Energy Content of Foods

Energy content is an important property of food. The energy your body needs for running, talking, and thinking comes from the food you eat. Energy content is the amount of heat produced by the burning of 1 gram of a substance, and is measured in joules per gram (J/g).

You can determine energy content by burning a portion of food and capturing the heat released to a known mass of water in a calorimeter. If you measure the initial and final temperatures, the energy released can be calculated using the equation

$$H = \Delta t \cdot m \cdot Cp$$

where H = heat energy absorbed (in J), Δt = change in temperature (in °C), m = mass (in g), and C_p = specific heat capacity (4.18 J/g°C for water). Dividing the resulting energy value by grams of food burned gives the energy content (in J/g).

OBJECTIVES

In this experiment, you will

- Use a computer to measure temperature.
- Use a computer to analyze data.
- Use a balance.
- Determine energy content.
- Compare the energy content of different foods.

MATERIALS

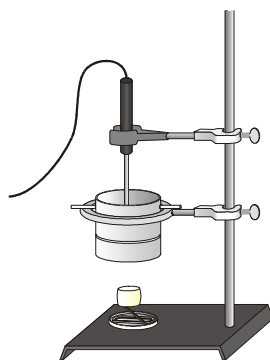|	
computer	2 stirring rods
Vernier computer interface	balance
Logger*Pro*	small can
Vernier Temperature Probe	slit stopper
2 food samples (nut, popcorn, or marshmallow)	cold water
	food holder
ring stand and 10 cm (4") ring	matches
100 mL graduated cylinder	wooden splint

Figure 1

PROCEDURE

1. Obtain and wear goggles.

2. Connect the probe to the computer interface. Prepare the computer for data collection by opening the file "10 Energy of Foods" from the *Physical Science w Vernier* folder.

3. Get a sample of food and a food holder like the one shown in Figure 1. Find and record the initial mass of the food sample and food holder. **CAUTION:** *Do not eat or drink in the laboratory.*

4. Set up the apparatus shown in Figure 1.

   a. Determine and record the mass of an empty can.
   b. Place about 50 mL of cold water into the can.
   c. Determine and record the mass of the can plus water.
   d. Use a stirring rod to suspend the can about 2.5 cm (1") above the food sample.
   e. Use a utility clamp and slit stopper to suspend the Temperature Probe in the water. The probe should not touch the bottom of the can.

5. Click ▶ Collect to begin measuring temperature. Record the initial temperature of the water.

6. Remove the food sample from under the can and use a wooden splint to light it. Quickly place the burning food sample directly under the center of the can. Allow the water to be heated until the food sample stops burning. **CAUTION:** *Keep hair and clothing away from an open flame.*

7. Stir the water until the temperature stops rising. Record this final temperature. Click ■ Stop to end data collection.

8. Determine the final mass of the food sample and food holder.

9. To confirm the initial temperature, examine the initial data points in the table. To confirm the final temperature, click on the graph and then click the Statistics button, 📊. The maximum temperature is listed in the statistics box on the graph.

10. Repeat the procedure for a second food sample. Use a new 50 mL portion of cold water.

11. When you are finished, place burned food, used matches, and partly-burned wooden splints in the container supplied by the teacher.

DATA

	Sample 1	Sample 2
Food used	_____	_____
Mass of food and holder (initial)	_____ g	_____ g
Mass of food and holder (final)	_____ g	_____ g
Mass of empty can	_____ g	_____ g
Mass of can plus water	_____ g	_____ g
Initial water temperature	_____ °C	_____ °C
Final water temperature	_____ °C	_____ °C

PROCESSING THE DATA

1. Calculate change in water temperature, Δt, for each sample, by subtracting the initial temperature from the final temperature ($\Delta t = t_{final} - t_{initial}$).

2. Calculate the mass (in g) of the water heated for each sample. Subtract the mass of the empty can from the mass of the can plus water.

3. Use the results of Steps 1 and 2 to determine the heat energy gained by the water (in J). Use the equation

$$H = \Delta t \cdot m \cdot C_p$$

where H = heat absorbed (in J), Δt = change in temperature (in °C), m = mass of the water heated (in g), and C_p = specific heat capacity (4.18 J/g°C for water).

4. Calculate the mass (in g) of each food sample burned. Subtract the initial mass from the final mass.

5. Use the results of Steps 3 and 4 to calculate the energy content (in J/g) of each food sample.

6. Record your results and the results of other groups below.

    Class Results

Food Type	Food Type	Food Type	Food Type
_____	_____	_____	_____
_____ J/g	_____ J/g	_____ J/g	_____ J/g
_____ J/g	_____ J/g	_____ J/g	_____ J/g
_____ J/g	_____ J/g	_____ J/g	_____ J/g
_____ J/g	_____ J/g	_____ J/g	_____ J/g
_____ J/g	_____ J/g	_____ J/g	_____ J/g
_____ J/g	_____ J/g	_____ J/g	_____ J/g
Avg._____ J/g	_____ J/g	_____ J/g	_____ J/g

7. Which of the foods has the greatest energy content? Why do these foods have the greatest energy content?

EXTENSION

1. Determine the energy content of other combustible foods.

Vernier Lab Safety Instructions Disclaimer

THIS IS AN EVALUATION COPY OF THE VERNIER STUDENT LAB.

This copy does not include:

- **Safety information**
- **Essential instructor background information**
- **Directions for preparing solutions**
- **Important tips for successfully doing these labs**

The complete *Physical Science with Vernier* lab manual includes 40 labs and essential teacher information. The full lab book is available for purchase at:
http://www.vernier.com/cmat/psv.html