# Potatosaurus* Lab

## 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), Lab Pro, Macintosh or PC Computer, Potatoes of different size but similar shape

## Procedure:

1. Plug the Temperature Probes into your Lab Pro. Connect the LabPro to your computer then launch Logger Pro software. When the software gets launched successfully, it should have 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 potato each represents.)

2. Press the icon with the stopwatch next to the LabPro icon. Click on the "Sampling" tab. Set the time for data collection to 10 minutes. A rate of 1 sample per second is okay for most modern computers to keep up with. Click [Okay] to set this data rate.

3. Determine the mass of each potato that you are using. Put these values in the Data Table. Determine the volume of each potato using water displacement. Record those values.

4. Heat the potatoes either using a hot water bath or a microwave oven. They don't have to be exactly the same temperature for purposes of this lab, but having them almost the same temperature will help to interpret the data. Note: Be sure to pierce the skin on the potatoes before placing them in the microwave oven to prevent messy exploding potatoes.

5. Once the potatoes are heated, bring them to the experimental area exercising caution as they may be hot enough to burn your hands. Separate the potatoes and then place a temperature probe in the center of each potato. Give them approximately a minute for the probe to rise to the temperature of the potato, then press [COLLECT] to begin data collection.

6. When data collection is complete, remove the temperature probes from the potatoes and clean in soap and water. Dispose of the potatoes as directed by the instructor. Return all equipment to the place indicated by the instructor.

## Analysis:

1. Print out your graph and include with your report. Label the different traces describing the relative sizes of the potatoes that created the graphs.

2. Compare the graphs from your different potatoes. 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?

3. Formulate a reason why the one cooled faster than the other(s).

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:

| | Mass | Volume | Cooling Speed |
|---|---|---|---|
| **Largest** | | | |
| **Medium** | | | |
| **Smallest** | | | |

* The term "Potatosaurus" was borrowed from Dr. Barbara Snapp, retired AP Biology teacher at Gunn High School in Palo Alto. She used decreasing surface area to volume ratio as one possible explanation for the demise of dinosaurs. The title is kind of catchy!

** Heating potatoes of different sizes in a microwave oven results in differences in starting temperatures. Another approach would be to immerse all of the potatoes in a boiling water bath. After about 2 minutes they should be fairly uniform in their starting temperatures.

I have used new potatoes for this activity. They can be obtained at various sizes so very small ones and relatively huge ones of the same basic shape are possible.

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