Osmosis, Diffusion, and Active Transport

Strand Cellular Organization

Topic Investigating processes used to maintain homeostasis

Primary SOL LS.3 The student will investigate and understand that living things show patterns of cellular organization. Key concepts include
b) patterns of cellular organization and their relationship to life processes in living things.

Related SOL LS.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which
a) data are organized into tables showing repeated trials and means;
g) variables are controlled to test hypotheses, and trials are repeated;
j) current applications are used to reinforce life science concepts.

LS.2 The student will investigate and understand that all living things are composed of cells. Key concepts include
a) cell structure and organelles.

Background Information

Homeostasis is the result of the processes that living things use to maintain a constant internal environment as the external environment changes. Explain to students that if a cell was like an impermeable bag, practically nothing would be able to enter or exit the cell. Sitting inside such a cell would be like sitting in a sealed house without doors or windows; nothing could come in or go out.

Materials

- Popcorn
- Electric fan
- Beakers
- Water
- Food coloring
- Eggs
- White vinegar
- Salt
- The Osmosis Egg-speriment (attached)
- Electronic balance scale
- Measuring tape

Vocabulary

active transport, diffusion, energy, homeostasis, osmosis, passive transport, permeable membrane, semi-permeable membrane

Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

Diffusion and Active Transport Demo

1. Begin the activity with a demonstration of diffusion. Place a bag of freshly popped popcorn at the back of the room, and time how long it takes for the aroma of the popcorn to reach a small group of students located in the front of the room. Discuss the movement of the aroma in terms of which students are exposed to the smell first. Also discuss the variation in the intensity of the smell by comparing the aroma enjoyed by students sitting closest to the bag to that experienced by students sitting furthest away from the bag.
2. To demonstrate active transport, ask students how to speed up the movement of the popcorn aroma. Discuss student responses. Place a fan near the bag of popcorn, and turn the fan on. Ask students how this would affect the movement of the air molecules. Ask, "If the fan had been on as soon as the bag came into the room would it have taken as long for the smell to reach the seats furthest from the bag? Would this help move the smell out of the room so that other classes don't get jealous of our class eating popcorn and not sharing?" The fan represents the use of energy to move materials from one area to another, just as cells occasionally need to use energy to move materials across a cell membrane.

Diffusion Student Experiment

1. Give each group of students a large beaker. Fill the container with water, let the water become still, and then place a few drops of food coloring on the surface. The color must be very intense to ensure that it will be visible at the end of the demonstration. Have students record their observations after set intervals of time and describe the process of diffusion as seen in their setup. Hold a class discussion of students' observations.

Osmosis Demonstration

1. Remind students that osmosis is the diffusion of water molecules through a membrane. Point out to students that a cell and an egg are similar in that both need to control what substances move through their membrane and shell. Have students observe what happens when an uncooked egg is soaked in different solutions. Conducting three trials will ensure reliable results. Begin by measuring each egg's mass and circumference and recording the results in the data chart. Soak the eggs in vinegar for 24 hours, and record results. Next, soak the eggs in water for 24 hours, and record results. Finally, soak the eggs in salt water for 24 hours, and record results. Discuss student observations and explanations about what happened to the egg at each stage of the experiment.

Assessment

- **Questions**
  - What did you notice as the food coloring moved through the water in terms of time and direction?
  - How did the size of the egg change during the experiment? Did the size of the egg always increase or decrease?

  - During the process of osmosis, can water move in only one direction? How do you know?
- **Journal/Writing Prompts**
  - Stirring the food coloring into the water would be an example of active transport. Explain how energy would be used to do this.
  - List an example of when you have noticed diffusion at your own home. Describe how far and in what direction the particles moved.
  - Explain why an egg can be used to represent a cell's life processes. Do you feel this is an accurate representation? What other substance(s) could be used to demonstrate the process of either osmosis or diffusion?

Extensions and Connections (for all students)

- At the end of the structured experiment, have students submerge the eggs in a solution of their choice. Each student develops a hypothesis predicting how the solution will affect the size, shape, and other properties of the egg. After completing the experiment, discuss how the different solutions changed the appearance of the egg, and explain the process that occurred.

Strategies for Differentiation

- Have groups design their own experiments and record data that accurately depict the process of osmosis, diffusion, or active transport.
- Use another example to demonstrate osmosis. Mix cornstarch and water inside zip-top bag, and submerge the bag into a beaker filled with an iodine-and-water solution. Within 20–30 minutes students will observe iodine moving through the semi-permeable membrane.
- Have students complete an online Web quest to identify the differences between active and passive transport.

The Osmosis Egg-speriment

Name: _____ **Date:** _____

	Trial 1 Mass (g) & Circ. (cm)	Trial 2 Mass (g) & Circ. (cm)	Trial 3 Mass (g) & Circ. (cm)	Average (MEAN) Mass (g) & Circ. (cm)	Important notes
Normal Egg					
After 24 hrs in VINEGAR					
After 24 hrs in WATER					
After 24 hrs in SALT WATER					

Independent Variable_____ Dependent Variable_____

Hypotheses

24 hrs. in vinegar _____

24 hrs. in water _____

24 hrs. in salt water _____

Were your hypotheses accurate? Explain.

24 hrs. in vinegar _____

24 hrs. in water _____

24 hrs. in salt water _____