

Name: _____

Date: _____

Materials: Textbook pages 40-43

Pipette (dropper) Petri dish (half) Penny

2 Paper clips

Paper towel

Capillary tub (will be provided by teacher)

Hydrogen bonds cause water molecules to hold onto each other, this makes it more difficult to pull the molecules apart. On the surface of water, these bonds hold the molecules of water making the surface of water stronger than other liquids.

Use the box below to make a drawing showing how a water molecule is polar, and label which atoms have which charge.



Use the box below to illustrate three water molecules forming through hydrogen bonds due to water molecules polarity.



Part I - Surface Tension Observations (cohesion)

Follow the directions and make detailed observations to help you answer the questions.

Activity 1

Place the penny in your petri dish heads up. Then place 1 drop of water on the penny and draw **from the side** the image of the water droplet in picture 1 below. Draw in picture 2 what the penny will look like just before the water spills over. When done picture 2 very slowly use the dropper to add water onto the penny until it overflows and sketch the result just before spilling in picture 3. Record the total number of drops before it spilled. Repeat this two times drying the penny between trials.

Picture 1



Sketch of the penny w/
1 drop of water

Picture 2



Predicted sketch of
penny before spilling

Picture 3



Actual sketch before
spilling

Trials	1	2	Average
# of Drops			

Average of how many drops you had before the water spilled over? _____

The shape of the droplet is formed from the hydrogen bonds pulling equally on the water molecules. In the absence of gravity (in deep/outer space), a drop of water would form a perfect sphere. On the penny, the droplet does not flatten out from the constant pull of gravity. The rounded top is formed as the hydrogen bonds are constantly pulling the water molecules together against gravity.

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Observations:

1) Describe the final shape of the water before it spilled. Were you surprised by the outcome, why or why not?

2) What property of water produced the resulting shape? _____

3) What is the term for the shape water takes inside of graduated cylinders, because of a similar property? _____

Activity 2

Use the same petri dish as before and fill it with water until the level reaches the top of the dish. Then carefully place the 2 paper clips as you can on top of the water, with out them sinking. *(Do not alter the shape of the clips in any way)*

4. What characteristic property of water was stronger than gravity in this example, and held up the paper clips?

Request the teacher add soap to your dish.

5. What happened after the soap was added by the teacher to the water? Why?

IMPORTANT -RINSE AND DRY THE PETRI DISH BEFORE CONTINUEING!!!!!!

Part II - Capillary Action (adhesion)

Water pulls itself towards the sides of the glass because the molecules of glass are polar. It only pulls up slightly because gravity is still pulling down on the molecules. Can the adhesion ever be strong enough to pull the water up the sides of the glass tube? Yes, if the tube is narrow enough. You must have a larger amount of molecules adhering to the sides and fewer in the center. In fact, many trees to help get water to the very top use this principal. Small tubes lined with polar molecules allow water to be drawn up by adhesion. This is called capillary action. Let's see if you can get it to work in the lab.

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Activity 3

Ask your teacher for a capillary tube (**DANGER, CAPILLARY TUBES ARE FRAGILE AND BREAK WITH SHARP EDGES. IF ONE BREAKS, GET YOUR INSTRUCTOR.** Observe how small the hole is in the center of this tube. Refill the petri dish to the top. Gently hold the tube vertically and place one end of the capillary tube halfway under the surface of the water in the petri dish you used before and then move it away from the dish. Leave the top uncovered for A, use a fingertip to cover it in part B. **Don't tip the tube over, keep it vertical for part A & B.**

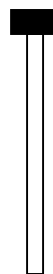
Predicted A



Actual A.



Predicted B



Actual B



6. Does the water move up the tube when you touch the surface in the dish in A? How far?

7. Why is the water staying in the tube after you moved it away from the cup and not dripping out in A?

8. Does the water move up the tube when you touch the surface in the dish in B? Explain why not.

9. Repeat the set-up for A leaving the tube uncovered. This time angle the tube into the water. Compare the amount of water in the tube now with your actual A drawing.

Repeat the set-up for part A again before continuing!!!!

Place a small piece of paper towel on the counter; now touch the bottom of the capillary tube to the paper towel.

9. The water now moves from the tube to the towel. What can you conclude about the strength of the capillary action of the paper towel verses that of the capillary tube? (Which is stronger?)

Part III - Polarity

We know that ionic bonds form due to the attraction between charged atoms. Some covalent molecules also have charged atoms as we've demonstrated with water in these activities. Remember it's a *polar molecule*. These charges are due to one atom having more force (a larger nucleus with more protons) attracting the electrons. Any unequal sharing results in a charge among the atoms in these molecules. (*Remember Mickey's face for the water molecule drawing*)

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Activity 4 (performed by teacher)

Carefully measure out exactly 50 mL of water in a 100-mL graduated cylinder. Have your teacher carefully measure out exactly 50 mL of anhydrous ethyl alcohol into a second 100-mL graduated cylinder.

10. When combining two solutions whose volume is 50ml each what should the total volume equal?

Pour the water from the first graduated cylinder (with H₂O) into the graduated cylinder containing the ethyl alcohol. Gently tap the graduated cylinder of alcohol and water then wait about one minute for the bubbles to come out of solution.

11. What can you observe about the graduated cylinder at this time?

12. What was the final recorded volume? _____

13. Predict why your answers for number 11 and 12 of Activity 4 are not the same.

Part 5. Extension

Water has other unique properties not discussed in your text. One example is the property of water that when frozen, its solid form is less dense than its liquid form.

24. Why is that important for living organisms?

25. What would happen to our fresh water lakes if the solid form was denser?

Another example is that water has a high specific heat. This means it takes more energy to raise the temperature of water one degree than other substances. Due to this property water holds its temperature longer when heat is no longer applied, and heats up slower than other liquids.

26. How does this benefit the homeostatic processes (sweating) in living organisms?

A final example is that water is a great solvent. It can dissolve other substances which contain polar bonds or are hydrophilic.

27. How do humans benefit from their bodies being mostly made of water?