

Objectives

- Students will identify the differences between the three main states of matter.
- Students will understand that temperature and pressure can cause one state of matter to turn into another state of matter.
- Students will learn how the states of matter apply to real situations such as making ice cream.


Vocabulary

- | | |
|------------------------|-----------------------------|
| • States of Matter | • Solid |
| • Liquid | • Gas |
| • Vaporization | • Freezing |
| • Melting | • Condensation |
| • Sublimation | • Deposition |
| • Temperature | • Pressure |
| • Pasteurization | • Heat of Fusion |
| • Heat of Vaporization | • Freezing-Point Depression |

About the Lesson

- The lesson introduces students to the states of matter through the process of making ice cream.
- Teaching time: one to two 45-minute class period(s)
- As a result, students will:
- Understand how states of matter can change based on temperature and pressure.
- Use simulations to see how state changes affect the food we eat and how temperature can change the state of a substance.

Activity Materials

- Compatible TI Technologies:
 -  TI-84 Plus CE *with the latest operating system*



Tech Tips:

- This activity includes screen captures taken from the TI-84 Plus CE handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at <http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials>.

Lesson Files:

- Image0.8ca
- Image1.8ca
- Image2.8ca
- Image3.8ca
- Image4.8ca
- Image5.8ca
- Image6.8ca
- Image7.8ca
- Image8.8ca
- Image9.8ca
- Pic1.8ci
- Pic2.8ci
- Pic3.8ci
- Pic4.8ci
- Pic5.8ci
- Ice_Cream_Cool_Science.8xp

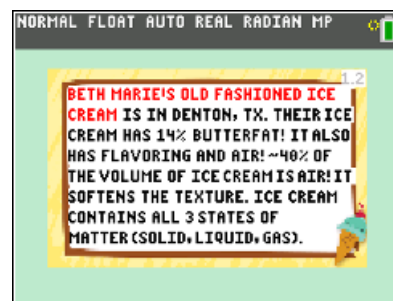
Background

CAREER FOCUS - This activity introduces how the science students learn can be used in the careers they will have someday. In this case, making ice cream involves an understanding of how temperature affects the states of the ingredients. The quality of the ice cream is dependent upon this understanding.

SIMULATION - This activity provides an animation that walks students through the process of making ice cream from the cow to the cone. During the animation, students will see a virtual thermometer indicating how the temperature of the process changes dramatically and how that change affects the state of the cream in the ice cream. Another animation involves a molecular representation of three different substances that go through the various phase changes (solid, liquid, and gas).

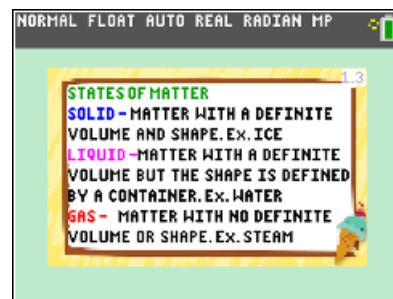
Move to page 1.2.

1. Students are introduced to Beth Marie's Old Fashioned Ice Cream, an ice cream shop in Denton, TX. They are also informed that ice cream is a combination of all three states of matter.



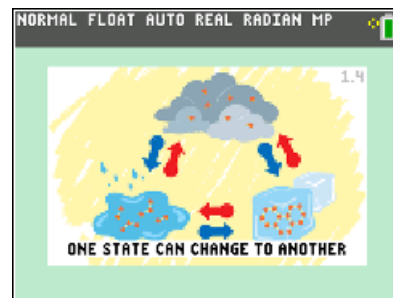
Move to page 1.3.

2. Page 1.3 explains how matter can change between states based on temperature and pressure.



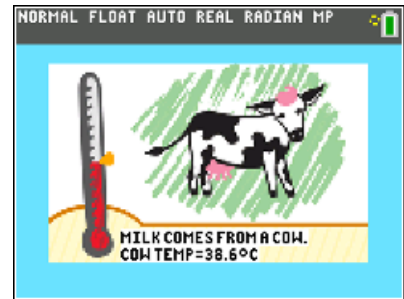
Move to pages 1.4 – 1.6.

3. These pages demonstrate and explain how each state of matter can change into another state of matter with the addition or removal of energy (heat) and/or pressure.



Move to page 1.7.

4. This page is the introduction to an animation walking students through the process of making ice cream from cow to cone. It also addresses the states of matter that different parts of the ice cream go through during the various temperature changes. Remind students to use RIGHT and LEFT arrows to navigate through the animation.



Answer the questions

Q1. Which of the following states are in ice cream (just served from the freezer)?

Answer:

- A. Gas**
- B. Liquid**
- C. Solid**

Q2. Ice cream contains air (gaseous nitrogen and oxygen), ice (solid water), and syrup (liquid sugar and flavoring).

Answer:

- A. True**

5. Meet Haddy Morales. Haddy is the lead ice cream maker at Beth Marie's. Haddy must know how much cream to add to the machines as well as how much flavorings and add-ins like candy bar crumbles and fruit. The more solid pieces that are added, the more it effects how the ice cream freezes. There is a delicate balance required.



Answer the questions

Q3. Identify the numbers where heat is removed.

Answer:

1, 3, 6



Q4. Label the phase changes on 1 and 2.

Answer:

1. Vaporization

2. Condensation

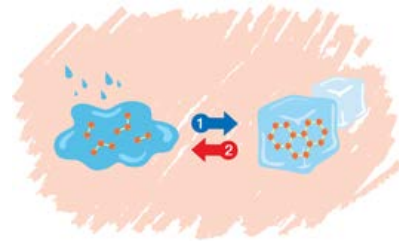


Q5. Label the phase changes on 1 and 2.

Answer:

1. Freezing

2. Melting



Q6. Label the phase changes on 1 and 2.

Answer:

A. Deposition

B. Sublimation



Q7. The image shows sublimation

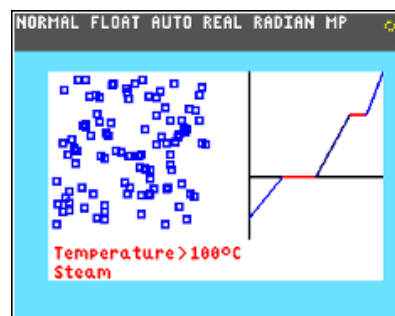
Answer:

B. False. It shows vaporization



Move to page 2.2.

6. This page introduces students to what happens at the molecular level during state changes. Students will be able to run a simulation of water going through various state changes due to temperature changes. The students will see that as temperature is added, the water changes states at the molecular level moving from solid to liquid to gas. Conversely, when heat is removed from the system the molecules become less excited and condense into a solid.



Move to pages 3.4–3.6 and answer the questions either here or in the .tns file.

Q8. The melting point for water occurs when the temperature is above _____.

Answer:

A. 0°C

Q9. The boiling point for water occurs when the temperature is _____.

Answer:

A. 100°C

Q10. As temperature increases, the amount of movement of the particles increases.

Answer:

A. Always

Optional Hands-On Activity

Become an ice cream pro like Haddy! Reading about ice cream has probably excited your sweet tooth. So, why not make your own? Follow the instructions to see what Haddy does at Beth Marie's every day!

Material:

- * Small ziptop bag
- * Quart or gallon size ziptop bag (with about 3 to 4 cups of ice; add 1/2 cup salt)
- * One tablespoon of sugar
- * One half cup of heavy whipping cream
- * Quarter teaspoon of vanilla extract

Directions:

Add the ingredients to the smaller bag and seal it. Put the smaller bag into the bigger ice & salt bag. Seal the bigger ice bag. Massage and shake the ice bag for about 5 to 8 minutes.

What's with the salt?

The salt lowers the freezing point of water to below 0°C. This process is called Freezing-Point Depression. Because more thermal energy would need to be removed in order for the salt + water mixture to freeze, the mixture can pull more energy from the smaller bag (where the ice cream is) more quickly causing it to turn into ice cream faster! Salt is also used on icy roads during the winter. It's safer to drive on wet roads than it is frozen roads.

Congratulations!

Like Haddy, you have what it takes to work in the food industry. A strong understanding of how temperature and pressure affect the states of matter and preparation of food is very important! What other culinary creations would require this knowledge? Think about cooking an omelet or making a cake. What processes are taking place? How do temperature and/or pressure play a role?

Wrap-Up

Students will gain a better understanding about the effects of temperature and pressure as it relates to the various states of matter. Tying these concepts to something they will likely enjoy, such as ice cream, should help them to retain and apply these concepts.

Assessment

- Students will answer questions throughout the lesson to ensure they understand the concepts of state changes and the effects of temperature and pressure at the molecular level.