Calorimetry Lab (aka "Burn Lab")

Goggles must be worn at all times!

Introduction:

By burning pieces of food, the chemical energy stored in molecular bonds is released as heat and light. The heat can be measured in units called **Calories** (Joules is a unit that also measures heat, but isn't used in the food industry). The more Calories a food contains, the more heat is given off when burned. Foods high in Calories will release large amounts of energy. One gram of a protein will release far fewer Calories than one gram of fat.

A calorie is the amount of heat (energy) required to increase the temperature of 1 gram of water by 1 ° C. This process is the basis of the technique of **calorimetry**. In this lab investigation, you will use the methods of calorimetry to approximate the amount of energy contained in a potato chip and/ or other food items. The heat given off from the reaction will be absorbed by water that is suspended above the burning food item. This method *indirectly* measures the amount of heat given off by the food.

Purpose:

- To calculate how many calories of energy/ serving food items contain & compare to real number as determined by the manufacturer.
- Determine how this experiment can be improved to provide more accurate results.

Materials:

- Test tube & holder
- Ring stand
- Thermometer & Clamp
- matches
- Evaporating dish
- matches
- Food items
- 2 Paper clips

Procedure:

1. Suspend your food item above the evaporating dish using 2 paper clips. The paper clips will be stretched out to resemble "railroad tracks" and will serve as a platform for your food.

2. Measure the mass of the potato chip & also the evaporating dish/ paper clips set-up prior to burning it. Record in data table

3. Using a graduated cylinder, measure 15 mL of distilled water and pour in into the test tube. Record the mass of H_2O in the data table (remember… 1 mL of H_2O= 1 g).

4. Place the chip in the evaporating dish at the base of the ring stand. Adjust the test tube height so that it will be directly above the chip. Insert a thermometer into the water and secure.

5. Measure and record the initial temperature of the water.

6. Momentarily move the chip/dish out from under the test tube. Use a match to ignite the bottom of the chip and then put the burning chip back under the test tube. The idea is to get as much of the heat from the burning chip to rise up and heat the water in the test tube.

7. With a stirring rod, stir the water in the test tube while the chip burns. Measure the highest temperature of the water and record it in the data table. **Re-light chip if it goes out**.

8. Measure the final mass of the "chip/ ash" in the evaporating dish after burning. Record data.

9. Repeat steps 1-7 using a different food item.

Data/Observations:

	1st Item burned: ***potato chip***	2nd Item burned:
Mass of 15 mL of distilled H_20		
Mass **(g)** of evaporating dish + paper clips + Food item **(Before burning)**		
Mass **(g)** of evaporating dish + paper clips + Ash/ charred remains **(After burning)**		
Total grams of food item burned (use math)		
Initial temperature of H_20 **(°C)**		
Final temperature of H_20 **(°C)**		
ΔT-Change in H_20 Temp (Use math)		
Nutritional Information for <u>1 Serving</u> of food item (on food label) Remember: Cal = kcal	**____ Cal/ ____ g**	**____ Cal/ ____ g**

Calculations: Perform the following calculations for the potato chip AND one additional food item.

1. **Calculate amount of calories absorbed by the water**: Use $q = m \bullet c \bullet \Delta T$ to calculate how much heat in calories was absorbed by the water. **Specific heat (c)** of water= 1 calorie / g °C, **mass** = mass of H_20 in test tube, Δ**T**= change in temp of water. It is assumed that the heat being absorbed by the water has come from the burning food.
2. **Convert the number of <u>c</u>alories calculated in #1 to nutritional <u>C</u>alories (aka a kilo- calorie), the type that is used when referencing food.**
   Conversion factor: 1 nutritional **<u>C</u>**alorie (a kilo- calorie) = 1000 chemistry **<u>c</u>**alories.
3. **Calculate the number of kcal heat/ gram food burned**. Use the number of kcal from #2 and divide by the total number of grams of food you burned (in your data table).
4. **Calculate the number of kcal's the water would have absorbed had you actually burned the number of grams in <u>1 serving</u> of the food (according to food packaging/ in data table).**
   Use your answer from #3 (# kcal/ 1 gram food burned) and multiply the top and bottom by the number of grams the manufacturer considers 1 serving (see your data table).
5. **Compare of your kcal's/ grams (your answer in #4) to those on the nutritional info. on food label (again, these are in your data table too)**. Calculate the percent error:

$$\frac{\text{Accepted Calorie Value (what bag says)} - \text{Experimental calorie value (what you got)}}{\text{Accepted Calorie Value (what bag says)}} \times 100 = \%\ \text{error}$$

6. **Repeat these calculations for a second food item.**

Discussion/Analysis Questions: (answer based on chip)

1. Is the reaction (the combustion of the chip) exothermic or endothermic? Explain your answer.
2. Describe the reactant and products of the chemical reaction. Was the reactant (chip) completely consumed? What evidence supports your answer?
3. What was the purpose of having the water in the test tube in this lab?
4. Was all of the heat that was released by the food absorbed by the water in the test tube (**use data** to support your answer)? How can the experimental equipment be improved to decrease the percent error?

Conclusion:

Write a minimum of 3-4 sentences restating the purpose of the lab. In addition you can discuss your results, what you learned from the lab, and any errors you made during the lab that you'd correct in the future.