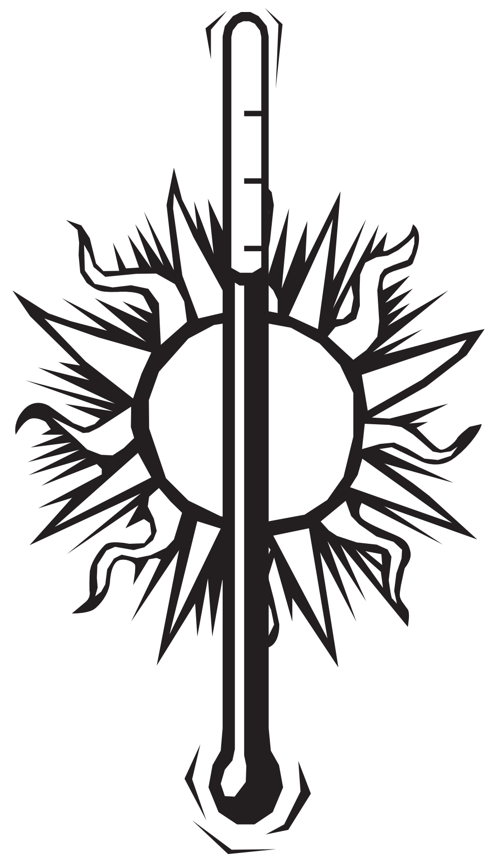
Educator Guide to

The Heat…



…is On!

A workshop presented by the Reuben H. Fleet Science Center for grades k-3

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Pre-Visit Activity

HEATING & COOLING RATE

MATERIALS:

- Clear plastic cups or glass beakers (3 per group)
- Thermometers (3 per group)
- Potting soil
- Sand
- Water
- Stopwatch or clock with second hand
- Clear plastic lids (optional)

TO DO:

1. Fill one cup with potting soil, one cup with sand, and one up with water (each cup should be about 3/4 full).

2. Create a table to record the temperature change of each cup over time (see example below).

3. Make a prediction. Which cup will heat up the fastest?

4. Record the starting temperature for the three thermometers and then place a thermometer in each of the cups. Make sure the bulb of the thermometer is 1 to 2 cm into the soil or water. (Note: You can use clear plastic lids to hold the thermometers in place. Just punch a hole in the lid and place it over the top of the cup. Slide the thermometer through the hole in the lid.)

5. Place the cups in the sun. Make sure all three cups receive equal amounts of sunlight.

6. Record the temperature in each of the cups every 3 minutes for the next 15 minutes.

7. Calculate the change in temperature for each of the cups. To do this, subtract the starting temperature from the final temperature for each cup.

8. Which cup heated up the fastest? Why do you think so?

NOW TRY THIS…

1. Which cup do think will cool off the fastest?

2. Move all of the cups into the shade and record the temperature reading for each cup.

3. Continue to record the temperature of each cup every 3 minutes for the next 15 minutes.

4. Calculate the change in temperature for each cup by subtracting the starting temperature from the final temperature.

5. Which cup cooled off the fastest? Is this what you expected?

WHAT'S GOING ON?

Land and water surfaces heat and cool at different rates because they absorb solar radiation differently. Water takes longer to heat than land, but once heated up, it retains its heat longer than the land. This is why, on a sunny day, the sand on a beach feels much hotter than the water. At night, however, the ocean is warmer than the land because the water loses heat very slowly. Places that are close to the ocean or a large lake have more moderate temperatures. These areas will not be as hot as inland locations during the day (or during the hot season) and they will not be as cool as inland locations during the night (or during the cool season).

The color of the land's surface also affects its heating and cooling rates. Darker surfaces absorb more solar radiation than lighter colored surfaces. In fact, some white surfaces, such as ice and snow, absorb very little solar radiation. Instead, these surfaces reflect most of the incoming sunlight. Another factor that affects heating and cooling rates is texture. Rough or bumpy surfaces absorb more radiation than smooth surfaces.

MATERIALS	0 MINUTES	3 MINUTES	6 MINUTES	9 MINUTES	12 MINUTES	15 MINUTES	CHANGE IN TEMPERATURE
SOIL							
SAND							
WATER							

SAVE THE CUBE

OBJECTIVE:
Students will conduct an experiment to determine which materials make good insulators.

MATERIALS:

- Small milk cartons, margarine containers, or other containers with lids (two per group)
- Ziploc bags
- Ice cubes of uniform size*
- Various materials for insulation (cotton balls, aluminum foil, packing peanuts, bubble wrap, cloth, popcorn, etc.)
- Graduated cylinders (or pre-marked medicine cups)
- Stopwatch or clock with second hand

* To make uniform size cubes, fill small paper cups with 30 or 40 ml of water

TO DO:

1. Place an ice cube in a Ziploc bag and put the bag into one of the milk cartons. Do not add any insulating material. This will be your control.

2. Place another ice cube in a second bag and place this bag in another carton. Choose one of the materials to insulate your ice cube. Fill any open space in the carton with your insulating material.

3. Place both cartons in the sunlight for 10-15 minutes.

4. After 15 minutes open your control carton and pour any melted water from the bag into a graduated cylinder. Record the amount of melted water.

5. Now open the second carton and pour the water from this plastic bag into the graduated cylinder. Record the amount of water.

6. Which ice cube melted more? Did your insulating material slow the melting process? Can you think of any other materials you would like to try or any other questions you would like to investigate?

7. Compare your results to those of your classmates. Do any of the materials appear to make better insulators?

NOW TRY THIS...

1. What would happen if you combined more than one insulating material? What would happen if you insulated the outside of the carton or container? Design an investigation to test one of these questions or come up with a question of your own.

2. Using your knowledge from this investigation, design a new type of ice chest that will keep frozen items from melting. Draw a diagram of your creation and write a sales pitch to market it to the public.

WHAT'S GOING ON?
An insulator is a material that resists the flow of heat energy. Wood is one example of an insulator. Many cooking utensils have wooden handles because wood prevents the transfer of thermal energy from the hot food to your hand. Other examples of insulators are fiberglass, Styrofoam, cloth, and plastic.

Insulators, such as foam, are used in ice chests to keep heat out, but they can also be used to trap heat inside a container. For instance, the insulation in a thermos prevents the transfer of the heat from the warm liquid inside the container to the cooler air outside the container. The same principle is true of the fiberglass insulation used in houses. In the summer months, insulation prevents the transfer of heat from the warm outside air to the cooler air-conditioned rooms inside. In the winter, the insulation keeps the heated inside air from escaping.