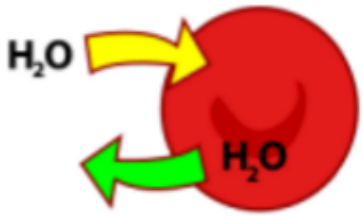
STATION 4: Part 2 - TONICITY (PAP)– due to OSMOSIS / Turgor Pressure in Plants

Tonicity is the concentration of solutions that determines the direction water will move across a semi-permeable membrane. A **solution** is a mixture of a **solute** and a **solvent**. A solute is the substance being dissolved and the solvent is doing the dissolving. In living things, the solvent will almost always be water, and the solute will usually be either salt or sugar.

ISOTONIC SOLUTION, HYPERTONIC SOLUTION AND HYPOTONIC SOLUTION

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

Example: When you get an IV, the saline solution contains a salt concentration equal to your cell's salt concentration. This prevents the cells from swelling and shrinking.

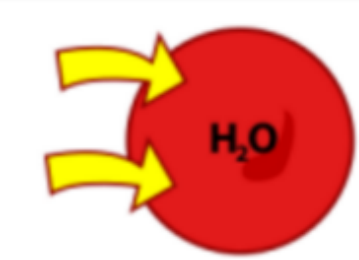


Hypertonic – "Hyper Viper": The solution has a **higher concentration of solutes** and a lower concentration of water than what is inside the cell. As a result, water will move from inside cell out into the solution and the cell will shrink in size.

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

Hypotonic – "Hypo Hippo": 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 could burst open. In plants, the pressure of water on the membrane is called **turgor pressure**. Loss of water in plant cells is called **plasmolysis**, and cells are no longer maintaining homeostasis.

Example: Putting saltwater fish in freshwater would cause the fish cells to swell. This is because the fish cells have a higher salt concentration than the freshwater and water would enter the cells.



INVESTIGATION

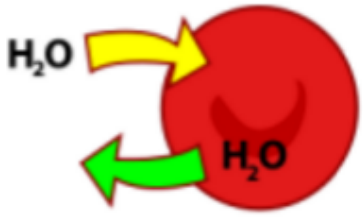
Look at the images of the plant cells exposed to different solutions under the microscope. DO NOT ADJUST THE SLIDES. IF YOUR IMAGE IS NOT VISIBLE ASK THE TEACHER FOR HELP.

STATION 4: TONICITY (OL) – cells shrink and swell due to OSMOSIS

Tonicity is the concentration of solutions that determines the direction water will move across a semi-permeable membrane. A **solution** is a mixture of a **solute** and a **solvent**. A solute is the substance being dissolved and the solvent is doing the dissolving. In living things, the solvent will almost always be water, and the solute will usually be either salt or sugar.

Cell size doesn't change: The concentration of solutes in the solution is **equal** to the concentration of the solutes inside the cell. As a result, water is also in equal concentration and will move equally in both directions and the cell remains equal in size (Equilibrium).

Example: When you get an IV, the saline solution contains a salt concentration equal to your cell's salt concentration. This prevents the cells from swelling and shrinking.

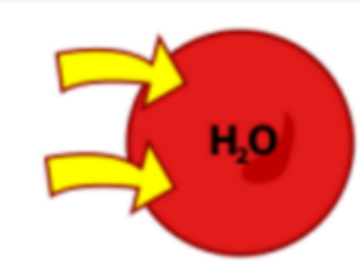


Cell shrinks in size: The solution **outside of the cell** has a **higher concentration of solutes** and a **lower concentration of water** than what is inside the cell. As a result, water will move from inside cell out into the solution and the cell will shrink in size.

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

Cell swells in size: 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 may burst open. In plants, the pressure of water on the membrane is called **turgor pressure**. Loss of water in plant cells is called **plasmolysis**, and cells are no longer maintaining homeostasis.

Example: Putting saltwater fish in freshwater would cause the fish cells to swell. This is because the fish cells have a higher salt concentration than the freshwater and water would enter the cells.



INVESTIGATION

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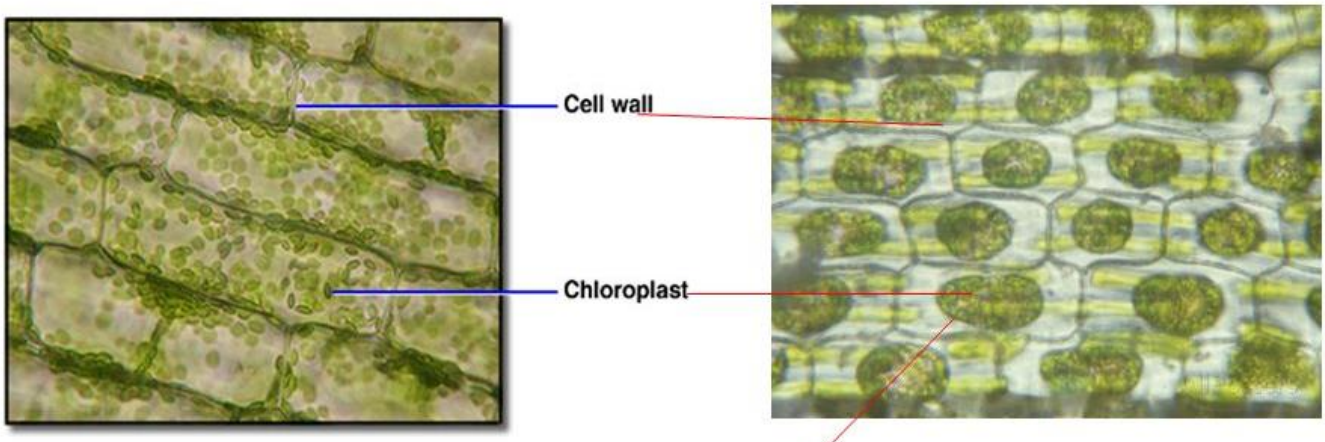
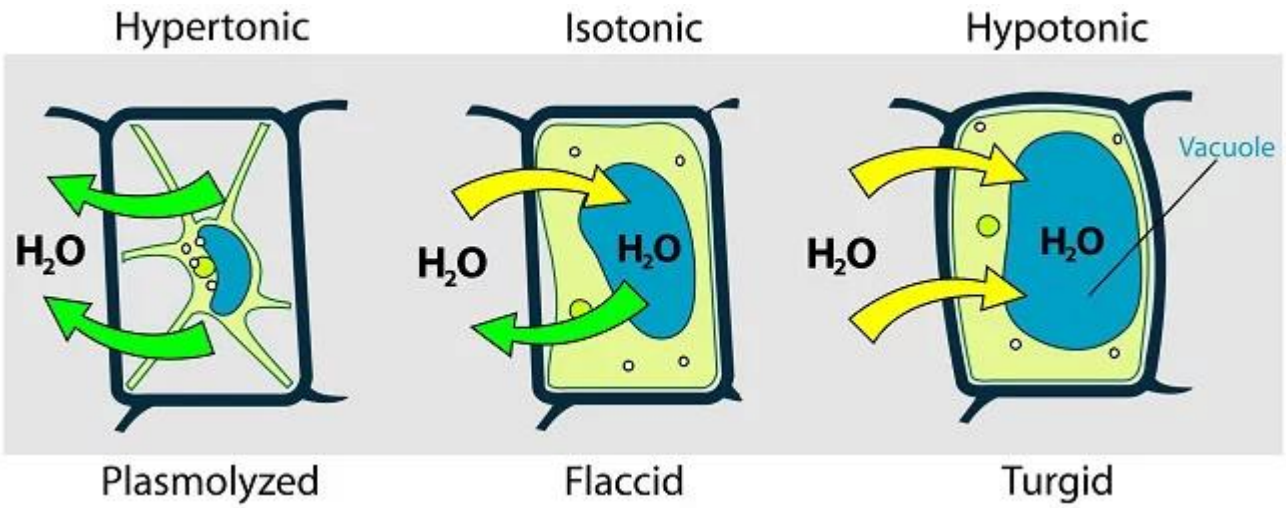
Fresh Water

Salt Water

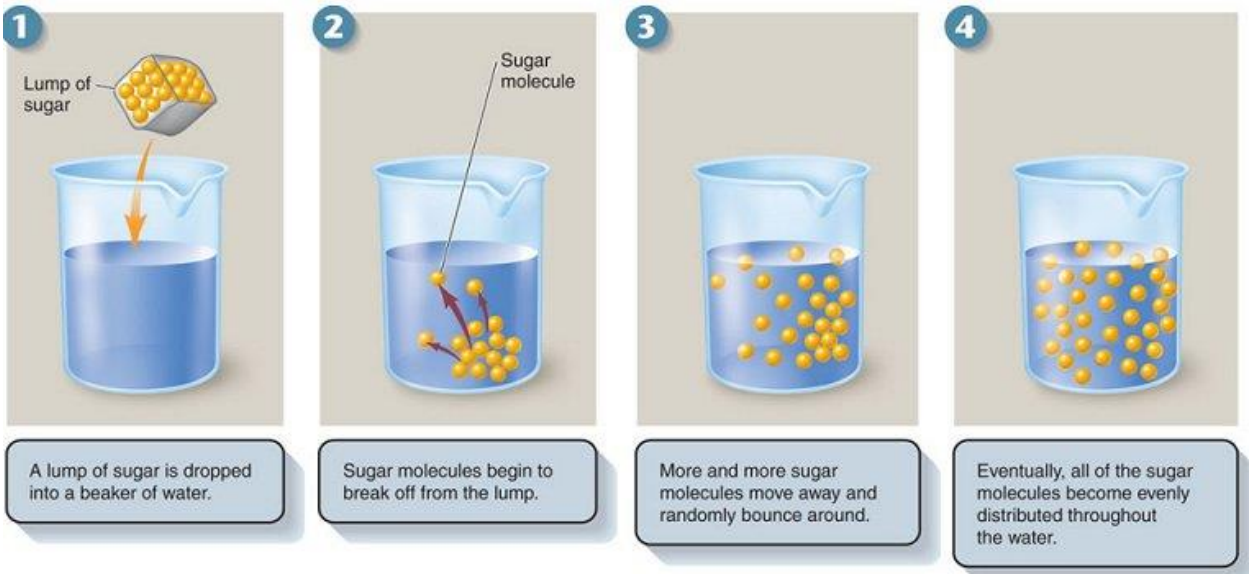




STATION FOUR: Part 1 - DIFFUSION

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.***



<u>INVESTIGATION</u>:

1. Fill up a beaker with water.
2. Drop 3 drops of food coloring **one at a time** into the beaker at the same time and observe what happens.
3. Pour out the beaker of water into the sink, rinse beakers and return to tray.
4. Put your nose up to the balloon to see if you can smell anything.

STATION THREE: Part one - 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. Put your finger in the soapy water than carefully "poke" it through the membrane.
7. Answer the questions on your lab sheet.

TURN OVER!

STATION THREE: Part two - 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 ***channel proteins.*** This type of diffusion is called ***facilitated diffusion*** because movement of the molecules is "helped" across the membrane by these channel 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 (unless you have a very large pet!). This "**choosey"** 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.

<u>Investigation/Procedure</u>:

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. Leave the thread in place.
4. Stick your finger through the opening/protein channel and move the opening around the membrane.
5. Now pass your pen or pencil through the thread loop to simulate facilitated diffusion.
6. Answer the questions on your lab sheet.

STATION ONE: OSMOSIS

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 it 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?

Examine the images below. What type of solution were these grapes placed in? Which direction did the water flow? How can you reverse the process?



STATION FOUR: ACTIVE TRANSPORT

Introduction: What happens when you are trying to get from one class to another class using Main Street? 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 upstairs, 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.

Name: _____ Period: ___ Date: _____

CELLULAR TRANSPORT STATION LAB - 2019

Station 1: OSMOSIS

1. Give a complete definition of **Osmosis.** _____

_____

2. Would it be considered passive or active transport? _____

Why? _____

3. Study the image of the grapes. What type of solution were the grapes placed in?

_____ How can you tell? _____

_____

5. Look at the raisins in the beaker of water. What happened to them and why?

_____

_____

6. When will water stop flowing across the cell membrane? _____

_____

7. Is equilibrium and homeostasis the same thing? _____ Explain. _____

_____

_____

Station 2: Part one - Active Transport

1. Define the term **Active Transport: __**_____

_____

2. What is **Endocytosis**? _____

_____

2. What is **Exocytosis**? _____

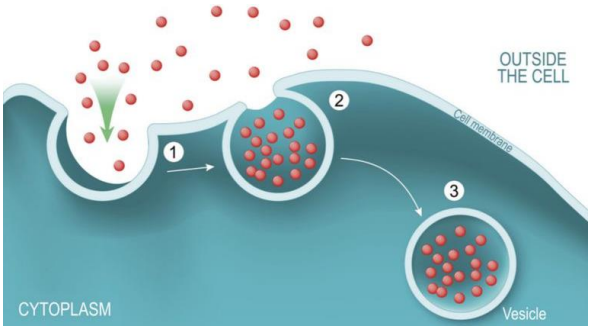
_____

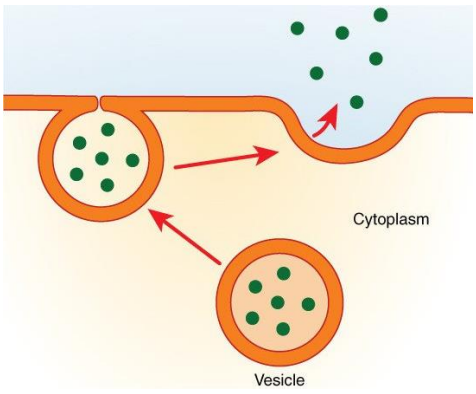
3. During Active Transport THROUGH the membrane, what biomolecule is needed?

_____

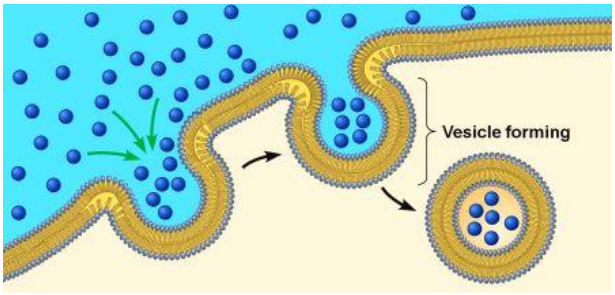
Station 2: Part two - Active Transport

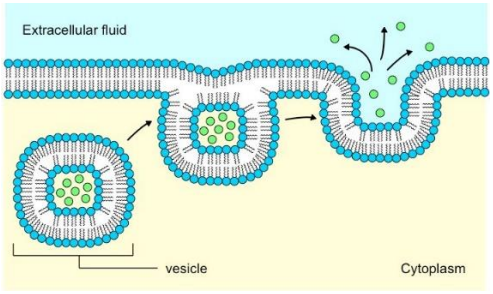
Label the pictures below. Use endocytosis and exocytosis.





_____ _____





_____ _____

Station 3: FACILITATED DIFFUSION ("HELPED")

1. Define the term **Facilitated Diffusion:** _____

   _____

2. What happened when food coloring was dropped on the soap membrane? _____

   _____

3. Did the membrane "self-repair" after you poked your finger through it? _____
4. What represented the carrier protein in this activity? _____
5. What type of molecules need a channel protein to pass through the plasma membrane? _____
6. Is facilitate diffusion passive or active transport? _____

   Why? _____
7. How does facilitated diffusion differ from simple diffusion? _____

   _____

Station 4: DIFFUSION

1. Explain the difference between high concentration and low concentration. _____

_____

_____

2. Define the term **diffusion:** _____

3. When does diffusion stop? _____

4. What does it mean when **equilibrium** has been reached? _____

_____

5. How did dropping food coloring into the water demonstrate diffusion? _____

_____

6. Why did the extract diffuse out of the balloon but the sand did not? _____

_____

7. Why is diffusion a type of passive transport? _____

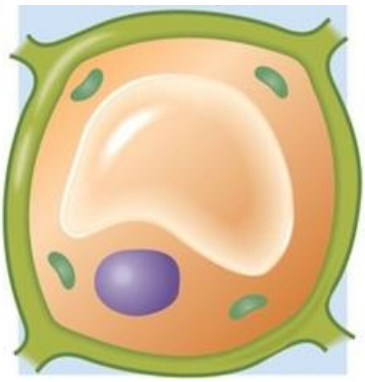
_____

Station 4: Turgid vs Plasmolysis

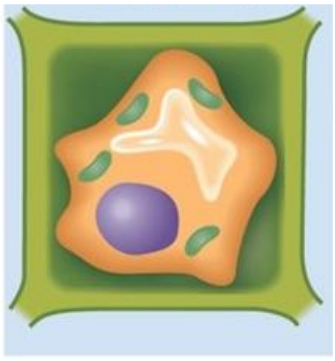
1. In a saltwater solution, what is the solvent? _____ solute? _____

2. Below are pictures of plant cells as seen under the microscope. For each solution, write **H** (HIGH) where the water concentration would be high (either inside the cell or in the solution), and **L** (LOW) where the water concentration would be low (either inside the cell or in the solution). Then draw an **arrow** to show the net movement of water that occurred.

1



2



3

3. Which cell shows plasmolysis? _____

4. Which cell is under turgor pressure? _____

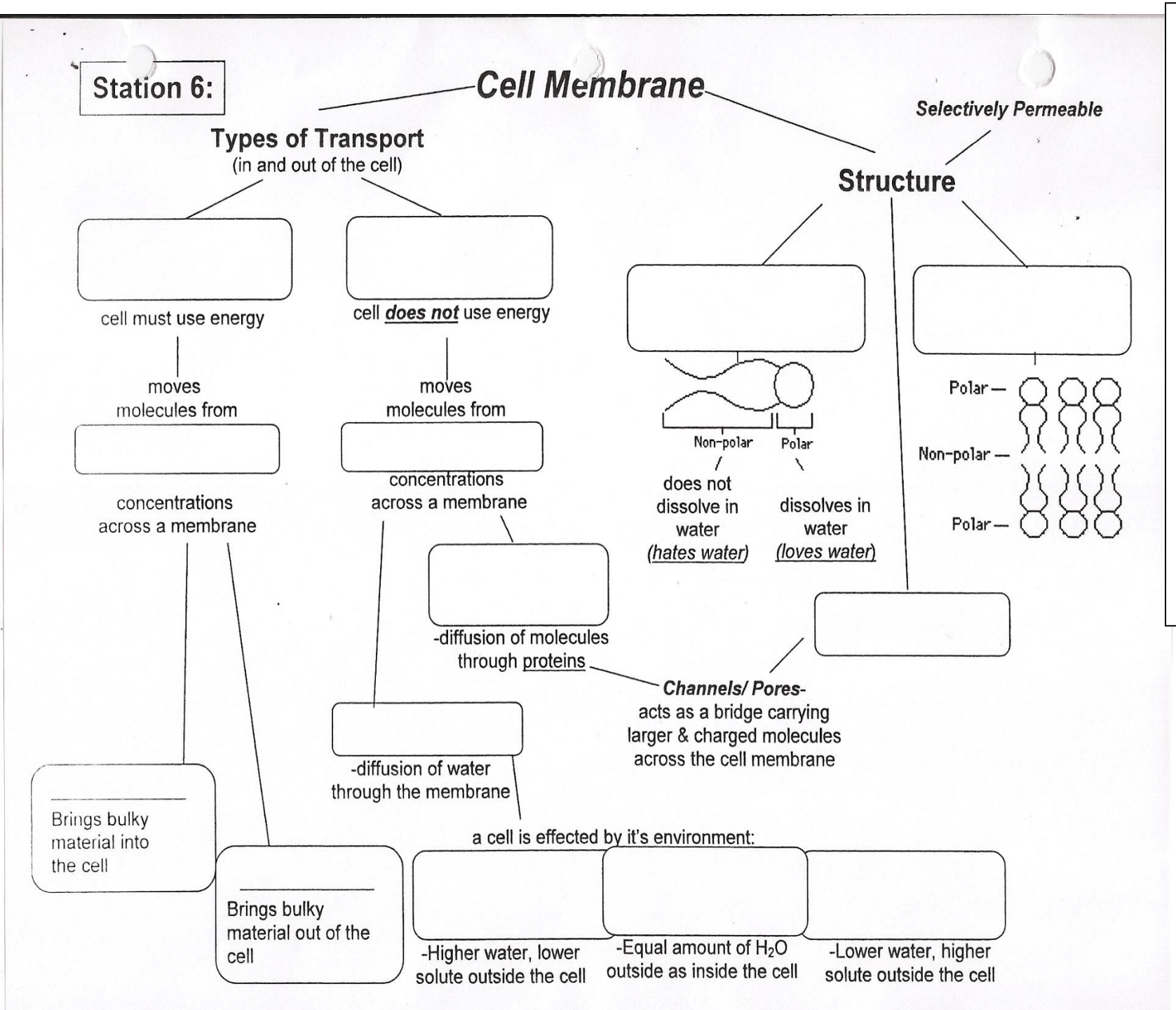
5. Which cell is maintaining homeostasis? _____

6. Which cell is in a hypotonic solution? _____ hypertonic? _____ isotonic? _____

NAME **Period**

HOMEWORK

Directions: Use the word bank to complete this flowchart over the cell membrane



WORD CHOICES TO COMPLETE FLOWCHART

-Active
-Facilitated Diffusion
-Isotonic Solution
-Phospholipid Bilayer
-High → Low
-Low → High
-Proteins
-Endocytosis
-Hypertonic Solution
-Osmosis
-Exocytosis
-Hypotonic Solution
-Passive