**Honors Chemistry Lab Manual**

2017-2018

**Lab #3: Calorimetry Lab - Food Energy in a Bugle**

**Background:** How do we know how much energy is stored in foods? Chemists can determine this by burning a known amount of food (combustion reaction) under controlled conditions and carefully measuring the quantity of thermal energy it releases. This procedure is called calorimetry and the measuring device is called a calorimeter.



All compounds, including foods, contain energy in the **bonds** of the atoms or ions they are composed of. When we digest our food, changes in those chemical bonds take place (bonds broken and new ones formed) and (net) energy is released. Our bodies then capture that energy in a series of complex biochemical reactions to fuel our daily activities.

The energy found in chemical bonds cannot be measured directly. There is no instrument which can be inserted into foods for some sort of digital readout of calories. In order to determine the energy

in a food we must consume the food and measure the changes that take place.

In this experiment you will burn a Bugle (the system) to release its energy. The oil in Bugles burns rapidly when combusted. As the Bugle burns it releases energy. This released energy will be captured by water (the surroundings) inside the calorimeter. The temperature change in the water will be measured, and from this change the amount of heat transferred can be calculated.

You will want to use calories so that you can compare your results with the food label. Both Joules and calories are units of heat however they are units of differences magnitudes. One calorie is equal to 4.184 joules. To make your comparison slightly more difficult, a "calorie" in the lab is not the same as a dietary "Calorie". The Calories you read about on food labels are actually ***kilo***calories (kcal), 1000 times greater in size than the calories you will be measuring in the lab. It takes 1000 laboratory calories to equal 1 food label Calorie.

Mathematically, when a calorimeter with water is used, the change in temperature of the surroundings is related to the thermal energy (heat) transferred through the equation:

 **q = mCΔT**

where q = heat (in Joules), m = mass (of water in grams), C = specific heat capacity constant (for water, this value is 4.184 J/g 0C), and ΔT = change in temperature (of water). Applying the Law of Conservation of Energy, and assuming no heat loss, the heat absorbed or released by the water (the surroundings) equals the heat released or absorbed by the Bugle (the system).

**Procedure**

1. Make a simple stand for the Bugle using a paper clip, as shown by your teacher.

2. Measure about 100 ml of room temperature water in a graduated cylinder. Record the **exact** value
 of the water in your data table. Pour the water carefully into the calorimeter’s flask.
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3. Set up the calorimeter. Use a temperature probe to measure the initial temperature of the water. Record this value in your data table. Remove the probe from the flask.

4. Place the Bugle on the support stand, and measure the mass of the entire assembly. Place the bugle assembly inside the calorimeter beneath the flask of water.

5. Use a match to light the Bugle directly, placing the match directly under the center of the Bugle. Do not keep the match under the flask for an extended period of time, as it will affect your results.

6. As soon as the Bugle stops burning, carefully stir the water with the probe. For a brief period the temperature may continue to rise. When the temperature has reached its maximum value and begins to drop, record the final (maximum) temperature of the water in your data table.

7. Allow the Bugle residue to cool, and then measure the mass of the entire assembly. Record this value.

8. Repeat Steps 2-7 with a new Bugle. (for Trial 2)



**Signature for cleanup**

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**PRELAB QUESTIONS: COMPLETE PRIOR TO COMING TO LAB**

1. The objective of the lab is to determine the energy in the Bugle. Why do we need
 to burn the Bugle?

2. What will happen to the temperature of the water as the Bugle burns? Why?

3. In this lab you will use calories (rather than Joules) so that you can compare your value with the value given on the food label. What is the conversion from joules to calories?

4. Imagine that you complete your calculations and determine that one burned bugle
 releases 4,000 calories. Should you stop eating Bugles in fear of gaining massive
 amounts of weight? Explain your answer.

**DATA TABLE(S): COMPLETE BEFORE COMING TO LAB (USE A RULER)**

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