CR Lesson 11: Types of Reactions

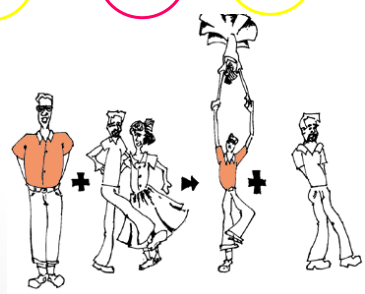
There are 5 MAJOR types of chemical reactions

Types of Reactions

- **1. Single Replacement/displacement:**
  - An element reacts with a compound to form a new compound and new lone element

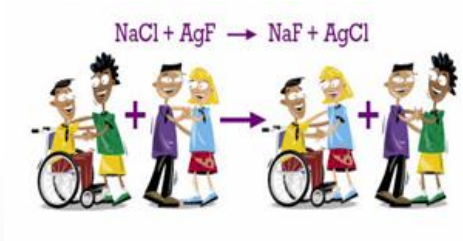
$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

$A + BC \rightarrow AC + B$



- **2. Double Replacement:**
  - The cations of two ionic compounds switch places

$$Ag(NO_3) + NaCl \rightarrow AgCl + Na(NO_3)$$



2a. Acid-Base Reaction

- A special double displacement reaction in which the products are always water (H_2O) and a salt (an ionic compound)

$$HBr + KOH \rightarrow KBr + H_2O$$

Combustion, Synthesis & Decomposition

3. Combustion Reactions

- Combustion is commonly called burning and therefore heat or energy is given off in the reaction.
- Combustion reactions always involve oxygen O_2.
- **hydrocarbon + oxygen → carbon dioxide and water**

  $C\_H\_ + O_2 \rightarrow CO_2 + H_2O$
- A hydrocarbon is made up of only carbon and hydrogen
- Combustion occurs predominantly in automobiles, homes, and in factories.

Combustion

- When a combustion reaction takes place, the result is carbon dioxide (CO_2), water (H_2O), and energy or heat.
- The following reaction represents a combustion reaction.

$$CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O + \text{energy}$$

- We do not always show the energy or heat in the reaction.

Some examples of Combustion

$CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$

Water and Carbon dioxide

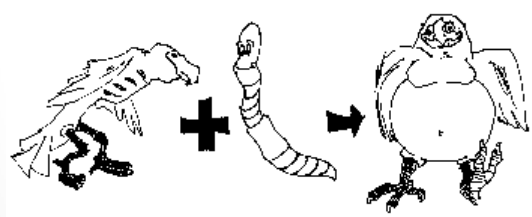
$2C_2H_6 + 7O_2 \rightarrow 6H_20 + 4CO_2$

$C_3H_8 + 5O_2 \rightarrow 4H_2O + 3CO_2$

4. Synthesis Reactions

- A synthesis reaction involves two or more substances combining to make a more complex substance.
- The general formula for this type of reaction can be shown as;

A + B → AB



- In the cartoon, the skinny bird (reactant) and the worm (reactant) combine to make one product, a fat bird.

Synthesis

- Synthesis is where two separate things combine to form one.
- Examples of synthesis:

$$2H_2 + O_2 \rightarrow 2H_2O$$

$$4Fe + 3O_2 \rightarrow 2Fe_2O_3$$

5. Decomposition Reactions

- In a decomposition reaction, one substance is broken down into two or more, simpler substances.
- This type of reaction is the opposite of a synthesis reaction, shown by the general formula below;

AB → A + B

or

reactant → product + product

Decomposition

- In this cartoon the egg (the reactant), which contained the turtle at one time, now has opened and the turtle (product) and egg shell (product) are now two separate substances.

Decomposition

- Some examples of decomposition reactions are shown below:

$$2Ag_2O \rightarrow 4Ag + O_2$$

$$2H_2O \rightarrow 2H_2 + O_2$$

How to Identify:

- Read through the questions below, in order, until you can answer "yes" to a question. When you answer "yes", don't move on to the next question because you have found your answer
  - Does the chemical equation contain oxygen, carbon dioxide and water? If yes, it's a combustion reaction
  - Do simple molecules combine to form more complex molecules? If yes, it's a synthesis reaction
  - Does a complicated molecule break apart to form two or more simpler substances? If yes, it's a decomposition reaction.
  - Are there any chemicals anywhere in the equation that consist of only 1 element? If so, it's a single displacement reaction.
  - Is water formed during this reaction? Of yes, it's an acid base reaction. If not, it's a double displacement reaction.

Practice

- $Mg + 2H_2O \rightarrow Mg(OH)_2 + H_2$
- $8\ Fe + S_8 \rightarrow 8\ FeS$
- $2\ NaBr + Ca(OH)_2 \rightarrow CaBr_2 + 2\ NaOH$
- $3\ HBr + Al(OH)_3 \rightarrow 3\ H_2O + AlBr_3$