Standard Indicator
7.7.3

Sugar Solutions

Purpose

Students will describe how physical and biological systems tend to change until they reach equilibrium and remain that way unless their surroundings change.

Materials

For each student: copy of Black Line Master (BLM) *Osmosis Lab,* science journal, pencil
For each group of students: 3 cellulose bags, 500 ml beaker, 4-250 ml beakers, lab tape, paper towels, sugar, water, spatula, balance

Activity

A. Pre-Activity Preparation

Set up stations around the room with all of the group materials.

B. Pre-Activity Discussion

1. Discuss the terms *diffusion* and *osmosis* with students. Explain that diffusion is the passive movement of particles from high concentration to low concentration and that osmosis is a special case of diffusion where water molecules diffuse across a selectively permeable membrane.
2. Show students a cellulose bag, and explain that the bag is made of a semi-permeable substance. Explain that plastic bags and umbrellas are impermeable and ask students to explain what *semi-permeable* means. Tell students that cells are surrounded by a cell membrane similar to that of the cellulose bag.
3. Explain that some small molecules, such as water, can move through the semi-permeable membrane (in and out of the cell) but that larger molecules cannot pass through the membrane.
4. Discuss how living things are made of cells, which normally contain dissolved materials and are approximately 80 percent water. Ask students: "If the solution outside of the cell also contains 80 percent water, would you expect water to diffuse into or out of the cell?"
5. Make sure students understand that once *equilibrium* is reached, there will still be movement of solution across the membrane; however, there will be no net change.

C. Sugar Solutions

1. Divide students into groups and distribute the BLM *Osmosis Lab*.

(continued)

connecting across the curriculum

Mathematics
Have students calculate concentrations of the solutions they prepared as percentages.

MEETING INDIVIDUAL NEEDS

For students who are having difficulty understanding the concepts, draw diagrams showing what happens to the water in each scenario presented in the lab.

Standards Links
7.2.6, 7.4.5

Activity (continued)

2. Ask students to make predictions about their results and have them record their predictions in their science journals.
3. Instruct students to begin working on the lab.
4. Discuss with students whether the percentage of water is greater inside or outside each of the three bags and how osmosis might act to equalize the concentrations on both sides of the membrane.

D. The Results

1. The next day, allow students to inspect the results of the lab.
2. After students have completed their observations, ask: “Did you observe changes in any of the bags? Why do you think those changes occurred?”
3. Discuss how the environment inside and outside of the bag in Beaker A was the same, creating a balance, or equilibrium.
4. Discuss the results from Beakers B and C with students.
5. Explain that water moved, through osmosis, to the area of lower concentration until the concentrations of water were the same on both sides of the membrane, and the system was in equilibrium.
6. Ask students if they would expect the masses of the bags to continue to change if they were left for another night. Explain that if the concentration of water has become equal on both sides of the membrane, then the system is in equilibrium and the amount of water in the bag will not change.
7. Ask students if their fingers have ever become “pruny.”
8. Ask students if they can think of a reason, related to osmosis and equilibrium, why this might occur.
9. Discuss how our bodies are made of millions of cells, and when the cells are exposed to different environments, such as bathing water, the cells’ equilibrium state is changed. Discuss how osmosis takes place, making the skin look shriveled.
10. Discuss how biological and physical systems tend to change until they reach equilibrium and remain that way unless their surroundings change.
11. Have students brainstorm other examples where this might occur.

Classroom Assessment

Basic Concepts and Processes

At the end of the activity, ask questions, such as the following:

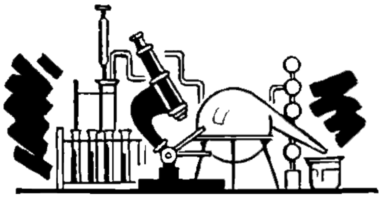
What is one way cells are in equilibrium?

How does a cell reach equilibrium?

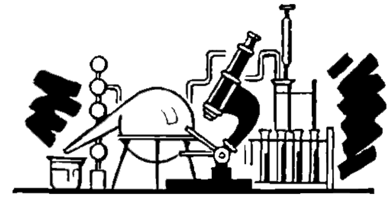
How do you know?

How does this lab relate to a cell’s equilibrium state?

Name: ____________________



Osmosis Lab



Osmosis Lab Procedure:
Record all measurements, data, and observations in your science journal.

Instructions:

1. Place a piece of lab tape on each small beaker and label them A, B, and C.
2. Label three paper towels 1, 2, and 3.
3. In your large 500 ml beaker, mix 45 g of sugar with 450 ml of water. Stir until the sugar has dissolved.
4. Add 150 ml of the sugar solution to both beaker A and beaker C.
5. Add 150 ml of water to beaker B.
6. Pour 75 ml of sugar solution into each of two cellulose bags. Seal the bags. Put one on paper towel 1 and the second on paper towel 2.
7. Pour 75 ml of water into the third cellulose bag. Seal the bag and place it on paper towel 3.
8. One at a time, mass the bags and record the initial masses in the table below.
9. Place bag 1 into beaker A.
10. Place bag 2 into beaker B.
11. Place bag 3 into beaker C.
12. Leave the bags in the beakers overnight. After 24 hours, remove each bag and take the mass of each. Record the final masses in the table below.

	Treatment	Initial Mass (g) of Bag	Final Mass (g) of Bag	Did Water Enter or Leave the Bag? (Net Change)
A	Beaker: Sugar Solution Bag: Sugar Solution			
B	Beaker: Water Bag: Sugar Solution			
C	Beaker: Sugar Solution Bag: Water			