Linking Activity 3: Infrared Meter: Radiation

A simple radiation meter, consisting of a fast-response temperature sensor taped to a black-painted foil surface on foam insulation, allows students to explore radiative transfer at ordinary temperatures. (From Edmund Hazzard, "Now you're cooking! Heat transfer labs: From basic recipe to full inquiry." *Science Scope (NSTA*), September 2012)

You will need

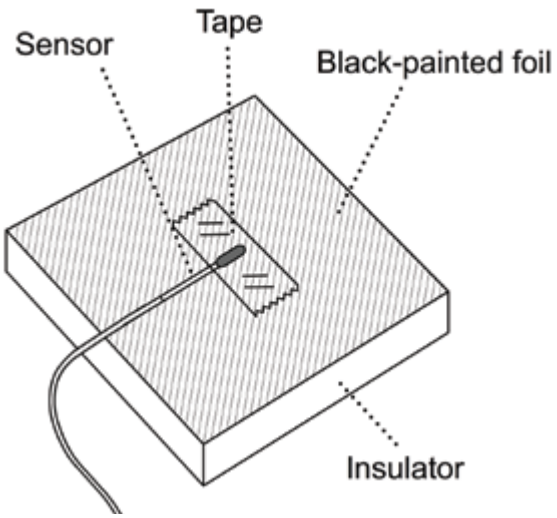
- a fast-response temperature sensor
- a small piece of foam to use as an insulator
- a piece of aluminum foil the same size as the foam
- black paint or permanent marker
- tape
- two empty glass jars
- hot water and ice water

Procedure

1. Have students build the simple infrared radiation (IR) meter shown in Figure 1, below.

A SIMPLE INFARED RADIATION METER (Figure 1)

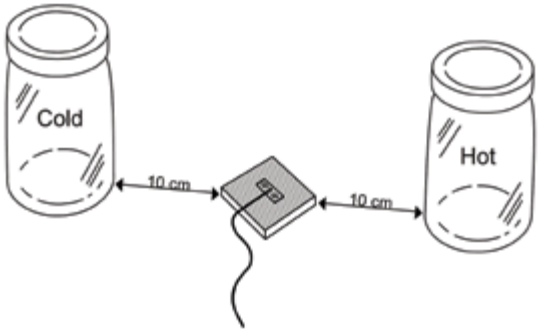
Courtesy of The Concord Consortium



2. Fill one jar with hot water and the other jar with ice water. Place the jars on a table, about 20 centimeters apart.

1. Place the IR meter halfway between the two jars, facing the ceiling, as shown in Figure 2, below.

INFRARED RADIATION EXPERIMENT (Figure 2)
Courtesy of The Concord Consortium



2. Take a temperature reading while the IR meter is aimed at the ceiling.
3. Turn the IR meter toward the hot water jar, wait about 30 seconds, and read the temperature.
4. Turn the meter toward the jar of ice water for about 30 seconds and read the temperature.
   [*Note*: The results should vary about 1º C. up or down from room temperature.]
5. Place various materials, such as glass, plastic bags of various colors, or paper between the IR meter and the hot water jar to see if they transmit IR radiation.
6. Test whether the jar radiates if it is wrapped in foil or paper.
7. Test the effect of different distances from the IR meter to the object.
8. Test the effect of different water temperatures.
9. Demonstrate how you can be sure the effect is due to IR radiation and not convection or conduction.
10. Test which materials, such as aluminum foil or paper, reflect IR.

Game Connection—Level 11 in *Galactic Gloop Zoo* shows the process of heat transfer by radiation. The level begins in the liquid medium and moves into the gaseous atmosphere. Stan gains heat from the heat source (Static Gloop) and transfers it to the Flying Gloop that moves up when its temperature is above 10 degrees. The heat from the Flying Gloop radiates (see the halo around the Gloop) as it moves up, and the heat is transferred to the Walker Gloop. The air heats up and is circulated as convection currents to heat up the egg.

This would be a good time to show students **Level 64** on a screen or SmartBoard. Enter the password "teacher feature" to access the level. This level is equivalent to Level 21 in the game, and illustrates three different environments—gas, liquid, and vacuum. It also shows that conduction and convection do not take place in a vacuum.

Once you have completed your instruction about radiation, use the question below as a Quick Write. Give students 10–15 minutes to answer the question.

- Describe how conduction, convection, and radiation play a role in losing heat through a double-pane window.

Collect student responses and conduct a class discussion about the answers.