Lesson 3: Naked Eggs

Forward for Parents and Educators:

Welcome! This is the third in of a series of five lessons. The series is designed for upper elementary students, but can be adapted to any child's ability level. Prior to beginning the experiment, watch the pre-lesson video. The lesson and video are accompanied by asynchronous, educator-led discussion. Frequent participation in the discussion will allow you to ask questions and check understanding of the content. During the series, students will become familiar with the scientific method within the life and physical sciences. Students will identify the scientific method as a way of knowing; understanding that science uses empirical methods that rely on logic, evidence and reasoning.

This series will address NGSS and NCSD Standards including Science and Engineering Practices, Disciplinary Core Ideas and Cross Cutting Concepts.

INTRODUCTION:

In this lesson, you will observe simple diffusion. You will also use a naked egg as a model to help understand how water moves into and out of animal cells through the process of osmosis. Students will construct a hypothesis, conduct an experiment to test the hypothesis, collect data, and draw conclusions.

Diffusion is the movement of matter from an area of high concentration to low concentration. Diffusion is a passive process, meaning that it does not require any energy. Matter is made up of atoms or molecules that are in constant motion. The speed at which molecules move depends on temperature. At a cold temperature, molecules move more slowly than they do at a warmer temperature.

Osmosis is the diffusion of water across a membrane. In cells, water move across the cell membrane from an area of high concentration to a low concentration. When the concentration of water on the inside of the cell is equal to the outside of the cell, there is no net movement of water (water still moves, but the concentration of water inside the cell stays the same as outside the cell).

Prior to completing this lesson, you will need to prepare a naked egg. To prepare a naked egg, gently place raw eggs into a jar. Cover the eggs with white distilled vinegar or apple cider vinegar. Allow the eggs to sit for about 3 days. If you need to speed up the process, you can change out the vinegar after 24 hours. You may also gently stir the eggs to ensure that the whole shell gets dissolved. As the egg soaks in vinegar, you will notice that it swells up (more about that later), and that tiny bubbles form around the egg. The shell of the egg is made of calcium carbonate. Vinegar contains a weak acid called acetic acid. When acetic acid and calcium carbonate are combined, the resulting chemical reaction makes calcium acetate, water and carbon dioxide. The bubbles you see are carbon dioxide. The chemical reaction between the calcium carbonate in the egg shell and the acetic acid in the vinegar dissolves the shell of the egg.

After a few days, you'll notice that the egg has become translucent. Gently pick up the egg and place it under cool running water. Use your fingers to gently remove the remnants of the shell.

A scientific model is used to help study things that are difficult to observe directly. We are using the naked egg as a model to study the movement of water across an animal cell membrane. In other words, the naked egg acts as a model to study the process of osmosis.

All cells are surrounded by a plasma membrane. The plasma membrane acts as an envelope to contain everything inside of the cell. Your naked egg is held together by the inner membrane of the egg. In our model, the inner membrane of the chicken egg represents the plasma membrane of an animal cell. The egg white represents a cellular structure known as the cytoplasm. The egg yolk represents the nucleus. While scientific models are helpful in understanding concepts, they are not perfect. Every model has limitations. One of the limitations of this model is that it does not accurately represent what happens when too much water enters an animal cell. If too much water enters an animal cell, the plasma membrane cannot withstand the pressure and the cell breaks open. Can you think of other limitations of our model?

MATERIALS:

- One or more naked eggs
- A liquid of your choosing (it can be anything from your home)
- Two cups
- Warm water
- Cold water
- Powdered drink mix OR food coloring

SAFETY CONSIDERATIONS:

- Naked eggs are raw. After handling eggs, vigorously wash your hands with soap and water for 20 seconds.
- Sanitize surfaces which come into contact with raw eggs.
- Refer to the label of your chosen liquid for proper disposal instructions.

PROCEDURES:

ACTIVITY 1: Observing Diffusion

1. Measure one cup of warm water into a clear drinking glass. Measure one cup of cold water into a clear drinking glass. Allow the water to settle.

2. Sprinkle an equal amount of powdered drink mix or food coloring into the clear drinking glasses. Use the same amount of powdered drink mix or food coloring for each drinking glass.

3. Observe the movement of the color through the glasses. In which liquid (hot or cold) does the color diffuse more quickly? Can you explain why?

ACTIVITY 2: Naked Egg Osmosis

1. If you have a kitchen scale, weigh your naked egg. Use grams as your unit of measure. If you do not have a kitchen scale, ***gently*** place your naked egg onto paper and measure the length and width in centimeters. Record your measurements in the table below.

2. Gently place your naked egg into a container large enough to allow a centimeter of space on each side of the egg.

3. Pour a liquid of your choosing over the egg. The egg only needs to be halfway submerged. Do you think there is more water inside of the naked egg, or in the fluid you chose? Form a hypothesis on which way water will flow.

If I place a naked egg into _____, then water will flow _____ the egg, because _____.

4. Cover the container with a piece of clear plastic wrap or a plastic baggie.

5. Observe the contents of your container (naked egg and liquid) in one hour.

    a. Has the appearance of the liquid changed? If so, describe the change.

    b. Does your naked egg look larger, smaller or the same size? Propose an explanation for your observation. Use your observations from 5a to help you with your explanation.

    c. Very gently remove the egg from the container. Use the same technique to measure your egg as you did in step 1. Record your data in the table below. Does the data you collected align with your observations in 5a and 5b?

6. Gently place the naked egg back into your container with the liquid. Allow the egg to sit covered and undisturbed for 24 hours.

    a. Has the appearance of the liquid changed? If so, describe the change.

    b. Does your naked egg look larger, smaller or the same size? Propose an explanation for your observation. Use your observations from 5a to help you with your explanation.

    c. Very gently remove the egg from the container. Use the same technique to measure your egg as you did in step 1. Record your data in the table below. Does the data you collected align with your observations in 5a and 5b? Explain.

	Measurements (include your units)
1 hour	
24 hours	

Draw a Conclusion: Look back at your hypothesis. Do your results support your hypothesis? If they do, explain how they support your hypothesis. If the results do not support your hypothesis, explain why they did not. Based on your results, did water move into or out of the naked egg? What are some limitations to this experiment? Describe those limitations.

DISCUSSION & APPLICATION

1. What does dehydrated mean? When a person is very dehydrated, they sometimes need intravenous (iv) fluids. The fluid used contains electrolytes and water. Care is taken to make sure that the amount of water in the iv fluid matches the amount of water that should be in cells. What would happen if the iv fluid contained too much water?

2. Plant cells and animal cells have many similarities. There are a few differences too. Can you explain why plants wilt when they don't have enough water?

Science and Engineering Practice	NCSD Grade Level Standards	Cross-Cutting Concepts
• Observation • Scientific methods are determined by asking questions • Obtaining, evaluating and communicating information	5.1.1- Develop a model to describe that matter is made of particles too small to be seen. 5.1.6- Conduct an investigation to determine whether the mixing of two or more substance results in new substances. 5.1.7- Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved	4. Systems and System Models 5. Energy and Matter: Flows, cycles and conservation 6. Structure and function

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