

Name: _____ Date: _____

Student Exploration: Solubility and Temperature

Vocabulary: concentration, dissolve, homogeneous mixture, solubility, solubility curve, solute, solution, solvent

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

1. What happens when you stir a spoonful of sugar into hot water? _____

2. When sugar or another substance is **dissolved** in water, it disappears from view and forms a **homogeneous mixture** with the water, also called a **solution**.

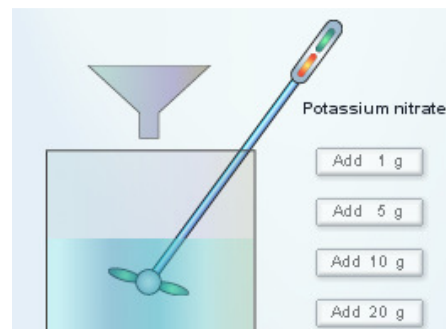
If you can't see the sugar, how can you tell that it is there? _____

3. Does sugar dissolve more easily in hot water or cold water? _____

Gizmo Warm-up

A solution generally consists of two parts, a **solute** that is dissolved and a **solvent** that the solute is dissolved into. For example, sugar is a solute that is dissolved into the solvent water. In the *Solubility and Temperature* Gizmo™, you will study how temperature affects how much solute will dissolve in a solution.

To begin, check that **Potassium nitrate** is selected and the **Temp.** of the water is 20 °C. Click **OK**.

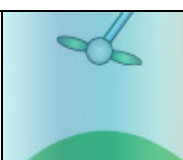


1. In this solution, what is the solute? _____ What is the solvent? _____

2. Click **Add 10 g** to mix 10 g of potassium nitrate into the water.

A. Did all of the potassium nitrate dissolve? _____

B. How can you tell? _____

Activity A: Solubility	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> • Click Reset. • Check that the Temp. is 20 °C and that Potassium nitrate is selected. 	
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Question: How do we find how much solute can be dissolved in a solvent?

1. Observe: Click **OK**. Click **Add 20 g**, and observe the potassium nitrate being mixed into the solution. On the right, select the **BAR CHART** tab and turn on **Show numerical value**. The bars show how much solute has been added and how much has piled up on the bottom.

Did all of the solute dissolve? _____

2. Calculate: The **concentration** of a solution is equal to the mass of solute divided by the volume of solvent. Units of concentration are grams per 100 milliliters (g/100 mL, or g/dL).

What is the concentration of this solution? _____

3. Experiment: Click **Add 20 g** again.

A. Did all of the solute dissolve? Explain how you can tell. _____

B. Based on the amount of solute added and the amount piled up on the bottom, how many grams of solute dissolved in the water? _____

C. The **solubility** of the solution is equal to the maximum concentration of the solute.

What is the solubility of potassium nitrate in 20 °C water? _____

4. Experiment: Click **Reset**, and select **Sodium chloride**. With the **Temp.** still set to 20 °C, click **OK**. Add sodium chloride to the beaker until it starts piling up at the bottom.

A. How much sodium chloride did you add? _____

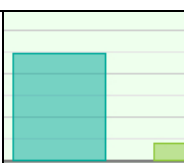
B. How much sodium chloride piled up at the bottom? _____

C. How much sodium chloride dissolved in the water? _____

D. What is the solubility of sodium chloride in 20 °C water? _____

5. Apply: At 20 °C, how much sodium chloride could be dissolved into 2 L of water? _____

How much potassium nitrate could be dissolved into the same amount of water? _____

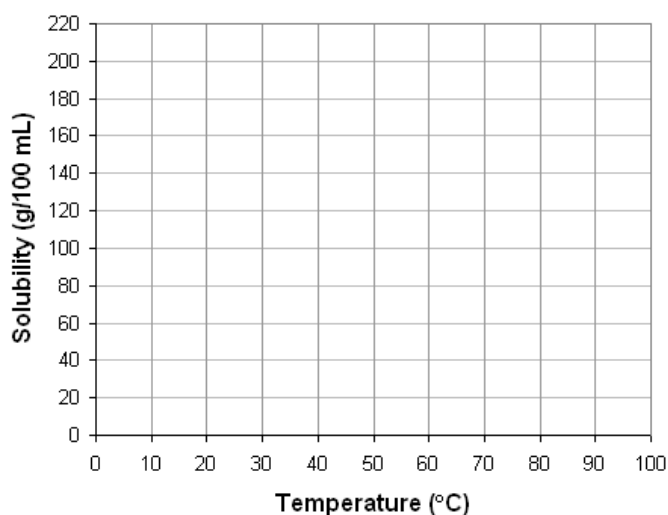
Activity B: Solubility and temperature	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> • Click Reset. • Set the Temp. to 10 °C. • Select Potassium nitrate, and click OK. 	
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Question: How does temperature of the solvent affect solubility?

1. Predict: Based on your own experience, how do you expect temperature to affect solubility?

2. Gather data: Use the Gizmo to measure the solubility of potassium nitrate at each temperature given in the table below. Then, graph the resulting **solubility curve** at right.

Temperature	Solubility (g/100 mL)
10 °C	
20 °C	
30 °C	
40 °C	
50 °C	
60 °C	
70 °C	
80 °C	
90 °C	



3. Infer: Based on your graph, what would you predict is the solubility of potassium nitrate at a temperature of 5 °C? 95 °C? Check your 5 °C prediction with the Gizmo.

5 °C predicted solubility: _____ 5 °C actual solubility: _____

95 °C predicted solubility: _____ (Impossible to find actual solubility using Gizmo.)

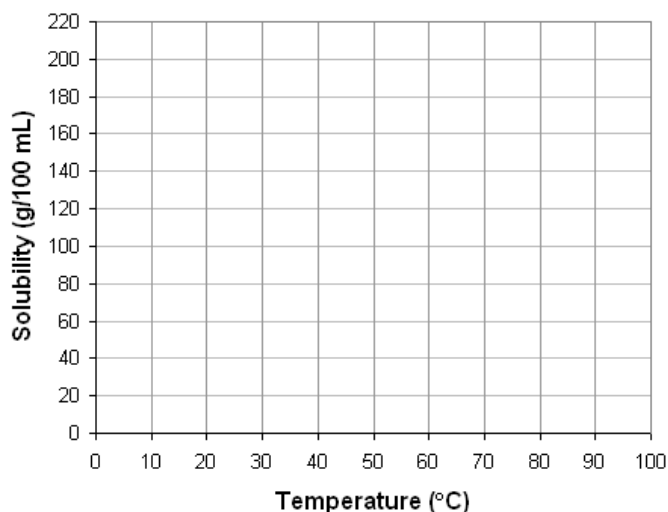
4. Explain: Potassium nitrate absorbs a large amount of heat energy from the water as it dissolves. How does this explain the solubility curve you graphed for potassium nitrate?

(Activity B continued on next page)

Activity B (continued from previous page)

5. Gather data: Now use the Gizmo to measure the solubility of sodium chloride at each temperature given in the table below. Then, graph the solubility curve of sodium chloride.

Temperature	Solubility (g/100 mL)
10 °C	
20 °C	
30 °C	
40 °C	
50 °C	
60 °C	
70 °C	
80 °C	
90 °C	



6. Infer: Based on your graph, what would you predict is the solubility of sodium chloride at a temperature of 5 °C? 95 °C? Check your predictions with the Gizmo.

5 °C predicted solubility: _____ 5 °C actual solubility: _____

95 °C predicted solubility: _____ 95 °C actual solubility: _____

7. Compare: How does the solubility curve for sodium chloride compare with the solubility curve for potassium nitrate?

8. Infer: Potassium nitrate absorbs a lot of heat from water as it dissolves. Based on its solubility curve, what can you infer about how much heat sodium chloride absorbs?

9. Think and discuss: What do you think the solubility curve would look like for sugar? Explain.
