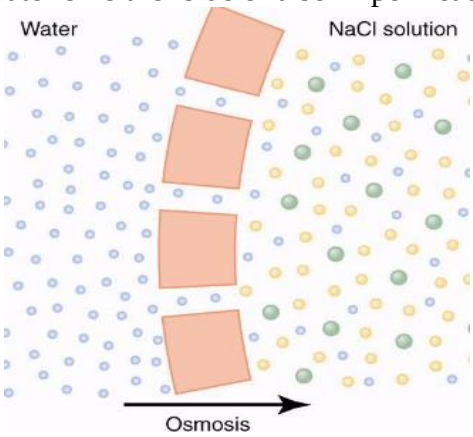
Unit I – Problem 2 – Physiology lab: Osmotic Fragility

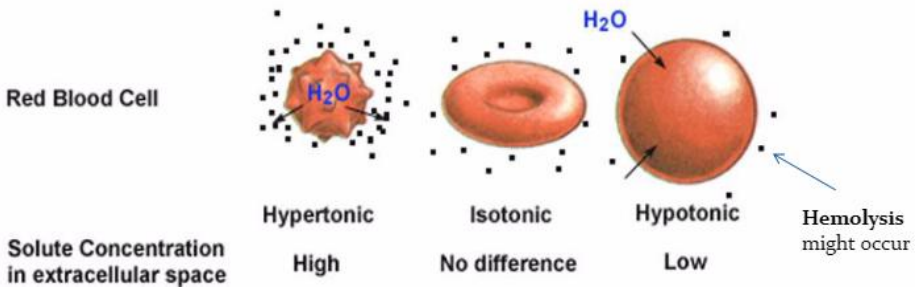
- **Relationship between molarity and osmolarity:**
  - Osmolarity = molarity x the number of particles of dissociation.
  - 1 mol/L NaCl solution is a 2 osmol/L NaCl solution.
  - The molarity of our body fluids is about 0.15 M (150mM) and the osmolarity is about 0.3 Osm or 300 mOsm.
- **Osmosis:**
  - **Definition**: it is a spontaneous net movement of water through a semi-permeable membrane into a region of higher solute concentration. It occurs when there is unequal distribution of water on either side of a semi-permeable membrane.



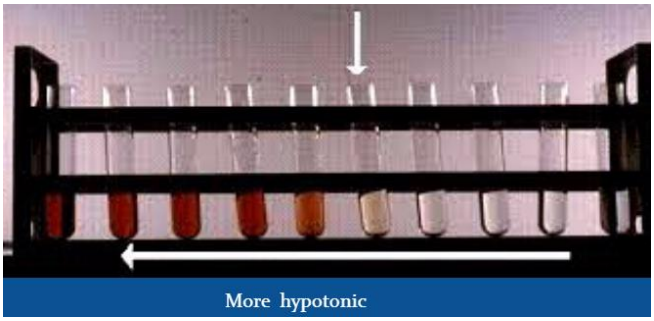
  - **Osmotic pressure and osmosis:**
    - ✓ Osmotic pressure: is the minimum pressure which needs to be applied to a solution to prevent the inward flow of water across a semi-permeable membrane (osmosis). It is also defined as the measure of the tendency of a solution to take in water by osmosis.
  - **Relation of osmolarity to osmotic pressure:**
    - ✓ 1 Osm/l will cause 19,300 mmHg osmotic pressure in the solution.
    - ✓ 1 mOsm/l concentration is equivalent to 19.3 mmHg osmotic pressure.
    - ✓ 300 mOsm/l gives a total calculated osmotic pressure of the body fluids of 5790 mmHg. The measured value for this, however, averages only about 5500 mmHg. Therefore, on average, the actual osmotic pressure of body fluids is about 0.93 times the calculated value.
- **Osmolarity vs tonicity:**
  - **Osmolarity**: takes into account the total concentration of penetrating solutes and non-penetrating solutes.
  - **Tonicity**: takes into account the total concentration of only non-penetrating solutes.

Penetrating solutes	Non-penetrating solutes
They can diffuse through the cell membrane, causing momentary changes in cell volume as the solutes pull water molecules with them (glucose and urea)	They cannot cross the cell membrane. Therefore, osmosis of water must occur for the solutions to reach equilibrium (sucrose, NaCl)

    - ✓ Effect of tonicity of Red Blood Cells (RBCs):
      - ❖ 0.9% NaCl solution is said to be isotonic with body fluids.



- ✓ Osmotic fragility test:
  - ❖ It is a test to measure RBC resistance to hemolysis (التحلّل) when subjected to osmotic stress by being placed in a series of increasingly dilute saline (hypotonic) solutions.
  - ❖ The sooner hemolysis occurs, the greater the osmotic fragility of the cells.
  - ❖ Osmotic fragility test is often performed to aid with diagnosis of diseases associated with RBC membrane abnormalities.
  - ❖ *Principle of osmotic fragility test:*
    - ➢ Whole blood is added to different concentrations of buffered NaCl solution.
    - ➢ After centrifugation, notice the:
      - ▪ Depth of color of supernatant fluid.
      - ▪ Volume of RBCs at the bottom of the tube.



  - ❖ Normal hemolysis starts in 0.45% NaCl solution.
  - ❖ *Factors which affect osmotic fragility:*
    - ➢ Cell membrane composition and integrity.
    - ➢ Surface-to-volume ratio: the larger the amount of red cell membrane (surface area) in relation to the size of the cell, the more fluid the cell is capable of absorbing before rupturing.

- **Calculation of osmolarity of solutions:**

- **0.7% NaCl solution.**
  - ✓ 0.7 % NaCl = 0.7 g/100 ml NaCl = 7 g/1000 ml NaCl = 7 g/L NaCl
  - ✓ Number of moles (NaCl) = $\frac{7\ g}{58.5\ g/mole}$ = 0.12 mole
  - ✓ Therefore, molarity of 7 g/L NaCl = 0.12 mole/L = 0.12 M
  - ✓ But, 1 osmole NaCl gives 2 osmoles in solution
  - ✓ 0.12 osmoles NaCl will give 0.24 osmoles in the solution = 0.24 osmoles/L
  - ✓ Expressing the value in mOsm/L gives 240 mOsm/L