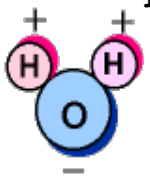
NAME _____

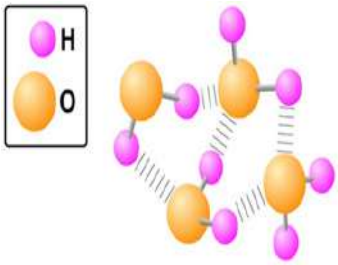
PARTNER _____

WATER LAB

Introduction:



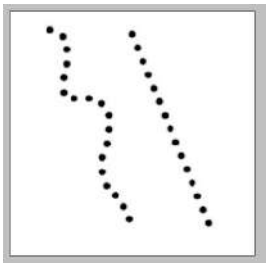
Water's chemical formula is H_2O. As the diagram to the left shows, that is one atom of oxygen bound to two



atoms of hydrogen. There are more electrons orbiting the oxygen atom compared to the hydrogen atoms, resulting in a water molecule having a positive charge on the side where the hydrogen atoms are and a negative charge on the other side, where the oxygen atom is. This uneven distribution of charge is called **polarity**. Since opposite electrical charges attract, water molecules tend to attract each other, making water kind of "sticky."

As the diagram at right shows, the side with the hydrogen atoms (partial positive charge) attracts the oxygen side (partial negative charge) of a nearby water molecule. This property of water is known as **COHESION.** The attraction between all these water molecules causes them to clump together. This is why water drops are, in fact, drops! If it wasn't for some of Earth's forces, such as gravity, a drop of water would be ball shaped -- a perfect sphere. Even if it doesn't form a perfect sphere on Earth, we should be happy water is sticky. Water is called the "universal solvent" because it dissolves more substances than any other liquid. This means that wherever water goes, either through the ground or through our bodies, it takes along valuable chemicals, minerals, and nutrients.

STATION #1



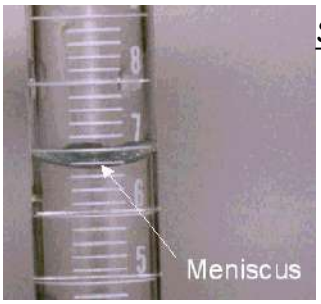
Place a sheet of WAX PAPER over the diagram and fill the start circle with water.
What happens to the water drop when you place in on the wax paper?

What property of water does this show? _____

What does this tell you about the ADHESIVE forces between water and wax paper?

Try to stretch the water drop along the path.
What happens to the back end of the drop when you pull the front end forward?

How far can you "stretch" your drop of water? _____ cm



STATION #2

Water molecules are not only attracted to each other, but can also be attracted to substances and surfaces around them. This attraction to other surfaces is called **ADHESION.**

Fill the **GLASS** graduated cylinder with water. Notice the level of the water at the top of the cylinder is not flat. The water molecules are attracted to the glass and stick to the sides of the cylinder causing it to dip down in the center. This is called a **MENISCUS.** When reading a graduated cylinder, always read the number at the **BOTTOM** of the meniscus.

Fill the PLASTIC graduated cylinder with water and look for the meniscus. What happens?

_____

The forces of ADHESION are greatest between water and which surface? PLASTIC GLASS

EXPLAIN YOUR ANSWER _____

*** * * * * * * * * * * * * * ***

STATION #3

HYPOTHESIS:
IF water molecules are polar and have a slight charge , , ,
THEN they should be attracted to another object with a charge.
Use the rod and fur provided to **TEST THIS HYPOTHESIS**
DRAW A CONCLUSION:

* * * * * * * * * * * * *

STATION #4.
Observe the paper towel race set up. The ability of water to **MOVE ALONG THE PAPER** is called **CAPILLARY ACTION**.

The attraction of the water molecules to the paper is called _____

The attraction of water molecules to each other is called _____

The adhesive properties between the water and which paper towel tested are the strongest?

STATION #5

STATION #4 How many drops of water will a penny hold?
The polarity of water molecules and its ability to form **HYDROGEN BONDS** results in a property called **surface tension**. In the center of a drop of water, each molecule is

surrounded and attracted by other water molecules. However, at the surface, those molecules are surrounded by other water molecules only on the water side. A tension is created as the water molecules at the surface are pulled into the body of the water. This tension causes water to bead up on surfaces (glass, fabric), which slows wetting of the surface and inhibits the cleaning process. You can see surface tension at work by placing a drop of water onto a penny. The drop will hold its shape and round up into a dome.

Add water to the surface of a penny ONE DROP AT A TIME keeping track of the number of drops added. When the penny is full and water starts to fall over the edge STOP COUNTING. Add class data to the table below.

Repeat the procedure using SOAPY water instead of PLAIN water. Complete the data table using class data.

	Group #1	Group #2	Group #3	Group #4	Group #5	Group #6	Group #7	CLASS AVG
Number of PLAIN WATER drops that fit on a penny								
Number of SOAPY WATER drops that fit on a penny								

DRAW A CONCLUSION

EXPLAIN why water shows surface tension.

_____

_____

Which liquid (Soapy or plain water) has the highest surface tension?
Provide evidence to support your conclusion.

_____

_____

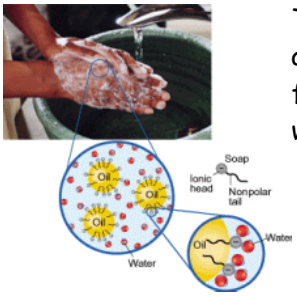
STATION #6 Explore surface tension further. Add enough water to cover the bottom of the glass bowl. Sprinkle enough pepper to cover the surface of the water. Insert a **PLAIN** toothpick into the pepper. Describe what happens.

_____

Repeat the procedure using one of the **SPECIAL** toothpicks from the labeled cup. Describe what happens.

_____

In the cleaning process, surface tension must be reduced so water can spread and wet surfaces. Chemicals that are able to do this effectively are called surface active agents, or surfactants. They are said to make water "wetter." Surfactants perform other important functions in cleaning, such as loosening, emulsifying (dispersing in water) and holding soil in suspension until it can be rinsed away. Surfactants can also provide alkalinity, which is useful in removing acidic soils.



The SPECIAL toothpick has been soaked in dish DETERGENT. Soap works because it has a POLAR end that has an affinity for water and a NON-POLAR end that has an affinity for "greasy dirt". By attaching to both water and dirt at the same time, the soap can wash away the dirt from your hands and clothes.

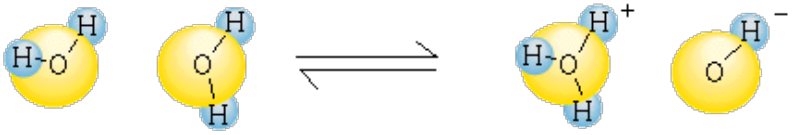
In order to clean a surface, surface tension must be INCREASED REDUCED? (Circle one)

_____

Name the surfactant used at STATION #6. _____

STATION #7

Most chemical reactions in organisms involved solutes dissolved in water. To understand chemical reactions, we need to know how many atoms and molecules are involved. Measuring small numbers of molecules is not practical. We usually measure molecules in units called moles. 1 MOLE (mol) represents an exact number of objects (AVAGADRO's NUMBER = 6.02×10^{23}).



Occasionally a hydrogen atom participating in a HYDROGEN BOND between two water molecules shifts from one molecule to another forming an H_3O^+ ion called a HYDRONIUM ION and an OH^- ion (HYDROXIDE ION). In PURE water the concentration of each is 1×10^{-7} M. That means there is 1/10,000,000th of a mole of hydronium ions per liter of pure water and an equal number of hydroxide ions. In any aqueous solution at 25° C, the PRODUCT of the H^+ and OH^- concentrations is constant at 10^{-14}. $[H^+][OH^-] = 10^{-14}$
Example: If a solution has a H^+ concentration of 1×10^{-2} the OH^- concentration would equal 10^{-12}.

Concentrations of hydronium and hydroxide ions are EQUAL in PURE WATER, but adding certain kinds of solutes called acids and bases, disrupts this balance. Biologists use something called a pH scale to describe how acidic or basic a solution is. AN ACID is a substance with a pH LESS THAN 7 that increases the H^+ concentration of a solution. A substance with a pH GREATER THAN 7 reduces the H^+ ion concentration and is called a BASE. NEUTRAL solutions have a pH = 7. Each pH unit represents a 10 fold difference in H^+ and OH^- concentrations. A solution with a pH of 3 is NOT THREE TIMES as acidic as a solution with a pH of 6, but a 1000 TIMES more acidic.

Use the pH paper provided to test the pH of the liquids listed below:

SUBSTANCE	pH	Is it an acid, base, or neutral?
Germ-X		
Water		
Pop		
Vinegar		
Maalox		
Baking soda		
Ammonia cleaner (Windex)		
Rubbing alcohol		

Which is more acidic, pop or rubbing alcohol? _____

Which is more basic, Ammonia cleaner or Germ-X? _____

How can you tell? _____

Pop is _____ times _____ acidic than Vinegar.
more less

Baking soda is _____ times _____ basic than bottled water.
more less

The pH for Pop = _____ What is the concentration of H^+ ions in pop? _____

What is the concentration of OH^- ions in pop? _____

Our stomachs produce hydrochloric acid to kill germs and help break down the food we eat. Too much stomach acid can cause an upset stomach. Use what you learned about acids and bases at STATION #5 to explain why people take antacids (like Maalox, Tums, or Rolaids) when they get heartburn. (Hint: The chemical in Maalox is magnesium HYDROXIDE)

_____

STATION #8

Use what you know about transport of water in plants to design an experiment exploring the factors that might speed up or slow down the movement of colored water up the flower stems.

WHAT ARE SOME FACTORS THAT MIGHT INFLUENCE THE RATE OF MOVEMENT UP THE STEM?

QUESTION:

HYPOTHESIS: (Use an If…. then statement)

CONTROL GROUP:

INDEPENDENT VARIABLE:

DEPENDENT VARIABLE:

How will you measure it?

Modified from: http://sps.k12.ar.us/massengale/properties_of_water.htm