Activity: Balancing Legos

FOR THE TEACHER

Summary
In this activity students use Legos to model the reactants and products in a chemical reaction. They use these “atoms” and “molecules” to balance the chemical reaction in order to demonstrate the law of conservation of matter.

Grade Level
High or Middle School

Objectives
By the end of this activity, students should be able to
- Understand how chemical reactions are balanced using coefficients
- Have a better understanding for the law of conservation of matter

Chemistry Topics
This activity supports students’ understanding of
- Chemical Reactions
- Balancing Chemical Equations
- Law of Conservation of Matter

Time
Teacher Preparation: 10 minutes
Lesson: 40-50 minutes

Materials
- Legos

Teacher Notes
- You can divide Legos into bags to make distribution easier or students can just take Legos out of a community bucket.
- Break student up into groups of 2 or 4 depending on class size and the number of Legos you have.
- Students might come up with a key for which type/color of Lego represents which element. But these keys might differ from equation to equation.
- I like to do the first equation for them while they watch. This way they can see me put the molecules together ahead of time and then just add and subtract whole molecules until everything is even.
- This example shows the balanced “Lego” equation for the synthesis of water. A diatomic hydrogen molecule and a diatomic oxygen molecule are shown. Students will determine that 2 hydrogen molecules and one oxygen molecule are needed as reactants, forming two water molecules.
• If you have one available, I have also used a balance, as shown below, to show that the two sides are equal.

[Image of a balance]

• If you want to incorporate technology into the lesson, there are building sites out there where you could demonstrate this activity with virtual Legos.
• Another simulation that could be used to accompany this activity is here.
• Optional: If your students have learned about them, you could incorporate polyatomic ions as a single Lego, pointing out that polyatomic ions typically stay together in reactions.

FOR THE STUDENT
Lesson
Balancing Legos

Background
According to the Law of Conservation of Matter, matter can neither be created nor destroyed. But it can be rearranged. That is what is happening when a chemical reaction occurs. We are taking atoms that are already there, sometimes combined with other atoms to form molecules, and we are rearranging them to make new molecules. The new molecules of the products are made from the atoms that are already there in the reactants.

Objective
In this activity we are going to become familiar with balancing chemical equations by making the product “molecules” from the available reactant “molecules”, both of which are in the form of Legos.

Procedure
1. Each group should obtain a bag of Legos. The first equation you are going to balance is the equation for making water.
   \[ H_2 + O_2 \rightarrow H_2O \]
   There are a few gases that are not going to be found by themselves in nature. These are called diatomic gases. When you hear them referred to, you always assume they are in diatomic form unless you are told otherwise. These gases are hydrogen, oxygen, nitrogen, fluorine, chlorine, bromine and iodine.
2. Take two yellow Legos of the same size and put them together. This is 1 hydrogen molecule.
3. Now take two red Legos of the same size and put them together. This is 1 oxygen molecule.
4. Now take two yellow Legos of the same size and put that with 1 red Lego. This is 1 water molecule.
5. Put the hydrogen molecule and the oxygen molecule on your left side and the water molecule on your right side. Are there the same numbers of each color of Legos on each side? In order to get the sides equal you can ONLY add another one of the
existing molecules. This means only either a complete hydrogen molecule or oxygen molecule to the left side or a complete water molecule to the right side.

6. Keep adding and taking away molecules to the sides until both sides are equal.
7. In the end you should have two hydrogen molecules and an oxygen molecule on the left side and two water molecules on the right side.

Draw/color your Lego equation below:

<table>
<thead>
<tr>
<th>Reactants</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. Notice how the types of atoms balance out? If we were to write this as a balanced chemical equation we would write:

\[ 2H_2 + O_2 \rightarrow 2H_2O \]

9. Take apart your molecules and try this reaction (note that oxygen is a diatomic gas, but sodium can be found by itself in nature)

\[ Na + O_2 \rightarrow Na_2O \]

*Note: you will need to correctly balance it!

Draw/color your Lego equation below:

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</table>

10. Have your teacher check that you constructed the equation correctly.
11. Try this one more time with this reaction

\[ Al_2O_3 \rightarrow Al + O_2 \]

*Note: you will need to correctly balance it!

Draw/color your Lego equation below:

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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
12. Have your teacher check that you constructed the equation correctly.
13. Now we are going to simulate what actually happens in a reaction. We will use the reaction for ammonia-NH₃ (note the two diatomic gases)
   \[ \text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3 \]
14. Make several of the nitrogen molecules and make several of the hydrogen molecules. (We are only making reactant molecules at this point).
15. Now using 1 nitrogen molecule and 1 hydrogen molecule, take the molecules apart and see if you can make an ammonia molecule. What are you lacking? What do you have too much of?
16. Pick up another reactant molecule that you think will enable you to use all the included atoms to make complete ammonia molecules.
17. By the end of this you should have completely used up 1 nitrogen molecule and three hydrogen molecules in order to make 2 complete ammonia molecules:
   \[ \text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3 \]
18. Take apart all your molecules and try this procedure with the following equation:
   \[ \text{H}_2 + \text{Cl}_2 \rightarrow \text{HCl} \] Write your balanced equation below. Have your teacher check it.
   \[ \underline{\text{H}}_2 + \underline{\text{Cl}}_2 \rightarrow \underline{\text{H}}\text{Cl} \]

**Conclusion**
1. In your own words, explain the Law of Conservation of Matter.
2. How would you apply the Law of Conservation of Matter to a concept like baking a cake?
3. Balance the following:
   \[ \underline{\text{C}}\text{S}_2 + \underline{\text{O}}_2 \rightarrow \underline{\text{C}}\text{O}_2 + \underline{\text{SO}}_2 \]
   \[ \underline{\text{Al}} + \underline{\text{Fe}}_2\text{O}_3 \rightarrow \underline{\text{Al}}_2\text{O}_3 + \underline{\text{Fe}} \]
   \[ \underline{\text{C}}_2\text{H}_2 + \underline{\text{O}}_2 \rightarrow \underline{\text{CO}}_2 + \underline{\text{H}}_2\text{O} \]