Investigation of the Solubility

Part 1

Purpose

The purpose of this part of the lab is to determine how temperature affects solubility.

What factors affect solubility?
You will observe individual sugar cubes dissolving in water at different temperatures. For each temperature of water, you will watch the cube and make observations. You will not stir the water, so the sugar cubes will no completely dissolve. Instead, the cubes will fall apart and become small piles of sugar at the bottom of the beakers. When one sugar cube has fallen apart and mostly dissolved, it is considered complete.

Procedures:

1. Obtain 3 sugar cubes. Using markers, color **one** side of each of the three sugar cubes. One will have a red side (goes in hot water), one will have a blue side (goes in ice water), and one will have a green side (goes in room temperature water). Only one side of each cube gets colored.
2. Obtain 3 beakers. One beaker will be filled with ice water, one with room temperature water, and one with hot water. Although the quantity of water will vary depending on the size of the beaker you choose, you want about 2 inches of water in each.
3. Record the starting temperatures of each of the water in Table 1(wiping off the thermometer in between each measurement).

Table 1: Starting and ending temperatures for the experiment

	Starting Temperature (°C)	Ending Temperature (°C)
Ice water		
Room Temperature Water		
Hot Water		

4. Record the start time for the experiment in Table 2. Record the time in minutes and seconds.

Table 2: Starting and ending times for the experiment

	Starting time (min:sec)	Ending time (min: sec)
Ice water		
Room Temperature Water		
Hot Water		

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5. Place the blue sugar cube in the ice water beaker, the green cube in the room temperature beaker, and the red cube in the hot water. First, observe how the ink from the side of the sugar cube dissolved in the water. Observe how the sugar cube dissolved in the water. Watch the cubes from the sides and tops of the beakers. Record your observations in Table 3. Repeat this process with the other two water temperatures.

Table 3: Sugar cube data

	Observations
Ice water	
Room Temperature Water	
Hot Water	

6. Record the total dissolve time for each of the water temperatures in Table 4.

Table 4: Sugar cube dissolve times

	Total time when cube dissolved in water
Ice water	
Room Temperature Water	
Hot Water	

Clean-Up

1. Carefully transfer the waste in your beakers to the sink.
2. Wash out glassware, with soap and water.
3. Place all cleaned items back where they came from.
4. Wipe your table with soap and water.

Observation questions:

1. What happened to the color on the sugar cubes?
    a. Ice water

    b. Room temperature water

    c. Hot water

2. What happened to the sugar cube as it dissolved?
    a. Ice water

    b. Room temperature water

    c. Hot water

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3. What does the water above the sugar cube look like?
    a. Ice water

    b. Room temperature water

    c. Hot water

Analysis/Conclusion

1. In which beaker did the three sugar cubes dissolve the fastest?

2. In which beaker did the three sugar cubes dissolve the slowest?

3. Did the Ice water stay Iceer than the room temperature water for the whole experiment?

4. Did the hot water stay warmer than the room temperature water for the whole experiment?

5. Why was it important to check the water temperature in each beaker at the start and at the end of the experiment?

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Part 2

Chemists say that “like dissolves like,” meaning that polar solvents tend to dissolve polar solutes, and nonpolar solvents tend to dissolve nonpolar solutes, while nonpolar and polar substances are immiscible (do not mix).You may have noticed solubility problems in your everyday life. If you get bike chain grease on your pants, sap from a coniferous tree on your shirt, or wax from a surfboard on your wetsuit, these substances are hard to remove with water. Why do you think this demonstrates a solubility problem, what is the polarity of these substances, and how do you eventually get the stain out of your clothes?

Knowing that “like dissolve like,” it is possible to determine the polar nature of various substances. Polar substances show obvious signs of dissolving in water (a polar solvent), while nonpolar solutes do just the opposite. Determine the polar nature of each item in the table by testing their solubility in what is considered the “universal solvent,” water.

Purpose

The purpose of this part of the lab is to determine the polar/nonpolar nature of various solutes when mixed with water or oil.

Procedure

1. Obtain two test tubes to test your solutes and a small beaker for waste.
2. Using the spatula (for solids) or pipette (for liquids), place a small amount of the solute to be tested into each of the test tubes.
3. Using the pipettes for each solvent (water and lamp oil), place the correct solvent into the one of the test tubes and then repeat the process using the other solvent. Approximately 10 drops of solvent per test tube.
4. Place the rubber stopper firmly but carefully in the test tube and shake gently to mix the contents.
5. Check to see if the substance dissolves into solvent to make a solution. Check for signs of solubility such as disappearance of the solute. If you are unsure, repeat step 4, and patiently watch to see if the substance dissolves or does not.
6. Record your observations of solubility in the data table. In the last column of the data table, write whether the substance is polar or nonpolar based on your observations.
7. Carefully pour the entire contents of the beaker into a waste beaker.
8. Repeat steps 1-7 until you have tested all substances.

Clean-Up

1. Carefully transfer the waste in your beakers to the sink.
2. Wash out glassware, with soap and water.

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3. Place all cleaned items back where they came from.
4. Wipe your table with soap and water.

Solute	Dissolved in Water (polar)	Dissolved in Oil (nonpolar)	Solute must be polar or nonpolar?
Glucose			
Hexane			
Aspirin			
Vegetable Oil			
Naphthalene			
Sodium Bicarbonate			
Urea			
Sodium Cholride			
Ammonium Chloride			
Copper II Sulfate			
Ethanol			
Iodine			

Analysis/Conclusion

1. For centuries, sailors used tree sap (pitch) to seal the spaces between the planks on wooden boats. Explain why pitch works well as a sealant.

2. Turpentine, a solvent, dissolves oil-based paints, but not latex house paints. Explain why you think this is so.

3. In order to reduce exposure to organic solvents, some art instructors recommend that students clean brushes and hands with a vegetable oil or mineral oil. Would such oils be more effective removing water-based pains or oil-based paints? Explain.

4. Coffee, tea, and soft-drink stains are generally removed in the wash, while

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stains from candle wax, salad dressing, and peanut butter require special treatment. Explain.

5. Explain the why oil can't blend /mix with water.

6. Based upon your lab, explain the phrase “like” dissolves “like.”

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Part 3 – PERFORM AT YOUR DESK

Purpose

The purpose of this part of the lab is to determine the other factors that affect solubility.

Materials: Sweet-tarts or smarties

Procedure

1. Place one piece of candy in your mouth and allow it to dissolve without using your tongue or teeth to help! Record the time it takes for the candy to dissolve in the chart. (Complete other parts of the lab while you wait!)
2. Place another piece of candy in your mouth and allow it to dissolve using only your tongue to move it around. Record the time it takes for the candy to dissolve in the chart.
3. Place another piece of candy in your mouth and allow it to dissolve using your tongue and teeth. Record the time it takes for the candy to dissolve in the chart.

Piece of Candy	Dissolving Time
1st	
2nd	
3rd	

Clean-Up

Make sure you candy wrapper is placed in the trash.

Analysis/Conclusion

1. Use your data to create a line graph on the back of this page showing your results. Be sure to label the parts of your graph!
2. In your solution, what was the solute and the solvent?

   Solute=_____ Solvent= _____

3. Identify the solute(s) and solvent in each solution.

HINT: A SOLUTE dissolves in a SOLVENT!

Solution	Solute(s)	Solvent
Ocean water		
Kool-Aid		
Antifreeze		
Pepsi		
Lemonade		
Sterling Silver		

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4. What liquid is called the “universal solvent”?

5. Which would have the most SOLUTE: a glass of very sweet Kool-Aid or a glass of barely sweet Kool-Aid? Give a reason for your answer.