Single & Double Displacement

What is "displacement"?

- it's an exchange/replacement with something else

These two types of reactions occur with *ionic compounds*.

Remember Ionic Compounds

- Ionic compounds combine a metal with a nonmetal, and the *metal always comes first*
- Ionic compounds dissolve in water & separate

In displacement reactions only metals can displace metals and only nonmetals can displace nonmetals. This is due to the charge of their outer orbit/valence.

Hydrogen is unusual **because it's a nonmetal, but carries a positive charge, so it can displace (and be displaced) by *metals*.**

Single Displacement

- Only ONE element or polyatomic ion is displaced.

$$AB + N \rightarrow AN + B$$

AND/OR

$$AB + M \rightarrow MB + A$$

In these generic equations, A & M are metals, and B & N are nonmetals.

Single Displacement

Example 1:

$$Br_2 + CaI_2 \rightarrow CaBr_2 + I_2$$

N AB AN B

bromine displaces the other nonmetal, iodine

Example 2:

$$Mg + 2AgNO_3 \rightarrow 2Ag + Mg(NO_3)_2$$

M AB A MB

magnesium displaces the other metal, silver

Double Displacement

What do you think will happen?

$$AB + MN \rightarrow AN + MB$$

- 2 elements or polyatomic ions will be displaced (often, they are exchanged for one another)

Example:

$$Pb(NO_3)_2 + 2KI \rightarrow PbI_2 + 2KNO_3$$

AB MN AN MB

Double Displacement

In double displacement reactions, two things can occur:

1. **an acid reacts with a base to produce a salt and water**
2. **a solid/precipitate forms in the solution (turns cloudy or actual particles form)**

Double Displacement

Terminology:

- ("g") for "gas"
- ("l") for "liquid"
- ("aq") for "aqueous", meaning in water solution
- ("s") for "solid" when a precipitate forms

Our Example:

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

In Conclusion…

- Displacement reactions occur in ionic compounds
- Metals switch with metals or other positively-charged ions (like hydrogen)
- Nonmetals switch with nonmetals or other negatively-charged ions
- Single displacement involves a compound and an element
- Double displacement involves two compounds