Lesson Topic: Heat as Energy Transfer

Objective:
Students will be able to:

1. Understand that heat is the transfer of thermal energy between objects due to differences in temperature.
2. Recognize that thermal energy movement always occurs from high temperature to low temperature.
3. Understand that adding or removing thermal energy can cause a change in state.

Time Required: 75 minutes

Materials Needed:

- Ice cubes (6 ice cubes)
- Beaker
- Hot plate
- Thermometer
- Teacher computer with internet access
- Projector/Smartboard/Interactive whiteboard
- Heat as Energy Transfer 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 – Heat as Energy Transfer
- Assign a Legends of Learning Content Review Quick Play playlist for the day(s) you will be teaching the lesson.
    - Content Review – Middle School – Heat as Energy Transfer
- Make copies of Heat as Energy Transfer Worksheet (1 per student)

Engage (10 minutes):

1. Hold up the beaker containing the ice cubes for the students to view.
2. Ask students what the temperature of the ice cubes is in both Celsius and Fahrenheit. (0° C, 32° F)
3. Place the beaker on a hot plate and heat the ice on low heat.
4. As the ice begins to melt, ask the students to describe the change of state occurring. (solid to liquid – melting)
5. Measure and record the temperature of the liquid.
6. Ask students to hypothesize how the temperature of the liquid water changes with the additional thermal energy or internal energy gained by liquid. (increases)
7. Continue to heat the ice and water until evaporation starts.
8. As steam appears, ask the students to describe the change of state occurring. (liquid to gas – evaporation)
9. Ask students to hypothesize how the temperature of the steam changes with the additional thermal energy. (increases)
10. Explain to students that they have observed 3 changes in state because of the

addition of thermal energy.

11. Describe to students that the area around the steam feels warmer.
12. Ask students to form a hypothesis describing why the air feels warmer. (the steam is warming it)
13. Explain to students that heat is an energy transfer and moves from areas of higher temperature to lower temperature. Expand on this example by explaining that if they held the ice cube in their hand, they would notice it slowly melting as the higher temperature of their bodies transfers heat to the area of lower temperature, the ice cube. Their hand feels cold because the temperature drops as heat transfers energy away from their bodies.

Explore (30 minutes):

1. Have 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 Heat as Energy Transfer 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 answers to Heat as Energy Transfer Worksheet by drawing the illustrations from the worksheet on the board or interactive whiteboard.
2. Relate student knowledge to the demonstration at the beginning of the lesson.
    a. What causes a change of state, such as ice melting into water? (additional of thermal energy)
    b. What is thermal energy? (internal energy from the random movement of particles in a substance)
    c. How does heat move as energy between two objects? (from higher temperature to lower temperature)
    d. Describe the particle movement in an object with increasing thermal energy? (moving faster)
    e. What is the scientific definition of heat? (transfer of thermal energy from areas of high temperature to low temperature?
    f. When does the heat as energy transfer between two materials stop? (when the materials reach the same temperature)

Elaborate (5 minutes):

1. Explain to students that although they feel both warm and cold depending on the temperature, that cold is feeling is the result of heat transferring energy away from the body to the lower temperature environment.
2. Show this video of dry ice turning into vapor.
3. Ask students to describe what they see in the video. Which direction is heat transferred?
    a. Answer: Students witness dry ice undergoing sublimation. The solid changes into gas and skips the liquid phase - heat transfers from the dry ice to the surrounding air.

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:

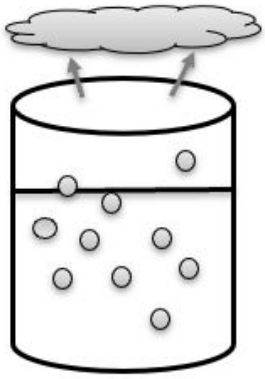
- To use Legends for additional instruction, create a custom playlist with an instructional game and pre and post assessment.
- To use Legends for a quick formative assessment, create a 5-question assessment in a playlist.
- To use Legends for a student-directed experience, create a targeted freeplay 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.

Heat as Energy Transfer

Name:__*KEY*_____

Directions: While completing the games in Legends of Learning, answer the questions below.

1. The beaker below is heated on a hot plate. The liquid bubbles, then steam releases from the beaker. Describe the change of state occurring and what is the change in energy responsible. Write your answer in the box.



Evaporation is the change of state. Liquid is heated becoming a gas. The addition of thermal energy is increasing the kinetic energy in the causing the change in state to occur.

2. Consider the two blocks of silver below. Describe the direction of the heat movement between the two blocks. Draw an arrow between the blocks to indicate the movement. Write your answer in the box below the blocks.

Heat is the transfer of thermal energy between two objects of different temperatures. This movement will always occur from the object of higher temperature to the object of lower temperature.

3. Consider the two same two blocks of silver. Explain to a curious observer when the heat transfer will stop between the two blocks. Write your answer in the box below.

The heat transfer will continue until both blocks have reached the same temperature.

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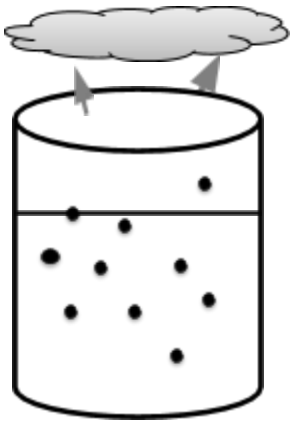

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