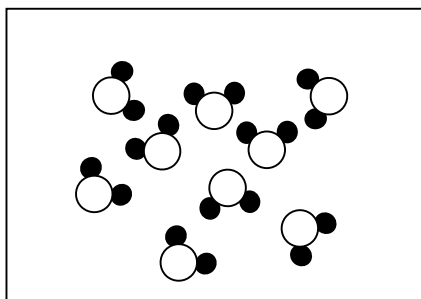


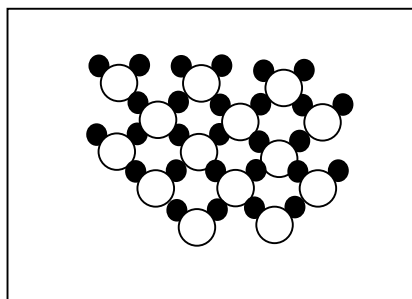
Science
Physical Science
Grade 8
Phase Change

Overview (For the Teacher)

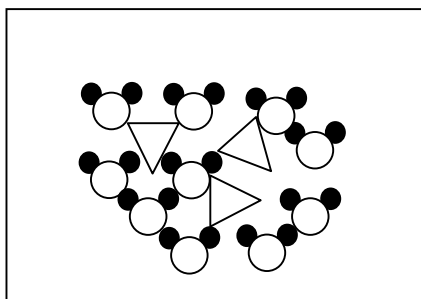
Molecular motion changes with changes in temperature. As the temperature and motion of liquid water molecules decreases, water molecules are able to move closer together until they fall into a regular repeating pattern.



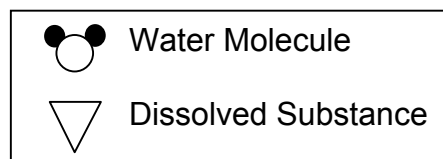
Liquid Water



Solid Water (Ice)



Water with Dissolved Substances
at 0° Centigrade



Symbol Key

Substances dissolved in liquid water interfere with the formation of a regular repeating pattern when water is cooled to form ice. Liquid water, containing dissolved substances, must be cooled to a lower temperature than plain water in order to freeze.

Temperature is a measure of molecular motion. The metric measurement for temperature is Centigrade or Celsius. Plain water freezes at 0° Centigrade.

In this investigation students will make ice cream by freezing a milk mixture. Milk is composed of dissolved substances and other substances suspended in water. These substances cause the freezing point to drop below the 0° Centigrade for plain water. Students will find that cooling their liquid ice cream mixture with plain ice will not allow

the mixture to freeze. They will observe that adding salt to the ice will keep the temperature low enough to make solid ice cream.

Teacher Preparation

1. Students should work in groups of 4.
2. Assemble all the materials in a central location.
3. Spread newspapers on student work areas. This is a very messy lab activity.
4. You may want to put newspaper on the floor around work areas because it tends to get wet and slippery.
5. Get the large plastic trash bag ready for students to discard trash.
6. Have students clean work areas with soap and water after the activity. If you don't have running water in your classroom, you may want to have a pan with soapy water and paper towels available for students.
7. Keep the milk at a safe temperature, especially if you do this activity for multiple classes. Do not allow students to pour milk back into the original container.
8. Supervise the addition of the vanilla to the ice mixture. It contains alcohol. In small quantities the alcohol vaporizes, but some students may add more than the recommended quantity.
9. Ice cubes are better to use than crushed ice. Students need to use the same amount of ice. Ice cubes can be counted instead of massed.

Benchmarks

- SI-M-A2** Designing and conducting a scientific investigation
- SI-M-A3** Using mathematics and appropriate tools and techniques to gather, analyze and interpret data
- SI-M-A4** Developing descriptions, explanations, and graphs using data
- SI-M-A7** Communicating scientific procedures, information, and explanations
- SI-M-A8** Utilizing safety procedures during scientific investigations
- PS-M-A5** Investigating the relationship among temperature, molecular motion, phase changes, and physical properties of matter
- PS-M-A4** Understanding that atoms and molecules are perpetually in motion
- PS-M-C5** Investigating and describing the movement of heat and the effects of heat in objects and systems

Open

Class Discussion- 15 Minutes

1. What happens to the motion of water molecules as water freezes?
[Decreases]
2. Demonstration:
 - Hold up a clear plastic cup containing enough marbles to cover the bottom of the cup.
 - Hold your hand over the cup and shake the cup so students can see the marbles moving around in a random manner.
 - Tell students that the bouncing marbles in the cup represent liquid water.
 - Allow the marble to stop moving and line the bottom of the cup. Tip the cup so the students can see the regular repeating pattern the marbles make on the bottom of the cup. Tell students that this represents ice.
3. What is the difference between the motion and arrangement of water and ice molecules?
[Liquid- molecules move fast in a random arrangement]
[Solid- molecules move slower and are arranged in a regular repeating pattern]
4. How is temperature measured?
[With a thermometer in Centigrade or Celsius]
5. At what temperature does water freeze?
[At or below 0°C]
6. What do dissolved substances do to the freezing point of water? Why?
[They lower the freezing point of water because they interfere with molecules, forming a regular repeating pattern we call crystals.]
7. Will a liquid mixture of milk and sugar freeze at 0°C? If no, why not?
[No, because milk is composed of dissolved substances and other substances suspended in water that interfere with the water molecules, forming a regular repeating pattern.]
8. Will putting a liquid mixture of milk and sugar in plain ice get cold enough to freeze the milk mixture?
[No, because the plain ice will melt at 0°C, which means that the ice will tend to stay around 0°C.]
9. How can you freeze the milk mixture?
[Cool the mixture below 0°C by keeping the ice used to freeze the mixture below 0°C with a dissolved substance.]

Body of the Lesson

To the teacher: Students should be assembled into groups of 4. Distribute the activity hand out, *Change the Phase*. Introduce the activity with the following discussion.

1. What are you going to do in this lab activity first (second, third etc.)? Look at the handout to answer.
[Let students call out the step-by-step procedure written in the activity.]
2. Why is it a violation of good safety practices to insert the thermometer into ice cream mixture?
[Thermometers that are used in regular lab activities are not clean enough to come into contact with substances intended for human consumption. The thermometers could be contaminated with hazardous chemicals.]
3. What should you do if the thermometer breaks?
[The teacher will clean up the broken glass. If the thermometer contains mercury, special clean up procedures are necessary.]
4. Why is important to wash your hands before eating the ice cream?
[A lab is not usually a place where students are allowed to eat due to the possible contamination of hazardous substances. In this activity, since lab equipment is not in direct contact with the ice cream and hands are washed to prevent contamination, eating in the lab area is acceptable.]
5. Why is it important to clean the work area after the lab activity?
[Milk and other substances may have leaked from the plastic bags. Bacteria could grow on surfaces contaminated with the milk mixture if not properly cleaned.]
6. Before you begin the experiment, you must read the directions thoroughly.
7. One student per group may gather the materials and equipment needed for the activity. No other students may be out of their seats during the activity.
8. When the activity is completed, one student per group will return the equipment to its original position.
9. Work areas must be thoroughly cleaned. Failure to properly clean a work area will result in 10 points being deducted from the grade of each member of the offending group.

Activity- 25 Minutes

Data Analysis Key

1.
 - a) concentration of salt in the surrounding ice
 - b) freezing time
 - c) ice cream
2. no salt in the surrounding ice
3. x-axis: Concentration of Salt in Grams, y-axis: Temperature in 0°C
4. The hypothesis is supported. The data will vary.
5. Yes; sugar does lower the freezing point of water. It was dissolved in the ice cream mixture and was partially responsible for the need for the ice to be at a lower temperature in order to freeze the ice cream. Experiments will vary.

Closing

Journal Entry- 10 Minutes

Ask students to keep a science journal. Use student entries to plan future lessons. At the end of the class period ask students to enter the responses to these prompts into their journals:

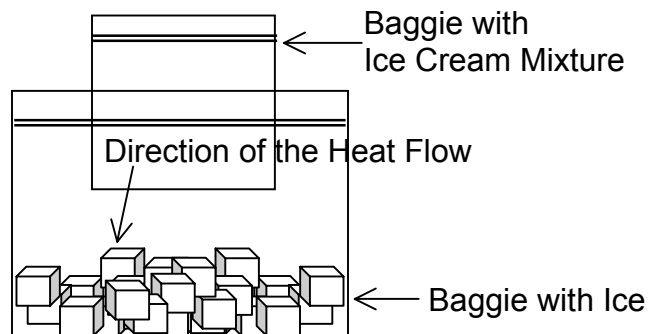
1. What did you learn today?
2. What questions would you like to ask about the lesson?
3. What would you like to know more about?

Assessment (attached, page 233)

Day 2 Quiz- 10 Minutes

Key

1. B
2. C
3. The heat in the ice cream mixture flows to the colder salty ice. Heat flows from the warmest to the coldest object.



ACTIVITY PAGES

CHANGE the PHASE

The Experiment

A liquid ice cream mixture will be frozen. Plain water freezes at 0°C, but water containing dissolved substances freezes at a lower temperature. Milk is composed of dissolved substances and other substances suspended in water. Will plain ice cool the ice cream mixture enough to freeze?



Materials per Class

Dishpan To Hold Liquid
Waste
Large Plastic Trash Bag

Materials per Group

Triple Beam Balance (opt.)
Weighing Paper
1/2 Cup Measure
Marker

1/8 Teaspoon
1 Tablespoon
Newspapers
3 Containers of Table
Salt

Materials per Student

1/2 Cup Whole Milk
1 Tablespoon Sugar
1/8 Teaspoon of Vanilla

1 Small Ziploc Bag
1 Large Ziploc Bag
Salt

Ice Cubes
1 Plastic Spoon
Thermometer

Safety

Directions: Use common knowledge to answer the questions.

1. Why is it a violation of good safety practices to insert the thermometer into ice cream mixture?
2. What should you do if the thermometer breaks?
3. Why is important to wash your hands before eating the ice cream?
4. Why is it important to clean the work area after the lab activity?

Activity

1. Wash your hands.
2. Each student will carefully measure and add the following: 1/2 cup whole milk, 1 tablespoon sugar and 1/8 teaspoon of vanilla extract (optional) to a small Ziploc bag.
3. Seal the plastic bag and **gently** shake the contents to dissolve the sugar.
4. Each student will fill about a quarter of a large Ziploc bag with ice cubes. All group members should use the same amount of ice.
(If ice cubes are the same size student can use the same number of cubes, otherwise students will need to mass the ice in the plastic bag.)
4. Each group member will add one of the amounts of salt listed below to his/her bag of ice. Label your bag with the amount of salt you use.

Group Member #1- 120 grams of salt
Group Member #2- 80 grams of salt
Group Member #3- 40 grams of salt
Group Member #4- 0 grams of salt
5. Mix the salt with the ice in your bag.
6. Insert the sealed bag of ice cream mixture into the large bag of ice, release the excess air in the large bag and seal the bag.
7. Gently move the ice cream mixture around in the bag of ice. Rough handling will cause a leak in the bag of ice.
- d) When the first bag of ice cream freezes in your group, measure the temperature of each group member's ice. Record each temperature in the data table.
(Be sure to bring the temperature of the thermometer down before each measurement.)
9. The group members that do not have frozen ice cream yet may add more salt and ice to their bags of ice to speed the process.
10. Enjoy your ice cream!

Data Collection

Group Member	Amount of Salt (g)	Temperature of Ice (0°C)
1	120	
2	80	
3	40	
4	0	

Data Analysis

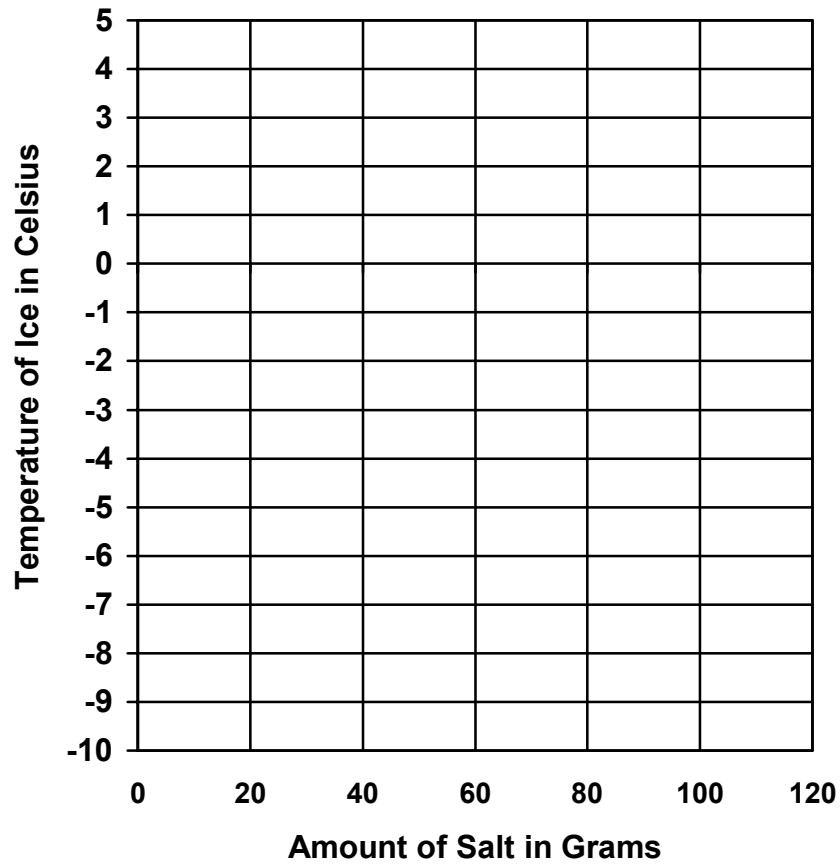
Hypothesis: An increase in the **concentration of salt** in the surrounding ice will cause the **freezing time to decrease** for the **ice cream**.

1. The hypothesis is written in the form:

The **independent variable** will cause the **dependent variable** to the **object**.

- a) What is the independent variable indicated by the hypothesis? How will you measure it?
 - b) What is the dependent variable indicated by the hypothesis? How will you measure it?
 - c) What is the object?
2. The control group is without an independent variable. What is the control implied in the hypothesis?

3. Plot your data below to produce a line graph.



4. Was the hypothesis proven or disproved? Use the data to explain your answer.

5. Could you have lowered the freezing point of ice with sugar? Why or why not? Design an experiment to test your guess.

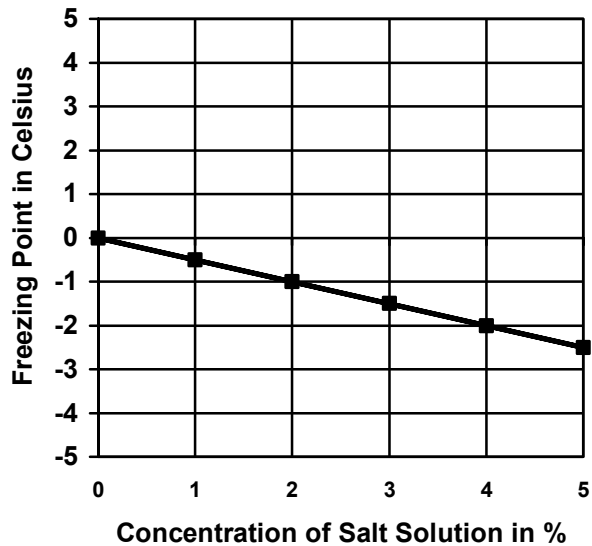
Change the Phase Assessment

Directions: Answer the questions below.

1. What is the most likely temperature of the frozen ice cream?
 - a) Greater than 0°C
 - b) Less than 0°C
 - c) Exactly 0°C
 - d) About 32°C

Use the graph to answer question 2.

Group Member #1-



2. According the graph, as the concentration of salt increases the freezing point of the solution
 - a) increases.
 - b) stays the same.
 - c) decreases.
 - d) is not possible to determine.
3. Draw a diagram to indicate the direction of the flow of **heat** in the process of making ice cream? Explain your diagram.