Name: _____ Period: _____ Assigned on Thursday, May 07, 2026

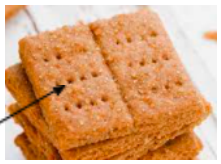
17.3 Lab: S'mores Limiting Reactants **Due Tuesday, May 12, 2026**

Work in groups of 2. For all calculations, be sure to show all work using dimensional analysis. Units and labels should be included with each number and your final answers should be expressed with correct significant figures and units.

Objective: By modeling a chemical reaction with the making of s'mores, you will be able to:

1. **Determine the meaning of "limiting reactant" and which reactant is the limiting reactant in a reaction;**
2. **Calculate how much of each reactant is left over and how much product will be formed after a reaction has taken place.**

A delicious camping treat known as a S'more is constructed from 4 graham cracker rectangles (available only as G_2, see picture to the right), 3 Hershey chocolate pieces, and 1 Large marshmallow.



Notice that two G rectangles are connected to make a G_2 square.

Part 1: Prelab

1. Using G for the graham cracker rectangles, C for the chocolate pieces, and M for the marshmallows, the balanced equation that would represent the production of S'mores from the starting materials is given below. (Note: the formula for the s'more will contain the symbols and subscripts for each component.)

$$\mathbf{2\ G_2 + 3\ C + M \rightarrow G_4C_3M}$$

2. If you were given each of the following starting materials, how many s'mores could you make?

   a. 24 graham cracker squares (G_2)

   b. 20 Hershey chocolate pieces (C)

   c. 19 Large marshmallows (M)

3. Which of the ingredients in problem #2 is limiting how many s'mores you can make?

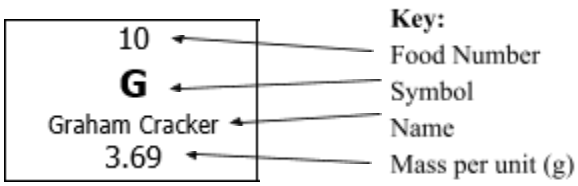
4. Which of the ingredients in problem #2 will be left over when you run out of the ingredient in problem #3?

5. <u>In your own words</u>, what do you think is meant by "limiting reactant?"

6. <u>In your own words</u>, what do you think is meant by "excess reactant?"

Part 2: Experiment

1 **St** Saltine Cracker 3.12	2 **Tr** Trix Marshmallow 0.42	3 **Mm** Plain M&M 0.92
4 **Rz** Ritz Cracker 3.20	5 **Sm** Small Marshmallow 0.71	6 **C** Hershey Chocolate 3.62
7 **Cb** Club Cracker 3.51	8 **M** Large Marshmallow 5.86	9 **Hn** Hershey Nugget 9.5
10 **G** Graham Cracker 3.69	11 **P** Peep 8.50	12 **Pb** Peanut Butter Cup 21.26



7. Using the periodic table of food above, determine the mass of one of each of the following.

1 graham cracker rectangle = _____ g (This represents G, not G_2!)
1 Hershey chocolate piece = _____ g
1 large marshmallow = _____ g

8. If you were given each of the following starting materials, how many S'mores could you make? Be sure to show your work using dimensional analysis. Be sure to use the equation in prelab to solve this.

a. 35.05g graham cracker squares (G_2)

b. 54.94g Hershey chocolate pieces (C)

c. 28.74g large marshmallows (M)

9. a. Which material in problem #8 is the limiting reactant? _____ How do you know? _____

_____

b. How many s'mores can you make? _____

c. Which materials are the excess reactants? _____ and _____

10. Go to the front of the room and gather the following amounts of each "reactant."
10 graham crackers rectangles (in other words, 5 square G_2 crackers)
6 Hershey chocolate pieces
6 Large marshmallows

11. Determine each of the following based on your gathered ingredients. Be sure to support all answers with a dimensional analysis calculation!

a. What is the limiting reactant?

b. What are the excess substances?

c. How many s'mores can you make?

12. Now it's time to make your s'mores!!! Put together your s'more, place on a paper towel, and bring all of your groups' s'mores to the microwave and heat as much or as little as you'd like. Fill out the following chart.

Remember: $\mathbf{2\ G_2 + 3\ C + M \rightarrow G_4C_3M}$

Item	# of Items Before Assembling S'mores	# of Items Left Over After Assembling S'mores
graham cracker rectangles (G)		
Hershey chocolate pieces		
large marshmallows		
s'mores		

13. Did your answers to problem #11 match your results in problem #12? _____

Part 3: Extension

14. Suppose you had 500.0 grams of graham cracker rectangles (G), 500.0 grams of Hershey chocolate pieces, and 500.0 grams of Large marshmallows.

    a. Which item do you have the most of? Which item do you have the least of? Explain your reasoning.

    b. If you attempt to make S'mores with these amounts of ingredients, what item will you run out of first (in other words, which ingredient is your limiting reactant)?

    c. How many S'mores can you make?

15. Is it correct to say that if we start with 4 lb each of G, C, and M, we should end up with 3 x 4 = 12 lb of S'mores? Explain.

Now let's apply the same concepts to a chemical situation: SHOW WORK!!!

Ammonia (NH_3) can be formed from the elements N_2 and H_2.

16. Write the balanced equation for the synthesis of ammonia as described above.

17. How many moles of ammonia can be made from 1.0 mole of N_2 and 3.0 moles of H_2?

18. Suppose we had 3.0 moles of N_2 and 3.0 moles H_2 available to react.

a) Which of the reactants would be the limiting reactant? (Hint: calculate moles of NH_3 produced by each and see which makes less.)

b) How many moles of ammonia could we make?

c) Which of the reactants (if any) would be left over? _____

4. Using the same equation above…

a) What mass of ammonia could we make when 100.0 grams of N_2 reacts with 100.0 grams of H_2?

b) What is the limiting reactant? _____

c) What is the excess reactant? _____