BIOLOGY
Topic Summary

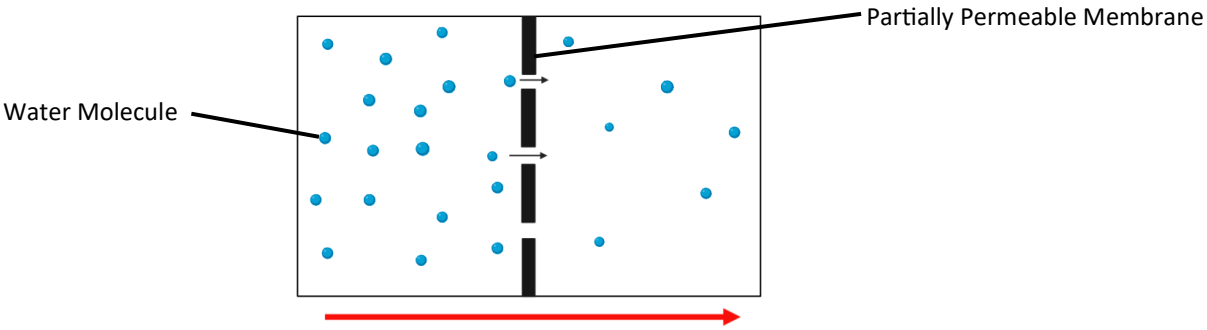
# LT12 - OSMOSIS & WATER POTENTIAL

## Osmosis

Osmosis is defined as the net movement of water molecules from a region of high concentration of water molecules to a region of low concentration of water molecules across a partially permeable membrane.

It is very similar to diffusion as it moves down a concentration gradient and is also a passive process. Osmosis may also be referred to as the 'diffusion of water'.

The net movement of water by osmosis is determined differences in water potential between two solutions connected by a partially permeable membrane.




*Water molecules move down the concentration gradient across a partially permeable membrane via osmosis*

## Water Potential

Osmosis can also be defined as water diffusing from a region of high water potential to a region of low water potential through a partially permeable membrane.

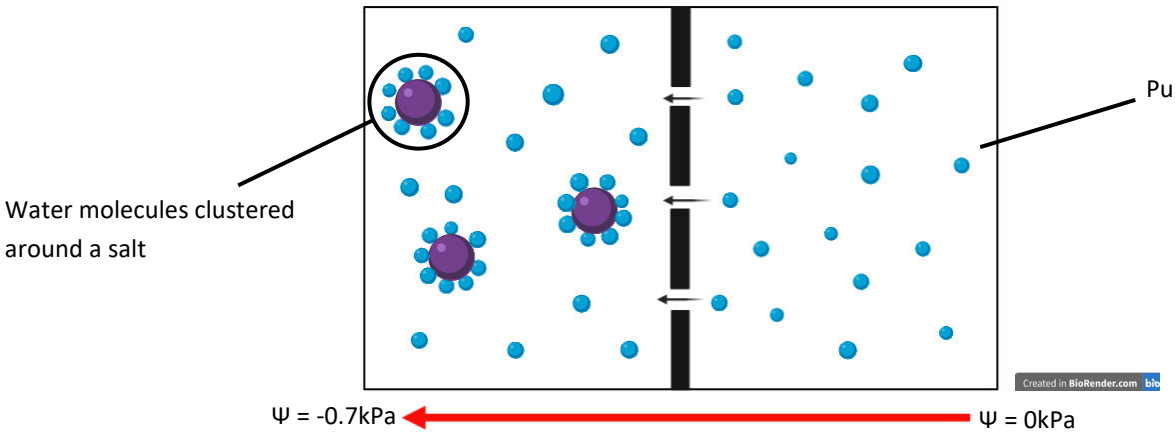
Water potential is the tendency of water molecules in a system to move. It is a measure of how freely water molecules can move in a system. Water potential is usually represented by the Ψ (psi) symbol and is measured in kilopascals (kPa). Water potential is defined as the potential energy of water per unit volume relative to pure water.

Pure water has the highest water potential and a has a value of 0kPa . Most other solutions have lower water potentials than pure water.

Many substances, like ions, dissolve in water as it is a polar molecule. Water molecules cluster around ions dissolved in water. When this happens, there are less free water molecules and therefore this lowers the concentration of water and will have a lower water potential.

The greater the amount solutes dissolved in water, the lower the water potential as there are less water molecules 'free' to diffuse. This is called the solute potential (Ψs) and always has a negative value.

The higher the pressure the higher the water potential. This is called pressure potential (Ψp) and is always a positive value. In plant cells the pressure potential is the result of the cell wall exerting pressure on the cytoplasm.



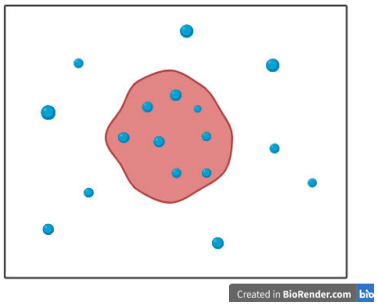

As the diagram above shows, water molecules will cluster around any solutes present. These solutes are usually salts and sugars and will cause the region to have a low water potential.

In the diagram above, the pure water has a water potential of 0kPa while the side with salts dissolved has a water potential of –0.7kPa. Due to having a higher water potential, the pure water will move across the partially permeable membrane to an area of low water potential (to the left in this case).

$$\Psi = \Psi s + \Psi p$$

This equation is used to calculate the water potential of a solution.

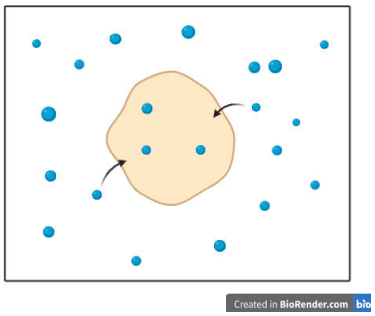
## Isotonic Solution




Isotonic solution is a solution of equal water potential to the cell it is surrounding.

This means that there is no net movement as the water potential is equal on both sides of the cell membrane.

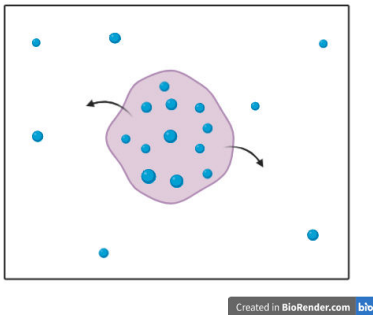
## Hypotonic Solution




A hypotonic solution is a solution of higher water potential than a cell.

This means that the net movement of water molecules will be into the cell as the solution surrounding the cell will have a higher water potential. This will result in cytolysis occurring. Cytolysis is when the cell swells and bursts.

## Hypertonic Solution




A hypertonic solution is a solution of lower water potential than a cell.

This means that the solution surrounding the cell will have a lower water potential and therefore the net movement of molecules will be out of the cell. However this can cause cell plasmolysis. Plasmolysis is when cells shrink.