ANCHORAGE MUSEUM

SCIENCE PASSPORT: SINK - PROPERTIES OF WATER

BACKGROUND INFORMATION

The Anchorage Museum has created a home edition of the Science Passport that uses the important science skills of observation, thoughtful questioning, and experimentation to learn more about the world around them. This lesson plan examines some properties of water, providing activities to discover this unique substance.

STUDENTS WILL:

- Understand water's cohesive and adhesive properties
- Discover how water acts in unique ways
- Engage in hands-on learning to make observations and predictions about water's interaction with other materials

MATERIALS

Activity 1, 2, & 3: Provided activity sheets and writing utensil
Activity 1: Small cup, small bowl, spoon, wax paper, aluminum foil, and paperclip
Activity 2: Paper towels, paper, food coloring (optional), liquid dish soap, and Q-tip or toothpick
Activity 3: Printed water maze sheet, wax paper, toothpick, two small cups, string, scissors, and food coloring (optional)

RECOMMENDED GRADE LEVEL

Third through sixth
Adapt for K-12 and adult learners

KEY TERMS

Matter: the 'stuff' that makes up everything in the universe, including all that is touched, seen, smelled, heard, and tasted; anything that takes up space and has mass

Atoms: the extremely small building blocks that make up matter

Molecules: formed by two or more atoms joining together; some common molecules interacted with every day are water (H_2O), carbon dioxide (CO_2), and salt (NaCl)

Mass: a measurement of the amount of matter in an object; mass always stays the same, and is different than weight, which can change

Volume: the amount of space an object takes up

Density: the amount of mass in an object compared to its volume; if an object is heavy and small, it has a high density; if an object is light and takes up a lot of space, it has a low density

Cohesion: the attraction or force of like molecules (water) to stick together

Adhesion: the attraction or force of nonlike molecules to stick together

Surface Tension: cohesion creates a 'solid-like' state upon which light-weight or low-density materials can be placed without sinking

ACTIVITIES

This lesson plan provides three activity options and explains each of them in detail on the next page. Complete one or more activities.

1. **Activity 1:** Observe - Cohesion
2. **Activity 2:** Ask - Adhesion
3. **Activity 3:** Experiment - Cohesion & Adhesion

ACTIVITY 1 - OBSERVE

Cohesion and Surface Tension

[10-15 minutes]

In this activity, you will make observations about the cohesive property of water by examining shapes of water droplets in and on different surfaces. Complete Appendix A to guide your observations.

ACTIVITY 2 - ASK

Adhesion

[10-15 minutes]

In this activity, you will learn about adhesion and how water sticks to other materials. Complete Appendix B to guide your exploration.

ACTIVITY 3 - EXPERIMENT

Cohesion and Adhesion

[10-15 minutes]

In this activity, you will conduct two experiments to investigate both cohesion and adhesion properties of water. Complete Appendix C to guide your exploration.

OBSERVE - Cohesion

1. Pour water into a small cup until it reaches the top. Carefully add drops or spoonfuls of water to the cup without spilling the water from the cup.
    a. Describe the shape of the water at the top of the cup.

    b. Sketch the waters shape at the top of the cup.

2. Carefully place a drop of water on the counter next to your sink.
    a. Describe the shape of the water droplet.

    b. Sketch the water droplet's shape.

    c. Is the shape similar or different than the waters shape at the top of the cup?

3. Careully place a drop of water onto wax paper.
    a. Describe the shape of the water droplet.

    b. What happens to the water droplet when you carefully move the wax paper around?

OBSERVE - Cohesion continued

c. Can you make the water droplet move across the wax paper?

Cohesion causes water molecules to be attracted to one another. Each drop of water has billions water molecules, all being attracted to each other. This constant pull causes the drop to form a shape that has the least amount of surface area (a sphere).

4. Are the water droplets you observed spheres? Why or why not?
    a. Water in cup.

    b. Water on counter.

    c. Water on wax paper.

Cohesion between water molecules creates surface tension, an effect where the surface of water is strong and can hold up a weight that would normally sink. Aluminum foil is more than twice as dense than water. Cut out a piece of aluminum foil roughly one inch by one inch, and fold it in half twice. Fill a bowl with water and carefully place the piece of foil flat on top of the water.

5. Water surface tension and foil.
    a. What do you observe?

    b. Can you make a paperclip float on the water?

    c. Explain how an insect like a water strider can run on the surface of water.

ASK - Adhesion

Fill a bowl with water and use a paper towel to explore water's adhesive properties. We learned in the previous activities how water molecules are attracted to each other and cause cohesion. Water molecules are also attracted to other materials and cause adhesion. For these two activities you will fill a bowl with water and food coloring, which will help you observe and track the movement of water.

1. Paper towel activity.
    a. Before dipping a paper towel in the bowl of water make a hypothesis or guess as to what you think might happen.

    b. Test out your hypothesis by holding a paper towel so the bottom is touching the water in the bowl. What is happening to the paper towel?

    c. Can you make the water travel straight up?

Using aluminum foil, cut out a triangle with all the sides the same length. In the middle of one side cut out a square or rectangle so one side of the triangle now has a small notch. The notch is the rear of your boat and the opposite point is the front of your boat.

2. Place your boat flat on top of the water in the bowl.
    a. Is your boat moving?

    b. Water molecules are attracted and pulling on all the sides of your boat. Because your boat is being pulled equally in all directions it does not move. Hypothesize how you could move your boat without touching it?

    c. Fill a cup with water and one drop of liquid dish soap. Mix up the solution and dip a Q-tip or toothpick into the cup. Now that your Q-tip or toothpick has some soap water on the end, carefully tap it into the bowl of water directly behind your boat. What hapens?

    d. Explain how you are able to move your boat around the bowl without touching and pushing on the actual aluminum foil boat.

EXPERIMENT - Cohesion and Adhesion

All of the previous activities showed both cohesion and adhesion, although these next experiments are designed to really highlight both of these water properties even better. Print off the Amazing Water Race page and place a piece of wax paper over the water maze. Add drops of water to the starting point and only using a toothpick try to move all of the water to the finish line.

1. Can you complete the maze by moving all the water to the end?

2. Test out how fast you can finish the maze. List your three best times and then calculate the average (add all three times and divide by three).
    a. Time 1:

    b. Time 2:

    c. Time 3:

    d. Average time:

3. What happens when you use two toothpicks instead of one? Is it easier or harder to move all the water?

In the water maze race, cohesion kept water droplets together and adhesion kept water droplets attracted and sticking to the toothpick. To experiment with these two properties again, fill up a cup of water and add a few drops of food coloring. Cut a piece of string roughly one foot in length, place in water cup, and then slowly run your fingers across the string to remove excess water. Tape one end of the string to the bottom of another (empty) cup. With adult supervision, hold the other end of the string inside the water cup and slowly begin to pour the water along the string. For a short video instruction of this activity click this link.

4. What happens when you pour the water slower or faster?

5. Change the height of the full water cup and the angle of the string (higher cup causes the string to be steeper, lower cup causes the string to be flatter). What do you notice when testing the heights and angle of the string?

6. Is there any relationship between the angle of the string and the speed you need to pour the water to make sure no water spills?