**Purpose/Objectives:**

Osmosis can have important consequences for the cell. The purpose of this lab is to study the effects of osmosis on a cell that is submerged in different aqueous environments: vinegar, sugar syrup, distilled water, colored water, cola, diet cola, salt water, and alcohol. You will use an egg to model a cell. The selectively permeable membrane you will use to study osmosis is the membrane within the eggshell. The membrane allows water to pass through it in response to concentrations of the solutions on either side of it.

By the end of this exercise, you should be able to:

- Describe how most small molecules cross the cell membrane.
- Explain why osmosis is important to cells.
- Tell the difference between passive and active transport.

**Background:**

The cell membrane protects the contents of the cell from the extra-cellular environment. The cell membrane also acts as a selectively permeable membrane, controlling the materials that enter and leave the cell. Molecules like water, oxygen, and carbon dioxide are able to easily pass in and out of the cell through the cell membrane while other molecules like specific proteins are strictly kept in or out of the cell.

Materials move into and out of cells through either passive transport or active transport. Passive transport includes the processes of diffusion and osmosis. In both forms of passive transport, molecules tend to move from a more crowded to a less crowded area in order to achieve a balance without using energy. Movement occurs when there are unequal concentrations of a substance inside and outside of the cell. Active transport is the movement of molecules from a less crowded to a more crowded area with the use of energy. Molecules are "carried" into or out of the cell using some of the cell's energy.

Diffusion is the main process by which small molecules move across the cell membrane. Diffusion is defined as the process by which molecules move from a region of higher concentration to a region of lower concentration. Osmosis refers to the specific diffusion of water through a selectively permeable membrane. Remember that molecules tend to move from an area of higher concentration to an area of lower concentration. In osmosis, water molecules move by diffusion from an area where they are highly concentrated to an area where they are less concentrated.
VOCABULARY:

Extracellular
Selectively permeable
Diffusion

Osmosis
Passive transport
Active transport

MATERIALS:

Per group:

- 16 plastic cups
- Marker and wax pencil
- Graduated cylinder
- 8 raw eggs

Per class:

- White vinegar (acetic acid)
- Solutions: clear sugar syrup, distilled water, tap water with food coloring, cola, diet cola, salt water and alcohol (i.e. ethanol)
- String
- Ruler

METHODS/PROCEDURE:

You will be working in groups of 6. Three of your group members will be responsible for eggs 1-4 and the other three members will be responsible for eggs 5-8.

DAY ONE:

1. Label 8 cups with your group's name. Then label each cup “egg 1” through “egg 8.”
2. Use a wax pencil to gently label each of your raw eggs with the numbers 1-8.
3. Use a string and ruler to carefully measure the horizontal and vertical circumferences of each of your eggs. Record your measurements in Table 1 of the Results/Data Sheet.
4. Use the graduated cylinder to measure 100 mL of vinegar. Carefully pour 100 ml of vinegar into each of the 8 cups.
5. Gently place egg number 1 in the cup labeled “egg 1”. The vinegar should cover the egg.
6. Repeat step 5 for eggs 2-8.
7. Put the cups on a plastic tray and allow them to sit for 24 hours.
DAY TWO:
1. Label 8 new cups with your group’s name. Then label one cup “vinegar, egg 1”, another “syrup, egg 2”, another “distilled, egg 3”, another “colored, egg 4”, another “cola, egg 5”, another “diet cola, egg 6”, another “salt water, egg 7”, and the last cup “alcohol, egg 8”.
2. Use the graduated cylinder to measure 100 mL of vinegar and pour it into the cup labeled “vinegar, egg 1”. Rinse the cylinder after use.
3. Repeat step 2 for cups 2-8, using the appropriate liquids.
4. Observe what has happened to eggs 1-8 from yesterday. Do not mix up the eggs! Record your qualitative observations in Table 2 of the Results/Data Sheet.
5. Carefully remove egg 1 from the vinegar. It is very fragile now as the shell is dissolved! Gently measure the horizontal and vertical circumferences of egg 1 using a string and ruler. Record your measurements in Table 1 of the Results/Data Sheet.
6. Using the graduated cylinder, measure the amount of vinegar left in the cup. Record the volume of remaining vinegar in Table 2 of the Results/Data Sheet.
7. Carefully place egg 1 in the new “vinegar, egg 1” cup.
8. Repeat steps 5, 6, and 7 with eggs 2-8, placing them in the appropriately labeled cups.
9. Allow all the eggs to sit for an additional 24 hours.

DAY THREE:
1. Observe what has happened to eggs 1-8 from yesterday. Do not mix up the eggs! Record your qualitative observations in Table 3 of the Results/Data Sheet.
2. Carefully remove egg 1 from its cup. It is very fragile. Gently measure the horizontal and vertical circumferences of egg 1 using a string and ruler. Record your measurements in Table 1 of the Data Sheet.
3. Using the graduated cylinder, measure the amount of liquid left in the cup. Record the volume of remaining liquid in Table 3 of the Results/Data Sheet.
4. Return egg 1 to the empty cup and carefully break it open to observe the inside of the egg. Record your qualitative observations in Table 3 of the Results/Data Sheet.
5. Repeat steps 2, 3, and 4 for eggs 2-8.
6. Dispose of all eggs as instructed by your teacher.
7. Discuss and answer the following questions with your group members.
Argg! I am so stressed out, I just need to relax right now before I crack!!
## Results/Data Sheet

Name: _____________________  Period: ____

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg #</td>
<td>Solution</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Vinegar</td>
<td>Sugar syrup</td>
<td>Distilled water</td>
<td>Colored tap water</td>
<td>Cola</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diet cola</td>
<td>Salt water</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7</td>
<td>Alcohol</td>
</tr>
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<td></td>
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<td></td>
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<tr>
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<td></td>
</tr>
</tbody>
</table>
### TABLE 2 (Started with 100 mL of vinegar in each cup)

<table>
<thead>
<tr>
<th>Egg #</th>
<th>Volume of vinegar after egg was removed (Day 2)</th>
<th>Qualitative Observations (Day 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
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<td>6</td>
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<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 3 (Started with 100 mL of liquid in each cup)

<table>
<thead>
<tr>
<th>Egg #</th>
<th>Liquid</th>
<th>Volume of liquid after egg was removed (Day 3)</th>
<th>Qualitative Observations (Day 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vinegar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Sugar syrup</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Distilled water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Colored tap water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Cola</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Diet cola</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Salt water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Alcohol</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Egg-Speriment (Osmosis Lab) 2009

Questions: Name: _____________________ Period: ____

1. Which direction did the water molecules move? Complete the table below. (12 pts)

<table>
<thead>
<tr>
<th>Solution</th>
<th>Direction of water movement</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vinegar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugar syrup</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distilled water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colored water</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. How do you explain the volume of liquid remaining when the egg was removed from the syrup? (2 pts)

_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________

3. How do you explain the appearance of the egg after it was removed from the syrup? (2 pts)

_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________

4. How do you explain the volume of liquid remaining when the egg was removed from the distilled water? (2 pts)

_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________

5. How do you explain the appearance of the egg after it was removed from the distilled water? (2 pts)

_____________________________________________________________________________
_____________________________________________________________________________
6. How do you explain the *volume of liquid remaining* when the egg was removed from the *colored water*? (2 pts)

______________________________________________________________________________

7. How do you explain the *appearance of the egg* after removing it from the *colored water*? (2 pts)

______________________________________________________________________________

8. Fill in the blanks on the following illustration. (6 pts)

A. ___________________________  
B. ___________________________  
C. ___________________________  
D. ___________________________  
E. ___________________________  
F. ___________________________

**Normal Red Blood Cell:**
Concentration of water inside the cell is the same as outside. There is no net gain or loss of water from the cell.

**Abnormal Red Blood Cell:**
Concentration of water inside the cell is \((D)\) than outside. Water moves \((E)\) the cell during osmosis which causes the cell to \((F)\).