

# Energy in Food

By Beth Mick

Food supplies energy for all animals—without it we could not live. The quantity of energy stored in food is of great interest to humans. The energy your body needs for running, talking, and thinking comes from the foods you eat. Not all foods contain the same amount of energy, nor are all foods equally nutritious for you. An average person should consume a minimum of 2,000 kilocalories per day. (In our everyday life we actually use the word calorie instead of kilocalorie.) That is equivalent to 8,360 kilojoules. Calories and joules are both units of energy. We will use joules in this lab since it is the accepted SI metric standard.

You can determine energy content of food by burning a portion of it and capturing the heat released to a known amount of water. This technique is called *calorimetry*. The energy content of the food is the amount of heat produced by the combustion of 1 gram of a substance. It is measured in kilojoules per gram (kJ/g).

## OBJECTIVES

In this experiment, you will

- Use a computer to measure temperature changes.
- Monitor the energy given off by food as it burns.
- Determine and compare the energy content of different foods.

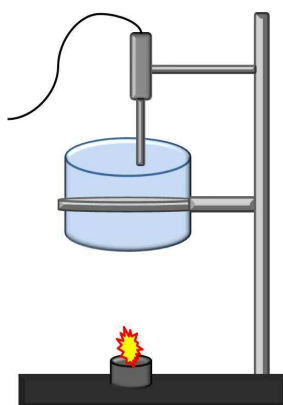


Figure 1

Figure drawn by Christine Rodriguez

## MATERIALS




Computer  
Vernier computer interface  
LoggerPro  
Temperature Probe  
100 mL graduated cylinder  
Balance  
food holder  
food samples (nut, popcorn, or marshmallow)

matches  
ring stand and 10 cm ring  
small can  
split 1-hole stopper  
two stirring rods  
utility clamp  
warm and cool water  
wooden splint  
two 1-hole rubber stoppers

## Experiment 1

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### PROCEDURE

1. Wear your goggles.
2. Obtain a sample of food and a food holder similar to the one shown in Figure 1. Mount the food onto the food holder so that it can burn without damaging the holder. Find and record the initial mass of the food sample **and** food holder. **CAUTION:** *Do not eat or drink in the laboratory.*
3. **Connect the Temperature Probe to the computer interface. Prepare the computer for data collection by opening the file “01 Energy in Food” from the *Biology with Computers* folder of *LoggerPro*.**
4. Set up the apparatus shown in Figure 1.
  - a. Determine the mass of an **empty can**. Record the value in Table 1.
  - b. Place about 50 mL of cold water into the can.
  - c. Determine and record the mass of the can plus the water.
  - d. Insert a stirring rod through the holes in the top of the can and hold it in place with two one-hole stoppers. Position the can 2.5 cm (~1 inch) above the food sample.
  - e. Use a utility clamp and split stopper to suspend the temperature probe in the water. The probe should not touch the bottom or side of the can.
5. Click  to begin data collection. Record the initial (minimum) temperature of the water in Table 1.
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. Stir the water constantly. **CAUTION:** *Keep hair and clothing away from an open flame.*
7. If the temperature of the water exceeds 60°C, blow the flame out. **Do not stop** the computer yet.
8. After 4 minutes, if the food is still burning, blow the flame out. Record the maximum temperature of the water in Table 1.
9. Once the water temperature begins to decrease, end data collection by clicking .
10. Determine the final mass of the food sample **and** food holder.
11. Place burned food, matches, and wooden splints in the container supplied by your instructor.
12. You can confirm your data by clicking the Statistics button, . The minimum temperature ( $t_2$ ) and maximum temperature ( $t_1$ ) are listed in the floating box.
13. Repeat Steps 4 – 12 for a second food sample. **Be sure to use a new 50 mL portion of cold water.**

## DATA

Table 1		
Measurements	Sample 1	Sample 2
Food used		
Mass of empty can (g)		
Mass of can plus water (g)		
Minimum temperature of water (°C)		
Maximum temperature of water (°C)		
Initial mass of food (g)		
Final mass of food (g)		

Table 2		
Calculations	Sample 1	Sample 2
Mass of water (g)		
$\Delta t$ of water (°C)		
$\Delta$ mass of food (g)		
Energy gained by water (J)		
Energy content of food ( <b>KJ/g</b> )		

## PROCESSING THE DATA

Record the following calculations in Table 2. Show your work in Table 3.

1. Calculate the change in mass of water. Show your calculations.
2. Calculate the change in mass of each food sample. Show your calculations.
3. Calculate the changes in the temperature of the water,  $\Delta t$ . Record this in Table 2. Show your calculations.
4. Calculate the energy gained by the heated water. Show your calculations. To do this, use the following equation:

$$\text{Energy gained by water} = (\text{mass of water}) \times (\Delta t \text{ of water}) \times (4.18 \text{ J/g}^\circ\text{C})$$

5. Convert the energy you calculated in Step 3 to kilojoules (1 kJ = 1000 J).
6. Use your answer in Step 4 to calculate the energy content of each food sample (in kJ/g):

$$\text{Energy content of food} = \text{Energy gained by water} / \Delta \text{mass of food}$$

***Experiment 1***

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

Table 4			
Class Results			
Food Type	Food Type	Food Type	Food Type
Energy content (kJ/g)			
Average			

**QUESTIONS**



ment of your data table.

be close to the value listed

## *Experiment 1*

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### Teacher Notes:

1. This lab uses Vernier equipment but can be modified by simply using a thermometer and carefully watching for results.
2. Walnuts, pecans, peanuts, almonds, cashews, kidney beans, lima beans, marshmallows are easy to use.
3. A small juice can (V-8) could be used with a glass rod suspending it.
4. The food stand could be made with a cork stopper and a paperclip.
5. With this experiment heat is obviously lost to the environment – so it is unlikely that the energy content will be the same as published values.