Lesson Topic: Changing Temperature

Objective:
Students will be able to:

1. Understand temperature change varies depending on material characteristics such as: composition and size.
2. Explain why temperature varies in two different objects of equal mass.
3. Explain why temperature varies in two identical objects with different masses.
4. Define temperature as the average kinetic energy of particles in an object.

Time Required: 75 minutes

Materials Needed:

- Candles (2)
- Balloons (2)
    - 1 balloon inflated with air
    - 1 balloon filled with small amount of water, then inflated with air
- Water
- Safety goggles
- Lighter
- Teacher computer with internet access
- Projector/Smartboard
- 1 computer/laptop/iPad with internet access per student
- Changing Temperature Worksheet (attached)

Teacher Preparation:

- Assign a Legends of Learning Instructional Quick Play playlist for the day(s) you will be teaching the lesson.
    - Instructional – Middle School – Changing Temperature
- Assign a Legends of Learning Content Review Quick Play playlist for the day(s) you will be teaching the lesson.
    - Content Review – Middle School – Changing Temperature
- Make copies of Changing Temperature Worksheet (1 per student)

Engage (10 minutes):

1. Light one candle and explain to students that many factors affect the rate of temperature change.
2. Show the two balloons to the students and explain how the contents are different.
3. Ask students to hypothesize what will happen to the balloons when placed over the candles.
4. Place the balloon filled with air over the candle.
    - Ask students to describe the particle speed in the balloon before and while being placed over the candle. (before: slow, while: faster)
    - Hold the balloon over the candle until it pops
5. Explain to students that the increased motion inside the balloon is the result of an increase in kinetic energy as heat energy.

6. Light the second candle.
    - Ask students if they think the second water-filled balloon will pop slower or faster than the air-filled balloon. (accept all answers)
7. Place the second balloon over the candle.
    - Ask students to describe the speed of the particles in the second balloon compared with the first balloon. (slower)
    - Ask students why the second balloon is taking longer to pop. (particles are moving slower, less pressure inside the balloon)
    - Ask students to compare the kinetic energy in the second balloon with the first balloon. (lower kinetic energy in the second balloon)
8. Write the definition of temperature on the board.
    - Temperature – the average kinetic energy of particles in an object
9. Have students speculate on the temperature differences between the two balloons, and why the balloon with the water might have a lower temperature. (water does not change temperature easily, keeping the overall temperature in the second balloon lower)

Explore (30 minutes):

1. Have your students sign into Legends of Learning. Instruct students to complete the Instructional playlist.
2. As students complete the assigned games, students should fill out the Changing Temperatures Worksheet.
3. Circulate as students work through the playlist and complete the worksheet. Listen for evidence of understanding and use this opportunity to correct any misconceptions.

Explain (20 minutes):

1. Review the answers to Changing Temperatures worksheet. Draw the three diagrams from the handout on the whiteboard or interactive board.
2. Relate student knowledge to the fire and balloon temperature change demonstration at the beginning of class.
    a. What are some examples of things that can slow down temperature change? (increasing the volume of a substance, using a different substance)
    b. If you wanted to boil a pot of water quickly, how could you adjust the volume of water? (add less water)
    c. When the average kinetic energy decreases, what happens to the temperature of the material? (decreases)
    d. How could you set up a system to check for the temperature difference between two solid materials using two cups filled with water and two thermometers? Work with a partner to come up with a short procedure to test which material heats up the fastest. Have a volunteer group share their process with the class. (heat materials for a set amount of time, record the initial water temperature, immerse the samples, record the final temperature in both cups and compare the differences)

Elaborate (5 minutes):

1. Explain to students that mood rings and some color changing nail polishes work by using liquid crystals that change colors at different temperatures.
2. Show this video of temperature-sensitive sheeting.

a. How could you make the color change quicker on the sheet? (change the temperature quicker, use an ice cube to cool it)

Evaluate (10 minutes):

1. Have students sign into Legends of Learning. Instruct students to complete the Content Review playlist.
2. Analyze student results to access topics that may require reteaching.

Additional Lesson Strategies:

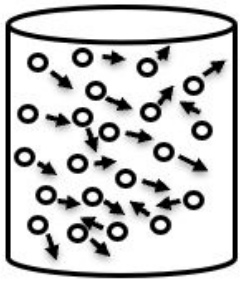
- To use Legends for additional instruction, create a custom playlist with an instructional game and pre and post assessment.
- To use Legends for a quick formative assessment, create a 5-question assessment in a playlist.
- To use Legends for a student-directed experience, create a targeted freeplay playlist.
- Encourage students to play on their own at home in Legends of Learning: Awakening for a student-driven experience including avatars, battling, and quests all centered around topics they are covering in class.

Changing Temperature

Name:_____

While playing the games in Legends of Learning, use what you learn to answer the questions.

1. Consider the container below:



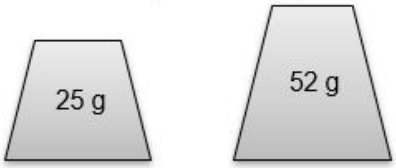
   a. Describe the particle motion and kinetic energy in the container.

   Particles are moving rapidly. Kinetic energy is increasing.

   b. If the average kinetic energy is increased in the container, what happens to the temperature in the container?

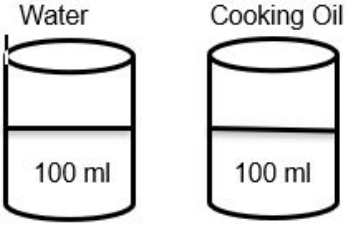
   The temperature will increase since temperature is the measure of the average kinetic energy in a substance.

2. Below are two pieces of gold. If heated for an equal length of time, which piece gold will have the greatest temperature increase, and why? Write your answer in the box below.



The 25 g piece of gold will have the greater temperature increase as it will have a higher average kinetic energy.

3. Below are two containers. Container A contains 100 ml of cooking oil. Container B contains 100 ml of water. Which contain will heat up the fastest? Explain why two identical volumes can heat up at different rates. Write your answer in the box below.



The cooking oil will heat up the fastest. Cooking oil changes temperature easier than water. Different substances are able to change temperature easier than others. Water takes more energy to change temperature.

Changing Temperature

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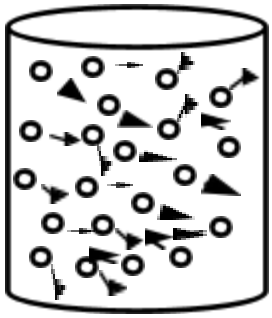

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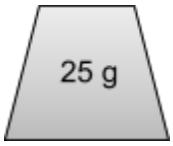
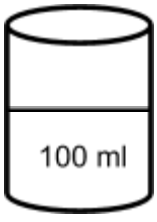


3. Below are two containers. Container A contains 100 ml of cooking oil. Container B contains 100 ml of water. Which contain will heat up the fastest? Explain why two identical volumes can heat up at different rates. Write your answer in the box below.

Water



Cooking Oil