Osmosis

The diffusion of the solvent across a semi – permeable membrane , in living system the solvent is always water , so biologists generally define osmosis as the diffusion of water across a semi permeable membrane from a region of higher can-centration with solvent (higher water potential) to a region of lower concentration with solvent (lower water potential) .

- That's means osmosis required :
    1. Water potential gradient .
    2. Semi permeable or partially permeable membrane

Osmosis will continue until the rate of water diffusion across the cell membrane in both directions is equal . This is called osmotic balance . The pressure generated from this movement of water is called osmotic pressure of a solution is the pressure needed to keep it in equilibrium with pure H2O . Therefore the osmotic pressure can be described as the pressure needed to stop the flow of water across the membrane . Osmotic balance →dynamic equilibrium.

Osmosis concept / if a membrane is placed between two solutions of unequal concentrations of solute- to which the membrane is impermeable to the solutes , water flows through the membrane from the more dilute to the more concentrated solution .

e.g/ solution(1) solution (2)

(less) lower solvent ← more solvent

(more) high solute ← less solute

Solvent molecules

e.g / Nacl 80% Nacl 20%

high osmotic pressure low(O.P)

(O.P)

The higher (concentrated) solution , is the higher in osmotic pressure.That's mean the (O.P) depends on the ions or molecules number of the solutes substances in certain volume of solution , in other words the (O.P) directly proportional with the concentration of solutes in the solution , how can you prove that ?

Answer/

Osmotic pressure = 22.4 × M × N × T/273

(O.P)

When/

22.4 : constant ratio

M : solution concentration with molarity

N : ions number that relised from ionized substance . e.g / Nacl =2

T : absolute tempreture (C + 273) .

It's found that the (O.P) to an ionized solution (1M : concentration) at the (0C: tempreture) equal to (22.4 : Atmospher pressure) = 24.7 bar

1 atmospheric pressure = 1.013 bar

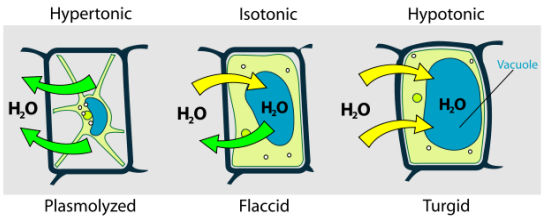
While the substance is ionized , the (O.P) value will be higher (because ionized the substance to ions) , and the colloidal substances gives less (O.P) value from the uppers because their molecules ability for accumulation .

Type of membrane:

1. **Permeable membrane*:*** is a membrane that allows all substances to pass through.**(such as cell membrane)**
2. **Impermeable membrane:** is a membrane that doesn't allow substances to pass through. .**(such as cork)**
3. **Semi-permeable membrane:** Partially permeable, allowing passage of certain, especially small, molecules or ions but acting as a barrier to others. Used of biological and synthetic membranes. One example of a semi permeable membrane is a phospholipids bilayer, a group of phospholipids (consisting of a phosphate head and 2 fatty-acid tails) arranged into a double-layer, with the hydrophilic phosphate heads exposed to the water content outside and within the cell and the hydrophobic fatty-acid tails hidden in the inside. The phospholipids bilayer is the most permeable to small, uncharged solutes. Protein channels float through the phospholipids, and, collectively, this model is known as the fluid mosaic model. A semi permeable membrane, also termed a selectively-permeable membrane, a partially-permeable membrane or a differentially-permeable membrane

Q / are the plant cell consider as an osmotic system ?

The plant cells covered by cellulose wall outlet most type of solution, and also present plasma membrane or Ectoplasm and vacular membrane or Tonoplast ,there are membranes which have selective permeability which similar to the industrial semi permeable membrane, so we can able account plant cell as Osmotic system, in this system transport water from solution that have low concentration of solute material to the solution that have high concentration of solute material. If we put the plant cell in solution that have high concentration of solute material, water transport from the cell (vacuole fluid) to the external, in this case the cell Contraction happen, and known as plasmolysis phenomenon.



But if we put this cell in solution that have low concentration of solute material or (water) the water transport from the external into the cell, and the cell gradually regain filled and return the plasma membrane and vacular membrane to the normal state and this state called as deplasmolysis.

Types of solution according to the plasmolysis

Or types of solutions according to their concentration gradient between in and outside of the cell /

1. Isotonic solution (equal-tention solution) has the same concentration of dissolved substance as the cell placed in it .

   The concentration of water molecules in the cell and in an- isotonic solution is the same , since the concentration gradient is zero , there is no net gain or loss of water in the cell .

2. Hypotonic solution (less – tention solution) contains a lower concentration of dissolved (solutes) substances than the cell put in it . (e.g/ the solution is mostly H2O) the concentration of water molecules is higher in this solution than it's in the cell , the water molecules > outside the cell than inside, there is a net movement of water into the cell water enter cells by osmosis , the cell becomes turgid .

   Q/ why the plant cell not burst ?

   Plant cells have a rigid cell wall that perevents them from bursting .

3. Hyper tonic solution (more-tention solution) contains a higher concentration , of solutes than the cell placed in it , the concentration of water molecules is lower than the cell solution , water > inside the cell than outside , water leaving the cell by osmosis , cytoplasm shrinks away from cell wall , cell loses it's turgor and becomes flaccid , as more water is lost , plasmolysis case has occurred .

We have two type of plasmolysis:

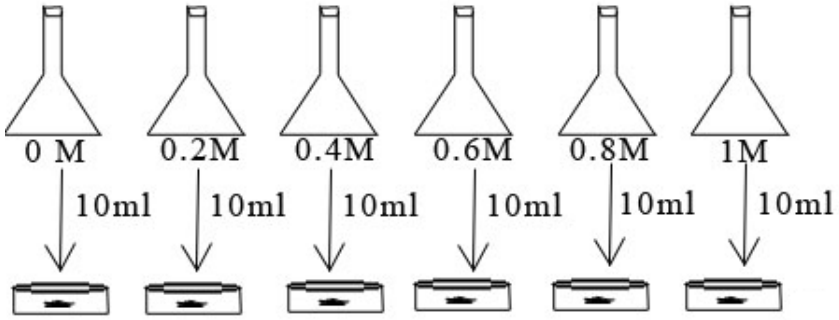
1. Permanent plasmolysis: occurs when put plant cell in very high concentrated solution, the cell fluid continuous in smallness and the plasma membrane contracting and inseparable whit cell wall and break protoplasmic relationship, which don't return cell to the original state when put it into diluted solution.

2. Temprary plasmolysis: occurs when put the cell into the concentrated Solution and plasma membrane allow some solute molecule material to pass through it from external solution to the cell fluid, when put cell in diluted solution the cell return to the normal state (original state).

Practice part:

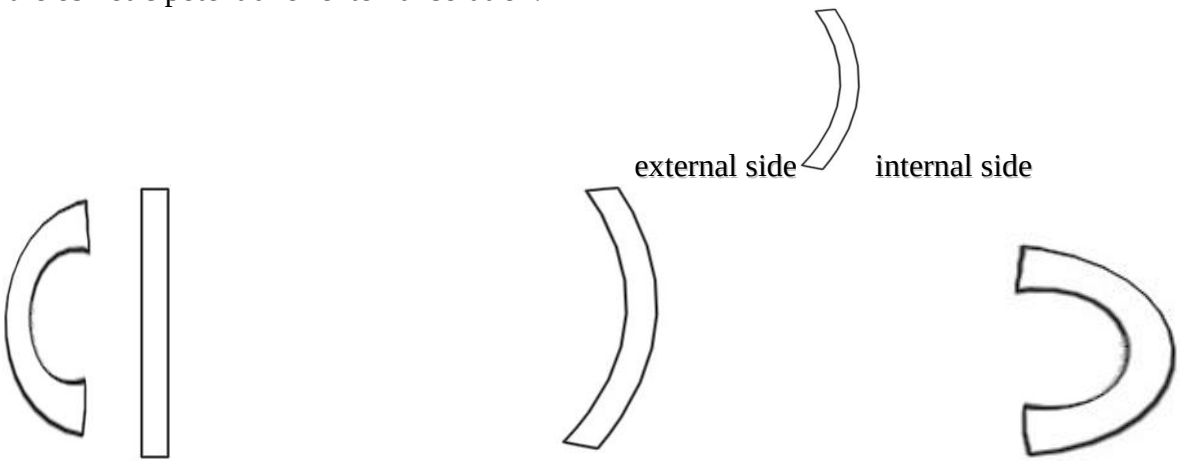
Exp1: Determine the water potential with the curvature method.

1. Prepare series from NaCl
diluted solution (0, 0.2, 0.4, 0.6, 0.8, 1M)



1. Cut the stalk s of Castor-oil plant leaves or other plants, four long equal Quarters notice that all Quarter to bow to the dermal direction and this by pressure Extinction which is stand on the cells and water loss.
2. Estimate water potential ((Y)) by the curvature and vault:
Leave for 30 minute after that notice curvature and vault that occur and discus results?

Answer/If increase the curvature degree this mean that the swelling cell of spinal absorb water from external solution and this mean that the external solution have negative osmosis, if decrease the curvature of dermal side with original curvature the stem segment become straight, this shows occurs of plasmolysis of spinal cells because of losing water, it proved that the external solution have positive concentration, but if the curvature of Square stem remain at its state with out change it is mean the absorb or losing of water, and the external solution have same concentration at this time consist water potential for cell fluid which equal to the osmotic potential of external solution.



Straight

Small curvature from The dermal side at original Curvature and become straight Or towards the shows this Occur of plasmolysis because of Losing Water instead of solution.

remain the original curvature with out loss or absorb water, and the external solution have some concentration Isotonic s.

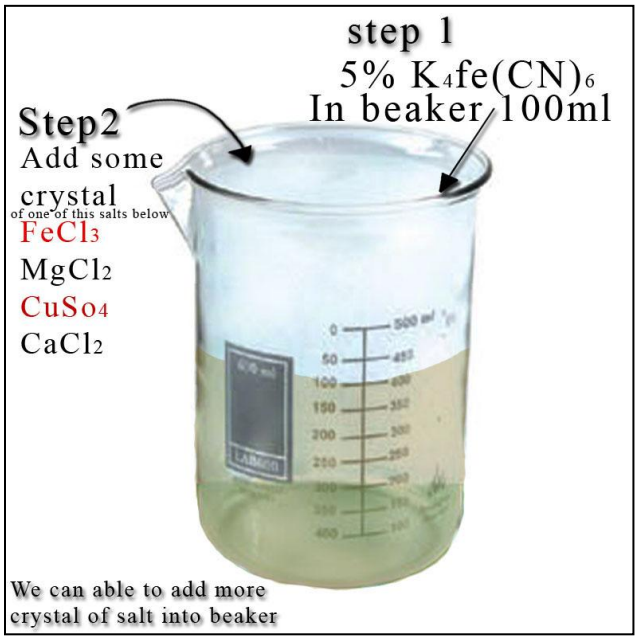
increase the curvature degree towards the dermal Swelling cells of absorbs water from external solution Hypotonic solution

Water potential must be equal to the osmotic potential

Water potential of cell = - 22.4 x M x N x T/273

T = Lab. Temperature +273
N = 2

Exp2: Prove the osmotic property by the synthetic membrane(Osmotic flower garden)



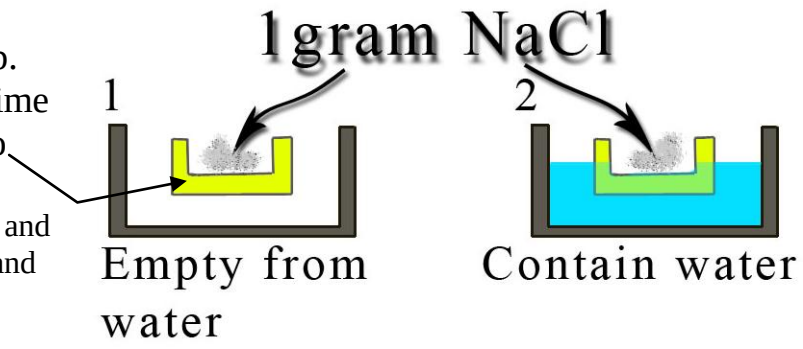
After 20 minute Notice the preparation of differential membrane with different color in the beaker. Explain the causation?

In which compose semi permeable membrane from (FeCN metal)around the surface of the Crystals, Which is this membrane allow the water molecules (solvent) to pass through it into the inner, and don't allow the (solute)

molecule to pass through it, results of that arise the pressure on this membrane causes to torn it, and exposure the surface of crystals again to the solution and interaction with it consisting semi permeable membrane which covering the crystals, and water distribute by osmotic properties into the membrane which results of that compose the pressure which lead to torn it for the next time(again),repeat this process several times until happen consume of crystals, finally produce compound similar to the garden called as osmotic garden.

Exp3: prove the Osmotic properties by a piece of Potato tubers
(Potato Osmoscope)
Leave the experiment to the end of lab.
And notice what happened after this time period.

Accumulate amount of water in each holes, and the strength of one cubic become shriveled and the other stays the same.
Explain the causation?



Exp:4 Measurement the amount of water either taken up or lost from living plant cells (cells of Potato tubers).

Procedure:

1. Cut and prepare (40) cubes (small cubes) from Potato and divide the cubes into 4 groups of (2 gm) = initial weight.
2. Each group will be immersed for (30 minutes) in a different solution. The four solutions you will use are:
   - Distilled water (water conc. 100%).
   - 20% saline solution (NaCl) W. conc. 80%.
   - 40% saline solution (NaCl) W. conc. 60%.
   - 60% saline solution (NaCl) W. conc. 40%.

3. After (30 minutes) weight them again = Final weight (each group weighting alone).
4. Record the initial and final weight of each group in the table below, then calculate the (percent change %) using this formula:

Change % = (wt. after 30 mint. – initial wt.) / initial wt. * 100

5. Record the change% in the table.

Table: changes in weight in Potato tissue:

Solution	Initial wt (t=0)	Final wt (t=30)	% change
0% saline			
20% saline			
40% saline			
60% saline			

Answer:

1. Which group had the least/ greatest amount of gain mass?
2. Which group had the greatest lost of mass?
3. Which group was in the most hypertonic solution? The most hypotonic?
4. If you repeat this experiment with (sucrose solution concentrations), do you notice any difference?