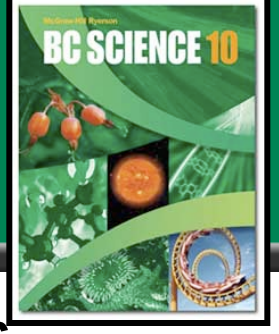
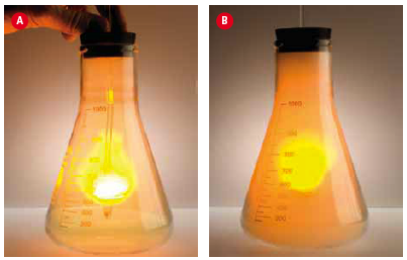
6.1 Types of Chemical Reactions: Synthesis



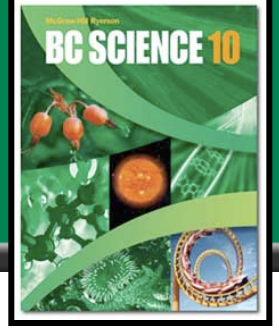
- **Synthesis reactions are also known as formation reactions.**
  - **Two or more reactants (usually elements) join to form a compound.**
  - **A + B → AB where A and B represent elements**
  - **The elements may form ionic compounds, like the following:**
  - **Sodium metal and chlorine gas combine to form sodium chloride.**
  - $2Na + Cl_2 \rightarrow 2NaCl$
  - **Magnesium metal reacts with oxygen gas to form magnesium oxide.**
  - $2Mg + O_2 \rightarrow 2MgO$
  - **Or the elements may form covalent compounds, like the following:**
  - **Nitrogen gas and oxygen gas join to form dinitrogen monoxide.**
  - $2N_2 + O_2 \rightarrow 2N_2O$



Sodium added to chlorine gas

See pages 258 - 259

An Analogy for Synthesis



- Guy meets girl, they become a couple ;)
- (or, assuming that in this example that the girl represents a metal and the guy represents a non-metal, it could be a covalent bond with two guys ☺)

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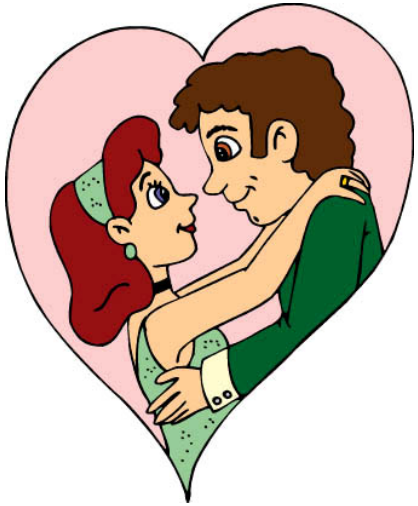
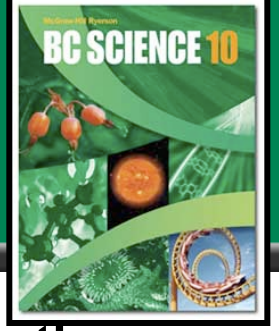


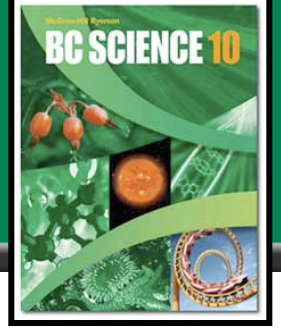
Types of Chemical Reactions: Decomposition



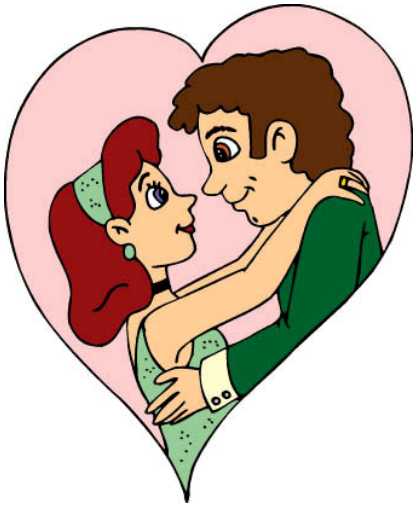
- **Decomposition reactions are the opposite of synthesis reactions.**
  - **A compounds breaks down into two or more products (often elements).**
  - **AB → A + B where A and B represent elements**
  - **Ionic compounds may decompose to produce elements, like the following:**
  - **Table salt, sodium chloride, can be broken down into sodium metal and chlorine gas by melting salt at 800ºC and running electricity through it.**
  - $2NaCl \rightarrow 2Na + Cl_2$
  - **Or covalent compounds may decompose into elements, like the following:**
  - **By running electricity through water, the water molecules decompose into hydrogen and oxygen gases.**
  - $2H_2O \rightarrow 2H_2 + O_2$

See page 260

An Analogy for Decomposition



- **Couple breaks up ☹**



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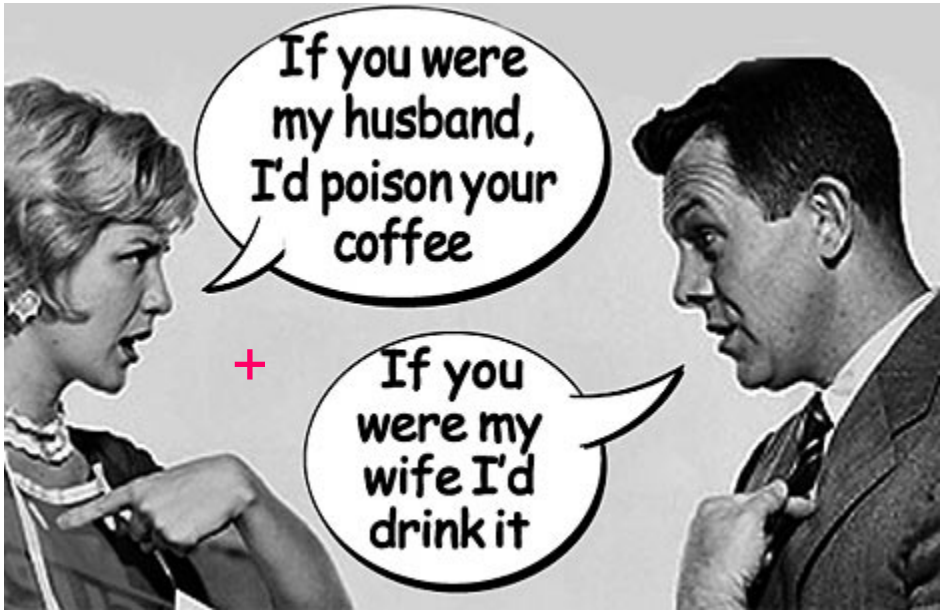
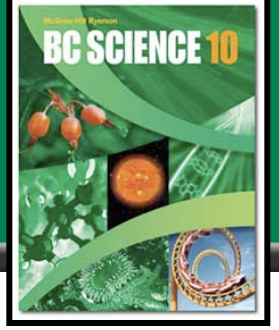


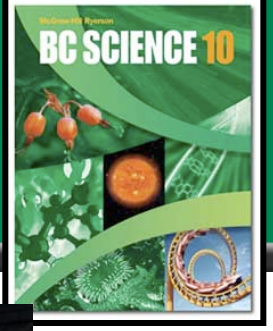
Types of Chemical Reactions: Single Replacement



- **Single replacement reactions replace one element from a compound with a separate element added as a reactant.**
  - **A compound and an element react, and the element switches places with part of the original compound.**
    - **B + AX → A + BX where A and B are metals, or**
    - **Y + AX → X + AY where X and Y are non-metal**
  - **Replacement of a metal:**
  - **Aluminum foil in a solution of copper(II) chloride produces solid copper and aluminum chloride.**
  - $2Al + 3CuCl_2 \rightarrow 3Cu + 2AlCl_3$
  - **Replacement of a non-metal:**
  - **When fluorine is bubbled through a sodium iodide solution, iodine and sodium fluoride are produced.**
  - $Fl_2 + 2NaI \rightarrow I_2 + 2NaF$

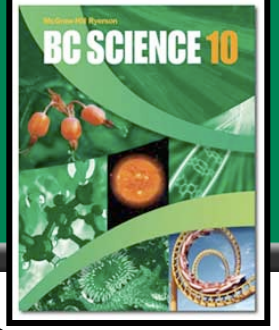
See page 261

An Analogy for Single Replacement Reactions



- **1 partner decides to ditch their current partner for someone new :O**

Types of Chemical Reactions: Double Replacement



- **Double replacement reactions swap elements between two compounds reacting together to form two new compounds.**
  - **Two compounds react, with elements switching places between the original compounds.**
  - **Two solutions react to form a precipitate (ppt, solid) and another solution**
    - **Ionic solution + ionic solution → ionic solution + ionic solid**
    - **AB + CD → AD + CB**
  - **When potassium chromate and silver nitrate react, they form a red precipitate, silver chromate, in a solution of potassium nitrate.**
  - $K_2CrO_4 + 2AgNO_3 \rightarrow Ag_2CrO_4 + 2KNO_3$

silver chromate

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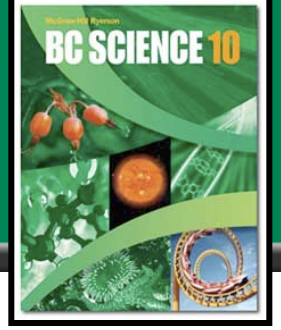
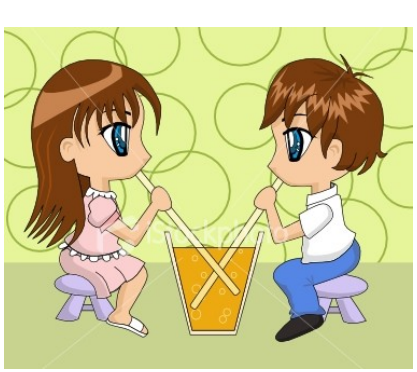
An Analogy for Double Replacement



- **Start with two couples, and they both switch partners**
  - **Swingers! :P**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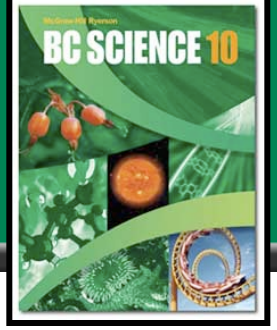
Types of Chemical Reactions: Neutralization (Acid-Base Reactions)



- **Neutralization reactions occur when an acid (most compounds starting with H) and a base (most compounds ending in OH, or beginning with NH_4) react to form a salt and water.**
  - **Acid + base → salt + water**
  - **HX + MOH → MX + H_2O where X is a non-metal ion and M is a metal ion**

  - **Sulfuric acid is used to neutralize calcium hydroxide:**
  - $H_2SO_4 + Ca(OH)_2 \rightarrow CaSO_4 + 2H_2O$

  - **Phosphoric acid helps to neutralize the compounds that cause rust, such as iron(II) hydroxide.**
  - $2H_3PO_4 + 3Fe(OH)_2 \rightarrow Fe_3(PO_4)_2 + 6H_2O$
- **Neutralization is just a special case of a double replacement reaction**

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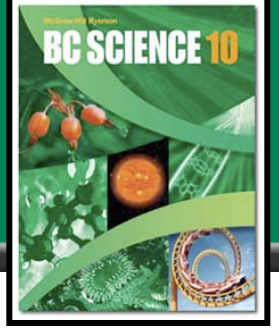
Types of Chemical Reactions: Combustion



- **Combustion reactions occur when a compound or element react with oxygen to release energy and produce an oxide.**
  - **Also sometimes referred to as hydrocarbon combustion.**
  - **$C_XH_Y + O_2 \rightarrow CO_2 + H_2O$ where X and Y represent whole numbers**
  - **Natural gas (methane) is burned in furnaces to heat homes.**
  - $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
  - **An acetylene torch is used to weld metals together.**
  - $2C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O$
  - **Carbohydrates like glucose combine with oxygen in our body to release energy.**
  - $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

Acetylene torch

See page 264

Types of Chemical Reactions: Summary of Types

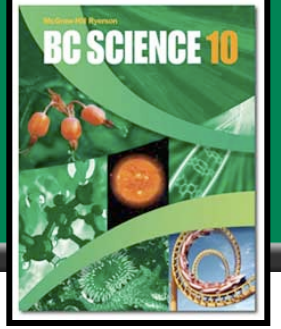


Table 6.1 Summary of Chemical Reactions

Reaction Type	Reactants and Products	Notes on the Reactants
Synthesis (combination)	$A + B \rightarrow AB$	• Two elements combine (Figure 6.9).
Decomposition	$AB \rightarrow A + B$	• One reactant only (Figure 6.9)
Single replacement		
If A is a metal	$A + BC \rightarrow B + AC$	• One element and one compound
If A is a non-metal	$A + BC \rightarrow C + BA$	
Double replacement	$AB + CD \rightarrow AD + CB$	• Two compounds react.
Neutralization (acid-base)	$HX + MOH \rightarrow MX + H_2O$	• Acid plus base
Combustion	$C_XH_Y + O_2 \rightarrow CO_2 + H_2O$	• Organic compound with oxygen

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Take the Section 6.1 Quiz