

Name: _____ Class: _____ Date: _____

Drink Mixture - Concentration vs. Solubility

Learner Outcomes:

- Investigate the solubility of different materials, and describe their concentration.
- Investigate and identify factors that affect solubility and the rate of dissolving a solute in a solvent (e.g., temperature, agitation, etc).

Key Terms:

| | | |
|---------------|---------|----------|
| solubility | solute | solution |
| concentration | solvent | dilution |

Background Information: Scientists have a variety of ways of describing liquid matter. Some liquids are made up of only one kind of particle, and so they are called pure substances. Other liquids are made up of more than one substance and so they are called solutions. The liquid in the larger amount is called the solvent and the liquid in the smaller amount is called the solute. A variety of factors will influence the proportion of solute to solvent in a solution.

Research Questions:

1. What is the difference between concentration and solubility?
2. How does temperature affect the concentration of a solution?
3. What happens to the number of solute particles in a solution when a solution is diluted?

Materials:

| | | |
|---|-------------------------|-------------|
| Food safe paper cups | | |
| Drinking water | Talcum powder | Wax paper |
| Koolaid drink powder (colored and sweetened) | Food safe measuring cup | Eye dropper |
| | Kettle | Wax pencil |

Procedure:

Part A - Concentration;

1. Using a measuring cup, pour exactly 100 mL of water into your drinking cup. Use a pencil or marker to mark the top of the water level.
2. Weigh out and record the mass of 1 level teaspoon of iced tea or KoolAid powder into the 100 ml cup. Discard.
3. Weigh a second level teaspoon of drink powder and add it into the 100mL of water without stirring. Record your observations.
4. Stir in the drink powder. Taste and make note of the color and record your observations. Calculate the concentration.

5. Add drink powder one teaspoon at a time (stirring) until powder crystals remain in the bottom of your cup. Record how many teaspoons were used, taste and note the color. Calculate the concentration. Dispose of the contents down the sink and rinse your cup.

Part B - Effect of Temperature

6. Repeat steps 1-5 (omit step 2) using 100 ml of hot water from the kettle. Record your observations.

Part C - Dilution

7. Draw 5 x 8cm diameter circles on piece of wax paper using a wax pencil.
8. Using the eyedropper, place 10 drops of the solution from part B in the first circle. Note the color of the circle.
9. Take one drop of the drink from the first circle and place it in the second circle. Add 10 additional drops of plain water and gently mix with the tip of the eyedropper. Record your observations.
10. Take one drop from the second circle and place it in a third circle. Add 10 additional drops of plain water and gently mix. Record your observations.
11. Repeat the process for the fourth and fifth circles, using one drop from the previous circle and adding an additional 10 drops of plain water.

Part D - Solubility

12. Empty and rinse your cup and add 100mL of room temperature water and one level teaspoon of talcum powder, stir and record your observations.
13. Discard the "solution" and repeat step 12, using 100 mL of hot water. Record your observations.

Observations:

Parts A and B:

Mass of 1 level teaspoon of drink powder _____ g

Volume of water used _____ mL

| | Cool Solution (Part A) | Warm solution (Part B) |
|--|-------------------------------|-------------------------------|
| Observations after adding 1 tsp drink powder - unstirred | | |
| Observations after adding 1 tsp drink powder - stirred | | |
| Concentration with 1 tsp drink powder. | | |
| Number of tsp added until no more dissolves | | |
| Observations when no more dissolves | | |
| Concentration when no more dissolves | | |

Part C:

| Sample | Observations |
|-----------------|---------------------|
| Circle 1 | |
| Circle 2 | |
| Circle 3 | |
| Circle 4 | |
| Circle 5 | |

Part D:

| | Talcum powder in cold water | Talcum powder in warm water |
|---------------------|------------------------------------|------------------------------------|
| Observations | | |

Analysis:

1. When you added 1 tsp of drink powder to the 100 mL of cold and 100 mL of warm water, did the concentration change? Explain.
2. What happened when the drink powder stopped dissolving? Was the concentration any different in the hot water than it was in the cold water? Why?
3. What impact did dissolving in hot water have on the solubility of the drink mixture? What does this tell you about solubility?
4. How did the concentration compare between using 1 tsp of drink powder and multiple teaspoons when it quit dissolving? What other evidence showed you that the concentrations were different?
5. On the wax paper, what was the difference between the first circle and the 5th circle? What would you expect the 5th circle to taste like?
6. Compare your results when you dissolved the drink powder and the talcum powder in the cold water? What was the difference?

7. Did it matter whether you used hot or cold water to dissolve the talcum powder? Why or why not?

Conclusion: Answer each of the research questions in a short statement or paragraph.

Extension:

1. Design an experiment to measure the solubility concentration of salt dissolved in one liter of water at 23°C.
2. Design an experiment to test and compare the solubility of two other drink solutions.
3. Use the information on the package of at least two different drink mixes to determine and compare the concentration of each drink when mixed in the recommended proportions. Why are they similar? Why are they different?