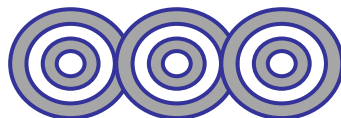




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Chapter 1

Chemistry: The Study of Change

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1.4

Classifications of Matter

Classification of matter

is anything that occupies space and has mass

Matter

is a combination of two or more substances in which the substances retain their distinct identities.

e.g., air, soft drink, milk, pizza

is a form of matter that has a definite (constant) composition and distinct properties.

e.g., water, table sugar, gold, oxygen

Mixtures

Separation by
physical methods

Pure
substances

Homogeneous
mixtures

the composition is the same throughout.

e.g., sugar in water, soft drink, milk

Heterogeneous
mixtures

the composition is not uniform throughout.

e.g., fruit salad, iron filings in sand

Compounds

is a substance composed of atoms of two or more elements chemically united in fixed proportions.

e.g., water, ammonia

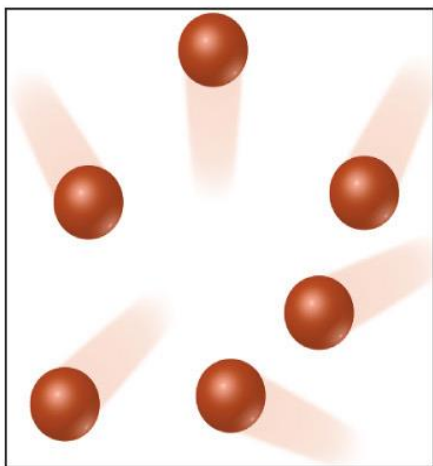
Separation by
chemical methods

Elements

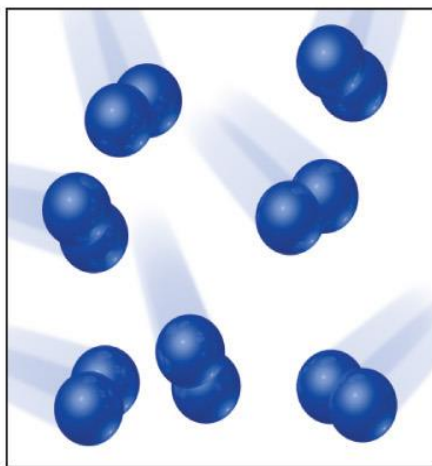
is a substance that cannot be separated into simpler substances by chemical means.

e.g., aluminum

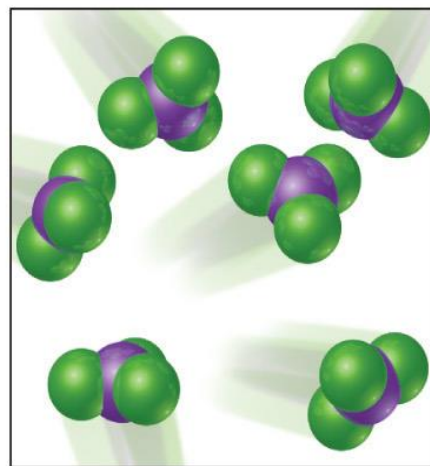
Classification of matter according to its composition



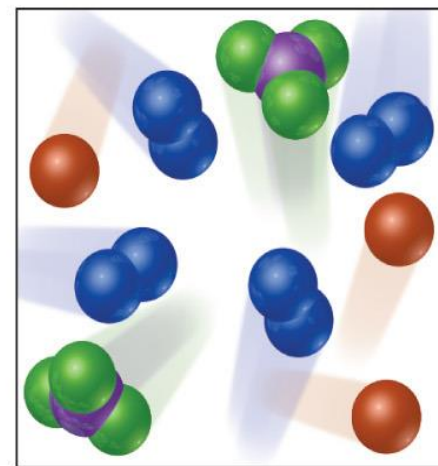
(a) Atoms of an element



(b) Molecules of an element



(c) Molecules of a compound



(d) Mixture of elements and a compound

How to write chemical symbols for elements

For convenience, chemists use symbols of one or two letters to represent the elements. The first letter of a symbol is *always* capitalized, but any following letters are not. e.g.,

- **Co** is the symbol for the element cobalt,
- **CO** is the formula for the carbon monoxide molecule.

Some common elements and their symbols

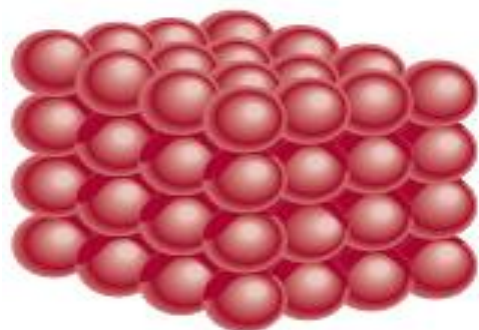
Name	Symbol	Name	Symbol	Name	Symbol
Aluminum	Al	Fluorine	F	Oxygen	O
Arsenic	As	Gold	Au	Phosphorus	P
Barium	Ba	Hydrogen	H	Platinum	Pt
Bismuth	Bi	Iodine	I	Potassium	K
Bromine	Br	Iron	Fe	Silicon	Si
Calcium	Ca	Lead	Pb	Silver	Ag
Carbon	C	Magnesium	Mg	Sodium	Na
Chlorine	Cl	Manganese	Mn	Sulfur	S
Chromium	Cr	Mercury	Hg	Tin	Sn
Cobalt	Co	Nickel	Ni	Tungsten	W
Copper	Cu	Nitrogen	N	Zinc	Zn

The symbols of some elements are derived from their Latin names, e.g., **Au** from *aurum* (gold), **Ag** from *argentum* (silver), **Fe** from *ferrum* (iron), and **Na** from *natrium* (sodium), whereas most of them come from their English names.

1.5

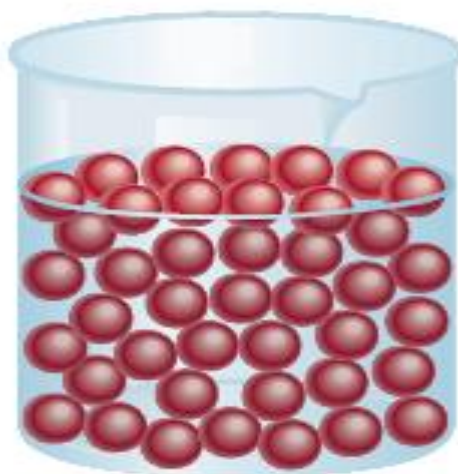
The Three States of Matter

All substances, at least in principle, can exist in three states: **solid**, **liquid** and **gas**.



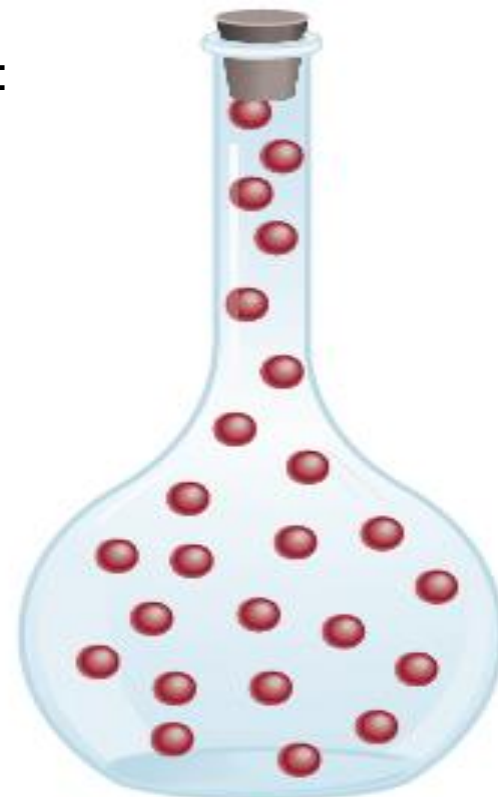
Solid

Molecules are held close together in orderly fashion with little freedom of motion. Has both definite shape and volume.



Liquid

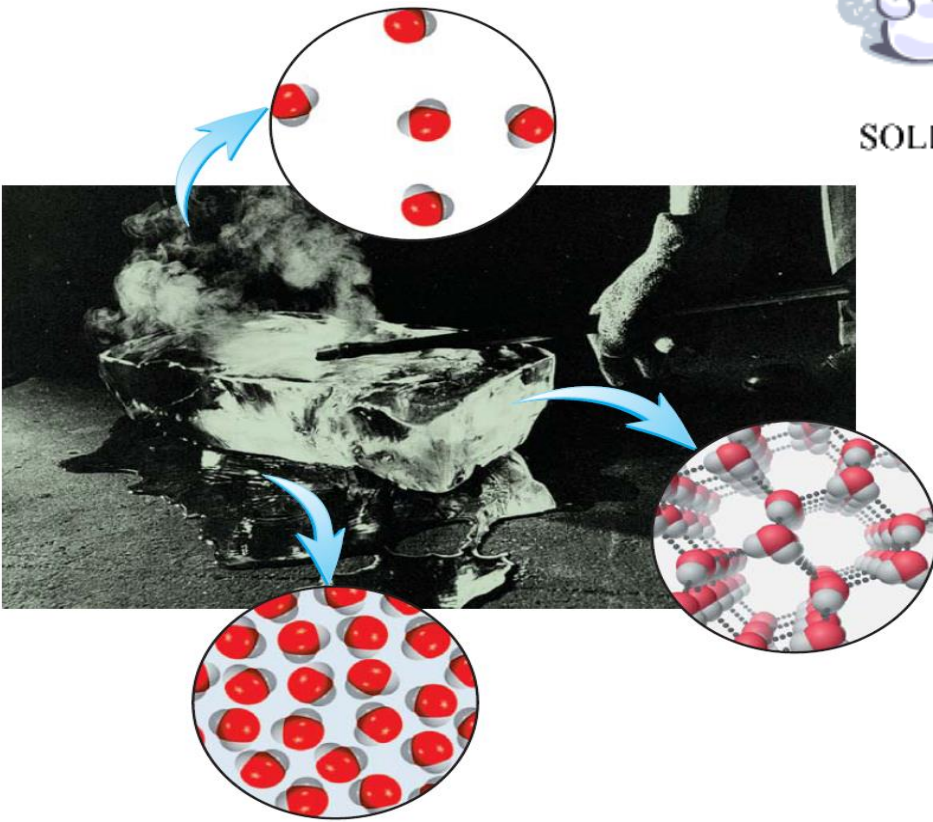
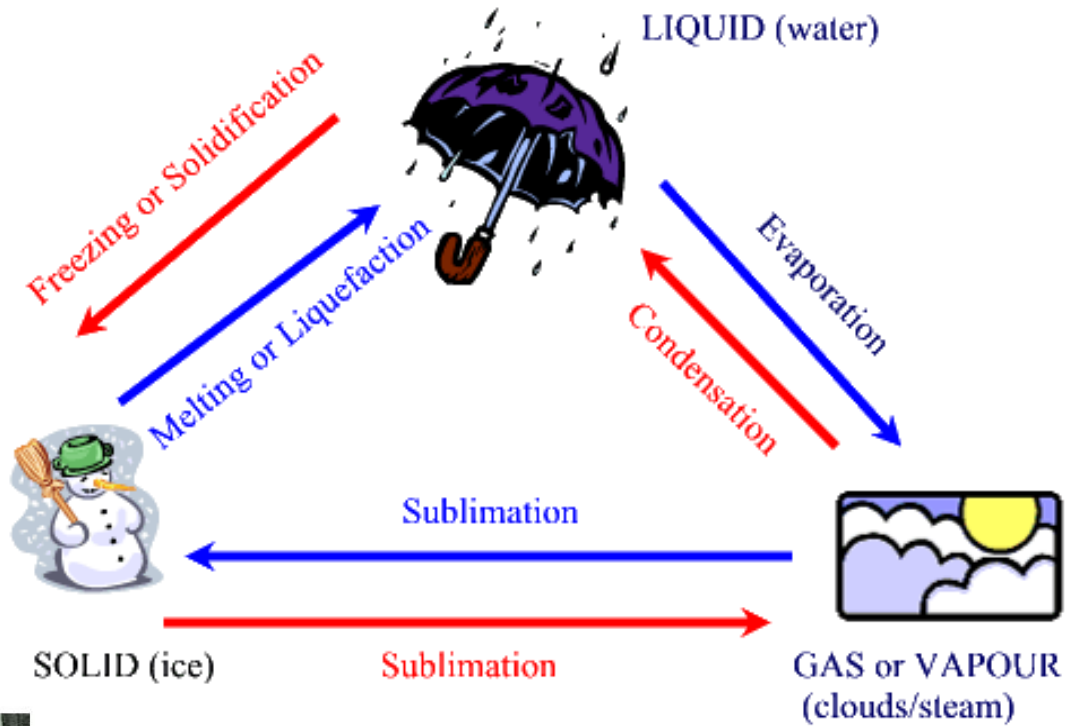
Molecules are close together but not held so rigidly in position and can move past on another. Has distinct volume but has no specific shape.



Gas

Molecules are separated by distance. Has no fixed volume or shape, they conform to the volume and shape of its containers. It can be compressed or expand.

The three states of matter can be interconverted without changing the composition of the substance.



1.6

**Physical and Chemical
Properties of Matter**

Physical & Chemical properties

Substances are identified by their **properties** as well as by their **composition**.

A chemical property and a physical property are related to chemical and physical changes of matter.

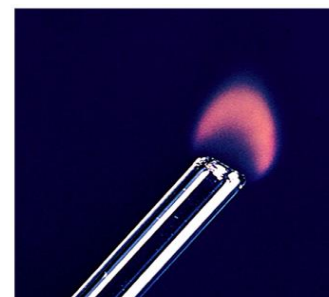
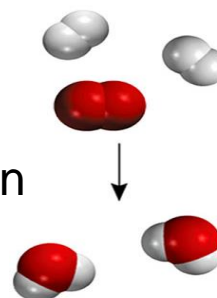
A **physical property** is an aspect of matter that can be observed or measured without changing the composition or identity of a substance.

e.g., color, volume, density, molecular weight, melting point & boiling point.

A **chemical property** may only be observed by changing the chemical composition or identity of a substance.

e.g., reactivity, flammability, pH & oxidation states.

Hydrogen burns in
air to form water



Extensive & Intensive properties

All measurable properties of matter fall into one of two additional categories;
extensive properties and intensive properties.

An **extensive property** of a material depends upon how much matter is being considered. The value of an extensive quantity depends on the amount of matter. Extensive properties are additive.

e.g., mass, length, volume.

An **intensive property** of a material does not depend upon how much matter is being considered. Intensive properties are not additive.

e.g., density, temperature, color.



Sulfur crystals

EXTENSIVE
(dependent on amount of substance)

39 g	mass	0.84 g
18.8 cm ³	volume	4.1 cm ³

INTENSIVE
(independent of amount of substance)

yellow	color	yellow
115.2°C	melting point	115.2°C



Sulfur powder



100 g	Mass of water	10 g
100 mL	Volume of water	10 mL
25 °C	Temperature of water	25 °C
1.0 g/mL	Density of water	1.0 g/mL

