Examples of acid-base chemistry:

When a neutralization reaction occurs, energy is released. There will be a temperature increase!

$$H_2SO_4(aq) + 2NaOH(aq) \longrightarrow 2H_2O(l) + Na_2SO_4(aq)$$

H^+ SO_4^{2-} Na^+ OH^-

Potential products:

H^+ OH^- → H_2O

Na^+ SO_4^{2-}, Na^+ → Na_2SO_4

Why "neutralization?

*The products of the reaction (water and a "salt") do not have any of the characteristic properties of acids and bases. These properties can be said to be "neutralized".

$$HCl(aq) + NH_4OH(aq) \longrightarrow H_2O(l) + NH_4Cl(aq)$$

H^+ Cl^- NH_4^+ OH^-

DOUBLE REPLACEMENTS THAT FORM GASES

1. Formation of hydrogen sulfide: H_2S

- need an ACID (source of hydrogen ion) and a SULFIDE

$$H_2SO_4(aq) + Na_2S(aq) \longrightarrow Na_2SO_4(aq) + H_2S(g)$$

H^+ SO_4^{2-} Na^+ S^{2-}

H^+ S^{2-} | H_2S

H^+

Na^+ SO_4^{2-} | Na_2SO_4

Na^+

Gas with rotten-egg odor!

Observation: Odor and visible gas bubbles

2. Formation of carbonic acid and carbon dioxide:

$$H_2CO_3(aq) \longrightarrow H_2O(l) + CO_2(g)$$

- to form carbonic acid by double replacement, you need a source of hydrogen ion (ACID) and a source of carbonate (can be CARBONATE or BICARBONATE)

CO_3^{2-} HCO_3^-

Example of a reactions that forms carbonic acid, then gas: The "baking soda volcano"!

VINEGAR

BAKING SODA

$2HC_2H_3O_2(aq) + Na_2CO_3(aq) \longrightarrow 2NaC_2H_3O_2(aq) + H_2CO_3$

H^+ $C_2H_3O_2^-$ Na^+ CO_3^{2-} $NaC_2H_3O_2$ H_2CO_3

... but carbonic acid decomposes, and we get GAS BUBBLES

$$2HC_2H_3O_2(aq) + Na_2CO_3(aq) \longrightarrow 2NaC_2H_3O_2(aq) + H_2O(\ell) + CO_2(g)$$

This is the overall process. We show carbon dioxide and water as products, since we want to show the reaction as it's actually observed -with carbonic acid broken down to water and (gaseous) carbon dioxide.