**Lesson Title: Osmosis and Diffusion: Egg Lab**

**Length of lesson: 4 Days**

**The Naked Egg Lab**

**Objective:**

* Demonstrate diffusion across a semi-permeable membrane
* Measure the effects of various concentrations of solute in the process of osmosis
* Differentiate between hypotonic, isotonic, and hypertonic environments

The objective of this experiment is to detect diffusion and osmosis across a selectively permeable membrane. We will be using shell-less chicken eggs placed in four different solutions including: distilled water, salt (NaCl) solution, sucrose solution and a substance of your choice over a period of three days.

**Definition Review:**

Diffusion: The spontaneous movement of molecules or particles in solution along a concentration gradient (i.e. from areas of high concentration to a low concentration) until there is an equilibrium.

Osmosis: The diffusion of water molecules through a selectively permeable membrane from a region of low solute concentration to a region of high solute concentration.

Selectively Permeable Membrane: A membrane that allows only certain materials to pass through it by diffusion.

Solvent: A liquid that dissolves a solute resulting in a solution (example: water).

Solute: Dissolved in another substance known as a solvent (example: salt).

Solution: A mixture made-up of solutes and a solvent (example: salt water).

Hypotonic: A condition in which the inside of the cell has a higher solute concentration than its environment. Osmosis causes a net flow of water into the cell, causing swelling and expansion. This swelling may cause cells without a rigid cell wall to burst.

Hypertonic: A condition in which the environment has a higher solute concentration than inside the cell. Osmosis pressure causes water to flow out of the cells and causing the cell to shrink.

Isotonic: A solution with equal concentration of solute inside and outside of the material.

**The Naked Egg Lab**

**Materials:**

4 eggs 4 plastic cups Graduated cylinder Vinegar

Distilled water Corn syrup Salt water Soda

Rubbing alcohol Food coloring String Ruler

Digital scale Masking Tape Sharpie Paper towels

**Procedure:**

**DAY 1**

We began by removing the eggshell with vinegar. How does this work? When you submerge an egg in vinegar, the shell dissolves. Vinegar contains acetic acid, which breaks apart the solid calcium carbonate crystals that make up the eggshell into their calcium and carbonate parts. The calcium ions float free (calcium ions are atoms that are missing electrons), while the carbonate goes to make carbon dioxide—the bubbles that you see. The eggs are still surrounded by a thin – selectively permeable – shell membrane. Be careful these are fragile. (If you break an egg you will be cleaning up the classroom)

1) In four plastic cups, pour 100 mL of vinegar.

2) Place a raw egg GENTLY into each of the cups of vinegar.

3) Allow the eggs to sit over the weekend.

**Questions:**

**Answer questions on your lab sheet.**

On Monday you will be placing each egg in four different solutions: Tap Water, Corn Syrup, Salt Water and Isopropyl Alcohol.

1) Based on what you know about diffusion and osmosis develop a hypothesis explaining the movement of water molecules across the semipermeable membrane. Include if you think the solution is hypotonic, hypertonic, or isotonic

* 1. Tap Water
  2. Corn Syrup
  3. Salt Water
  4. Alcohol

1. Will the eggs gain or lose weight in the Tap Water solution?
2. Will the eggs gain or lose weight in the Corn Syrup solution?
3. Will the eggs gain or lose weight in the Salt Water solution?
4. Each class will need to propose a treatment for a fourth egg. Based on what you know about osmosis and the experimental setup, propose a treatment for this additional egg. Each class will vote on the other substance. Examples of materials that will be available to you include: food coloring, rubbing alcohol, soda (i.e. 7up, coke, etc), cleaners, soap, etc.

**DAY 2**

1) Carefully remove eggs from the vinegar solution.

2) Rinse the eggs off with cold water and gently blot each of them dry with a paper towel.

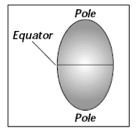
3) Make qualitative observations (color, shape, texture, smell, and any other notable characteristics) on each of the eggs and record these observations in your lab notebook.

Measure Circumference of the Eggs:

4) Wrap a piece of string snugly around each egg at the equator, be careful not to cut into the egg’s membrane with the string.

5) Keeping your finger on the point at which the string circled the egg, lay the string straight on the lab bench.

6) Use a metric ruler to measure the distance from the end of the string to this circumference point and record this measurement in your lab notebook.



Measure Mass of the Eggs:

7) Weigh each of the eggs by placing them on an electric scale. Record the weight for each egg to the nearest 0.1 gram in your lab notebook

8) Pour remaining vinegar down the drain and rinse each of the cups.

9) Label four plastic cups with Tap Water, Sucrose, Salt and solution of your choice.

In one cup, pour 125 mL of tap water

In a second cup, pour 125 mL of corn syrup

In a third cup, pour 125 mL of salt water

In a fourth cup, pour 125 mL of chosen solution (i.e. rubbing alcohol, soda, colored water, soap, etc)

10) Carefully place one egg in each of the above solutions. MAKE SURE TO LABEL WHICH EGG IS IN EACH SOLUTION ON YOUR DATA SHEET IN YOUR LAB NOTEBOOK.

11) Allow eggs to sit overnight.

**DAY 3**

1) Carefully remove eggs from the each of the solutions.

2) Rinse the eggs off with cold water and gently blot each of them dry with a paper towel.

3) Make qualitative observations (color, shape, texture, smell, and any other notable characteristics) on each of the eggs and record these observations in your lab notebook.

4) Measure the circumference of each of the eggs and record this value in your lab notebook

5) Weigh each of the eggs by placing them on an electric scale. Record the weight for each egg to the nearest 0.1 gram in your lab notebook.

**The Naked Egg Lab Sheet**

**Hypothesis:**

1) Based on what you know about diffusion and osmosis develop a hypothesis explaining the movement of water molecules across the semipermeable membrane. Include if you think the solution is hypotonic, hypertonic, or isotonic

* 1. Tap Water
  2. Corn Syrup
  3. Salt Water
  4. Alcohol

2) Will the eggs gain or lose weight in the Tap Water solution?

3) Will the eggs gain or lose weight in the Corn Syrup solution?

4) Will the eggs gain or lose weight in the Salt Water solution?

5) Will the eggs gain or lose weight in your Isopropyl Alcohol solution?

Record results in the following 3 data tables:

**Qualitative Observations**

|  |  |
| --- | --- |
| **Solution** | **Observations** |
| 1. Tap Water |  |
| 1. Corn Syrup (Sugar/Sucrose) |  |
| 1. Salt Water |  |
| 1. Isopropyl Alcohol |  |
| 1. Control (Vinegar) |  |

**Circumference of Eggs (Size)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Solutions** | **Initial Circumference**  **(Control- vinegar)** | **Final Circumference** | **Change in Size** |
| 1. Tap Water |  |  |  |
| 1. Corn Syrup |  |  |  |
| 1. Salt Water |  |  |  |
| 1. Isopropyl Alcohol |  |  |  |

**Mass of the Eggs**

|  |  |  |  |
| --- | --- | --- | --- |
| **Solutions** | **Initial Mass**  **(Control- vinegar)** | **Final Mass** | **Change in Mass** |
| 1. Tap Water |  |  |  |
| 1. Corn Syrup |  |  |  |
| 1. Salt Water |  |  |  |
| 1. Isopropyl Alcohol |  |  |  |

**Questions:**

1) An egg is the largest cell in the world. After the shell was removed, what organelle was the thin white layer around the egg (keeps the outside out and the inside in)?

2) A solution that has LOTS of solute and causes a cell to shrivel is known as \_\_\_\_\_\_\_\_\_\_\_\_

What is an example of this type of solution in this lab?

3) A solution that has LOTS of solvent and causes a cell to burst is known as \_\_\_\_\_\_\_\_\_\_\_\_\_

What is an example of this type of solution in this lab?

4) Which solutions were hypertonic, isotonic or hypotonic? Explain how you know.

5) Is this type of transport passive or active? How do you know?

6) What is one question you have about osmosis after this lab?