Introduction to General Chemistry

1. Classifications of Matter

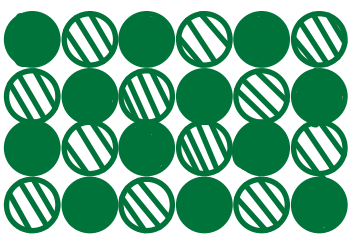
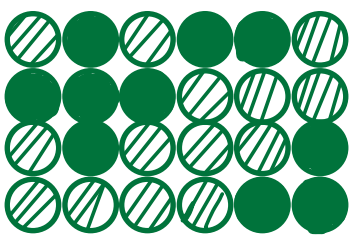
When matter is classified based on composition, it is either a mixture or a pure substance. Pure substances are either elements or compounds. Mixtures are either homogeneous or heterogeneous.

Vocabulary

- **matter**: anything with mass that occupies space
- **mixture**: composed of two or more substances (and each substance retains their identity)
  - ex. solutions are a mixture containing a solvent and solute
  - **homogeneous mixture**: uniform mixtures where the composition is the same throughout
  - **heterogeneous mixture**: nonuniform mixtures where composition varies
- **pure substance**: fixed composition with a unique set of properties
  - **compound**: contains more than one element in a fixed composition*
    - ex. H_2O, CH_4, Na_2SO_4
    - * In any amount of water, the ratio of hydrogen to oxygen is always 2:1
  - **element**: cannot be broken down into more substances
    - ex. H, O, Al, Zn, Fe

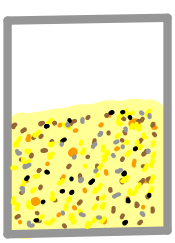
★ Mixtures vary in composition, but pure substances have a fixed composition.

Ex. of types of mixtures

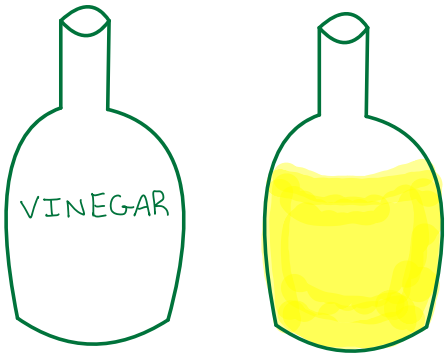
Homogeneous	Heterogeneous
• air • steel • salt water • wine • vinegar	• blood • sand • chicken noodle soup • soil • cereal and milk • ice in soda
 The particles are equally distributed.	 The particles are unequally distributed.

Note: When a mixture looks heterogeneous, it is most likely heterogeneous... but just because a mixture looks homogeneous doesn't mean it's homogeneous.

In simpler terms,



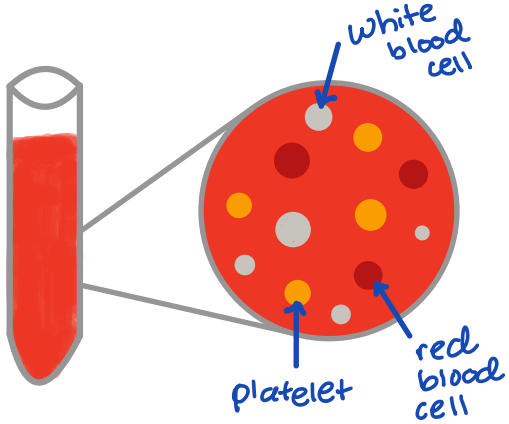
In a jar of sand, you can see it is not uniform in composition because there are thousands of different grains varying in size and shape. This is a heterogeneous mixture.



In a bottle of vinegar, the vinegar looks uniform in its composition. There are no visible particles that look unequally distributed.

This is a homogeneous mixture.

BUT...



To the human eye, blood looks like a uniform mixture. But when magnified, it is seen that there are many non-uniform parts of blood. Blood is a heterogeneous mixture.

★ Do not determine a mixture type by its appearance!

Note: Compound or homogeneous mixture?

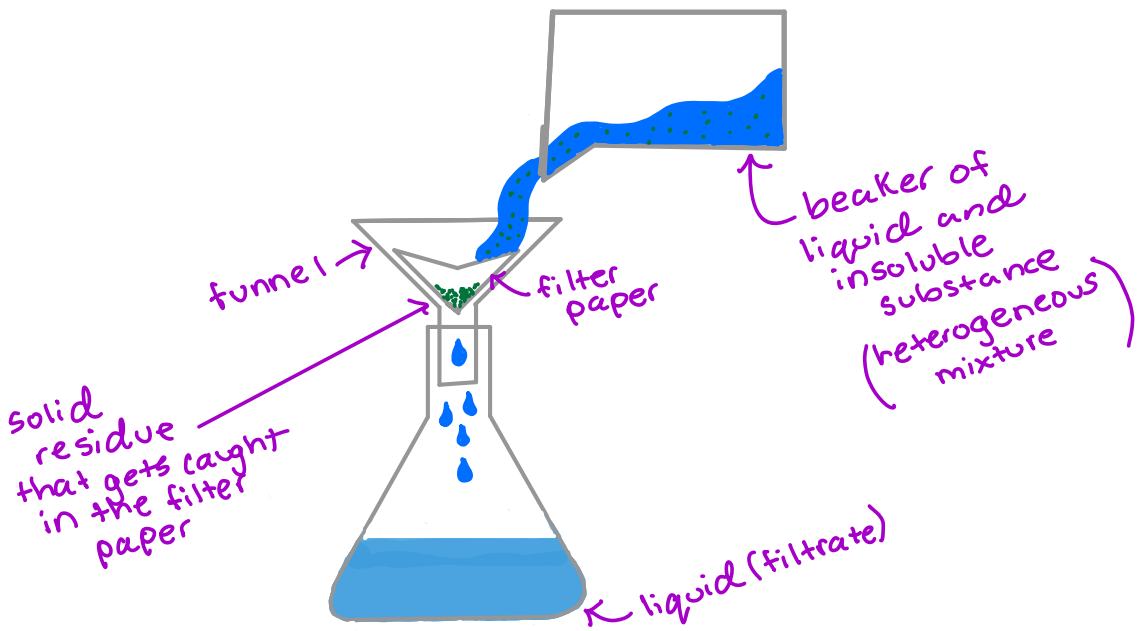
Often, these two terms are confused. A compound can be broken down into elements and always has a fixed proportion of those elements. Also, in a compound, the elements are chemically binded to one another, but in mixtures they aren't. Mixtures are composed of multiple pure substances (compounds or elements) that aren't chemically binded to one another.

water → compound (H_2O)

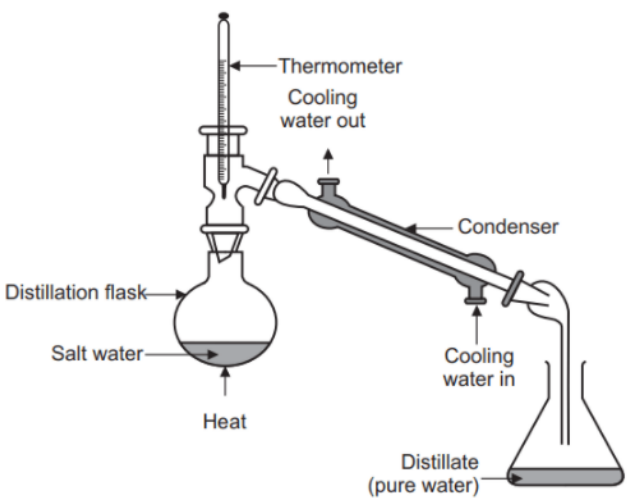
salt water → homogeneous mixture

Methods to Separating Mixtures

a. Filtration: separates heterogeneous solid/liquid mixtures with filter paper



b. Distillation: separates homogeneous solid/liquid mixture by vaporizing then condensing liquid



Note: separates mixtures by selective evaporation and condensation

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vapors are produced, separated, and then condensed back into liquid.

c. **Gas-liquid Chromatography:** separates various mixtures using solubility

↳ a tube is filled w/ solid and viscous liquid and a carrier gas to separate mixture

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2. Measurements + Sig-Figs

Metric Prefixes Chart		
Factor	Prefix	Abbrv.
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	Kilo	K
10^{2}	hecto	h
10^{1}	deka	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p

SI Units

- length: meter (m)
- mass: Kilograms (Kg)
- volume: cubic meter (m^3)
- temperature: Kelvin (K)

↳ Quick note: mass vs. weight

mass is a measure of the amount of matter and weight is the measure of gravitational force.

★ Important Conversions!

volume $\begin{cases} 1\ mL = 1\ cm^3 \\ 1\ L = 1\ dm^3 \end{cases}$

Celsius / Fahrenheit:

$$T_F = 1.8\,T_C + 32$$

Celsius / Kelvin:

$$T_K = T_C + 273.15$$

Unit Conversions		
Length	**Volume**	**Mass**
1 ft = 12 in	$1\ m^3 = 10^6\ cm = 10^3\ L$	1 lb = 16 oz
1 yd = 3 ft	$1\ cm^3 = 1\ mL$	1 lb = 453.6 g

1 mi = 5280 ft 1 in = 2.54 cm 1 m = 39.37 in 1 mi = 1609 m	1 gal = 4 qt = 8 pt 1 L = 1.057 qt	1 short ton = 2000 lb 1 g = 0.03527 oz 1 metric ton = 1 Mg 1 metric ton = 1.102 short ton