STOICHIOMETRY OF S'MORES

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Annotation

In this activity, students will explore the principles of stoichiometry and the Law of Conservation of Matter 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.

Georgia Performance Standards:

Characteristics of Science

SCSh3. Students will identify and investigate problems scientifically.

SCSh4. Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

Physical Science Content

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

Chemistry Content

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

Duration:

Teacher Preparation: 15 minutes
Introduction: 10 minutes
Student Activity: 30 minutes
Conclusion: 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, 5 marshmallows, and 4 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 laboratory 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:

Prepare for each student a copy of *The Stoichiometry of S'mores* student handout. For each group, prepare a plate containing 1 Hershey's® chocolate bar, 5 marshmallows, and 4 graham crackers.

Introduction:

Stoichiometry is the quantitative relationship between reactants and products in a chemical reaction. Using stoichiometry, you can predict the amount of product that can be produced from a given amount of reactants, and vice versa.

Explain to students that in this activity they will be building S'mores. Each of the S'mores ingredients, the chocolate (C), the marshmallow (M), and the graham crackers (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. *(Note: It is likely that students will have different molecular formulas for their S'mores.)* Further, explain to students that they must determine the limiting reactant in their S'mores reaction.

Student Activity:
Students should follow procedures outlined in the *Stoichiometry of S'mores* student handout to build S'mores, write and balance a synthesis reaction for the formation of a S'more, and determine the limiting reactant in the S'mores reaction.

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

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

STOICHIOMETRY OF S'MORES *Student Handout*

Introduction:
Stoichiometry is the quantitative relationship between reactants and products in a chemical reaction. Using stoichiometry, you can predict the amount of product that can be produced from a given amount of reactants, and vice versa.

In this activity, you will explore the principles of stoichiometry by building S'mores, the delicious, chocolate, marshmallow, and graham cracker treats. Each of the S'mores ingredients, the chocolate (C), the marshmallow (M), and the graham crackers (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. You are to write and balance a synthesis reaction for the formation of a S'more, in which you can choose any size of each of the ingredients to use when making the S'mores, and determine the limiting reactant in your S'mores reaction.

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

Materials:
Per Group:
1. 1 Hershey's® chocolate bar
2. 5 Marshmallows
3. 4 Graham crackers
4. Paper plate
5. Napkins
6. Electronic balance

Procedures / Data:
1. Mass and record one of each reactant.

   Chocolate (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 one 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. _____

5. Write a balanced equation representing all of the reactants provided.

Post-Laboratory 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.

Discussion Questions:

1. How many whole 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?