Ice Cream, Cool Science

TEACHER NOTES

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
- Liquid
- Vaporization
- Melting
- Sublimation
- Temperature
- Pasteurization
- Heat of Vaporization
- Solid
- Gas
- Freezing
- Condensation
- Deposition
- Pressure
- Heat of Fusion
- 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.

TI-Nspire™ Navigator™

- Send out the *Ice_Cream_Cool_Science.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

- Compatible TI Technologies: TI- Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software

Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the 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:

Student Activity

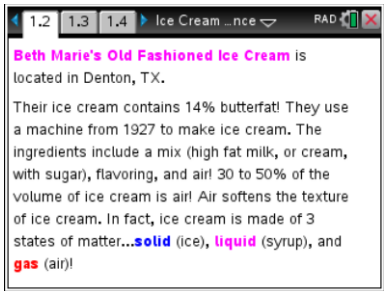
- Ice_Cream_Cool_Science.pdf

TI-Nspire document

- Ice_Cream_Cool_Science.tns

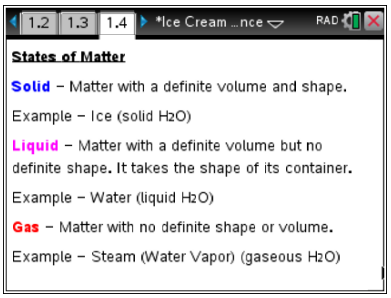
CAREER FOCUS - This activity addresses how the science that students learn can be used in the careers they will have someday. In this case, making ice cream involves an understanding of how temperature affects the states of the ingredients. The quality of the ice cream is dependent upon this understanding.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

Open the TI-Nspire document *Ice_Cream_Cool_Science.tns.*



Move to pages 1.2–1.3.

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.

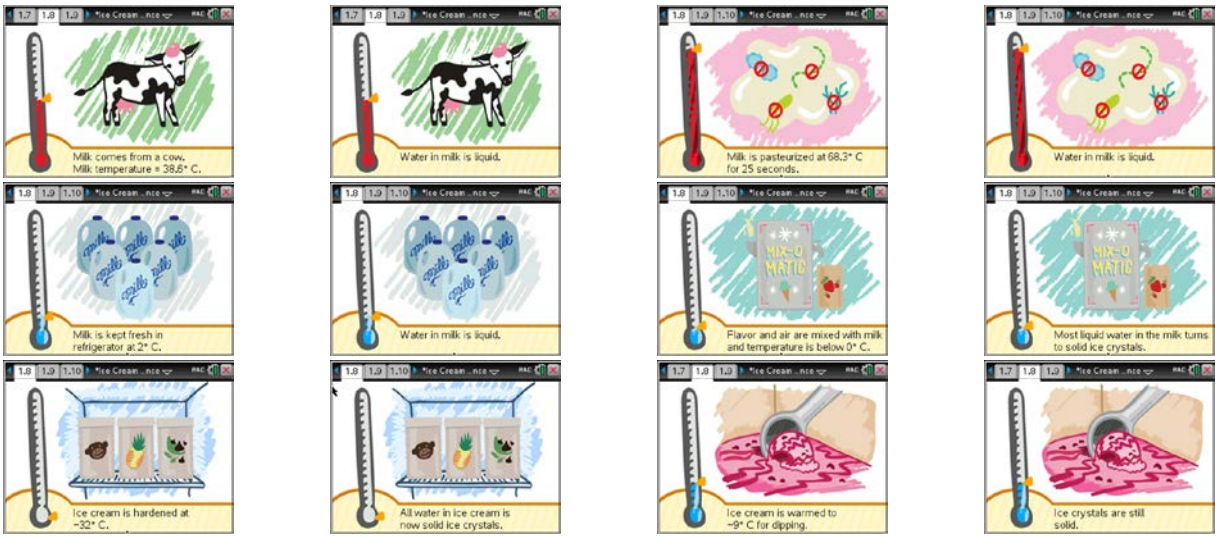


Move to pages 1.4–1.7.

2. Pages 1.4 to 1.7 describe how matter can change between states based on temperature and pressure.

Move to pages 1.8—1.9.

3. These pages illustrate the process of making ice cream, from the "cow to the cone." With each image, the text explains what is happening and how the matter that makes up ice cream is changing states based on temperature changes.

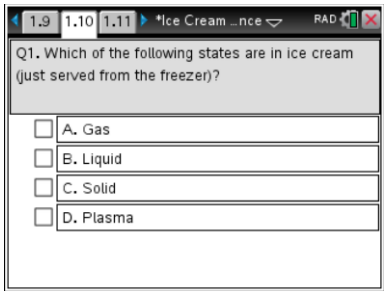


Move to pages 1.10–1.11 and answer the questions either here or in the .tns file.

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

Answer:

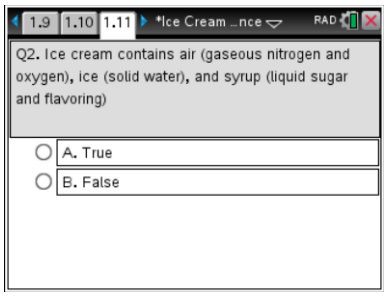
A. Gas B. Liquid C. Solid



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

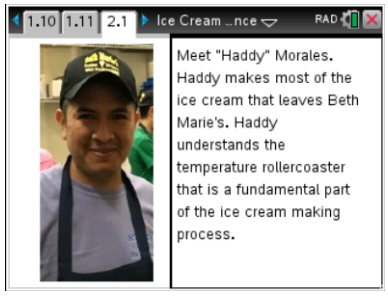
Answer:

A. True



Move to pages 2.1 – 2.2.

4. These pages introduce students to 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 affects how the ice cream freezes. There is a delicate balance required.

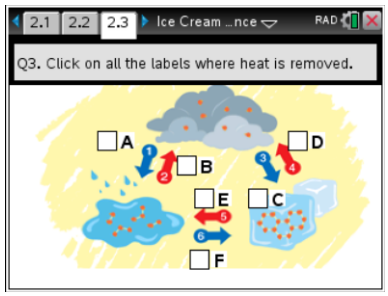


Move to pages 2.3–2.6 and answer the questions either here or in the .tns file.

Q3. Click on all the labels where heat is removed.

Answer:

A, C, F

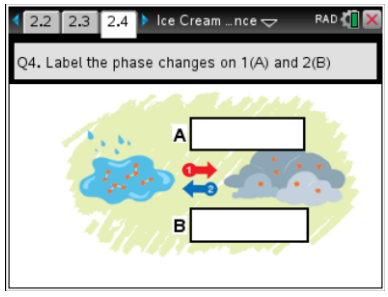


Q4. Label the phase changes on 1(A) and 2(B).

Answer:

A. Vaporization

B. Condensation

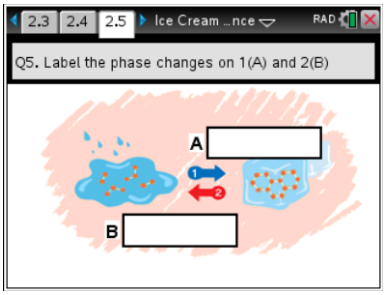


Q5. Label the phase changes on 1(A) and 2(B).

Answer:

A. Freezing

B. Melting

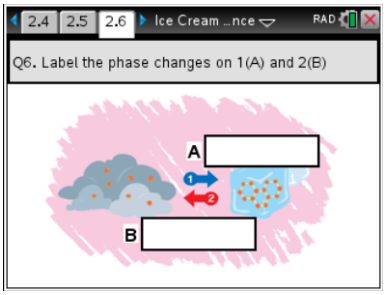


Q6. Label the phase changes on 1(A) and 2(B).

Answer:

A. Deposition

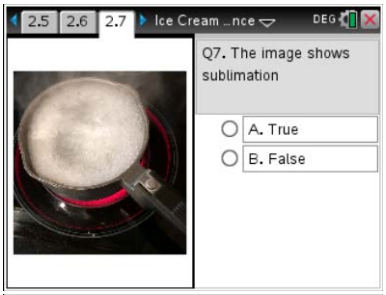
B. Sublimation



Q7. The image shows sublimation

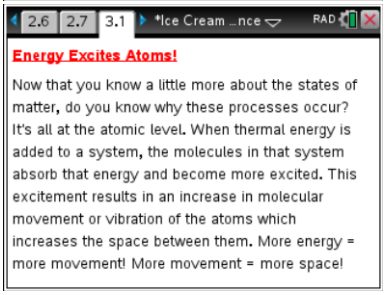
Answer:

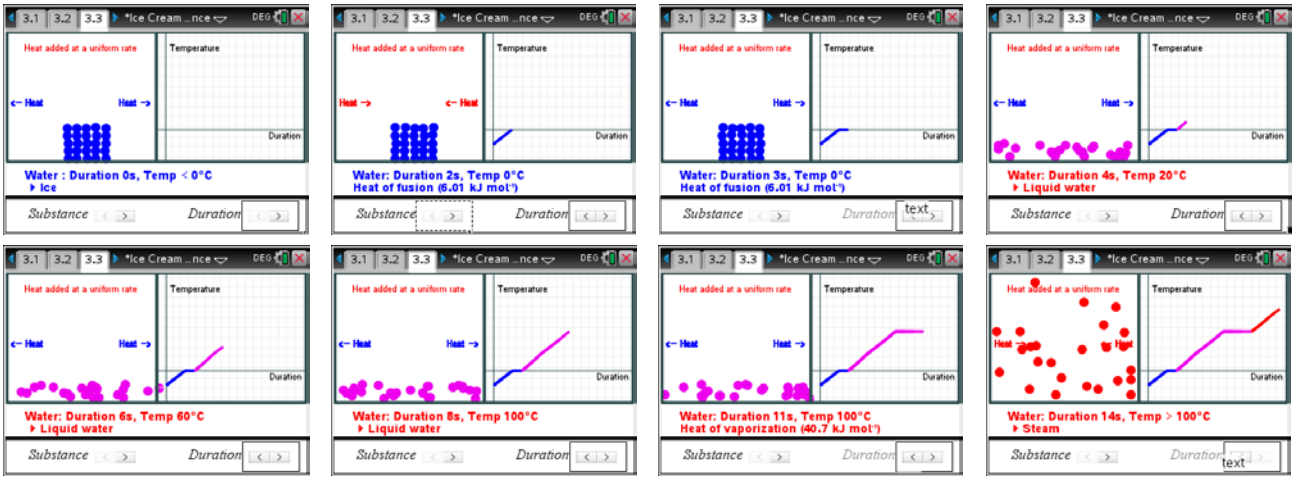
B. False. (It shows vaporization)



Move to pages 3.1 – 3.3.

5. These pages describe what happens at the molecular level during state changes. Students will be able to run a simulation using three different materials (water, ethyl alcohol, and iron). The students will see that as temperature increases, the material 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.



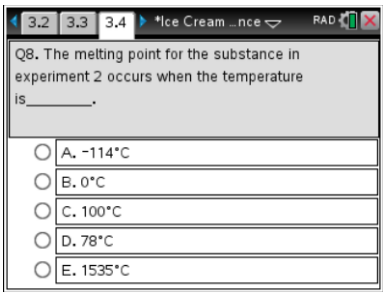


Move to pages 3.4–3.6 and answer the questions either here or in the .tns file.

Q8. The melting point for the substance in experiment 2 occurs when the temperature is _____.

Answer:

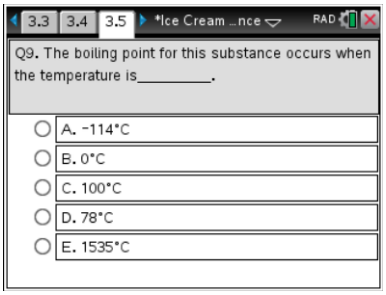
A. -114°C



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

Answer:

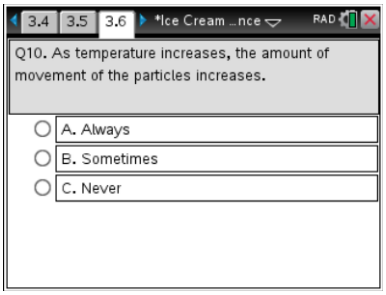
A. 78°C



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

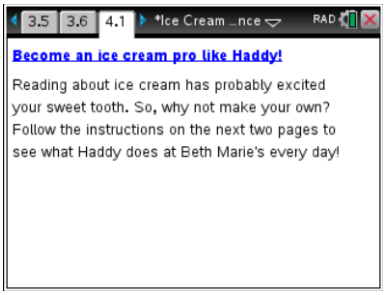
Answer:

A. Always



Move to pages 4.1—4.5.

6. These pages describe an optional hands-on activity where students are challenged to make their own ice cream. It also introduces the idea of freezing-point depression.



TI-Nspire Navigator Opportunities

Make a student handheld be the Live Presenter to demonstrate changing the *Substance* and *Duration* in the simulation on page 3.3.

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.

Optional Hands-On Activity for Students:

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 zip-top bag
* Quart or gallon size zip-top 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?