

**Inquiry Question****Which solids can dissolve in which liquids?****Name:** \_\_\_\_\_ **Date:** \_\_\_\_\_

Solutions are a special kind of mixture and solubility is a term used to describe the amount of materials (solids, liquids, or gas) which can be dissolved in a solvent to make a solution. A solvent is the dissolving agent, ex. water. A solute is the substance that is dissolved into solution. The research aspect of this project is testing the solubility of a variety of solids in several common liquid substances.

Several common liquids such as water, rubbing alcohol, and club soda will have solids such as salts, sand, baking soda, etc. added to them in order to determine which solids dissolve in which liquids at room temperature. The rule of thumb for solubility in different solvents is "like dissolves like." What does this mean?

Based on the results of this investigation, a data table will be prepared and the results plotted on a series of graphs.

### General Instructions

The goal of this project is to learn about solubility and get a better idea of which solids can dissolve in which liquids.

#### Materials you'll need:

- Rubbing alcohol
- club soda
- cooking oil
- table salt
- baking soda
- table sugar
- Epsom salt
- plastic drinking cups
- coffee stirrers
- metric measuring cup
- clean playground or beach sand and rubber or Latex disposable gloves

#### Ideas and Hints:

This project involves investigating solutions in which the solvent is a liquid. Whether a substance will dissolve in a particular solvent depends on both what the substance is and what that solvent is. The rule of thumb for solubility is "like dissolves like."

This means that, in general, polar compounds are soluble in polar solvents and non-polar compounds are soluble in non-polar solvents. Water is an example of a polar solvent. Cooking oil is an example of a non-polar solvent.

Polar compounds are more positively charged at one end and more negatively charged at the other. They have a positive pole and a negative pole, hence the term polar. This can be compared to a battery that has a positive pole and a negative pole. Non-polar compounds do not have a charge difference between the ends. They do not have charged poles or ends.

Water is the most commonly used liquid solvent. It is sometimes called the "universal solvent" because it dissolves more substances than any other liquid solvent. This is due to the polar nature of water.

#### Research Questions

- What is a solvent?
- What is a solute?
- Which solvent was able to dissolve most or all of the solutes?
- Which solute was the most soluble in the solvents tested?
- Does it seem accurate to call water a "universal solvent" based on your results?

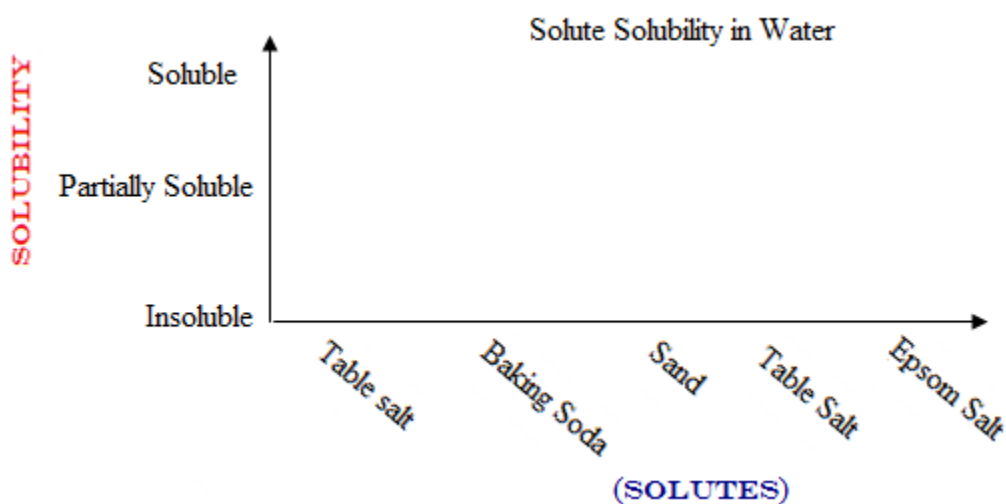
Include any required diagrams/pictures (remember, a picture is worth a thousand words!)

### Experimental Procedure

1. On a sheet of paper, or with the use of a computer and printer, make a table similar to the one shown below.
2. Using a graduated measuring cup, measure out 10 ml of water and pour into a cup.
3. Measure out a teaspoon of table salt and add it to the cup of water and stir using a coffee stirrer.
4. If all of the salt (solute) disappears then the solute is said to have dissolved in the solvent and a solution is produced. An insoluble solute will settle out of the mixture. Insoluble solutes are usually found at the bottom of the cup or floating on the surface of the liquid.
5. Record the results by writing the words "soluble" if the entire solid dissolves (nothing left at the bottom), "insoluble" if the solid doesn't look like it dissolved at all, or "partially soluble" if it looks like just some of the solid dissolves.
6. In another clean cup, add 10 ml of water but this time add a teaspoon of sand and stir. Record the results in the table as before.
7. Repeat the same procedure for the Epsom salt, baking soda, and sugar. Each time, use a clean cup and coffee stirrer.
8. Now switch to gears to different liquid solvents. Follow the same procedure for the rubbing alcohol, club soda, and cooking oil.

|                 | <b>Solutes:</b> |             |      |             |            |
|-----------------|-----------------|-------------|------|-------------|------------|
| <b>Solvents</b> | Table Salt      | Baking Soda | Sand | Table Sugar | Epsom Salt |
| Water           |                 |             |      |             |            |
| Alcohol         |                 |             |      |             |            |
| Club Soda       |                 |             |      |             |            |
| Cooking Oil     |                 |             |      |             |            |

9. Using graph paper, visually display the data in the table by plotting a bar graph similar to the one shown below. The names of the solutes should be along the horizontal axis and their solubility ratings in water should be along the vertical axis. Repeat this same procedure for each solvent tested. There should be a total of four bar graphs, one for each solvent.

**Project submission:**

You can either submit photos or a video of your project (along with an explanation and/or steps of construction) or, if you can drop-in to the school, you can present this project to your teacher in-person. Be sure to carefully organize any data collected so that any other student or teacher could reproduce your experiment and achieve the same results.