Virtual Lab instruction for Diffusion and Osmosis.

Got o the following link. You may need to register (for free) in order to use the PHet website. Follow registration directions.

<https://phet.colorado.edu/en/simulation/legacy/membrane-channels>

Use the lab handout below to guide you through the virtual lab and answer the questions.

READ and ANNOTOATE the following reading on diffusion and osmosis;

The cell membrane is a cell’s interface with its surroundings. In one sense, this membrane must function as a barrier: it must keep together in one bundle the enzymes, DNA, and metabolic pathways that make life possible. The cell membrane must also function as a gateway: waste products must be discharged through it and essential materials (oxygen, water, etc.) must enter through it. A membrane that allows some molecules to pass through while blocking the passage of others is said to be **semipermeable**. Molecules pass through the cell membrane either through processes that require the cell to expend energy (**active transport**), or through processes driven by the kinetic (thermal) energy of molecules (**passive transport**).

In these lab activities, you will investigate the passage of materials through a semipermeable membrane by passive transport. The membrane you will use, dialysis tubing, is semipermeable because it has submicroscopic holes through it. Molecules are in constant random motion. By chance, a molecule’s motion may move it toward the membrane (Figure 1). If it collides with the membrane wall, it rebounds. If its motion takes it toward a pore, it may either pass through the pore, or it may rebound, depending upon the size of the molecule relative to the diameter of the pore. Molecules that are small enough to pass through the pores can pass through in either direction. Notice that on one side of the membrane solute molecules have displaced some of the water molecules. Thus, there is a higher concentration of water molecules on the opposite side of the membrane. More water molecules are available to collide with the membrane on the side having the higher concentration of water. Thus, although water molecules will move in both directions across the membrane, more will move from the side having the higher concentration to the side having the lower concentration. The movement of molecules from areas of higher concentration to areas of lower concentration is called **diffusion**. The diffusion of water molecules across a semipermeable membrane is termed **osmosis**. A process that depends upon random motion might seem inefficient, but so many water molecules are involved and they move so fast, that it is estimated that a red blood cell floating in blood plasma gains an amount of water equal to 125 times its own volume every second. It also loses the same amount of water each second, all by osmosis. This occurs because the concentration of solutes in the blood plasma is the same as the concentration of solutes in red blood cells. Solutions that have the same solute concentration are **isotonic**. If we took a sample of whole blood and added salt to the plasma, increasing its solute concentration, the plasma becomes **hypertonic** to the solution in the red blood cells, and the cells lose water and shrink. If we add water to the blood plasma, decreasing its solute concentration, the plasma becomes **hypotonic** to the solution in the red blood cells. The cells gain water, swell, and may even burst.

Diffusion Lab

**Add 50 green particles (this does not need to be exact so don’t worry if you are out by 1 or 2).**

1. Slow the animation down and describe the motion of the green particles. Is it random are pre-determined? What happens when the particles hit each other?
2. What does the membrane do?
3. What do you think a membrane is? Google membrane definition if you are unsure.
4. Click on the show concentrations box. How would you describe the concentration of the green particles on the top half of the membrane? (High or Low) How would you describe the concentration of green particles below the membrane? (High or Low)

**Add 3 evenly spaced gated channels to the membrane. Speed up the animation again and then click the Open Channels button.**

1. The process you are observing is the process of diffusion. Describe the process using the key words **particle, movement, concentration, high and low**.
2. Closely observe the motion of the particles again and describe why diffusion takes place.

**Click on the reset all button and set up the green particles again. This time do the same thing with the blue particles.**

1. Speed up the animation to full speed. Open both gates and observe the concentrations. Wait for at least 1 minute. What happens to the concentration lines on both sides of the membrane?

**This is called *the equilibrium point*. The concentrations will change somewhat on either side of the membrane but they will stay relatively equal.**

**Your teacher will show you a video on diffusion.** <http://www.youtube.com/watch?v=H7QsDs8ZRMI>

1. Why do particles diffuse faster in a vacuum?
2. Why do nitrogen oxide particles travel faster than bromine particles?
3. How does temperature affect the rate of diffusion? Why do you think this is so? (It has to do with the speed of the particles.)

**Go back to the animation and press reset. Fill the top half with the maximum particles. Place 3 gated channels into the membrane. Set the animation speed to full speed then go to** [**http://www.online-stopwatch.com/**](http://www.online-stopwatch.com/) **and start the stop watch and open the channels at the same time. Time how long it takes to reach the equilibrium point.**

Reset the animation and do the same thing with 50 particles.

1. Which one was faster? How does concentration affect the rate of diffusion?
2. How do you think the thickness of the membrane would affect the rate of diffusion? Why?
3. How do you think the surface are of the membrane would affect the rate of diffusion? Why