Can-Can Lab - Comp

Theory:

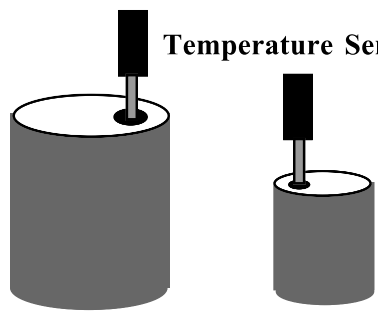
Cooling of objects takes place along their surface. An object with a larger surface area will lose heat faster than an object with smaller area. But larger objects have more mass and therefore more heat energy to release while cooling. Which of these two variables, surface area or mass, increases faster as objects grow in size?

Purpose:

Compare the cooling rate for objects of different size.

Equipment:

Temperature Probes (2 or 3), LabPro*, Macintosh or PC Computer, Cans of similar shape but different size, Hot water, Ring stands, Universal (buret) clamps



Prediction:

1. For the cans of hot water, where does cooling take place? Which can has the most of this and therefore loses heat at the fastest rate?
2. For the cans of hot water, which can had the most heat to lose in order to get back to room temperature? Based on this concept, which can should cool fastest?
3. If your answers to the questions above are different, how can you arrive at the correct prediction of what should happen in this lab?

Procedure:

1. Plug the Temperature Probes into your LabPro. Connect the LabPro to your computer then launch Logger *Pro* or Logger *Lite* software. When the software launches, it will set up a graph with a number of temperature inputs equal to the number you plugged in initially. Note that each is assigned its own color so you can differentiate them easily. (The one in CH1 is called "Temperature 1", etc. If you go to the data table, you can double-click on the title and change it to describe which size can each represents.)

2. Press the "stopwatch" icon in the menu bar of Logger *Pro* or choose Experiment > Data Collection in Logger *Lite*.. Set the time for data collection to 15 minutes (900 sec) at a rate of 1 sample per second. Click [Done].

3. Determine the dimensions of each can you are using. Ignore small features and focus on the volume of water that will be added. Put these values in the Data Table. Calculate the volume of each can and its total surface area, recording those values in the Data Table.

4. Heat water in a coffee maker or a microwave oven. When handling the cans once you've introduced the water, be careful. Tongs or folded paper towels should be used as the water may be close to boiling!

5. Pour hot water into each of the cans, filling it almost to overflowing. Separate the cans and then place a temperature probe as close to the center of each as possible. Use a ring stand and clamp to hold the temperature probe. Wait approximately a minute for the probe to rise to the temperature of the water, then press the green Collect button to begin data collection.

6. When data collection is complete, remove the temperature probes from the cans. Dispose of the hot water carefully. Return all equipment to the place indicated by the instructor.

Analysis:

1. Label the different traces so you will know the relative sizes of the cans that created the graphs. If you labeled the columns in the data table, simply double-click on the graph proper and check the box next to "Legend". Or you could go to Insert > Text Annotation. Type in the descriptor, move the text box to a convenient place, then drag the end of the arrow to the graph line you wish to label.

2. Compare the graphs from your different cans. Which cooled the fastest? Which cooled slowest? How did you determine this from your graph? Can you determine a mathematical value for the cooling rate, how fast the can cooled?

3. Formulate a reason why one cooled faster than the other(s). Compare the relative cooling rates to the SA/V Ratio, the ratio of surface area to volume. For the same amount of volume, which can had the most surface area? Did it also have the fastest cooling rate?

4. Think of other situations where objects cool (or heat) faster or slower depending solely on their size. Explain these situations as part of your report.

Data Table:

	Smallest	**Medium**	**Largest**
Diameter (D)			
Height (H)			
Volume (V)			
Surface Area (SA)			
SA/V Ratio			
Cooling Rate			

Radius (R) = Diameter (D) / 2 Volume (V) = $\pi R^2 H$ Surface Area (SA) = $\pi D H$

*** Notes:** Go! Links will substitute successfully for LabPro in this lab. If using a single temperature sensor, use Experiment > Store Latest Run to store the first run then begin a second run with a second can.

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