**NSF INCLUDES DISCUSSION Network**

**NCAT/NCCU STEM Camp**

**Determination of the Rate of Osmosis Using the Naked Egg**

***Directions:*  Read all of the information and follow the procedure steps for this experiment. Answer the five (5) questions after the procedure. There is also a “Key Terms Comparison Chart”, on the last page of the handout**

***Overall Experiment*: To determine the effects of various concentrations of aqueous solutions on the how fast (rate) of osmosis using the naked egg.**

***Definitions to know:***

* **Diffusion** - a spontaneous movement of particles from an area of high concentration to an area of low concentration. (ex. tea flavoring moving from an area of high to low concentration in hot water.)
* **Osmosis** – the movement of a solvent through a semipermeable membrane from a region of lower solute concentration (*higher solvent concentration*) to a region of higher solute concentration (*lower solvent concentration*)

***Purpose:*** To determine the effects of three different NaCl solutions (NaCl(aq)) on the rate of osmosis - ***(measurement changes = % mass over time)***

***Egg Chemistry***

Water content of Egg white (+yolk) 88 % (w/w)

Sodium ion (Na+) content ~0.15 g/100g (0.06 M of Na+)

Ref: Food: The Chemistry of its Components (4th ed.), Author T.P. Coultate

***Hypotheses:* Salt concentration effect on the mass of naked eggs via changing the rate of osmosis.**

* **Hypothesis 1**: If a naked egg is placed into a bowl with 0 M NaCl(aq) (De-ionized water), then over time, the egg would maintain the same mass because there would be the same concentration of water in- and out-side of the egg membrane.
* **Hypothesis 2**: If a naked egg is placed into a bowl of 0.01 M NaCl(aq), then the egg will be in a solution with Na+  that is hypotonic to the egg and the egg will increase in its mass because there is a lower concentration of Na+  in the solution that is hypotonic to the egg, so there will be an overall net movement of water into the egg.
* **Hypothesis 3**: If a naked egg is placed into a bowl containing 1.0 M NaCl(aq), then the egg will be in a solution of Na+ that is hypertonic to the egg and the egg will decrease in its mass because there is a higher concentration of Na+ in the solution hypertonic to the egg, so there will be an overall net movement of water out of the egg.

**Variables, controls and constants:**

* IDV: The independent variable is the NaCl(aq)
* DV: The dependent variable would be the rate of the osmosis in the egg
* Control: The estimated control variable is the 0 M water solution.
* Constant:  The estimated constants would be the eggs, the amount of water and NaCl(aq) in each bowl, same type of bowl, same timing, and using the same weighing scale.

**Materials**

* Naked Eggs (N = 3)
* Bowls (N = 4)
* Timer (can use timer on cellphones)
* One scale per group
* Data collector
* Paper towels

**Procedure:**

1. Take 3 bowls.  
2. Put the 0 M salt solution (de-ionized water) in one bowl, 0.01 M salt solution in the second bowl, and 1.0 M salt solution in the third bowl.  
3. Use the timer on one of your cell phones.  
4. Take the initial mass of each of the three eggs needed for this experiment. (Use the paper towels to CAREFULLY remove any excess water.)   
5. In a coordinated effort, place the three individual eggs in one of the three bowls.  
6. Start the timer as soon as each egg is placed in each bowl  
7. Carefully take the egg out of the beaker with a spoon after 3 minutes  
8. Very carefully dry the egg with a paper towel so it won’t have excess water  
9. Place it on a weighing bowl on zeroed-out the scale  
10. Place the weighing bowl on the balance  
11. Weigh the egg in grams  
12. Record the measurement  
13. Repeat steps 6-11 for 9 more times.

**Answer the following questions:**

1. Look at the chart comparing OSMOSIS and DIFFUSION. How are these seen in your experiment?
2. Compare the appearance and mass of the eggs before and after the treatment. Try to explain each solution's effect on the egg.
3. Was water passing into or out of the egg? If so, does your experiment allow you to predict the process?
4. Are there other possibilities?
5. How would you design the experiment differently, to test the different aqueous solutions?

**Key Terms Comparison Chart**

|  | **Diffusion** | **Osmosis** |
| --- | --- | --- |
| **What is it?** | Diffusion is a spontaneous movement of particles from an area of high concentration to an area of low concentration. (ex. tea flavoring moving from an area of high to low concentration in hot water.) | Osmosis is the spontaneous net movement of water across a semipermeable membrane from a region of low solute concentration to a solution with a high solute concentration, down a solute concentration gradient. |
| **Process** | Diffusion mainly occurs in gaseous state or within gas molecules and liquid molecules.(e.g. The molecules of 2 gases are in constant motion and if the membrane separating them is removed the gases will mix because of random velocities.) | It occurs when the medium surrounding the cell has a higher water concentration than the cell. The cell gains water along with important molecules and particles for growth. It also occurs when water and particles move from one cell to another. |
| **Importance** | To create energy; Helps in exchange of gases during respiration, [photosynthesis](http://www.diffen.com/difference/Photosynthesis_vs_Respiration), and transpiration. | In animals, osmosis influences the distribution of nutrients and the release of metabolic waste products. In plants, osmosis is partially responsible for the absorption of soil water and for the elevation of the liquid to the leaves of the plant. |
| **Concentration Gradient** | Goes from a high concentration gradient to a low concentration gradient | Moves down concentration gradient |
| **Water** | Doesn’t need water for movement | Needs water for movement |
| **Examples** | Perfume or Air Freshener where the gas molecules diffuse into the air spreading the aroma. | Movement of water into root hair cells. |