Lab: How Much Energy is in Your Snack Food?

Summary
In this lab, students will find the amount of heat energy stored in foods and compare heat calories with food calories.

Resource Type: Lab
Grade Level: High school

Objectives
By the end of this lesson, students will
- understand the law of conservation of energy.
- measure heat released by a snack food.

Chemistry Topics
This lesson supports students’ understanding of
- Calorimetry
- Law of conservation of energy
- Combustion

Time
Teacher Preparation: 30 minutes
Lesson: 90 minutes

Materials
For each group:
- 5 pieces of snack food
- Large cork with needle or platform
- Thermometer
- Matches
- Large metal can
- Empty soda can with tab
- Bamboo skewer
- Water
- 100-mL graduated cylinder
- Balance
- Timer

Safety
- Always wear safety goggles when working with chemicals in a lab setting.
- Food in the lab should be considered a chemical, not for consumption.
- Always be aware of an open flame. Do not reach over it, tie back hair, and secure lose clothing.
- Students should wash their hands thoroughly before leaving the lab.
- When students complete the lab, instruct them how to clean up their materials and dispose of any chemicals.

Teacher Notes
- Check for food allergies before deciding on snack foods.
- Students get confused with food calories and heat calories, so this is a fun lab to do for them to get hands on experience finding heats of combustion. Also, food science is a
great discipline for them to get interested in and many of them do not think their foods would really burn and give good results.

FOR THE STUDENT

Student Activity Sheet: How Much Energy is in Your Snack Food?

Lesson

Background
Energy is an essential part of life for all organisms. Without energy, cells would not be able to operate, and organisms would not be able to fulfill their niches. There are many types of energy: mechanical, thermal, electromagnetic, and chemical are just a few. The process of making and breaking of bonds is an energy source that keeps us up and running—the food you eat is full of chemical energy. Exothermic reactions (release heat) and endothermic reactions (absorbs heat) happen when a chemical change occurs.

Calorimetry is a technique used to measure heat released or absorbed in a reaction. Snack foods contain potential energy (stored energy) and this can heat water if it is released.

In this experiment, you will calculate the amount of energy in your chosen snack food using calorimetry. You will use the heat from burning the snack food to warm a can of water. Measuring the change in temperature of the known amount of water will help to find the heat from the snack food.

Calorimetry uses the following equation:

\[ Q = m \times \Delta T \times c \]

(heat of water) = (mass of water) x (change in temp of water) x (specific heat of water)

Remember, the data used in this equation must be for one substance.

The specific heat capacity of a substance is the quantity of heat energy needed to raise the temperature of 1.00 g of the substance by 1.00 °C or 1.00 K. The specific heat of water is 4.18 J/g °C.

Purpose
To investigate and calculate the heat of combustion of a snack food.

Materials
- 5 pieces of snack food
- Large cork with needle or platform
- Thermometer
- Matches
- Large metal can
- Empty soda can with tab
- Bamboo skewers
- Water
- 100-mL graduated cylinder
- Balance
- Timer
Procedure
1. Get a cork with a needle in it or a platform to hold your snack food.
2. Carefully place the piece of snack food on the needle or platform and record the mass of everything.
3. Measure 100.0 mL of water and pour it into the soda can. Measure and record the initial temperature of the water.
4. Light the snack food with a match. Quickly place the large can around the burning food and using the skewer and tab on the soda can, balance the can over the burning food. Record how long the snack food burns.
5. Measure the final temperature of the water and reweigh the snack food and cork or platform. Record each in the data table.
6. Repeat for a total of five trials, starting with fresh water and a new piece of food each time.

Data

<table>
<thead>
<tr>
<th>Trial</th>
<th>T_f H_2O</th>
<th>T_i H_2O</th>
<th>m_i food</th>
<th>m_f food</th>
<th>Time</th>
<th>Observations</th>
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<tbody>
<tr>
<td>1</td>
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Calculations  (show one full set of calculations)
1. Find the change in water temperature (ΔT).
2. Using the density of water as 1.00 g/mL, find the mass of the water (m_w) used.
3. Find the mass of the snack food that was actually used to heat the water (m_sf).
4. Find the heat released by the snack food that was absorbed by the water.
5. Calculate the % change in mass of each snack food piece.
6. Find the average heat released for the snack food item.

<table>
<thead>
<tr>
<th>Trial #</th>
<th>ΔT</th>
<th>Burned mass</th>
<th>m_w</th>
<th>Q</th>
<th>M_sf</th>
<th>% m_sf</th>
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Analysis
1. List five possible sources of error for this experiment.
2. How did you use the law of conservation of energy?
4. Convert the joules of heat to calories. Look up the calories for your snack food on the package or Internet. How close are you to the calories listed? (1 cal = 4.18 J)
5. How does the energy of the snack food you used relate to the measured ΔT.
6. Does the size of the piece of snack food burned make a difference in the heat released? Support your answer.
7. Were you surprised by the amount of energy stored inside your snack food? Why or why not?