

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? \_\_\_\_\_

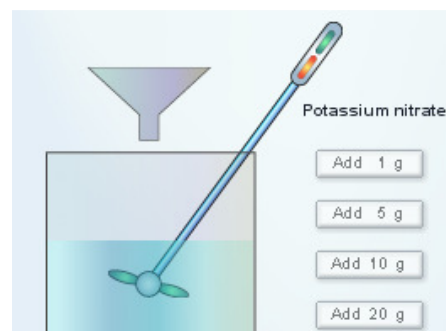
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3. Does sugar dissolve more easily in hot water or cold water? \_\_\_\_\_

### 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**.



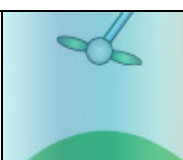
1. In this solution, what is the solute? \_\_\_\_\_ What is the solvent? \_\_\_\_\_

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? \_\_\_\_\_

\_\_\_\_\_

<b>Activity A:</b> <b>Solubility</b>	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> <li>• Click <b>Reset</b>.</li> <li>• Check that the <b>Temp.</b> is 20 °C and that <b>Potassium nitrate</b> is selected.</li> </ul>	
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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? \_\_\_\_\_

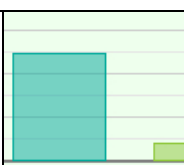
B. How much sodium chloride piled up at the bottom? \_\_\_\_\_

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? \_\_\_\_\_

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

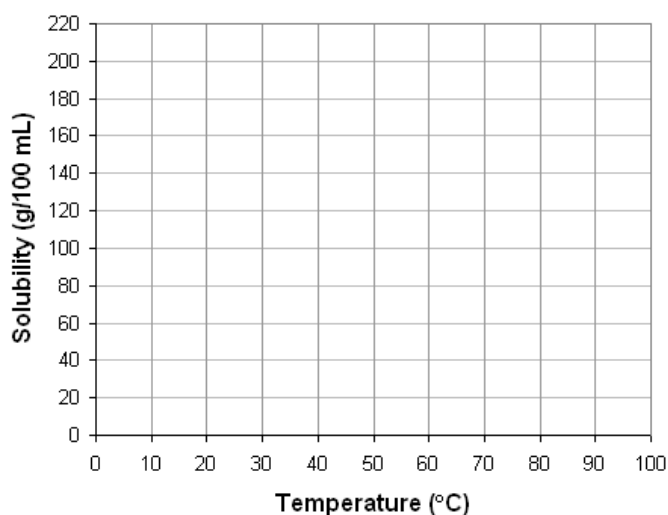
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2. Gather data: Use the Gizmo to measure the solubility of potassium nitrate at each temperature given in the table below. Then, graph the resulting **solubility curve** at right.

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?

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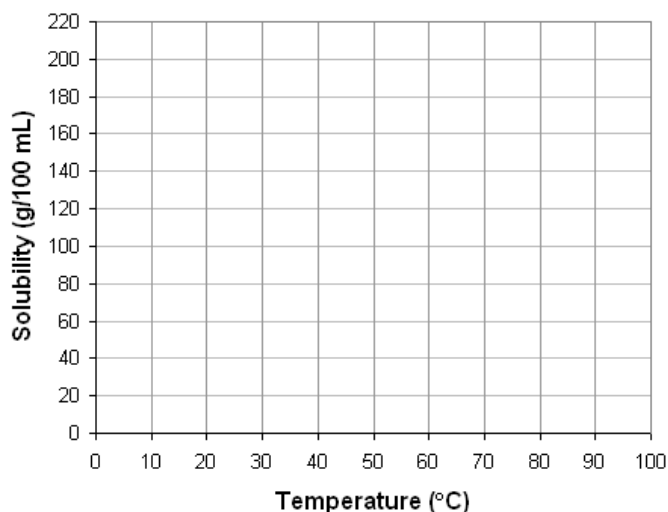
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**(Activity B continued on next page)**

**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?

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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?

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

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