CHEMICAL EQUATIONS

VISUAL CHEM CARDS

Nigel Freestone

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The Anatomy of Chemical Equations

Chemical reactions occur everywhere.

Atoms of the **reactants** are rearranged to form the **products**.

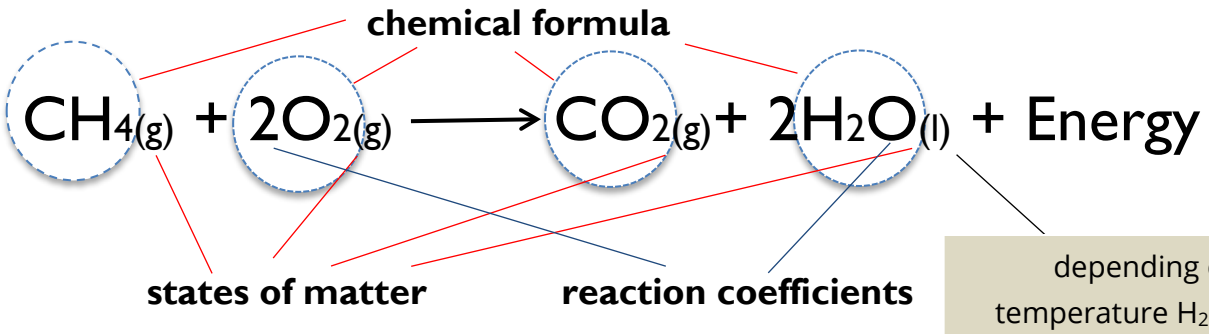
Reactant ⟶ Products

Chemical **reactions** normally occur because the products have less energy (more stable) than the reactants.

Chemical reactions can be represented in several ways.

Methane combusts in air to form carbon dioxide, water and lots of energy.

Methane + Oxygen ⟶ Carbon Dioxide + Water



depending on the temperature H_2O can be a liquid (l) or a gas (g)

Number of Atoms

Reactants vs products

1C	1C
4H	4H
4O	4O

Since they are the same the reaction is 'balanced'.

Matter is neither created nor destroyed, the atoms are simply rearranged by the breaking of bonds and the formation of new ones.

Chemical Equations

Methane + Oxygen ⟶ Carbon Dioxide + Water

$$CH_{4(g)} + 2O_{2(g)} \longrightarrow CO_{2(g)} + 2H_2O_{(l)} + \text{Energy}$$

Mass Balance

	$CH_{4(g)}$	+	$2O_{2\,(g)}$	⟶	$CO_{2\,(g)}$	+	$2H_2O_{\,(l)}$
Reaction Cofficients	1		2		1		2
M_r	16		32		44		18
Mass Balance	16	**80**	64		44	**80**	36

Stoichiometry - the quantitative relationships or ratios between two or more substances undergoing chemical change (chemical reaction).

The balanced equation tells us that:

- 1 molecule of CH_4 reacts with 2 molecules of O_2 to form 1 molecule of CO_2 and 2 molecules of H_2O
- 1 mole of CH_4 reacts with 2 moles of O_2 to form 1 mole of CO_2 and 2 moles of H_2O
- 16 g of CH_4 reactsts with 64 g of O_2 to form 44 g of CO_2 and 36 g of H_2O
- 1 g of CH_4 reacts with 4 (64/16) g of O_2 to form 2.75 (44/16) g of CO_2 and 2.25 (36/16) g of H_2O

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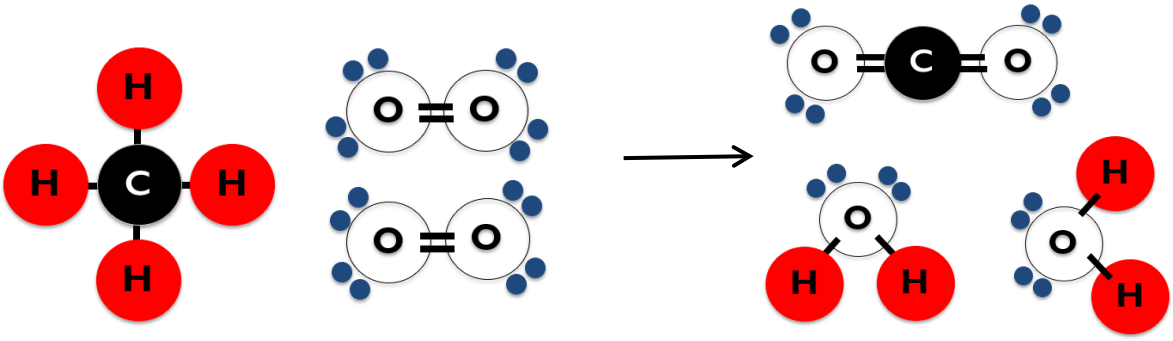


Reactants atoms are rearranged to form products.

Reactant bonds are broken – bonds are formed to form products.

4 C-H bonds and 2 O=O bonds are broken

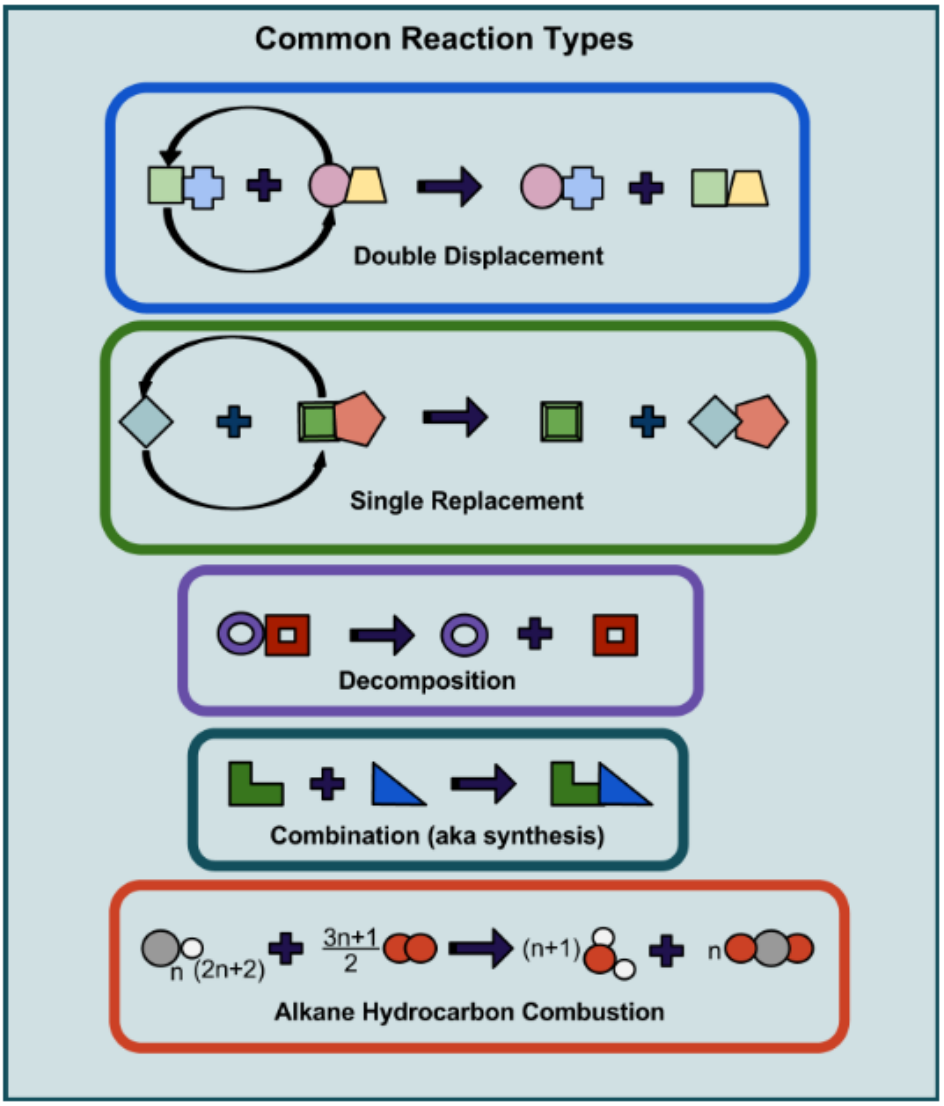
Consumes energy (Endothermic)

2C=O and 4O-H bonds are formed

Releases energy (Exothermic)

Energy of Reaction = Energy Consumed – Energy Released

Chemical Reaction Types



Reaction Type	Model	Example
Combination	A + B --> C	$3Ca(s) + N_2(g) \rightarrow Ca_3N_2$
Decomposition	A --> B + C	$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$
Single Replacement	A + BC --> B + AC A + BC --> C + BA	$Cu(s) + 2AgNO_3 \rightarrow 2Ag + Cu(NO_3)_2$ $Cl_2(g) + 2NaBr(aq) \rightarrow Br_2(l) + 2NaCl(aq)$
Double Replacement	AB + CD --> AD + CB	$Pb(NO_3)_2(aq) + 2KI(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$ $HCl(aq) + KOH(aq) \rightarrow KCl(aq) + H_2O(aq)$
Combustion	$C_xH_y + O_2 \rightarrow CO_2 + H_20$	$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$