Diffusion and Osmosis Lab

Introduction

Many aspects of the life of a cell depend on the fact that atoms and molecules have kinetic energy and are constantly in motion. This kinetic energy causes molecules to bump into each other and move in new directions. One result of this molecular motion is the process of diffusion.

Diffusion is the random movement of molecules from an area of higher concentration to an area of lower concentration. For example, if one were to open a bottle of hydrogen sulfide (H_2S has the odor of rotten eggs) in one corner of a room, it would not be long before someone in the opposite corner would perceive the smell of rotten eggs. The bottle contains a higher concentration of H_2S molecules than the room does and therefore the H_2S gas diffuses from the area of higher concentration to the area of lower concentration. Eventually, a dynamic equilibrium will be reached; the concentration of H_2S will be approximately equal throughout the room and no net movement of H_2S will occur from one area to the other.

Osmosis is a special case of diffusion. Osmosis is the diffusion of water through a selectively permeable membrane (a membrane that allows for diffusion of certain solutes and water) from a region of higher concentration to a region of lower concentration.

Diffusion and osmosis do not entirely explain the movement of ions or molecules into and out of cells. One property of a living system is ***active transport***. This process uses energy from ATP to move substances through the cell membrane. Active transport usually moves substances against a concentration gradient, from regions of low concentration of that substance into regions of higher concentration.

The Experiment: Osmosis

In this experiment you will use dialysis tubing to investigate the relationship between solute concentration and the movement of water through a selectively permeable membrane by the process of osmosis.

When two solutions have the same concentration of solutes, they are said to be ***isotonic*** to each other (iso- means same, -ton means condition, -ic means pertaining to). If the two solutions are separated by a selectively permeable membrane, water will move between the two solutions, but the concentrations on each side of the membrane will stay the same.

If two solutions differ in the concentration of solutes that each has, the one with more solute is ***hypertonic*** to the one with less solute (hyper- means over, or more than). The solution that has less solute is ***hypotonic*** to the one with more solute (hypo- means under, or less than). These words can only be used to compare solutions.

Now consider two solutions separated by a selectively permeable membrane. The solution that is hypertonic to the other must have more solute and therefore less water. The net movement of water will be from the hypotonic solution into the hypertonic solution.

Procedure

Obtain eighteen carrot disks. Place three disks in each of the six beakers. Try to distribute the carrots so that each beaker has carrot pieces that are approximately the same size. Label the six beakers A-F. Weigh the contents of each beaker and record these initial masses in Table 1.1. Place the carrots back in the beakers and fill each beaker to 50mL with the solutions below.

A) distilled water
B) 0.2 M NaCl
C) 0.4 M NaCl
D) 0.6 M NaCl
E) 0.8 M NaCl
F) 1.0 M NaCl

Let the carrots soak in the beakers for 25 minutes. Carefully remove the carrots from the beakers and gently blot the carrots to remove excess water. Place the carrots on the scale and record the final masses in Table 1.1. Now, calculate the mass difference and percent change in mass. Share your group's percent change in mass on the front board for use in Table 1.2. Record the data posted by other groups and calculate the class' average percent change in mass for each beaker.

Table 1.1

Contents of beakers	Initial Mass	Final Mass	Mass Difference	Percent Change in Mass*
a) 0.0 M (H_20)				
b) 0.2 M NaCl				
c) 0.4 M NaCl				
d) 0.6 M NaCl				
e) 0.8 M NaCl				
f) 1.0 M NaCl				

* Percent Change in Mass = ((Final Mass - Initial Mass)/Initial Mass) x 100

Table 1.2

	Percent Change in Mass of Carrots				Class Average
	Group 1	Group 2	Group 3	Group 4	(Total/# of Groups)
0.0 M (H_20)					
0.2 M NaCl					
0.4 M NaCl					
0.6 M NaCl					
0.8 M NaCl					
1.0 M NaCl					

The Assignment

- Submit a completed table 1.1. Show the % change in mass calculations for the carrots in each beaker.

- Submit a completed Table 1.2. Show the class average % change in mass calculations for the carrots in each beaker.

- Create a graph for the data in Table 1.2. Be sure to label all axis, title the graph, create a legend, and include a caption that explains what the graph displays.

- Answer the following questions:

Questions:

1) Explain the relationship between the change in mass and the concentration of NaCl in the beakers.

2) Why did you calculate the percent change in mass rather than simply using the change in mass?

3) Carrots are placed in a beaker and soaked in a solution.. The carrots' collective initial mass is 20g and its final mass is 18g. Calculate the percent change of mass, showing your calculations.

4) Was the solution in the beaker isotonic, hypertonic or hypotonic to the carrots?

5) List and explain 5 possible sources of error for this lab.