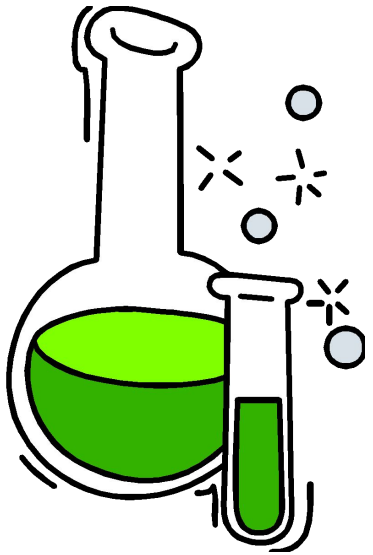
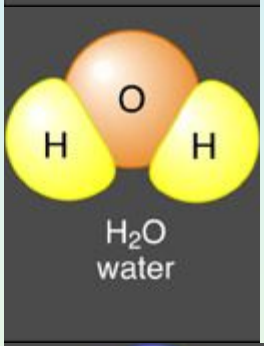
CHEMICAL REACTIONS & EQUATIONS

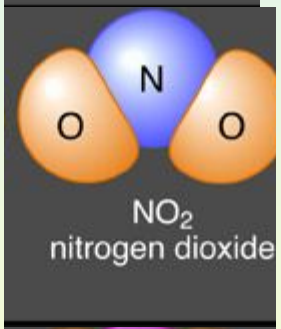


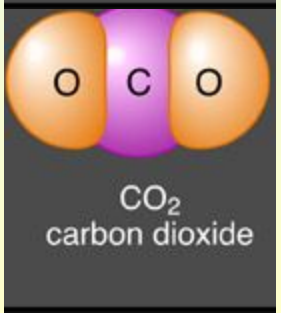
But First a Quick Review…

Elements

- Elements are pure substances
  - made of only one kind of material
  - has definite properties
  - is the same all throughout
- They cannot be broken down into simpler substances without losing their identity
- Represented by a symbol (Au,Na)
- They’re on the periodic table!







Compounds

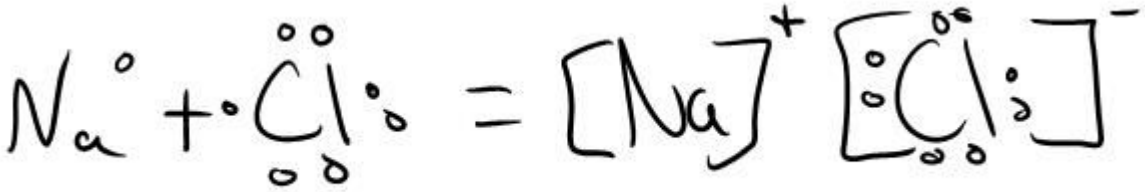
- Made up of *2 or more different elements* that are *chemically combined*.
- They are represented by formulas
  - **Ex:** H_2O, NaCl, $C_6H_{12}O_6$, CO_2
- Compounds have different properties than their original elements
- They cannot be separated by physical means
- Unlike elements, compounds can only be broken down to simpler substances through a chemical reaction

Compounds

- The properties of the elements that make up a compound are often quite different from the properties of the compound itself

  - Sodium – Na = highly reactive metal
  - Chlorine – Cl = poisonous gas

Sodium Chloride = NaCl (table salt)



NaCl- Sodium Chloride (salt)

Mixtures

- Mixtures - two or more substances that are physically combined and retain the properties of their substances
  - Mixture of elements – brass (mixture of copper and zinc)
  - Mixture of elements and compounds – air
  - Mixture of compounds – sand, saltwater
  - Solution – particles are evenly distributed

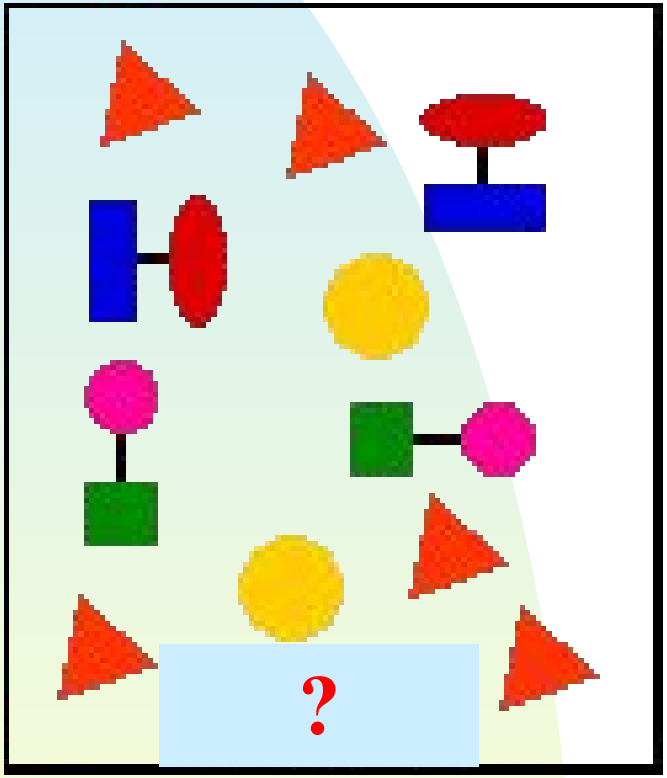
Types of Mixtures

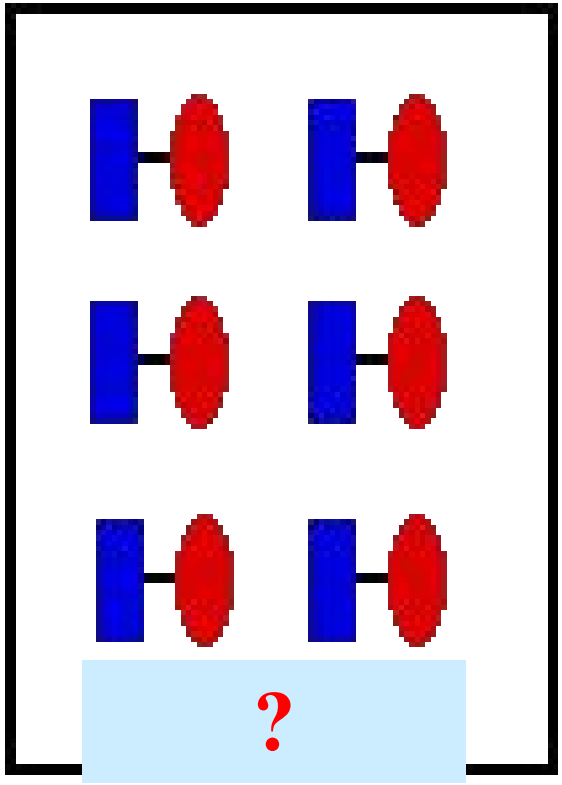
- **Homogeneous** - Entire mixture looks the **same** throughout
  - Ex. Milk, Bronze

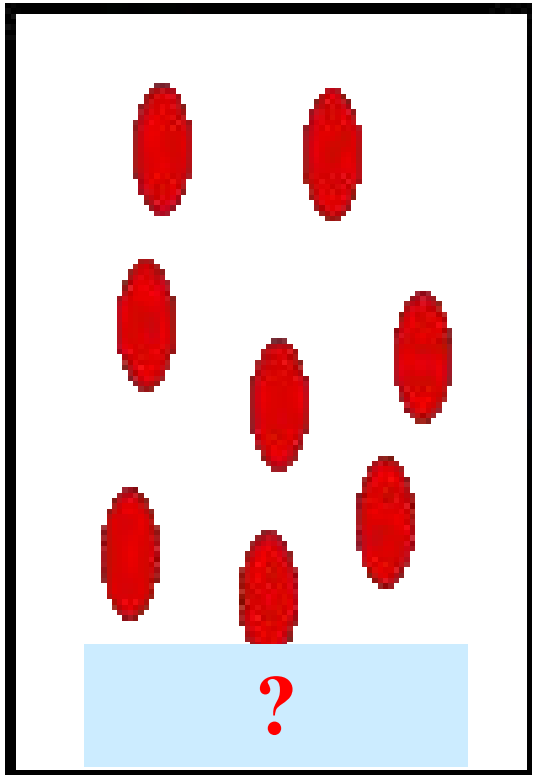
- **Heterogeneous** – Parts of the mixture look **different**
  - Ex. Fruit Salad, Trail Mix

Both types of mixtures can be separated by a physical change!

Element, Compound, or Mixture







Quick Check

Element, Compound, or Mixture?

Element 1. Platinum Pt

Compound 2. Carbon Dioxide CO_2

Mixture 3. Air O_2, N_2, and Ar

Mixture 4. Brass Alloy of Cu and Zn

Compound 5. Glucose $C_6H_{12}O_6$

Molecules

- **A molecule is two or more atoms chemically bonded**
  - Water - 2 atoms of hydrogen and one atom of oxygen (together they form one molecule of H_2O)

- **All compounds are molecules but not all molecules are compounds**
  - H_2 is a molecule, but not a compound
  - H_2O is both a molecule and a compound (notice the 2 <u>different</u> elements)

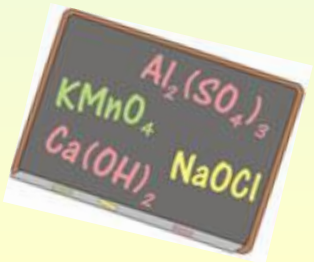
Quick Check

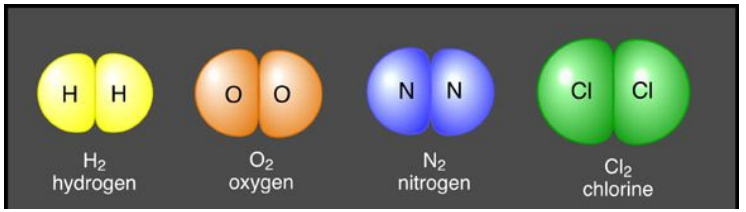
Which substances are molecules and which substances are both molecules and compounds?

Molecule	1. O_2
Both	2. CO_2
Both	3. $C_6H_{12}O_6$
Molecule	4. Cl_2
Both	5. NH_3

Chemical Formulas

- **Chemical Formulas** - a shorthand way of representing compounds
  - If chemical symbols are the “letters,” these are the “words.”
    - **Ex:** NH_3 = ammonia, C_3H_7OH = rubbing alcohol
- Sometimes, the formula represents a molecule of a single element.
  - These are called diatomic molecules. This is how that element is naturally found.
    - O_2-Oxygen H_2-Hydrogen Cl_2-Chlorine





Let's Break it Down

Formula for Photosynthesis:

$6CO_2 + 6H_20 + \text{energy from sunlight} \longrightarrow C_6H_{12}O_6 + 6O_2$

CO_2 = Carbon Dioxide

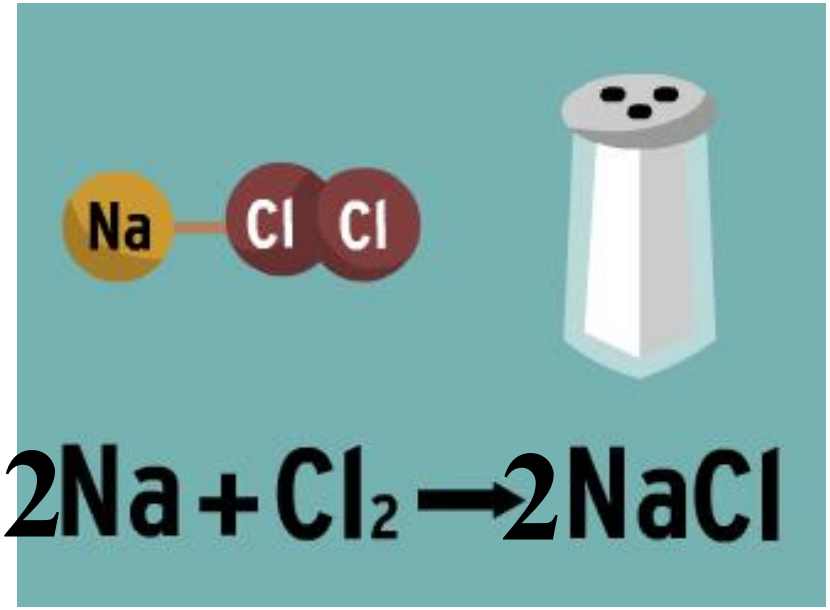
H_20 = Water

$C_6H_{12}O_6$ = Glucose

O_2 = Oxygen

Chemical Equations

A chemical equation is a symbolic representation of a chemical reaction



Equation Example:

The burning of methane gas in oxygen is:

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

Chemical Formulas - Subscripts

- Subscripts are small numbers used in chemical formulas
- Shows the elements & number of atoms of each element in a molecule
- H_2SO_4 ← **subscript** ← Draw this example

Element Totals:

Hydrogen; **2** atoms

Sulfur: **1** atom

Oxygen: **4 a**toms

7 atoms total

Coefficients

- A formula may begin with a number
- If there is no number, then “1” is understood to be in front of the formula.
  - **This number is called the coefficient**
  - The **coefficient** represents the number of **molecules** of that compound or atom needed in the reaction
  - For example:
    - $2H_2SO_4$ – 2 molecules of Sulfuric Acid

Coefficient →

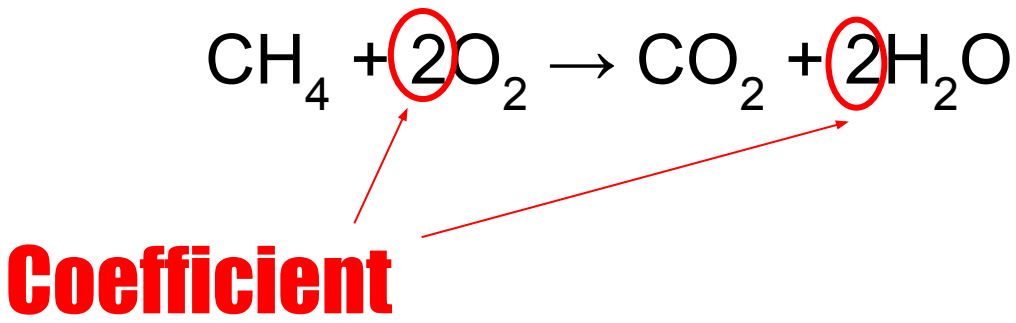
Draw this example

Coefficients

- $2H_2SO_4$ - this means 2 molecules of Sulfuric Acid
  - A coefficient is distributed to **ALL** elements in a compound
    - 2 H_2 (for a total of **4** H atoms)
    - 2S (for a total of **2** S atoms)
    - $2O_4$ (for a total of **8** O atoms)

Reading Chemical Equations

- Each side of an equation represents a combination of chemicals
- The combination is written as a set of chemical formulas, separated by **+** symbols.



The equation for the burning of methane gas in oxygen is:

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

Subscript

Shows # of atoms

Coefficient

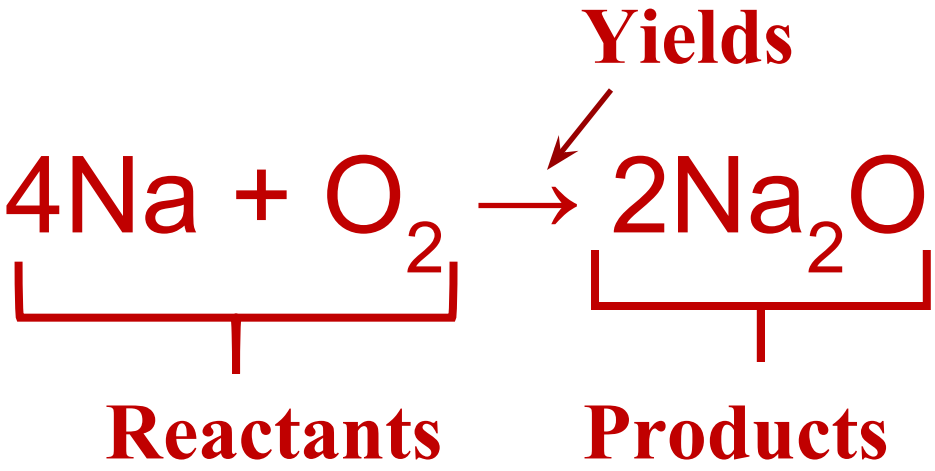
Shows # of molecules

Reading Chemical Equations

- The two sides of the equation are separated by an arrow
  - **Reactants** - the combination of chemicals ***before*** the reaction are on the left side of the arrow
  - **Products** - the right side indicates the combination of chemicals ***after*** the reaction

Language of Chemical Equations

- **Reactants**
- Arrow **(yields)**
- **Products**



- In this reaction, sodium (**Na**) and oxygen ($\mathbf{O_2}$) react to produce a single molecule, $\mathbf{Na_2O}$

Language of Chemical Equations