

# History of Chemistry

Chem I – Mr. Gilbert

## History

- The first controlled chemical reaction was fire.
  - Fire could burn wood
  - Heat from a fire could boil water
    - Both transforming one substance into another



## History



- The rise of metallurgy
  - It was fire that led to the discovery of glass and the purification of metals which in turn gave way to the rise of metallurgy.
    - Study of the physical and chemical behavior of metallic elements, intermetallic compounds, and their mixtures which are called alloys.
  - This purification of metals included gold, which was a precious metal.
  - The discovery of alloys started the Bronze Age.
  - After the Bronze Age, metallurgy was marked by which army had better weaponry.

## History



- Alchemy
  - Due to the demand of gold, many people were interested in a method that could convert cheaper metals into gold.
  - The material that would help them do this was rumored to exist and it was called the philosopher's stone.
  - This led to the proto-science called alchemy.
    - The tradition of converting cheaper metals into gold.
  - Although there was no philosopher's stone ever found, there were compounds being formed during the process of alchemy.
    - These included medicines and other useful compounds.
    - The issue with Alchemy was there was no universal process to follow.

## History

- In the Arab World, chemists were starting to take their modern shape.
- These people were experimenting with scientific ideas.
- This was the early development of the modern scientific method.
- These scientist used this science to create medications.



## Important People

- Robert Boyle – refined the modern scientific method for alchemy and have further separated it away from alchemy.
- Antoine Lavoiser – developed the law of conservation of mass:  
– Mass of a closed system will remain constant over time.
- Dmitri Mendeleev – responsible for the periodic table
- Marie and Pierre Curie - radioactivity



## Matter - Important Introduction Definitions

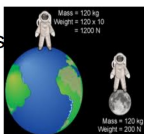
1. Matter - anything that has mass and volume

2. Mass - the amount of matter in something  
the amount of "stuff" in something



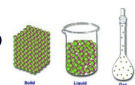
3. Law of Conservation of Mass/Matter

- Matter cannot be created nor destroyed but transformed
- total mass of products = total mass of reactants



4. Weight - the effect of gravity on a mass

- Mass does not change
- weight will change depending on gravitational pull



5. Volume - the amount of space something takes up

6. The States of Matter - solid, liquid, gas, plasma

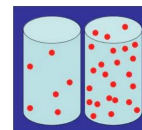
Low Energy ----->High Energy

## Properties of Matter - describes the matter

1. Density - how tightly packed the matter is

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$D = \frac{M}{V}$$



a. typical units - g/cm<sup>3</sup> for solids



g/mL for fluids  $\left\{ \begin{array}{l} \text{liquid} \\ \text{gases} \end{array} \right.$



Example: A sample of lead has a mass of 22.7g and a volume of 2.0 cm<sup>3</sup>. What is the density of Lead?



### Properties of Matter - cont.

2. Electrical Conductivity - how easily it conducts electricity



3. Heat Conductivity - how easily thermal energy is transferred from, and through the matter



4. Reactivity - how the matter reacts with different items



5. Malleability - ability to hammer out matter into a shape



6. Ductility - ability to be drawn into a wire



7. Brittleness - how easily it breaks



8. Magnetism - how attracted matter is to a magnet



9. Melting/freezing Point - the temperature at which a solid becomes a liquid and vice versa



10. Boiling/Condensing Point - the temperature at which a liquid becomes a gas and vice versa

### Categories of Properties of Matter

1. Chemical Properties - property that deals with how a substance reacts with another substance



2. Physical Properties - property that can be observed without chemically changing the substance



3. Extensive Property - depends upon how much of the substance you have



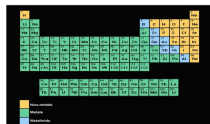
4. Intensive Property - does not depend upon how much you have



\*Note - each property of matter can be categorized by one above the line and one below the line

## Properties of the Elements

### 1. Metals - most of the elements

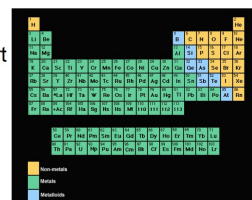


- Usually shiny, dense, and melt at high temperatures.  
↳ Hg is exception
- shape can be easily changed into thin wires (ductile) or flat sheets (malleable)
- Metals will corrode (reactivity)
- Heat and electricity travel easily through metals



## Properties of the Elements

### 2. Non-metals - right side of the periodic chart



- Surface is dull
- Have low densities
- Low melting and boiling points  
↳ exception is C
- Shape of non-metals cannot be changed because they are brittle and will break
- Do not conduct electricity and heat

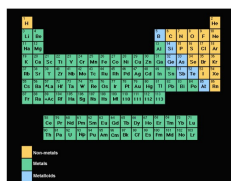


**Sulphur is a yellow non-metal**

## Properties of the elements

### 3. Metalloids - elements at the border of the metals and non-metals

- they can be shiny or dull
- Their shape is easily changed but also can be brittle
- Electricity and heat can travel through metalloids but not as easily as they travel through metals



arsenic



germanium

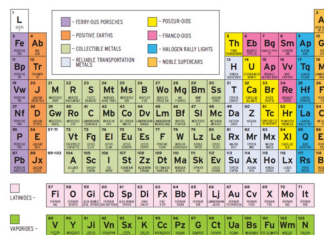


antimony

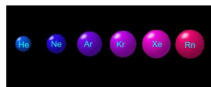
## Composition of Matter - what the matter is made up of

### 1. Atom - basic building block of matter

- ~100 different types of atoms
- periodic table

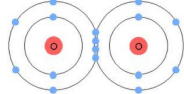


c. monatomic atoms - elements that consist of one unbonded atom  
 i. Ex: He, Ne, Ar, Kr, Xe, Rn

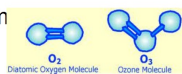


d. polyatomic atoms - elements that consist of two or more "like" atoms

i. diatomic atoms -  $O_2$ ,  $H_2$ ,  $N_2$ ,  $F_2$ ,  $Cl_2$ ,  $Br_2$ ,  $I_2$



e. Allotropes - different form same state



ment in nature in the same state → Both gases

2. Compounds - contains two or more different types of atoms  
 a. have different properties from those elements it makes up

b. Example:

Sodium (Na) : Explodes in water



+

Chlorine ( $Cl_2$ ) : Poisonous Gas



=

Sodium Chloride (NaCl) : Table Salt



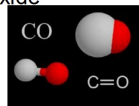
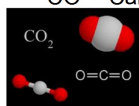
c. compositions of compounds

i. The Law of Multiple Proportions states that elements can combine

in different ratios to form different compounds.

Example:  $CO_2$  - Carbon Dioxide

$CO$  - Carbon Monoxide

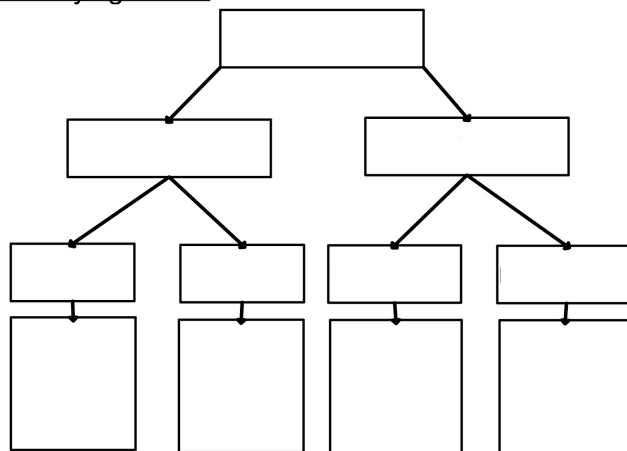


ii. The Law of Definite Proportions states that a compound has a fixed ratio of the elements it makes up.

Example:  $CO_2$

1:2 ratio always

### Classifying Matter



1. Mixtures - two or more pure substance mixed together
  - a. have varying compositions
  - b. have varying properties
  - c. These substances are **NOT** chemically bonded and they retain their physical properties
  - d. Example: salt water



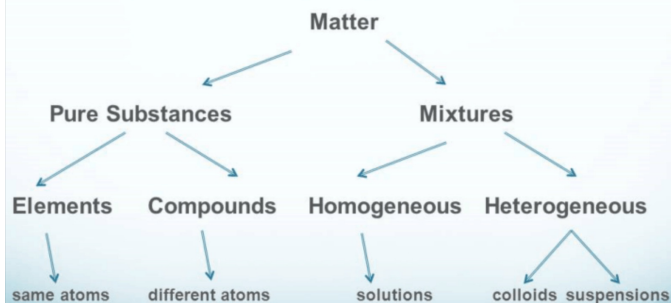
2. Two types of mixtures
  - a. homogenous mixture - solutions
    - i. particles are microscopic
    - ii. sample has the same composition throughout
    - iii. sample has the same properties throughout
  - b. Heterogenous mixture
    - i. different compositions throughout the mixture
    - ii. has different properties throughout
    - iii. unevenly mixed



## Methods of Separating Mixtures

Chem I

## Classifying Matter





## Separating Mixtures

- There are many ways to separate mixtures.
  - We can separate them because each part of a mixture still has its unique properties.
  - Chemical reactions are NOT needed to separate mixtures.
  - We can separate them physically.
- What kinds of materials must we separate chemically?
  - Compounds – due to chemical bonds

## Methods of Separating Mixtures

Method	Property Involved	Applications	Link
Magnet	magnetism	recycling	<a href="#">Iron and Sand</a> <small>https://www</small>
Filter	Particle size	Water treatment plant	<a href="#">Water Filtration</a>
Decant – gradually pour from one container to another without disturbing the sediment	Particle size; density	Separating water and oil from olives	
Evaporation	Liquid evaporates, but solid stays behind	Salt production	<a href="#">Salt from Sea Water</a> <small>http://www.youtube.com/watch?v=126InPI TaPA</small>

Method	Property Involved	Applications	Link
Distillation	Liquid boiled off, removed, and re-condensed	Purifying seawater (Saudi Arabia) <small>http://www.youtube.com/watch?v=tQzLpEWgs8</small>	<a href="#">Oil Distillation</a>
Centrifuge	More dense materials go to the bottom	Red blood cells from blood plasma	<a href="#">Example</a>
Chromatography	Different materials in a mixture have different attraction to chromatography paper	Nutrition studies, forensics analysis	Lab