Lab Exercise Bio 135 Osmosis and diffusion

Membrane Transport Mechanisms and Osmosis

What you need to be able to do on the exam after completing this lab exercise:

 Be able to define Brownian motion.

 Be able to explain the criteria for passive transport and how certain factors influence it.

 Be able to name and explain the different types of passive transport.

 Be able to explain osmosis and explain which way water will move in or out of a cell.

 Be able to define hypotonic, hypertonic, and isotonic, and explain what happens to a cell when placed in each of these solutions.

 Be able to explain the results of the osmosis demonstration.

Membrane Transport Mechanisms & Osmosis

Brownian Motion

In 1827, the English botanist Robert Brown noticed that pollen grains suspended in water jiggled about under the lens of the microscope, following a zigzag path. This zigzag motion of the particles resulted from collisions with smaller particles and is referred to as **Brownian motion**.

Although the individual molecules cannot be seen, the random motion of the molecules colliding with one another can be observed. The higher the temperature of the liquid, the faster the movement of the particles.

We will not be observing Brownian motion in this lab, but know the definition of Brownian motion.

 Answer Questions 1 – 2 on your "Membrane Transport & Osmosis" homework sheet.

Passive Transport

Passive transport involves the movement of particles from an area of higher concentration to an area of lower concentration, without the input of energy.

Simple diffusion: Simple diffusion is a type of passive transport. Molecules simply move from where they are more concentrated to where they are less concentrated, down the concentration gradient (the difference between high and low concentration).
In simple diffusion, molecules may move through a solid (such as gel-like agar), a liquid (such as water or blood), or a gas (such as the air).

Several factors can affect the rate of diffusion. Some of these include temperature, particle size, molecular weight, and concentration of particles.

The higher the temperature, the faster the rate of diffusion.
The smaller the particle size, the faster the rate of diffusion.
The smaller the molecular weight, the faster the rate of diffusion.
The more concentrated the particles, the faster the rate of diffusion.

 Answer Questions 3 – 4 on your "Membrane Transport & Osmosis" homework sheet.

Observing the Simple Diffusion of Dye Through a gel:

Your instructor will do this activity as a class demonstration. Read this exercise, Collect the data for the activity in the table located in your homework. Record the initial diameter of the wells above the chart. Turn this in along with your Osmosis homework located later in this packet.

Facilitated Diffusion

To travel in or out of a cell, molecules must move across the **plasma membrane**.

The plasma membrane is **selectively permeable**. It acts as a barrier to the movement of some molecules, but allows other molecules to pass through. You could say it "selects" what ions/molecules can enter and leave the cell.

If the ions/molecules require the aid of a membrane-protein to move in or out of the cell, we call the movement **facilitated diffusion**. The movement of the ions/molecules is facilitated (or "helped") by membrane-proteins.

 Answer Question 5 on your "Membrane Transport & Osmosis" homework sheet

Osmosis

The diffusion of water through a selectively permeable membrane is called **osmosis**. Water will move from where it is more concentrated to where it is less concentrated across the plasma membrane. Since most solvents contain water, osmosis is the movement of solvent across the membrane. Water moves from the side of the membrane that has a **lower solute concentration** to the side of the membrane that has a **higher solute concentration**.

> **Hypotonic** describes the solution with a **lower solute concentration**; higher water concentration
> **Hypertonic** describes the solution with a **higher solute concentration**; lower water concentration
> **Isotonic** describes the solution with an **equal solute concentration**; equal water concentration

Water moves from a hypotonic solution to a hypertonic solution (**Hypo > Hyper**) across a selectively permeable membrane.

If you place a cell (70% water/30% solute) in a **hypotonic** solution (90% water/10% solute), the **cell will gain water and swell**. Water moves by osmosis from the solution (which has a higher water concentration) into the cell (which has a lower water concentration).

If you place a cell (70% water/30%solute) in a **hypertonic** solution (40% water/60% solute), the **cell will lose water and shrink (crenate)**. Water moves by osmosis from the cell (which has a higher water concentration) into the solution (which has a lower water concentration).

If you place a cell (70% water/30% solute) in an **isotonic** solution (70% water/30% solute), the **cell will not gain or lose water and will stay the same**. Water moves in and out of the cell at the same rate, so there is no net gain or loss of water.

Observing Osmosis Through a Selectively Permeable Membrane:

Your instructor will do this activity as a class demonstration.

You will record the data on your "Membrane Transport & Osmosis" homework sheet (Question #7).

Procedure:
1. On the front desk, you will see three beakers with the following solutions:
Beaker #1 – 0% sucrose solution
Beaker #2 – 40% sucrose solution
Beaker #3 – 40% sucrose solution

2. Your instructor will fill the first bag of dialysis tubing (a selectively permeable membrane) with 40% sucrose solution. The bag will be weighed on the balance before the instructor places it into Beaker #1. Record the weight of the bag on your homework sheet.

3. Next, your instructor will fill the second bag with a 0% sucrose solution. The bag will be weighed on the balance before being placed into Beaker #2. Record its weight.

4. Finally, your instructor will fill a third bag with 40% sucrose solution. The bag will be weighed on the balance before being placed into Beaker #3. Record its weight.

5. Your instructor will leave the bags in the beakers for approximately 1 hour.

6. After 1 hour, your instructor will take each bag out of the beaker one-by-one, dry off the excess water on the outside of the bag, and weigh each bag on the balance. Record the weight of each bag in the appropriate box on your homework sheet.

7. Calculate and record the change in weight for each bag.

 Answer Questions 6 & 8 – 11 on your "Membrane Transport & Osmosis" homework sheet.

Filtration
Filtration is a passive transport process where water and solutes move from an **area of higher hydrostatic (fluid) pressure** to an **area of lower hydrostatic (fluid) pressure**. The water and solutes will move through pores in the membrane, down a pressure gradient. Example: Coffee moves by filtration through the pores of a coffee filter from the side of the filter that has the highest (gravitational) pressure to the side of the filter that has the lowest pressure.