Research Experiences for Teachers (RET) – 2011
LESSON PLAN For Courtney Ricca

MODULE TOPIC:
Cell Transport and Solubility

RATIONALE:
This unit discusses the structure and function of the phospholipid bi-layer membrane of cells. The cell membrane separates a cell from its environment. Cell membranes possess both hydrophilic and hydrophobic properties which lead to selective permeability. The lipid tails allow for fluidity of the fluid mosaic model. Some molecules move freely across the cell membrane without the use of energy. This is known as diffusion (where molecules move from a high concentration to a low concentration). Polar and large molecules cannot penetrate the phospholipid bi-layer through the act of simple diffusion, they need to be aided by a carrier protein because of solubility rules and polar attractions. Passive and active transport are necessary for meeting a cell's necessary life

STANDARD(S) & INDICATOR(S):
5.1.12.B.1: Design investigations, collect evidence, analyze data, and evaluate evidence to determine measures of central tendencies, causal/correlational relationships, and anomalous data.
5.1.12.B.3 Revise predictions and explanations using evidence, and connect explanations/arguments to established scientific knowledge, models, and theories.
5.2.12.A.5 Describe the process by which solutes dissolve in solvents.
5.3.12.A.3 Predict a cell's response in a given set of environmental conditions.

OBJECTIVE(S):
Students Will Be Able To:
- **Explain** the importance of solubility in regards to meeting a cell's metabolic needs.
- **Distinguish** between diffusion and osmosis.
- **Predict** the movement of molecules through semi-permeable membranes.
- **Explain** how substances cross the cell membrane through facilitated diffusion.
- **Distinguish** between passive transport and active transport.
- **Explain** how water's polar nature affects its ability to dissolve substances citing observations made while creating home-made lava lamp.
- **Identify** the roles of solutes and solvents in solutions.
- **Identify** the correlation between surface area and volume as it applies to solubility, and cell transport.
- **Evaluate and Interpret** qualitative and quantitative data in a laboratory activity.

MATERIALS:
\Iodine
Beakers (1 per student)
Corn Starch
Sealable baggie
Food Coloring
Balance
Graduate Cylinder
Magnets

Half-Filled water bottle
Alka-Seltzer
Food Coloring
Vegetable Oil
Large Beaker for demonstration

LIST OF HANDOUTS (attach original copies of each handout - teacher & student edition)
2 Power Point presentations
Vocabulary List
Diffusion Lab

BACKGROUND INFORMATION:
This unit discusses the structure and function of the phospholipid bi-layer membrane of cells. The cell membrane separates a cell from its environment. Cell membranes possess both hydrophilic and hydrophobic properties which lead to selective permeability. The lipid tails allow for fluidity of the fluid mosaic model. Some molecules move freely across the cell membrane without the use of energy. This is known as diffusion (where molecules move from a high concentration to a low concentration). Polar and large molecules cannot penetrate the phospholipid bi-layer through the act of simple diffusion, they need to be aided by a carrier protein because of solubility rules and polar attractions. Passive and active transport are necessary for meeting a cell's necessary life functions.

Lessons and activities in this unit contain biomedical and chemical engineering topics such as particle suspension, applications of experimental and analytical techniques in living systems, food processing and processes of nature. Also covered in the unit is a description of the procedure used by engineers and scientists when designing an experiment with controls.

CLASSROOM ACTIVITY DESCRIPTION (LABORATORY/EXERCISES/PROBLEMS) including detailed procedures:
This module will be implemented to explain the process of transport in a cell, and later related to the holistic organism.

1. Students will incorporate the idea of polarity as it applies to transport. This will first be illustrated with the use of two sets of magnets. Showing that it is much more laborious to hold the larger magnets together when they repel one another to show how the body reacts with insoluble substances. This will be related to cellular absorption.
2. Students will be presented with a key concept power point of cell membrane structure and properties of water.
3. Lava Lamp Demonstration: Students will make observations and inferences about how making the "Lava Lamp" works. The students will Identify the materials used as polar or non-polar based on their observations.
4. Polarity activity: In this activity, students will first hypothesize what happens when six different substances (salt, sugar, flour, oil, food coloring, and regular ground coffee) are mixed with water. Students will then create their mixtures, make and record observations, and explain why some substances mix and others do not.
5. Once the activity is completed, students will be taught the process of cell transport
6. Transport across membranous structures: Active vs Passive Transport

- To introduce this lesson, students will be asked what they need to survive. Once food and water are mentioned, I will ask the students how their bodies actually use the food and water down to the cellular level
- Introduce the two types of Transport (Active and Passive)
- Explain Diffusion as it applies to getting into a classroom. (one student remains in the class while the rest stand in the doorway. First the singular student attempts to enter the hall against the class (Low concentration to high concentration, diffusion does not occur) Next, roles are reversed and students act out diffusion).
- Students will then be instructed on cell transport
- Next students will perform the iodine solution diffusion lab to illustrate the properties of diffusion as it applies to molecular size

SAMPLE QUESTIONS TO ELICIT CLASS DISCUSSION:

1. Explain diffusion.
2. Compare diffusion to osmosis.
3. What is the main difference between facilitated diffusion and simple diffusion?
4. What are indicators we use in our daily life?
5. Why don't doctors administer pure water into IV's when treating dehydration?
6. What are qualities a molecule has to have in order to pass a membrane through simple diffusion?
7. How does surface area to volume ratio affect cell efficiency?
8. Would a cell be more likely to absorb a small molecule or large? Explain.

HOMEWORK ACTIVITY/EXERCISES/PROBLEMS:

1. Students will complete a formal Lab write-up
2. Students will explain why the lava lamp experiment works
3. Students will answer section review questions
4. Students will work in pairs to explain why some substances mix and others do not. They will also work together to come up with ideas of how to mix the immiscible.

PARAMETERS TO EVALUATE STUDENT WORK PRODUCTS:

- One written paragraph to explain the importance of solubility in regards to meeting a cell's metabolic needs.
- One sentence to distinguish between diffusion and osmosis in.
- Use a diagram to explain how substances cross the cell membrane through facilitated diffusion.
- One written paragraph to distinguish between passive transport and active transport.
- A one paragraph journal write-up to explain how water's polar nature affects its ability to dissolve substances citing observations made while creating home-made lava lamp. Use one or two sentences to identify the roles of solutes and solvents in solutions.
- Identification of the correlation between surface area and volume as it applies to solubility, and cell transport.
- A written laboratory report that evaluates and Interprets data in a laboratory activity.
- Student responses to questions posed about the demonstration will be used to gauge understanding of polarity. Students will also be assessed through worksheets, and a formal lab write-up using the standard grading rubric and answer the extension questions using proper terminology and scientific principles.

How to make a Lava Lamp:

1. Add water to an empty water bottle about (Fill about ¼ of the bottle)
2. Add enough oil to reach the last ring on the bottle
3. Add five drops of food coloring
4. Add ½ an Alka-Seltzer tablet

Questions to ask:

Before adding food coloring:

- Why won't the oil and water mix?
- Do you think Food Coloring is polar or nonpolar? Why?
- Is the Alka-Seltzer polar or nonpolar? Why do you think that?

After adding the food coloring and antacid:

- Do you think Food Coloring is polar or nonpolar? How do you know?
- Is the AlkaSeltzer polar or nonpolar? How do you know?

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