To react or not to react?
THAT is the question!

Chp 15.2 & 3

- Chemical changes are a result of chemical reactions.
- All chemical reactions involve a change in substances and a change in energy.
- Neither matter or energy is created or destroyed in a chemical reaction---only changed.
- There are so many chemical reactions that it is helpful to classify them into 5 general types:

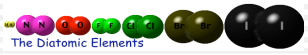
Types of Reactions

- **Synthesis: A + B -> AB**
- **Decomposition: AB -> A + B**
- **Single Replacement: A + BC -> AC + B**
- **Double Replacement: AB + CD -> AD + CB**
- **Combustion:**
- Here is a short explanation and examples of each type of reaction

4. 5 types of chemical reactions

Diatomic Elements Info!

- Diatomic elements are nonmetal elements that form a covalent bond between two atoms.
- The diatomic elements are: hydrogen, nitrogen, oxygen, fluorine, chlorine, bromine and iodine.
- They always travel in pairs of atoms and therefore you must write then as:
- H_2 N_2 O_2 F_2 Cl_2 Br_2 and I_2



The Diatomic Elements

1. Synthesis (Composition)

- In a synthesis reaction (also known as a composition reaction), two or more simple substances combine to form a more complex substance.
- Two or more reactants yielding one product is another way to identify a synthesis reaction.
- In the simplest type of synthesis reaction, **two elements combine to form a compound**.

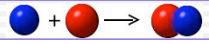
1. Synthesis Examples

- Hydrogen + oxygen yields water:
  $2H_2 + O_2$ -> $2H_2O$
- Magnesium + nitrogen yields magnesium nitride **$3Mg + N_2$ -> Mg_3N_2**
- Iron + sulfur yields iron(II) sulfide
  Fe + S -> FeS
- Barium + phosphorus yields barium phosphide
  $3Ba + P$ -> Ba_3P

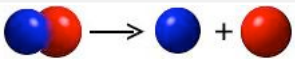
1. Synthesis

- The chemical equation for a synthesis reaction looks like:
- **reactant + reactant -------> product**

#1. Synthesis Summary

Definition	Two or more substances combine to form a new substance
Equation	A + B --> AB
Looks Like	
Example	$4Fe + 3O_2$ --> $2Fe_2O_3$
Extra Info	Also called **composition** & **addition** reactions

2. Decomposition



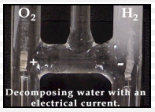
- In a decomposition reaction, **a larger substance breaks apart and forms two or more simpler substances.**

2. Decomposition

- The first thing you may notice about a decomposition reaction is that it is the complete opposite of a synthesis reaction.
- In fact many synthesis reactions can be reversed into a decomposition reaction.
- When you burn hydrogen gas, the hydrogen combines with oxygen to produce water.

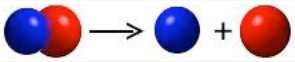
2. Decomposition

- $2H_2 + O_2 \rightarrow 2H_2O$ **Synthesis Reaction**
- With an electrical current, water can be decomposed into hydrogen and oxygen gas.
- $2H_2O \rightarrow 2H_2 + O_2$ **Decomposition Reaction**



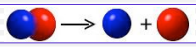
Decomposing water with an electrical current.

2. Decomposition



- For example, water can be broken down into hydrogen gas and oxygen gas.
- The chemical equation for this decomposition reaction looks like:
- **reactant -------> product + product**

2. Decomposition Summary

Definition	A single compound is broken down into two or more smaller compounds
Equation	AB --> A + B
Looks Like	
Example	$H_2CO_3 \rightarrow H_2O + CO_2$
Extra Info	Large compounds can also decompose into several other compounds.

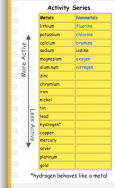
3. Single Replacement

- In a single replacement reaction a single uncombined element replaces another in a compound.
- **Two reactants yield two products.**
- For example when zinc combines with hydrochloric acid, the zinc replaces hydrogen.

3. Single Replacement

- The chemical equation for this single replacement reaction looks like:
- **reactant + reactant---> product + product**
- In a single replacement reaction, a more active element replaces a less active element in a compound.

3. Single Replacement



- Generally, as you go across the periodic table (from I-A to IIIV-A) metals become **less chemically active.**
- A metal such as magnesium is more chemically active that transition metals such as copper, tin or zinc.
- An easier way to identify the activity of element is to use an activity series which shows the chemical activity of both metals and nonmetals.

#3. Single-Replacement

Definition	One element replaces a similar element in a compound.
Equation	AB + C --> AC + B
Looks Like	
Example	$2HCl + Zn \rightarrow ZnCl_2 + H_2$
Extra Info	Here, more-reactive elements replace less-reactive ones - so sometimes it is impossible to reverse this reaction.

4. Double Replacement

- **In a double replacement reaction, two metal ions (in aqueous compounds) switch places.**

4. Double Replacement

- In a double replacement reaction parts of two compounds switch places to form two new compounds.
- Two reactants yield two products.
- For example when silver nitrate combines with sodium chloride, two new compounds--silver chloride and sodium nitrate are formed because the sodium and silver switched places.

4. Double Replacement

- The chemical equation for this double replacement reaction looks like:
- **reactant + reactant ----> product + product**
- One of the products is insoluble and forms a solid.
- This solid, called a **precipitate**, is more dense than the surrounding solution and falls to the bottom of the test tube.
- An arrow down is used to identify a precipitate (because the precipitate sinks)

4. Double Replacement

- In a reaction between sodium chloride solution NaCl (aq) and silver nitrate solution $AgNO_3$ (aq) the products are sodium nitrate
- $NaNO_3$ (aq) solution and silver chloride solid AgCl (s).

4. Double Replacement

- Since silver chloride is insoluble (won't dissolve in water) it forms a white solid and sinks to the bottom of the test tube.

4. Double Replacement

- A solid that forms in a double replacement reaction is called a precipitate. Here is a photo of this reaction:

$NaCl_{(aq)} + AgNO_{3(aq)} \rightarrow NaNO_{3(aq)} + \downarrow AgCl_{(s)}$

#4. Double-Replacement

Definition	Ions in two compounds switch places.
Equation	AB + CD --> AC + BD
Looks Like	
Example	$NaCl + AgNO_3 \rightarrow NaNO_3 + AgCl$
Extra Info	Often, a solid combines with a liquid & forms a precipitate in this reaction.

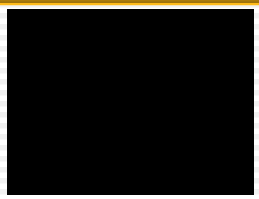
Combustion

- Combustion or **burning** is the sequence of exothermic chemical reactions between a fuel and an oxidant accompanied by the production of heat and conversion of chemical species.
- The **release of heat** can result in the production of light in the form of either glowing or a flame.
- Fuels of interest often include organic compounds (especially hydrocarbons) in the gas, liquid or solid phase.

#5. Combustion

Definition	A complex series of exothermic reactions between fuel & oxygen which produces energy.
Equation	Fuel + Oxygen --(heat)--> Energy
Looks Like	Fire!!
Example	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ + energy
Extra Info	Cars are powered by a combustion reaction which uses petroleum.

5. Summary



Energy & Rates of Chemical Reactions

Chapter 15 Section 3

CHEMICAL REACTIONS & Energy

- If you've every sat by a warm campfire or in front of a stove, you've experienced heat from a chemical reaction.
- Burning is a chemical reaction that gives off or releases energy in the form of heat & light.
- In plants,photosynthesis uses or absorbs energy from sunlight.
- In fact, all chemical reactions involve energy

Two Types of Reactions :

- Energy is involved in chemical reactions in two ways.
- 1. At the start of a chemical reaction, some (or all) bonds between atoms in the reactants must be broken so that the atoms are available to form new bonds.
- 2. Energy is released when new bonds form as the atoms recombine into the new compounds of the products
- We classify chemical reactions based on how
  (1) energy used in
  (2) compares to energy released in

Type #1: Exothermic

- If forming new bonds releases more energy than it takes to break the old bonds, the reaction is **exothermic.**
- Exo means "go out" or "exit" and thermic means "heat" or "energy". If energy/heat is released, the reaction feels hot.
- A good example is the burning of hydrogen in oxygen

EXOTHERMIC REACTION

Oxygen + Hydrogen → Water + Energy

$O_2 + 2H_2 \rightarrow 2H_2O + Energy$

Type #2: Endothermic

- If forming new bonds in the products releases less energy than it took to break the original bonds in the reactants, the reaction is endothermic.
- **Endothermic** reactions absorb or use energy.
- Endo- means "go in" or "into". If energy is absorbed, the reaction may feel cold. An example of an important endothermic reaction is photosynthesis.

Endothermic Reaction

(Photosynthesis)

Carbon Dioxide + Water + Energy → Glucose + Oxygen

$6CO_2 + 6H_2O + Energy \rightarrow C_6H_{12}O_6 + 6O_2$

Review: THE 4 RULES OF CHEMICAL REACTIONS

- 1. Chemical reactions are processes in which **atoms are rearranged** into different combinations of molecules.
- 2. Reactants interact, change bonds, and **form products with different chemical properties.**

Review: THE 4 RULES OF CHEMICAL REACTIONS

- 3. In a reaction, the **number of atoms stays the same**, no matter how they are arranged, so their total mass stays the same.
- 4. Chemical reactions **usually liberate/release or absorb heat**.

Tim & Mobey: Fire

- Brainpop:
- Click here

BrainPOP FIRE

December 3, 2011
elaine

SCORE: 10/10

1 What is the main difference between a log and a flame?
A The flame contains energy; a log contains no energy
B The log is made of matter; the flame isn't
C The log is made of wood molecules; the flame is made of fire molecules
D The log is a solid; the flame is a gas

2 Where can you find a combustion reaction taking place?
A Inside a car engine
B Inside an electric toaster
C Inside a firefly
D Inside a lightbulb

3 Which of the following is an essential ingredient of fire?
A Smoke
B Wood
C Sulfur
D Oxygen

4 Place the following events in sequence: A) A flame ignites; B) Fuel vaporizes; C) Heat is added to fuel
A C, A, B
B C, B, A
C B, C, A
D B, A, C

5 In most fires, where does the oxygen come from?
A Inside the fuel
B Water vapor released by the heat of the flame
C The earth's atmosphere
D Pressurized tanks of pure oxygen

6 If a piece of ice vaporized, it might:
A Melt into water
B Lose all its energy
C Catch on fire
D Turn into steam

7 When you strike a match, you create friction between the match head and the striking surface. What else is an example of friction?
A An atom being split apart in a nuclear reaction
B A lightbulb being switched on
C Bicycle tires skidding on the pavement
D A log bursting into flame

8 What can you infer about the exhaust that comes out of a car's tailpipe?
A It contains carbon compounds
B It's mostly oxygen
C It's highly combustible
D It's generated through friction

9 The main difference between a fire and an explosion is:
A The amount of heat that's required
B The amount of fuel that's required
C The amount of oxygen that's required
D The speed at which the reaction takes place

10 Which option best describes fire?
A Mostly harmful
B Mostly harmless
C Mostly helpful
D Both helpful and dangerous