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

Temperature probe(s), data collection platform, soda cans painted different colors, water

Procedure

1. Plug the temperature probe into your data collection platform. When the software launches and gets connected to the temperature probe, it will set up a graph of Temperature versus Time.

2. If you have Logger Lite, Logger Pro or a LabQuest, set the time for data collection to 600 seconds. A rate of 1 sample per second is a good rate but it can be set slower like 1 sample per 5 seconds.

3. Pour room temperature water into the can, filling it close to overflowing. Place the can in the direct sunlight. Place a temperature 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. Consider blocking the sunlight while the probe is adjusting to the water temperature. Once the temperature is stable, begin data collection.

4. When data collection is complete, remove the temperature probe 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. Store your data by clicking or tapping on the file cabinet icon, or choosing "Store Latest Run" under **Experiment**.
6. Fill your second can with water. Repeat Steps 3-4.

7. Repeat Steps 3-4 with a third can, if it is available. When finished, return the equipment then answer the questions in the Analysis section.
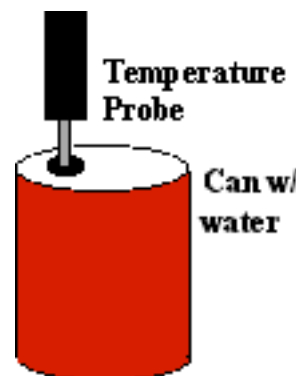
Analysis

1. 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?

2. 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.
3. Determine how much the temperature changed for each of your trials. Record the values in the data table.

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

5. 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

Trial #:	1	2	3
Color:			
Heating Rate:			
Temperature Change:			

Extensions

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.

Equipment

The chart below shows several options for measuring temperature with Vernier Software & Technology equipment. More information about each is available on the Vernier website, www.vernier.com, or in the catalog that is published each January.

Data Collecting Device	Interface	Sensor	Software
Computer	none	Go! Temp	Logger Lite or Logger Pro
Computer	Go! Link	TMP-BTA	Logger Lite or Logger Pro
Computer	LabPro LabQuest Mini LabQuest	TMP-BTA	Logger Lite or Logger Pro
LabQuest	none	TMP-BTA Go! Temp Go Wireless Temp	LabQuest App (built in)
Smart Phone or Tablet (iOS or Android)	none	Go Wireless Temp	Graphical Analysis (for iOS or for Android)
Chromebook	none	Go! Temp	Graphical Analysis for Chromebook
Chromebook	Go! Link LabQuest Mini	TMP-BTA	Graphical Analysis for Chromebook

| TMP-BTA | Go! Temp | Go Wireless Temp |

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