Energy Content of Foods

All human activity requires "burning" food for energy. In this experiment, you will determine the energy released (in kJ/g) as various foods, such as cashews, marshmallows, peanuts, and popcorn, burn. You will look for patterns in the amounts of energy released during burning of the different foods.

I.) ASTRACT (no need to copy questions)

Wrtie 3-5 sentences on how heat is transferred form one object to another. Explain using the law of conservation of mass

II.) PURPOSE

In this experiment, you will

- Determine the energy released from various foods as they burn.
- Look for patterns in the amounts of energy released during burning of different foods.
- Before you do the experiment, predict which food will have the most and least energy per gram. Write this in an if-then format as your hypothesis.

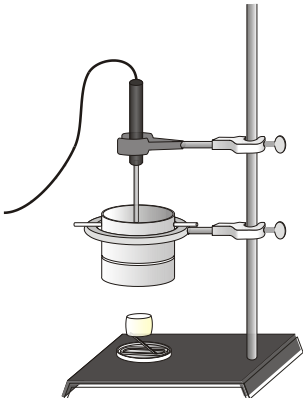

Figure 1

III.) MATERIALS

LabQuest	Glass stirring rod
LabQuest App	ring stand and ring
Temperature Probe	100 mL graduated cylinder
2 food samples	small can
food holder (bent paperclip and watch glass)	cold water
utility clamp	matches

III.) PROCEDURE (SUMMARIZE OR USE FLOWCHART)

1. Obtain and wear goggles.

2. Connect the Temperature Probe to LabQuest and choose New from the File menu. If you have an older sensor that does not auto-ID, manually set up the sensor.

3. On the Meter screen, tap Rate. Change the data-collection rate to 0.5 sample/second and the data-collection length to 600 seconds. Data collection will last 10 minutes. Select OK. (You can stop data collection after the food stops burning and the temperature stabilizes).

4. Obtain a piece of one of the two foods and a food holder (see Figure 1). Record the initial mass of the food sample and food holder. **CAUTION:** *Do not eat or drink in the laboratory.*

5. Determine and record the mass of an empty can. Add 100.0 mL of tap water to the can. Determine and record the mass of the can and water.

6. 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 food sample. Use a utility clamp to suspend the Temperature Probe in the water. The probe should not touch the bottom of the can. **The Temperature Probe must be in the water for at least 30 seconds before you do Step 7.**

7. Start data collection. Record the initial temperature of the water, t_1, in your data table. **Note:** You can monitor temperature to the right of the real-time graph displayed on the screen. Place the food sample under the can and use a match to light it. As soon as the food is burning, center the flame under the can, reposition as needed to keep the flame under the can. Allow the water to be heated until the food sample stops burning. Gently tap the can until it rocks back and forth to stir while the food is burning. **CAUTION:** *Keep hair and clothing away from open flames.*

8. Continue rocking the can until the temperature stops rising. Record this maximum temperature, t_2. Data collection will stop after 10 minutes (or stop *before* 10 minutes has elapsed if the food stops burning and the temperature stabilizes).

9. Allow to cool, then determine and record the final mass of the food sample and food holder.

10. To confirm the initial (t_1) and final (t_2) values you recorded earlier, examine the data points along the curve on the displayed graph. As you tap each data point, the temperature and time values are displayed to the right of the graph.

11. Repeat Steps 4–10 for the second food sample. Use a new 100 mL portion of cold water.

12. When you are done, place burned food and used matches in the container provided by the teacher. Clean all lab equipment and table top.

IV.) DATA

Food type (choose 2 of the 4 food items)	_____	_____
Initial mass of food and holder	g	g
Final mass of food and holder	g	g
Mass of food burned	g	g
Mass of can and water	g	g
Mass of empty can	g	g
Mass of water heated	g	g
Final temperature, t_2	°C	°C
Initial temperature, t_1	°C	°C
Temperature change, Δt	°C	°C

Heat, q	kJ	kJ
Energy content in kJ/g		

CLASS RESULTS TABLE

Cheetos	Corn Chips	Marshmallows	Rice Cakes
kJ/g	kJ/g	kJ/g	kJ/g
kJ/g	kJ/g	kJ/g	kJ/g
kJ/g	kJ/g	kJ/g	kJ/g
kJ/g	kJ/g	kJ/g	kJ/g
kJ/g	kJ/g	kJ/g	kJ/g

Average for each food type

kJ/g	kJ/g	kJ/g	kJ/g

V.) CALCULATIONS

1. Find the mass of water heated for each sample.
2. Find the change in temperature of the water, Δt, for each sample.
3. Calculate the heat absorbed by the water, q, using the equation

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

where q is heat absorbed, C is the specific heat capacity of water, m is the mass of water, and Δt is the change in temperature. For water, C is 4.184 J/g°C. Change your final answer to kJ.

4. Find the mass (in g) of each food sample burned.
5. Use the results of Steps 3 and 4 to calculate the energy content (in kJ/g) of each food sample.
6. Record your results and the results of other groups in the Class Results Table.

VI.) Questions

1. Food energy is often expressed in a unit called a Calorie (kilocalorie). These are the units used to express energy content on food packaging. There are 4.184 kJ in one Calorie (kilocalorie). Based on the class average for each food, calculate the number of Calories in a 50 g package of each food. Which food had the highest energy content per gram? The lowest energy content per gram?
2. Two of the foods in the experiment have a high fat content (Cheetos and corn chips) and two have a high carbohydrate content (marshmallows and rice cakes). From your results, what generalization can you make about the relative energy content of fats and carbohydrates?
3. Draw or diagram the energy transfer that occurred in burning the different samples of food used in the experiment. Explain your diagram using the Law of Conservation of Energy. You may choose one of the samples.
4. What are two possible ways we can increase the temperature change of the water? Explain why each change affects the temperature change, and what the effect might be.
5. Look up the food industry's determination of the calorie content of your Cheeto (by reading the label or a Google search). How does this compare with the values you determined? Calculate your percent error:

Percent error = (experimental value-industry value)/industry value x 100

VII.) Discussion of Error

Discuss your percent error, and the reason for it. Is the method you used a reliable and accurate method for determining the energy content of food?

VIII.) Conclusion

Using your own words write a conclusion. The conclusion has the following basic format and should be 2 to 3 paragraphs long:

a. Claim: Restate your hypothesis; was it correct or incorrect?

b. Evidence: What evidence is there in your data to support or not support your hypothesis? This is very important, as it connects your results to the conclusion.

c. Reasoning: How does your data support the scientific principle explored in this lab? This is a research section. Use your text as one reference and you will need one additional reference beyond the text and the notes.

d. Connections to the Real World: How could your results be used to help people make food choices that will help them lose weight?

e. Further Experiment: Give an idea for an experiment that tests this concept further. You may not describe the same experiment with different materials.