

Shall We Dance? – Classifying Types of Chemical Reactions

Why?

Chemical reactions can be classified into different categories. Four common types are synthesis, decomposition, single replacement and double replacement. Specific reactions corresponding to these general types are associated with health issues, environmental problems, and manufacturing processes. In order to use chemical reactions or evaluate their effects, you need to be able to identify the type of reaction.

Success Criteria

- Identify and differentiate between four types of chemical reactions: synthesis, decomposition, single replacement and double replacement.

Prerequisites

- Reaction equation nomenclature
- Balancing equations

New Concepts

Types of Chemical Reactions:

- Synthesis elements or less complex compounds come together to form a single more complex compound
- Decomposition a compound breaks apart into either elements or less complex compounds
- Single replacement a single element replaces another one in a compound
- Double replacement ions in a compound switch places with ions in another compound to form two new compounds

Model 1: Analogy - Dancing with Reactants

When you are thinking about the four different types of reactions I'd like you to think about its similarity to dancing (yes, dancing). I'll show you what I mean.

The dance...

Adam and Barbara were both single. No one was talking about "Adam and Barbara" being together before the dance. They both go to the dance alone. However, they meet at just the perfect time when a song they both adore is playing. They end up holding hands the entire dance. After that fateful meeting no one ever sees Adam without Barbara, they are forever referred to as "Adam and Barbara".

Key Questions

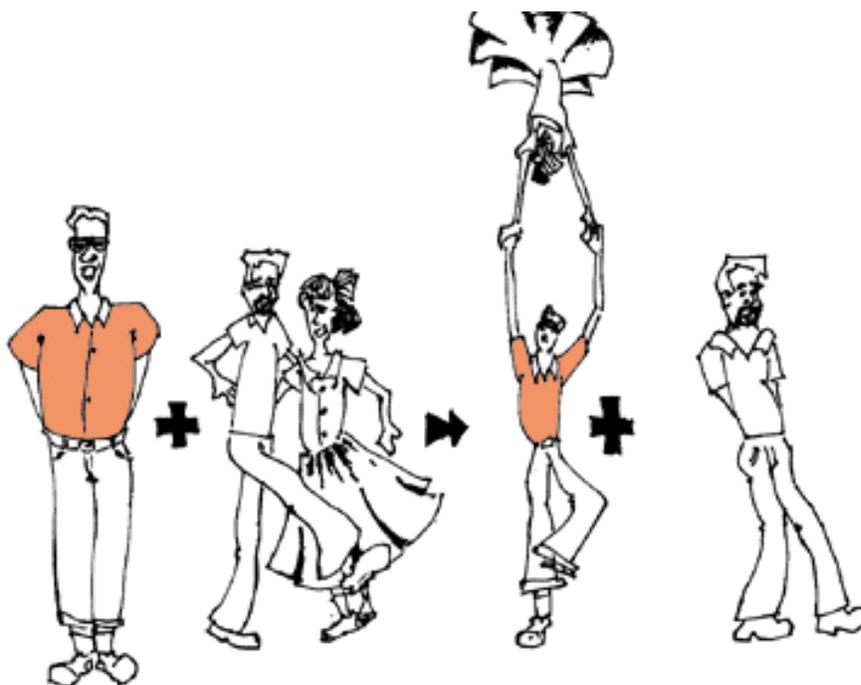
1. Represent the drama of Adam and Barbara as a chemical equation? Use A to represent Adam and B to represent Barbara.
2. If A and B represent elements can you describe what is happening?
3. How would you classify A and B using the words from the New Concepts section on the first page of this activity?

The dance continues...

Later that same evening Xavier and Yasmine, who have been 'the couple' forever, have a heated quarrel and break up.

4. Represent the drama of Xavier and Yasmine as a chemical equation? Use X to represent Xavier and Y to represent Yasmine.
5. If X and Y represent elements can you describe what is happening?
6. How would you classify X and Y using the words from the New Concepts section on the first page of this activity?

7. What type of reaction is represented in the picture below? Write your own analogy for the reaction illustrated in the picture.



<http://www.usoe.k12.ut.us/curr/science/sciber00/8th/matter/sciber/chemtype.htm>

8. Write a chemical reaction for this scenario.

The dance continues...

In their blissful state, Adam and Barbara (AB) try to help Xavier and Yasmine (XY) reconcile their differences. After everyone agrees to stop quarreling, Adam asks Yasmine to dance. Xavier and Barbara decided that they will dance together as well.

9. Represent Adam and Barbara's attempt to reconcile Xavier and Yasmine's differences as a chemical equation.

10. How would you summarize this reaction?

11. What type of reaction does this scenario represent? (Based on the New Concepts words)

Model 2: Types of Reactions

Classification (Type) of Reaction	Example: Using Symbols	Example Reactions
Synthesis	$A + B \rightarrow AB$	$2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$
Decomposition	$XY \rightarrow X + Y$	$2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{H}_2(\text{g}) + \text{O}_2(\text{g})$
Single Replacement	$A + BC \rightarrow AC + B$	$2\text{Al}(\text{s}) + 3\text{Cu}(\text{NO}_3)_2(\text{aq}) \rightarrow 2\text{Al}(\text{NO}_3)_3(\text{aq}) + 3\text{Cu}(\text{s})$
Double Replacement	$AC + DE \rightarrow AE + DC$	$\text{Pb}(\text{NO}_3)_2(\text{aq}) + 2\text{KI}(\text{aq}) \rightarrow \text{PbI}_2(\text{s}) + 2\text{KNO}_3(\text{aq})$

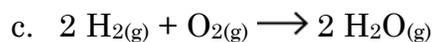
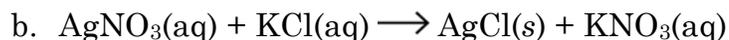
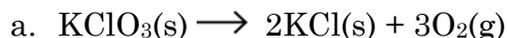
aq = aqueous, g = gas, s = solid, l = liquid

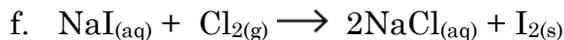
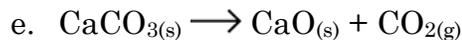
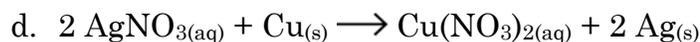
Key Questions

- As shown in the model, list the number of reactants and the number of products found in the synthesis reaction?
- As shown in the model, list the number of reactants and the number of products found in a decomposition reaction?
- How would you compare a single replacement reaction to a double replacement reaction?

Exercise

1. Identify the type of reaction shown in each of the following chemical equations:





Problems

1. For the reaction between zinc metal and hydrochloric acid (aqueous) producing zinc chloride (aqueous) and hydrogen gas
 - (a) write an equation for this reaction

 - (b) balance the equation from Part a

 - (c) classify the reaction

2. For the reaction between aqueous calcium nitrate and aqueous sodium hydroxide producing the precipitate (solid) calcium hydroxide and aqueous sodium nitrate
 - (a) write an equation for this reaction

 - (b) balance the equation from Part a

 - (c) classify the reaction

3. Nitrogen molecules and hydrogen molecules react to form ammonia gas.
 - (a) write an equation for this reaction

 - (b) balance the equation from Part a

 - (c) classify the reaction and explain how you came to this conclusion