Honors Biology - *Calorimetry Lab*

You hear the term "calories" every day. What, though, is a calorie? **The calorie is a measure of the energy in foods**. Food contains chemical bonds (think about the structure of glucose – all the carbons are held together by a chemical bond). It takes energy to put the bonds together. When the bonds are broken, energy is released. All food contains chemical bonds. Every time you digest the food you eat chemical bonds are broken and energy is released.

By definition, a calorie is the amount of energy needed to raise the temperature of 1 gram of water (or 1 ml of water) by 1 degree Celsius (C°). When we talk about the calories in food, however, we usually refer to the kilocalorie (Kcal or Calories, with an upper-case C). A Kcal equals 1000 calories (with a lower-case c)

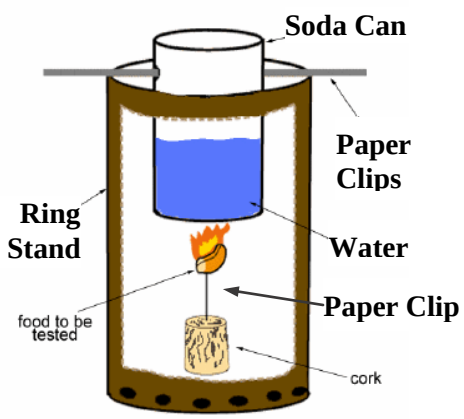
In this lab, you will use a simple calorimeter to calculate the energy content of 4 types of food items (mini-marshmallows, cheese puffs, Dorito and gingersnap cookie). By measuring the increase in temperature of a can of water, you will be able to determine the amount of heat given off by the tasty morsel and calculate the energy (in Kcal) in the food.

Materials:

- aluminum soda can
- ring stand set up
- Paper clips
- Rubber bands
- thermometer
- small cup of water
- Graduated cylinder
- ~2x2 inch piece of cardboard
- balance
- 1 cork
- matches
- Food items

Procedure 1: Setting up the calorimeter

1. Set up the calorimeter as demonstrated (it will look something like the picture shown).
2. Add 200 ml of water to the aluminum can.
3. Place the thermometer through the hole in the piece of cardboard. Place cardboard/thermometer on the top of the soda can so that the thermometer goes through the hole in the can and into the water. **Do not let the thermometer touch the bottom of the can.** The cardboard should hold the thermometer up and off the bottom of the can.
4. Straighten out one loop of the paper clip and secure it in the middle of the cork.



Procedure 2: Burning the food

1. Measure the temperature of the water in the can. Record this value as "starting water temperature" in your data table (**row A**) in the appropriate column.
2. Weigh the first food item and record its mass in the table as "starting food mass" (**row E**) in the appropriate column.
3. Place the food item on the paper clip that is stuck into the cork.
4. Place the food item and cork under the aluminum can.
5. Light the match and start burning the food item. Once the food item starts to burn, put the match in the small cup of water.
6. Let the food item burn completely.
7. When the food item stops burning, measure the temperature of the water in the can and record as "final water temperature" in your data table (**row B**).
8. Calculate the change in water temperature (Final – Starting) and record in your data table (**row C**).
9. Set the burned food item aside to cool (**do not throw out yet!**).
10. Repeat steps #1-9 for the rest of your food items.
11. Use the balance to weigh the burned food items. Record this value as "final food mass" (**row F**).
12. Calculate the change in food mass (Final – Starting) and record in your data table (**row G**).
13. Calculate the number of Calories produced by burning the food item using the following equation and record in your data table (**row D**):
    (Change in Temperature) / 5 = # of kilocalories (Kcal) per food
14. Calculate the number of calories per gram of food item using the following equation and record in your data table (**row H**):
    Kcal burned per food item / (Change in food mass) = # Kcal per gram of food

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Hypothesis: In an "if...then" statement, explain which of the foods will have more calories.

_____

_____

_____

Data Table:

	Name of Food Item:	Food #1	Food #2	Food #3	Food #4
A	Starting water temperature (°C)				
B	Final water temperature (°C)				
C	Change in Temperature (**B-A**)				
D	Calories (Kcal) per food (**C/5**)				
E	Starting food mass (grams)				
F	Final food mass (grams)				
G	Change in food mass (**F-E**)				
H	Calories (Kcal) per gram of food (**D/G**)				
I	Expected Calories (Kcal)				
J	Percent Error				

Conclusions:

1. Did your experimental results support your hypothesis? Why or why not?

2. What is the name for the energy stored in food?

3. Give some examples of how you would use this stored energy.

4. Why do you think the final mass of the food was less than the original mass of the food? (Remember that matter cannot be destroyed.)

5. Find the percent error for your experimental values for the four foods you tested. You will need to look up the accepted caloric values of the food items. Show your work below and record your values (expected caloric values and % error) in your data table (rows I and J). Remember, the values reported will be in units of kilocalorie (Kcal) not calorie.

$$\frac{\text{Observed value} - \text{expected value}}{\text{Expected value}} \times 100 = \%\ \text{error}$$

Food #1	Food #2
Food #3	Food #4

6. In figuring the number of calories in your food item, why did you divide the change in temperature by 5? (Hint, think about the definition of calories and kcals.)

7. Your calculations assumed that all of the heat produced by the burning of the food was absorbed by the water in the can. What is your evidence that this is not really true?

8. What else absorbed heat energy (besides the water)?

9. What evidence is there that the burning might have been incomplete?

10. What was the ultimate SOURCE of energy for the food items?