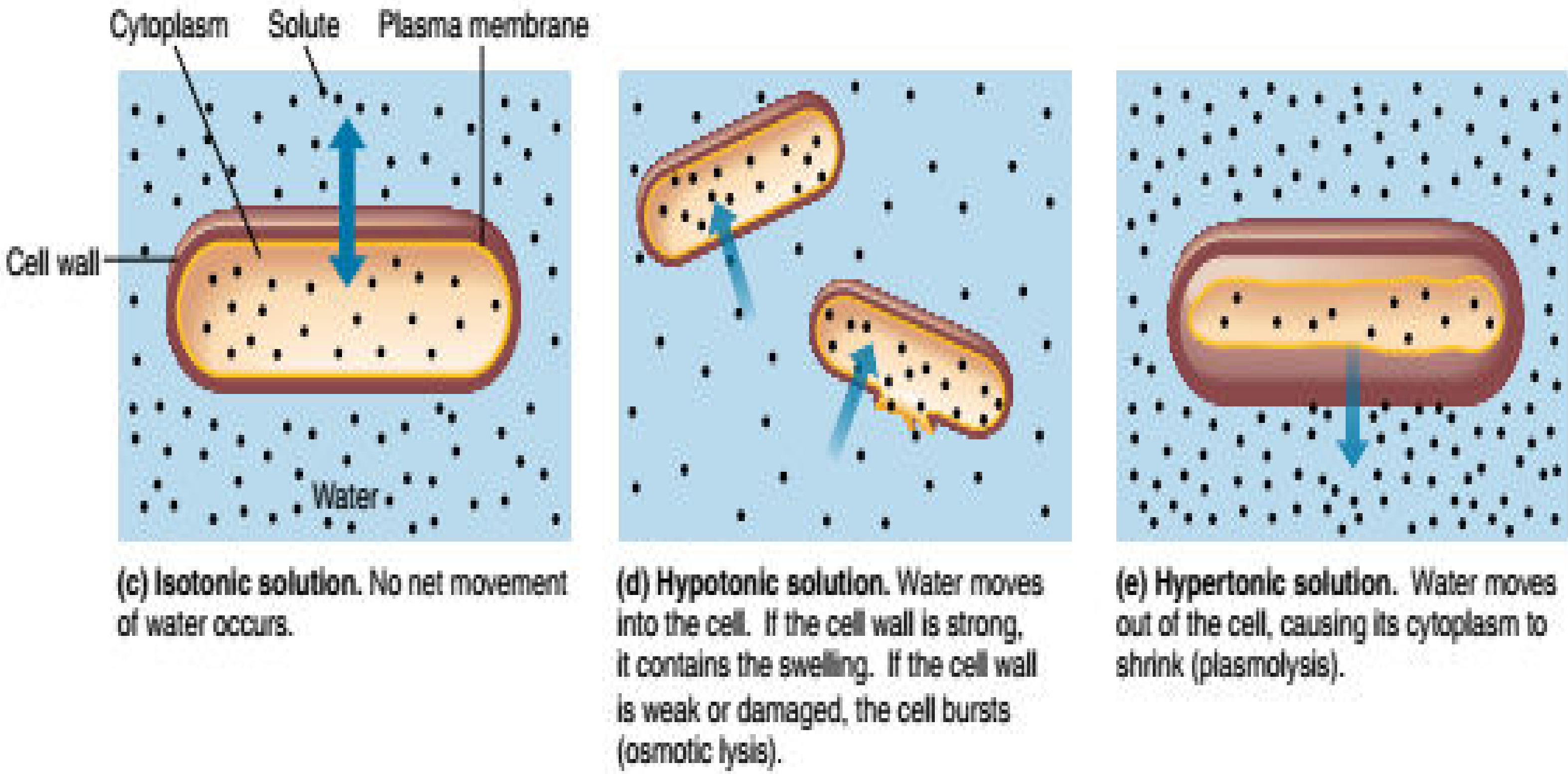

Figure : Effect of solutions with varying concentration of solute on plasma membrane