Properties of Water Lab: What Makes Water Special?
An Investigation of the Liquid that Makes all Life Possible: WATER!

Background: Water has some peculiar properties, but because it is the most common liquid on Earth, we typically do not recognize how truly peculiar water really is. Water is everywhere. It's in the air we breathe. It's in our sink faucets, and it's in every cell of our body. Water is an unusual substance with special properties. Just think about the wonder of water:
- How does water rise from the roots of a redwood tree to the very top?
- How do insects walk on water?
- Why does ice float rather than sink?
- Why do people become seriously ill, or die, if they go without liquid for a week or so?
- How would life in a lake be affected if ice sank and lakes froze from the bottom up?

When it is your turn to run your station: read aloud the information and instructions to your group. Perform any necessary activity & clean-up...get help from lab table-mates when you need it. Then, lead the discussion of what happened. Run one test at a time with everyone in your group paying attention.

What to write down: the number of the station, the title of the station, the data from the station (i.e. what you observe (qualitative data), any quantitative data, & answer any question(s) for that section.

Clean-up – it is imperative that you clean up each station so that the next class will be ready to go! Get Mrs. Futch’s initials on your paper before ANYONE leaves your lab table.

Station 1: Solubility - Water the Super Solvent – The Universal Solvent!
Solubility is the ability of one substance to dissolve another substance. (Remember: the chemical being dissolved is the solute and the chemical doing the dissolving is the solvent!). Water is a good solvent, especially for ionic compounds – salt is an ionic compound.

Ions have to be able to dissolve quickly in cell fluids for cellular metabolism (the energy pathways of a cell) to work properly! As a matter of fact, water is called the UNIVERSAL SOLVENT....Do you remember what this term means? If not, Look at your Chem notes!

1. Put a pinch of salt in the water that is already in the beaker.
2. Stir vigorously for 1 minute. Record what happens?
3. The beaker with oil already has salt in it. Stir vigorously for 1 minute. Record what happens?
4. Which is a better solvent for an ionic substance like salt .... water? or oil?
   (i.e. is it the non-polar oil?, or is it the polar water?)
   & Why might this be?
   Think back to using the water and salt models in class yesterday!

Clean-up – Leave the oil and salt as you found it. Pour the beaker of salty water into the sink. Rinse it and dry it (and dry the lab table), and fill the beaker with the same volume of water as there is oil in the beaker. Re-set the station as you found it...beakers, stir rods, salt, etc...

***As ALWAYS Clean-up - Return your station to the condition in which you found it! ...or cleaner!
Station 2: Surface Tension –

Adhesion (water ↔ other) and Cohesion (water↔ water)
Because each water molecule is polar, the water molecules are highly attracted to one another. This is especially true at the surface, where the water is much more attracted to itself than it is attracted to the air...It almost seems like water can form a skin on the surface...this is called surface tension...

Surface tension is really a combination of:
the attraction between molecules of water
= cohesion = water sticks to water = think: “water attracted to water”
& the molecular attraction between water molecules and other substances
= adhesion = water sticking to something else...think: “adhesive tape”!

1. Pour a small amount of water on a Petri dish, sprinkle the surface with some pepper....
2. Observe the pepper floating on the surface of the Petri dish.
3. Take the Q-tip from the soapy water and barely touch it to the center of the surface of the peppery water in the center of the dish.
4. Record what happened to the pepper? & 5. Why do you think this happened?

Leave lots of space here after your explanation...later, we will discuss all the cool things that were really happening and you’ll want to take notes here!

****As ALWAYS Clean-up - Return your station to the condition in which you found it! ...or cleaner!

Station 3 Surface Tension & Adhesion Drop Behavior - Water on Penny

Part A
1. Obtain a medicine dropper and a small (10 ml) graduated cylinder. Make sure the dropper is clean.
2. Drop water into the graduated cylinder with the dropper, counting each drop.
3. How many drops, of the size produced by your medicine dropper, are in each cubic centimeter (cc) of water? (1 cubic centimeter = 1 milliliter)? __________ drops
4. Conversely, how much water is in each drop? (divide 1cc by the number of drops) __________ cc. per drop, average.

Part B
1. How many drops of water can pile on a penny before it overflows? Predict in a table like below:

<table>
<thead>
<tr>
<th>person</th>
<th>#1</th>
<th>#2</th>
<th>#3</th>
<th>#4</th>
<th>Total</th>
<th>Average</th>
</tr>
</thead>
</table>

Draw this table in your notebook – use a ruler! Complete the table!
6. Now, let's see how many drops of water you can place on the surface of a penny before it overflows. Drop water from the dropper onto a penny, keeping careful count of each drop. **Draw a diagram like the one below, showing the shape of the water on the penny after one drop, when the penny is about half full, and just before it overflows.**

![Diagram](image)

**Figure 1. Drawing of Drops on a Penny**

7. How many drops were you able to place on the surface of the penny before it overflowed? 
   ________ drops

8. How is the number of drops different from your prediction, explain what accounts for any difference. Explain your results in terms of cohesion

**Station 3  Surface Tension & Adhesion  Drop Behavior - Water on Penny**

**Part C  Effects of Detergent**

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

2. How many drops do you think this penny will hold after being smeared with detergent, more, less, or the same as before? Why?

3. Exactly how many drops do you think it will hold? **Draw this table with a ruler and complete!**

   **Table 2. Prediction of # of Drops of Water on a Penny with Detergent**

<table>
<thead>
<tr>
<th>person</th>
<th>#1</th>
<th>#2</th>
<th>#3</th>
<th>#4</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Using the same dropper as before, add drops of water to the penny surface. Keep careful count of the number of drops, and **draw the water on the penny after one drop, about half full, and just before overflowing.**

![Diagram](image)

**Figure 2. Drawing of Drops on a Penny with Detergent**

5. How many drops were you able to place on the penny before it overflowed this time? 
   ________ drops

6. Did the detergent make a difference? Describe the effect of the detergent.

****As ALWAYS Clean-up - Return your station to the condition in which you found it! ...or cleaner!
**Station 4: Surface Tension - Floating Paperclip**

Using a steady hand and a piece of string, see if you can get the paper clip to rest on the surface of the water in such a way that it will not sink. After you succeed, answer the question below:

1. What property(ies) of water allows the paperclip to rest on the surface of the water?

*****As ALWAYS Clean-up - Return your station to the condition in which you found it! ...or cleaner!

**Station 5: Density of Water and Density of Ice – Ice is Weird!**

Typically solid things sink because they are denser than the liquid that they are placed in. This is true even of solids placed in a liquid of the same substance; for example, solid gold would sink in liquid gold before the solid gold melted. Let’s see how solid water acts!!!

1. Observe this principle by placing a slice of solid vegetable oil in liquid vegetable oil.
   - If you don’t already have solid vegetable oil, then get a slice from the refrigerator.
2. Record your observations of what solid oil does in liquid oil?
   - Ask yourself, which is denser solid or liquid oil?
   - Now, let’s do this with water because water behaves differently.
3. Place the solid water (what is this?) in liquid water.
   - If you don’t already have solid water, then get some from the freezer.
4. Record your observations of what solid water does in liquid water?
   - Ask yourself: Which is denser water or ice?
5. In order for the ice to have floated, what had to have happened to the molecules of water when they water froze?
   - (Think about what happens when you freeze a full water bottle that is sealed, or if you freeze a can of soda?)

*****As ALWAYS Clean-up - Return your station to the condition in which you found it! ...or cleaner!

**Station 6: The Climbing Property of Water**

Water moves to the tops of tall trees due to capillary action combined with root pressure and evaporation from the stomata (openings) in the leaves. Water will also climb up paper, and often the migrating water will carry other molecules along with it. The distance traveled by these other molecules will vary with their mass and charge.

1. How fast do you think water would climb a strip of absorbent paper about 1.5cm wide?
   - about one cm per ______ minutes
2. Observe the demonstration: 50 ml graduated cylinder, with a torn off strip of chromatography paper that is just long enough to hang over the side of the cylinder (inside) and reach to the bottom.
   - A single small drop of ink from a black vis-a-vis pen was placed on the paper, about one inch from the bottom, and it dried completely.
   - Then 10mL of water was added to the graduated cylinder so the bottom end of the paper below the ink was in the water.
3. Note the time the paper was placed in the water.
4. How does the ink change?
5. How long did it take the water to climb to the top?
6. What was the rate of water flow up the paper? ______ cm/min.

Figure 3.
50 ml Graduated Cylinder with Chromatography Paper & Ink
**Station 7: The Meniscus**

The meniscus:

1. Draw a picture like the one to the left.
2. Label the meniscus.
3. How much water is in this cylinder?
   a. 7ml  b. 6.4ml  c. 6.8ml
4. What property is making the water curve up along the sides of the glass?
5. What property is making the water curve down in the center?

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**Station 8: Capillary Action – Can water climb a thin tube? –**

**Part A:**

1. Observe the celery in the colored water on day 1, 2 or 3, 4 and 5

   **Table 3:** (give this table a descriptive title)

<table>
<thead>
<tr>
<th>observation</th>
<th>Qualitative observations</th>
<th>Quantitative observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 hours (Mon.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 or 48 hours (Tues. or Wed.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>72 hours (Thurs.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>96 hours (Fri.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. What is happening with the celery in terms of the properties of water?

**Part B:**

Write about your observations of the capillary tube demonstration!
**Class Summary**

1. Summarize class results for drops on a penny in the table below.

   **Table 4. Number of Drops on a Penny**

<table>
<thead>
<tr>
<th>Group</th>
<th># Drops without Detergent</th>
<th># Drops with Detergent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
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<td>4</td>
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<td>5</td>
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<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Explain the variation from group to group.
3. What general conclusions can you draw from the class data?

**Organizing Your Knowledge**

Describe at least one observation you have made outside the laboratory at some point in your life that illustrates each phenomenon below whether related to water or something else…..

- **Polarity**
- **Hydrogen bonds**
- **Cohesion**
- **Surface tension**
- **Adhesion**
- **Capillary action**
- **Dissolving**
- **Density**