Name:_____ **Date:**_____ **Period:**____

Investigating Some Properties of Water

Introduction: Water is arguably the most important molecule. Without it, biological systems, from individual organisms to ecosystems, could not function, let alone exist. It is truly critical to life; it is indispensible. This indispensability stems from the molecular structure of the water molecule itself. Can you sketch it?

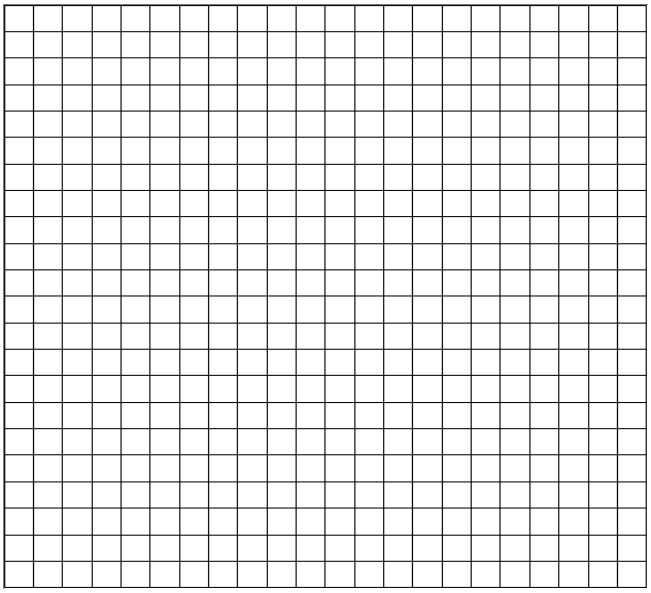
Purpose: In this activity, you will be using several tools to extend your senses. You will observe several characteristics of water.

Part I - The relationship between water's mass and its volume–
A) Using both a 10 and 25mLgraduated cylinder and balance, calculate the mass of several volumes of water. You will need to zero the balance to negate the mass of the graduated cylinder. Choose and then add an additional 5 data points to the table below, measuring the mass of increasing volumes of water. (READ YOUR MASSES AND VOLUMES TO THE NEAREST 0.1mL or gram)

Volume of Water (ml)	Mass of Water (g)
2.5 mL	
5.0 mL	
8.5 mL	

B) **Graphing the relationship between mass and volume of water** – plot the information from the data table above onto the graph provided below. Be sure to include labels and units for the axes of your graph. Set an appropriate scale for each axis. Plot volume (mL) on the x-axis and mass (g) on the y-axis. (Again, be sure to label the axis appropriately.) Provide a title for your graph. Lastly, draw a "line of best fit".

Title: _____



Calculate the slope of the graph? _____
(apply what you've learned in math class)

What does this number represent? _____
(look at the units to help you)

Part II - Adhesion/Cohesion

A) **Drops on a Penny**

Procedure:

1. Clean with soap, rinse, and dry a penny.
2. Draw up water in the dropper.
3. Place the penny, heads up, on top of a paper towel.
4. Using your dropper, add drops of water to the top of the penny until it overflows. Count the drops as you apply them!
5. Record the number of drops the surface of the penny can hold in the below.Repeat this for three trials.
6. Repeat steps #1-5 for soapy water and rubbing alcohol.

Liquid	Trial 1	Trial 2	Trial 3	Average
Water				
Soapy Water				
Rubbing Alcohol				

B) Shape of a drop of water on wax paper vs. glass slide - Fill in the data table below

1. Place several drops on the wax paper.
2. Place several drops on the glass slide.
3. Be sure that the wax paper and slide are next to each other for comparison.
4. Tilt the surfaces up and observe and record the behavior of the drops.

Surface	Prediction	Observation (drawings if needed)	Explanation
Wax Paper			
Glass Slide			

Part III - Water as a Solvent

1. Obtain 4 small, disposable cups. Label them 1-4, respectively.
2. Fill cups 1 and 2 each 1/8 full of tap water. Fill cups 3 and 4 each 1/8 full of vegetable oil.
3. Add 1-2 drops of food coloring into both cups 1 and 3. Stir vigorously. Watch to see if the food color "blends in" (dissolves) in the substance. *Record your observations of cups 1 and 3 in the data table below.*
4. Then add one heaping scoop of salt into both cups 2 and 4. Stir vigorously. Watch to see if the salt "disappears" (dissolves) in the substance. *Record your observations of cups 2 and 4in the data table below.*
5. CLEAN-UP: Dump the contents of cups 1 and 2 (water) in the sink, before throwing cups 1 and 2 out. Cups 3 and 4 (oil) can be thrown in the trash (including their contents).

Cup #	Observation Before	Observation After	Explanation
Cup 1			
Cup 2			
Cup 3			
Cup 4			

Part IV - Specific Heat Capacity of Water

Some students measured out the same mass of water, ethanol, olive oil, and mercury in beakers. (They did this with special help and in fume hoods for the mercury – it is very toxic!!). They let all four liquids equilibrate to 10°C. They then put them over identical heat sources that provided exactly the same amount of heat to each of the liquids. They then measured the temperature of the liquids for 5 minutes. Here is what they observed:

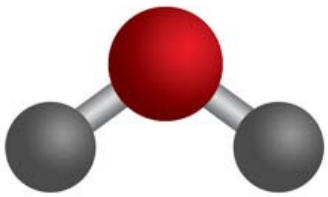
Substance	0 minutes	1 minute	2 minutes	3 minutes	4 minutes	5 minutes
water	10.0 °C	11.0 °C	11.9 °C	13.1 °C	14.0 °C	15.0 °C
ethanol	10 °C	11.6 °C	13.3 °C	15.2 °C	16.7 °C	18.1 °C
olive oil	10 °C	12.3 °C	14.2 °C	16.5 °C	18.6 °C	21.0 °C
mercury	10 °C	39.9 °C	70.0 °C	99.8 °C	120 °C	150.1 °C

Plot a graph of temperature versus time for water, ethanol and olive oil on the same graph. Be sure to include proper units, scale, and titles for each axis.Use different colors for each line.

Title: _____

Questions:

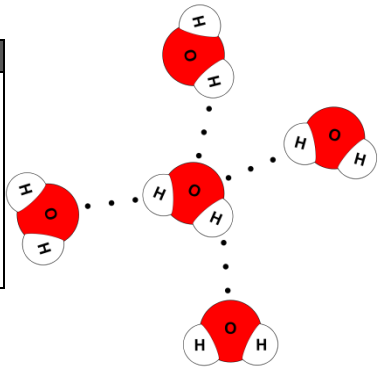
1. Label the water molecule to the right. Be sure to include the names of the elements in the molecule as well as the charges on each.



2. Explain the polar nature of a water molecule?

3. Water tends to hang out in groups of 5 molecules. This is due to the relative size of the molecules and their hydrogen bonding. Label the hydrogen bonds in the drawing below, then fill in the table explaining the differences between hydrogen bonds and covalent bonds. How many are there of each hydrogen and covalent bonds? _____ & _____

Hydrogen Bond	Covalent Bond



4. How might the number of bonds water can make with itself contribute to the formation of ice? In other words, why does ice float?

5. Why is there a difference in the number of drops you got onto the penny with the different solutions?

6. With which solution were you able to get the most drops onto the penny? Provide and explanation.

7. Why is there a difference between how the water behaves on the glass slide vs. how it behaves on the wax paper? Include the words cohesion and adhesion in your answer.

8. Why do you think water makes such a great solvent? Why is it called “the universal solvent”?

9. Specific heat capacity is an important attribute of water. Explain the role heat capacity plays in your body.

10. Why might the heat capacity be different for the four different substances you graphed?