Introduction:

In this experiment, you will be assembling artificial cells and using them to investigate the movement of water across the cell membrane. Before completing the lab, you will observe a demonstration that will show how the artificial cell material works.

**Demo: Movement of Materials Across a Membrane**

In this activity, you will observe the diffusion of small particles across dialysis tubing, an example of a selectively permeable membrane. In the medical field, dialysis is used to remove toxins from a patient’s bloodstream. Small solute molecules and water molecules can move freely across this membrane, but larger particles will pass through more slowly, or not at all. The size of the small pores in the dialysis tubing determines which substances can pass through the membrane.

Procedure:

1. Obtain a 15 cm piece of dialysis tubing that has been soaked in water. Tie off one end of the tubing to form a bag. Rub the other end of the tubing to open the other end of the bag.

2. Place 10-15 mL of a solution containing starch and salt in the bag, then tie off the open end, leaving sufficient space for potential expansion of the bag. Rinse the tube in fresh water.

3. Place the tube in a beaker of water to which iodine has been added. Iodine will turn purple/black in the presence of starch.

4. After 10-15 minutes, observe the solutions in and outside of the bag.

5. Using silver nitrate, test the outside solution for the presence of salt. When silver iodide is added to a solution containing salt, the solution will become cloudy. Also test a small sample of the original solution that was put in the bag.

Data:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Solution: | Initial Contents | Initial color | Final Color | Test Result for starch | Test Result for salt |
| Inside Bag |  |  |  |  |  |
| Outside of Bag |  |  |  |  |  |

Discussion:

1. Was starch able to cross the membrane and leave the bag? Provide evidence for your answer.

2. Was salt able to cross the membrane and leave the bag? Provide evidence for your answer.

**Experiment: Movement of Water Across a Membrane**

Problem:

Can we determine the concentration of sucrose in an artificial cell?

Procedure: Day 1

1. Read the entire procedure and then divide the tasks between the group members.

2. Label four cups with the solution types listed in the data table.

3. Pour the appropriate solution into each cup until you reach the line marked on the side of the cup.

4. Obtain 4 pieces of dialysis tubing. All pieces should be close to the same size.

5. Tie one end of each piece of dialysis tubing as close to the end as possible.

6. Carefully pour 10 mL of simulated cytoplasm into one piece of dialysis tubing and tie off the open end. Repeat for the other 3 pieced of dialysis tubing. You now have 4 artificial cells, each filled with simulated cytoplasm.

7. Rinse each cell with tap water and pat dry on a paper towel.

8. Mass the first cell, record the mass in the data table, then place the cell in the cup labeled “water.” Repeat for the other three cells, placing one in each of the remaining solutions.

9. Let cups stand for one hour.

10. Remove the cell from one cup. Gently pat it dry on a piece of paper towel, then mass it and record the mass in the data table.

11. Clean up.

Data:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | initial  mass | final  mass | change in  mass | % change  in mass  your group | % change  in mass  class ave. |
| water |  |  |  |  |  |
| 0.25 M |  |  |  |  |  |
| 0.50 M |  |  |  |  |  |
| 1.00 M |  |  |  |  |  |

Data Analysis

1. Calculate the percentage change in mass for each cell using the following equation:

X 100

2. Graph the solution concentration on the x axis and the percentage change in mass on the y axis. Use the following guidelines:

* Each axis uses at least 55% of the length of the graph paper in that direction.
* Each axis has a linear scale with equal divisions.
* Each axis is labeled, including units of measure.
* A line of best fit is drawn through the data points. It is a STRAIGHT line.

Questions:

1. a. Which solution or solutions had a positive % change?

b. Why?

2. a. Which solution or solutions had a negative % change?

b. Why?

3. Using your graph, determine the concentration of sugar that is isotonic to the artificial cell. This is the concentration that has zero percent change in mass.

Isotonic concentration = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. What happens to cells that are placed into each of the following types of solution? Include change in mass and direction of water movement in your response.

a. a hypotonic solution?

b. a hypertonic solution?

c. a isotonic solution?

5. In comparison to the artificial cell, which of your solutions was:

a. isotonic?

b. hypertonic?

c. hypotonic?

6. In your own words, what is osmosis?

7. CONCLUSION STATEMENT: What is the concentration of sucrose in the simulated cytoplasm and how do you know?

8. If a person drinks a very large amount of water in a short time, this may result in confusion, seizures, coma, or even death, due to abnormal functioning of nerve cells in the brain. Explain how these problems could result from drinking too much water too rapidly.

9. What do you think is the reason that a person who is stranded at sea should not drink ocean water? How could drinking salty water harm a person's cells?