**Activity: Cohesion and Adhesion**

Investigate the cohesive and adhesive properties of water.

**Materials**

**Parts A and B:**

* Tap water
* Penny
* Plastic pipette
* Paper clip
* Binder clip
* Barbeque skewer or toothpick

**Part C:**

* Tap water
* Two flexible plastic rulers
* Paper clip
* Penny

**Part D:**

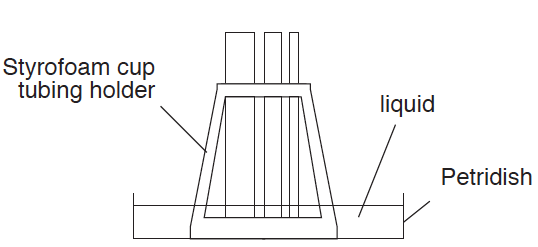
* Tap water
* Paper clip
* Petri dish
* Liquid detergent
* Barbeque skewer or toothpick
* Other materials as needed

**Part E:**

* Food coloring
* Petri dish
* Capillary tubes of three different diameters
* Styrofoam or paper cup
* Rulers
* Scissors (optional)

**Procedure**

1. How many drops of water can you fit on the surface of a penny without the water spilling over?
   1. Predict how many drops of water will fit on a penny. Record your prediction.
   2. Use the plastic pipette to drop water on the surface of a penny. Drop carefully and slowly to fit as many drops as possible on the penny. Count each drop until the water spills over the side of the penny and record your results.
   3. Compare your results to those of your classmates. Record the range and calculate the average number of drops that fit on a penny.
   4. Add more drops to the penny, without letting the water spill over. Carefully observe and draw the water on the penny.
   5. Invent and record a hypothesis for the behavior of water that you observed, using the language of cohesion and adhesion in relation to the water and the penny.
2. Can you prod the water on the penny without spilling it?
   1. Add drops of water to the penny, until the water is almost ready to spill over.
   2. Predict what will happen when you insert a skewer or toothpick into the surface of the water piled on the penny. Record your prediction.
   3. Insert the skewer and carefully observe the surface of the water.
   4. Try inserting the skewer in various ways. Observe the surface of the water. Pay special attention to the water surface where the skewer enters the water.
   5. Record your observations and draw what you see.
   6. Repeat procedures B1-B5 using a paper clip and the metal clip part of a binder clip. Try to indent the pile of water as much as possible without spilling it.
   7. Record your observations and draw what you see, paying carefully attention to the surface of the water.
   8. 8. Invent and record a hypothesis for the behavior of water that you observed using the language of cohesion and adhesion in relation to the skewer, the paperclip, the binder clip, and the water.
3. Can you stick two plastic rulers together using only water?
   1. Use your knowledge of adhesion and cohesion to to invent a way to stick two plastic rulers together using only water.
   2. Record your findings and describe your ability to stick two rulers together.
      1. Does the amount of water you use make a difference?
      2. What happens when you hold the rulers at an angle, lift them up and down, or turn them on their sides?
   3. Test the strength of your rulers stuck together by lifting one ruler with the other and lifting an object such as a paper clip or a penny.
   4. Invent and record a hypothesis for the behavior of water that you observed using the language of cohesion and adhesion in relation to the rulers.
4. A paper clip is more dense than water. Can prevent one from sinking?
   1. Test your ability to float a paper clip. If necessary, you can change the shape of the paper clip or, with your teacher’s permission, use additional resources from your classroom. Record your results and any procedures that make it easier to float the paper clip.
   2. Compare your results to those of your classmates and record any differences in procedure.
   3. Make a prediction about what will happen if you disturb the surface of the water with a skewer or poke the paperclip with a skewer. Test your prediction and record your results.
   4. Invent and record a hypothesis for the ability to float a paper clip on water using the language of cohesion, adhesion, and density.
   5. Float the paper clip again, then add a drop of liquid detergent near the paper clip. Record your findings.
   6. Invent and record a hypothesis for what happens when you add liquid detergent to water on which a paper clip is floating, using the language of cohesion, adhesion, and density.
5. Create the tallest column of water.
   1. Predict which of the three capillary tubes will create the tallest column of water. Record your prediction.
   2. Add food coloring to water in a Petri dish so that you can see the level of water clearly inside the capillary tubes.
   3. Create a holder for the capillary tubes by cutting out a window in a cup and poking holes with a skewer to hold the capillary tubes (see Fig. 3-9).
   4. Test your prediction by placing each capillary tube vertically in the cup holder and lowering it into a Petri dish filled with water. The bottom of the tubes should almost rest on the bottom of the Petri dish. The bottom of all the tubes should be at the same height. You will need to wait at least 5 minutes to observe the maximum height of the water in each tube.
   5. Carefully observe the height and look of the water in each of the three tubes. Record your observations and draw each tube, showing the level of water.
   6. Observe the **meniscus**, the curve in the upper surface of a liquid, in each tube. Measure the height of the meniscus in each tube from the bottom of the Petri dish. Record the height of the water in each of the tubes.
   7. Invent and record a hypothesis for any differences in water height or meniscus that you observed in the capillary tubes. Use the language of cohesion and adhesion in relation to the water and the tubes.

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**Activity Questions (answer in SNB):**

1. How did adhesion and cohesion of water influence the behavior of water in the activities?
2. Describe two examples of adhesion and two examples of cohesion that you have observed outside of science class.
3. What factors contributed to being able to pile a large number of drops on a penny without spilling?
4. What procedures made it easier to float the paper clip on water? Why do you think these procedures made floating the paper clip easier?
5. How did the addition of soap to water change the properties of the water? Why do you think this happened?
6. Why do you think you had to wait five minutes before measuring the height of the tubes? What would have happened if you did not wait five minutes before recording your results?
7. What might happen to the height of the water columns in the capillary tubes if you added soap to the water?
8. How would an organism like a water strider, which walks on water, be affected by the runoff of soap into its environment?