Name _______________________________ Date ____________Per._______

Biology Osmosis and Diffusion Lab

Driving Question: *What causes plants to wilt if they're not watered?*

Background
Cells must move materials through membranes and throughout cytoplasm in order to maintain homeostasis. The movement is regulated because cellular membranes, including the plasma and organelle membranes, are selectively permeable. Membranes are phospholipid bilayers containing embedded proteins; the phospholipid fatty acids limit the movement of water because of their hydrophobic characteristics.

The simplest form of movement is diffusion, in which solutes move from an area of high concentration to an area of low concentration; diffusion is directly related to molecular kinetic energy. Diffusion does not require energy input by cells. The movement of a solute from an area of low concentration to an area of high concentration requires energy input in the form of ATP and protein carriers called pumps. Water moves through membranes by diffusion; the movement of water through membranes is called osmosis. Like solutes, water moves down its concentration gradient. Water moves from areas of high potential (high free water concentration) and low solute concentration to areas of low potential (low free water concentration) and high solute concentration. Solutes decrease the concentration of free water, since water molecules surround the solute molecules. The terms *hypertonic*, *hypotonic*, and *isotonic* are used to describe solutions separated by selectively permeable membranes. A hypertonic solution has a higher solute concentration and a lower water potential as compared to the other solution; therefore, water will move into the hypertonic solution through the membrane by osmosis. A hypotonic solution has a lower solute concentration and a higher water potential than the solution on the other side of the membrane; water will move down its concentration gradient into the other solution. Isotonic solutions have equal water potentials with no net movement.

In non-walled cells, such as animal cells, the movement of water into and out of a cell is affected by the relative solute concentration on either side of the plasma membrane. As water moves out of the cell, the cell shrinks; if water moves into the cell, it swells and may eventually burst. In walled cells, including fungal and plant cells, osmosis is affected not only by the solute concentration, but also by the resistance to water movement in the cell by the cell wall. This resistance is called turgor pressure. The presence of a cell wall prevents the cells from bursting as water enters; however, pressure builds up inside the cell and affects the rate of osmosis. Water movement in plants is important in water transport from the roots into the shoots and leaves. This will be addressed later in transpiration.

Observing Osmosis in Living Cells

Materials

- Potatoes
- Knife
- Balance
- Cups
- Color-coded sucrose solutions

Procedure

Day 1

1. Using the graduated cylinder, pour 100 mL of each solution into the correlating cup (labeled by color).
2. Cut 6 potato cubes using a knife.
3. Measure the mass of each cube and record. Keep track of which cube you will put in which solution.
4. Put the cubes in the cups- one per cup. Make initial observations.
5. Cover the cups with plastic wrap and place them in the area designated for your class.

Day 2

1. Observe and record any visible changes in your potato cubes.
2. Remove the potato cubes from their solutions one at a time, blot off excess water, and measure the final mass. Record on your data table.
3. Clean everything well with soap and water. This is a sugar solution- don't leave anything sticky behind!

Analysis: Graphs and Calculations

1. Calculate the percent change in mass for each potato cube.
2. Record your percentage change on the class data sheet. Positive and negative is important!!!
3. Calculate the class average percentage of change. Positive and negative is important!!!
4. Determine which color solution is which sucrose molarity. <u>When you've reached a conclusion, double check your answer before you go on!</u>
5. Graph sucrose molarity within beaker vs. % change in mass of potato cube <u>for the class averages</u>. Use a different color to draw a line of best fit. (A **line of best fit** is a straight **line** drawn through the center of a group of data points plotted on a scatter plot. Scatter plots depict the results of gathering data on two variables.)
6. Determine and record the molar concentration of the potato cube. This is the sucrose molarity in which the mass of the potato cube doesn't change. It is where the line of best fit crosses the X-axis. Highlight this point with a yellow "X".

Data Table Set-ups

Table 1

Solution Color	Initial Observations	Final Observations
Red		
Orange		
Yellow		
Green		
Blue		
Clear		

Table 2

Solution Color	Hypothesized Molarity	Conclusion of Molarity	Actual Molarity
Red			
Orange			
Yellow			
Green			
Blue			
Clear			

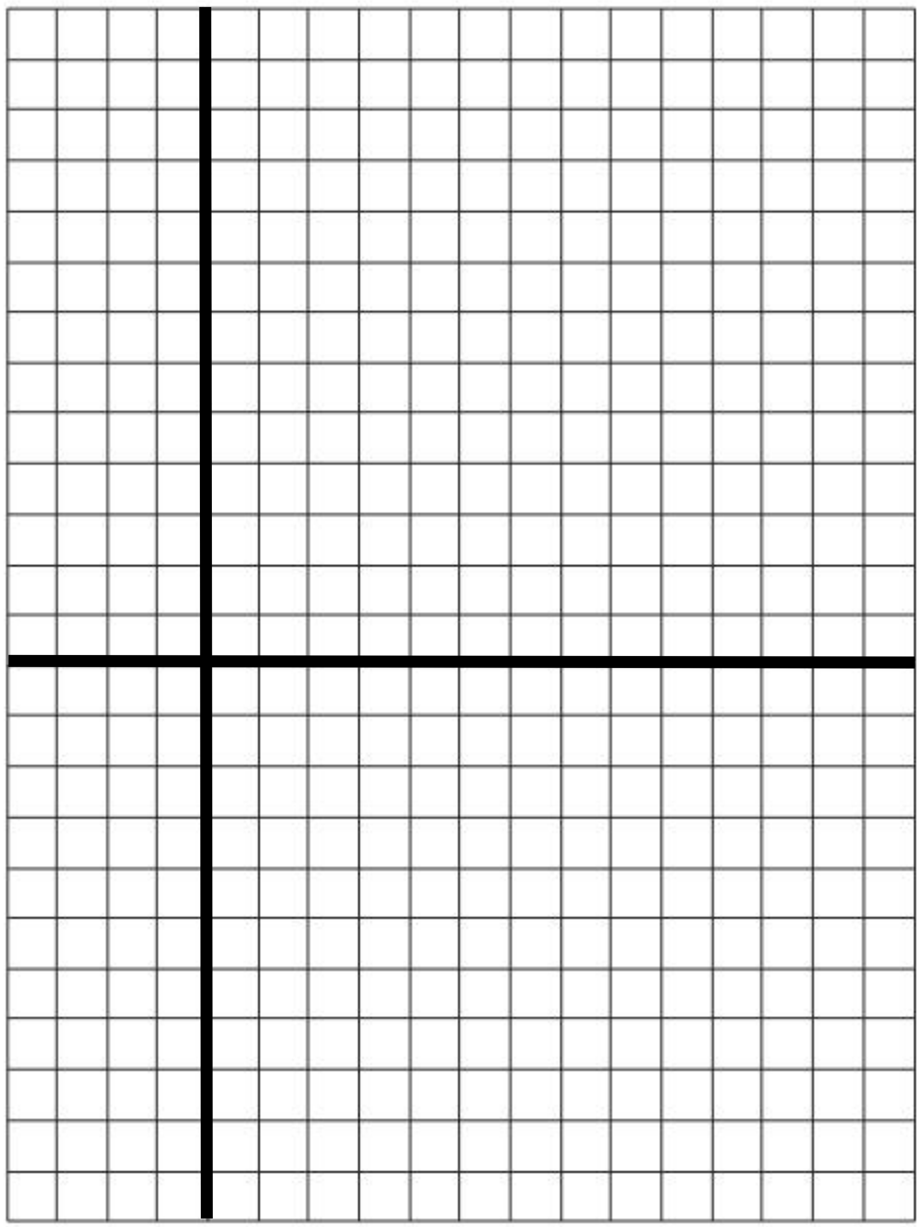
Table 3

Solution in Beaker	Initial Core Mass	Final Core Mass	Mass Difference	Percent Change in Mass	Class Average Percent Change in Mass
Red					
Orange					
Yellow					
Green					
Blue					
Clear					

Class Data

	Percent Change in Potato Core Mass									Class Average
Solution in Beaker	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9	
Red										
Orange										
Yellow										
Green										
Blue										
Clear										

Sucrose Molarity (X-axis) VS Percentage of Change in Mass (Y-axis)



Discussion (Individual Response)

1. Using evidence from this lab and your notes and reading, explain in detail a reason why plants wilt.
2. Turn in your data tables and graphs along with the answers to the questions.

Hints for setting up this lab:

- Set up various sugar molarity solutions (0M, .15M, .29M, .44M, .58M) in beakers at a station or stations identifying them by color. Only you know which solution has which percentage, the students use the color to identify, as their job is to figure molarity. Place a graduated cylinder at each beaker for the students to use to reduce the chance of cross contamination (discuss this concept if students are not yet aware of what this can do) of sucrose solutions.
- Using a 1000mL beaker, to make the solutions. Make the solutions by percentage.
    - 0% solution is the 0M
    - 5% solution is the .15M
    - 10% solution is the .29M
    - 15% solution is the .44M
    - 20% solution is the .58M
- Recommend that students make the cubes similar in size. Not required, but easier for them to see differences in the mass percentage changes.