Laboratory #2 – Permeability of the Red Blood Cell: Spontaneous Movements of Molecules through the Membrane of Sheep Cells

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February 5th, 2016

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<u>**Observations**</u>

Part A – Permeability Experiments

Table 1 – Permeability with Various Substances from Set A with the Red Blood Cells of Sheep.

	Distilled Water (dd water)	***Glycerol 0.3 M***	***Ethylene Glycol 0.3 M***	***Sucrose 0.3 M***	***Urea 0.3 M***
Time to cause hemolysis in sheep red blood cells (seconds)	2	59	12	55	12
	2	63	10	65	10
	2	50	10	45	7
****Mean***	2	57	11	55	9.7
****StDev (Standard Deviation)***	0	6.7	1.2	10	2.5
****S.E.M (Standard Error of Method)***	0	3.8	0.67	5.8	1.5

* Sigfigs applied – Microsoft Excel was used to find these values

Part B – Red Blood Cells Subjected to Various Osmotic Conditions

1. 0.145 M solution of NaCl: Computer Screen = 47 cm Cell Size = 1.2 cm

$$actual\ size\ of\ the\ cell\ (A1) = \frac{actual\ size\ of\ the\ FOV(B1)}{On - Screen\ size\ of\ the\ FOV\ (B2)}\ x\ On - Screen\ Size\ of\ the\ object\ (A2)$$

$$actual\ size\ of\ the\ cell\ (A1) = \frac{0.0018\ cm}{47\ cm}\ x\ 1.2$$

$$actual\ size\ of\ the\ cell\ (A1) = 0.000045957\ cm$$

2. 0.350 M solution of NaCl: Computer Screen = 47 cm Cell Size = 0.9 cm

$$actual\ size\ of\ the\ cell\ (A1) = \frac{actual\ size\ of\ the\ FOV(B1)}{On - Screen\ size\ of\ the\ FOV\ (B2)}\ x\ On - Screen\ Size\ of\ the\ object\ (A2)$$

$$actual\ size\ of\ the\ cell\ (A1) = \frac{0.0018\ cm}{47\ cm}\ x\ 0.9$$

$$actual\ size\ of\ the\ cell\ (A1) = 0.000034468\ cm$$

3. 0.065 M solution of NaCl: Computer Screen = 47 cm Cell Size = 1.4 cm

$$actual\ size\ of\ the\ cell\ (A1) = \frac{actual\ size\ of\ the\ FOV(B1)}{On - Screen\ size\ of\ the\ FOV\ (B2)}\ x\ On - Screen\ Size\ of\ the\ object\ (A2)$$

$$actual\ size\ of\ the\ cell\ (A1) = \frac{0.0018\ cm}{47\ cm}\ x\ 1.4$$

$$actual\ size\ of\ the\ cell\ (A1) = 0.000053617\ cm$$

Questions:

1. What are the factors that affect the diffusion of the solutes in the permeability experiment?

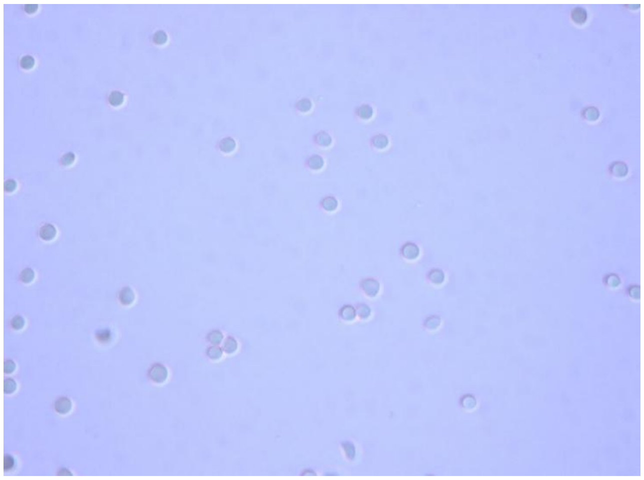
Some factors that could affect the diffusion of the solutes in the permeability part of this experiment are as follows; temperature, concentration, molecular size, and surface area to volume ratio. Also, the most obvious one would be the permeability of cell membranes, which is important in aiding with diffusion and osmosis.

2. How do these factors affect the diffusion of solutes?

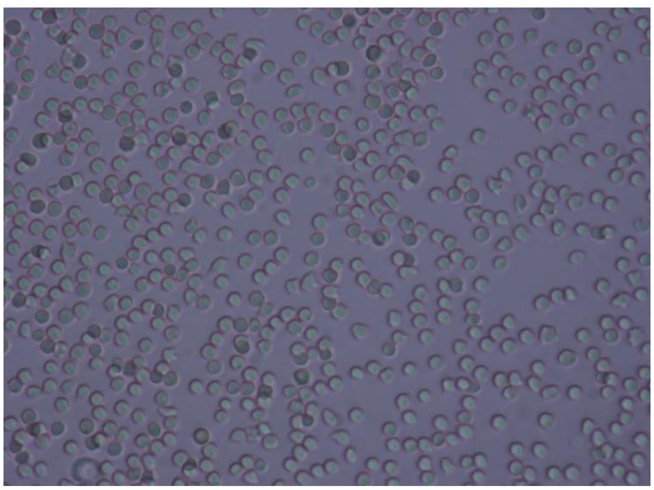
To start off, temperature affects the diffusion rate of solutes by either increasing or decreasing. Faster diffusion will take place if the surroundings are warmer. Thus, an increase in temperature means an increase in kinetic energy (when molecules collide with one another). Therefore the molecules will move faster and there will be more spontaneous spreading of the material, causing diffusion to occur faster. Concentration will also have an effect when there is a difference in concentration between two solutions separated by a cells semi-permeable membrane. This membrane plays a key role in osmosis because if the concentration difference is increased, the rate of osmosis will also increase. Molecular size is also very important in the diffusion of solutes. Some molecules are small enough to pass through the cell membrane without any assistance (passive diffusion) or through small channels in the membrane while others are too large to pass through and need help by other key components of the membrane such as proteins and even ATP (active diffusion). The surface area to volume ratio will help with diffusion. The larger the surface area, the higher the rate of diffusion because there is more space to move through. Lastly, if a membrane is permeable to all the solutes, osmosis will not be significant after the solute reaches equilibrium, thus permeability directly affects diffusion and osmosis rate. Factors for permeability include the chemical properties of the solute, and things such as the presence of channels in the membrane (as mentioned above pertaining to passive and active diffusion). Another important factor is the voltage across a membrane, which will affect the diffusion of charged solutes (such as ions). For example, in part B the cells that had added 0.350 M NaCl (highest concentration) were smaller compared to the cells that had added 0.065 NaCl solution. Thus it can be inferred that the higher the concentration, the smaller the cell size and vice versa.

Part B – Pictures (if interested)

0.065 M added NaCl Solution



0.145 M added NaCl Solution



0.350 M added NaCl Solution