Instructor Information

**Lego Stoichiometry**

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When first learning stoichiometry, many students can be intimidated by the jargon and baffled by the concepts. Understanding can be greatly enhanced by presenting the concepts of stoichiometry in a concrete manner, utilizing familiar objects such as Lego (or other brand) building-block car kits.

**Integrating the Activity into Your Curriculum**

This Activity works well as either an introduction or review of stoichiometry. The concepts of limiting and excess reagents are introduced and understanding of the law of conservation of matter is reinforced.

**About the Activity**

The object is to determine the relationship between number and mass of each required component and the mass of the final product. The required components are the pieces in a building-block car kit; the final product is the car.

Each student or group of students should be provided with a complete kit. The kit used to develop this Activity was Lego kit # 2535—a race car. (This kit is no longer available. The online supplement includes data for similar kits.) Any small, inexpensive building kit could be used. Cars are a good choice because they usually have at least one piece that is used at least four times (tires) and at least one piece that is used only once (steering wheel). No specific kit is mandated in this Activity because the availability of kits varies greatly. Kits can be purchased in toy stores or discount stores, or online. It is important to make sure that the kits are neither too simple nor too complex (about 30 pieces is recommended). As the number of components increases, the time spent building increases, leaving less time for exploring stoichiometric relationships.

The data table included on the Student Side is general so that it may be used with any kit. Sample data from kit # 2535 are shown here. The masses of identical parts should be equal to within ± 0.1 g. Weighing to ± 0.01 g will show slight variations in mass. In most kits, names are not provided for the components. To avoid confusion, you may wish to provide students with names for the components.

To introduce *limiting* and *excess* you may wish to remove a component from one kit and add it to another kit; this “swapping” may occur inadvertently and can provide fruitful discussion. In addition, number of bonding sites could be introduced by having students reflect on the relationship between the number of bumps per piece and the number of other pieces it can connect to.

**Answers to Questions**

Answers will depend upon the kit used. If all students in a class use the same kit, the discussion of results is simplified. Sample answers for Lego kit # 2535 are provided. The online supplement includes answers for similar kits.

1. Tires and rims are each used 4 times in building the race car. Several components are used only once. The heaviest component used only once, chassis at 4.2 g, is A. The heaviest most often-used component, tires at 0.9 g, is B.

2. You would run out of B first. One of A would be left over. You could build 3 cars.

3. You’d have to go to the toy store. Enough of (40 are required), but 2 more of A are needed.

4. In question 2, B is limiting and A is in excess. In question 3, A is limiting and B is in excess.

5. The total mass of components used is equal to the mass of the completed car. Matter was neither gained nor lost.

6. 100 g of A is 23 pieces (100 g / 4.2 g); enough for 23 cars. 100 g of B is 111 pieces (100 g / 0.9 g); enough for 27 cars. A is limiting and only 23 cars could be built.

**Additional Related Activities and Demonstrations**


JCE Classroom Activity: #43

Lego Stoichiometry

From your studies of chemistry, you may or may not be familiar with the word *stoichiometry*, but you know about its underlying principles. The term *stoichiometry*, which literally means “element measuring”, applies to many facets of everyday living—from baking brownies to the knocking in a car engine. In the case of brownies, it is important to mix the proper amounts of sugar and flour and other ingredients so the brownies taste good. Likewise a combustion engine requires the correct ratio of gasoline and oxygen to run smoothly. In this Activity you will use building-block car kits to explore the importance of being able to figure out how much of each ingredient is “enough”.

Try This

You will need: a building-block car kit, balance, pencil, and table like the one shown. There are many different types of building-block kits. Your kit may not be identical to the kits used by your classmates. If your kit includes a “driver” figure or decorative stickers, set them aside and do not use them in this Activity.

1. Set out all the components included in the kit; record the name and a description of each component. Your instructor may provide you with names for the components. Count the number of each type of component and record it in your table.

2. Verify that all identical components have the same mass. Record the mass (± 0.1g) of one of each component in your table.

3. Build the car according to the instructions included in the kit.

4. Make sure that you have recorded in your table the number of each component actually used to build the car. If you have any extra pieces or require additional pieces, note this information in your table and tell your instructor.

5. Calculate the total mass of components used to build the car.

Questions

1. Which component(s) is (are) utilized the most frequently? How many times is it (are they) used? Which component(s) is (are) used only once? If there is more than one component in each category, identify the one with the greatest mass in each case.

In the following questions, A is the heaviest component that is used only once and B is the heaviest, most frequently used component.

2. Suppose you have enough components to build 100 cars, except that you have only 4 of A and 12 of B. If you start building cars, which component (A or B) would you run out of first? How many of each of these components would be left over? How many complete cars could you build?

3. You are planning activities for a younger sibling’s birthday party. You decide that each of the 10 partygoers will build a car to take home. In your box of building blocks you find the following: 8 of A and 45 of B. You have more than enough of all the other components. Do you relax? Or do you run to the toy store? Explain.

4. *Limiting* reactants are those that directly limit the amount of product produced. Reactants in *excess* are abundant and so do not limit the amount of product produced. In questions 2 and 3, which component (A or B) is limiting and which is in excess? Explain.

5. The law of conservation of matter states that matter can be neither created nor destroyed. Explain how building the car demonstrates this law.

6. Suppose that you have 100 g of A and 100 g of B. How many of each do you have? (Fractions or broken pieces, if present, should not be counted.) How many cars could you build, assuming that you have more than enough of all the other required components?


1. Stoichiometry Table of Contents: [http://dbhs.wvusd.k12.ca.us/Stoichiometry/Stoichiometry.html](http://dbhs.wvusd.k12.ca.us/Stoichiometry/Stoichiometry.html)

2. LEGO Home: [http://www.lego.com](http://www.lego.com)