

Unit One: Matter & Change

we will use mass not weight in class!

Describing Matter:

Matter is anything that has mass and takes up space. The mass of an object is a measure of the amount of matter the object contains. The Volume of an object is a measure of the space occupied by the object. Are mass and weight the same thing? **No!**

- Weight depends on gravity, mass does not.
- Gravity can vary from location to location, which can then change the weight of an object.

Earth = 150 lbs
 moon = 24.9 lbs
 Sun = 4,060.8 lbs

}

same mass in all 3 locations!

There are two different types of properties that we use to describe matter are:

Extensive Property: Depends on the amount of matter in a sample

- mass
- Volume

Intensive Property: Depends on the type of matter in a sample, not the amount of matter.

- Density
- specific heat
- Body temperature

Matter that has a uniform and definite composition is called a Substance. Aluminum (Al) and Copper (Cu) are examples of substances, which are also referred to as Pure Substance.

- ▶ Every sample of a given *substance* has identical intensive properties because every sample has the same composition!

Aluminum and Copper have some properties in common, but there are differences besides their distinctive colors:

| Aluminum | Copper |
|-------------------|---------------------------------------------|
| Highly reflective | Harder than Aluminum |
| Used in Paints | Better conductor of heat/electrical current |
| Malleable | Malleable |

Hardness, color, conductivity, and malleability are all examples of physical properties!

Physical property = a quality or condition of a substance that can be observed or measured without changing the substance's composition.

- phase of matter
 - color
 - Smell
- Freezing point
 - Boiling point

Physical Changes: Some properties of a material change, but the composition of the material does not change.

• Phase changes

Freeze \longleftrightarrow melt

Evaporate \longleftrightarrow Condense

Sublimate \longleftrightarrow Deposit

States of Matter:

What are the three states of matter?

1) Solid

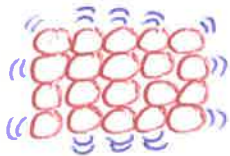
2) liquid

3) gas

* plasma - only exists at extremely high temperatures in this high energy state atoms are torn apart into smaller particles. (Sun, stars, other intergalactic matter).

There are several characteristics that distinguish each state of matter from the other two:

Solid: Definite shape and volume. Atoms are held tightly in a rigid structure but vibrate slightly

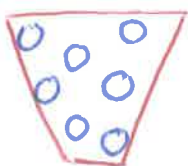


Liquid: Indefinite shape, flows, yet has a fixed volume



• particles can "slip past" one another.

Gas: Takes both the shape and volume of its container.



• particles are not held together.

Classifying Mixtures:

A Mixture is a physical blend of two or more components. Most samples of matter are mixtures, some mixtures are easier to recognize than others.

Heterogeneous Mixtures: Composition is not uniform throughout.
 • mixture will "settle out" over time.

- milk
- orange juice
- soup
- Blood.

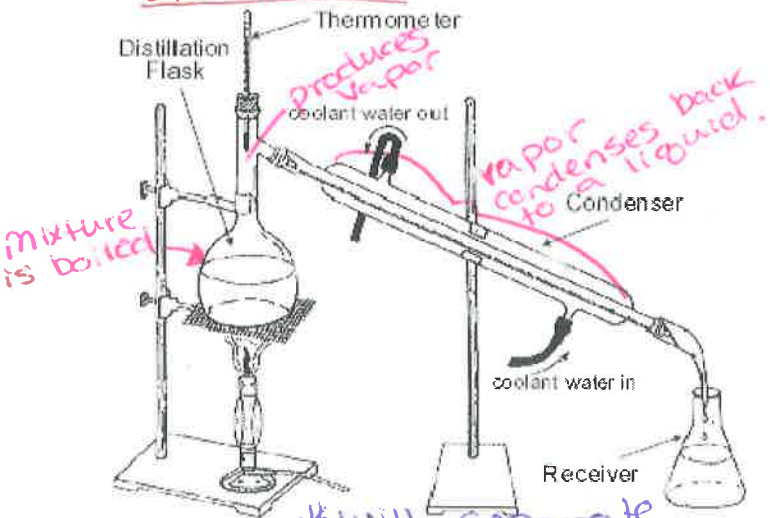
Homogeneous Mixtures: Composition is uniform throughout.

• Any part of the mixture you sample from will be exactly the same.

- salt water
- vinegar
- olive oil
- Apple Juice

In the lab we can use two different techniques to separate mixtures; **filtration** and **distillation**. We will use filtration several times this semester to separate mixtures!

Distillation



Elements and Compounds:

We will classify substances as either elements or compounds.

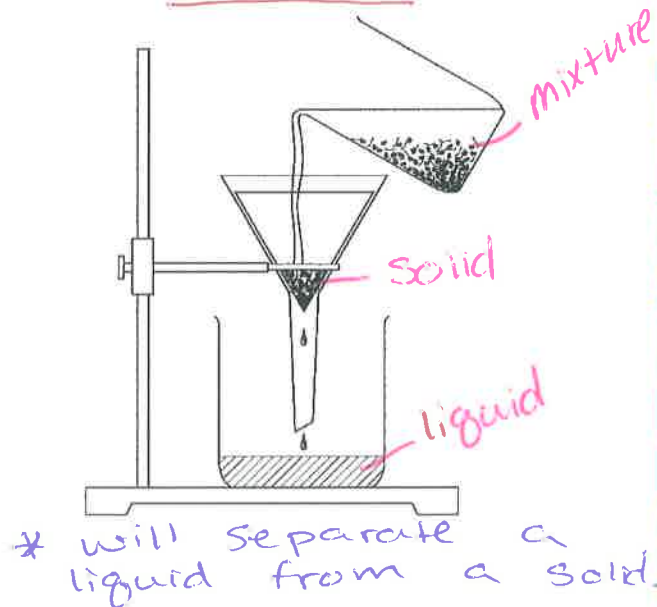
Element: The simplest form of matter that has a unique set of properties.

- oxygen (O)
- Iron (Fe)
- Hydrogen (H)

Compound: a substance that contains two or more elements chemically combined in fixed proportions.



Filtration



In general, the properties of chemicals are different than those of the elements that make up the compound!

Table Salt (NaCl)

Na = highly reactive with water

Cl₂ = poisonous green gas

Compounds cannot be broken down into simpler substances by the same physical methods that we use to separate mixtures. For example, water (H₂O) is a compound if you boil liquid water you wind up with water vapor, not the individual elements of oxygen and hydrogen that water contains.

A Chemical Change is a change that produces matter with a different composition than the original matter.

- ▶ Heating is one of the processes used to break down compounds into simpler substances (if you heat sugar it goes through a series of chemical changes, the final products of these changes are solid carbon and water vapor).
- ▶ There is no chemical process that will break down an element into any simpler substance.

Symbols and Formulas:

As chemists, we use symbols to represent elements, and chemical formulas to represent compounds. You will be responsible for memorizing the chemical symbols for 36 common elements that we will use throughout the year.

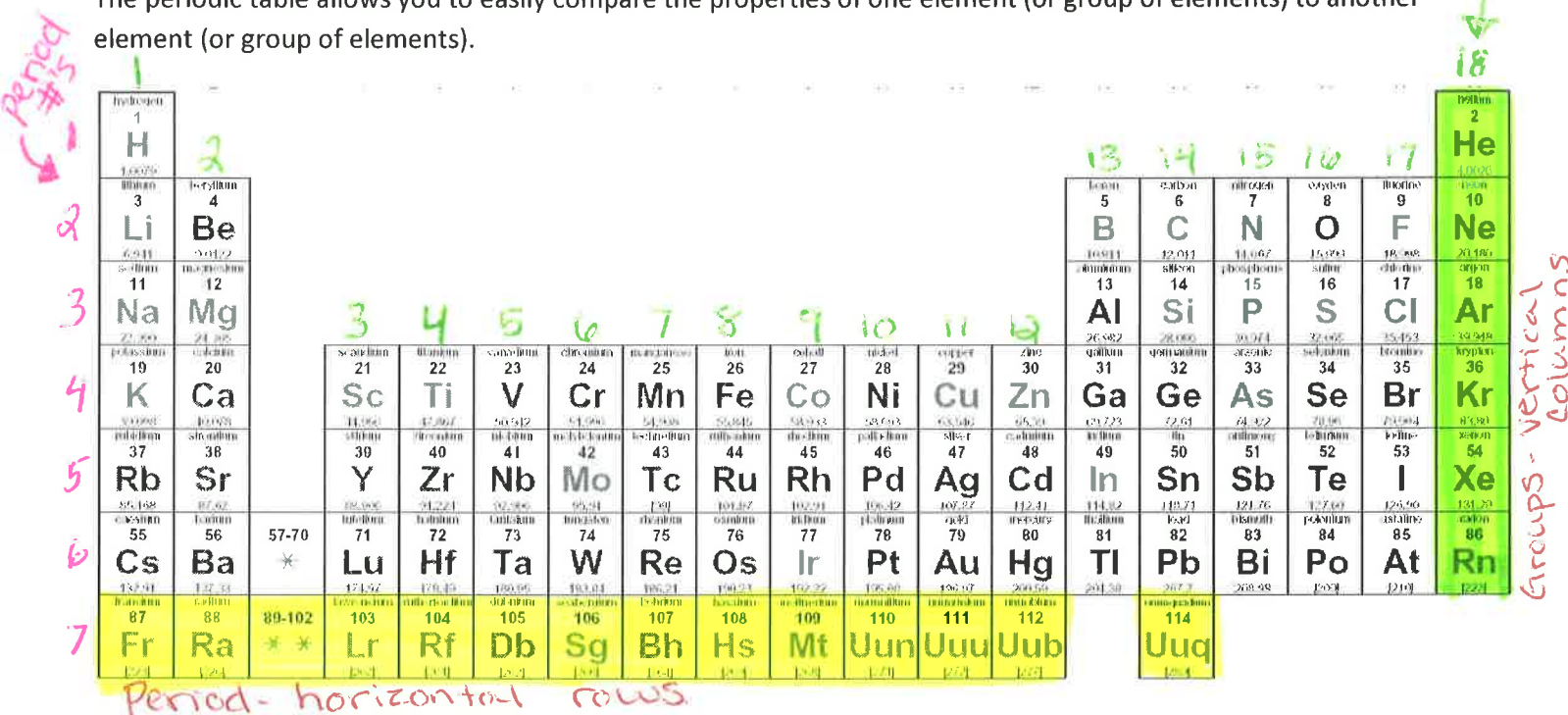
* Make sure you start looking at the "Elements you should know" sheet!

Na
Cl } chemical symbols for elements

NaCl - chemical formula for a compound

The Periodic Table- A Preview: (We will spend an entire unit talking about the periodic table!)

The periodic table allows you to easily compare the properties of one element (or group of elements) to another element (or group of elements).



Lanthanide series

* Actinide series

| | | | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|-----|-----|-----|
| 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 |
| La | Ce | Pr | Nd | Pm | Sm | Eu | Gd | Tb | Dy | Ho | Er | Tm | Yb |
| 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 |
| Ac | Th | Pa | U | Np | Pu | Am | Cm | Bk | Cf | Es | Fm | Md | No |

Chemical Reactions:

Iron rusting is an example of a chemical reaction occurring between iron (Fe) and oxygen (O), which results in iron oxide (Fe₂O₃). Words such as burn, rot, rust, decompose, ferment, explode, and corrode usually signify that a chemical change has occurred.



Products - substance present at the end of a reaction.

Reactants - substances present at the start of a reaction.

The ability of a substance to undergo a specific chemical change is called a Chemical Property. # only observed when one substance interacts with another.

How do we recognize that a chemical change has taken place?

- change in temperature
- bubble formation
- gas formation
- color change
- precipitate formation.

The Law of Conservation of Mass:

- In any physical change or chemical reaction, mass is conserved (neither created nor destroyed).

* if we take 75g of a solid metal and ground it into a powder the mass of the powder is still 75g.

Percent Composition:

One way to describe a mixture quantitatively is to report the percentage by mass of components.

$$\left(\frac{\text{mass of substance}}{\text{total mass}} \right) \times 100 = \% \text{ Composition}$$

Practice:

When 25.0g of a particular salt solution is evaporated to dryness, the residual salt is found to have a mass of 1.32g. What is the percent composition of the salt in the solution?

$$\begin{array}{l} \text{mass of salt} = 1.32\text{g} \\ \text{Total mass} = 25.0\text{g} \end{array} \quad \left(\frac{1.32\text{g}}{25.0\text{g}} \right) \times 100 = \boxed{5.28\%}$$

A chocolate chip cookie consists of 17.33g of cookie and 11.49g of chocolate chips. What are the percentages of cookie and chocolate?

$$\begin{array}{l} \text{mass of chocolate} = 11.49\text{g} \\ \text{mass of cookie} = 17.33\text{g} \\ \text{Total mass} = 28.82\text{g} \end{array} \quad \left(\frac{11.49\text{g}}{28.82\text{g}} \right) \times 100 = \boxed{39.87\% \text{ Chocolate}}$$

$$\left(\frac{17.33\text{g}}{28.82\text{g}} \right) \times 100 = \boxed{60.13\% \text{ Cookie}}$$