DIFFUSION THROUGH A CELLULAR MEMBRANE

Performance Standard 12 A/11A.I

Students will apply the processes of scientific inquiry to analyze common and specific cellular organelles and functions accordingly:

- *Knowledge:* Know the concepts of diffusion, osmosis, permeability, equilibrium, hypotonic, hypertonic, and isotonic solutions and the direct connection to the semi-permeability of cell membranes.
- *Application:* Test osmosis using eggs with hypotonic and hypertonic solutions and relate the model of osmosis to human organ-systems.
- *Communication*: Analyze and report findings and a visual model of osmosis to explain osmotic changes in a human organ-system.

Procedures

1. ***In order to know and apply concepts that explain how living things function, adapt and change (12A), and the concepts, principles and processes of scientific inquiry (11A),*** students should experience sufficient learning opportunities to develop the following:
   - Formulate hypotheses based on foundational understanding of osmosis in living systems.
   - Reference pertinent research of osmosis in specific body systems.
   - Relate foundational knowledge of hypotonic, hypertonic, and isotonic solutions, equilibrium. diffusion and osmosis to investigation options.
   - Design investigation with appropriate variables and technology applications, and data-formatting procedures within classroom framework.
   - Conduct investigation following all procedural steps and safety precautions.
   - Analyze the change of mass in the samples to investigate osmosis in different solutions.
   - Construct a visual model to illustrate experimental results.
   - Report, display and defend the findings from investigation.
   - Explain how the model could apply to a human condition.
   - Reflect on comparable inquiry investigations of classmates for consolidation or refinement of procedures in subsequent investigations.

   Note to teacher: This activity relates to knowledge associated with standard 12A, while addressing the performance descriptors for stage I within standard 11A. Applying applicable principles of safety as directed in standard 13A are foundational.
2. Have students review and discuss the assessment task and how the rubric will be used to evaluate their work.
3. Provide each student with a copy of the "Diffusion through a Cellular Membrane" instruction/ application sheet. Supply the students with the listed materials.
4. Evaluate each student's work using the Science Rubric as follows and add the scores to determine the performance level:
   - *Knowledge:* The use of descriptive, scientific terms was accurate, illustrating understanding of the concepts of diffusion and osmosis in solutions of different concentrations. The hypothesis statement and rationale were complete and expressed understanding of the concepts.
   - *Application:* The investigation provided a good test of the hypothesis. The data collected was relevant. Drawings of the constructed model were correct. The application of the model to the human condition was accurate.
   - *Communication:* The data table was neat and organized. The conclusion summary was well organized, detailed, and thoroughly explained the analysis of data in relationship to the hypotheses. The visual model was clearly drawn and labeled. The application sheet was completed and showed adequate transfer of knowledge and application of the principles of osmosis to human organ-systems.

Examples of Student Work not available

Time Requirements

- Three class periods plus 1 week out-of-class

Resources

- Diffusion through a Cellular Membrane Instruction/Task Sheet
- Science Rubric
- Books/Internet for student research for applications
- Fresh Eggs (at least 2/group)
- Corn syrup
- Vinegar
- Balance
- 200 mL beakers (at least 2/group)
- 500 or 600 mL beakers (at least 2/group)
- Goggles

Diffusion Through A Cellular Membrane

The purpose of this activity is to help you construct a model of osmosis in a biological system. You will then apply your model to applications of osmosis in the human body.

Before beginning the activity, do background research to be sure you understand the following concepts: diffusion, osmosis, hypertonic, hypotonic, isotonic solutions, and equilibrium.

An egg is a large cell. Its shell may be removed by a chemical reaction with vinegar over a 12-24 hour period, leaving the egg enclosed only in its cell membrane. For this investigation, you will be supplied with the following materials:

2 raw eggs
2 cups vinegar
1 cup corn syrup
1 cup distilled water
beakers
electronic balance
goggles

Design an experiment to investigate osmosis in the egg cells in hypotonic and hypertonic solutions. Formulate a hypothesis about the direction the water will diffuse through the semi-permeable membrane of the egg. Include the rationale used in formulating your hypotheses statements. Write a step-by-step procedure to test your hypothesis and have it approved by the teacher before conducting the experiment. Be sure to designate what safety precautions need to be followed. Make sure to record both qualitative and quantitative data for each day. Draw a visual model to show what happened to the flow of water for each egg after it was put into different solutions. Be sure to be neat, organized, and have all parts of the model labeled, using correct scientific terms. Write a conclusion summary that incorporates the question, hypothesis, summary of findings, analysis of data in relationship to the hypothesis, explanation of results, and reflection on peer critiques**.** You will be given three class periods to complete the investigation and the model. The summary will be due the following day three of the investigation.

One week after completion of the investigation and model, the attached *application* portion of the investigation will be due.

Application:

1. If the egg had neither gained nor lost mass, what term would be used to describe the system?

2. Describe what changes to the solution would create a situation in which the egg neither gained nor lost mass.

    - Using your model of osmosis, find literature resources to help you describe how the following chemicals act as regulators of osmosis in human organ-systems:

        - Caffeine

        - Sodium Chloride (Table Salt)

        - Hydrochlorothiazide (Blood Pressure Medication)

3. Using your model of osmosis, find literature resources to help you describe how semi-permeability. Is very important in membranous systems:

    - The brain's blood barrier

    - Absorption through the skin of various substances

    - Peritoneal dialysis for patients with diseased kidneys