NAME: Joe

PARTNER: Dan

LAB DATE: November 13, 2006

LAB TITLE: Water – The Universal Solvent

INTRODUCTION:

Water plays a critical role in the article that we are studying ("Impact From The Deep"), and as we are beginning to learn, water is absolutely essential to life on Earth for a variety of reasons. Water's chemical composition and physical behavior are unique and have earned it the name "The Universal Solvent". In this lab we will investigate several of its most interesting and important properties and we will learn about why these properties make water so unique. You have probably observed many of these properties before in less scientific settings. Today's lab may cause you to look at water somewhat differently in the future.

PURPOSE:

To answer the following questions –

1. Why is water referred to as the Universal Solvent?
2. What are cohesion and adhesion? Are they the same?
3. What is polarity and how does it apply to water?
4. What is surface tension and why is it important?
5. How does the density of water change in its different phases (solid, liquid, gas)?

HYPOTHESIS:

1. I hypothesize that water is called the universal solvent because many different substances can dissolve in it.

2. I hypothesize that cohesion and adhesion are similar because both are types of intermolecular attraction. They are different because cohesion is attraction between like-molecules and adhesion is attraction between unlike-molecules.

3. I hypothesize that polarity is a concept in chemistry, which describes how equally bonding electrons are shared between atoms. One polar compound is water (H_2O). The electrons of water's hydrogen atoms are strongly attracted to the oxygen atom, and are actually closer to oxygen's nucleus than to the hydrogen nuclei; thus, water has a relatively strong negative charge near the oxygen atom and strong negative charge near the hydrogen atom.

4. I hypothesize that surface tension is the attraction of molecules to each other on a liquid's surface. Thus, a barrier is created between the air and the liquid. I hypothesize that it is important because it allows a controls the amount of dissolved oxygen in the water. The surface tension also allows a water skimmer to walk along the surface.

5. In general as a substance changes from gas to liquid to solid it becomes denser. However water has an exception. When water changes phase from gas to liquid it becomes denser. But when it changes state from liquid to solid it expands becoming less dense whence ice floats.

MATERIALS & EQUIPMENT:

- ❒ Water
- ❒ Small graduated cylinder
- ❒ Pipette
- ❒ Detergent

- ❒ A one penny coin
- ❒ Wax paper
- ❒ Glass slide
- ❒ Toothpick
- ❒ Small beaker
- ❒ Food coloring
- ❒ Strip of filter paper

PROCEDURE (adapted from San Diego State University web site http://www.biologylessons.sdsu.edu/):

1. Drop water into the graduated cylinder with the pipette, counting each drop.
2. Record the number of drops needed to fill 1ml of water.
3. Place your penny on the table and begin placing water drops on the surface of the coin.
4. Record the number of drops that the penny will hold before it overflows.
5. Draw the shape of the water on the surface of the penny when it's about half full and just before it overflows.
6. Repeat 2 more times being careful to dry the penny between trials.

7. Next, spread one drop of detergent on the surface of a dry penny using your finger.
8. Repeat steps 1 through 6.
9. Place a piece of wax paper on the table and place a glass slide on the wax paper.
10. Place a drop of water on the paper and another on the glass slide.
11. Record what you see.

12. Now place two drops of water on the wax paper fairly close to each other, but leaving a small space between them.
13. Dip one end of the toothpick in a beaker of water.
14. Put the toothpick near the drops but do not let the toothpick tough the drops.
15. Record what happens.
16. Try steps 12 through 15 with a dry toothpick.

17. Fill your small beaker half way with water.
18. Place one drop of food coloring in the water.
19. Place a strip of filter paper in the water.
20. Record what happens.

21. Carefully measure 5 ml of water into your graduated cylinder.
22. Label your cylinder so that you can identify it later.
23. Place your graduated cylinder in the freezer.
24. Check on it on Tuesday morning and record the volume of your frozen water.

Data Tables And Observations:

This is my data table from the first time I performed the procedure numbers 1-6.

The number of water drops it took me to fill 1ml of water: 22

Number of drops that the penny would hold before it overflowed: 25

This is the shape of the water on the surface of the penny right before it overflowed:

This is my data table from the second time I performed the procedure numbers 1-6.

The number of water drops it took me to fill 1ml of water: 22

Number of drops that the penny would hold before it overflowed: 30

This is the shape of the water on the surface of the penny right before it overflowed:

This is my data table from the third time I performed the procedure numbers 1-6.

The number of water drops it took me to fill 1ml of water: 22

Number of drops that the penny would hold before it overflowed: 30

This is the shape of the water on the surface of the penny right before it overflowed:

Observations: Every time the water overflowed it moved to one side.

This is my data table from when I repeated numbers 1-6 but I used detergent.

The number of water drops it took me to fill 1ml of water: 22

Number of drops that the penny would hold before it overflowed: 16

This is the shape of the water on the surface of the penny right before it overflowed:

This is my data table from when I repeated numbers 1-6 but I used detergent.

The number of water drops it took me to fill 1ml of water: 22

Number of drops that the penny would hold before it overflowed: 14

This is the shape of the water on the surface of the penny right before it overflowed:

This is my data table from when I repeated numbers 1-6 but I used detergent.

The number of water drops it took me to fill 1ml of water: 22

Number of drops that the penny would hold before it overflowed: 12

This is the shape of the water on the surface of the penny right before it overflowed:

These are my data tables from the procedure numbers 21-24:

Volume of frozen water on Tuesday: 5 ½ ml

Observations: Every time that we added a drop of water it (still in the form of a drop) it rolled from the top of the previous drops formed on the surface of the penny to the side of the water and then joined, but this only happened with the detergent, it did not happen when there was no detergent.

These are my observations from the procedure number 11:

When I added a drop of water to the glass slide it acted very differently from the drop of water on the wax paper, when I added it to the wax paper it was very small in area but it was taller than the drop of water on the glass slide, so the drop of water on the glass slide may have had a larger area but there volume was equal.

These are my observations from the procedure number 12-15 (with soaked toothpick):
As soon as the soaked toothpick touch the drop of water on the wax paper the drop of water seemed to immediately join with the under side of the toothpick relative to were I was looking which was around directly over the toothpick.

These are my observations from the procedure number 12-15 (with dry toothpick):
When the toothpick and the drop of water on the wax paper touched the water hardly reacted, the toothpick went directly through the water droplet hardly affecting the droplet at all. One thing that I noticed was that as the wet toothpick was leaving the opposite side that it entered it began the water droplet began to follow the toothpick in any direction as long as it stayed at a steady speed.

These are my observations from the procedure number 20:
When we added the filed paper into the water (now died red) I noticed that it soaked each bump once it reached a certain point and when I took the filed paper out it was died a light red.

These are some additional observations that I made with the alcohol that Michelle gave to us: When we added the alcohol to the 10ml beaker it took 31 drops to fill 1ml.

CALCULATIONS:

1. Calculate the volume of one drop of water from your pipette.

If it takes 22 drops of water to make one milliliter, then the volume of one drop of water is 1/22ml.

2. Calculate the average volume of water that the penny can hold with and without the detergent.

First we take the three measurements and add them together: 25+30+30= 85, then we divide

The sum by the amount of numbers we added in this case it would be three: 85/3, which equals 28.3, and we round to 28.

3. Given that 1g of liquid water takes up 1ml, what is the density of liquid water?

The density is grams divided by milliliters in this case 1/1, which is 1g/1ml.

4. What is the density of your frozen water sample?

The density is grams divided by milliliters in this case 5/5.5, which is .9g/ml.

Data Analysis:

What I measured and why I measured it: I measured the number of water droplets that will remain on the surface of a penny. I also measured the amount of water droplets that can fill one milliliter, and the rise of frozen water. These measurements allowed me to better understand the amount of space water can fill up and the increase space water takes up when water is frozen and that many droplets of water can fit on such a small surface. I also learned that when a wet toothpick approaches a water droplet as soon as they touch the water immediately joins with the toothpick, but when a dry toothpick touches a water droplet it hardly reacts.

What my data means: By dividing grams by milliliters I found that there was an increase in volume, this means that when freezing the water its volume increased but its density roughly stayed the same. For instance, before I froze the water its density was 1g/ml, after I froze the water the density was .9g/ml, so its density only lowered by .1g/ml. I was surprised to discover that there was a decrease in density. I was also surprised that the surface of a penny could hold so much water. My observational data indicates that when I added one drop of water to the glass slide it spread out more than the drop of water on the wax paper. I think that it was more spread out on the glass slide because the was a smoother surface than the wax paper and there was less friction preventing it to spread out than the wax paper.

Possible sources of error: It is worth noting that more than one drop could have come out at a time and that may alter my data for when I measured hoe many drops fill one ml I only did it once.

QUESTIONS TO CONSIDER:

1. What does cohesion have to do with the penny portion of your lab?

Cohesion is the attraction between like molecules such as water molecules, the water molecules joined together on the surface of the penny.

2. What did the detergent do & how?

The detergent created the surface of the penny smoother making he water molecules slip of that is why less drops stayed on the surface of the penny.

3. What does adhesion have to do with the wax paper & glass slide part of your lab?

Because the attraction between the water molecule and the wax paper was different between the attraction between the water molecule and the glass slide.

4. Explain how polarity is involved in the toothpick part of your lab?

So, when the wet toothpick got close enough to the water droplet they attracted to each other because they were like molecules, when the dry toothpick approached the water molecule they were not attracted due to adhesion; this is because there was no molecular attraction. It followed the wet toothpick because there was still a molecular attraction.

5. Explain surface tension and how it manifested itself in your lab.

Surface tension is the attraction of molecules to each other on a liquid's surface. Once the water had enough molecules on the bottom molecules and there weight exceeded the surface tension the molecule fell causing the water droplet to collapse and fall from the surface of the penny.

6. Why does the water move UP the filter paper despite the force of gravity?

Because the adhesion attraction is stronger on the microscopic level then the gravitational force, but on the macroscopic level the gravitational force is stronger.

7. Would you expect a substance in solid form to be more of less dense than its liquid form? How does water act and why?

Usually when a substance changes from gas to liquid to solid it becomes denser. However water has an exception, when water changes phase from gas to liquid it becomes denser. But when it changes state from liquid to solid it expands becoming less dense whence ice floats.

CONCLUSION:

My hypothesis was correct because I correctly stated that cohesion is attraction between like-molecules and adhesion is attraction between unlike-molecules, and I also correctly hypothesized that water is called the universal solvent because many different substances can dissolve in it. I also correctly stated that polarity is a concept in chemistry, which describes how equally bonding electrons are shared between atoms. I also correctly stated that surface tension is the attraction of molecules to each other on a liquid's surface. I also correctly stated that as a substance changes from gas to liquid to solid it becomes denser. However water has an exception. When water changes phase from gas to liquid it becomes denser. But when it changes state from liquid to solid it expands becoming less dense whence ice floats.

In this lab I learned: what cohesion, adhesion, polarity, surface tension and how water changing states is different from any other substance.

WEB LINKS:

http://www.uni.edu/~iowawet/H2OProperties.html

http://www.physicalgeography.net/fundamentals/8a.html