



Chemical Reactions



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Types of Chemical Reactions

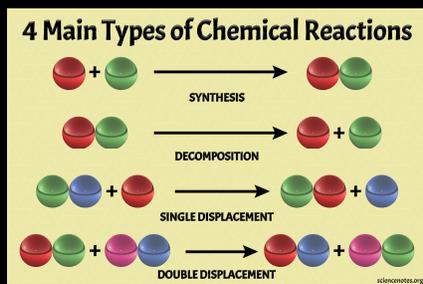
Knowledge of types useful for:

Predicting products from starting materials

Estimating starting materials from analyzed products

Evaluating potential health/safety issues

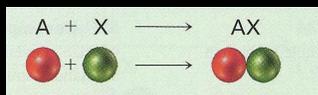
**Focus on type recognition (pattern recognition),
NOT individual reactions**



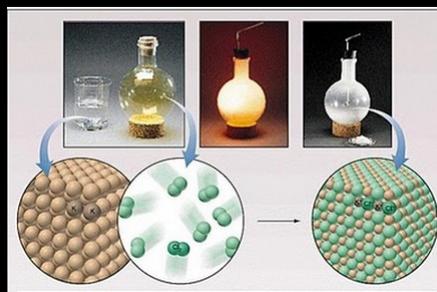
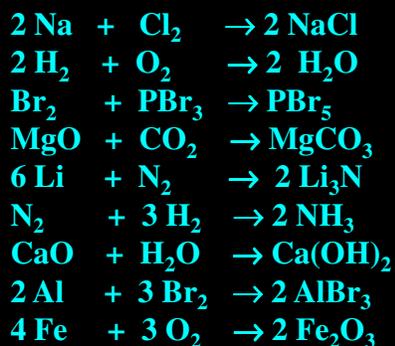
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Combination (Synthesis) Reactions



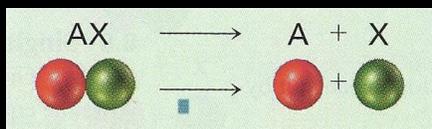
2 or more substances combine to form 1 single product



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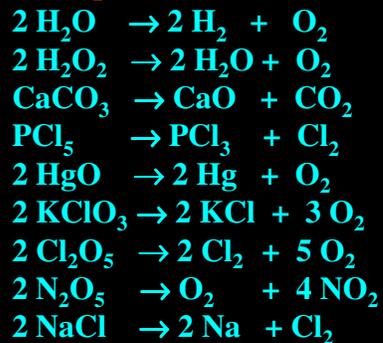
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Decomposition Reactions



Opposite of combination reaction

1 compound breaks down into simpler substances



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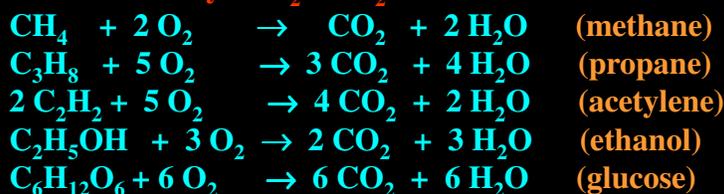
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Burning or Complete Combustion



One reactant is organic (contains C & H; sometimes N & O)
Other reactant is always O₂

Products are always CO₂ + H₂O

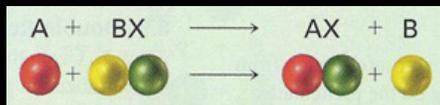


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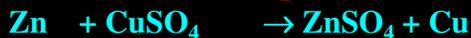
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Single Replacement (Displacement)



One free element replaces another element
Reactant & Product side have different free element

Metal replaces another Metal



Metal replaces Hydrogen



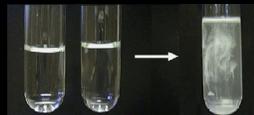
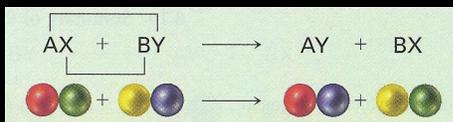
Non-Metal replaces another Non-Metal



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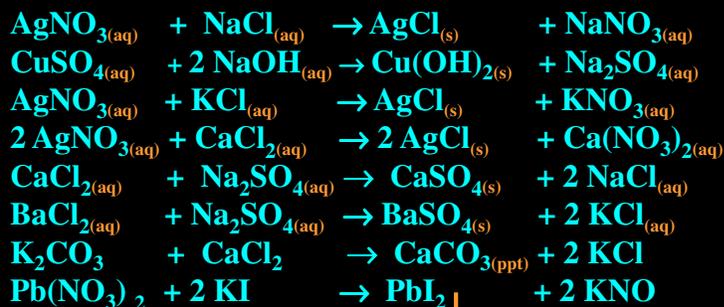
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Double Replacement (Displacement) Reactions



Precipitation

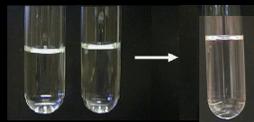
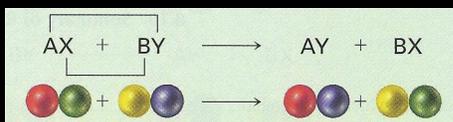
Precipitation: (+) and (-) ions switch partners ; AY insoluble



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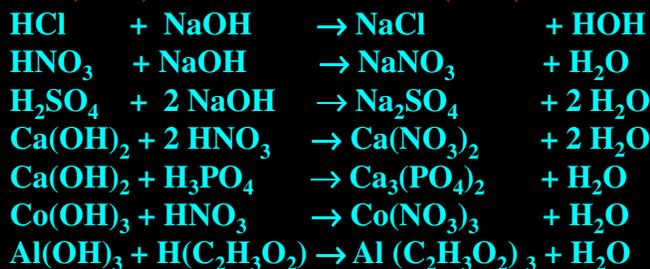
Double Replacement (Displacement) Reactions



Neutralization Heat Evolved

Neutralization Reactions:

H^+ (Acid) combines with OH^- (Base) to form HOH (H_2O)

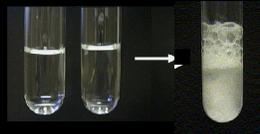
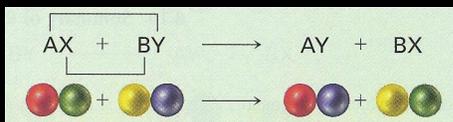


Salt = product of acid & base

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Double Replacement (Displacement) Reactions



Gas Forming:

(+) and (-) ions switch partners; **BX** Breaks down to a gas

Gas Forming



Other Common Gases Evolved



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Summary of Types of Reactions and Equations

Reactants	Reaction Type	Equation Type	Products
Any combination of elements and compounds that form one product	Combination	$A + X \longrightarrow AX$ Red-Green \longrightarrow Red-Green	One compound
One compound	Decomposition	$AX \longrightarrow A + X$ Red-Green \longrightarrow Red + Green	Any combination of elements and compounds
Element + ionic compound or acid	Single-replacement	$A + BX \longrightarrow AX + B$ Red + Yellow-Green \longrightarrow Red-Green + Yellow	Element + ionic compound
Solutions of two compounds, each with positive and negative ions	Double-replacement	$\boxed{AX + BY} \longrightarrow AY + BX$ Red-Green + Yellow-Purple \longrightarrow Red-Purple + Yellow-Green	Two new compounds, which may be a solid, water, an acid, or an aqueous ionic compound

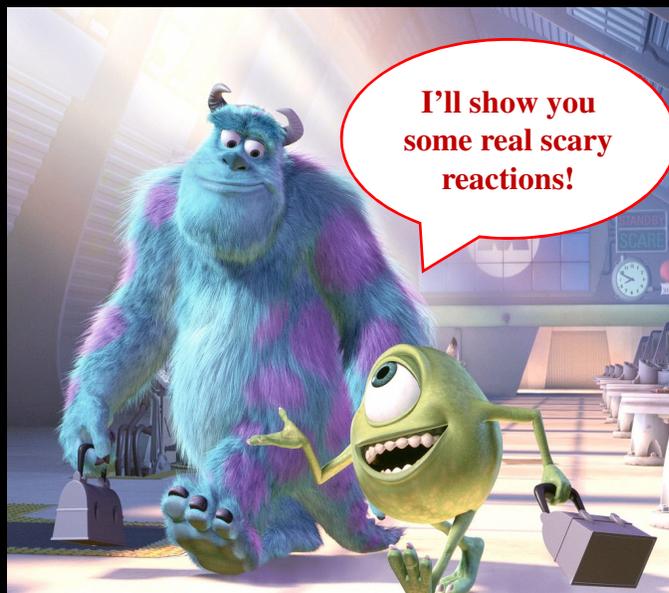
Fuel + Oxygen



CO₂ + H₂O

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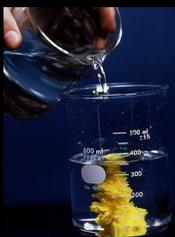


I'll show you
some real scary
reactions!



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Chemical Reactions Lab



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Reactions Lab

Purpose:

observe a number of chemical reactions
note the signs that a chemical change has occurred,
classify chemical reactions, and
communicate chemical changes



Procedure:

The lab is a combination of instructor demos and student run reactions
The data is the observations
The data is already provided for you since this is a virtual class.

All you need to do to complete and balance the listed chemical reactions

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Combination Reactions

Metals + Oxygen reactions can be quite hot!



Lighting Mg



Thermite - Welder



Sparklers



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Decomposition Reaction

Hydrogen Peroxide



Oxygen kills anaerobic microbes

Considered extremely potent for certain infections

Foaming result catalase enzyme decomposing peroxides

Peroxides (ROS's) are very destructive to cellular components

Catalase is one method of protecting cells

One of highest "turnovers" known

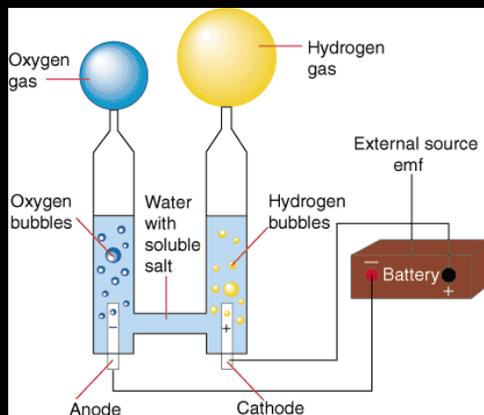
Catalase runs reaction on 40 million molecules / second



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Decomposition Reaction



Electrical decomposition (Electrolysis) of water
Provides source of hydrogen and oxygen



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Burning or Complete Combustion



Note color of Bunsen Burner flame with complete & incomplete combustion

Place several drops of ethanol on a watch glass:
ignite it with a lighted match



Burning
Anything organic (contains C & H)
Puts Carbon Dioxide into the air



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Single Replacement (Displacement)

Put 20 drops of copper(II) sulfate solution into a small test tube
Add a small piece of zinc.
Observe the reaction for several minutes
Put the test tube aside and observe again after 30 minutes



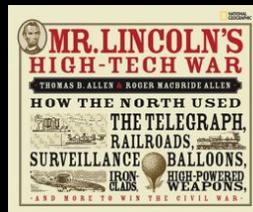
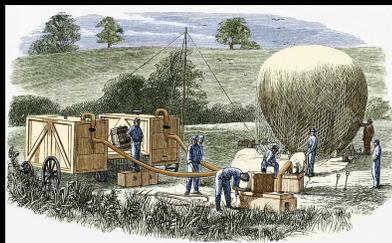
Put 20 drops of hydrochloric acid into a test tube
Add a small piece of magnesium metal
Observe the reaction for several minutes



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Single Replacement (Displacement)



Hydrogen was used in the civil war for observation balloons

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Double Replacement (Displacement) Reactions

Reactant A

Reactant B

Precipitation Reaction

Copper(II) sulfate Sodium hydroxide

Calcium chloride Sodium sulfate

Potassium carbonate Calcium chloride

Gas-Forming Reaction

Potassium carbonate Hydrochloric acid

Sulfuric acid Sodium carbonate

Neutralization Reaction

Nitric acid Sodium hydroxide

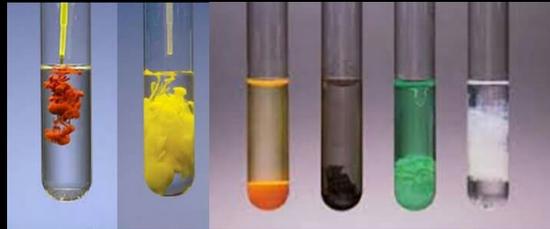
Sulfuric acid Sodium hydroxide



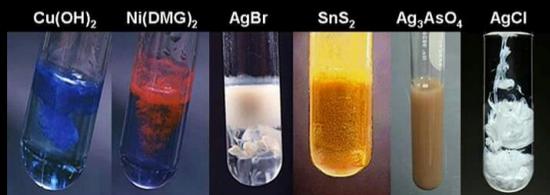
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Double Replacement: Precipitation



Ag_2CrO_4 PbI_2 CdS Bi_2S_3 $\text{Ni}(\text{OH})_2$ $\text{Al}(\text{OH})_3$



$\text{Cu}(\text{OH})_2$ $\text{Ni}(\text{DMG})_2$ AgBr SnS_2 Ag_3AsO_4 AgCl

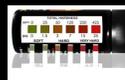


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Double Replacement: Precipitation

Hard Water: Dissolved Minerals Form Precipitates



Test Strips



Test Meters

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Let's Boldly Go Explore Today's Lab



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