Lesson 2: Water Magic

Forward for Parents and Educators:

Welcome! This is the second in of a series of five lessons. The series is designed for elementary students. You may adapt the lesson according to your child's ability level. Prior to beginning the experiment, please watch the pre-lesson video. The lesson and video are accompanied by asynchronous, educator-led discussion. Please participate frequently in the discussion threads which accompany the lessons. 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:

Water is a molecule that is required for life. There are several properties of water that are required for living systems. In Lesson 1, you observed that water exists in three different states. All of these states are part of life on earth. Today, we will explore the properties of ***cohesion, adhesion, and water's high surface tension.***

Upon close examination of a liquid, you notice that there seems to be a "sheet" separating the liquid from the air above it. The molecules in the liquid are more strongly attracted to each other than the air. This is called ***cohesion.*** The molecules in a liquid 'stick to' other molecules of the liquid better than they 'stick to' air. If you place a cup of water on the table and let it settle, you'll see what looks like "a skin" at the surface. This isn't really a "skin." You are observing the water molecules sticking together through cohesion. Collectively, the cohesive forces at the surface form what is known as ***surface tension.*** Surface tension allows the surface of a liquid to resist external forces. Compared to other liquids, water has a high surface tension.

Surface tension of water can be lowered by soaps and detergents. Today, you will observe the surface tension of water, and the effect of soap on the surface tension of water. We will complete the lesson by forming a prediction, and then using the scientific method to test that prediction.

In this lesson, you will also use a coin to observe the cohesion and ***adhesion*** of water. Adhesion is when molecules that are not the same stick together. If you look closely at a straw placed into water, you'll notice that the water in the straw appears to "climb" the straw. The water molecules are sticking to the straw through adhesion. The water level in the straw is higher than in the cup because water is "climbing" up the straw through a process called *capillary action*. Capillary action occurs when the adhesive forces are stronger than the cohesive forces.

This at home lesson has three activities. The first two activities will allow you to observe properties of water. You will use your observations in the third activity to form two hypothesis statements. You will then test your hypotheses using an experiment.

MATERIALS:

- Coin
- Medicine dropper, or your finger
- A shallow dish (such as a shallow plastic tray), filled half-way full of water
- At least four paper clips
- Cardboard
- Scissors
- Cake pan filled with an inch of water
- Drop of soap OR a tiny fleck of soap scraped from a bar

SAFETY CONSIDERATIONS:

- Use care when cutting cardboard

PROCEDURES:

ACTIVITY 1: A Balancing Act

1. Place your coin onto a flat surface

2. Carefully drop water, one drop at a time, onto the surface of the coin. If you don't have a dropper, dip your finger into a cup of water and allow the water to drop off of your finger.

3. Do the water drops spread out or collect in the center of the coin? What property of water helps you explain how the water droplets interact with each other?

4. Continue adding water drops to the coin? Describe the appearance of the water. Does the water look like a dome, or is it caved inward? Sketch your results.

5. As you continue to drop water onto the coin, observe the interaction between the edge of the coin and the water. Describe the results. What property of water helps you explain how the water interacts with the edge of the coin? Sketch your results.

Water Competition: How many drops of water can you balance on the surface of your coin? Post a picture and your results in the discussion forum.

ACTIVITY 2: Paperclip Magic

1. Fill a small tray (such as a plastic tray) half way full of water. Allow the water to settle.

2. Use a bent paperclip (shown below), or a plastic fork to gently lower a paperclip onto the water's surface. Once you have floating paper clip, observe the appearance of the water and paperclip. If you have a magnifying glass, use it to look at the paperclip. Describe the interaction of the water and the paperclip. Sketch your results.
   If you don't get your paper clip to float the first time, dry the paper clip and try again.

3. What property of water explains the floating paper clip phenomenon? What animals can you think of that use this same property of water to live?

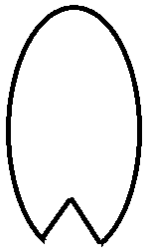
4. Gently place two drops of soap into your container. Observe your paper clip(s). Describe what happens.

5. After adding soap to your tray, try floating paper clips. Do the paper clips float? Write a sentence to propose an explanation for your observations.

Water Competition: How many paper clips can you float in your tray? Post a picture discussion forum.

ACTIVITY 3: Let's Row!

1. Use a piece of cardboard to make a "boat". Your boat should be about 3 inches long, and should be flat. A possible design is provided in the picture. You may shape your boat in any way you choose, but make sure there is a notch at the end.



2. Fill a cake pan with an inch of water.

3. We will now make two hypotheses. Use the instructional video that accompanies this lesson to make observations that will help you form your hypotheses.

    a. Predict how your boat will move through the water in the cake pan if you place a tiny drop of water or soap immediately behind the notch? Propose an explanation for your prediction.

Hypothesis 1: *If* I place a drop of water behind my boat, *then* my boat will_____

*because*_____.

    b. What do you think will happen if you drop a tiny drop of dish soap (or a small flake of bar soap) behind your boat? Propose an explanation for your prediction.

Hypothesis 2: *If* I place a drop of water behind my boat, *then* my boat will _____

*because*_____.

4. Now, it's time to test your hypotheses. Place your boat into your pan. Complete your experiment for Hypothesis 1 ***first.*** After you complete the experiment for your first experiment, immediately conduct the second. Record your results in the table below:

Description of Boat Movement with Water droplet	Description of Boat Movement with Soap droplet.

Draw conclusions:

Write a paragraph using what you know about surface tension and how soap affects surface tension to discuss your results. Did your results support your hypothesis? Are there similar demonstrations you have observed which offer results that also support your hypothesis?

DISCUSSION & APPLICATION

1. Many insects rely on surface tension to complete their life cycles. What would happen to these insects if detergent was accidentally spilled into a lake or pond?

2. Imagine you are taking a bubble bath. Now, think back to what happened when you added soap to your tray. Were you able to float paper clips on the water's surface? Now, think back to your bubble bath. Could you propel a cardboard boat using a drop of soap in a bubble bath? Can you think of a way to test your prediction?

Science and Engineering Practice	NCSD Grade Level Standards	Cross-Cutting Concepts
• Observation • Scientific methods are determined by asking questions • Obtaining, evaluating and communicating information	2.1.2- Observe, collect and record data on the properties of different kinds of materials • Matter can be described and classified by its observable properties • Different properties are suited to different purposes 3.4.4 – Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. 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	1. Patterns 4. Cause and Effect

The "Learn with the Doc" at-home science series was made possible through the support of these generous sponsors.