Name________________________________

Date________________ Class____________

HOLT ChemFile LAB PROGRAM

EXPERIMENT D10

Counting Calories

OBJECTIVES

- **Construct** a calorimeter setup.
- **Determine** the amount of energy, in Calories, of oil-roasted walnuts and peanuts.
- **Compare** measured caloric data.
- **Determine** which food is a better source of energy.

INTRODUCTION

We expend energy in three ways—through exercise, Specific Dynamic Action (SDA), and through basal metabolism (BM). Exercise is the composite of all physical work we do with our bodies. SDA accounts for the energy consumed in digesting and metabolizing food. BM accounts for the energy needed to maintain key bodily functions that sustain life.

Food provides energy. Food chemicals are classified as fats and oils, carbohydrates, or proteins. Fats furnish 9 Cal per gram, carbohydrates 4 Cal per gram, and proteins 4 Cal per gram. The amount of energy each of these chemicals delivers to the body is independent of the kind of food or quantity of other macronutrients. A meal containing 10 g of fat, 15 g of carbohydrates, and 20 g of protein would deliver 230 Cal of energy: 90 Cal from fat, 60 Cal from carbohydrates, and 80 Cal from protein. In this experiment, you will construct a calorimeter and indirectly determine the caloric content of peanuts and walnuts by measuring the temperature change in a sample of water.

Note: The C in nutritional Calorie is capitalized. The nutritional Calorie is equal to 1000 calories, or 1 kilocalorie.

SAFETY


Always wear safety goggles and a lab apron to protect your eyes and clothing. If you get a chemical in your eyes, immediately flush the chemical out at the eyewash station while calling to your teacher. Know the location of the emergency lab shower and the eyewash station and the procedures for using them.

Do not touch any chemicals. If you get a chemical on your skin or clothing, wash the chemical off at the sink while calling to your teacher. Make sure you carefully read the labels and follow the precautions on all containers of chemicals that you use. If there are no precautions stated on the label, ask your teacher what precautions you should follow. Do not taste any chemicals or items used in the laboratory. Never return leftovers to their original containers; take only small amounts to avoid wasting supplies.

Call your teacher in the event of a spill. Spills should be cleaned up promptly, according to your teacher's directions.

Never put broken glass in a regular waste container. Broken glass should be disposed of properly.

Never stir with a thermometer because the glass around the bulb is fragile and might break.

When using a flame, confine long hair and loose clothing. If your clothing catches on fire, WALK to the emergency lab shower and use it to put out the fire. Do not heat glassware that is broken, chipped, or cracked. Use a hot mitt or pot holder to handle heated glassware and other equipment because hot glassware does not always look hot.

MATERIALS

- peanut halves
- walnut halves
- heavy aluminum foil, 5 × 5 cm
- 250 mL flask
- 100 mL graduated cylinder
- aluminum pie plate
- can opener
- centigram balance
- cork stopper
- digital temperature recorder or thermometer
- knife or single-edge razor blade
- matches
- metal file
- metric ruler
- paper clip
- pot holder
- 16 oz tin can
- tin snips

PROCEDURE

1. Use **Figure A** to prepare the retort. Remove the label from the can. Use the can opener to punch four triangular openings in the unopened end (top) of the can and three openings in the side of the can near the top. Use tin snips to cut a viewing hole in the side of the can, beginning at the can's open end: 5 cm high, 3 cm wide at the top, and 4 cm wide at the bottom. Use a file to remove all burrs and sharp edges.

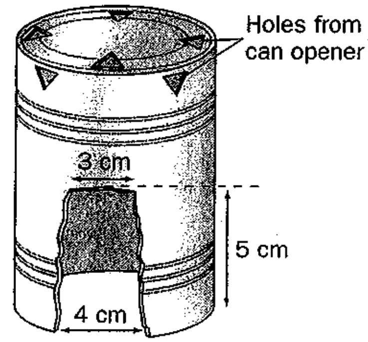

FIGURE A

2. Refer to **Figure B** to construct the sample holder. Bend a paper clip so that it can hold food samples between the wires. Measure and cut the cork stopper so that its height when resting on its widest flat surface is 2 cm. Mold a piece of aluminum foil around the cork. Insert the bent paper clip into the cork. The total height of the holder assembly should be no higher than 3.5 to 4.0 cm.

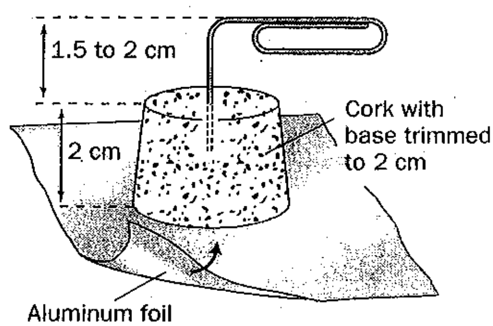

FIGURE B

3. Obtain three peanut samples and three walnut samples. Use a balance to determine the mass of each sample to the nearest 0.1 g. For each sample, record the type of nut and its mass in the **Data Table.**

4. Using a graduated cylinder, pour 100 mL of tap water into the 250 mL flask.

5. Insert the temperature recorder into the flask. Make sure that the sensing element is fully submerged and does not make contact with the bottom glass. If a digital temperature recording device is unavailable, use an alcohol thermometer.

6. Measure the temperature of the water in the flask; record this value in the **Data Table.**

7. Place a peanut half in the wire holder that is anchored in the cork. Position the wire-holder assembly in the center of the aluminum pie plate.

8. Using matches, carefully set fire to the nut. Once burning is sustained, carefully position the metal can with holes (retort) over the burning sample so that the viewing hole faces you. Set the flask on top of the retort. Refer to **Figure C.**

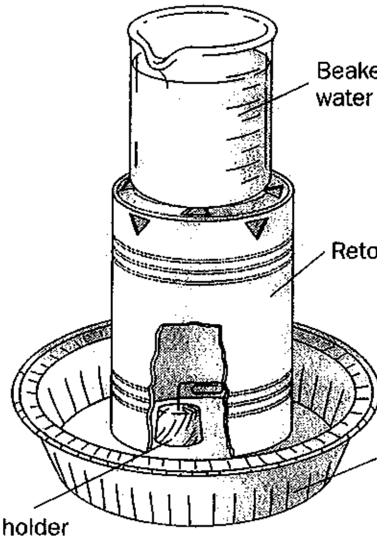

FIGURE C

9. Carefully observe the digital readout of the temperature until it starts to fall. Record the maximum temperature value in the **Data Table.**

10. Cool for 2 to 5 minutes. Using a pot holder, remove the flask from the retort and pour the water into the sink. Using a pot holder, remove the retort from the pie plate.

11. Repeat steps 4 through 9 until you have collected data for three peanut halves and three walnut halves.

Cleanup and Disposal

12. Clean all apparatus and your lab station. Return equipment to its proper place. Dispose of chemicals and solutions in the containers designated by your teacher. Do not pour any chemicals down the drain or put them in the trash unless your teacher directs you to do so. Wash your hands thoroughly after all work is finished and before you leave the lab.

CALCULATIONS

1. **Organizing Data** Determine the average mass for each nut type tested; record this value in the **Data Table.**

Data Table

		Water temperature (°C)			Food energy		
	Mass of sample (g)	**Before burning (T_1)**	**After burning (T_2)**	**Change in water temperature**	**calories**	**kcal**	**kcal per 100 g of food sample**
Trial 1 peanut							
Trial 2 peanut							
Trial 3 peanut							
Average							
Trial 1 walnut							
Trial 2 walnut							
Trial 3 walnut							
Average							

2. **Organizing Data** Calculate the change in water temperature for each trial in the **Data Table** by subtracting T_1 from T_2. Enter the results in the **Data Table.** Then calculate the average change in water temperature for each nut type tested; record the values in the **Data Table.**

3. **Organizing Data** Determine the Calories (kcal) produced per 100 g of food sample for both nut types tested; record the values in the **Data Table.** The energy transferred by the combustion of the nut equals the energy absorbed by the water. Use 1 cal/g•°C as the specific heat capacity of water when calculating the calories produced.

4. **Predicting Outcomes** Suppose a package of lunchmeat contains 5% fat according to the label. If this value is a percentage of the total mass of the macronutrients, what percentage of the total calories does this amount of fat provide? Assume that the food portion is 100 g and is 5% fat by mass.

   The lunchmeat sample contains 5 g of fat and 95 g of carbohydrates and proteins combined. Both carbohydrates and proteins have a caloric value of 4 Cal/g.

GENERAL CONCLUSIONS

1. **Inferring Conclusions** According to your experimental data, which nut tested is a better source of energy? Why?