OBJECTIVES
1. Predict net movement of molecules across a semi-permeable membrane
2. Define which molecules move during osmosis
3. Determine changes in volume caused by osmosis
4. Define hypertonic, hypotonic and isotonic solutions

BACKGROUND INFORMATION

Osmosis is the diffusion of a solvent, such as water through a selectively permeable membrane like the plasma membrane. Osmosis occurs whenever there is a difference in water concentration on the two sides of the membrane. If distilled water is present on both sides of a selectively permeable membrane, no net osmosis occurs, even though water molecules continue to move in both directions through the membrane. If, however, the solute concentration on the two sides of the membrane differs, water concentration differs as well, because as a solute concentration increases, water concentration decreases. The extent to which water’s concentration is decreased by solutes depends on the number, not the type, of solute particles in a solution, because one molecule or one ion of solute displaces one water molecule.

The total concentration of all solute particles in a solution is referred to as the solution’s osmolarity. When equal volumes of solutions of different osmolarity are separated by a membrane that is permeable to all molecules in the system, net diffusion of solvent (often water) occurs, moving down its own concentration gradient. If one solution has a higher solute concentration than another it is termed a hyperosmotic solution; if two solutions have the same osmolarity then they are iso-osmotic solutions; and a solution with a lower solute concentration and lower osmolarity than another solution is termed a hypo-osmotic solution.

Osmosis is the movement of solvent molecules from an area of high solvent concentration to an area of low solvent concentration. Cell membranes are completely permeable to water, therefore, the environment the cell is exposed to can have a dramatic effect on the cell.

The tonicity of a solution describes the effect a solution will have on a cell. Hypertonic solutions contain a high concentration of solute relative to a cell. When a cell is placed in a hypertonic solution, the concentration of solute is higher in the solution than in the cell and the water moves by osmosis out of the cell, causing the cell to shrivel.
Hypotonic Solutions: contain a low concentration of solute relative to the concentration inside a cell. When a cell (such as a red blood cells) is placed in a hypotonic solution, the water diffuses into the cell, causing the cell to swell and possibly explode.

Isotonic Solutions: contain the same concentration of solute as the concentration of solute within a cell. When a cell is placed in an isotonic solution, the water diffuses into and out of the cell at the same rate, but there is no net movement of fluid. The shape of the cell does not change. The fluid that surrounds the body cells is isotonic.

Osmosis is important in biological systems as many biological membranes are semipermeable. In general, these membranes are impermeable to organic solutes with large molecules, such as polysaccharides, while permeable to water and small, uncharged solutes. Permeability may depend on solubility properties, charge, or chemistry as well as solute size. Water molecules travel into cells in two ways: either by diffusing across the phospholipid bilayer directly, or via aquaporins (small transmembrane proteins which create pores). Osmosis provides the primary means by which water is transported into and out of cells.

WHAT YOU NEED
- 5g Cornstarch (1 heaped teaspoon)
- Large test tube with stopper
- Iodine solution (ten drops)
- Small plastic bag
- Rubber band
- 250mL Beaker
- 100mL measuring cylinder
Osmosis through a Bag

WHAT TO DO
1. Mix cornstarch with 50mL of water in test tube with stopper and shake well.
2. Add cornstarch solution to the plastic bag and wrap rubber band around the top.
3. Measure 100mL of water and pour into 250mL beaker.
4. Add 10 drops of iodine to water in beaker.
5. Place the plastic bag in the 250mL beaker so that the cornstarch solution is submerged in the iodine water mixture
6. Wait 15 minutes and record your observations in the table below.

QUESTIONS
While waiting for 15 minutes answer the following questions:

1. What is the main difference between osmosis and diffusion?
   Osmosis is the movement of a solvent through a semi-permeable membrane from high water concentration to low water concentration whereas diffusion is the movement of molecules from areas of high concentration to low concentration.

2. Molecules tend to move from areas of high concentration to areas of low concentration.
   At the start of the experiment:
   a) Is the bag or beaker more concentrated in starch? bag
   b) Is the bag or beaker more concentrated in iodine? beaker
   c) Iodine solution: Is the bag or beaker hyperosmotic? beaker
   d) Starch solution: is the bag or beaker hyperosmotic? bag

<table>
<thead>
<tr>
<th></th>
<th>Solution in the Beaker</th>
<th>Solution in the bag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting colour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour after 15 minutes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial amount of water in beaker</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount of water in beaker after 15 minutes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Based on your observations, which substance moved, the iodine or the starch?
   The iodine moved. It has changed the colour of the solution inside the bag. Also the water is attracted into the bag containing a high concentration of starch and the volume of water in the beaker will decrease as water travels by osmosis into the bag.

2. How did you determine this?
   Change of colour in the bag and decrease in amount of water in the beaker.

3. The plastic bag was permeable to which substance? The water and iodine.
4. Is the plastic bag selectively permeable? Yes
5. What happened to the amount of water in the beaker? Why did this happen?
   Amount of water in the beaker decreased as water moved into the bag by osmosis down its concentration gradient from high water concentration to low water concentrations.
6. Sketch the beaker and bag. Use arrows to illustrate how diffusion occurred.

7. What would happen if you did the experiment again with the starch in the solution and the iodine in the bag? The starch solution would still be hyperosmotic and draw the iodine/water solution into it.

8. Why is it not a good idea to store iodine in a plastic bag? The bag is permeable to the iodine—it will move out of the bag by osmosis.

CURRICULUM

Essential Learnings Year 5:
Structures of living things have particular functions.

Essential Learnings Year 7:
Cells are the basic unit of all living things and perform functions that are needed to sustain and reproduce life.

Essential Learnings Year 9
Complex organisms depend on interacting body systems to meet their needs internally and with respect to their environment.

Science21
LS1: The cell is the lowest form of organisation that can perform all activities required for life.

REFERENCES

www.biologycorner.com