IT'S MELTING! (1 Hour)

In this activity, students will observe how ice melts on wood and metal blocks, and they will draw conclusions about how heat conducts through different materials.

Topic: Heat transfer

Real World Science Topics:

- An exploration of the thermal conductivity of different substances
- An exploration of heat and phase changes

Objective

Students will gain an understanding of how heat is conducted through different materials, and they will explore how materials can be modified to alter their conductive properties.

Materials Needed for Student Activity

Materials Needed for Teacher Demonstration

- beaker
- hot plate
- ice cubes (enough to fill the beaker)
- plastic straw
- metal spoon

Materials Needed for Each Student Team

- block of wood, painted
- block of metal, painted[1]
- ice cubes
- stopwatch or clock with second hand
- tape
- various insulating and conducting materials, such as plastic wrap, aluminum foil, paper bags, wax paper

Teacher Notes

Use your knowledge of your particular class to help you decide when it's more appropriate for your students to simply observe you conducting the experiment and when they can conduct their own hands-on experiments. In general, the older grade levels will be better able to make group decisions and conduct simple experiments on their own. Leveled methodologies for K-1 and 2-3 grade levels are provided where appropriate.

[1] Inexpensive aluminum blocks can be purchased from most hardware stores. If these are unavailable, the metal blocks can be replaced with metal trays or plates. Alternatively, the metal blocks can also be swapped out for plastic blocks.

IT'S MELTING!

Teacher Preparation

You will need to prepare the wood and metal blocks ahead of time. If possible, use blocks that are the same size and shape, and use a lightweight metal (such as aluminum) so that they are similar in mass. Paint the blocks the same color so that they look reasonably similar.

STEPS FOR *IT'S MELTING!*

1. **Warm-Up Activity:** Place the beaker on the hot plate, set on low, and fill the beaker with the ice cubes. Ask students what they think will happen to the ice cubes and prompt them to explain their reasoning. (Students should conclude that the ice will melt.) While the ice is melting, have students brainstorm instances when they have seen ice melting before. Have students think about what factors might affect the process of ice melting. (For example, would ice melt faster in a glass of cold water or a glass of hot chocolate?) Briefly review the definition of temperature. Explain to students that the temperature of an object can be changed when heat energy is added or removed from the object. Point to the hot plate and ask them if they know that it becomes hot. Explain that the hot plate adds heat energy to the beaker. When the heat energy is transferred to the ice cubes, it increases their temperature. This causes them to melt.

2. Ask students to try to explain how different materials warm up. For example, ask them to think about wrapping cold hands around a hot mug of hot chocolate. Or, ask them what would happen if they dropped an ice cube in the cup of hot chocolate. By this point, the ice cubes in the beaker should have melted into water, and the water should be heating up. Show a plastic straw and metal spoon to students. Pass the objects around the classroom and have students observe the temperature of the objects. Ask students what will happen when you place a plastic straw and metal spoon in the hot liquid. Will the objects heat up? Will they be the same temperature or different temperatures? Place the objects in the liquid for at least two minutes. Then remove the objects from the liquid and have a few student volunteers observe and report the new temperature of the objects. Have students think about why the objects might not be the same temperature. It is okay if students do not have answers (or have incorrect answers) to these questions. Then explain that in this activity, students will explore how heat moves through different objects.

3. Divide students into groups and distribute the wooden and metal blocks as well as the Student Handouts. The blocks should be painted beforehand so that they look similar to each other. (This also ensures that one block will not absorb more ambient heat energy than the other due to its color.) Tell the students to each take turns placing their hands on top of the blocks. Which feels warmer? Students should note that the metal block feels colder than the wooden block.

   Ask the students to make predictions about what they think will happen when each block has an ice cube on it. Which ice cube will melt more quickly? Have students record their observations and predictions on the Student Handouts.

4. Instruct students to observe the ice cubes on each block as they melt.

   Instruct students in the correct use of the stopwatch. Give each team a stopwatch, and have groups choose one student to time the experiment. Give each team a pair of ice cubes. Have each team place one cube on the wooden block and one cube on the metal block. You may want to place paper towels beneath each block to minimize water spills. Have the students work together to time how long it takes each ice cube to melt completely. They should record all observations on their Student Handouts.

5. Help students find a way to change the results of the first trial.

Challenge students to modify the blocks so that they observe the opposite results. For example, if the ice melted more quickly on the metal block, they should try to modify the blocks so that the ice melts more quickly on the wooden block. Suggest several possible ways that students might alter their blocks, then allow each group to select one material and wrap one block in that material. As before, have them use the stopwatches to time how long it takes for the ice cubes to melt. If enough time remains, you may repeat this again, having students select another material with which to wrap one block. Offer guidance to help students fill out the appropriate boxes in the table on the Student Handout.

If students at any grade level need more guidance than the procedure detailed above, suggest that they first wrap both blocks with wax paper and then repeat the ice-melting investigation. Then have them wrap the blocks with aluminum foil and repeat the investigation again. Have them observe whether either material increased or decreased the rate at which the ice melted on the wooden or metal block. (They should observe that the wax paper reduced the rate at which the ice cube melted.) Then have students observe what happens when they wrap the block on which the ice melted more quickly with the material that reduces the melting rate. Have them leave the second block untreated and repeat the investigation. Allow students to modify the investigation, with your supervision and suggestions, as necessary until they observe the desired results.

6. Wrap-up Activity: Bring the class together and have groups share their results. Prompt discussion by asking some of the following questions: Which block caused the ice cube to melt the fastest? Did these results match their predictions? Did the ice cube melt faster on the wood or the metal block? Why did the ice cube melt quicker on the metal surface than on the wooden surface? How did wrapping the blocks with materials change how the ice melted? After students have shared their results, explain to them that heat moves at different rates through different materials. Some materials allow heat to pass through easily, while others do not. Even though the metal block feels colder than the wooden block, it transfers the heat it has to the ice cube more easily than the wooden block does, and this makes the ice cube melt faster.

It's Melting! Extension Activity

Have students investigate how other factors might affect the rate at which ice cubes melt on the blocks used in this experiment. They could vary the following: initial temperature of the blocks, initial temperature of the air around the blocks, or the composition of the liquid in the ice (adding salt or sugar). You can provide your students with modified ice cubes, such as ice with a small amount of salt added, and have them repeat the experiment, noticing any differences.

What is the difference between temperature and heat energy?

Temperature is a measure of the heat energy in a substance. When the particles in a substance move faster, the temperature increases, and vice versa. When you rub your hands together, you momentarily cause particles in your skin to move more quickly, and this increases the temperature of your skin.

What is heat?

Heat is a generally misunderstood concept due to its misuse in common language. Heat is the *movement* of thermal energy from a high temperature region to a low temperature region. When something is "heated," you can say that an object with a high temperature is transferring heat energy to an object at a lower temperature. However, it is incorrect to use the term "heat" to refer to a substance (such as hot air traveling from a vent). While it is important for you, the teacher, to understand this concept, it will likely be too advanced for your students. Simplify this concept as needed to aid in student comprehension.

Why does the metal block cause the ice cube to melt faster, despite the fact that it is initially cooler than the wooden block?

Metal is a conductor. This means it transfers heat energy much more readily than other materials. Whenever a conductor is put in contact with a substance at a different temperature, it will either transfer heat energy or absorb heat energy rather quickly so that it comes to the same temperature as the other substance. For example, if a metal spoon is resting at 65°F and it is placed in a beverage that is 95°F, the metal spoon will absorb heat energy until it is the same temperature as the beverage. Alternatively, if the metal spoon is placed in a colder beverage with a temperature of 45°F, the spoon will *release* heat energy into the beverage until it is at equilibrium with the beverage.

It can be estimated that the ice cube in this activity is at a temperature around 30°F, and the metal block is at room temperature, around 75°F. The wooden block conducts heat energy less readily than the metal. It may be initially at 80°F. When the ice cube is placed on the metal block, the metal block, despite being colder than the wooden block, transfers its heat energy much faster to the ice cube than the wooden block. This causes the ice cube to melt more quickly on the metal block than on the wooden block.

Key Vocabulary

temperature: a measure of how much heat energy is in a substance

heat energy: the average amount of motion energy in the particles of a substance

heat: the transfer of heat energy from a hot substance to a cold substance

1. Observe the temperature of the metal and wooden blocks. Which one is hotter and which one is colder?

The metal block is colder than the wooden block.

2. Do you think the ice cube will melt faster on the wooden block or the metal block? Why?

I think the ice will melt faster on the wooden block than on the metal block because the wooden block is warmer.

3. Record your observations of the ice changes on the metal and wooden blocks in the chart below.

[Sample answers included in the chart.]

Type of Block	Time for Ice to Melt	Material Added to the Block/New Melt Time	Second Material/New Melt Time
Metal	2 minutes	None	Wax paper/3 minutes and 20 seconds
Wooden	3 minutes and 20 seconds	Wax paper/4 minutes and 30 seconds	Paper/4 minutes

4. Which block caused the ice to melt faster? Were your predictions correct?

The metal block caused the ice to melt faster. My prediction was not correct.

5. Were you able to change the blocks so that the results from Question 4 were reversed? If so, what did you do?

Yes. I wrapped the metal block with wax paper.

Name:

Date:

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