Name ______________________________ Date ________ Period ________

PROPERTIES OF WATER LAB

PURPOSE:

In this investigation, you will observe the various properties of water, such as **cohesion**, **adhesion**, **surface tension**, and **capillary action**. You will also see how water, a **polar** substance, interacts with oil, a **non-polar** substance. Finally, you will learn how **hydrogen bonding** contributes to these important properties. By completing these activities, you will learn just how truly amazing the **H–O–H** molecule is!

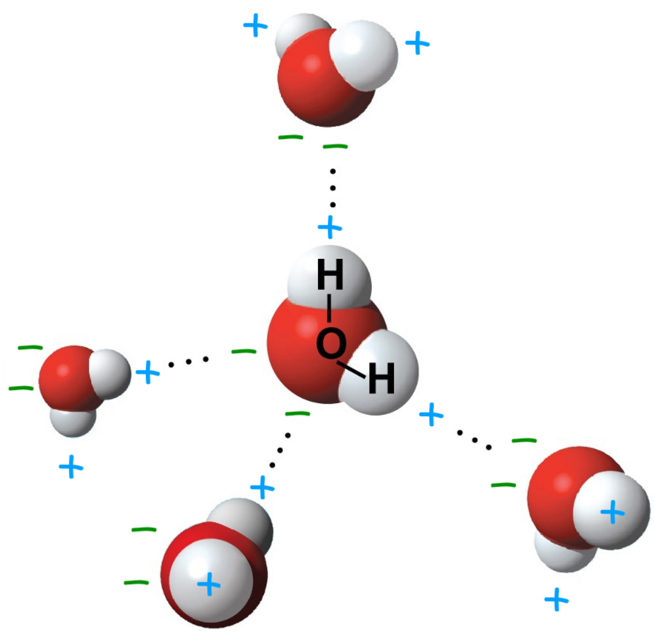
HYPOTHESIS:

If I perform multiple experiments with water, then I _______________ see hydrogen bonds.

WORD BANK FOR HYPOTHESIS: will / will not

MATERIALS PER GROUP:

- penny
- 2 slides – 1 glass and 1 plastic
- pieces of wax paper
- strip of chromatography paper
- flask filled with water
- plastic dropper
- 1 large graduated cylinder (50 ml)
- 2 small graduated cylinders (10 ml)
- stirring rod
- blue or black pen
- 2 small paper cups
- 1 small or medium beaker



SHARED MATERIALS:

- beaker with detergent
- beaker with oil
- food coloring
- ground black pepper

PROCEDURE:

Part 1 – The Climbing Property of Water

1. Water moves to the top of tall trees in part due to **capillary action**. This can be modeled using a strip of chromatography paper, a graduated cylinder, water, and a pen. Using your pen, color a dark ¼” – ½“ circle about 1” from the bottom of the chromatography paper.

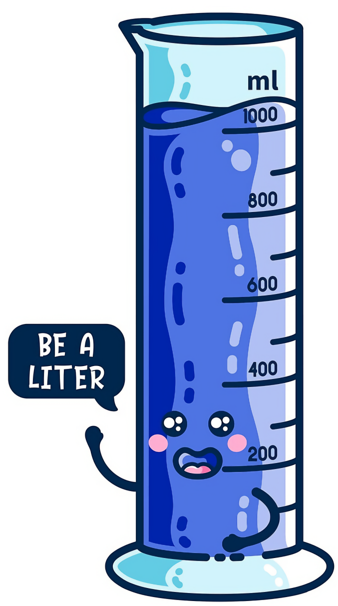
2. Pour a few milliliters of water into the graduated cylinder. Hold up the chromatography paper next to the graduated cylinder to make sure the water level is lower than the circle of ink.

3. Place the chromatography paper in the graduated cylinder, making sure that you do not get the ink wet.

4. Let the paper sit for 30-60 minutes. You should see evidence that the ink has traveled up the strip of chromatography paper. Remove the paper from the graduated cylinder.

5. Take a photo of it. Rotate the photo so that it is horizontal with the ink circle on the left side. Crop the photo.

    - a. How can you explain your results? Your answer should include a discussion of **capillary action**, **polar molecules**, and **hydrogen bonding**.



Part 2a – Drop Behavior on a Penny

6. Obtain a medicine dropper and a small (10 ml) graduated cylinder. Make sure the dropper is clean. Using the dropper, add water to the graduated cylinder, counting each drop. STOP when you have reached the 1 ml line.

   • b. How many drops are in 1 ml of water? ______________

   • c. Conversely, how many ml of water are in 1 drop? 1/_________ ml

7. Now, let's see how many drops of water you can place on the surface of a penny before it overflows. How many drops do you and your partner(s) predict?

Name of Partner	# of Drops Predicted
____________________________	___________
____________________________	___________
____________________________	___________
____________________________	___________
AVERAGE	___________

8. Drop water from the dropper onto a clean penny, keeping careful count of each drop. Draw a sketch of the penny after 1 drop, when it is half full, and when it is near overflowing.

single drop

half full

_______ drops

near overflowing

_______ drops

   • d. How many drops were you able to place on the surface of the penny before it overflowed? ______________

   • e. Explain what accounts for the difference in terms of **cohesion**.

Part 2b – Effect of Detergent on a Penny

9. With your finger, spread one small drop of detergent on the surface of a dry penny.

- f. Do you think the penny will hold, more, less, or the same amount of water? Why?

10. Specifically, how many drops do you and your partner(s) <u>predict</u>?

Name of Partner	# of Drops Predicted
____________________	________
____________________	________
____________________	________
____________________	________
AVERAGE	________

11. Drop water from the dropper onto a clean penny, keeping careful count of each drop. Draw a sketch of the penny after 1 drop, when it is half full, and when it is near overflowing.

single drop

half full

_______ drops

near overflowing

_______ drops

- g. After the detergent was added, how many drops were you able to place on the surface of the penny before it overflowed? ____________

- h. Did the detergent make a difference? Describe the effect of the detergent.

- i. What does the detergent do to the **hydrogen bonds** in between the water molecules? Explain how detergents act as cleaning agents. Consider both the **cohesion** among water molecules and the effects of **amphipathic molecules**.

Part 2c – Drop Shape on Glass, Plastic, and Wax Paper

12. What will be the shape of one drop of water on a piece of wax paper, a glass slide, and a plastic slide? Draw your <u>predictions</u> below.

________________	________________	________________
wax paper	glass	plastic

- j. Why did you make those predictions? What assumptions did you make?

13. Place one drop of water on each of the three surfaces. Draw the results below.

________________	________________	________________
wax paper	glass	plastic

- k. Compare your predictions with your observations. Explain.

- l. Explain the differences in drop behavior in terms of **adhesion**. Which surface(s) is/are able to make **hydrogen bonds** with the water molecules?

Part 3a – Water and Oil

14. Put 8 ml of water into a 10 ml graduated cylinder.

15. <u>Predict</u> what will happen if you add cooking oil. ____________
    a. The oil will float on top of the water.
    b. The oil will sink to the bottom of the water.
    c. The oil will dissolve in the water.
    d. The oil will become mixed up with the water.

16. Gently add 2 ml of cooking oil by tilting the graduated cylinder of water slightly and letting the oil run slowly down the inside of the cylinder.

17. Put 8 ml of cooking oil into a 10 ml graduated cylinder.

18. Predict what will happen if you add water. _______________
    a. The water will float on top of the oil.
    b. The water will sink to the bottom of the oil.
    c. The water will dissolve in the oil.
    d. The water will become mixed up with the oil.

19. Gently add 2 ml of water by tilting the graduated cylinder of oil slightly and letting the water run slowly down the inside of the cylinder.

• m. Describe what happened. Are the results from steps 16 and 19 the same or different? Explain.

• n. Which is less dense, oil or water? How do you know?

• o. What mechanism causes water molecules and oil molecules to separate from one another? Your explanation should involve **polar molecules**, **non-polar molecules**, **hydrogen bonding**, and the phrase **"like dissolves like".**

Part 3b – Water, Oil, and Dye

20. Observe the two graduated cylinders containing oil and water that you prepared in steps 16 and 19.

• p. Predict what will happen if you add a few drops of food coloring to each of the graduated cylinders containing oil and water. Will the dye mix with the water, the oil, or both?

21. Add a few drops of food coloring to each graduated cylinder. Use a glass stirring rod to penetrate the interface between each layer, giving the dye access to both the water and the oil.

- q. How does the dye behave in each cylinder? Does it diffuse into the oil? Does it diffuse into the water?

- r. Will the contents remain mixed? Why or why not?

- s. Determine if the food coloring is **polar** or **non-polar**. Explain your answer in terms of **hydrogen bonds**.

Part 3c – Sheen

22. Fill a clean beaker three-quarters full with water.

    - t. <u>Predict</u> what will happen if you add one small drop of oil to the water using a dropper.

23. Add one small drop of oil to the water using a dropper. (If necessary, add a few more drops of oil to see it more clearly.)

    - u. Can you see the oil? Was your prediction correct? Describe the interaction between **polar** and **non-polar** substances.

    - v. <u>Predict</u> what will happen if you add a drop of detergent to the beaker.

24. Add one small drop of detergent to the beaker.

    - w. What did you observe? Was your prediction correct?

    - x. How did the detergent effect the separation of **polar** and **non-polar** substances? Use the term **amphipathic** in your answer.

    - y. Oil spills can be very problematic to marine life. Why might scientists use detergents to “clean up” oil spills?

Part 4 – More Surface Tension!

25. Pour some water into each of two small paper cups. Fill them almost to the top.

26. Shake a little bit of ground black pepper into each cup.

27. Dip your finger into the detergent. Then stick your finger into one of the cups.

    - z. Describe the appearance inside each of the cups.

    - aa. Explain what happened in this experiment in terms of **cohesion**, **hydrogen bonds**, and **surface tension**.

<u>POST-LAB QUESTION</u>:

1. For each of the following terms, provide one "real-life" example that was not mentioned in this lab. You are allowed to use examples from the slideshow.

    a. polarity
    b. cohesion
    c. surface tension
    d. adhesion
    e. capillary action
    f. amphipathic
    g. dissolving
    h. density

<u>QUESTIONS TO HELP YOU WITH YOUR LAB REPORT</u>:

1. Did this lab have an experimental design?

2. Was your hypothesis correct? Explain using CLAIM → EVIDENCE → REASONING.

3. Identify 1 or 2 sources of error for this lab. Explain your answer(s).

4. Identify 1 or 2 ways to improve this lab. Explain your answer(s).

5. What conclusion(s) can you draw hydrogen bonds and the properties of water?

<u>ITEMS TO INCLUDE IN THE RESULTS SECTION OF YOUR LAB REPORT</u>:

5, b, c, 7, 8, d, 10, 11, g, 12, 13, 15, 18, m, n, p, q, t, u, v, w, z

<u>ITEMS TO INCLUDE IN THE DISCUSSION SECTION OF YOUR LAB REPORT</u>:

a, e, h, i, k, l, o, r, s, w, x, y, aa