CHEMISTRY

The good news and the bad news

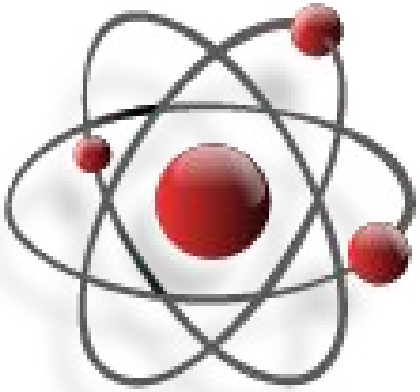
Types of Chemical Reactions

Why???

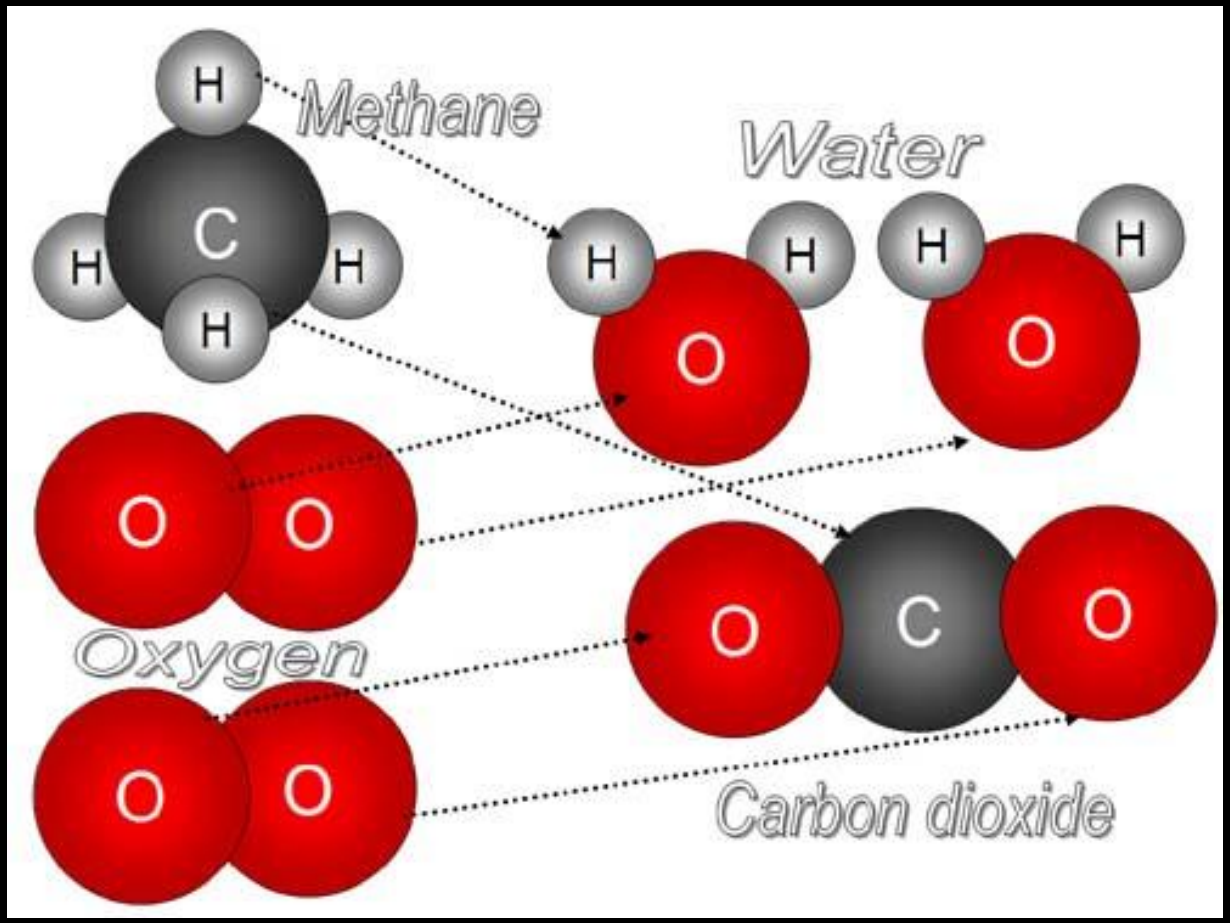
As you've already seen… Chemical reactions occur around us everyday--- so many in fact that looking at them all individually would be REALLY overwhelming!
So instead we classify them based on common properties!

Classification of Chemical Reactions

- Chemical reactions can be classified in one of two ways:
  1. Based on how atoms are rearranged
  2. Based on how energy/ heat is transferred



VS.



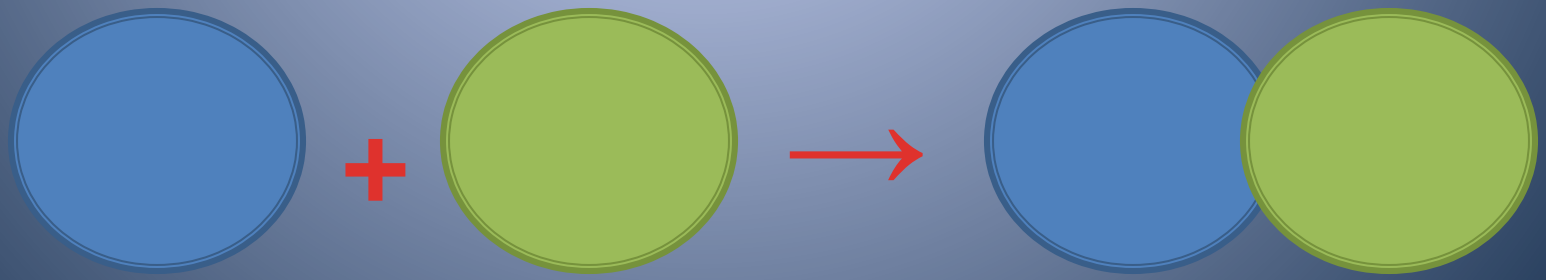
1. Classifying based on atom rearrangement

1) Synthesis Reaction

This is a reaction in which two or more elements or compounds combine to form a single product. This type of reaction follows the general equation

$$A + B \rightarrow AB$$

- *where A and B may be either elements or compounds.*



Example: Synthesis Burning Magnesium

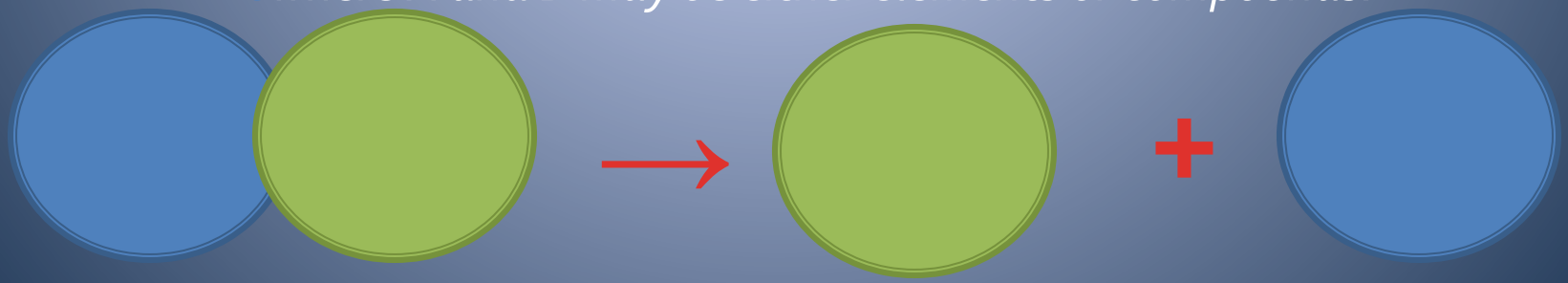
- $2Mg + O_2 \rightarrow 2MgO$

Decomposition Reaction

In this type of reaction a single reactant, a compound, breaks into two or more parts. Often these are the most difficult to predict.
Here is the general equation:

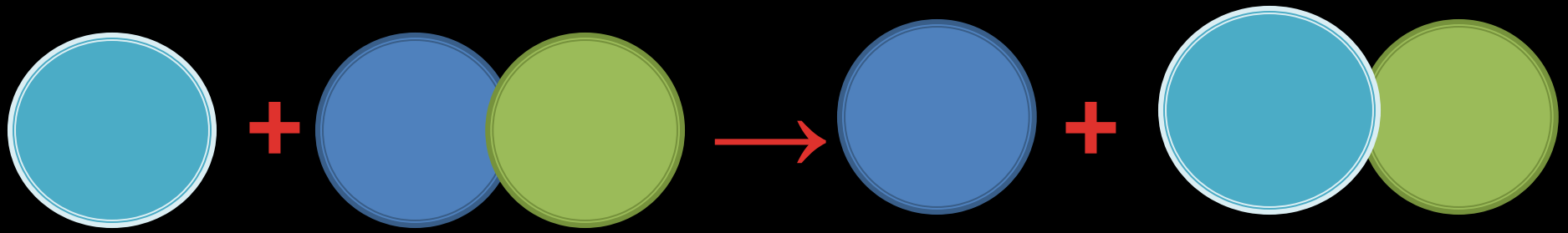
$$AB \rightarrow A + B$$

- *where A and B may be either elements or compounds.*

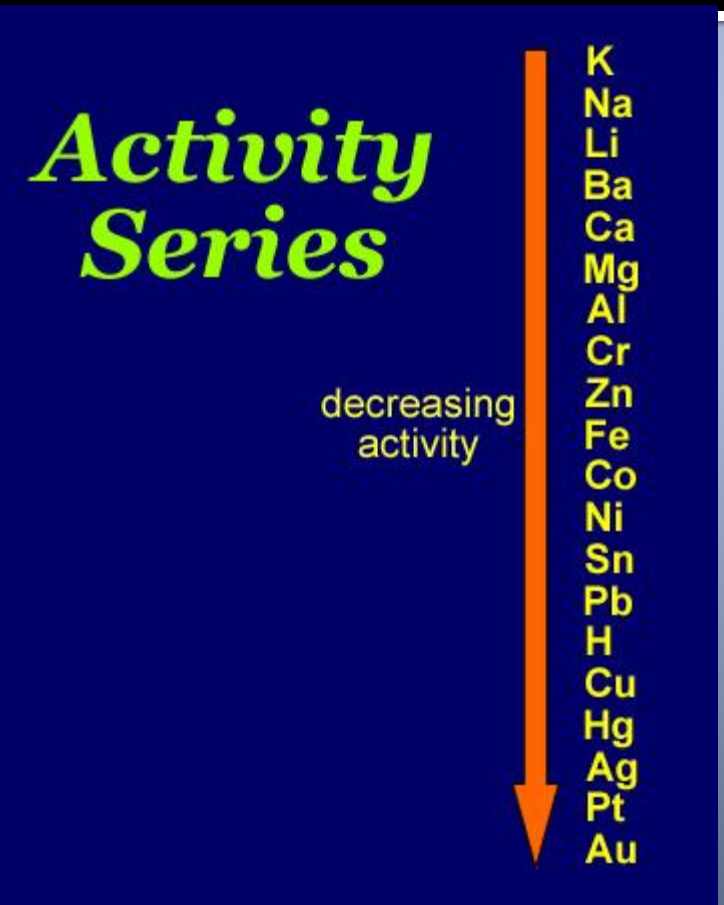


Example: Decomposition Hydrogen Peroxide

- $H_2O_2 \rightarrow H_2O + O_2$



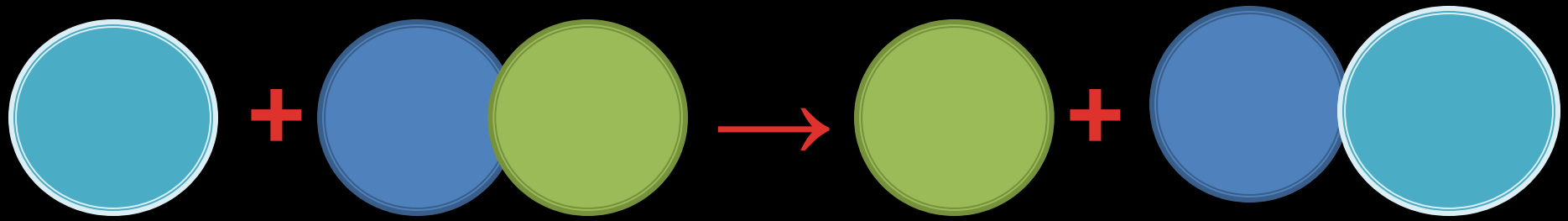
Single Replacement Reaction



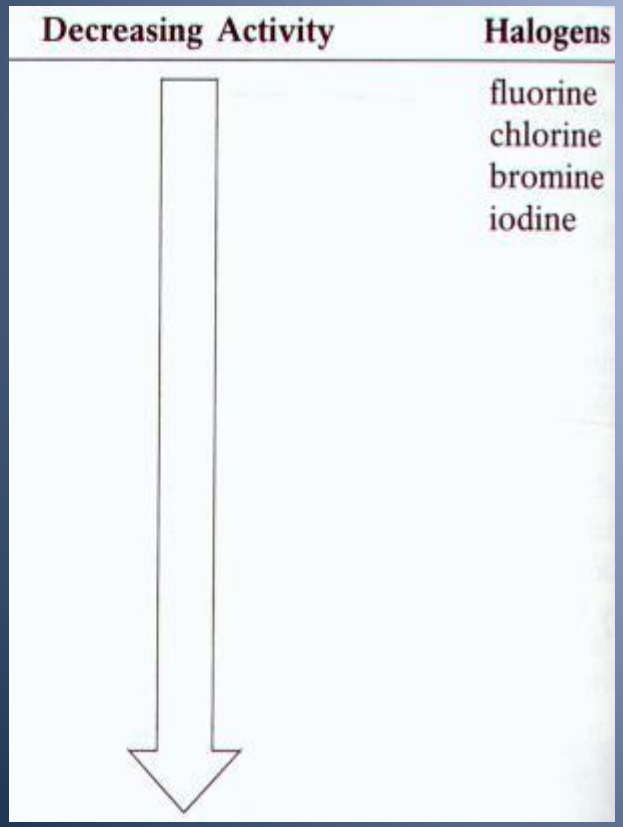
In this type of reaction, a more reactive **element** replaces a less reactive element in a compound. For the metals, you will need to use an activity series (you'll be provided one)– the higher the element is the more REACTIVE it is. The general equation:

$$A + BC \rightarrow AC + B$$

- *where A is a metal.*



More on: Single Replacement Reactions



Among the halogens, F_2 is the most active halogen, and the activity of the halogens decreases as you go down the group.

The general equation:

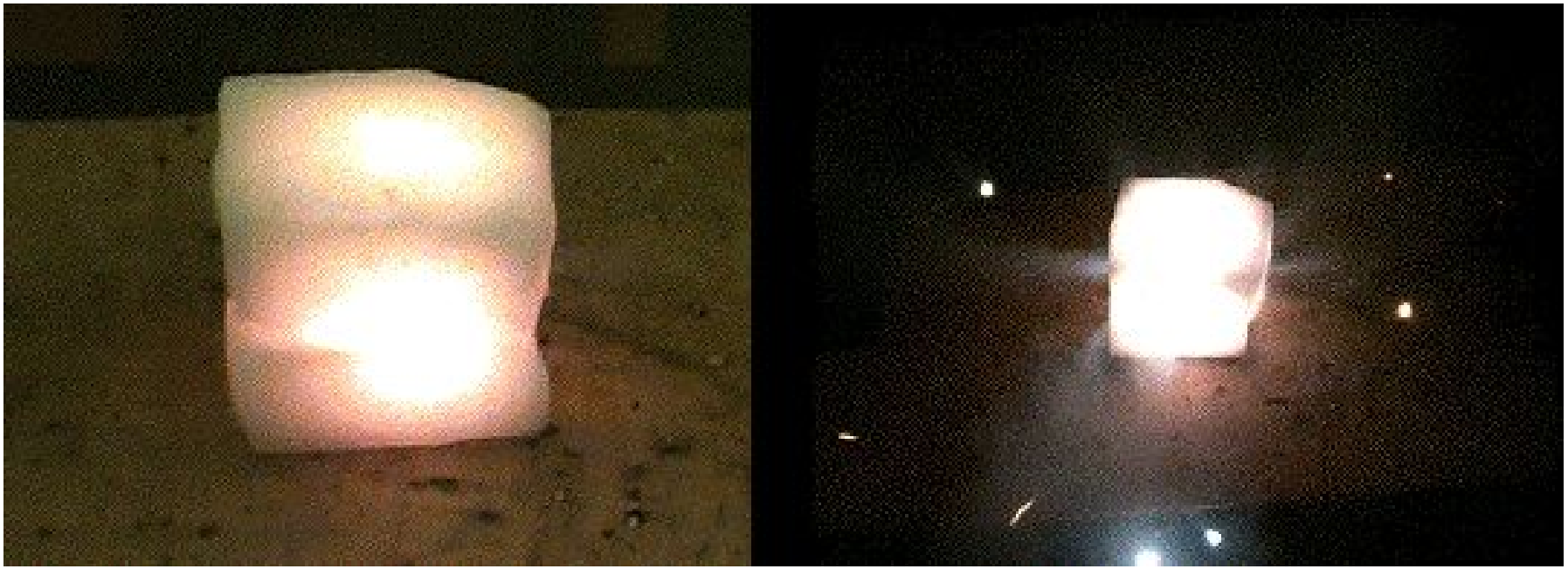
$$A + BC \rightarrow BA + C$$

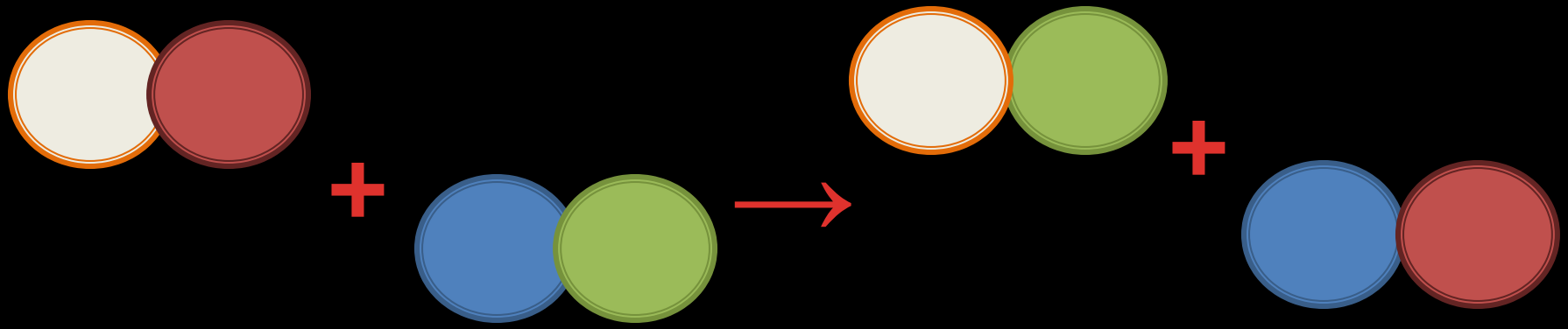
- *where A is a nonmetal*

Note: *This is the same general equation, it's just that metals only replace metals and non-metals only replace non-metals*

Example: Single Replacement Magnesium and carbon dioxide

- $Mg + CO_2 \rightarrow MgO + C$





Double Replacement Reaction

In this type of reaction, two compounds react to form two new compounds. The formation of a molecular compound such as water, the formation of a gas, or the formation of a precipitate usually drives these reactions.

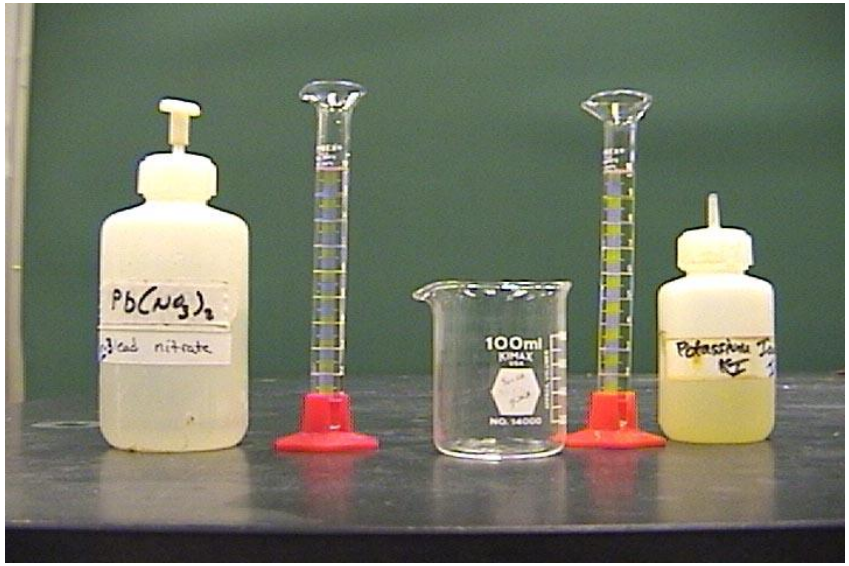
Here's the general equation:

$$AB + CD \rightarrow AD + CB$$

Note: "Metals" replace "metals" and non-metals replace non-metals

Example: Double Replacement
Potassium Iodide and Lead (II) Nitrate

- $KI_{(aq)} + Pb(NO_3)_{2(aq)} \rightarrow KNO_{3(aq)} + PbI_{(s)}$



Combustion Reaction

In this type of reaction, a hydrocarbon is burned in the presence of oxygen gas to form carbon dioxide and water. Here is the general equation in the presence of plenty of oxygen:

$$C_xH_y + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(aq) \text{ or } (g)}$$

Note: If combustion is inefficient (insufficient oxygen) then carbon monoxide is formed!

Example: Combustion
Burning Methane (Natural Gas)

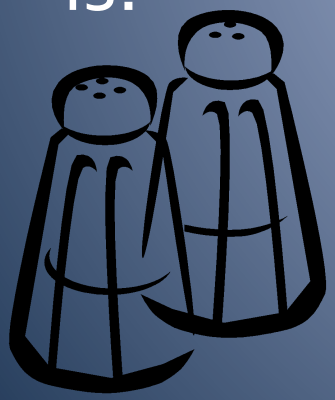
- $CH_4 + O_2 \rightarrow CO_2 + H_2O$

Neutralization Reactions

Unfortunately we cannot forget about neutralization reactions (a.k.a. acid-base reactions)! ☺

In this type of reaction, an acid and a base react to form a salt and water.

The general equation for this type of reaction is:



$$HA + BOH \rightarrow AB + H_2O$$

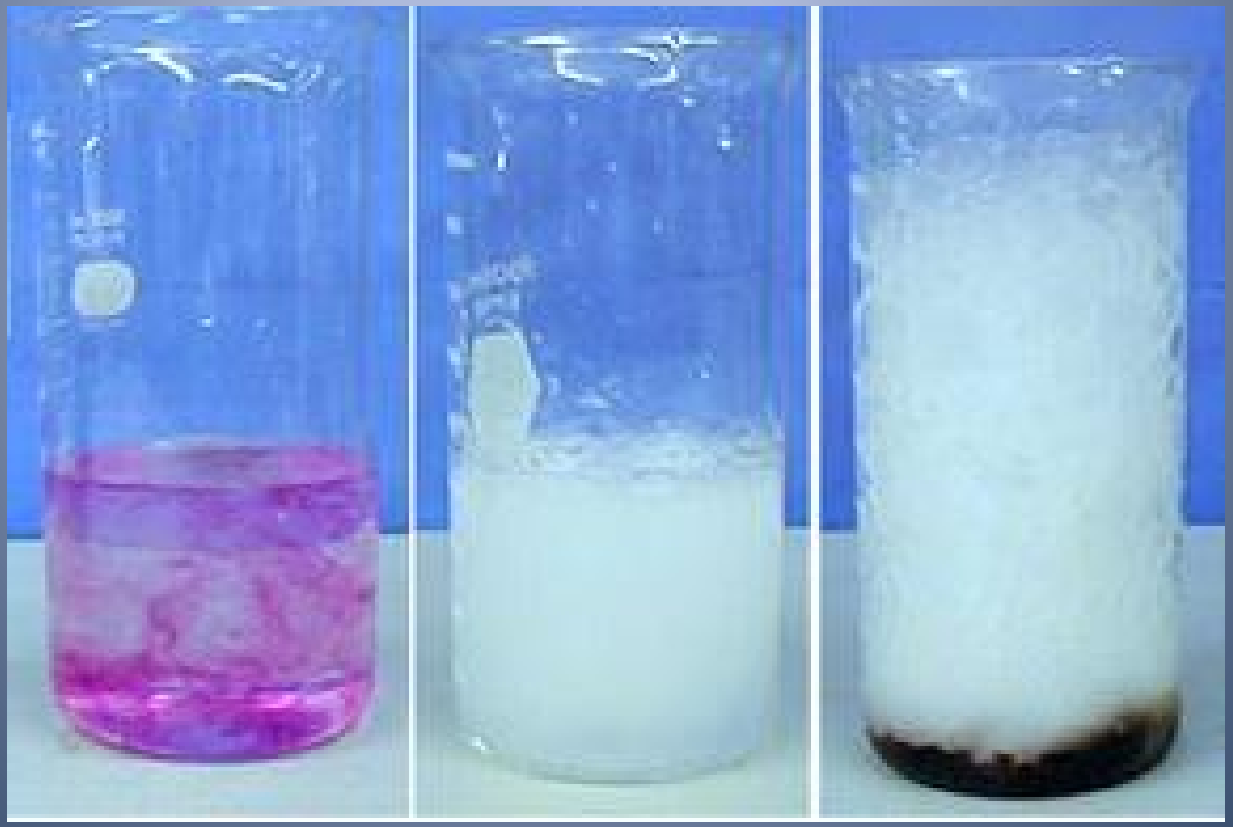
1. Classifying based on energy transfer

Endothermic vs. Exothermic

Reactions are classified by looking at whether energy is required or released during a chemical reaction:

1. EXOTHERMIC (*exo= outside*)- energy is released during a chemical reaction (i.e. is a product), given off as heat
2. ENDOTHERMIC (*endo= inside*)- energy is required during a chemical reaction (i.e. is a reactant), and heat is absorbed

Example of an Exothermic Reaction: Decomposition of H_2O_2



Example of an Endothermic Reaction:

The "Green" Cold pack— Ammonium Nitrate in Water