

Measuring Calories

Pillar(s): Healthy Eating and Active Living

Division(s): III and IV

Grade Levels: Science 7, 8, 14, 10-4, 20-4, 24

Core Curriculum Connections: Junior High and Senior High Science

I. Rationale: The evening before a marathon, runners are advised to eat a huge plate of pasta. Why? Because pasta, a carbohydrate, is a terrific source of energy, or fuel for the body. Different foods contain varying amounts of energy, which is calculated as calories or kilocalories. In other words, calories are a way to measure the energy you get from the food you eat. In this activity, you will demonstrate how calories are measured. First, you need to build an inexpensive calorimeter. A calorimeter is a device that measures the transfer of heat energy during a chemical or physical change. One type of calorimeter contains a combustion chamber surrounded by water. When matter is placed in the chamber and physically or chemically changed (usually by burning), the temperature change of the surrounding water is measured and used to determine the energy (calorie) content of the sample. This lab indirectly measures food calories (kilocalories) using a homemade calorimeter.

II. Curriculum Links: Science

Science 7: Unit C: Heat and Temperature

Science 8: Unit B Cells and Systems

Science 10-4 and 20-4 Unit B: Understanding Energy Transfer

Science 14: Unit B: Understanding Energy Transfer

Science 24: Unit B: Understanding Common Energy Conversions

III. Materials:

- goggles
- ring stand
- wire ring
- large cork
- matches
- balance
- water
- 200ml beaker
- 12-oz. soda can
- Celsius thermometer
- compass or scissors

- gloves or forceps
- shelled peanut or other high-fat food such as a potato chip

CAUTION: Be sure the room is well-ventilated. Use gloves or forceps to handle hot equipment and burned peanut.

IV. Procedure:

ACTIVITY: PEANUT CALORIMETRY LAB

1. Punch four holes evenly around a soda can, 2 to 3cm from the top (use a compass or scissors). Place two straightened paper clips (or pieces of a wire hanger) into opposing holes. Hang the can in the wire ring on the ring stand and adjust the height accordingly. Add 200ml of water to the soda can. This apparatus is your calorimeter.
2. Straighten part of the third paper clip and leave one end bent. Turn the cork upside down and poke the straight end into the cork. The bent or looped end of the clip (it should be flat) is the platform for the peanut.
3. Place the thermometer into the mouth of the can. Remember to suspend the thermometer in the water when taking a temperature reading. Before going any further, check the apparatus to make sure that everything is secured.
4. Choose a peanut, measure its initial mass and record in the data table (below).
5. Take an initial temperature reading of the water in the can and record in the data table.
6. Place the peanut on its stand. Use a match to set the peanut on fire. This may take several tries. Closely observe the nut as it burns. If the peanut falls off the stand, start over immediately.
7. As soon as the peanut stops burning, immediately take a final water temperature reading and record it in the data table.
8. As soon as the peanut has cooled, use forceps to lift the burned remains onto the balance. Take a final peanut mass and record in the data table.

DATA TABLE

Volume of water in can (in liters):

Initial reading:	0.200L (1/5 of liter)
Final reading:	0.200L

Mass of peanut:

Initial reading:	
Final Reading:	

Water temperature:

Initial reading:	
Final reading:	

CALCULATIONS

1. Change in mass of peanut equals (initial mass minus final mass).
2. Change in water temperature equals (final temperature minus initial temperature).
3. Peanut energy in kcal (for .200L of water) equals change in water temperature times volume of water or 0.200L.
4. Kcal per gram of nut burned equals peanut energy in kcal divided by change in mass of the nut.

V. Extensions and Variations:

- Discuss the sources of heat loss during this experiment. Can you suggest a better design?
- Discuss the pros and cons of eating peanuts as a staple in the average Canadian diet.
- Create a diet for an athlete, taking into consideration metabolism of fats, proteins and carbohydrates.

Note: Expect the kcal for the peanut to range between 2 and 8. This activity is an adaptation of a classic calorimeter lab. The idea for using a soda can originally appeared in Science Teacher, September 1992 (p. 54).

JUST FOR FUN

- How does your school lunch measure up? Analyze some typical lunches, and compare results with friends in other schools or other parts of Canada. Consider such items as calories, vitamins, calcium and other minerals, fat and sodium content. Then, design a healthier alternative and hold a cook-off to test the school lunch of the future!
- Keep your own food diaries for three days or a week. Use a calorie database or reference to track the amount of calories you eat.
- Convert your favorite recipes to metrics. Most cookbooks include conversion tables.