**DIFFUSION THROUGH A MEMBRANE LAB**

**INTRODUCTION**

Your cells — actually all cells — need sugars and oxygen to make energy to fuel daily life. Cells also need raw materials to be able to repair themselves and to build new cells. And of course cells always need water to remain healthy. All these materials have to move into a cell to feed it.

On the other hand, cells produce waste products during their daily activities. Cells make the waste product, carbon dioxide, when they make energy. They also make the waste product ammonia when they digest proteins. Both of these waste products have to be removed or the cell will be poisoned and die.

All of these materials enter or leave the cell through the  **cell membrane**. In most cases, they move through the cell membrane through a process called **diffusion**. ***Diffusion is the movement of molecules from an area of higher concentration of those molecules to an area of lower concentration.*** A good metaphor for this movement of molecules is what happens if you were to open a bottle of perfume in one corner of a room. It would not be long before someone in the opposite corner of the room would smell the perfume. The molecules moved from an area of higher concentration of perfume where the open bottle was to an area of lower concentration of perfume like the opposite corner of the room. Eventually a balance, or **equilibrium**, is reached. In other words, the concentration of perfume will be approximately equal throughout the room and no **net** movement of perfume will occur from one area to the other.

Diffusion is how most materials move into and out of a cell. When there is more sugar outside of a cell, the sugar automatically moves into a cell — moving from high concentration to low concentration. When there is more water in a cell, then water automatically moves out of the cell

— moving from high concentration to low concentration. This movement of molecules does not

require any energy because it is an automatic process. We refer to this as **passive transport**

because it doesn’t cost the cell any energy.

Sometimes a cell needs to move material against this automatic direction of movement. They need to move materials from areas of low concentration to areas of higher concentration. This would be for materials that are very valuable to the cell, like sugars, that the cell would use to make energy. That would be like swimming upstream against the current, so it requires energy. The only way for cells to do this is to use energy to pump the material “upstream” across the cell membrane. We call this process, **active transport**, because it actively uses energy to move molecules either into or out of the cell. The energy that the cell uses is in the form called ATP. ATP is used to move material from areas of low concentration of that substance into regions of higher concentration.

In this lab, we will investigate diffusion of sugars, starches, water and other materials across a membrane.

**Pre Lab:**

1. **Read and summarize the introduction material; define at least 4 vocabulary words from the reading.**
2. **State the purpose of the lab and record your predictions about what what you believe will pass through the semi-permeable membrane and why.**
3. **Write out the procedures in your own words (you may do this in flow chart or diagram form where appropriate) don’t forget the indicator procedures.**
4. **Copy all three data tables into your lab book observations and results section.**
5. **Write down 3 safety practices that you should follow while completing this experiment.**

**A. CHEMICAL TESTING**

Before we start our actual experiment, we will perform a series of chemical tests to become familiar with our  **indicator solutions**. We will use these indicator solutions throughout this lab so we need to be sure they are working properly and to see what a positive and a negative results looks like for each indicator solution.

|  |  |
| --- | --- |
| **HOW TO**  **TEST FOR STARCH** | 1. 4 drops  **Lugol’s Iodine indicator +** 2ml of solution to be tested  2. Solution  **immediately** turns from amber to blue-black if starch is present |
| **HOW TO**  **TEST FOR GLUCOSE** | 1. 4 drops  **Benedict’s solution indicator** + 2 ml solution being tested 2. Heat test tube in a hot water bath (beaker with water on a hot plate) be sure test tube opening is pointed away from yourself and those around you   2. Solution turns from blue to bright orange when  **heated** if glucose is present |

Your teacher will demonstrate the proper way to use the indicators above, pay close attention to safety concerns especially when heating liquids in a test tube.

Copy Table 1 into your Lab book and record the color observed for each test

**TABLE 1. CHEMICAL TESTS**

|  |  |  |  |
| --- | --- | --- | --- |
| **INDICATOR** | **MATERIAL TESTED** | | |
| **WATER** | **STARCH**  **SOLUTION** | **GLUCOSE**  **SOLUTION** |
| **BENEDICT’S SOLUTION** |  |  |  |
| **IODINE SOLUTION** |  |  |  |

**B. DIFFUSION EXPERIMENT**

In this experiment, you will measure the diffusion of small molecules through dialysis tubing, an example of a  **semi-permeable membrane**. A semi-permeable membrane is a barrier that allows some materials through, but stops others. Small dissolved molecules and water molecules can move freely through a semi-permeable membrane, but larger molecules will pass through more slowly, or perhaps not at all. The size of the tiny pores in the dialysis tubing determines which substances can pass through the membrane. We will explore the process of diffusion through a semi-permeable membrane in this activity.

**PROCEDURE:**

1. Measure 20mL of the sugar-starch solution (15% glucose/1% starch solution).

2. Take a 30cm piece of 2.5cm dialysis tubing that has been soaking in water. Tie off one end of the tubing to form a bag.

3. Pour plain water into a 250mL beaker until it is about two-thirds full.

4. Add iodine to the water in the beaker. Add only enough iodine to turn the water a medium amber color.

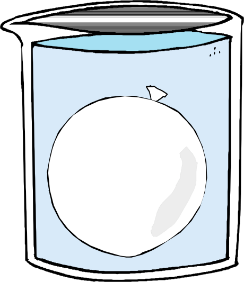
5. Now pour your sugar-starch solution into the dialysis bag.

Tie off the other end of the bag. Rinse off the model “cell” you just made by holding it under running water to remove any solution that may have spilled.

6. Place the “cell” in the beaker of iodine solution. Be sure the “cell” is covered. Set the beaker aside to sit undisturbed for 30 min.

7. Record your observations of the initial “cell” contents and colors in your data table. Draw and Label your INITIAL “cell” and the beaker contents in you lab book. Be sure to color the diagram and label water, glucose, starch and iodine locations.

8. What do you think will happen? Record your predictions in the table

**PROCEDURE Continued**

1. Carefully exam your beaker and the “cell”. It is now in its “**Final State**”

2. Record the final colors of the solution in the beaker and in the “cell” as a “**Final State**” diagram.

3. Use a pipette to transfer a 2mL sample of the solution from the beaker to a clean test tube. Test the solution for the presence of  **glucose** using Benedict’s solution (remember to heat it). Record the results

4. You do  ***not*** need to take a sample of the solution from the beaker to test for the presence of **starch**, because the iodine indicator is already in the beaker, so this already served as a test for starch. Record your results.

7. Compare your  **predictions** to your actual data. Any surprises? If so, discuss with the class.

8. Complete the **“Final State”** diagram in  **Figure 1** by labeling the contents of both the solution in the beaker and in the “cell”. Using arrows, be sure to indicate the movement of each of the materials involved. Glucose, Starch and Water.

Data and Observations

**TABLE 2. OBSERVATIONS & PREDICTIONS: CONTENTS**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Initial contents** | **1**  **Presence of Glucose** | | | **2**  **Presence of Starch** | | |  |
| **A Initial** | **B Predicted Final** | **C Final** | **A Initial** | **B Predicted Final** | **C Final** |
| **“Cell”** | **15%**  **glucose**  **1% starch** |  |  |  |  |  |  |
| **Beaker** | **H2O & Iodine** |  |  |  |  |  |  |

**TABLE 3. OBSERVATIONS & PREDICTIONS: COLOR OF SOLUTIONS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Initial contents** | **A Initial State** | **B**  **Predicted Final State** | **C**  **Final State** |
| **“Cell”** | **15% glucose**  **1% starch** |  |  |  |
| **Beaker** | **H2O & Iodine** |  |  |  |

**SUMMARY QUESTIONS**

1. Did glucose diffuse out of the cell? Explain how you can tell

2. Did starch diffuse out of the cell? Explain how you can tell.

3. What is the best explanation for the color change that occurred inside the “cell”?

4. Based on your tests, which substance(s) diffused through the dialysis “cell” membrane?

5. Based on your tests, which substance(s) did not diffuse through the dialysis “cell” membrane?

6. Explain why some substances were able to pass through the membrane while others were not able to.

7. Although we didn’t measure it, what other molecule can we assume also moved across the membrane?

8. How could we have accurately measured whether water moved into or out of the dialysis tubing “cell” in this experiment?

9. Why did the glucose flow out of the cell?

10. Why did the iodine flow into the cell?

11. What results would you expect if the experiment was set up incorrectly: the water and iodine solution was placed inside the dialysis bag and the starch and glucose solution was placed in the beaker.

12. Animals (including humans) often eat starches in the form of fruits and vegetables and breads and baked goods The starches are then digested into glucose in the small intestines. This is done by the enzyme amylase. The glucose then diffuses from the cells of the small intestines to the blood stream and is then transported from the digestive system by the blood through the body to all cells, so they can use it to make energy. Based on the findings of this lab, explain why the digestion of starch to glucose is necessary.

Conclusion: write a brief conclusion paragraph following the rubric you have been given

**Diffusion through a Membrane Lab Checklist** Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

preLab Period\_\_\_\_\_\_\_

\_\_\_\_\_(1)important information from the **introduction** contained in a brief summary.

\_\_\_\_\_(2) **4 vocabulary** words identified and defined( 0.5 points each)

\_\_\_\_\_(1)**title** at top of lab

\_\_\_\_\_(2)**purpose** of the lab clearly stated

\_\_\_\_\_(3)**predictions** with explanation**; glucose and starch** mentioned specifically.

\_\_\_\_\_(3)**procedures** clearly written and easy to follow.

Observations and results

\_\_\_\_\_ (1)table 1: chemical tests neatly written

\_\_\_\_\_ (1)table 1 results filled in correctly

\_\_\_\_\_ (1)table 2: contents clearly written

\_\_\_\_\_ (1)table 2 results filled in correctly

\_\_\_\_\_ (1)table 3: colors clearly written

\_\_\_\_\_ (1)table 3 results filled in correctly

\_\_\_\_\_ (1)Initial drawing **neat**

\_\_\_\_\_ (4)Initial drawing labelled with **glucose, iodine, starch, and H2O.**

\_\_\_\_\_ (1)Initial drawing **colored**

\_\_\_\_\_ (1)Final drawing **neat**

\_\_\_\_\_ (4)Final drawing labelled with **glucose, iodine, starch, and H2O**.

\_\_\_\_\_ (1)Final drawing **colored**

\_\_\_\_\_ (2)Final drawing has **arrows** indicating the movement of molecules

Conclusion

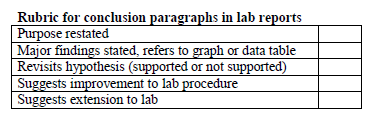
\_\_\_\_\_ (1)summary questions answered in **complete sentences** or questions written.

\_\_\_\_\_ (12) **Summary questions** answered correctly

1. \_\_\_ 2. \_\_\_ 3. \_\_\_\_ 4. \_\_\_\_ 5. \_\_\_\_ 6. \_\_\_\_\_

7. \_\_\_\_ 8. \_\_\_\_\_ 9. \_\_\_\_\_ 10. \_\_\_\_\_ 11. \_\_\_\_ 12. \_\_\_\_\_

\_\_\_\_\_ (5)**Conculsion** paragraph



Total points earned:\_\_\_\_\_\_\_\_/ 50 possible

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| --- |
| **VERIFICATION**  Graded By: (print name) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Date:  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  I verify that I assessed this lab report accurately and honestly, and only awarded points when clearly earned by the student whose lab book I was viewing. To the best of my knowledge, the score shown above is correct. I understand any points given in error can be taken from my lab points.  Signed:  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |