I Hear You Knocking But You Can't Come In

Lori Hypes

OVERVIEW: Cellular Transport. This lesson will feature use of the Flex Cam as it relates with any subject in the classroom setting. The Flex Cam is the perfect camera and microphone for all video conferencing systems that use standard video-in and line-level audio. This lesson centers on how substances move in and out of the cell membrane. Students will investigate and understand that cells have certain functions and processes that must be carried out in order to meet the basic needs of an organism. Diffusion, osmosis and active transport will be explored.

GRADE LEVELS: 6^{th} – 8^{th} grade

TIME ALLOTMENT: 3 – 45 minute blocks

SUBJECT MATTER: Science

LEARNING OBJECTIVES:

Students will be able to:

- Define diffusion as the movement of molecules from an area of greater concentration to an area of lesser concentration.
- Describe osmosis as the diffusion of water across a cell membrane.
- Describe active transport as the movement of materials from an area of low concentration to an area of high concentration.
- Differentiate the cellular processes of diffusion, osmosis, and active transport.

STANDARDS:

State Standards:
The objectives listed may be used in part to address the Virginia Standards of Learning at http://pen.k12.va.us

- The student will investigate and understand that organisms perform life processes that are essential for the survival and perpetuation of the species. VA SOL Science 6.8
- The student will investigate and understand that living things show patterns of cellular organization. VA SOL LS.3
- The student will investigate the processes of cells (cellular transport) VA SOL LS.3
- The student will use wide-area networks and modem-delivered services to access and retrieve information form electronic databases. (VA. SOL Computer/Technology C/T 8.4)

MEDIA COMPONENTS:
Video: Microorganisms Series: #2, Cell Processes

Web Site: http://www.bbc.co.uk/education/asguru/biology

Then choose BBC – ASGuru – Biology

At this site students can see three animated graphics on diffusion, osmosis and active transport. They will be responsible for analyzing the graphics distinguishing between diffusion, osmosis and active transport.

MATERIALS:

- Television
- VCR with remote control
- Video: Microorganisms Series: #102 Cell Processes
- Computer
- Flex Cam
- (1) 1000 ml beakers or quart mason jars
- Clear Karo syrup
- (1) egg per group with shell dissolved (see directions in "Prep for Teachers")
- (6) 11" balloons (clear or light colored)
- "Needle Thru Balloon" trick (see "Prep for Teachers")
- Dark food coloring (one per group)
- Three-In-One oil (to oil cloth)
- Iodine
- 12" x 12" piece of cotton cloth
- (10) clear 10 oz. Plastic cups
- (1) sandwich baggie
- (1) Tbsp. cornstarch
- Video Lab Sheet
- Web Site Instructions Sheet
- Experiment Lab Sheet

PREPARATION FOR TEACHERS:

- ✓ Prior to teaching the unit, bookmark the Web sites.
- ✓ Cue your videotape for the correct starting point.
- ✓ Photocopy all student handouts for distribution as needed during the lesson.
- ✓ Practice the balloon trick several times with the brand of balloons you are going to use. (18" needle and balloon may be ordered from The Magician's Magic Shop, 2768 Columbia Road, Gordonsville, VA 22942 540-832-0900.) Approximate cost: $12.00. The trick includes about six clear balloons, but I have found that any quality balloon that you purchase at a department store works well. *If the balloon breaks during the trick, remind the students of the tremendous concentration necessary to do this trick. This will make the trick seem more impressive. Inflate another balloon and repeat.*

- ✓ Make sure you go through the instructions from the student materials handouts to make certain that you understand and are familiar with the lesson format and what the students need to do or understand for the lesson.
- ✓ When using media, always provide the students with a **Focus for Media Interaction**, which is a specific task to complete during or after viewing video segments, Web sites, or other media material.
- ✓ Two days before the lab activities, place eggs in vinegar to remove the shell but leave the membrane intact.

- ✓ Prior to this lesson, students should have been introduced to the following:

- Cell structure and organelles (cell membrane, cell wall, cytoplasm, vacuole, mitochondrion, endoplasmic reticulum, nucleus and chloroplast)
- Similarities and differences between plant and animal cells
- Development of cell theory
- Cellular organization: Cells, tissues, organs, and systems
- Definition of the word "solute"

INTRODUCTORY ACTIVITY: SETTING THE STAGE

1. As soon as students are seated say, "I'm going to try and pass this needle through a balloon without breaking it."
2. Have a student blow up an 11-inch balloon. Only inflate the balloon to about 9-10 inches. Watch the student, and when the balloon reaches the appropriate size, have him/her stop and tie it off.
3. Oil a cloth with Three-In-One oil before students enter the room. Thread the needle with the ribbon that was included in the kit. When you are "cleaning" the needle with the oiled cloth, don't say anything. The students will draw their own conclusions.
4. Insert the needle right into the edge of the dimple in the center of the balloon. Push it through the thick spot around the neck of the balloon and stop. Allow the students to make brief comments. Lead them into a discussion on how the needle can pass through the balloon's membrane without breaking it. (Example questions: How do you think the needle passed through the balloon's membrane without bursting? Can just anything pass through the balloon's membrane without bursting it? What characteristics of the balloon's membrane allow the needle to pass through?) Accept reasonable answers that pertain to selective permeability.
5. Carefully push the needle right on through the balloon.
6. Toss the balloon in the air, and pop it by striking it with the needle. Say, "There is nothing more fragile than a balloon. What you just witnessed is a very good example of what we are going to be studying today."

LEARNING ACTIVITIES

1. Give each student the Video Lab Sheet to record information. Provide the students with a **Focus for Media Interaction** by saying, "Students, I'm going to show a segment of a video that demonstrates how a cell membrane allows substances to pass through the membrane without

destroying it. After watching this first clip, I want you to answer these two questions: 1. What does the term "selective permeability" mean? 2. How is this process demonstrated on the video?" **Start** Microorganisms Series #2 Cell Processes, where the words "Selective Permeability" are shown on the screen for the first time. **Pause** after the narrator says the words "selective permeability" and the words are seen on the screen again. **Ask**, "What does the term "selective permeability" mean? (Some materials are allowed to pass through the membrane, while others are not.) "How was this process demonstrated on the video?" (Rocks and sand were poured into a mesh bag. The rocks were too big to exit the bag. The sand easily exits through the openings.)

2. **Focus for Media Interaction**: Say, "During this next clip, I want you to answer the question that appears on the screen. The question is: What will happen when we drop this food coloring into this beaker of water? **Resume** the video and **Pause** after the narrator reads the question that is on the screen. **Ask**, "What do you think will happen to the food coloring?" (Answers will vary.) **Resume** and **Pause** after the narrator says the word "Diffusion" and it appears on the screen. **Ask**, "What happened to the food coloring?" (The food coloring diffuses throughout the container until all the water is colored.)

3. **Focus for Media Interaction:** Say, "When this next clip is over, I want you to answer two questions: 1.What is the definition of *diffusion*? 2.Why is diffusion important to the cells?" **Resume** and **Stop** when you hear "…in and out of the cell." and when you see a single-celled organism on the screen. **Ask**, **"**What is the definition of diffusion? (Diffusion is the movement of molecules from an area of greater concentration to an area of lesser concentration.) *Have students write this definition on Video Lab Sheet.* Ask, "Why is *diffusion* important to cells?" (It is the driving force behind the movement of substances in and out of the cell.)

4. **Focus for Media Interaction**: Say, "In this next clip I want you to be able to tell me where the highest concentration of food molecules is and what happens to them. **Resume** and **Pause** when narrator says "…some molecules to pass through." **Ask**, "Where was the highest concentration of food molecules and what happened to them?" (The higher concentration was outside the cell. The food molecules moved from outside the cell to inside the cell.)

5. **Focus for Media Interaction**: Say, "I want you to watch this next segment and be able to give a definition for o*smosis*." **Resume** and **Pause** when you hear "…across a cell membrane." and you see the word *Osmosis*. **Ask**, "What is osmosis? (When water flows from an area of higher concentration to an area of lower concentration. Osmosis is the diffusion of water across a cell membrane.) *Have students write this definition on Video Lab Sheet.*

6. **Focus for Media Interaction:** Say, "In this next clip, the narrator is going to give you an example of osmosis in a cell. When the segment is over I want you to tell me what happened to the cell and why. **Resume** and P**ause** when you hear " …causing this cell to shrink." just after the blue arrows appear on the screen. **Ask**, "What happened to the cell and why?" (There is a lower concentration of pure water outside the cell than inside the cell. Therefore, water flows from inside the cell to the outside, causing the cell to shrink.)

7. **Focus for Media Interaction**: Say, "Watch this next segment and be able to explain what active transport is." **Resume** and **Pause** when you hear "This is called active transport." and words

Active Transport appear on the screen. **Ask**, "What is active transport?" (When materials move from an area of low concentration to an area of high concentration.) *Have students write this definition on Video Lab Sheet.*

8. **Focus for Media Interaction**: Say, "In this last clip, what example is given to demonstrate active transport? Does it require energy?" **Resume** and **Stop** the video at the end of this segment when you hear "…you would have to use a great deal of energy." and the boy is peddling the bike up the hill. **Ask**, "What example is given to demonstrate active transport?" (Boy riding a bicycle up hill.) Does it require energy? (Yes)

9. **Focus for Media Interaction**: Tell the students. "We are now going to use the computer to find out more about diffusion, osmosis and active transport. You have questions that are to be answered at the Web site. These questions will be evaluated for a grade." Have students work in groups of two. Pass out Web Site Instruction sheets. Say, "These pages have directions for the Web site that you will be accessing. Be sure to follow the directions on the worksheet and not those found at the Web site."

Web Site Instructions
The teacher will assist the students as they work their way through the Web Site Instruction sheet.

1. After accessing web site, choose "Pathways Into and Out of the Cell" under the heading "Cells".

2. Scroll down to the three bullets, and choose "simple diffusion".

3. Look at the animated graphic. There are molecules moving.

4. In which direction are these molecules moving? *In both directions across the cell membrane.*

5. How does this meet the definition of diffusion? *The concentration of molecules in a cell can change over time; therefore, molecules will move from an area of higher concentration to an area of lower concentration.*

6. Scroll down the page and choose "osmosis."

7. Read the passage above the graphic and analyze it.

8. What do the red molecules represent? _*Solute* __

9. What is a solute? *A substance dissolved in another substance, usually the component of a solution present in the lesser amount.*

10. What do the blue molecules represent? _*Water molecules* _____

11. Which way are the red molecules moving across the cell membrane? *They are not able to cross the cell membrane. It is selectively permeable.*

12. Explain your answer. _*The plasma membrane will not allow the molecules to cross the cell membrane.*

13. Which way are the blue molecules moving across the cell membrane? *Both ways*

14. Explain your answer. _*Water molecules can pass through a partially permeable membrane either way.*

15. Osmosis is a special type of _d*iffusion*_

16. Osmosis can be defined as *water molecules that can pass through a partially permeable membrane from an area of higher concentration to an area of lower concentration.*

17. Scroll down to bottom of screen and choose "active transport."

18. Read the passage before the graphic and then analyze it.

19. Active transport can be defined as__*crossing the cell membrane using energy*

20. Which way are the brown molecules moving across the cell membrane?__*Both ways*

21. What does the "E" represent in the graphic? __*Energy*_

Have students turn in Web site Instruction sheet for evaluation..

CULMINATING ACTIVITY

The student will prepare and participate in four lab experiments that illustrate and distinguish between the three types of cell processes: diffusion, osmosis, and active transport.

Hook flex cam up to your TV. Set your VCR on "line" instead of a channel. Insert the yellow plug from the flex cam into the back of the VCR jack that says "video-in". Adjust the focus lens of the flex cam according to the activity.

Lab Procedure:

These activities demonstrate and differentiate between diffusion, osmosis and active transport. Tell the students, "You are going to differentiate between diffusion, osmosis and active transport by doing and observing several experiments."

1. Place students into groups of four. Give each student the Lab Procedure Instruction Sheet and the Experiment Lab Sheet.
2. Use flex cam for experiment 1. (The Iodine is toxic and gives off an unpleasant odor.)

3. Have students follow the Lab Procedures sheet and record their observations on the Experiment Lab Sheet as they complete the four experiments.

The teacher will assist the students as they work their way through this lab.

EXPERIMENT ONE

1. The teacher will mix one 1 TBSP of cornstarch with one cup of water and pour this solution into a baggie. Add 15 Ml of Iodine to 250 Ml of water. Place the baggie into the Iodine solution. (Watch the TV screen because this experiment will be done by using the Flex cam. The Iodine is toxic and gives off an unpleasant odor.) Sketch observations in diagram on Lab Sheet.

2. Hypothesis: Which way will the molecules move across the baggie (membrane)? Record on Lab Sheet.

3. Record your initial observations on lab sheet where it says "Experiment 1, Starch.". Draw the baggie inside the beaker.

4. Wait 15 minutes and record observations again. Sketch observations in diagram on Lab Sheet under second observation.

EXPERIMENT TWO

1. Question: Which has the higher concentration of water: the egg or the Karo syrup?

2. Hypothesis: Which way will the water molecules move across the egg membrane? Record on Lab Sheet.

3. Each group needs 1 cup, enough Karo syrup to cover the egg, and one egg.

4. Place egg in cup. Pour enough Karo syrup in the cup to cover the egg.

5. Record your initial observations on the lab sheet. Sketch observations in diagram on lab sheet where it says "Experiment 2, Egg."

6. Wait 15 minutes and record observations again. Sketch observations in diagram on lab sheet under second observation.

EXPERIMENT THREE

1. Hypothesis: What will happen if you place three drops of food coloring in a cup of water? Record on Lab Sheet.

2. Each group needs a clear plastic cup, food coloring, and water.

3. Fill cup with water. Add 3 drops of coloring.

4. Record your initial observations on the lab sheet that says "Experiment 3, Food Coloring." Sketch observations in the diagram.

5. Wait 15 minutes and record observations again. Sketch observations in diagram.

EXPERIMENT FOUR

1. While waiting on the other experiment to process, have half the students form a circle (cell membrane) by holding hands.

2. Put two-thirds of the students that are left inside the cell membrane (they are Potassium (K) and Calcium (Ca) molecules). The remaining one-third of the students are the same molecules outside the cell.

3. One at a time, the student "molecule" outside the cell says: "Little cell, Little cell, let me in"

4. The cell replies: "Not by *Diffusion*, not by *Osmosis* are you coming in. I hear you knocking but you can't come in."

5. The outside molecule says" Then if not by *Diffusion* and not by *Osmosis*, then I will come in by *Active Transport*. (The molecule then breaks through the cell membrane joining the others inside, expending energy to get inside the cell.)

6. On lab sheet where it says "Experiment 4, Circle" have students fill in the circle with five Potassium (K) molecules and five Calcium (Ca) molecules. Place three K and three Ca molecules outside the circle.

7. In the circle under second observation have students draw six K molecules and six Ca molecules inside the circle. Place two K and two Ca molecules outside the circle.

ASSESSMENT

- Video Lab Sheet evaluated
- Web Site sheet evaluated
- Experiment Lab Sheet Evaluated
- Quiz on three types of cellular transport

CROSS-CURRICULAR EXTENSIONS

Art:
Students can sketch scientific drawings to illustrate the concepts of diffusion, osmosis, and active transport.

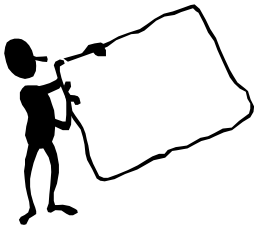
Science:
Explore the various systems of the body which are dependent upon these processes of diffusion, osmosis, and active transport.

Language Arts:
Students can write a short story about scientists who become tiny and use a small vehicle to actually go inside a cell via diffusion, osmosis, or active transport.

COMMUNITY CONNECTIONS

- Local medical personnel could explain and demonstrate how these processes affect actual medical situations.
- Agricultural extension agent who could review the effects of these processes on crops and forestry management, which in turn can effect the production of livestock and other food sources.
- Environmental Protection Agency personnel could outline an emergency management or evacuation policy in regard to hazards chemical spills.

Video Lab Sheet Key



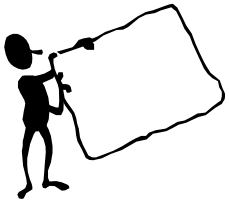
1. Record a working definition for diffusion. *Diffusion is the movement of molecules from an area of greater concentration to an area of lesser concentration.*

2. Record a working definition for osmosis. *Water flows from an area of higher concentration to an area of lower concentration. Osmosis is the diffusion of water across a cell membrane.*

3. Record a working definition for active transport. *When molecules move from an area of low concentration to an area of high concentration using energy.*

Note: These definitions will be needed in order to complete web site activity and the experiments later on in this lesson.

Video Lab Sheet



1. Record a working definition for diffusion. _____

_____

2. Record a working definition for osmosis. _____

_____

3. Record a working definition for active transport. _____

_____

Note: These definitions will be needed in order to complete web site activity and the experiments later on in this lesson.

Web Site Instructions

Diffusion, Osmosis and Active Transport Activity

1. After accessing web site, choose “Pathways Into and Out of the Cell” under the heading Cells.

2. Scroll down to the three bullets, and choose “simple diffusion”.

3. Look at the animated graphic. There are molecules moving.

4. In which direction are these molecules moving?_____

_____

5. How does this meet the definition of diffusion?

_____

_____

6. Scroll down the page and choose “osmosis.”

7. Read the passage above the graphic and analyze it.

8. What do the red molecules represent? _____

9. What is a solute? _____

10. What do the blue molecules represent? _____

11. Which way are the red molecules moving across the cell membrane? _____

12. Explain your answer. _____

_____

13. Which way are the blue molecules moving across the cell membrane? _____

14. Explain your answer. _____

_____

15. Osmosis is a special type of _____

16. Osmosis can be defined as _____

_____

17. Scroll down to bottom of screen and choose “active transport”.

18. Read the passage before the graphic and then analyze it.

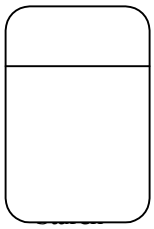
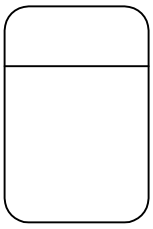
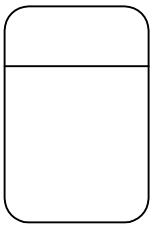
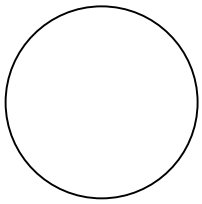
19. Active transport can be defined as_____

_____

20. Which way are the brown molecules moving across the cell membrane?_____

21. What does the “E” represent in the graphic? _____

EXPERIMENTAL LAB SHEET

Experiment 1	Experiment 2	Experiment 3	Experiment 4
			
Egg	Syrup	Food Coloring	Circle
_____	_____	_____	_____

Initial Observation (IO)

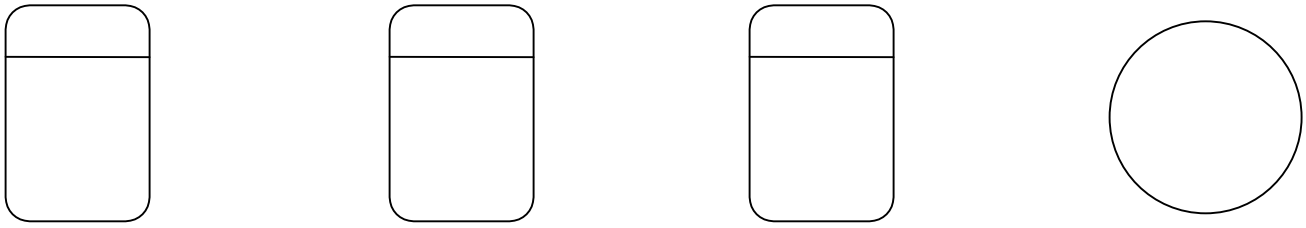
Exp. 1 *The student will write down his/her hypothesis. Students should observe that no visible change is seen. Draw the baggie inside the beaker and use shading to depict the different solutions in the diagram above.*

Exp. 2: *The student will write down his/her hypothesis. Students should observe that the egg membrane has expanded to capacity. When Karo syrup is poured over the egg no visible change is seen. Draw the egg inside the beaker.*

Exp. 3: *The student will write down his/her hypothesis. The molecules are very concentrated in the beaker and are moving very slowly. Students should draw a ribbon in the beaker of water to represent the food coloring. Use arrows to represent the direction the molecules are moving.*

Exp. 4 *The student will write down his/her hypothesis. A few molecules (students) are outside the cell. More molecules (students) are inside the cell. Draw more molecules in the circle than outside the circle.*

Second Observation (SO)



Exp. 1 *After 10 to 15 minutes, students should observe that the starch inside the baggie has started to turn blue-black close to the inside of the baggie. Draw the baggie inside the beaker in*
Why: *The baggie acts like a cell membrane. The baggie is selectively permeable and allows the iodine molecules to pass through and react with the starch molecules turning the solution black.*

Exp. 2: *After 10 minutes students should observe that the egg has shrunk and the syrup immediately surrounding the egg has a more liquid consistency. Draw this in the second diagram. Use arrows to show the direction of movement of the water molecules.*

Why: *There was a higher concentration of water inside the egg than outside the egg; therefore, the water molecules flowed from an area of higher concentration to an area of lower concentration.*

Exp. 3: *After 5 to 10 minutes, students should observe that the food coloring has moved (diffused) evenly to all parts of the beaker. In the second drawing they should color in the bottom half of the container. Use arrows to indicate movement in direction of the food coloring molecules.*
Why: *There was a higher concentration of food coloring in the droplets. Therefore, the food coloring molecules moved to areas of lower concentration.*

Exp. 4 *Students should observe that by using energy, molecules were able to cross the cell membrane from an area of lower concentration to an area of higher concentration.*