Student’s Lesson at a Glance

Lesson Summary

This lesson contains five activities designed to help students define and understand five basic types of reactions: combination (synthesis), decomposition, single displacement, double displacement, and combustion reactions. Students begin with a Connecting Activity that provides a general introduction to the different types of reactions. Teachers can provide the formal definitions and examples of the reactions. Following the teacher demonstration of the simulation, students compare and contrast the ten reactions from Lesson 2 (L2A2-3). Students provide balanced equations and then classify the types of reactions. In the final activity, small groups will teach each other about their assigned reaction.

SWBAT (Student will be able to)

- Classify chemical reactions according to how the reactants rearrange to form products
- Know that chemical reactions occur from the collisions between elements or molecules
- Know that combustion reactions occur when an element or a compound reacts with oxygen
- Know that double displacement reactions occur from the exchange of anions and cations between two ionic compounds
- Know that combination reactions occur when two or more reactants combine to form a single product
- Know that decomposition reactions occur when a single reactant is broken down into two or more products
- Know that single replacement reaction when one element replaces a second element in a compound
- Classify a chemical reaction from an observation of submicroscopic interactions
- Represent different types of chemical reactions using submicroscopic chemical representations
- Represent different types of chemical reactions using chemical equations
Essential Vocabulary

Keep a list of all important words from this lesson. This list, in addition to the lists from other lessons, will make studying easier and improve scientific communication skills. The essential vocabulary from the unit is in bold. Additional words that will expand your scientific vocabulary are in italics.

CCC Reminder

- Prefixes and suffixes on words can help you discover the meaning of a word.
- Use the vocabulary section and note section to take good notes so that studying for tests and quizzes will be easier.
- Make sure equations are balanced on both sides.
- Phases will be used in the chemical equations. Make sure you are correctly sketching the location of the substances in the simulation so that you are able to identify the phase of each substance.
- Draw a key when you are sketching. Symbolic keys can help you and others decode your sketches at a later time. Make sure to include ions separately from regular atoms in the key.
- Ions are charged particles that show up with a grey halo in the simulations. Ions make up ionic compounds. Use the periodic table to determine the charge of an ion.

Notes
Activity 1: Connecting

Millions of reactions occur in the universe. Although many reactions seem unique, chemists created a classification system by comparing similarities. There are five types of reactions.

The first type of reaction is a combination or synthesis reaction. An example of this is when hydrogen gas and oxygen gas combine to produce water.

\[ 2H_2 (g) + O_2 (g) \rightarrow 2 H_2O (g) \]

1. Based on what “combination” means, predict the product of the following generic reaction. \[ A + B \rightarrow \]_______

The second type of reaction is a decomposition reaction. An example of this is when water undergoes electrolysis, a process that uses electrical current to drive a chemical reaction. During electrolysis, liquid water becomes hydrogen gas and oxygen gas.

\[ 2 \text{H}_2\text{O (l)} \rightarrow 2 \text{ H}_2 (g) + \text{O}_2 (g) \]

2. Based on what “decomposition” means, predict the products of the following generic reaction. \[ \text{AB} \rightarrow \]_______

The third type of reaction is called a single displacement reaction. An example of this is when magnesium reacts with hydrochloric acid to form magnesium chloride and hydrogen gas.

\[ \text{Mg (s)} + \text{HCl (aq)} \rightarrow \text{MgCl}_2 (aq) + \text{H}_2 (g) \]

3. Based on the words “single” and “displacement,” predict the products of the following generic reaction. \[ \text{AB} + \text{C} \rightarrow \]_______

The fourth type of reaction is a double displacement reaction. An example of this is when two ionic compounds are mixed together such as silver nitrate and lithium chloride yields silver chloride and lithium nitrate.

\[ \text{AgNO}_3 (aq) + \text{LiCl (aq)} \rightarrow \text{AgCl (s)} + \text{LiNO}_3 (aq) \]

4. Based on the words “double” and “displacement,” predict the products of the following generic reaction. \[ \text{AB} + \text{CD} \rightarrow \]_______

The final reaction is a combustion reaction. An example of this reaction is when magnesium reacts with oxygen to produce magnesium oxide.

\[ 2 \text{Mg (s)} + \text{O}_2 (g) \rightarrow 2 \text{ MgO (s)} \]

5. Based on the example of magnesium combusting, predict the products of the following generic reaction. \[ A + \text{O}_2 \rightarrow \]_______

Some combustion reactions, such as the combustion of a hydrocarbon like pentane, can produce \( \text{H}_2\text{O} \).
## Activity 2: Defining the Five Chemical Reactions

Complete the chart below as your teacher reviews the types of reactions.

<table>
<thead>
<tr>
<th>Type of Reaction</th>
<th>Definition</th>
<th>General Equation</th>
<th>Example Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Combination</strong> (Synthesis)</td>
<td>Two or more reactants combine to make a single product.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Decomposition</strong></td>
<td>A single reactant is broken down into two or more products.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Single Displacement</strong></td>
<td>A single element displaces a second element within a compound.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Double Displacement</strong></td>
<td>The cations and anions in two reactants are exchanged.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Combustion</strong></td>
<td>An element or a compound reacts with oxygen.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Activity 3: Classifying Reactions Demonstration

Based on the submicroscopic interactions of the reactions in Lesson 2, all five basic types of reactions are represented by the simulations. Using the classification system defined in Activity 2, we can categorize the reactions seen in Lesson 2 (L2A2-3). Use the sketches and formulas completed starting on page 17 to complete comparisons. If clarification is needed on any of the simulations, watch each simulation again for 30 seconds and then make comparisons. Your teacher will demonstrate how to categorize the first pair of reactions. Next, your small group will complete the remaining comparisons.

Demonstration: Use Simulation 1, Sets 3 and 5

Compare sketches and formulas for these reactions.

6. What is similar between the two reactions before the simulation runs?

________________________________________________________________________

7. What is similar between the two reactions after the simulation runs?

________________________________________________________________________

8. Write balanced chemical equations for these reactions. Include phases in both equations.

   Set 3: _________ + _________ → _________ + _________

   Set 5: _________ + _________ → _________ + _________

9. What type of reaction are these two reactions? Provide evidence for your response.

________________________________________________________________________
Activity 4: Students Classifying Reactions

Complete the next set of exercises with your small group as you did with the teacher.

**Part 1:** Use Simulation 1, Sets 1 and 8

Compare sketches and formulas for these reactions.

10. What is similar between the two reactions before the simulation runs?

11. What is similar between the two reactions after the simulation runs?

12. Write balanced chemical equations for these reactions. Include states of matter in both equations.

   Set 1: _________ + _________ → _________

   Set 8: _________ + _________ → _________

13. What type of reaction are these two reactions? Provide evidence for your response.

**Part 2:** Use Simulation 1, Sets 4 and 6

Compare sketches and formulas for these reactions.

14. What is similar between the two reactions before the simulation runs?

15. What is similar between the two reactions after the simulation runs?

16. Write balanced chemical equations for these reactions. Include phases in both equations.

   Set 4: _________ + _________ → _________ + _________

   Set 6: _________ + _________ → _________ + _________
17. What type of reaction are these two reactions? *Provide evidence for your response.*

________________________________________________________________________

**Part 3** Use Simulation 1, Sets 2 and 9

*Compare sketches and formulas for these reactions.*

18. What is similar between the two reactions *before* the simulation runs?

________________________________________________________________________

19. What is similar between the two reactions *after* the simulation runs?

________________________________________________________________________

20. Write balanced chemical equations for these reactions. Include phases in both equations.

   Set 2: __________ → __________ + __________

   Set 9: __________ → __________ + __________

21. What type of reaction are these two reactions? *Provide evidence for your response.*

________________________________________________________________________

**Part 4:** Use Simulation 1, Sets 7 and 10

*Compare sketches and formulas for these reactions.*

22. What is similar between the two reactions *before* the simulation runs?

________________________________________________________________________

23. What is similar between the two reactions *after* the simulation runs?

________________________________________________________________________
24. Write balanced chemical equations for these reactions. Include phases in both equations.

Set 7: _________ + _________ → _________ + _________

Set 10: _________ + _________ → _________ + _________

25. What type of reaction are these two reactions? Provide evidence for your response.

__________________________________________________________

__________________________________________________________

Lesson Reflection Question

26. How did you determine the states of matter of each substance from the simulation?

__________________________________________________________

__________________________________________________________

__________________________________________________________