Name: _____ Date: _____

Student Exploration: Freezing Point of Salt Water

Vocabulary: freeze, freezing point, liquid, melt, melting point, solid, transformation rate

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

1. In the winter, people often buy large bags of rock salt to sprinkle on their walkways. Why do people do this? _____

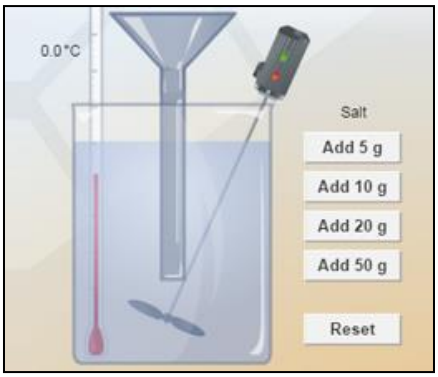
   _____

2. The **freezing point** of pure water is 0 °C (32 °F). How do you think adding salt to water affects its freezing point? _____

   _____

Gizmo Warm-up

People often use salt to alter the freezing point of water. The *Freezing Point of Salt Water* Gizmo shows you how this works.



1. With the **Room temp.** set to 0.0 °C, observe the water molecules in the **Molecular view**. Describe the motion of water molecules in the **liquid** phase:

   _____

   _____

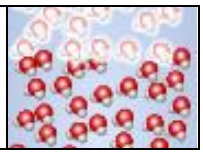
2. Set the **Room temp.** to -10.0 °C and observe. What is happening? _____

   _____

   The process of changing from a liquid to a **solid** is called **freezing**.

3. Describe the motion of molecules in a solid: _____

   _____

Activity A: **Freezing point depression**	Get the Gizmo ready: • Click **Reset**. • Set the **Room temp.** to 5.0 °C.	

Question: How does salt affect the freezing point of water and the melting point of ice?

1. Observe: With the room temperature at 5.0 °C, the water should be in a liquid state. Lower the **Room temp.** one degree at a time until the water first starts to freeze. Look at the thermometer inside the container of water

   A. What is the freezing point of pure water? _____

   B. Lower the **Room temp.** a few more degrees. What do you notice about the water temperature as the water is freezing?

   _____

   C. Lower the **Room temp.** to -10.0 °C, wait until all the water has frozen, and then wait a little while more. What happens to the ice temperature after all the water is frozen?

   _____

   _____

   D. Now raise the **Room temp.** back to 5.0 °C and observe the thermometer inside the container. At what temperature does the ice **melt**? This is the **melting point** of ice.

   _____

2. Predict: How do you think adding salt will affect the freezing and melting points of water?

   _____

   _____

3. Experiment: Click the **Add 50 g** button to add 50 grams of salt to the water. Lower the **Room temp.** to -10.0 °C and observe the temperature as the water freezes.

   What is the freezing point of this salt solution? _____

4. Observe: Look for the salt particles in the ice. What do you notice? _____

   _____

(Activity A continued on next page)

Activity A (continued from previous page)

5. Experiment: After the water has completely frozen, raise the **Room temp.** to 5.0 °C. Observe the water temperature as the ice melts.

   What is the melting point of this salt solution? _____

6. Collect data: Use the data you have collected so far to fill in the first two rows of the table below. Then, find the freezing and melting points of water with 100 grams of salt.

Amount of salt (g)	Freezing point (°C)	Melting point (°C)
0 g		
50 g		
100 g		

7. Summarize: How does increasing the concentration of salt affect the freezing and melting points of water? _____

   _____

8. Analyze: How much is the freezing point lowered by adding 50 g of salt? _____

9. Test: Based on your data, what do you expect the freezing and melting points to be when 150 grams of salt are added? How about with 200 grams of salt? Write your predictions in the appropriate columns below.

Amount of salt	Freezing Point (predicted)	Freezing Point (actual)	Melting point (predicted)	Melting Point (actual)
150 g				
200 g				

   After writing your predictions, use the Gizmo to find the actual values. Fill in as much of the table as you can. (Write “less than -10 °C “ or “< -10 °C “ if the actual value is less than the minimum room temperature available in the Gizmo.)

10. Think and discuss: Why do people add salt to roads and walkways in the winter?

    _____

    _____

    _____

Activity B: **Transformation rates**	Get the Gizmo ready: • Click **Reset**. • Turn on the **Transformation rate** checkbox.	

Introduction: The **transformation rate** is the speed at which particles are changing from one phase to another. In the **Transformation rate** display, the purple bar represents the speed of liquid water changing to ice, while the green bar indicates the speed of ice changing to liquid.

Question: How does salt affect transformation rates?

1. Observe: Move the **Room temp.** slider back and forth, and observe the effect on the transformation rates. What do you observe?

   _____

   _____

   _____

2. Explain: As the temperature of a liquid increases, the average speed of the molecules increases as well. How does this account for the observed changes in transformation rates?

   _____

   _____

   _____

3. Predict: How will adding salt affect the water-to-ice and ice-to-water transformation rates?

   _____

   _____

4. Experiment: Set the **Room temp.** to -5.0 °C, and observe the transformation rates. Add 50 g of salt before the ice reaches the bottom of the funnel.

   A. How does adding salt affect each transformation rate? _____

      _____

      _____

   B. Now add 50 more grams of salt. What happens now? _____

      _____