



## THE STOICHIOMETRY OF S'MORES

Written by Amy Rowley and Jeremy Peacock

### Annotation

In this activity, students will explore the principles of stoichiometry by building S'mores, the delicious, chocolate, marshmallow, and graham cracker treats.

### Primary Learning Outcome:

Students will be able to identify and demonstrate the Law of Conservation of Matter.

Students will be able to write and balance a chemical equation for a synthesis reaction.

Students will be able to define and identify the limiting reactant of a reaction.

Students will be able to solve stoichiometry problems relating mass to moles and mass to mass.

### Assessed GPS:

**SPS2. Students will explore the nature of matter, its classifications, and its system for naming types of matter.**

d. Demonstrate the Law of Conservation of Matter in a chemical reaction.

e. Apply the Law of Conservation of Matter by balancing the following types of chemical equations:

- Synthesis

**SC2. Students will relate how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions.**

a. Identify and balance the following types of chemical equations:

- Synthesis

d. Identify and solve different types of stoichiometry problems, specifically relating mass to moles and mass to mass.

e. Demonstrate the conceptual principle of limiting reactants.

### Duration:

Preparation: 15 minutes

Pre-Lab: 10 minutes

Laboratory Assignment: 30 minutes

Post-Lab: 10 minutes

**Total Class Time: 50 minutes**

### Materials and Equipment:

For Teacher Preparation:

1. Hershey's Chocolate bars
2. Marshmallows (large)
3. Graham crackers

4. Paper plates

Per Class:

1. Electronic balance(s)

Per Group:

1. 1 Paper plate containing 1 Hershey's Chocolate bar, 6 marshmallows, and 5 graham crackers
2. Napkins

**Safety:**

Because students will be allowed to eat their S'mores at the end of the activity, precautions should be taken to prevent materials from coming into contact with lab equipment or surfaces. Materials should remain on paper plates or on clean napkins at all times. Napkins can be used as weighing paper while weighing materials on the balance.

**Technology Connection:**

Not applicable.

**Procedures:**

Teacher Preparation:

For each group, prepare a plate containing 1 Hershey's Chocolate bar, 5 marshmallows, and 4 graham crackers.

*Estimated Time:*

15 minutes

Pre-Lab:

Provide students with the *Stoichiometry of S'mores* student handout. Introduce them to the lab activity by reviewing the student handout, as well as the basic concepts of stoichiometry and limiting reactants. Explain to students that in this activity each of the S'mores ingredients, chocolate square (C), marshmallow (M), and graham cracker (G), represent an element on the periodic table. Graham cracker represents a diatomic element, always found in pairs, and should therefore be represented as  $G_2$ . Explain to students that they are to write and balance a synthesis reaction for the formation of a S'more, in which they can choose any size of each of the ingredients to use when making the S'mores. Therefore, it is likely that students will have different molecular formulas for their S'more. Further, explain to students that they must determine the limiting reactant in their S'mores reaction.

*Estimated Time: 10 minutes*

Laboratory Assignment:



Students should follow procedures outlined in the attached *Stoichiometry of S'mores* student handout.

*Estimated Time:*

30 minutes

Post-Lab:

Perform with students a sample calculation, if needed. Collect handouts and review answers to post-lab and extension questions. Answer any student questions pertaining to lab activity. Once the laboratory activity is complete, students may eat their S'mores and remaining ingredients.

*Estimated Time:*

10 minutes

**Assessment:**

Assessment should be based on completion of the *Stoichiometry of S'mores* student handout.



Name:

Date:

Class Period:

## THE STOICHIOMETRY OF S'MORES

### Student Handout

#### Introduction:

In this laboratory experiment, you will explore the principles of stoichiometry by building S'mores, the delicious, chocolate, marshmallow, and graham cracker treats.

#### Purpose:

To determine the limiting reactant in the synthesis of S'mores.

#### Materials:

Per Group:

1. 1 Chocolate bar
2. 6 Marshmallows
3. 5 Graham crackers
4. Paper plate
5. Napkins
6. Electronic balance

#### Procedures / Data:

The following symbols will be used for each reactant.

C = chocolate square

M = marshmallow

G = graham cracker

1. Mass and record one of each reactant.

Chocolate square (the size you wish to use on each S'more): \_\_\_\_\_ g

Marshmallow: \_\_\_\_\_ g

Graham cracker (the size you wish to use on each S'more): \_\_\_\_\_ g

2. Perform a **synthesis reaction**, thus forming a S'more. Write the balanced equation for the reaction below.
  
  
  
  
  
  
  
  
  
  
3. Cause the reaction to go to completion by forming as many of the products as you possibly can. Mass and record **ONE** of the representative products.

S'more: \_\_\_\_\_ g

4. Count and record the number of products you were able to form. \_\_\_\_\_

**Post-Lab Questions:**

1. Is there a relationship between the mass of a S'more and the masses of the reactants used to make it? If so, what is the relationship? What law have you studied in this course that might define this relationship?
2. A limiting reactant is the material responsible for a reaction reaching completion. In the reaction, what was the limiting reactant?
3. What reactants, if any, were in excess? Mass and record the total of each excess reactant.

**Extension Questions:**

1. How many S'mores could you make if you had started with 100g of each reactant?
2. What would be the limiting reactant?
3. How much of each excess reactant would result?