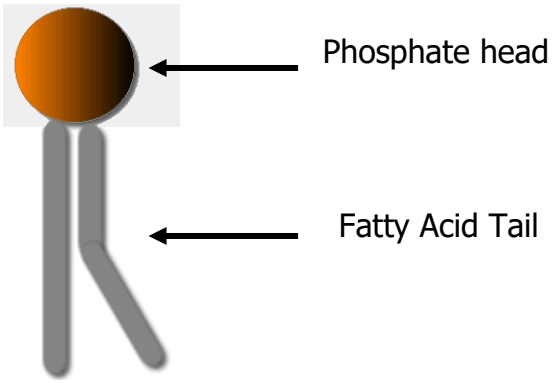
STATION ONE: THE PHOSPHOLIPID BILAYER (CELL OR PLASMA MEMBRANE)

<u>Introduction</u>: The cell membrane is also referred to as the **phospholipid bilayer**. It is called a bilayer because there are 2 layers of phospholipids.

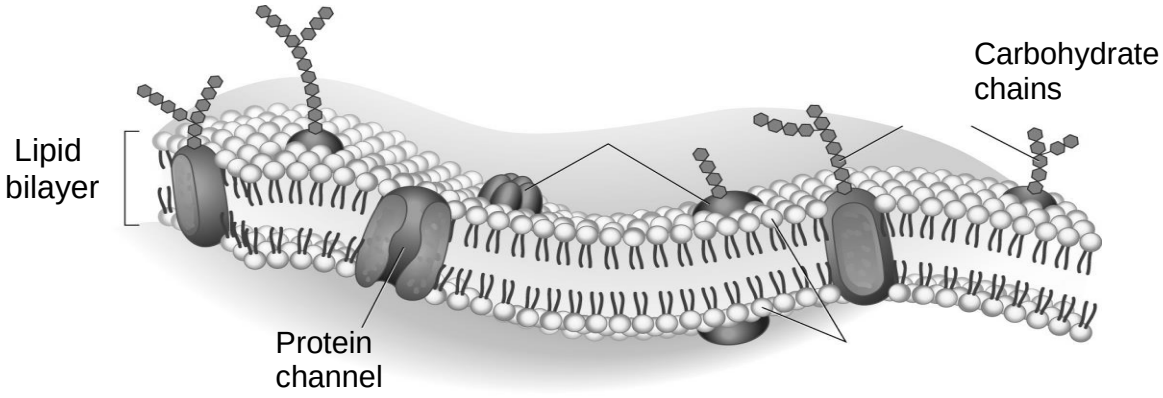


The **phosphate group** is found on the outer side of the membrane and is **hydrophilic** (water loving). The **fatty acid group** is found in the middle of the bilayer and is **hydrophobic** (water fearing)

The importance of the cell/plasma membrane is to control what enters and leaves the cell. The membrane is ***selective*** to what is ***permitted*** to come into or go out of the cell. This is why the cell/plasma membrane is said to be ***selectively permeable***. The cell membrane also provides protection and support for the cell.

The phospholipid bilayer also contains **membrane proteins**. These proteins have many important functions in the cell including transport of materials which are too large to pass through the membrane and as receptors for hormones and other molecules.

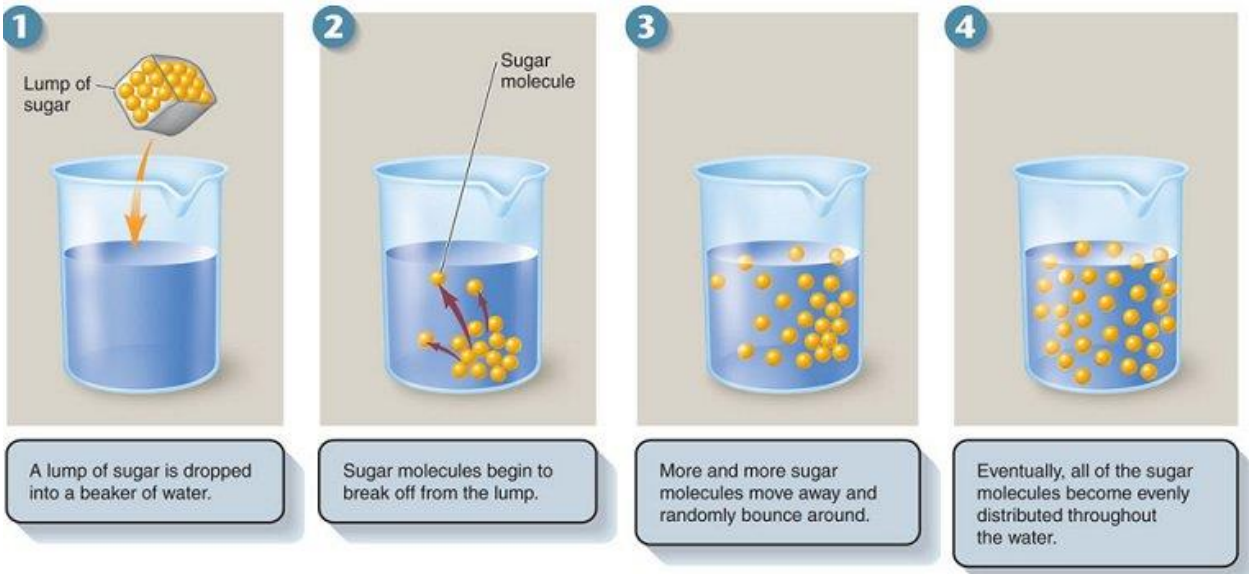
DIRECTIONS: *Using the materials provided at your station construct a phospholipid bilayer, with a transport protein. Once you are finished, raise your hand and have the teacher initial your answer document. Once you have finished, be sure to* ***disassemble the parts*** *for the next lab group.*



STATION TWO: PART A: PASSIVE TRANSPORT (DIFFUSION)

Introduction: The word ***concentration*** refers to how much stuff or mass is found in a given space or volume. An espresso coffee has more coffee particles than a regular cup of coffee; therefore the espresso is more concentrated. You can also say that a cup of coffee with three sugar cubes has a **higher concentration** of sugar then a second cup of coffee that has only one sugar cube added.

When the sugar cube was first added to the coffee, the sugar was concentrated or tightly packed into a sugar cube. However, the water in the coffee gradually dissolves the sugar cube causing the sugar cube to randomly spread out in the solution. The dissolved sugar molecules moved away from the cube where it was highly concentrated into the coffee liquid where it was less concentrated. This random movement of particles from an area of high concentration to an area of lesser concentration is called ***diffusion***. The uneven distribution of sugar particles is called a ***concentration gradient***. Normal diffusion goes with the gradient moving particles from high to low concentrations. Diffusion **stops** when the particles are spread out evenly. The particles are still in constant motion, but because there is no concentration gradient, the solution has reached ***equilibrium.***



DIRECTIONS:

1. Fill up 2 separate glass beakers - one with cold water and one with warm water.
2. Drop 3 drops of food coloring **one at a time** into each beaker at the same time and observe what happens.
3. Pour out the beakers of water into the sink, rinse beakers and return to tray.

STATION TWO: PART B: PASSIVE TRANSPORT (DIFFUSION – CONTINUED)

Diffusion happens through the cell/plasma membrane of the cell even though the membrane is ***selectively permeable.*** This means that the cell/plasma membrane is able to select what it permits or allows through it. Diffusion is random movements of particles and requires **no energy** on the part of the cell. Therefore, diffusion through a cell membrane is passive and is referred to as ***passive transport***.

For example, the cell is in constant need for oxygen to burn food for energy. Because of this, the cell uses all of the oxygen molecules as soon as they enter the cell creating an inner cell environment where there is less oxygen molecules present than outside the cell. The cell is passive here because it does not use energy and it lets diffusion happen. Particles can also diffuse out of the cell such as in the case of carbon dioxide (CO_2) waste.

The balloons at this lab table are filled with air, flavored extracts (like mint, vanilla) and sand. The balloon itself represents a **selectively permeable membrane**. Some things can pass through it, while others can not. Because of the air pressure pushing out on the balloon's surface, very small particles of the extract will be forced out through tiny pores in the balloon where you can smell it. The sand particles are too big and can not pass through so it stays inside the balloon. Therefore, the balloon, like a cell/plasma membrane, is selectively permeable.

Procedure/Investigation:

1. Put your nose up to the balloon to see if you can smell the extracts.
2. Answer the following questions:
    a. Estimate at what distance away from the balloon can you no longer smell the extracts?

    b. Why can't you smell the balloon the farther away you get?

STATION THREE: FACILITATED DIFFUSION ("HELPED")

Introduction: The cell membrane is selectively permeable, meaning it allows only certain molecules to pass through easily. The simplest example of a cell membrane is a soap bubble. Have you ever seen the colors swirl on a bubble? Both bubbles and cells are fluid, meaning molecules move around constantly on its surface.

Many smaller molecules like water, oxygen and carbon dioxide can easily pass straight through the cell/plasma membrane without harming it. The membrane has strong forces that hold the membrane together and seal it up whenever molecules pass through it. The membrane is still fragile though. The cell ***must have water*** inside and outside the cell; not only to dissolve materials needing to be transported through the membrane, but to hold the membrane together itself.

Investigation/Procedure:

1. Place the smooth side of the Styrofoam ring found on your table into the bowl of soapy solution.
2. Pull the Styrofoam ring out of the bowl and observe the soap film (membrane). Notice that the soap molecules are in constant motion.
3. Hold the foam ring over the piece of paper towel at your table.
4. To see this self-sealing membrane in action, release a drop of food coloring above the soap film and observe what happens. **Don't contaminate the soap bowl with food coloring please!!!**
5. Try dripping some of the soapy water above the film and observe what happens.
6. Record your observations on your notes page.

STATION THREE: FACILITATED DIFFUSION (Continued)

Larger molecules such as glucose and amino acids, are unable to pass through the membrane easily. To facilitate or "help" these molecules across the membrane, bridges are used to carry them across. These bridges are **transport proteins** called ***protein channels or pores.*** This type of diffusion is called ***facilitated diffusion*** because movement of the molecules is "helped" across the membrane by these transport proteins. Most of these proteins are specific, allowing only certain molecules to pass. This is similar to the idea of a pet door. The pet can pass through the door to get into and out of the house, but I doubt very seriously that **you** could crawl through the pet door. This **choosy** characteristic of the membrane is called **selectively permeable.**

You will demonstrate how these transport proteins work using a **loop of thread** inside your soap film.

Investigation/Procedure:

1. Locate the tied loop of thread at your table. Dip it in the soap solution to get it wet.
2. Dip the styrofoam ring into the soap solution to get a soap film. Carefully place the thread loop onto the surface of your soap film.
3. Touch the inside of the loop with the end of the paper clip. It should pop the soap film inside the loop of thread but leave the surrounding soap film intact.
4. Stick your finger through the opening/pore and move it around the cell.
5. Now pass the straw through the thread loop to simulate facilitated diffusion.
6. Record your observations.

STATION FOUR: ACTIVE TRANSPORT

Introduction: What happens when you are trying to get from the West Wing to the Gym? Is it easier to move with the crowd or against the crowd? Have you ever been on a slide at a playground? Does it take more energy to climb the stairs to get to the top or to actually slide to the bottom? What does it mean to you to be ***"active?"*** When you are moving against something, or climbing up stairs, you are actively using energy to get the task done.

Sometimes a cell needs to use energy to move molecules ***against*** the concentration gradient to where they are needed. This is like pushing against the crowd on Main Street. Molecules are moved from an area of low concentration to an area of high concentration. This is called **active transport**, because it takes ***energy*** to actively move molecules against the concentration gradient.

Energy is also required if the cell needs to take in or release large bulky materials. The molecules would be too large to pass through the cell membrane on their own. Let's look at two processes used in moving these kinds of large, bulky materials. In science, root words (prefixes and suffixes) are helpful in figuring out the meaning of words.

For example: The root word ***Endo-*** means "Into," ***Exo-*** means "Out of" and ***Cyto-*** means "Cell."

During the process of ***Endocytosis***, energy is used to move large, bulky materials *into the cell.* These molecules are engulfed by an enfolding cell membrane that surrounds and closes up around the large, bulky materials. The cell enfolds and pinches off inside of the cell creating a **vacuole** or *"pocket of materials."*

During the process of ***Exocytosis***, energy is used to move large, bulky materials *out of the cell.* Materials can be broken down inside a vacuole in the cell. Materials that are not used by the cell are removed as wastes. The membrane of the vacuole fuses with and becomes part of the cell membrane. The vacuole then opens up to the outside of the cell and releases its content. This is how the cell can rid itself of cellular wastes and dump needed materials, such as hormones, into the blood stream.

Investigation/Procedure:

1. Get a piece of Jell-o and a bead attached to a string.
2. Push your bead into the Jell-o so that only the string remains outside. What did you observe?
3. Pull the bead of the Jell-o using the string. What did you observe after you pulled the bead out?

STATION FIVE: OSMOSIS

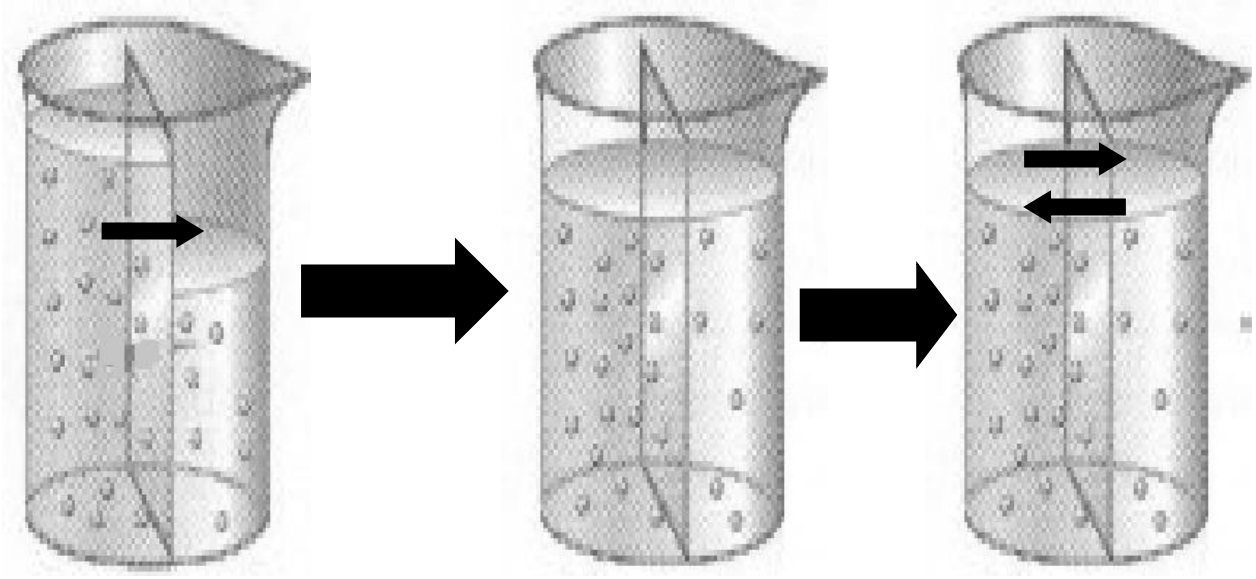
Introduction:

Osmosis is a **specialized case of diffusion** that involves the **passive transport of water** across the cell/plasma membrane. In osmosis, water moves through a selectively permeable membrane from a region of higher concentration (more water) to a region of lower concentration (less water). I always remember is as **H_2O**smosis.

The cell membrane is selectively permeable which means it allows passage of certain types of molecules while restricting the movement of others. **Water** is allowed to pass freely, and without using energy, through the cell/plasma membrane. Therefore, osmosis if a form of **passive transport.**

If there was a membrane with twice as many water molecules on one side as there were on the other (and remember, water can move freely through the membrane), what do you think would happen to the water molecules?

Correct, the side with twice as many water molecules would move in one direction to the other side where the concentration was lower until eventually causing the concentration of water to be **equal** or **in equilibrium on both sides**. After that the **flow of water would then diffuse through the membrane in both directions to** maintain equilibrium.

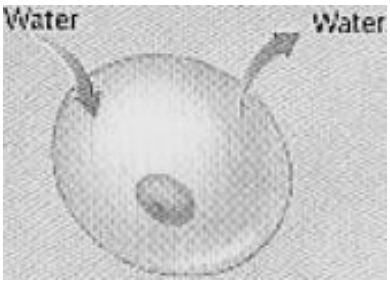


REMEMBER:

Water is considered the **Universal Solvent**. While discussing osmosis, when we use the word solves we will always be referring to water (Ex. Salt Solution, Sugar Solution...)

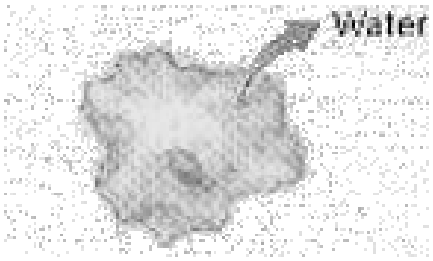
ISOTONIC SOLUTION, HYPERTONIC SOLUTION AND HYPOTONIC SOLUTION

Isotonic: The concentration of solutes in the solution is **equal** to the concentration of the solutes inside the cell. As a result, water will move equally in both directions and the cell remains equal in size (Equilibrium).



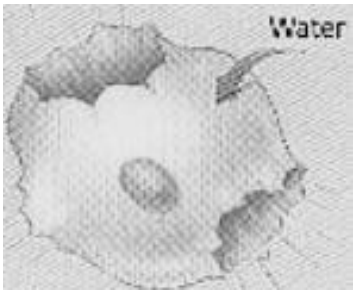
Example: Blood is isotonic to body cells. This means that the body cells will not shrink or burst when they come in contact with blood.

Hypertonic: The solution has a higher concentration of solutes and a lower concentration of water than what is inside the cell. As a result, water will move from inside cell out into the solution and the cell will shrink in size.



Example: Putting salt on a slug (snail would kill it by drawing water out of the slug (dehydrating the slug).

Hypotonic: The solution outside of the cell has a lower concentration of solutes and a higher concentration of water than what is inside the cell. As a result, water moves from the solution into the cell and the cell swells and bursts open (cytolysis).



Example: Putting 100% pure water into a patient's IV bag would cause excess water to get into their cells. To keep cells from bursting, IV's usually contain a salt or sugar solution.

Name: _____ Period: ___ Date: _____

CELLULAR TRANSPORT STATION LAB

Station 1: The Phospholipid Bilayer

1. Define the term **selectively permeable:** _____

_____

2. Define the term **hydrophobic:** _____
3. Define the term **hydrophilic:** _____
4. What are the 2 functions of the cell/plasma membrane? _____

_____

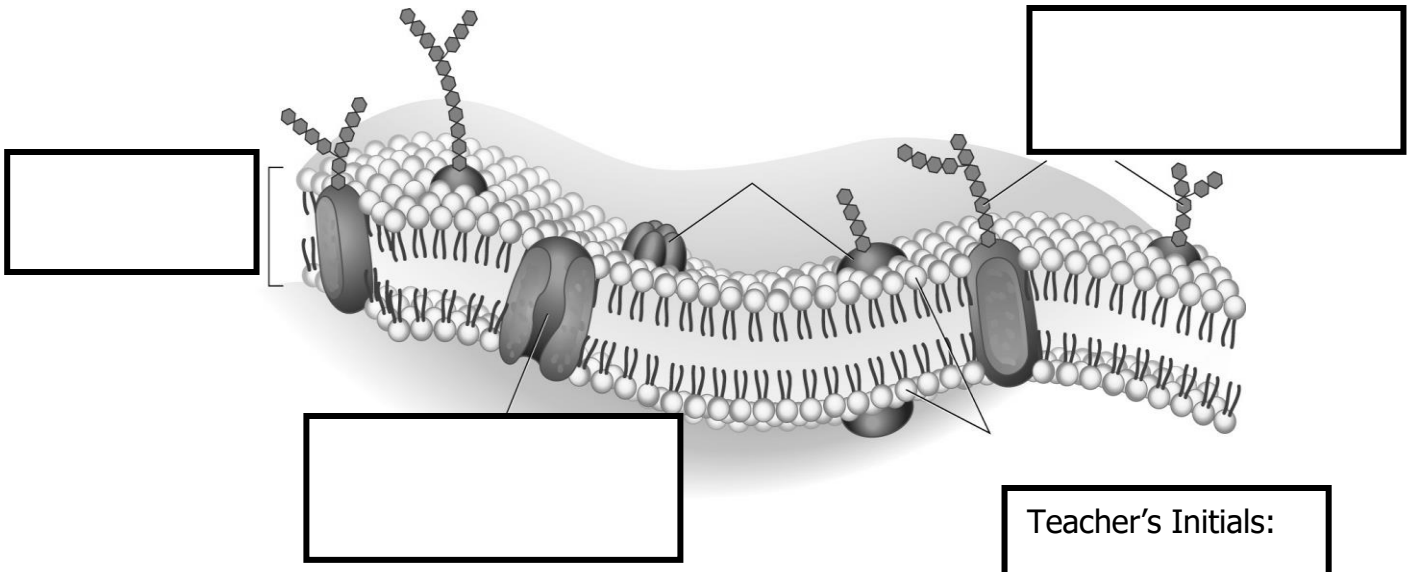
5. What does it mean that the cell membrane has a **lipid bilayer?** _____

_____

6. Why is the cell/plasma membrane referred to as a **fluid mosaic?** _____

_____

Label the parts of the cell membrane:



Teacher's Initials:

_____

Station 2: Passive Transport (Diffusion)

1. Define the term **diffusion:** _____
2. Define the term **concentration:** _____
3. What is a **concentration gradient?** _____
4. When does diffusion stop? _____
5. What does it mean when a solution has reached its **equilibrium**? _____

_____

Investigation:

1. Describe what happened when you dropped the food coloring into the warm water and the cold water**:** _____

_____

2. What conclusion can you make about diffusion and the water temperature? _____

_____

3. Why did the extracts diffuse out of the balloon but the sand did not? _____

_____

4. How far away can you get and still smell the balloons? _____
5. Why can't you smell them after a certain distance away? _____

_____

6. Why is diffusion a type of **passive transport?** _____

_____

Station 3: Facilitated ("*Helped*") Diffusion

Observation: Characteristic #1

1. Describe what happened when you dropped food coloring onto the soapy membrane: _____

   _____
2. How is the soapy membrane similar to a cell/plasma membrane? _____

   _____
3. What happened when you dribbled the soapy solution onto the soapy membrane?

   _____

Observation: Characteristic #2

1. Describe what happened when you placed the thread loop onto the soapy membrane: _____

   _____
2. In this simulation, the hole made inside the thread loop represents? _____

   _____
3. Transport proteins called _____ or _____ move molecules across the cell during **facilitated diffusion.**
4. Does facilitated diffusion require energy? _____
5. Does the concentration gradient play a role in facilitated diffusion? _____

   Explain your answer: _____

   _____

Station 4: Active Transport

1. Define the term **Active Transport:** _____
2. Why does Active Transport require **energy** to transport materials? _____

   _____
3. What does the term **Endocytosis** mean? _____

   _____
4. What does the term **Exocytosis** mean? _____

   _____
5. What did you observe when you pushed the bead into the jell-o? _____

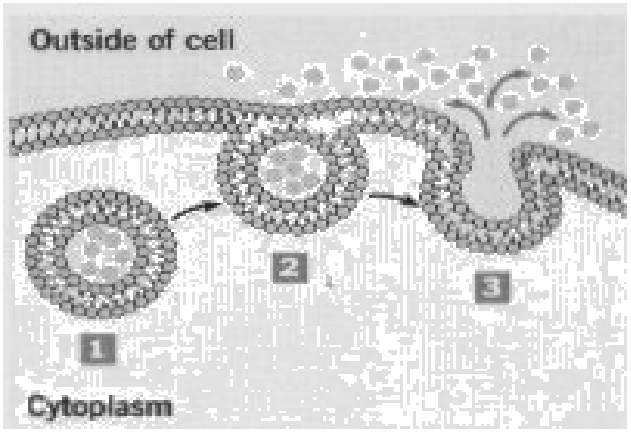
   _____
6. Describe the process of **endocytosis:** _____

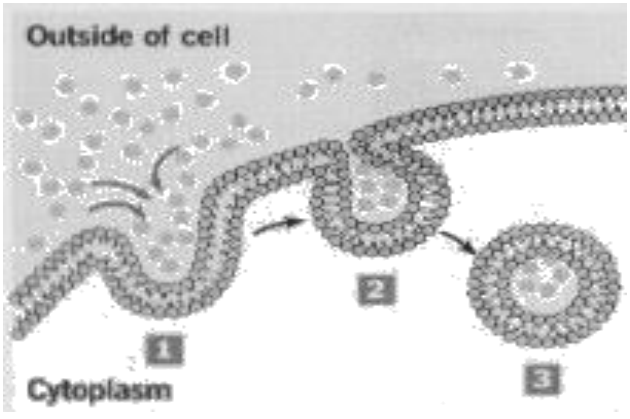
   _____
7. Describe the process of **exocytosis:** _____

   _____
8. What is **pinocytosis?** _____

   _____

Label the pictures below:

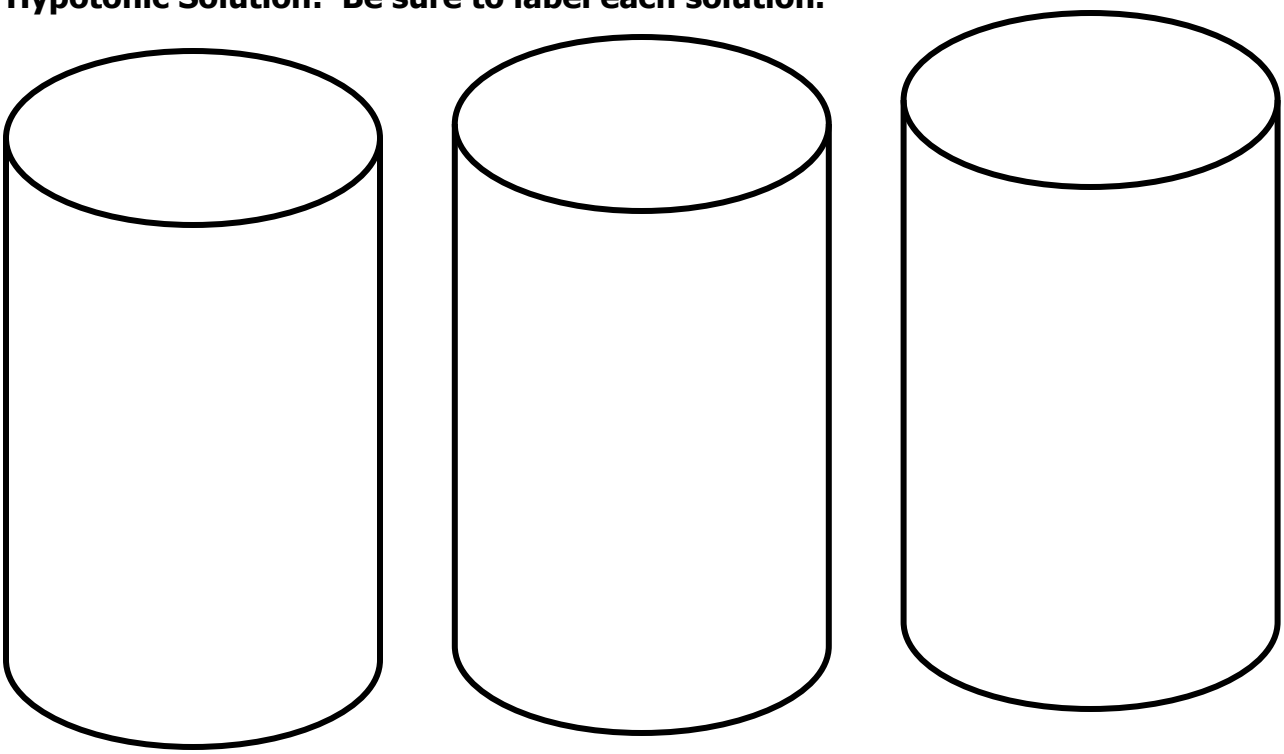




Station 5: Osmosis

1. What is **Osmosis?** _____
   _____
2. What is a **solution**? _____
3. What is a **solute?** _____
4. What is a **solvent?** _____
5. Define the term **isotonic solution:** _____
   _____
6. Give an example: _____
7. Define the term **hypertonic solution:** _____
   _____
8. Give an example: _____
9. Define the term **hypotonic solution:** _____
   _____
10. Give an example: _____

Draw examples of what a cell would look like in an Isotonic, Hypertonic and Hypotonic Solution: Be sure to label each solution.



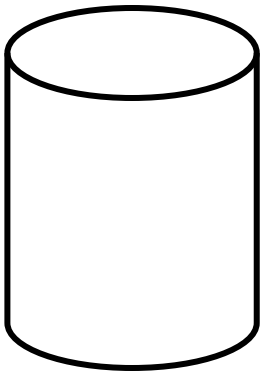
Egg Lab: *The purpose of this lab is to observe the process of* ***osmosis*** *occurring through the membrane of an egg.*

Day 1: Gently place an egg in a glass beaker and using the graduated cylinder, measure 150 ml of vinegar and carefully pour the syrup over the egg. Record any observations and then cover with a piece of foil and set aside.

Day 1: What happened when you poured the vinegar over the egg? _____

_____

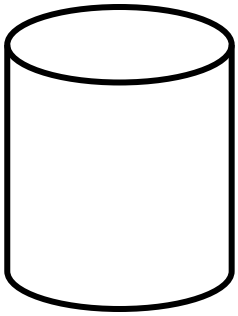
Draw what your egg looked like when you placed it in the vinegar:



Day 2: Observe and record what happened to the egg and record the amount of vinegar left in the beaker once the egg was removed (use the graduated cylinder to get an accurate reading).

1. What happened to the egg? _____
2. How much vinegar was left in the beaker once the egg was removed? _____
3. What do you think happened to the missing vinegar? _____

   _____
4. What type of solution do you think the vinegar is? _____
5. Explain your answer: _____
6. Draw what your egg and solution looked like after being in vinegar:
   Be sure to **draw arrows** showing the direction of water flow.

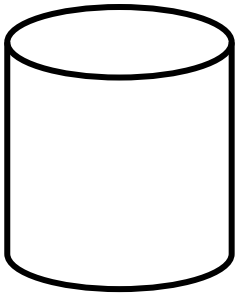


Rinse off the egg gently, removing all of the white powdery substance on the egg and place back into the glass beaker. Using the graduated cylinder, carefully measure 150 ml of corn syrup and gently pour over the egg, cover with the foil and let sit.

Day 3: Observe and record what happened to the egg and record the amount of syrup left in the beaker once the egg was carefully removed (use the graduated cylinder to get an accurate reading).

1. What happened to the egg? _____
2. How much syrup was left in the beaker once the egg was removed? _____
3. Why do you think there is more syrup then when you started? _____

   _____
4. What type of solution do you think the syrup is? _____
5. Explain your answer: _____
6. Draw what your egg looked like after being in syrup:
   Be sure to **draw arrows** to show the direction of water flow.

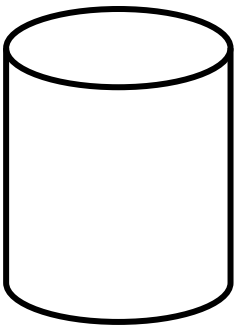


Gently rinse off the egg, place back into the glass beaker and using the graduated cylinder, measure 150 ml of distilled water. Pour the distilled water over the egg, cover with foil and let sit.

Day 4: Observe and record what happened to the egg and record the amount of distilled water left in the beaker once the egg was carefully removed (use the graduated cylinder to get an accurate reading).

1. What happened to the egg? _____
2. How much distilled water was left in the beaker once the egg was removed? _____
3. What do you think happened to the rest of the distilled water? _____

   _____
4. What type of solution do you think the distilled water is? _____
5. Explain your answer: _____
6. Draw a picture of what the egg looked like after being in distilled water:
   Be sure to **draw arrows** to show the direction of water flow.



Station 6:

Cell Membrane

Selectively Permeable

Types of Transport
(in and out of the cell)

- cell must use energy
  - moves molecules from _____ concentrations across a membrane
    - Brings bulky material into the cell
    - Brings bulky material out of the cell
- cell ***does not*** use energy
  - moves molecules from _____ concentrations across a membrane
    - -diffusion of molecules through proteins
      - ***Channels/ Pores***- acts as a bridge carrying larger & charged molecules across the cell membrane
    - -diffusion of water through the membrane
      - a cell is effected by it's environment:
        - _____ -Higher water, lower solute outside the cell
        - _____ -Equal amount of H_2O outside as inside the cell
        - _____ -Lower water, higher solute outside the cell

Structure

- _____
  - Non-polar
  - Polar
  - does not dissolve in water *(hates water)*
  - dissolves in water *(loves water)*
- _____
  - Polar —
  - Non-polar —
  - Polar —
- _____