Glossopedia™

Learning Activity Guide

Heat

www.globio.org/glossopedia/heat

GLOBIO-created Learning Activity Guides are designed to simplify integration of Glossopedia based learning into classroom and extra-curricular activities and curriculum. Each activity is designed around the use of Glossopedia articles and subjects, incorporating technology into interdisciplinary instruction. Learning Activities are intended to be fun, inquiry-driven, and interesting; exciting for students and helpful to teachers.

Activity

Cold Plunge — Pages 2-3

Extensions

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Concepts

- Heat always moves in the same direction: from hot to cold.
- Heat can travel by conduction, convection, or radiation.
- The laws of thermodynamics state that heat energy cannot be created or destroyed, it only changes forms.

Related Topics

- Electricity
- Energy
- Light
- Sun

Standards

PS ES SI T M

Standards Key available at www.globio.org/standards

Recommended Outside Links

- **Energy, Temperature, and Heat (University of British Columbia):** http://www.physicalgeography.net/fundamentals/6c.html
- **Heat and Temperature (NASA's Infrared Processing and Analysis Center):** http://coolcosmos.ipac.caltech.edu/cosmic_classroom/light_lessons/thermal/index.html

Vocabulary

- Atom
- Conduction
- Convection
- Element
- Endothermic
- Engine
- Exothermic
- Fever
- Fission
- Liquid
- Nuclear Reactor
- Radiation
- Solid

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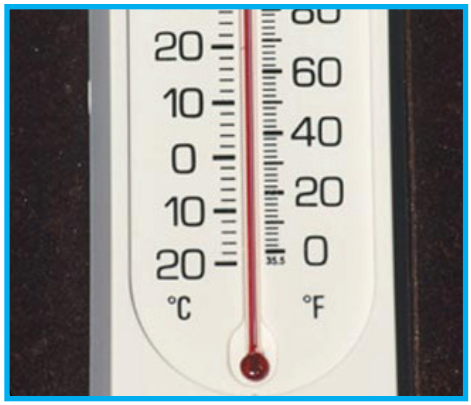
Activity: Cold Plunge

Time:
- 30 minutes

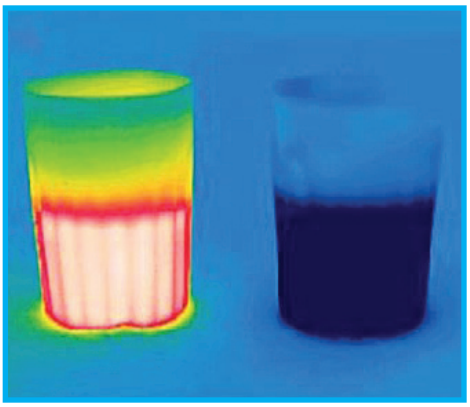
Materials:
- You will need access to a sink.
- Large pickle jar or similarly sized jar (any labels should be removed)
- Ice cubes
- Spoon
- Small bowl
- Red food coloring
- Eyedropper
- Thermometer
- Timer
- Pencil and data notebook
- Glossopedia:
- www.globio.org/glossopedia/heat



Directions:

- Before starting the activity, have students read the Glossopedia article ***Heat***. Instruct students not to overlook the images, captions, and interactive feature. Be certain they click on the definitions of *conduction*, *convection*, *radiation*, and other key terms.
- Organize students in small groups and distribute the materials.
- Tell them they will do an experiment that will allow them to "watch" heat travel. One of their tasks will be to identify how the heat traveled: by conduction, convection, or radiation.
- Ask groups to fill their jars about half full of cold tap water and then add several ice cubes. Have them stir the water for one minute and then remove the ice.
- Direct them to measure and record the temperature of the ice water.
- Next, have students fill the bowl with about 50 mL of very hot tap water and then stir in 15 drops of red food coloring. Have them record the temperature of the colored water.
- Ask students to fill the eyedropper with colored water and position themselves at eye level with the jar. They should slowly let 10 drops of the colored water trickle down the inside of the jar and into the ice water.
- Instruct them to record the way in which the red water moves. Set a timer for five minutes and have students record observations of the red water's movement at one-minute intervals.
- After five minutes, have them carefully record the temperature in the colored region of the jar and in a region the color hasn't reached. Caution them to disturb the water as little as possible while measuring the temperature. Note: Do not empty or discard the jars if you plan to have students do the Extension Activity.

Observation Questions:



- Describe what happened to the hot red water as it came into contact with the cold clear water.
- What allows you to see the way heat is traveling in the water?
- In which directions does the heat move? Does it ever change direction? Does it travel to all parts of the jar?
- Make a prediction about the temperature of the water in the jar. Do you think the temperature is the same in all parts of the jar? Where might the temperature be higher or lower?

Discussion:

- Calculate how the temperatures of the hot red water and the ice water changed between the first time you took the temperature (before adding the red water) and the second time (after adding the red water).
- Were your predictions about how the temperature changed correct?
- How many degrees warmer or cooler was the hot red water after it had been added to the ice water?
- Was the red region of the water hotter or cooler than the clear region?
- Did the temperature of the clear region change?
- What do changes in temperature indicate?
- Have students review the section “How Does Heat Travel?”
- Did the experiment demonstrate the transfer of heat by conduction, convection, or radiation? [convection]
- Encourage volunteers to explain their conclusions.

Brain Twister:

What would happen to the temperature of the water if you left the jar out in the Sun for several hours on a summer day? What would be responsible for any changes in temperature: conduction, convection, or radiation? [radiation]

Extension:

All Evened Out

Note: This activity should be done soon after students complete "Cold Plunge."

Directions:

- Start this activity after groups have finished "Cold Plunge," and after the water in the jars has turned a uniform pink color (approximately 20 minutes).
- Have students record observations about the appearance of the water.
- Based only on the appearance of the water, have them predict whether the water is now hotter or cooler than the initial temperature of the ice water (recorded at the beginning of the "Cold Plunge activity).
- Have students refer back to the temperatures they recorded (during the "Cold Plunge" activity) when there was a distinct red region and clear region in the water.
- Then have them predict, based on the appearance, whether there will be differences in water temperature if they measure the temperature in different parts of the jar now.
- Have them measure and record the temperature in three different parts of the jar.

Observation and Discussion:

- How does the water look compared to how it looked when you made your observations in the previous activity?
- Do the temperature measurements confirm the predictions you made?
- How do these temperature readings compare with your earlier measurements?
- Have students review the sections "The First Law..." and "... And the Last Law" in the "Heat" article. *Ask: How does this experiment demonstrate the laws of thermodynamics? Is the water in a state of equilibrium? How can you tell?*

Time:

- 20 minutes (plus time needed to make graphs and/or conduct research)

Materials:

- Jar of water from "Cold Plunge" activity
- Observations and data from "Cold Plunge" activity
- Thermometer
- Pencil and data notebook
- Graph paper (optional)

Additional Extension Ideas:

- Using data from both "Cold Plunge" and "All Evened Out," have pairs of students make two line graphs: one that charts changes in temperature in the red water against time (its initial unmixed temperature; the temperature after it was added to the ice water; and the temperature recorded at equilibrium) and one that charts the changes in the clear ice water against time (its initial unmixed temperature; the temperature after the red water was added; and the temperature recorded at equilibrium). Ask partners to write a summary explaining how the graphs show the movement of heat energy.
- Encourage advanced students to research convection currents and diffusion in order to gain a deeper understanding of what was occurring during "Cold Plunge" and "All Evened Out." Invite them to share their findings with the class.