Solar Heating - Elementary

Theory

Heating of objects that are placed in the sun takes place along their surface. Changing the color of an object may affect the rate at which it absorbs sunlight and thus the rate at which it heats up.

Purpose

Compare the heating rate for objects of different color.

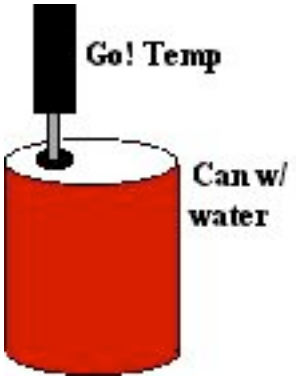
Equipment

Go! Temp probe, Macintosh or PC Computer, *Logger Lite* software, cans of same size but different color, water

Procedure

1. Plug the Go! Temp probe into your computer then launch *Logger Lite*. The software will set up a graph of Temperature versus Time.

2. Click on **Experiment** then choose **Data Collection…** Set the time for data collection to 600 seconds. A rate of 1 sample per second is a good rate for Go! Temp. Click [Done] to set this new time.



3. Pour room temperature water into the can, filling it close to overflowing. Place the can in the direct sunlight. Place a Go! Temp probe as close to the center inside the can as possible and hold it there. (You could use a ring stand to hold the probe.) Wait approximately a minute for the probe to adjust to the temperature of the water. Press the green Collect button to begin data collection.

4. When data collection is complete, remove the Go! Temp from the can. Dispose of the warm water carefully. Return the can to the place indicated by the instructor and obtain a second can that is a different color. This will be used for your second run.

5. Click the Store button (file cabinet). This leaves the graph you just obtained on the screen while allowing you to make another run.

6. Fill your second can with water. Repeat Steps 3-4. A second graph line should appear, but it may start out slightly higher or lower than your first trial.

7. Repeat Steps 3-4 with a third can, if it is available. When finished, complete the Analysis activities.

Analysis

1. Go to the column in the computer data table labeled "Temp 1". Double-click on this space. When the dialog box appears, change the name to "Xxx Can" with a short name of "Xxx", where "Xxx" is the color of the can. This will help you sort out results later. Do the same for additional cans you used.

2. Click on the Scale button (graph axes with large, capital A). This enlarges or shrinks the graph so that the graph line occupies the most space on the screen.

3. Did the cans heat at a steady rate? Did they heat fastest at the beginning or at the end? How did you determine your answer?

4. Compare the graphs from your cans. Which heated the fastest? Which heated slowest? How did you determine this from your graph? In the Data Table below, record "fastest", "medium" or "slowest" for the Heating Rate of each can.

5. Formulate a reason why you think one heated faster than the other. Think of other situations where objects heat (or cool) fast or slow depending solely on their color. Explain these situations as part of your report.

6. If you were going to rely on the heat you absorbed from sunlight, what are some changes you might make in your experiment to get a greater heat gain? Explain why you think this would work. Describe an experiment to test your idea.

Data Table

Color:			
Heating Rate			

Extensions

If you have updated *Logger Lite* to at least version 1.4, you can choose a section of each graph line near the beginning of each trial that is nearly straight. Click and drag your cursor so you select this section. Click on **Analyze** then choose **Linear Fit**. The result is the equation giving the best straight line fit to your data. From the equation, the value of **m**, the slope, gives the rate at which the temperature changed. Compare the mathematical rates for your different cans.

Reverse the process. Put hot water into the cans and watch them cool off. Before you start, predict which one will cool fastest. Does it? How do the rates for heating and cooling compare?

Can you figure out a way to maximize how hot the water gets in a limited amount of time? Make some suggestions, do them, and then report on your results.

No mention is made in these instructions about keeping the water stirred up during the experiment. How much will stirring or not stirring affect the results? Test your hypothesis.

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