

## DIFFUSION THROUGH A SEMI-PERMEABLE MEMBRANE

### Performance Standards 12A/11A/13A.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 in agricultural applications.
- *Application*: test osmosis using eggs with hypotonic and hypertonic solutions and relate the model of osmosis to agricultural applications.
- *Communication*: present and explain a visual model of osmosis to explain osmotic changes in agricultural applications.

### Procedures

1. ***In order to know and apply concepts that explain how living things function, adapt and change (12A); the concepts, principles and processes of scientific inquiry (11A); and the accepted practices of science (13A),*** agriculture/horticulture students should experience sufficient learning opportunities to develop the following:
  - Formulate hypotheses based on foundational understanding of osmosis in living systems in agricultural applications.
  - Reference pertinent research of osmosis in general and specific examples.
  - Relate foundational knowledge of hypotonic, hypertonic and isotonic solutions; equilibrium diffusion and osmosis to the investigation and its applications in agricultural settings.
  - 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 agricultural applications.
  - 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. This assessment aligns with the Illinois Workplace Skills D1 (Communicating on the Job/Prepare written communication), D5 (Communicating on the Job/Follow written directions), H1(Solving Problems and Critical Thinking/Identify the problem), H2 (Solving Problems and Critical Thinking/Clarify purposes and goals), H3 (Solving Problems and Critical Thinking/Identify solutions to a problem and their impact) and I1 (Maintaining a Safe and Healthy Work Environment/Identify safety and health rules/procedures). The Agriscience Kit entitled, “Eggciting Experiments,” has an activity called, “Membrane Permeability Activity,” that expands this assessment.

2. Have students review and discuss the assessment task and how the rubric will be used to evaluate their work.
3. Agriculture/horticulture students will apply an understanding of diffusion, osmosis, osmotic pressure, (hypotonic, hypertonic and isotonic solutions) and equilibrium using an egg as the semi-permeable membrane. Begin investigation with questions about how water moves in a plant, how some structures ‘shrink’ and others ‘expand’ after soaking in water. They can extend some of the examples of where the terms of diffusion and osmosis apply in familiar agricultural settings. Suggest settings such as warnings about poisons, dehydration, transpiration or kidney dialysis to propose how osmosis applies in real world examples. Students are asked to formulate a strategy to model the process of osmosis using an egg and then apply the basic principles of osmosis in practical agricultural settings. Provide each student with a copy of the “Diffusion through a Semi-permeable Membrane” instruction sheet. Supply the students with the listed materials. Discuss findings from initial investigation and extend these findings into additional examples for additional study and discussion. Students should respond to worksheet questions after discussions.

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 in general and specific agricultural examples.
  - *Application:* The osmosis investigation with procedures, data collection and analysis was correct and thorough. The model and applications to agricultural settings were correct and complete.
  - *Communication:* The conclusions were well organized and sufficiently detailed. 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 agricultural settings.

**Examples of Student Work**

- [Meets](#)
- [Exceeds](#)

**Time Requirements**

- Three class periods plus one week outside of class

**Resources**

- Diffusion through a Semi-permeable Membrane Instruction Sheet
- Books/Internet for student research for applications
- Fresh eggs (at least two per group)
- Corn syrup
- Vinegar
- Balance
- 200 mL beakers (at least two per group)
- 500 or 600 mL beakers (at least two per group)
- Goggles
- Science Rubric

**DIFFUSION THROUGH  
A SEMI-PERMEABLE MEMBRANE**  
Instruction Sheet

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 agricultural applications.

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 36-48 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 (white shell preferred)
- 2 cups vinegar (white the best)
- 1 cup corn syrup
- 1 cup distilled water
- 3 beakers
- electronic balance
- goggles

Design an experiment to scientifically 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. 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. Prepare a data table to record both qualitative (observations) and quantitative (like mass, size, etc.) data from the investigation.

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 summary of your findings, an analysis of data, an explanation of results and a reflection which notes how the investigation could be improved.

Complete the application portion of the worksheet after class presentations and discussion.



## SCIENCE RUBRIC

Exceeds - must receive no more than one 3 and the rest 4s in the other areas of the rubric.

Meets - may receive no more than one 2 and a combination of 3s and 4s in the other areas of the rubric.

Approaches - may receive no more than one 1 and a combination of 2s, 3s or 4s, in the other areas of the rubric.

Begins - must receive at least a 1 in all 3 areas of the rubric.

	<b>KNOWLEDGE</b>	<b>APPLICATION</b>	<b>COMMUNICATION</b>
	Knows and understands scientific terms, facts, concepts, principles, theories and methods.	Applies scientific knowledge, skills and methods to manipulate, analyze, synthesize, create and evaluate.	Communicates scientific knowledge and applications through writing, speech and visual displays.
<b>4</b>	<ul style="list-style-type: none"> <li>• Descriptions of scientific terms, facts, concepts, principles, theories and methods are complete and correct.</li> </ul>	<ul style="list-style-type: none"> <li>• Applications are thorough, appropriate and accurate.</li> </ul>	<ul style="list-style-type: none"> <li>• Written, oral and/or visual communication is well organized and effective.</li> </ul>
<b>3</b>	<ul style="list-style-type: none"> <li>• Descriptions of scientific terms, facts, concepts, principles, theories and methods are mostly complete and correct.</li> </ul>	<ul style="list-style-type: none"> <li>• Applications are mostly thorough, appropriate and accurate.</li> </ul>	<ul style="list-style-type: none"> <li>• Most of the written, oral and/or visual communication is well organized and effective.</li> </ul>
<b>2</b>	<ul style="list-style-type: none"> <li>• Descriptions of scientific terms, facts, concepts, principles, theories and methods are somewhat complete and correct.</li> </ul>	<ul style="list-style-type: none"> <li>• Applications are somewhat appropriate and accurate.</li> </ul>	<ul style="list-style-type: none"> <li>• Some of the written, oral and/or visual communication is organized and effective.</li> </ul>
<b>1</b>	<ul style="list-style-type: none"> <li>• Descriptions of scientific terms, facts, concepts, principles, theories and methods are minimally present or correct.</li> </ul>	<ul style="list-style-type: none"> <li>• Applications are minimally appropriate and accurate.</li> </ul>	<ul style="list-style-type: none"> <li>• Little of the written, oral and/or visual communication is organized and effective.</li> </ul>
<b>0</b>	<ul style="list-style-type: none"> <li>• All descriptions of scientific terms, facts, concepts, principles, theories and methods are missing and/or incorrect.</li> </ul>	<ul style="list-style-type: none"> <li>• All applications are missing and/or incorrect.</li> </ul>	<ul style="list-style-type: none"> <li>• All of the written, oral or visual communication is missing and/or lacks organization.</li> </ul>
<b>Score</b>			