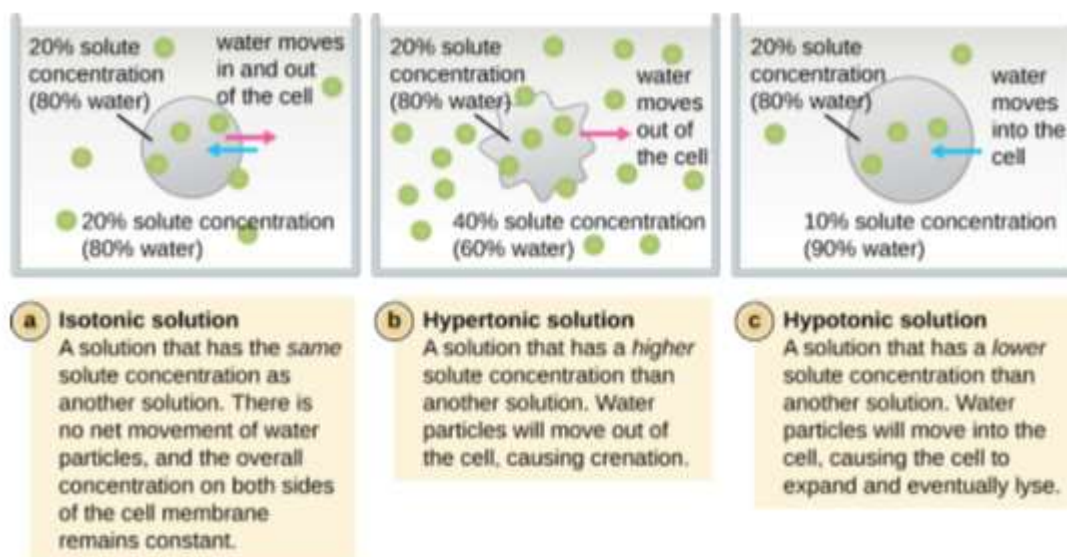


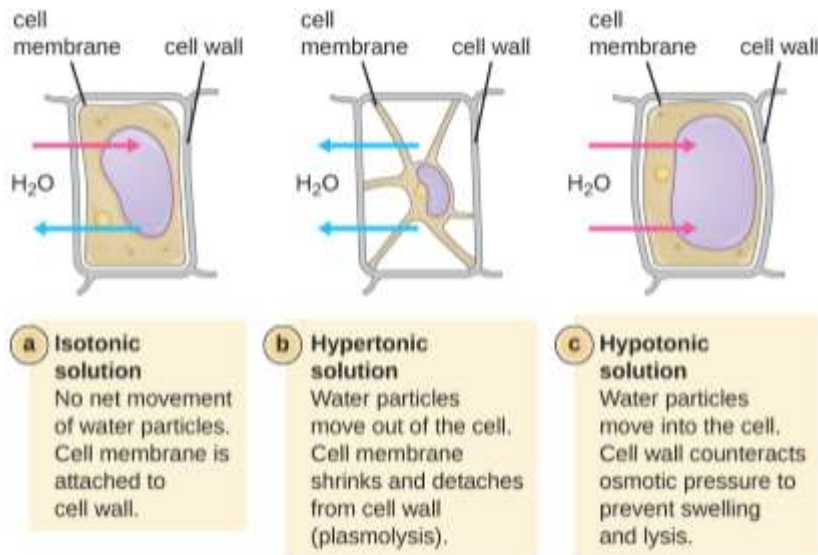
06- Cell Structure

(Instructor: Şeref Tağı)

In most prokaryotic cells, morphology is maintained by the cell wall in combination with cytoskeletal elements. The cell wall is a structure found in most prokaryotes and some eukaryotes; it envelops the cell membrane, protecting the cell from changes in osmotic pressure. Osmotic pressure occurs because of differences in the concentration of solutes on opposing sides of a semipermeable membrane. Water is able to pass through a semipermeable membrane, but solutes (dissolved molecules like salts, sugars, and other compounds) cannot. When the concentration of solutes is greater on one side of the membrane, water diffuses across the membrane from the side with the lower concentration (more water) to the side with the higher concentration (less water) until the concentrations on both sides become equal. This diffusion of water is called **osmosis**, and it can cause extreme osmotic pressure on a cell when its external environment changes. The external environment of a cell can be described as an **isotonic, hypertonic, or hypotonic** medium.



In an isotonic medium, the solute concentrations inside and outside the cell are approximately equal, so there is no net movement of water across the cell membrane. In a hypertonic medium, the solute concentration outside the cell exceeds that inside the cell, so water diffuses out of the cell and into the external medium.

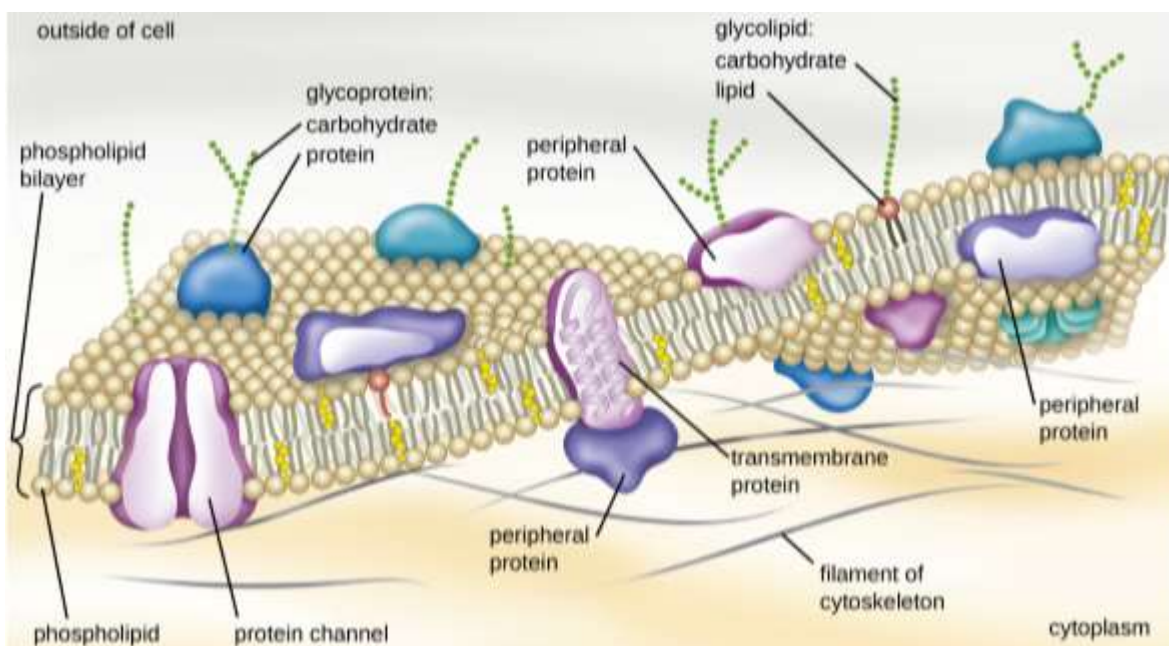


In a hypotonic medium, the solute concentration inside the cell exceeds that outside of the cell, so water will move by osmosis into the cell. This causes the cell to swell and potentially lyse, or burst. The degree to which a particular cell is able to withstand changes in osmotic pressure is called tonicity. Cells that have a cell wall are better able to withstand subtle changes in osmotic pressure and maintain their shape. In hypertonic environments, cells that lack a cell wall can become dehydrated, causing crenation, or shriveling of the cell; the plasma membrane contracts and appears scalloped or notched. By contrast, cells that possess a cell wall undergo plasmolysis rather than crenation. In plasmolysis, the plasma membrane contracts and detaches from the cell wall, and there is a decrease in interior volume, but the cell wall remains intact, thus allowing the cell to maintain some shape and integrity for a period of time. Likewise, cells that lack a cell wall are more prone to lysis in hypotonic environments. The presence of a cell wall allows the cell to maintain its shape and integrity.

In prokaryotic cells, the cell wall provides some protection against changes in osmotic pressure, allowing it to maintain its shape longer. The cell membrane is typically attached to the cell wall in an isotonic medium (left). In a hypertonic medium, the cell membrane detaches from the cell wall and contracts (plasmolysis) as water leaves the cell. In a hypotonic medium (right), the cell wall prevents the cell membrane from expanding to the point of bursting, although lysis will eventually occur if too much water is absorbed.

Plasma membrane

Plasma Membrane Structures that enclose the cytoplasm and internal structures of the cell are known collectively as the cell envelope. In prokaryotic cells, the structures of the cell envelope vary depending on the type of cell and organism. Most (but not all) prokaryotic cells have a cell wall, but the makeup of this cell wall varies. All cells (prokaryotic and eukaryotic) have a plasma membrane (also called cytoplasmic membrane or cell membrane) that exhibits selective permeability, allowing some molecules to enter or leave the cell while restricting the passage of others. The structure of the plasma membrane is often described in terms of the fluid mosaic model, which refers to the ability of membrane components to move fluidly within the plane of the membrane, as well as the mosaic-like composition of the components, which include a diverse array of lipid and protein components. The plasma membrane structure of most bacterial and eukaryotic cell types is a bilayer composed mainly of phospholipids formed with ester linkages and proteins. These phospholipids and proteins have the ability to move laterally within the plane of the membranes as well as between the two phospholipid layers.



The bacterial plasma membrane is a phospholipid bilayer with a variety of embedded proteins that perform various functions for the cell. Note the presence of glycoproteins and

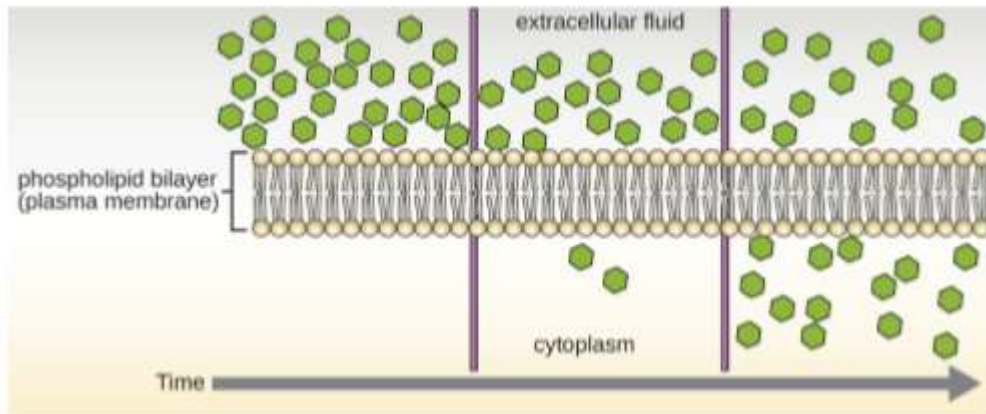
glycolipids, whose carbohydrate components extend out from the surface of the cell. The abundance and arrangement of these proteins and lipids can vary greatly between species.

Archaeal membranes are fundamentally different from bacterial and eukaryotic membranes in a few significant ways. First, archaeal membrane phospholipids are formed with ether linkages, in contrast to the ester linkages found in bacterial or eukaryotic cell membranes. Second, archaeal phospholipids have branched chains, whereas those of bacterial and eukaryotic cells are straight chained.

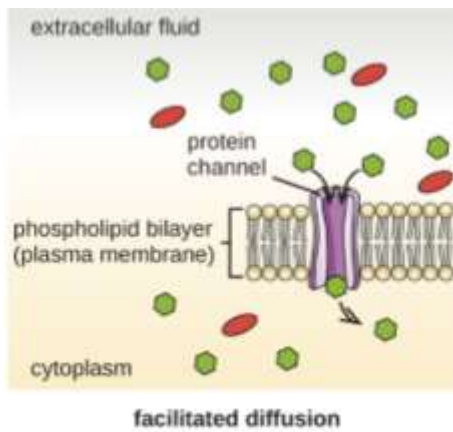
Membrane Transport Mechanisms

One of the most important functions of the plasma membrane is to control the transport of molecules into and out of the cell. Internal conditions must be maintained within a certain range despite any changes in the external environment. The transport of substances across the plasma membrane allows cells to do so. Cells use various modes of transport across the plasma membrane. For example, molecules moving from a higher concentration to a lower concentration with the concentration gradient are transported by simple diffusion, also known as passive transport. Some small molecules, like carbon dioxide, may cross the membrane bilayer directly by simple diffusion. However, charged molecules, as well as large molecules, need the help of carriers or channels in the membrane. These structures ferry molecules across the membrane, a process known as facilitated diffusion (Figure 3.23). Active transport occurs when cells move molecules across their membrane against concentration gradients.

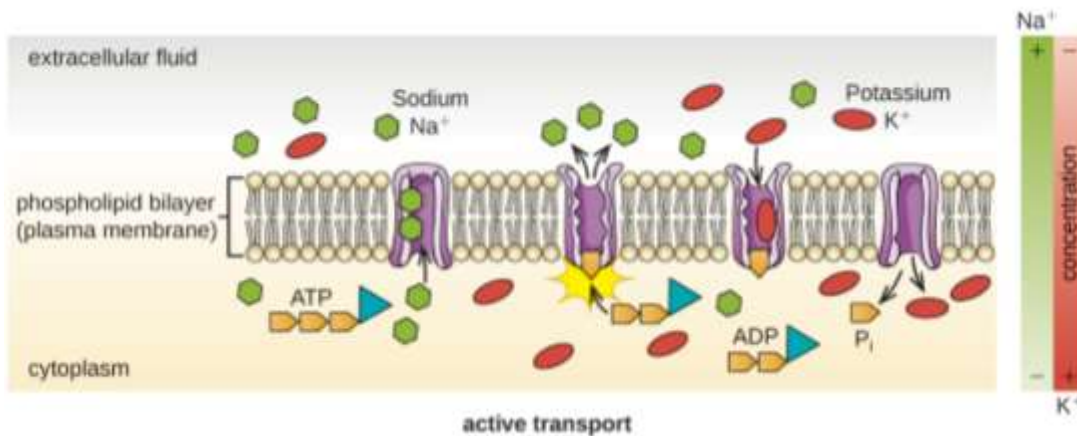
A major difference between passive and active transport is that active transport requires adenosine triphosphate (ATP) or other forms of energy to move molecules “uphill.” Therefore, active transport structures are often called “pumps.”



Simple diffusion down a concentration gradient directly across the phospholipid bilayer.



Facilitated diffusion down a concentration gradient through a membrane protein.



Active transport against a concentration gradient via a membrane pump that requires energy.

References:

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