

DIFFUSION THROUGH A HUMAN RED BLOOD CELL

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:* understand osmosis and the semi-permeability of cell membranes.
- *Application:* test the model of osmosis to human organ systems (specifically blood cells).
- *Communication:* analyze and report findings 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); the concepts, principles and processes of scientific inquiry (11A); and the accepted practices of science (13A),*** 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.
 - Use technologies for testing, observing, collecting and recording data.
 - Analyze the change of mass data from multiple trials with multiple samples.
 - 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. Societal applications from 13A are addressed specifically in the medical field. Health Occupations students must clearly understand the concepts associated with osmosis and red blood cells. This assessment aligns with the Clinical Laboratory Science/Biotechnology Cluster occupational skill standards #3 (General Laboratory Skills/Demonstrate the use of a microscope) and #23 (General Laboratory Skills/Perform dilutions). It also aligns with the National Health Care Skill Standards in the area of Safety Practices, (Health care workers will understand the existing and potential hazard to clients, coworkers and self/Use Universal Precautions to control the spread of infection).

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 the Human Red Blood Cell” 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

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

Time Requirements

- One class period plus one week out-of-class

Resources

- Diffusion through a Human Red Blood Cell Instruction/Application sheet
- Science Rubric
- Books/Internet for student research for applications
- Red blood cells
- NaCl
- Distilled water
- Beakers
- Electronic balance
- Microscope
- Slides
- Cover slips
- Pipettes
- Goggles

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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 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.

The human body must maintain homeostasis. For this investigation, you will be supplied with the following materials:

- Red blood cells
- NaCl
- Distilled water
- Beakers
- Electronic balance
- Microscope
- Slides
- Cover slips
- Goggles
- Pipettes

Design an experiment to investigate osmosis in the red blood cells in hypotonic and hypertonic solutions. Formulate a hypothesis about the direction the water will diffuse through the semi-permeable membrane of the red blood cell. 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 cell 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 one class period to complete the investigation and the model.

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

APPLICATION:

1. Describe what happened to the red blood cells as they were placed into the three different solutions?

2. Describe what changes to the solution would create a situation in which the red blood cell membrane lost its integrity.

3. 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)

4. 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

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.

	KNOWLEDGE	APPLICATION	COMMUNICATION
	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.
4	<ul style="list-style-type: none"> • Descriptions of scientific terms, facts, concepts, principles, theories and methods are complete and correct. 	<ul style="list-style-type: none"> • Applications are thorough, appropriate and accurate. 	<ul style="list-style-type: none"> • Written, oral and/or visual communication is well organized and effective.
3	<ul style="list-style-type: none"> • Descriptions of scientific terms, facts, concepts, principles, theories and methods are mostly complete and correct. 	<ul style="list-style-type: none"> • Applications are mostly thorough, appropriate and accurate. 	<ul style="list-style-type: none"> • Most of the written, oral and/or visual communication is well organized and effective.
2	<ul style="list-style-type: none"> • Descriptions of scientific terms, facts, concepts, principles, theories and methods are somewhat complete and correct. 	<ul style="list-style-type: none"> • Applications are somewhat appropriate and accurate. 	<ul style="list-style-type: none"> • Some of the written, oral and/or visual communication is organized and effective.
1	<ul style="list-style-type: none"> • Descriptions of scientific terms, facts, concepts, principles, theories and methods are minimally present or correct. 	<ul style="list-style-type: none"> • Applications are minimally appropriate and accurate. 	<ul style="list-style-type: none"> • Little of the written, oral and/or visual communication is organized and effective.
0	<ul style="list-style-type: none"> • All descriptions of scientific terms, facts, concepts, principles, theories and methods are missing and/or incorrect. 	<ul style="list-style-type: none"> • All applications are missing and/or incorrect. 	<ul style="list-style-type: none"> • All of the written, oral or visual communication is missing and/or lacks organization.
Score			