Lesson Topic: Conservation of Matter in Chemical Reactions

Objective:
Students will be able to:

1. Describe what the Law of Conservation of Matter means.
2. Identify that an equation is unbalanced and take proper steps to balance it.
3. Identify that a chemical equation is a representation of a chemical reaction.
4. Illustrate a balanced equation using M&Ms.

Time Required: 95 minutes

Materials Needed:

- Teacher computer with internet access
- Projector/Smartboard
- 1 computer/laptop/iPad per student with internet access
- Conservation of Matter in Chemical Reactions handout (attached)
- M&Ms or some other multi-colored candy in baggies (1 bag per group)
    - In each bag there should be at least
        - 12 reds
        - 14 yellows
        - 4 browns
        - 12 reds
        - 2 greens
        - 4 blues
- Piece of steel wool
- 1 beaker
- Vinegar (enough to cover the steel wool in a beaker).
- 1 balloon
- Scale
- Coloured pencils

Teacher Preparation:

- Assign a Legends of Learning Instructional Quick Play playlist for the day(s) you will be teaching the lesson.
    - Instructional - Middle School - Conservation of Matter in Chemical Reactions
- Assign a Legends of Learning Content Review Quick Play playlist for the day(s) you will be teaching the lesson.
    - Content Review - Middle School - Conservation of Matter in Chemical Reactions
- Make copies of Conservation of Matter in Chemical Reactions Worksheet (1 per student)
- Put M&Ms in baggies and make sure there are enough of each color in each bag (refer to materials)

Engage (15 minutes):

1. Tell students “Today we are going to be talking about the Conservation of Matter

principle."

2. Write this phrase on the board: Matter cannot be created or destroyed.
    a. Read the statement aloud to students and tell them, "Keep this in mind as I carry out the demonstration."
    b. Do not give too much detailed information at the beginning.
3. Pass out the Conservation of Matter in Chemical Reactions handout.
4. Show students the piece of steel wool.
    a. Walk around and show students
    b. Allow students to touch the steel wool
5. Ask students "How would you describe the steel wool?"
    a. Write their descriptions on the board in a T chart, labeled "Before" and "After."
    b. Have students jot it down in their handout.
    c. These descriptions will be under the "Before" side.
    d. Tell students "steel wool is mainly made of iron."
6. Go through the demonstration and explain each step.
7. Place a beaker on top of the scale.
8. In the beaker place the steel wool, and pour in some vinegar (enough to completely cover the steel wool.
9. Attach a balloon atop the beaker.
    a. Ask a student to read and record the overall mass of the beaker.
10. As the experiment unfolds, a chemical reaction will take place.
    a. The balloon should get pulled into the beaker because the oxygen is being used up within the beaker.
    b. Notice that the mass of the beaker is not changing, as indicated by the scale.
11. After a minute or so, when you can tell the chemical reaction is complete, empty out the beaker.
    a. Allow the students to look and feel the steel wool again.
12. Write their observations in the T chart labeled "After, "and have students copy it down in their handout.
    a. Possible answers: more brittle, turned orange/brown, soaked up all the liquid, etc.
13. Tell students "Hopefully your gears are turning as to what has just happened. We are going to work through this today."

Explore (20 minutes):

1. Have your students sign in to Legends of Learning. Instruct students to complete the Instructional playlist.
2. Assist students as needed during game play, pause playlist if you need to address content or questions to the entire class.

Explain (30 minutes):

1. Tell students "Think back to the demonstration from the beginning of class. Someone remind me what happened to the steel wool."
    a. Allow a volunteer to summarize the demonstration.
2. Tell students "This was a chemical reaction and a perfect example of the Conservation of Matter principle. Someone remind me what the principle says."
    a. Have a volunteer essentially read the board.

3. Tell students “Correct, this means that all atoms that make up matter comes from somewhere, because it is not created. It also means even when matter seems to disappear, it has to go somewhere because it is not destroyed.
    a. Ask students “In a chemical reaction, where could matter go?” (change state)
4. Tell students “So let’s think about this chemical reaction. We have steel wool that is made mostly of iron, mixed with vinegar, and the balloon got completely sucked into the glass. With a partner, I want you to think about why this happened to the balloon.”
    a. Allow students time to discuss.
    b. Then, have them share their ideas.
5. Tell students “Yes, the oxygen is being used in the chemical reaction, so it is taking it from the balloon, forcing it back into the beaker.”
6. Tell students “Looking at the our T chart, what made all of these changes to the steel wool?
    a. Possible answers: The liquid vinegar and oxygen made the iron rust. The iron went from the gray colour, to a rusty orange/brown colour. The liquid and oxygen broke down the iron so that it became more brittle.
7. “Now that we broke down this chemical reaction. Let’s look at another chemical reaction as an equation.”
8. Write the following equation on the board:
    a. $CH_4 + O_2 \rightarrow CO_2 + H_2O$
9. Tell students “The important thing we just learned is that matter is not created or destroyed, that means in a chemical reaction, all the parts of the atoms involved are still there, just rearranged.”
10. Count how many of each atom are on the left side of the arrow. Then, do the same to the right side of the arrow.
    a. 1 C, 4 H, 2 O ----------> 1 C, 2 H, 3 O
11. Tell students “As you can see, the numbers of each atom are different. We need to fix it so that the numbers are balanced.We do that by adding a coefficient, or a number in front of the molecule we need to adjust.
12. Work through each atom.
    a. The carbon numbers are the same, so leave that alone for now.
    b. Start with hydrogen number. There are 4 on the right, so let’s put a 2 in front of H_2O to make the hydrogen number 4 on both sides of the arrow.
        i. Remember you have to multiply the coefficient with any subscript numbers (numbers that hang below the line).
    c. Doing that gives me 4 oxygen atoms on the right side of the arrow and only two on the left. What could we do to fix that?
        i. Put a 2 in front of the O_2 on the left side.
    d. We now have an equation that reads:
    $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
        i. Recount how many atoms are on each side:1 C, 4 H, 4 O --> 1 C, 4 H, 4 O
13. Remind students if there is no number in front of the atoms, it is 1.
14. Give students a problem to complete in pairs/individually.
    a. $ZnS + O_2$ -----> $ZnO + SO_2$
    b. Answer: $2ZnS + 3O_2$ -------> $2ZnO + 2SO_2$
15. Repeat as many examples as you see fit.

Elaborate (20 minutes):

1. Explain the M&M activity to students while they follow along with the instructions in their handout.
2. Have them get into partners or groups to complete the activity.
3. Make it clear they are NOT to eat the M&Ms until they have gotten their papers' checked by a teacher.
4. Pass out the M&Ms to student groups.
5. Walk around and monitor as they work.
6. When everyone has finished, go through the answers together.
    a. Answer Key attached
    b. Answer any common mistakes.

Evaluate (10 minutes):

1. Have your students sign in to Legends of Learning. Instruct students to complete the Content Review playlist.
2. Analyze student results to determine what concepts need to be a focus for reteaching.

Additional Lesson Strategies:

- To use Legends for additional instruction, create a custom playlist with an instructional game and pre and post assessment.
- To use Legends for a quick formative assessment, create a 5-question assessment in a playlist.
- To use Legends for a student-directed experience, create a targeted freeplay playlist.
- Encourage students to play on their own at home in Legends of Learning: Awakening for a student-driven experience including avatars, battling, and quests all centered around topics they are covering in class.

Name:_____

Conservation of Matter in Chemical Reactions

Steel Wool Observations

Before	After

Balancing Equations

_____ ----------> _____

Reactants **“yields” or “makes”** **Products**

When a chemical reaction takes place, atoms are conserved. Whatever you have on the left of the arrow, must also be on the right.

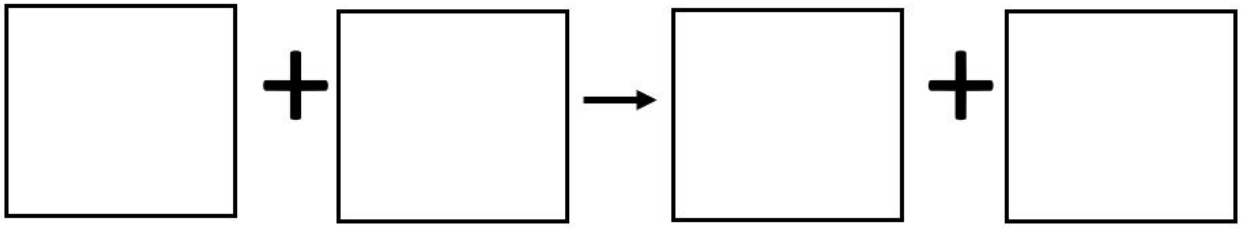
M&M Lab

DO NOT EAT THE M&Ms UNTIL THE END

Color	Red	Orange	Yellow	Green	Blue	Brown
Atom	H	C	O	Zn	Cl	N

In the boxes below, place the correct number of each color M&M in the box to represent the following equation.

1. $N_2 + H_2$ -------> NH_3



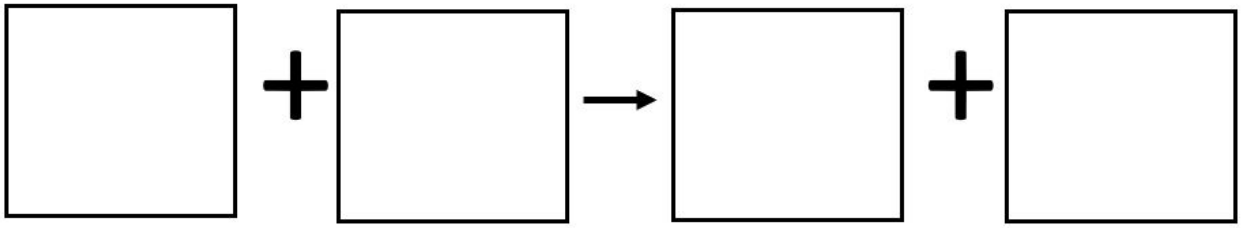
N = How many are on the left? _____ How many are on the right? _____

H = How many are on the left? _____ How many are on the right? _____

Balance the equation by moving the candies. Write the balanced equation below.

_____ + _____ ----------> _____ + _____

Then, with colored pencils, color the correct way to represent the M&Ms in the boxes below.



2. $Zn + HCl$ --------> $ZnCl_2 + H_2$

Zn= How many are on the left? _____ How many are on the right? _____

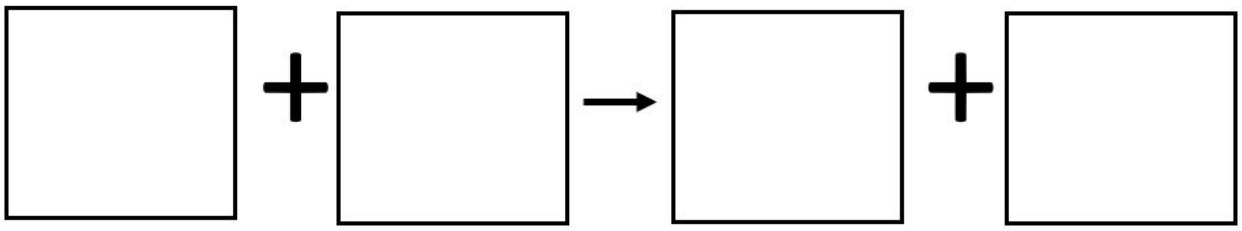
H = How many are on the left? _____ How many are on the right? _____

Cl= How many are on the left? _____ How many are on the right? _____

Balance the equation by moving the candies. Write the balanced equation below.

_____ + _____ ----------> _____ + _____

Then, with colored pencils, color the correct way to represent the M&Ms in the boxes below.



3. $C_2H_6 + O_2$ ------> $CO_2 + H_2O$

C= How many are on the left? _____ How many are on the right? _____

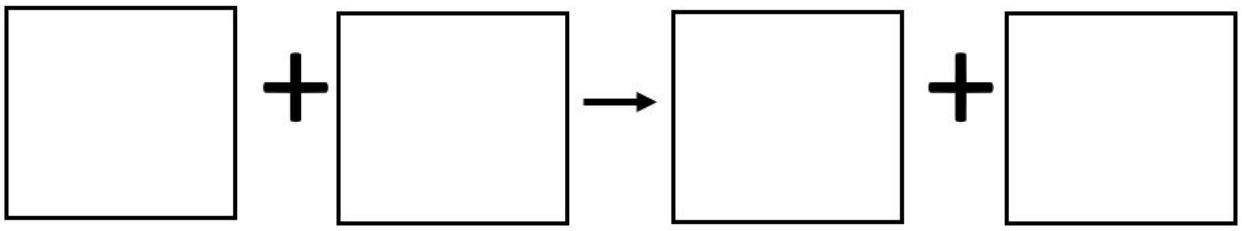
H = How many are on the left? _____ How many are on the right? _____

O= How many are on the left? _____ How many are on the right? _____

Balance the equation by moving the candies. Write the balanced equation below.

_____ + _____ ----------> _____ + _____

Then, with colored pencils, color the correct way to represent the M&Ms in the boxes below.



**Get your equations checked by a teacher. Once approved, go ahead and eat your M&Ms. As you eat, balance the following equations.

4. _____SnO_2 + _____H_2 ----> _____Sn + _____H_2O

5. _____NH_3 + _____O_2 ----> _____NO + _____H_2O

6. _____KNO_3 + _____H_2CO_3 ----> _____K_2CO_3 + _____HNO_3

7. _____$SeCl_6$ + _____O_2 ----> _____SeO_2 + _____Cl_2

8. _____Al + _____O_2 -----> _____Al_2O_3

Answer the following questions:

9. What did the M&Ms represent in this activity?

10. What does the Law of Conservation of Matter have to do with balancing equations?

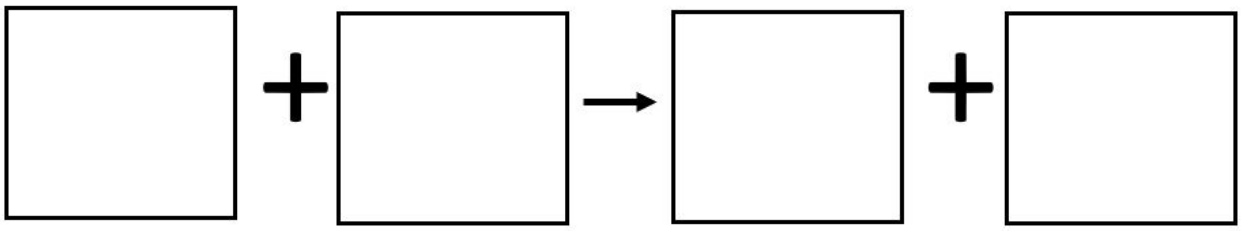
M&M Lab KEY

DO NOT EAT THE M&Ms UNTIL THE END

Color	Red	Orange	Yellow	Green	Blue	Brown
Atom	H	C	O	Zn	Cl	N

In the boxes below, place the correct number of each color M&M in the box to represent the following equation.

1. $N_2 + H_2$ -------> NH_3



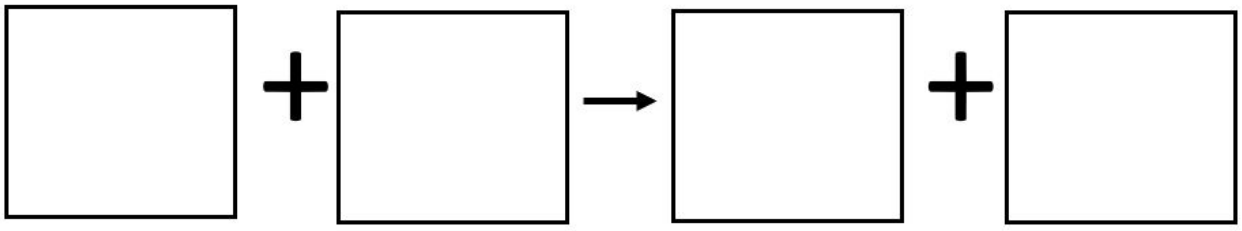
N = How many are on the left? **2** How many are on the right? **1**

H = How many are on the left? **2** How many are on the right? **3**

Balance the equation by moving the candies. Write the balanced equation below.

N_2 + 3H_2 ----------> 2NH_3

Then, with colored pencils, color the correct way to represent the M&Ms in the boxes below.



2 browns + 6 reds -----> 2 browns and 6 reds (leave the last box empty)

2. $Zn + HCl \text{ --------> } ZnCl_2 + H_2$

Zn= How many are on the left? **1** How many are on the right? **1**

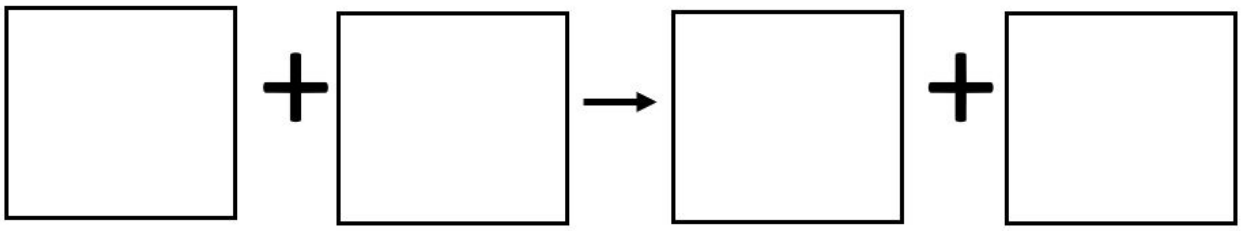
H = How many are on the left? **1** How many are on the right? **2**

Cl= How many are on the left? **1** How many are on the right? **2**

Balance the equation by moving the candies. Write the balanced equation below.

$Zn + 2HCl \text{ -----> } ZnCl_2 + H_2$

Then, with colored pencils, color the correct way to represent the M&Ms in the boxes below.



1 green + 2 reds and 2 blues ------> 1 green and 2 blues + 2 reds

3. $C_2H_6 + O_2 \text{ ------> } CO_2 + H_2O$

C= How many are on the left? **2** How many are on the right? **1**

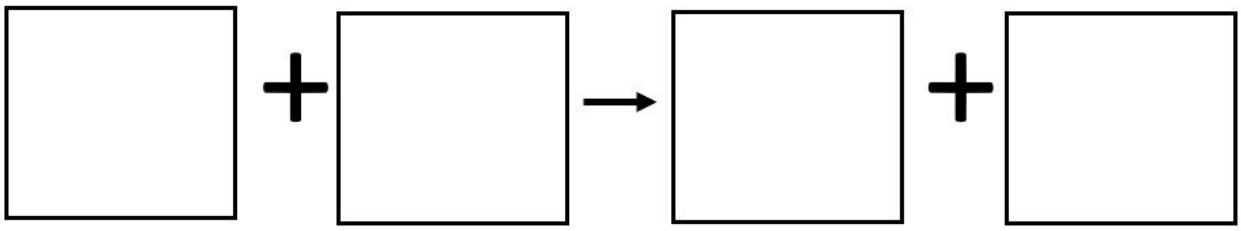
H = How many are on the left? **6** How many are on the right? **2**

O= How many are on the left? **2** How many are on the right? **3**

Balance the equation by moving the candies. Write the balanced equation below.

$C_2H_6 + 7O \text{ -------> } 2CO_2 + 3H_2O$

Then, with colored pencils, color the correct way to represent the M&Ms in the boxes below.



2 oranges & 6 reds + 7 yellows --> 2 oranges & 4 yellows + 6 reds and 3 yellows

**Get your equations checked by a teacher. Once approved, go ahead and eat your M&Ms. As you eat, balance the following equations.

4. **1** SnO_2 + **2** H_2 ----> **1** Sn + **2** H_2O

5. **4** NH_3 + **5** O_2 ----> **4** NO + **6** H_2O

6. **2** KNO_3 + **1** H_2CO_3 ----> **1** K_2CO_3 + **2** HNO_3

7. **1** $SeCl_6$ + **1** O_2 ----> **1** SeO_2 + **3** Cl_2

8. **4** Al + **3** O_2 -----> **2** Al_2O_3

Answer the following questions:

9. What did the M&Ms represent in this activity?

The different atoms within the chemical reactions.

10. What does the Law of Conservation of Matter have to do with balancing equations?

The Law of Conservation states that during a chemical reaction, matter is not created or destroyed. These equations represent atoms in a chemical reaction and they must be balanced with the same number on each side since they are not created or destroyed.