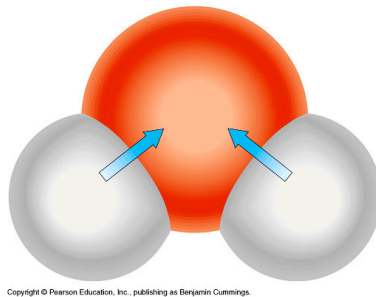


## Properties of Water Lab: AP Biology Lab 1

**Introduction:** Water is a simple molecule, yet it's most vital to all living things. It has the highest specific heat of everyday substances. Unique properties of water enable it to carry out functions that no other substances can. In a neutral aqueous solution, five molecules of water are bonded together by weak hydrogen bonds. Furthermore, due to the electronegativity of oxygen, water is a polar molecule. Due to its polarity, water is classified as the universal solvent. You will investigate the life-sustaining properties of water throughout this lab.

### **Part One: Polarity**

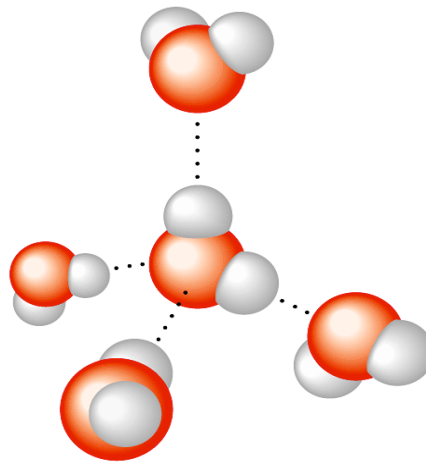
Label the diagram of water below. Make sure you label the oxygen, hydrogen atoms as well as the partial charges which creates water's polarity.



1. What causes polarity?
2. Why does polarity allow water to be such a good solvent?
3. Measure 10 grams of NaCl and add this to a beaker of 100 ml water.
  - a. Stir the salt with a spoon to dissolve. Record how long it takes to dissolve all of the salt. \_\_\_\_\_
  - b. What should we call the resulting solution? \_\_\_\_\_
  - c. Which is the solute? \_\_\_\_\_
  - d. Which is the solvent? \_\_\_\_\_

**Part Two: Hydrogen Bonding, Expansion on Freezing**

Water tends to “hang-out” in groups of five molecules. This is due to hydrogen bonding. Label the 4 hydrogen bonds shown in the below diagram. Explain what a hydrogen bond is (as compared to covalent and ionic bonds).



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hydrogen	ionic	covalent

Water expands when it freezes. Describe a test that you could complete at home to prove water expands as it freezes.

**Part Three: Adhesion, Cohesion, Surface Tension**

Adhesion is the ability of water to stick to other substances. For example, water can stick to the side of a swimming pool. Cohesion is the ability of water molecules to stick to themselves (H-bonds). Cohesion causes the surface of the water to have tension and tests can be done to measure the relative tension of different aqueous solutions. In this portion of the lab, you will test these three properties and apply them to the concept of capillary action.

**Procedure:** Obtain two pennies, 2 pipettes, and a beaker of tap water and some paper towel. You will also need your solution of salt water made in part one.

Use your pipette to drop tap water onto a penny, one drop at a time. Count how many drops you can add before any water spills over the edge. Record the number of drops in your data table. Repeat this 4 more times and find the average number of drops of tap water a penny will hold. Be sure to completely dry your penny between each trial. Repeat with your solution of salt water and then answer the questions below. Give the data table a title:

---

trials	tap water	salt water
1		
2		
3		
4		
5		
average		

1. Which type of water had more cohesion? How do you know?
2. Give an explanation for your results in terms of hydrogen bond and cohesion.

Name \_\_\_\_\_

Date \_\_\_\_\_

#### **Part 4: Capillary Action**

Water has the ability to stick onto things (adhesion) and stick to itself (cohesion). These two properties together allow water to defy gravity and climb up tubes of small diameter. This is called capillary action.

**Directions:** Obtain a stalk of celery that has been soaking in water. Holding the celery stalk under water, use a razor blade to make a new horizontal cut on the far end of the celery (away from the leaves). Measure 100 mL of water into a 250 mL beaker and add 10 drops of food coloring. Place the cut end of the celery into the colored water. Record the time below:

\_\_\_\_\_ Time placed celery in colored water

After 50 minutes remove the celery from the colored water and dry it off with a paper towel. Observe the cut end of the celery. Describe and draw below:

Using a razor blade and a ruler slice off 2 mm from the end of the celery. Observe the cut end of the celery. Does it appear the same? Keep cutting in 2 mm increments until there is a change in appearance. Draw the celery each time it appears different and label the distance of the total amount of cut celery.

1. What happened to the colored water?
2. Did the colored water travel through all parts of the celery? Explain.
3. If the water traveled differently in different places, suggest a reason for the difference you observed.

### Part 5: Specific Heat of Water

For such a small molecule, water has a very high specific heat. This means it takes a lot of energy to raise the temperature of water. Another important property is the range of temperature for which water remains a liquid. When water evaporates, like from sweat, it also removes a lot of heat from our body. Using the data below, create a graph to demonstrate the heating curve of water. The water starts out as ice and is heated until it is all water vapor. **When you are finished with the graph, label the areas on the graph as: ice, water, steam, melting, or evaporating. Don't forget to give it a title and completely label the axes.** Then answer the questions below.

minutes	degrees Celcius	minutes	degrees Celcius	minutes	degrees Celcius	minutes	degrees Celcius
0	-15	9	15	18	60	28	100
1	-10	10	20	19	65	29	100
2	-5	11	25	20	70	30	100
3	0	12	30	21	75	31	100
4	0	13	35	22	80	32	100
5	0	14	40	23	85	33	100
6	0	15	45	24	90	34	105
7	5	16	50	25	95	35	110
8	10	17	55	26	100	36	115
				27	100		

1. At what temperature does ice melt? How do you know?
2. At what temperature does water boil? How do you know?
3. Why doesn't the temperature of the water change while the ice is melting or boiling? (what is happening to the heat energy?)
4. How does water's specific heat relate to its usefulness for life? (give as many examples as possible)

Name \_\_\_\_\_

Date \_\_\_\_\_

### **Part 6: Design Your Own Investigation**

Now that you have investigated the properties of water, design your own experiment to test, measure or manipulate a property of water. Record your work in your lab note book.

Be sure to record these important aspects of your experimental design.

- 1) Property of water investigated/Background info
- 2) Hypothesis
- 3) Materials
- 4) Procedure
- 5) Data/measurements
- 6) Analysis
- 7) Conclusion/implications

You may use this space below to begin brainstorming, but be sure to write all necessary information into your lab notebook.