Cell Structures: Selective Permeability of an Artificial Membrane

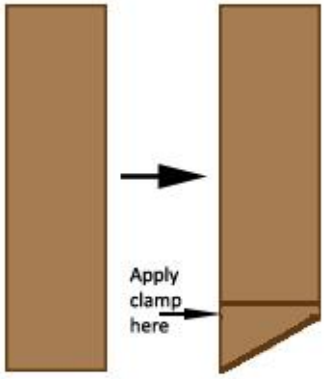
One of the plasma membrane's seminal characteristics is selective permeability. The membrane permits the passage of selected molecules while prohibiting the passage of others. This characteristic is not only essential to maintaining homeostasis, but to keeping the cell alive.

Dialysis tubing can serve as an artificial membrane. Dialysis tubing is a flat, very thin-walled tube made of either cellulose or from a polysulfone derivative. As the tubes are produced, the membrane is pierced to make molecular-sized holes. You can't see the holes, but they are there. Manufacturers make dialysis tubing with various sized holes to meet the needs of the customer. When dialysis tubing is purchased, it arrives as a dry tape which must be hydrated before use.

In this activity, you will be using starch ($glucose_n$) a large macromolecule, glucose a monosaccharide, and iodine to observe diffusion and selective permeability. Remember, diffusion is the process where molecules move from a region of high concentration to a region of lower concentration.

Materials

Dialysis tubing
Starch solution
Glucose solution
Iodine
Beaker – 250 mL
Beaker – 25 mL
Distilled water
Tubing clamps, string or dental floss
Graduated cylinder – 50 mL
Graduated cylinder – 15 mL
Funnel - optional
Pipette
Glucose test tape



1. Use the 50 mL graduated cylinder to acquire 20 mL of the starch solution from the supply bench. Use the 15 mL graduated cylinder to acquire 10 mL of glucose solution.
2. Pick up a piece of dialysis tubing, beaker and dialysis tubing clamps or string from the supply bench.
3. At your bench, use the string or tubing clamps to seal one end of the dialysis tubing. If using clamps, fold one corner of the tubing to make a triangle before applying the clamp.
4. Rub the top of the tubing between your fingers to open the tube.
5. Pour the starch and glucose solutions into the dialysis tubing. If a funnel is available, insert the end of the funnel just into the top of the tubing and pour in the glucose and starch.
6. Seal the top of the dialysis tubing with either tubing clamps or string. Rinse the outside of the dialysis tubing with water to remove any starch or glucose on the outside of the bag.
7. Add 175 mL of water to the 250 mL beaker. Add 5 drops of iodine to the beaker of water. The water in the beaker should be a yellow-brown color. Gently place the dialysis tubing into the beaker. If you observe purple color coming out of the dialysis tubing and into the beaker, remove the dialysis tubing and reseal the clamps. Pour out the water in the beaker and add fresh water and iodine. Place the dialysis tubing back in the beaker.
8. Allow the beaker and dialysis tubing to remain undisturbed for 20 minutes.

9. After 20 minutes, insert a pipette into the bottom of the beaker and remove a small sample of fluid from the beaker. Apply the sample to the glucose test tape. What is the result? Is glucose present? _____
10. What is the color of the solution in the dialysis bag? _____ What does this color indicate?

_____

Complete this table:

Molecule	Initial location (where was this molecule at the beginning of the experiment in the dialysis tubing or in the beaker)	Final location (where was this molecule after 20 minutes)	What is your evidence for the location of the molecule at the end of the experiment?
glucose			
iodine			
starch			

Complete this sentence by using the appropriate sign (<,> or =)

The molecular size of iodine is _____ the size of glucose which is _____ the size of starch.

How did your experiment demonstrate the relative sizes of these molecules? Hint: Which molecules diffused and which were retained by the dialysis tubing?

How did you demonstrate selective permeability?