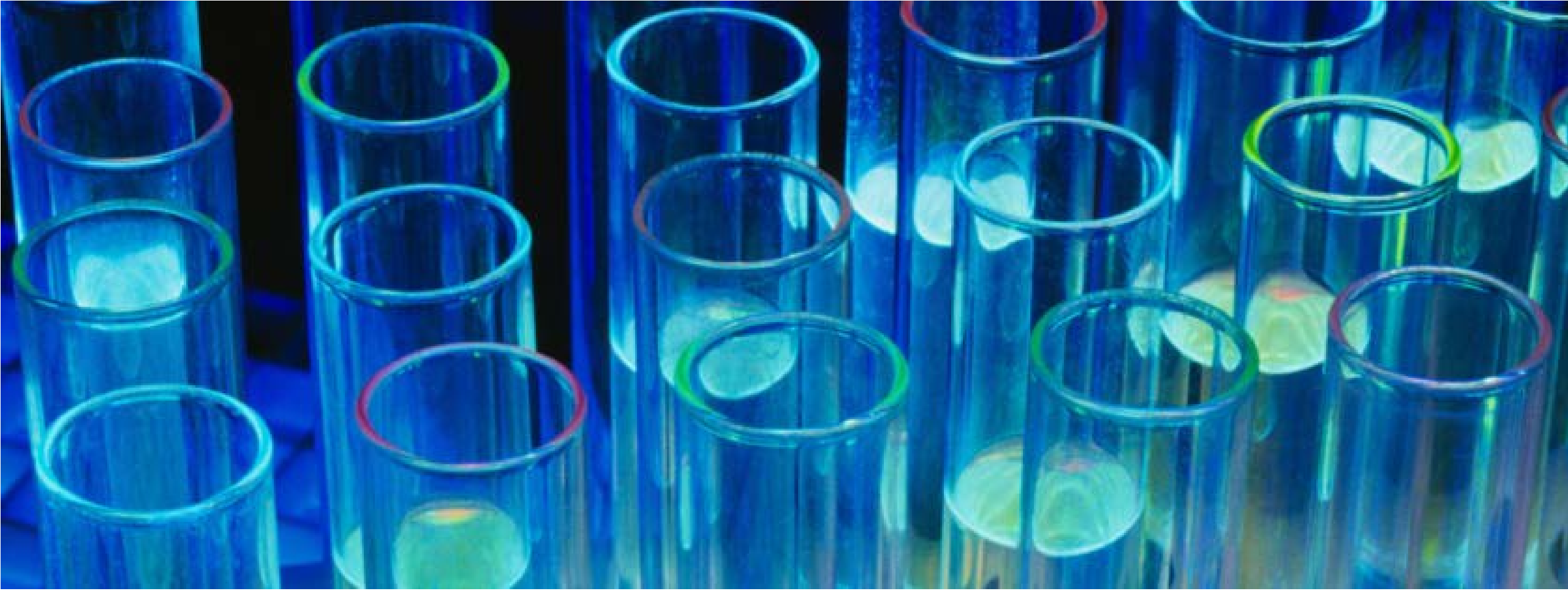


Balancing Chemical Equations

Created by Gbaker www.thesciencequeen.net

Balancing Equations

- Chemical reactions occur when bonds (between the electrons of atoms) are formed or broken
- Symbols represent elements
- Formulas describe compounds
- Chemical equations describe a chemical reaction.

Chemical Equations

A chemical equation is written as an expression similar to a mathematic equation that can be compared to a recipe that a chemist follows in order to produce desired results.

Chemical Equations

- A chemical equation represents the changes that occur during a chemical reaction. A chemical equation has the general form:

Reactants → Products

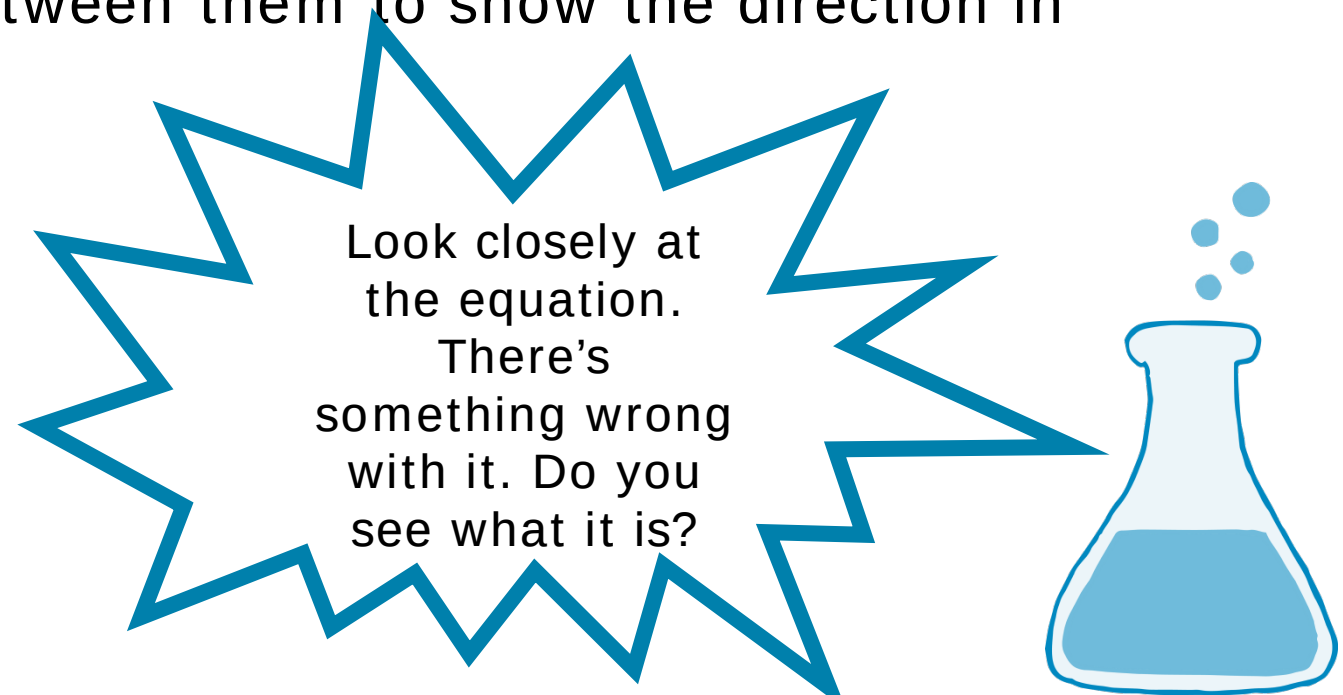
substances that are present before the chemical change takes place

signifies the actual change. A reaction arrow separates the reactants from the products

substances that are formed during the chemical change

Example Simple Chemical Reaction

- Hydrogen (H_2) and Oxygen (O_2) combine to produce water (H_2O).
- In this reaction, the reactants are hydrogen and oxygen and the product is water. To write the chemical equation for this reaction, you would start by writing the reactants on the left and the product on the right, with an arrow between them to show the direction in which the reaction occurs:
- $H_2 + O_2 \rightarrow H_2O$



Balance must be achieved...

Equation :

$H_2 + O_2 \rightarrow H_2O$

All chemical equations must be balanced. This means that there must be the same number of each type of atom on both sides of the arrow. That's because mass is always conserved in chemical reactions.

Count the number of hydrogen and oxygen atoms on each side of the arrow.

There are two hydrogen atoms in both reactants and products. There are two oxygen atoms in the reactants but only one in the product.

Therefore, the equation is not balanced.

Enter the Coefficients

- Coefficients are used to balance chemical equations.
  - A coefficient is a number placed in front of a chemical symbol or formula.
  - It shows how many atoms or molecules of the substance are involved in the reaction.
    - Ex: two molecules of hydrogen would be written as 2 H_2, and two molecules of water would be written 2 H_2O.
- A coefficient of 1 usually isn't written.

Enter the Coefficients

- Coefficients can be used to balance our equation $H_2 + O_2 \rightarrow H_2O$
  - $2\ H_2 + O_2 \rightarrow 2\ H_2O$
- The equations shows that two molecules of hydrogen react with one molecule of oxygen to produce two molecules of water. The two molecules of hydrogen each contain two hydrogen atoms and so do the two molecules of water. Therefore, there are now four hydrogen atoms in both reactants and products.
- **Q:** Is the equation balanced?
- **A:** Count the oxygen atoms to find out. There are two oxygen atoms in the one molecule of oxygen in the reactants. There are also two oxygen atoms in the products, one in each of the two water molecules.

Steps in Balancing a Chemical Equation

- Balancing a chemical equation involves a certain amount of trial and error. In general, however, you should follow these steps:

  1. Count each type of atom in reactants and products. Does the same number of each atom appear on both sides of the arrow? If not, the equation is not balanced, and you need to go to step 2.

  2. Place coefficients, as needed, in front of the symbols or formulas to increase the number of atoms or molecules of the substances. Use the smallest coefficients possible.

  3. Warning! Never change the subscripts in chemical formulas. Changing subscripts changes the substances involved in the reaction. Change only the coefficients.

- Repeat steps 1 and 2 until the equation is balanced.

Practice Time

- Balance this chemical equation for the reaction in which nitrogen (N_2) and hydrogen (H_2) combine to form ammonia (NH_3):

$$\overset{2}{N_2} + H_2 \rightarrow \quad \overset{2}{2}NH_3$$

1. Count the nitrogen atoms on both sides of the arrow.
2. How do we make them BALANCED?

   (Add a coefficient!)

Practice Time

- Is it balanced yet? – No…

$$N_2 + 3H_2 \rightarrow 2NH_3$$

(2 times H_3 = 6)

Now count the hydrogen atoms on both sides of the arrow.

There are six hydrogen atoms in the products so there must also be six in the reactants.

Place the coefficient 3 in front of H2 to balance hydrogen

Practice Time

- Balance this chemical equation for the reaction in which nitrogen (N_2) and hydrogen (H_2) combine to form ammonia (NH_3):

$$N_2 + H_2 \rightarrow NH_3$$