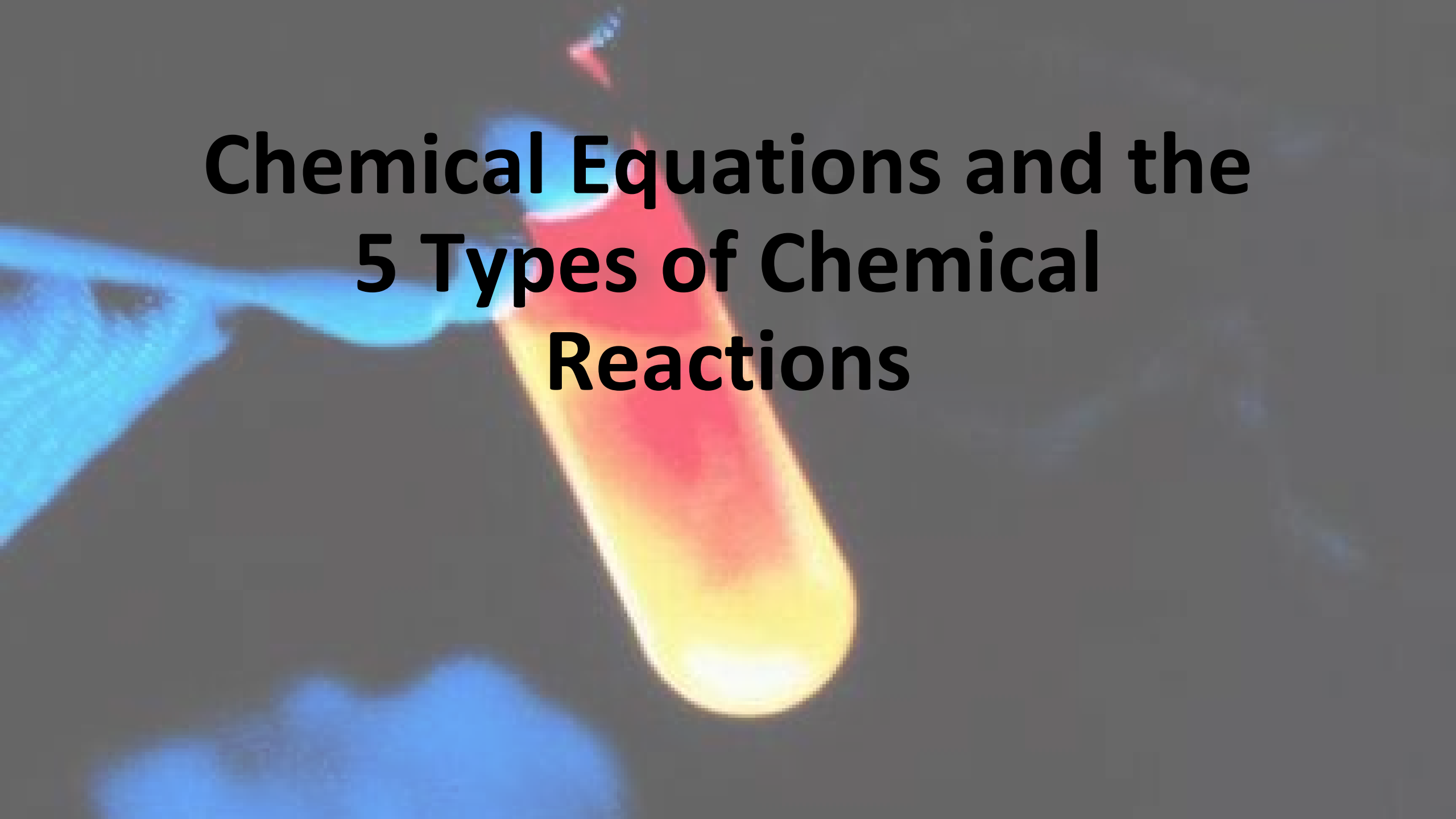
Welcome to

MR. Li ddell 's

3
6.939

Chem-is-try

classroom



Chemical Equations and the 5 Types of Chemical Reactions

Essential Question

Explain how to write, balance and identify the type of chemical equations to show all reactants, products and compound states.

hydrogen + oxygen = water

$H_2 + O_2 = H_2O$

$2H_2 + O_2 = 2H_2O$

Characteristics of Chemical Equations

A properly written chemical equation must contain:

1. Known facts – Correct element symbols, information from a verified source (periodic table)
2. Correct formulas for the reactants and products (use charges to create the correct formulas. Remember the 7 diatomic molecules
3. The law of conservation of mass must be satisfied – All chemical equations must be balanced.

Hydrogen	**H_2**
Nitrogen	**N_2**
Oxygen	**O_2**
Fluorine	**F_2**
Chlorine	**Cl_2**
Bromine	**Br_2**
Iodine	**I_2**

Exceptions are S_8, and P_4

Formula Equations

A formula equation is an equation in which the reactants and products are represented by symbols and formulas.

It has no qualitative meaning, until the equation is balanced.

Provide valuable information such as the number of moles or atoms of the elements or formulas contained in the equation.

Example

methane + oxygen →carbon dioxide and water

$CH_4(g) + O_2(g) \rightarrow CO_2(g) + H_2O(g)$ Unbalanced

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$ balanced

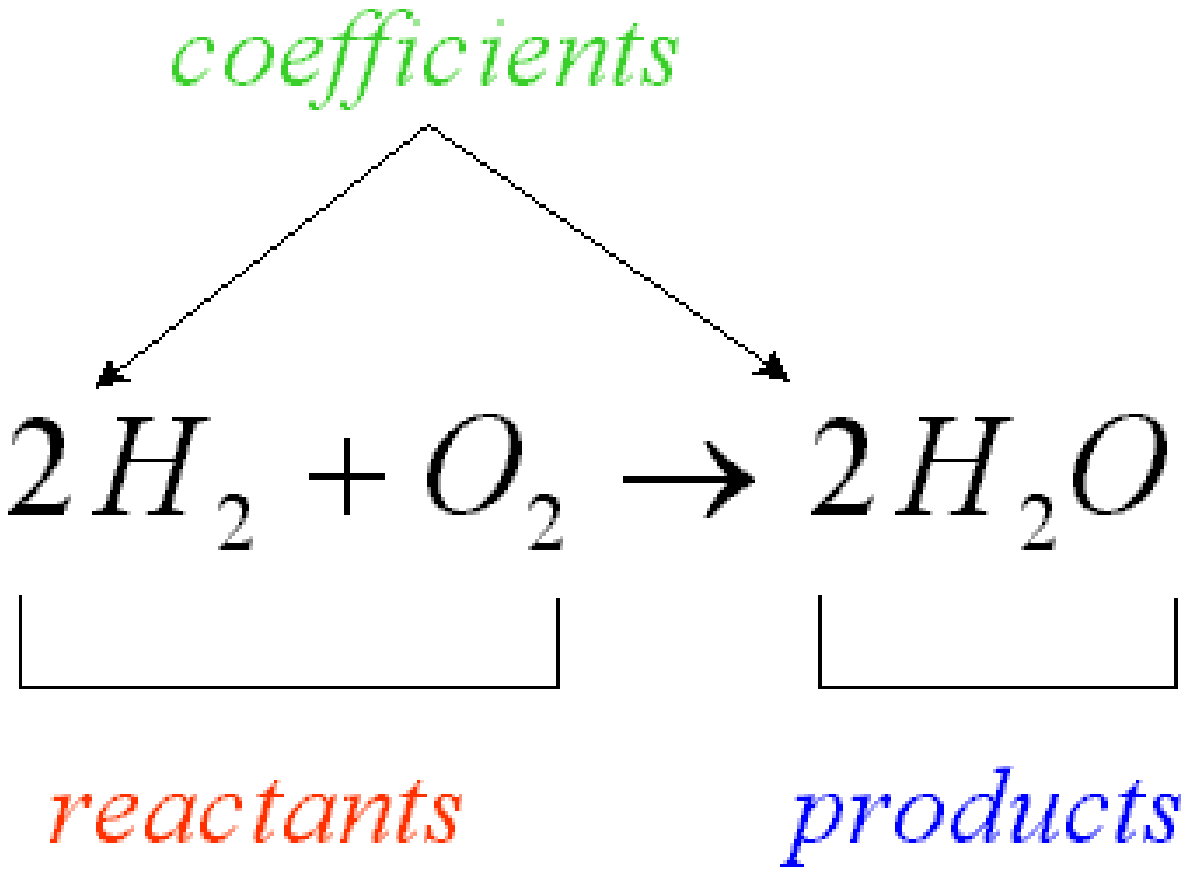
Symbols Used in Chemical Equations

TABLE 2 Symbols Used in Chemical Equations

Symbol	Explanation
$\longrightarrow$	"Yields"; indicates result of reaction
$\rightleftharpoons$	Used in place of a single arrow to indicate a reversible reaction
(s)	A reactant or product in the solid state; also used to indicate a precipitate
$\downarrow$	Alternative to (s), but used only to indicate a precipitate
(l)	A reactant or product in the liquid state
(aq)	A reactant or product in an aqueous solution (dissolved in water)
(g)	A reactant or product in the gaseous state
$\uparrow$	Alternative to (g), but used only to indicate a gaseous product
$\xrightarrow{\Delta}$ or $\xrightarrow{\text{heat}}$	Reactants are heated
$\xrightarrow{2\text{ atm}}$	Pressure at which reaction is carried out, in this case 2 atm
$\xrightarrow{\text{pressure}}$	Pressure at which reaction is carried out exceeds normal atmospheric pressure
$\xrightarrow{0^\circ\text{C}}$	Temperature at which reaction is carried out, in this case 0°C
$\xrightarrow{MnO_2}$	Formula of catalyst, in this case manganese dioxide, used to alter the rate of the reaction

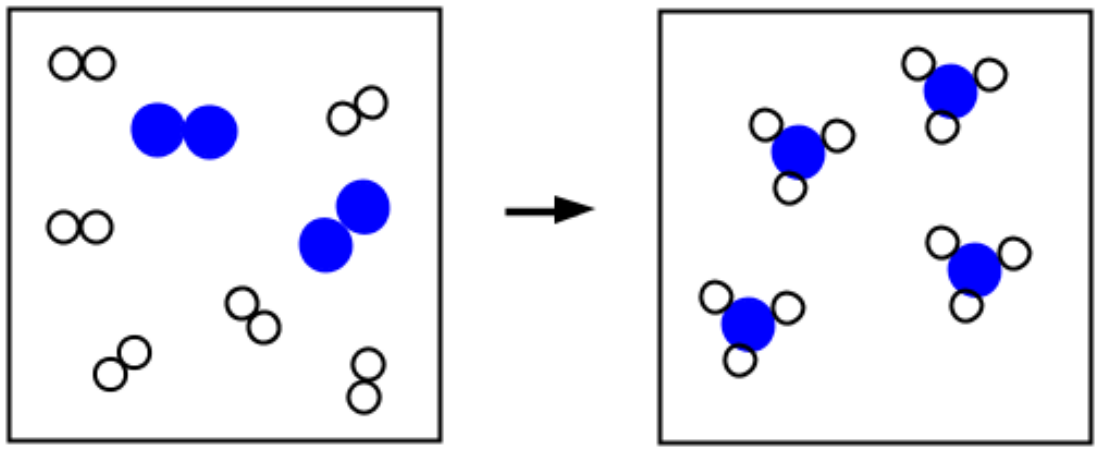
List can be found on page 266 of your textbook.

Balancing Chemical Equations



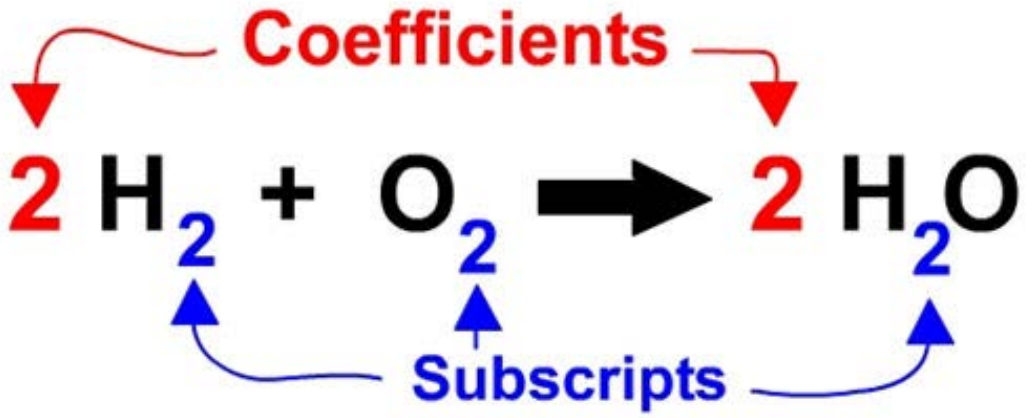
Law of Conservation of Mass

- All chemical equations must satisfy the law of conservation of mass
- Matter is neither created or destroyed
- In a chemical reaction matter is rearranged, but never destroyed.



Balancing a Chemical Equation

- The number of each type of atom must be equal on both sides of the equation
- Add or subtract coefficients when balancing chemical equations
- Never adjust subscripts when balancing chemical equations



Steps to Balancing a Chemical Equation

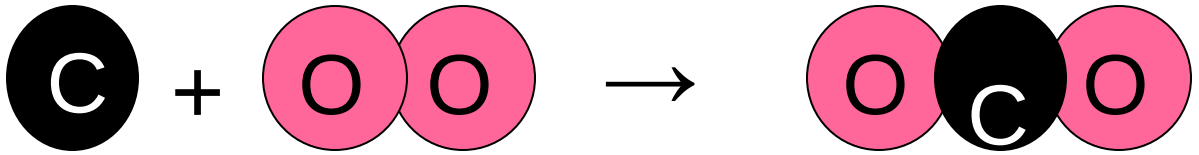
1. Start with the largest compound
2. Balance each element one at a time
3. Polyatomic ions should be balanced as a unit if they appear in ***both sides of the equation***
4. Try to balance H's and O's last as they appear in most compounds and may be balanced as a result of balancing other elements.

Figure 1: *Types of chemical reactions*

5 Types of Chemical Reactions

1. Synthesis/ Composition/Combination

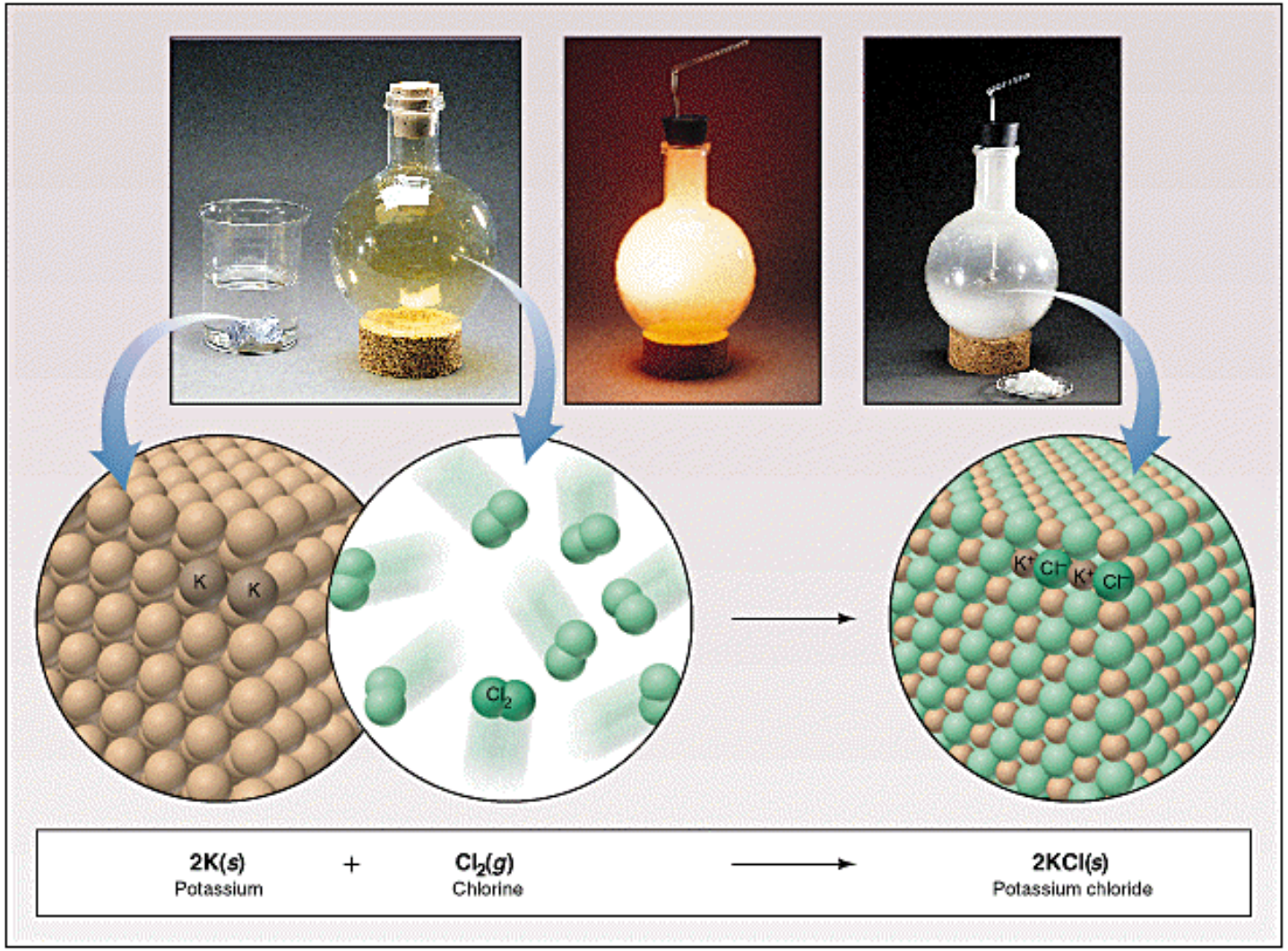
Example $C + O_2$



Synthesis Reaction: Two or more elements/compounds combine to form a more complex product.

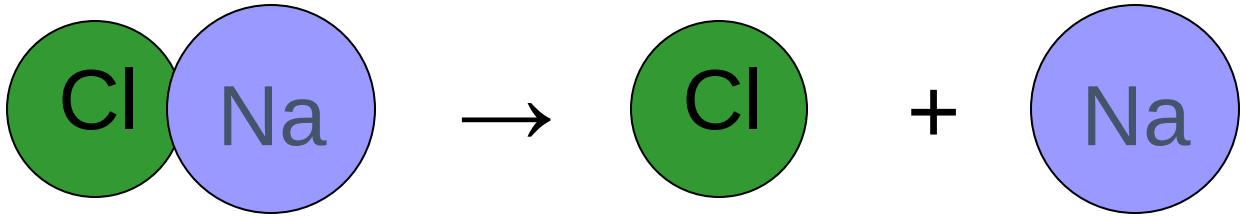
General: $A + B \rightarrow AB$

Ex. Synthesis Reaction



2. Decomposition

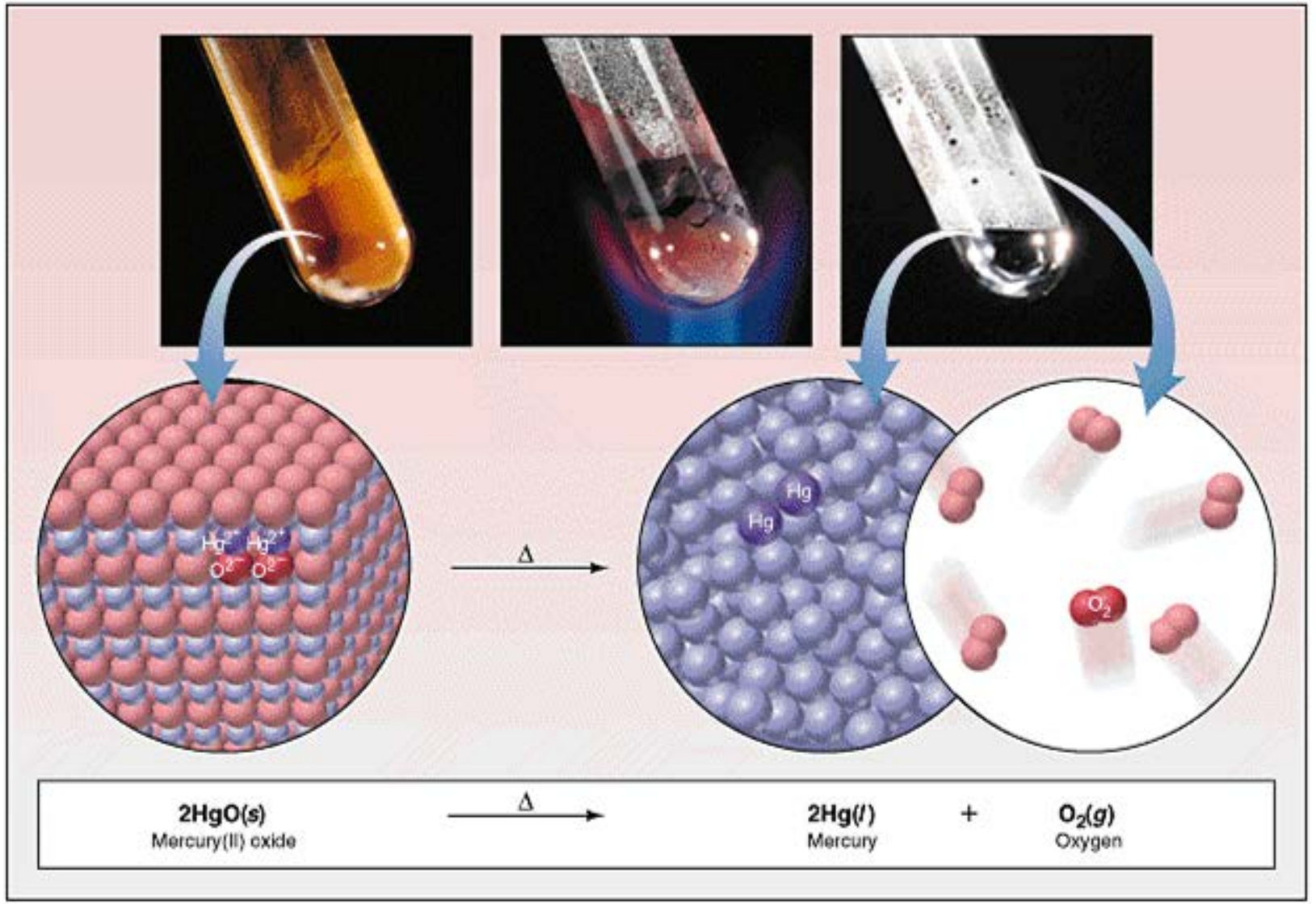
Example: NaCl



Decomposition Reaction: One chemical species breaks down to simpler elements/compounds.

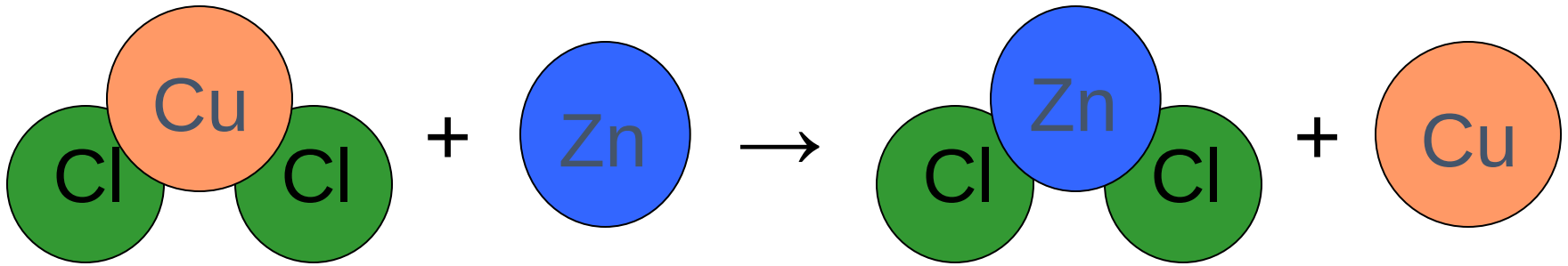
General: $AB \rightarrow A + B$

Ex. Decomposition Reaction



3. Single Displacement

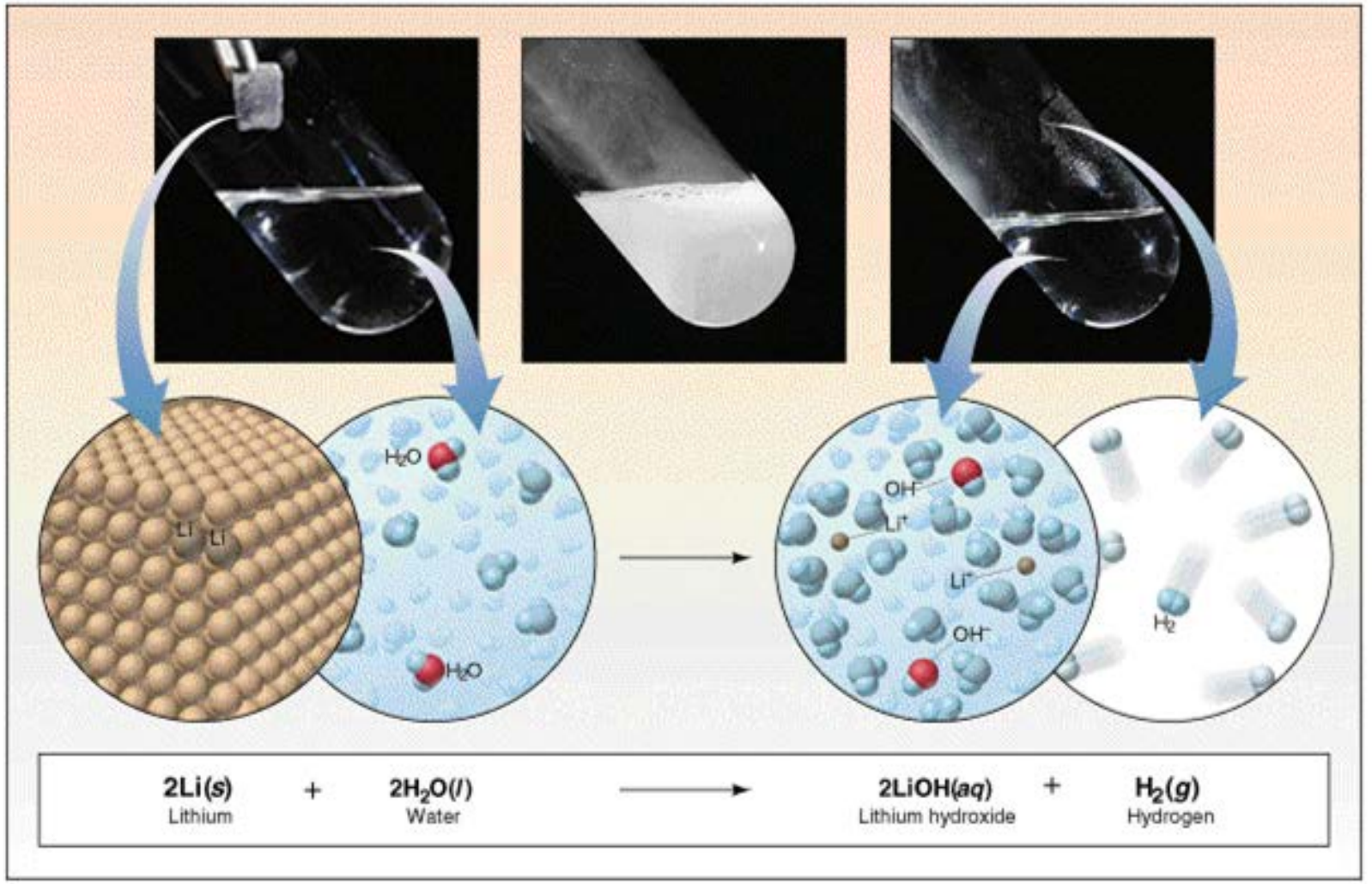
Example: $Zn + CuCl_2$



Single Replacement Reaction: An uncombined element replaces a less reactive element in a compound, creating a new compound and a single element.

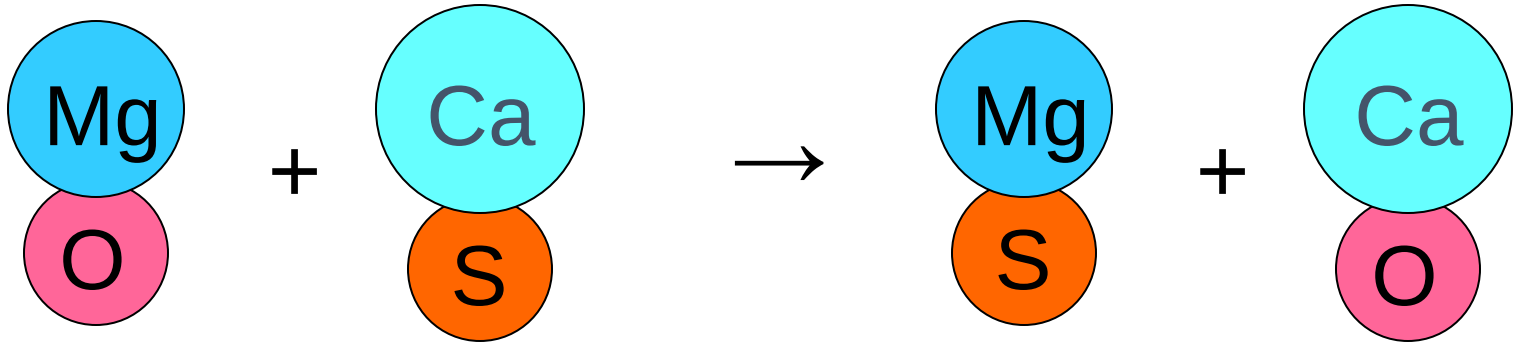
General: $AB + C \rightarrow AC + B$

Ex. Single Replacement Reaction



4. Double displacement

Example: MgO + CaS



Double Replacement Reaction: Involves two ionic compounds (in solution) that trade cations, creating two new compounds.

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

5. Combustion Reactions

Hydrocarbon + Oxygen → Carbondioxide and Water

Always

$CH + O_2 \rightarrow CO_2 + H_2O$

Combustion Reaction: A hydrocarbon (or other organic molecule) burning in oxygen, producing carbon dioxide and water.