Lab: Calorie Lab /30 points

Key Questions: Which food product – cheese puffs, marshmallows, or crackers (YOUR CHOICE: triscuits, cheese nips or wheat thins) – has the most energy (Calories)?

Introduction: You will measure the amount of heat produced by samples of cheese puffs, marshmallows, or crackers (triscuits, cheese nips or wheat thins), and convert this to Calories per gram of each food. You will use each piece of laboratory equipment appropriately and make all measurements to the correct number of digits. You will use your measurements to perform calculations using precision measurement rules.

Materials: Soda can, glass stirring rod, burner, tongs, graduated cylinder, thermometer, balance, copper wire, watch glasses cheese puffs, marshmallows, or crackers (triscuits, cheese nips or wheat thins).

Variables:

IV:
DV:

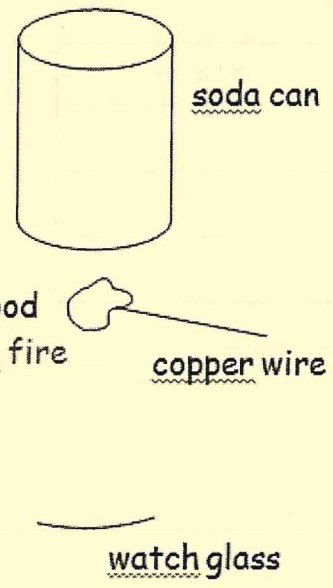
Hypothesis: Which food will contain the most Calories per gram?

Controlled Variables (at least 3):

Procedures:

1. Obtain a clean watch glass and a sample of food to be tested.
2. Zero the balance.
3. Place the watch glass AND food on the balance, record the mass of both together in the data table.
4. In a graduated cylinder measure 100.0 mL of water. *Precision measuring note:* if the bottom of the meniscus in the cylinder is exactly on the 100 mL line, you have 100.0 mL. Remember that you estimate 1 place beyond the increments on the measuring device. Why should this be the same for each trial?
5. Pour the water into the soda can. Use the thermometer to record the beginning temperature of the water (remember precision measuring!) in the data table.
6. Adjust the burner to a tall, hot flame.
7. Pierce the cheese puff with the copper wire—it will probably be necessary to bend the wire and/or wrap the wire around the food so it won't fall off.
8. See Figure 1. Carefully light the cheese puff on fire with the burner and immediately hold the burning food directly beneath the soda can keeping the watch glass beneath to catch any food particles that fall. Pay attention to the distance below the can—should you control this variable?
9. Hold the thermometer in the middle of the water (not the bottom) and move it around to get some mixing. Record the highest temperature the water in the soda can reaches <u>after</u> the food stops burning in the data table.
10. Place any remaining residue from the copper wire onto the watch glass and determine the mass of the watch glass with any remaining / burnt food. Record in the data table.
11. Replace the water in the soda can with 100.0 mL of fresh water (remember precision measuring). Repeat the process for all the remaining trials of all the food samples.

Figure 1. Heating the water



Data: Complete the table as you work.

Temperature and Mass Changes as Foods Burn

	Cheese Puff			Marshmallow			Cracker (CIRCLE ONE: triscuits, cheese nips or wheat thins)		
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3
Mass of unburned food sample and watch glass (g)									
Mass of burned sample and watch glass (g)									
Beginning water temperature (°C)*									
Ending water temperature (°C)*									

*NOTE: it is unlikely every measurement will end in zero.

MEASUREMENTS SCORE: /5

Calculations: Use your data and show all of your work in the spaces below. Record your final results in the table. Be sure to apply the rules for precision measured numbers.

1. Mass of food sample converted into energy: How much of each food sample actually burned? THE MATH: Mass of original sample on watch glass - Mass of burned sample on watch glass. Sig Figs in subtraction: use the decimal places.

Food Sample	Trial 1 (g)	Trial 2 (g)	Trial 3 (g)
Cheese Puff			
Marshmallow			
_____Cracker			

Show at least one sample calculation showing your use of the subtraction rule and units:

2. Temperature change for each trial: where did the temperature start and where did it finish? THE MATH: Ending water temperature – Beginning water temperature. Sig Figs in subtraction: use the decimal places.

Food Sample	Trial 1 (°C)	Trial 2 (°C)	Trial 3 (°C)
Cheese Puff			
Marshmallow			
_____Cracker			

Show at least one sample calculation showing your use of the subtraction rule and units:

ADDITION/SUBTRACTION RULE SCORE: /5

3. The Heat (energy) absorbed by water can be calculated using the equation: THE MATH: $H = m\,c\,\Delta T$ (c is a constant and for water is 1.00 cal/g°C; be sure to use the mass of the water for m! Since the density of water is 1.00 g/mL, 100.0 mL of water has a mass of 100.0 grams.) Show work! Include units as you work. Sig Figs for multiplication: use the number of sig figs in each measurement.

Food Sample	Trial 1 (cal)	Trial 2 (cal)	Trial 3 (cal)
Cheese Puff			
Marshmallow			
_____Cracker			

Show at least one sample calculation showing your use of the multiplication rule and units:

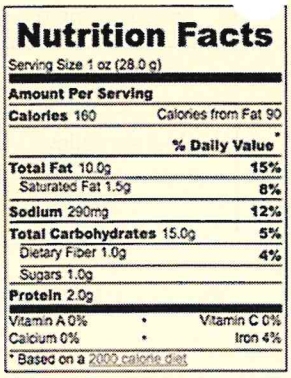
4. Heat released by the food: Consider the Law of Conservation of Energy—where did the water get the heat to increase its temperature? From the food, right? So, how much energy, or heat, did the water gain from the food? No calculations needed!

Food Sample	Trial 1 (cal)	Trial 2 (cal)	Trial 3 (cal)
Cheese Puff			
Marshmallow			
_____Cracker			

5. What you have calculated are lab calories, which are not the same as food calories like you see on a nutritional label. The label shown is for Cheetos. Food calories are actually kilocalories (1000 cal = 1 kcal = 1 Cal) to give more convenient numbers; these are often written using a capital "C" instead of writing kcal. One serving of Cheetos actually contains 160,000 calories—that seems like a lot! THE MATH: To convert lab calories to food calories, just take your results in #4 and divide by 1000.

Example: $160 \text{ calories} \times \frac{1 \text{ Cal}}{1000 \text{ cal}} = 0.160 \text{ Calories}$

Sig Figs for division: use the number of sig figs in each measurement.
NOTE: 1 Cal / 1000 cal is the definition of Cal so 1 and 1000 each have infinite significant figures.



Nutrition Facts

Serving Size 1 oz (28.0 g)

Amount Per Serving

Calories 160 Calories from Fat 90

	% Daily Value*
Total Fat 10.0g	**15%**
Saturated Fat 1.5g	**8%**
Sodium 290mg	**12%**
Total Carbohydrates 15.0g	**5%**
Dietary Fiber 1.0g	**4%**
Sugars 1.0g	
Protein 2.0g	

Vitamin A 0% • Vitamin C 0%
Calcium 0% • Iron 4%

* Based on a 2000 calorie diet

Calculate the number of Calories released by each food sample.

Food Sample	Trial 1 (Cal)	Trial 2 (Cal)	Trial 3 (Cal)
Cheese Puff			
Marshmallow			
_____Cracker			

Show at least one sample calculation showing your use of the multiplication rule and units:

6. To compare the different foods to each other, we have to account for how much of each sample actually burned. If you had a bigger food sample it would release more heat energy than a smaller one. THE MATH: We will divide the Calories released by each sample (#5) by the mass of each sample that burned (#1) to get Cal/gram. Sig Figs for division: use the number of sig figs in each measurement.

Food Sample	Trial 1 (Cal/g)	Trial 2 (Cal/g)	Trial 3 (Cal/g)	Average (Cal/g)
Cheese Puff				
Marshmallow				
_____Cracker				

Show at least one sample calculation showing your use of the division rule and units:

7. Finally, you will average your trials for each type of food. THE MATH: add the trials together and divide by 3. (T1 +T2 +T3)/3. Note: 3 has infinite sig figs. Sig Figs: use BOTH the addition rule then the division rule.

Show how you calculated THE AVERAGE showing your use of the addition AND division rule and units:

MULTIPLICATION/ DIVISION RULE SCORE: /5

Learning Activity: Use the following questions to help you think about the information needed for your CER.

Use the internet to find answers to the following questions. You will use this information in your lab report.

1. How many Calories (kilocalories) do YOU need to have each day? Take into account your activity level, gender, etc…

2. Find out how many Calories per gram there are supposed to be in Cheetos, marshmallows, and your type of cracker. You might have to read a nutritional label (can be found online) and divide the Calories in a serving by the grams in a serving.

	Cheese Puff	Marshmallow	_____Cracker
Number of grams in 1 serving			
Number of Calories in 1 serving			
Number of Calories per gram			
Number of Calories per gram from your data			

3. Compare the published Calories per gram to your Calories per gram. What is true about all of your values? What happened during your lab that could explain the differences?

4. Which snack (cheese puff, or marshmallows or cracker) would you recommend people to eat and why?

5. You go to the food court at the mall and can't decide what to eat, so you make the rounds! You get a medium order of waffle fries and a large lemonade at Chick-Fil-A, a large Chicken California at Charlies, and finish it off with a small vanilla with chocolate chips mix-in at Marble Slab. How many Calories did you eat?

Claim-Evidence-Reasoning Report. ***Use the rubric as you write.***

Claim: Which food contains the most Cal/g? Was your hypothesis correct? How does this relate to your everyday life?

Evidence: **TYPE** a new table which summarizes what you have done and which supports your claim. Consider adding a graph of your data to reach level 4, or incorporate data other than your own (from another lab group, the wiki...).

Reasoning: Chemical vocabulary/explanation: What is the Law of Conservation of Energy? How is this lab related to them? What are sources of error in your experiment? Include **random** (measurement and other human errors) and **systematic** errors (an inherent defect in the experiment itself which will make results consistently high or consistently low).

References: Where did you get the chemical information you used in this lab? Site a textbook and/or internet sources you used.

CIRCLE THE LEVEL WHICH YOU ARE ATTEMPTING FOR EACH SECTION.

Criterion/Level	Beginning (1)	Approaching (2)	Meeting (3)	Surpassing (4)
Claim ___ / 3 possible	Claim is **absent** or **off topic**. (0-1 pts)	Claim lacks **detail** or does not take a **clear stance**. (1-2pts)	Makes a clear **chemisty** claim based on the prompt given. (2.5pts)	Meets previous level and includes chemistry concepts beyond what have been discussed in class. (Use outside sources-internet, etc.) (3pts)
Evidence (Data) ___ / 5 possible	**More than 2** items from level three are missing or **incorrect or unclear**. (0-1 pts)	Evidence has **1 or 2** missing items from level 3 or items are **incorrect or unclear**. (2-3 pts)	Evidence is present as a **typed table** summarizing your results and supporting your claim. Includes correct **sig figs**, a **title** and **units**. (4 pts)	Meets previous level and includes collaborative data or a graph of data. (5 pts)
Reasoning ___ / 5 possible	Either fails to explain or only somewhat explains how & why data/evidence supports claim; gives **limited/no chemical explanation and/or error analyis**. Several questions needed for clarification. (0-2 pt)	Moderately explains how & why data/evidence support(s) claim, gives incomplete chemical explanation and/or error analysis. One or two questions needed for clarification. (3 pts)	Clearly, succinctly & logically explains how & why the data/evidence support(s) the claim; accurate **chemical vocabulary/explanations** are present. Discussion of **RANDOM** and **SYSTEMATIC** errors present in the experiment. (4 pts)	Meets previous level & reasoning also includes and analyzes **relevant** information gathered beyond what was discussed in class. Includes pictures to explain chemical concepts. (5 pts)
References ___ / 1 possible	References are incomplete/missing. (0-.5 pt)		References are listed. (class notes, textbook, web pages) (.5 pts)	Meets previous level and includes **relevant** references from **credible outside sources**, such as the internet. (1 pts)

+ _____ 1 point for student self-evaluation.

_____

_____/ 15 total

PRINT A COPY OF YOUR CLAIM-EVIDENCE-REASON REPORT AND STAPLE IT TO THE BACK OF THIS PACKET!