

# Teacher Preparation Notes for Diffusion across a Selectively Permeable Membrane

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The experimental setup for this activity is very similar to the experimental setup for our activity, Investigating Osmosis (available at [http://serendip.brynmawr.edu/sci\\_edu/waldron/#osmosis](http://serendip.brynmawr.edu/sci_edu/waldron/#osmosis)). If your primary learning goal is an understanding of osmosis, we suggest that you use Investigating Osmosis and/or one of the demonstrations described on page 3.

Students should have a basic understanding of molecules and diffusion before beginning this activity.

## Teaching Points

- Each cell is enclosed by a selectively permeable membrane which regulates what gets into and out of the cell. (Selectively permeable membranes are also called semipermeable membranes.)
- Starch does not pass through the synthetic membrane because starch molecules are too large to fit through the pores of the dialysis tubing. In contrast, glucose, iodine and water molecules are small enough to pass through the membrane.
- Diffusion results from the random motion of molecules. Diffusion moves substances from regions of higher concentration to regions of lower concentration.
- Diffusion of water across a selectively permeable membrane is called osmosis; osmosis results in net movement of water from a solution with a high concentration of free water molecules (low concentration of solutes) to a solution with a low concentration of free water molecules (high concentration of solutes).

## Equipment and Supplies

200 ml beaker or container (1 per group)

15% Glucose solution (about 4 ml per group)

(Glucose may be sold as Dextrose, can be found online, in the pharmacy often times in tablet form, or sometimes in a cake decorating supply store (e.g. Joann's))

1% Starch solution, Corn or Potato (about 4 ml per group)

1" Dialysis Tubing (15 cm per group)\*

String (2 6" pieces per group)

Iodine-Potassium Iodide Solution (IKI) (0.2 mL per group)\*

Transfer pipets (3-5 per class)

Diastix glucose test strips (1 per group)\*

Graduated cylinder, scale or ruler\*\*

Paper Towels (several per group)

## \* Purchasing Information

Iodine-Potassium Iodide Solution 86-9055 from Carolina Biological [www.carolina.com](http://www.carolina.com) \$7.50 for 500 mL (alternatively you can purchase Iodine Tincture or Povidone-Iodine through your local pharmacy)

Glucose test strips from [www.testyourselfathome.com](http://www.testyourselfathome.com) - \$4.95/100 strips

1" Dialysis Tubing from Connecticut Valley Biological - 10 feet \$ 4.95 or 100 feet \$39.95

\*\* Students can measure diffusion of water into (or out of) the dialysis tube by measuring change in the volume of solution in the tube, change in the weight of the solution in the tube, or change in the volume of solution in the beaker. A reasonable measure of change in volume in the tube is

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<sup>1</sup> These teacher preparation notes and the related student handout are available at [http://serendip.brynmawr.edu/sci\\_edu/waldron](http://serendip.brynmawr.edu/sci_edu/waldron).

change in the length of the part of the dialysis tube which is filled with solution (which should be approximately 5-10 mm change in 10-20 minutes). For measures of change in weight, you can expect changes of approximately 0.5-1.0 g in 10-20 minutes; the outside of the tube and the string should be as dry as possible for both weighings. To measure the relatively small change in the volume of water in the beaker outside the dialysis tube, students will need to use a graduated cylinder.

### **Preparation before Class**

- Prepare 15% glucose solution by dissolving 15 g glucose for every 85 ml of water.
- To prepare 1% starch solution, add 1 g of corn starch or potato starch to every 99 mL of cold water. Bring the mixture to a full boil and allow time to cool. Starch is insoluble in cold water and needs to be boiled to stay in solution. This can be done in a microwave.
- Cut the dialysis tubing into 15 cm lengths. To expedite the activity we suggest that you have the pieces of dialysis tubing soaking at the beginning of the period. We suggest that you also pre-cut the 6 inch pieces of string. Instead of using string, you may provide students with longer pieces of dialysis tubing and have them tie knots in the tubing.

### **Teaching Information**

In order to complete the hands-on portion of the activity in a 45-50 minute period, you probably will want to have your students complete the questions on page 1 and the top of page 2 on the day before the hands-on activity.

After filling and tying their dialysis tubes students need to rinse the tubes in fresh water to remove any spilled starch and glucose from the outside. They need to make especially sure to squeeze out the excess liquid from the strings which tie the tubes closed. To contribute to more accurate results the students may also want to trim the strings as short as possible once the knots have been tied. If you do not have a sink, a series of large containers of water will work.

The Iodine-Potassium Iodide Solution is used as an indicator for the presence of starch. Iodine ( $I_2$ ) is relatively insoluble in water so potassium iodide (KI) is added to the solution. Iodine ions ( $I_3^-$ ), which are soluble in water, are then formed. When iodine ions and starch are in the same solution the iodine ions get bound up in the beta amylose coils of the starch. This is what causes the color change of starch from white/clear to blue. This binding also removes the iodine ions from solution. Therefore, students will see the brown tinted water in the beaker get continually lighter throughout the activity as the iodine ions continually diffuse into the dialysis tubing and become bound up.

In the second part of the diagram in Diffusion Question 3 (on page 5 of the student handout), the arrows represent diffusion of free water molecules across the selectively permeable (semipermeable) membrane. Students should understand that there is a net diffusion of water into the right beaker because the rate of flow is higher in the direction from high to low concentration of free water molecules and the concentration of free water molecules is lower where the concentration of solutes is higher. This illustrates how diffusion moves substances down a concentration gradient, from regions of higher concentration to regions of lower concentration.

## **Demonstrations of Osmosis**

You may want to enhance student learning about osmosis by including one or both of the following demonstrations of osmosis. If your primary learning goal is an understanding of osmosis, we suggest that use our activity, Investigating Osmosis.

The demonstration of osmosis in this activity can be supplemented by a demonstration of osmosis using chicken eggs. Have students place raw eggs in a container of vinegar. Within 24 hours the shell will dissolve leaving the inner membranes intact. Have students gently remove the egg from the vinegar and gently wash off the egg shell remnants. The students can then experiment by placing the egg in solutions with different osmotic potentials (such as water or corn syrup) and observe changes in the weight or volume of the egg.

If you have microscopes available, you can demonstrate the effects of osmosis in the cells of Elodea (sometimes called Anacharis; available in fish stores). Cells can be observed in both a hypotonic solution (water) and a hypertonic solution (concentrated salt water). In the hypertonic solution water will diffuse out of the Elodea cells and into the surrounding solution; it is easy to observe the cell membrane pull away from the cell wall as the cell loses water (called plasmolysis).