**Properties of Water: a lab investigation**

**Background**

Water is a richly complex molecule, without which, life, as we know it could not exist. Water is a clear, colorless, odorless liquid with important chemical properties that influence the FORM and FUNCTION of all of the important BIOMOLECULES that are essential for life. All of the chemical reactions essential for life take place in WATER. Water is the most abundant liquid on the planet. It is everywhere—in the air we breathe and in every one of our cells. A human body is 65% water!

This lab will investigate the chemical properties of water to include:

**Polarity in the structure**

**Surface tension**

**Cohesion**

**Adhesion**

**Water as a universal solvent**

**Capillary action**

**Part I: Water is a polar molecule**

Water, H2O, is a polar molecule. This means that the oxygen atom shares a pair of electrons with hydrogen in an unequal manner. Since oxygen is more ELECTRONEGATIVE than hydrogen, it pulls the electrons towards itself more than hydrogen does. As a result, each end of the molecule carries a partial charge. Oxygen is a little bit negative while the hydrogen atoms are both weakly positive.

Look in your box and find the molecular model of water. The oxygen (red) carries a slight negative charge while the hydrogen (white) is weakly positive.

**1. Draw a picture of the molecular structure of water.**

**2. Like (+/+), (-/-) charges repel, while opposite charges attract (+/-). If hydrogen is weakly positive and oxygen is weakly positive, predict how neighboring water molecules will interact with each other. Draw a picture that shows 4 water molecules interacting.**

**Part II. Capillary action**

In your lab materials are 2 graduated cylinders (10 mL volume). Find 2 strips of filter paper, the green and orange markers and the ruler. Use one filter paper for green and the other for orange. Place a mark using the markers, at the end of each filter paper, 2 cm from the bottom edge of the paper.

1. Using a dropper, carefully add distilled water provided to the 1mL mark on the cylinder.

2. Using tweezers, being careful not to touch the glass, place the filter paper into the cylinder, colored mark end down (facing the water).

3. Note the time to mark the beginning of the experiment. Move on the next section of the lab, checking back periodically to observe the progress of the water-front as it moves up the paper. Record the time when the water gets to the top of the paper. Remove the paper and record what you see. The ability of water to “wick” up the paper relates to “capillary action”. This essential function allows water to move up the tubes in the stems of plants. ***Capillary action*** allows water to move against gravity.

**Part III: Adhesion**

Adhesion is the ability of water molecules to stick to a surface. You will investigate this in two ways. First, you will predict and then measure how many drops of water will fit on the surface of a penny. Next, you will also explore how water interacts with wax paper. In both cases, you will examine what happens to these adhesive interactions when detergent is added.

**A. Penny Exploration**

Predict: How many drops of water do you think will fit on the head of a penny?

Write your prediction on the white board so that other groups in the class can compare their predictions with yours. Fill in the table below.

***Penny Drop Experiment-Class Results***

|  |  |  |
| --- | --- | --- |
| Lab Group | Drops predicted | Drops counted |
|   |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
| mean | mean | mean |

1. Now try the experiment. How many drops were you able to place on the surface of the penny before it overflowed? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. How does this number compare with your prediction? How do these numbers compare with the predictions of other lab groups in the class? Fill in the table above with results from each lab group.

**B. Water on wax paper**

1. Place several drops of water on a piece of wax paper. You may add food coloring to the water if you wish (food coloring is found at the back of the lab on the counter with materials). Use a toothpick to push the water droplets on the wax paper. What happens to the water droplets as you roll them around on the wax paper?
2. Draw a diagram of one single water droplet on wax paper as viewed from the side.
3. Now dip a toothpick in soap and touch it to the water droplet. Draw a diagram of the result.
4. What effect do you think soap has on the chemical properties of water?
5. Predict what would happen if you put detergent on the surface of a penny before trying to add water droplets. Test your prediction and record your result here:

**Part IV. Surface Tension**

Sometimes it seems as though water forms a “skin” on the surface where it meets the air. When water molecules stick to each other at the surface we call it “surface tension”.

1. Find the petri dish in your kit. Place the dish on a white background. Fill the dish with fresh tap water. Sprinkle the surface with some black pepper.
2. Observe the pepper floating on the water.
3. Take a clean Q-tip and touch it to the surface. Record what happened.
4. Now take the Q-tip and dip it into the vial labeled “detergent” and barely touch it to the center of the surface of the peppery water in the center of the dish.
5. Record what happened to the pepper. Why do you think this happened?

**Part V: Surface tension and adhesion—paper clip challenge**

1. See if you can float a paper clip on the surface of your beaker filled with water.
2. What property allows a paper clip to rest on the surface of the water?
3. Touch the surface with detergent. Did anything happen to the paper clip?

 **Part VI: Solubility: water-The Universal Solvent**

Solubility is the ability of one substance to dissolve another substance. The chemical being dissolved is the ***SOLUTE*** while the chemical doing the dissolving is the ***SOLVENT***. Water is an excellent solvent, especially for ionic compounds. Table salt (NaCl) is an ionic compound.

The ability of ions to dissolve in cellular fluids is critical for cellular metabolism (the energy pathways of the cell).

1. Add a pinch of table salt from the cup provided, to a small beaker containing about 40 mLs of water and swirl. What happens?
2. Now find the vial with oil and salt already in it. Swirl it around. What do you notice?
3. Which is a better solvent for an ionic substance like salt…water or oil? Why might this be?