

## PRELIMINARY ACTIVITY FOR

# Investigating the Energy Content of Foods

### Open Inquiry Version

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. That is equivalent to 8,360 kilojoules. Calories and joules are both units of energy. We will use joules in this experiment 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 the food, and is measured in kilojoules per gram (kJ/g).

In the Preliminary Activity, you will determine the energy content of a peanut. You will first use the energy from a burning peanut to heat a known quantity of water. By monitoring the temperature of the water, you can find the amount of heat transferred to it (in kJ), using the formula

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

where  $q$  is heat,  $C_p$  is the specific heat capacity of water,  $m$  is the mass of water, and  $\Delta t$  is the change in temperature of the water. Finally, the *amount* of peanut burned will be taken into account by calculating the heat *per gram* of peanut consumed in the combustion.

After completing the Preliminary Activity, you will first use reference sources to find out more about calorimetry, food, and food energy sources before you choose and investigate a researchable question dealing with the energy content of food.

Some topics to consider in your reference search are:

- calorimetry
- energy
- carbohydrates
- proteins
- fats
- food composition table

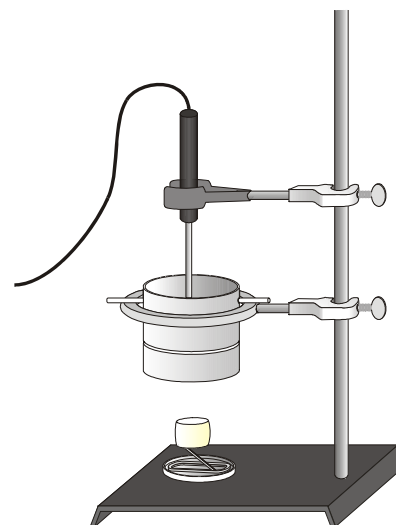
## PROCEDURE

1. If you are allergic to nuts, or have any severe food allergies, inform your instructor before starting the experiment.
2. Obtain and wear goggles.
3. Connect the Temperature Probe and the data-collection interface.
4. Set up the data-collection program to collect data for twenty minutes following your instructor's directions.

## Experiment 6

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- Obtain a peanut and a food holder like the one shown in the figure. **CAUTION:** *Do not eat or drink in the laboratory.*
- Find and record the combined mass of the peanut and the food holder.
- Determine and record the mass of an empty can. Add 50 mL of chilled water to the can. Determine and record the mass of the can and water.
- Set up the apparatus as shown in Figure 1. Use a ring and stirring rod to suspend the can about 2.5 cm (~1 inch) above the peanut. Use a utility clamp to suspend the Temperature Probe in the water. The probe should not touch the bottom of the can. **Important:** Stir the water until the Temperature Probe has cooled to the temperature of the water before you do Step 9.
- Begin data collection. Record the initial water temperature. Remove the peanut and its food holder from under the can and use a wooden splint to light it. Quickly place the burning peanut directly under the center of the can. Allow the water to be heated until the peanut stops burning. **CAUTION:** *Keep hair and clothing away from an open flame.*
- Stir the water until the temperature stops rising. Record this final temperature, and then stop data collection.
- Allow the burned peanut to cool for about a minute, then determine and record the final mass of the peanut and the food holder.



**Figure 1**

## QUESTIONS

1. Find the mass of water heated.
2. Find the change in temperature of the water,  $\Delta t$ .
3. Calculate the heat absorbed by the water,  $q$ , using the formula in the introduction of this experiment. For water,  $C_p$  is  $4.18 \text{ J/g}^\circ\text{C}$ . Change your final answer to kJ.
4. Find the mass of peanut burned.
5. Calculate the energy content of the peanut in kJ/g. Use your Step 3 and Step 4 answers.
6. Calculate the % *efficiency* of the experiment. Divide your experimental value (in kJ/g) by the accepted value, and multiply the answer by 100. A value for the energy content of peanuts available from the United States Department of Agriculture (USDA) is  $25.0 \text{ kJ/g}$ .
7. Discuss heat loss factors that contribute to the inefficiency of the experiment.
8. List at least one researchable question concerning the energy content of foods.

**Note:** The plan that you submit for instructor approval should list laboratory safety concerns, including chemical safety concerns, and specify how you will address these safety concerns during your investigation.

# 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 *Investigating Chemistry through Inquiry* lab manual includes 25 inquiry-based labs and essential teacher information. The full lab book is available for purchase at:

<http://www.vernier.com/cmat/chemi.html>

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