Name: _____ Date: _____

# Activity: Behavioral Characteristics of Water

**Materials: Textbook pages40-43**
**Pipette(dropper) Petri dish (half) Penny 3 Paper clips Capillary tube**
**Graduated cylinder (glass & plastic) Wax paper**

## *Part I - Surface Tension Observations (cohesion)*

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

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 two water molecules forming through a hydrogen bond due to waters polarity.

**Activity 1**

Place a drop of water on the counter using the dropper. Do not drop it from high above. (Max. height about 1.5cm) Notice the shape of the drop from the top and from the side. Sketch a picture of the shape in the boxes below.

| From the top looking down | From the side looking across |
|---|---|
| | |

Compare the shape of the droplet with another you put on wax paper. Describe the differences you see between the two drops.

_____

_____

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

Define polarity: _____

_____

Name: _____ Date: _____

## Part 4 Surface Tension Observations (cohesion)

The properties of water allows some small animals to sit on the surface of the water or even run across with out falling in. Watch the video clip and read the information sheets on the Basilick lizard and the water spider to answer the following questions.

1. The Basilick lizard is said to walk on water. Does he really walk? Explain?

2. What is special about the body of the Basilick lizard which helps it move across the water?

3. Could humans move across the water in the same way? Explain?

4. What special feature does the spider have on its feet which allow it to walk on the water?

5. Does the weight of the spider (or any animal) make a difference in its ability to walk on water? Explain?

**Activity 2**

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 if you added water until it spilled over. When done picture 2 very slowly use the dropper to add water onto the penny until it overfills and sketch the result just before spilling in picture 3. Record the total number of drops before it spilled. Repeat this three times drying the penny between trials.

| Picture 1 | Picture 2 | Picture 3 |
|---|---|---|
| | | |
| Sketch of the penny w/ a drop of water | Predicted sketch of penny before spilling | Actual sketch before spilling |

| Trials | 1 | 2 | 3 | Average |
|---|---|---|---|---|
| # of Drops | | | | |

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

Name: _____ Date: _____

Observations:

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

_____

_____

2) What property of water produced the resulting shape (the bubble)?

_____

3) What is the term for the shape water takes inside of graduated cylinders?

_____

4) Define cohesion:

_____

5) Define adhesion:

_____

**Activity 3**

Use the same petri dish as before and fill it with water until the level reaches the top of the dish. Then carefully place as many of the 3 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)*

6. How many paper clips were you able to have the water support? What characteristic property of water was stronger than gravity in this example?

_____

_____

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

_____

_____

**IMPORTANT – RINSE AND DRY THE PETRI DISH BEFORE CONTINUEING!!!!!!**

Name: _____ Date: _____

***Part 2* - Meniscus (adhesion)**

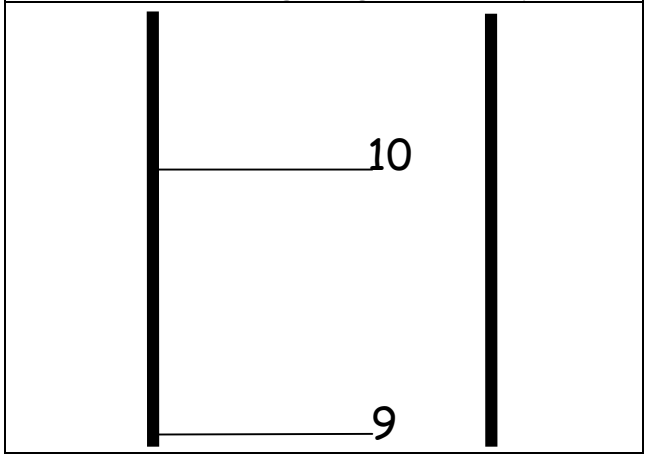
*Follow the directions and make detailed observations to help you answer the questions.*

Hydrogen bonds also allow water molecules to hold onto other polar molecules. The molecules that make up glass are also polar. Therefore, water molecules will adhere to them.

**Activity 4**

Fill a small ***glass*** graduated cylinder to the 10ml mark with water. Use the dropper to be accurate. Look closely at the top of water in the cylinder and sketch it on the following page.

The water line in a glass graduated cylinder



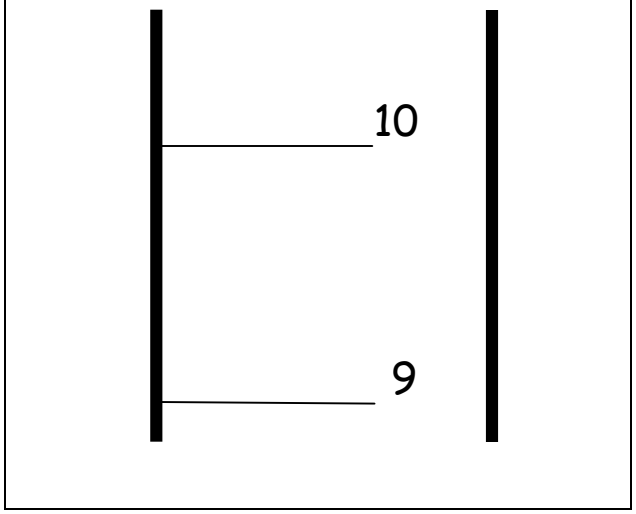

8. Is the water line strait or is it curved? Explain what causes the final shape of the water level.

_____

_____

Fill a small ***plastic*** graduated cylinder to the 10ml mark with water. Use the dropper to be accurate. Look closely at the top of water in the cylinder and sketch it below.

The water line in a plastic graduated cylinder




9. Is the water line strait or is it curved? Explain what causes the final shape of the water level.

_____

_____

Name: _____ Date: _____

10. From what you saw above are the molecules of plastic polar? Explain your logic

_____

_____

***Part 3* - Capillary Action**

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.

**Activity 5**

Ask your teacher for a capillary tube **(DANGER, CAPILLARY TUBES ARE FRAGILE AND BREAK WITH SHARP EDGES. IF ONE BREAKES, GET YOUR INSTRUCTOR).** Observe how small the hole is in the center of this tube. Gently hold the tube vertically and touch one end of the capillary tube to 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

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

_____

_____

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

_____

_____

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

_____

_____

**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.

Name: _____ Date: _____

18. 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?)

_____

_____

19. Explain your answer to question 18 in terms of surface area.

_____

_____

***Part 4* - 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. 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*)

**Activity 6 (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.

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

_____

Pour the water from the first graduated cylinder (with $H_2O$) 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.

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

_____

_____

22. What was the final recorded volume? _____

23. Explain how your answers for number 1 and 2 of Part III are not the same.

_____

_____

Name: _____ Date: _____

***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 homeostasis processes 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?

_____

_____

_____