

Food Energy

by Dan O'Brien

Grade level 10 - 12

Time required

Two 50 minute class periods

Materials/Technology

Some sensitive means of measuring temperature (e.g., computer interface, digital thermometer, or CBL)

Wooden matches or a lighter

16 x 150 test tube

16 oz. empty tin can

46 oz. empty tin can

Safety goggles

Masking tape

Electric balance

10 ml graduate

Rubber bands (2)

Aluminum foil (50 x 30 cm)

Large paperclip

Calculator

Food items with high lipid content, i.e. Brazil Nuts or Cheetos

Summary

In this lesson, students will predict what native food substances would have offered the best survival strategy to an early indigenous people and then test their hypothesis using a calorimeter.

Objectives

The student will:

- 1) identify the problem and formulate an appropriate hypothesis with respect to the best survival foods.
- 2) use a calorimeter to measure and calculate the amount of stored energy in each food type.
- 3) compare the energy value of traditional foods with those of commercial foods.
- 4) based on their calculations, identify the best survival foods.
- 5) identify sources of discrepancies in their results.

Montana Science standards addressed

- 1) Students design, conduct, evaluate and communicate scientific investigations.
- 2) Students demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.

Assessment

Evaluate the students based on their answers to the in-lab questions.

Procedural Notes

The calorimeter this lab is designed around is obviously not a perfectly efficient energy measuring device. It does, however, possess sufficient accuracy to allow us to calculate the relative energy of the tested foods. For this degree of accuracy to be obtained, you will have to eliminate all extraneous variables.

The greatest source of error in this type of lab involves the relative combustibility of the food sample. Some food types contain far more lipids and therefore will tend to burn much more readily. You should not attempt to control this variable since it is, in fact, one of the main

lessons of the lab, i.e., foods which contain more stored energy will burn more readily than foods lower in energy.

A second variable that can produce confusing results has to do with the water content of the sample. You will have to use a food drier or stove to ensure that the samples you are testing are quite dry and therefore more likely to burn unassisted.

A related, and very important, variable is that of sample thickness. Unless cautioned about it, you will find students repeatedly holding the flaming lighter inside the calorimeter door in their frequent attempts to re-light samples that are too thick or damp. The relatively intense heat from the lighter can rapidly skew the resulting data. Your students must understand that they will be comparing “apples to oranges” if they introduce the non-food energy of the burning butane to the calorimeter by constantly re-lighting a thick or damp sample near the door or inside the calorimeter.

To solve both of the above problem variables please consider purchasing one of the very inexpensive plastic “Jerky Presses” currently on the market. This tool will allow your students to produce consistently uniform samples. They will all be very thin, which promotes thorough burning via easy access to oxygen. A thin sample is also easier to hold. In addition, the samples will all dry quickly, which is important for time con-strained lab situations.

Lighters, while more expensive, provide an intense and focused heat source. If used outside the calorimeter they can allow rapid, full heat, re-lights and avoid the smoldering and mess problems of matches. Controlling the “toy” factor is obviously another matter!

Students will ask why their results don't come close to the values published on food packages. Help them figure out the inherent design flaws in their calorimeter. However, also help them to see that as long as all samples lose heat to the room at the same rate we should still be able to obtain a perfectly usable relative energy content figure. We are, after all, trying to determine what food types would be best to take with us to ensure our survival. Exact calories per gram are not needed to solve this problem. However, for your background information:

Carbohydrates = 4 calories / gram

Proteins = 4 calories / gram

Lipids = 9 calories / gram

Further information

For further information about this lesson, contact the author at:

Dan O'Brien
Polson High School
Polson, MT 59860
406-883-6316
dobrien@digisys.net