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6/10/2021
Anatomy & Physiology I

Title: The Cell - Transport Mechanisms and Cell Permeability - Activity 3

Objective: Investigating Diffusion and Osmosis Through Nonliving Membranes

Purpose: Tracking the movement of water, glucose, sucrose, and NaCl within a dialysis tube and the surrounding solution.

Materials: 4 dialysis tubes, 4 beakers, 8 extra tubes (for additional testing), a tube rack, water, NaCl, Glucose, Sucrose, A water boiler with a separate beaker, a weight scale, Benedict's solution, and AgNO3, and a timer.

Methods: Prepare each dialysis tubing with 25mL of the initial concentration of the various materials. The ends must be tied off as to not leak any solution. The tubes should be dried off and labeled properly the according to beaker they will be submerged into. Prior to submerging the tubes, they need to have their weight recorded as their initial weight for the experiment. Similar to the four tubes, the four 250 mLbeakers also need to be prepared. Three with distilled water and one with glucose solution. Once the tubes and beakers are filled properly with the correct solutions and labeled 1 - 4, they can be submerged in their respective tubes. Once submerged, they are to be left alone for 45 minutes. After this time is up, the tubes need to be dried once more and weighed again for their final weight. These results are all recorded for further analysis. At this point, a beaker should be filled with distilled water and brought to a boil on a hot plate. The solutions from both the tubes and the beakers are going to placed in tubes. Some of the dialysis tube content will be empty into new tubes for testing which solutes are inside. These tubes will be labeled 1A, 2A, 3A, and 4A respectively. The same will happen to the beaker. Samples from each beaker into the test tubes of each respective beaker and labeled: 1B, 2B, 3B, and 4B. Those tubes examining the movement of glucose and sucrose will use Benedict's test and will be mixed and submerged into the boiling beaker to examine if a color change occurs from blue to yellowish-brown. AgNO3 will be administered to the solution containing NaCl. If positive, this will result in AgCl2 forming, which is a milky white precipitate.

Results:

Activity 3: Experimental Data on Diffusion and Osmosis Through Nonliving Membranes

Beaker and	Beaker Content	Dialysis Tube	Initial Weight	Final Weight	Weight Change	Beaker Fluid Test	Dialysis Tube Test

Tube #	(All Half Full)	all 20mL					
1	Distilled Water	40% Glucose	7.1 gm	8.0 gm	0.9 gm	Benedict's Test: Positive	Benedict's Test: Positive
2	Distilled Water 40% Glucose	40% Glucose	6.9 gm	6.9 gm	0.0 gm	Benedict's Test: Positive	Benedict's Test: Positive
3	Distilled Water	10% NaCl	7.2 gm	7.8 gm	0.6 gm	AgNO3 Test: Positive	AgNO3 Test: Positive
4	Distilled Water	40% Sucrose	7.1 gm	8.0 gm	0.9 gm	Benedict's Test: Negative	Benedict's Test: Positive

Conclusion:

The results of this experiment demonstrated the movement of both the solutes and water through the dialysis tube membrane. Through the process of diffusion, the solutes if they are small enough, travel from higher concentrations to lower concentrations. Water similarly does this through osmosis between the tube and the beaker. In trial one, with distilled water in the beaker and a 40% glucose solution in the tube, The tube gained 0.9 gm in weight. This illustrates that there was an influx of water into the tubing. By using the Benedict's test, it showed that glucose from the tube diffused across the membrane into the beaker. Both the beaker and solution inside the dialysis tube tested positive. This showed that after 45 minutes, glucose moved out into the beaker and water moved into it as they followed the concentration gradients.

The second trial has the same concentration of 40% glucose both inside the beaker and inside the dialysis tube. As they share the same concentration, they should have not had any drive for diffusion or osmosis from one side to the other. The lack of weight gain in the tube indicated that there was no movement of water in. Similarly, The results of the Benedict's test illustrated that both sides retained the glucose solution in both the beaker and the tube.

The third trial utilized a 10% NaCl solution within the dialysis tube in a beaker of distilled water. The final weight of the tube indicated that water flowed into the tube through osmosis since the weight went up by 0.6 gm. To indicate whether NaCl diffused through the membrane into the beaker, an AgNO3 test was performed. If AGNO3 meets with NaCL, AgCl will form and looks like a milky precipitate. Both the beaker and the tube tested positive for AgCl illustrating that NaCl diffused through the membrane into the beaker as well.

The fourth trial consisted of a dialysis tube with a 40% sucrose solution inside a beaker filled with distilled water. The final weight of this trial went up by 0.9 gm illustrating that water diffused into the tube because of the concentration gradient. A Benedict's test was used to confirm if any sucrose had diffused outside the dialysis tube. The Benedict test was positive for the presence of sucrose within the tube, but the beaker fluid had tested negative. Sucrose did not diffuse through the membrane.

This experiment is meant to illustrate the diffusion of solutes and osmosis similar to how cells do it in organisms. Cells use many different channels and energy to regulate themselves to maintain homeostasis. Unlike a cell, the dialysis tubing is not selectively permeable. It has pores that allow only certain molecules to pass based on the size of the molecule. Based on the results of this experiment, it became clear which molecules were too large to diffuse through despite a concentration gradient. Water, glucose, and NaCl were all able to pass through the membrane, while sucrose (a dimer) was too large. If the pores in the membrane we larger, it would have been able to cross and sucrose would have moved from the inside of the tube to the beaker.