Cell Transport Model Activity Name: ______________________________________ Per:_____

Essential Question: How do cells maintain homeostasis?

Part 1: Introduction

In a cell respiration, almost all cells use oxygen to generate energy from chemical reactions with simple sugars like glucose. A waste product of this reaction is carbon dioxide (CO_2). So, it is very important to understand how oxygen and carbon dioxide move into and out of cells. Diffusion is a process where fluids (including gases and liquids) move across a semi-permeable membrane (like the cell membrane) from an area of high concentration to an area of low concentration.

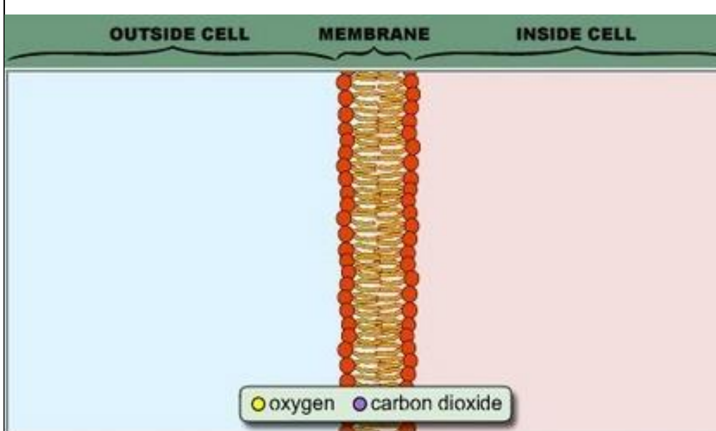
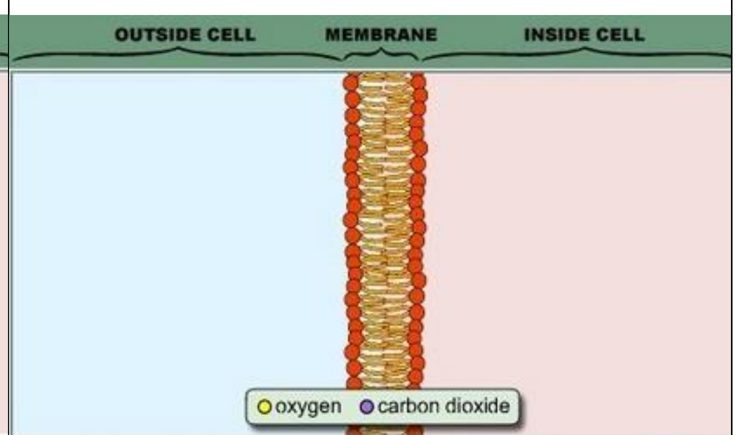
Osmosis is the diffusion of water through a semi-permeable membrane (again, like a cell membrane), from a low solute (hypotonic) concentration to a high solute (hypertonic) concentration. Water accounts for over 70% of the human body. If water levels are not regulated and maintained in an organism, the consequences can be disastrous.

Important Terms to know:

- Solute
- Solution
- Solvent
- Concentration
- Dilute
- Concentrated
- Equilibrium
- Diffusion
- Osmosis

Part 2: Diffusion Model

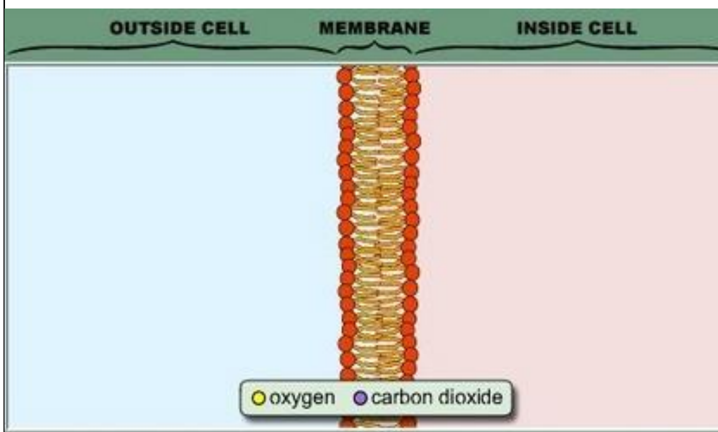
1. Open up this link: https://lab.concord.org/embeddable.html#interactives/itsi/diffusion/permeable-membrane.json The model is divided in half by a cell membrane. On the left is the liquid outside the cell, and on the right is the liquid inside the cell. We are going to use this model to discover how O_2 and CO_2 move across the cell membrane.
2. Set up the model so that there is a high concentration of CO_2 outside and a low concentration of CO_2 inside. Draw what your model looks like initially below. Then, click the play arrow. After a minute of letting the model run, pause your model and draw what your model looks like after. Draw an arrow to show the overall movement of CO_2.

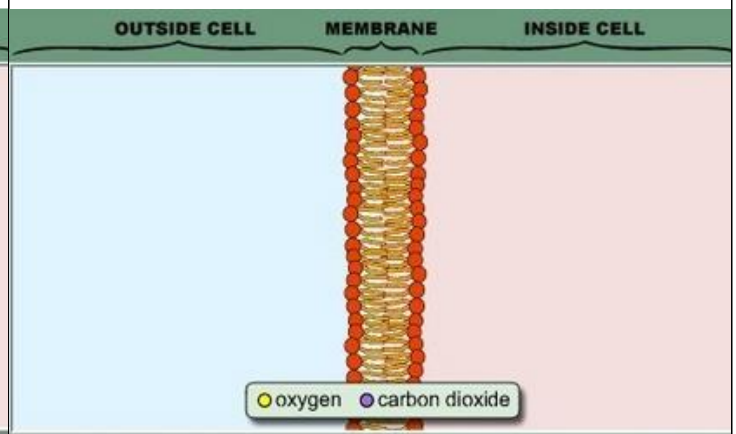
Initial	**Final**
	
CO_2 concentration outside the cell: (none/low/high)	Overall direction of CO_2 molecules:
CO_2 concentration inside the cell: (none/low/high)	CO_2 concentration on both sides: (same/different)

3. Describe the flow of molecules when there are areas of high and low concentration.

Nature always tends to move toward equilibrium. <u>Equilibrium</u> is a state of balance where energy is minimized and concentrations remain constant. Equilibrium at the atomic level is dynamic, with atoms and molecules in continual motion.

4. In the diffusion model you can set up various situations such that the concentrations inside and outside of the cell are either out of equilibrium or in equilibrium. Set up the model so that there is a high concentration of O_2 inside and a low concentration of O_2 outside. Draw what your model looks like initially below. Then, click the play arrow. You may need to wait for a few minutes, and use the graphs to help you know when equilibrium has been reached. Draw what it looks like after as well.

<table>
<tr><th>Initial</th><th>Final</th></tr>
<tr><td>


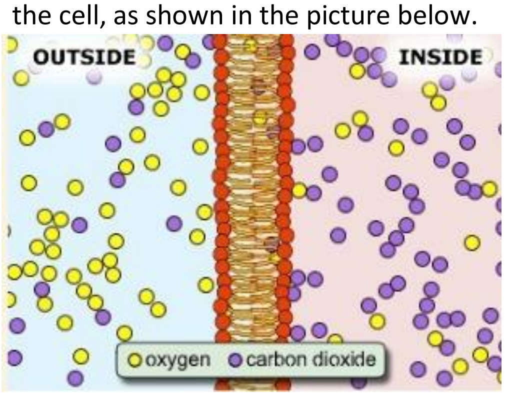
</td><td>


</td></tr>
<tr><td>O_2 concentration outside the cell: (none/low/high)</td><td>Overall direction of O_2 molecules:</td></tr>
<tr><td>O_2 concentration inside the cell: (none/low/high)</td><td>O_2 concentration on both sides: (same/different)</td></tr>
</table>

5. What is equilibrium and how does it relate to diffusion?

You have seen that concentration affects the overall flow of a substance across a membrane. If a cell moves (or is moved) into an area of low or high concentration, it will cause the concentration inside the cell to change. For red blood cells, this is part of the story that helps to explain how they pick up oxygen in your lungs and deliver it to the rest of your body.

6. Use the model at https://lab.concord.org/embeddable.html#interactives/itsi/diffusion/concentration-and-breathing.json to move a red blood cell into environments with different concentrations of oxygen and observe how the oxygen concentration inside of the red blood cell changes when you put it in different environments. Drag the slider to change the oxygen concentration surrounding the cell.
7. Describe what will happen if a cell has an oxygen concentration that is higher outside of the cell than inside of the cell, as shown in the picture below.



STOP

Part 3: Osmosis Model

1. Open the Interactive model at : https://web.archive.org/web/20170622155806/http://www.glencoe.com/sites/common_assets/science/virtual_labs/LS03/LS03.html
   Read the introduction on the left and define the 3 terms by filling in the blanks with either "greater," "less," or "same."

   a. Hypotonic: *water* concentration is _________________ outside the cell than inside the cell

   b. Isotonic: *water* concentration is the _________________ outside the cell as inside the cell

   c. Hypertonic: *water* concentration is _________________ outside the cell than inside the cell
2. Using the model, you will place a red blood cell and an Elodea (plant) cell in hypotonic, isotonic, and hypertonic solutions. You will examine how and why these cells gain or lose water in the different solutions.
3. Select the *red blood cell* and drag it into the beaker labeled "hypotonic." Observe the process of osmosis. Determine whether water (represented by blue arrows) moves into, stays in equilibrium (no movement), or moves out of the cell. Record your observations below. Press reset and then select the *red blood cell* and drag it into the beaker labeled "isotonic." Record your observations below. Press reset and then select the *red blood cell* and drag it into the beaker labeled "hypertonic."

Red Blood Cell – Hypotonic Solution	**Red Blood Cell – Isotonic Solution**	**Red Blood Cell – Hypertonic Solution**
Draw the results (blue arrows show water movement)	Draw the results (blue arrows show water movement)	Draw the results (blue arrows show water movement)
Water moves (circle one): Into cell Out of cell No movement	Water moves (circle one): Into cell Out of cell No movement	Water moves (circle one): Into cell Out of cell No movement
Cell (circle one): Shrinks Expands No change	Cell (circle one): Shrinks Expands No change	Cell (circle one): Shrinks Expands No change

4. Select the *Elodea cell* and drag it into the beaker labeled "hypotonic." Observe the process of osmosis. Determine whether water (represented by blue arrows) moves into, stays in equilibrium (no movement), or moves out of the cell. Record your observations below. Press reset and then select the *Elodea cell* and drag it into the beaker labeled "isotonic." Record your observations below. Press reset and then select the *Elodea cell* and drag it into the beaker labeled "hypertonic."

Elodea Cell – Hypotonic Solution	**Elodea Cell – Isotonic Solution**	**Elodea Cell – Hypertonic Solution**
Draw the results (blue arrows show water movement)	Draw the results (blue arrows show water movement)	Draw the results (blue arrows show water movement)
Water moves (circle one): Into cell Out of cell No movement	Water moves (circle one): Into cell Out of cell No movement	Water moves (circle one): Into cell Out of cell No movement
Cell (circle one): Shrinks Expands No change	Cell (circle one): Shrinks Expands No change	Cell (circle one): Shrinks Expands No change

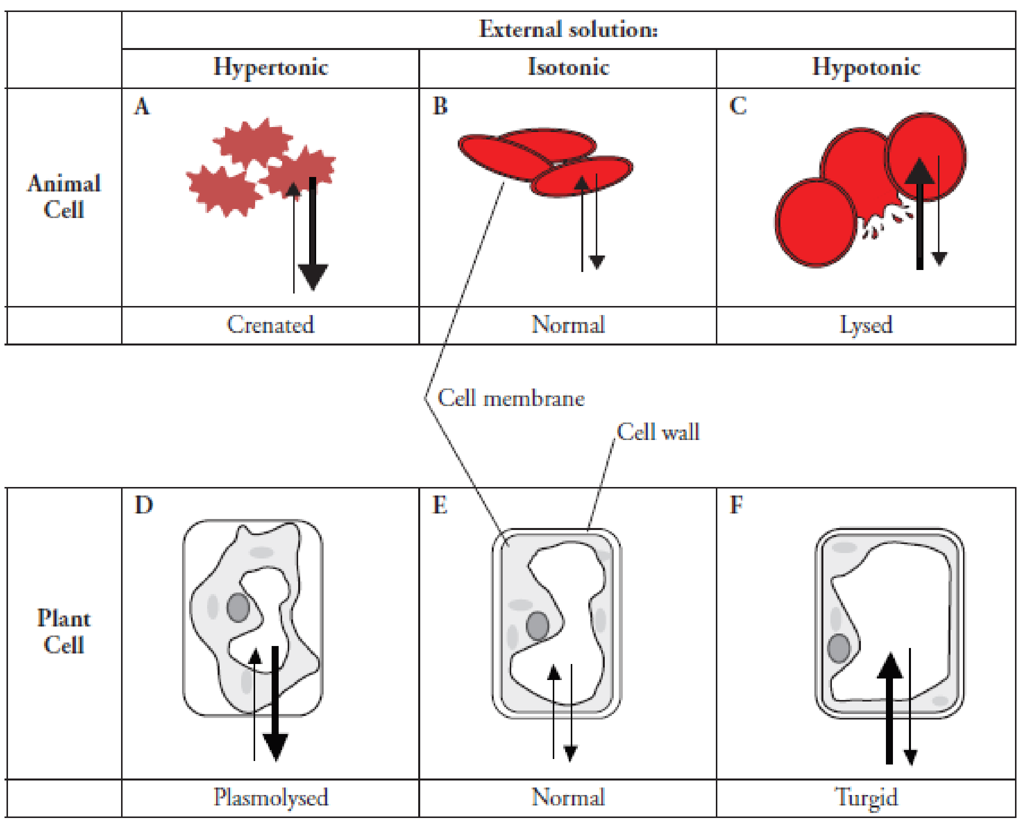
5. Consider the definition for osmosis and the net movement of water from a dilute solution (high concentration of water) to a concentrated solution (low concentration of water). Using the diagram below, answer the following questions.
    a. Describe the concentration of the solution surrounding cells A and D ("extracellular"), relative to the concentration of the solution inside cells A and D ("intracellular").

    b. Describe the concentration of the solution surrounding cells C and F ("extracellular"), relative to the concentration of the solution inside cells C and F ("intracellular").

    c. Describe the concentration of the solution surrounding cells B and E ("extracellular"), relative to the concentration of the solution inside cells B and E ("intracellular").

6. When animal cells are in a hypotonic solution, they can undergo <u>lysis</u>. However, plant cells do not, they only become <u>turgid</u>.
    a. Define lysis based on the diagram in the diagram below.

    b. What structure on the plant cell prevents lysis from occurring in a hypotonic solution?



7. In extreme cases, it is possible to die from drinking too much water. The consumption of several liters of water in a short amount of time can lead to brain edema (swelling) and death. Explain the effect of ingesting an extremely large amount of water at the level of the brain cells, including the role of osmosis in this process.