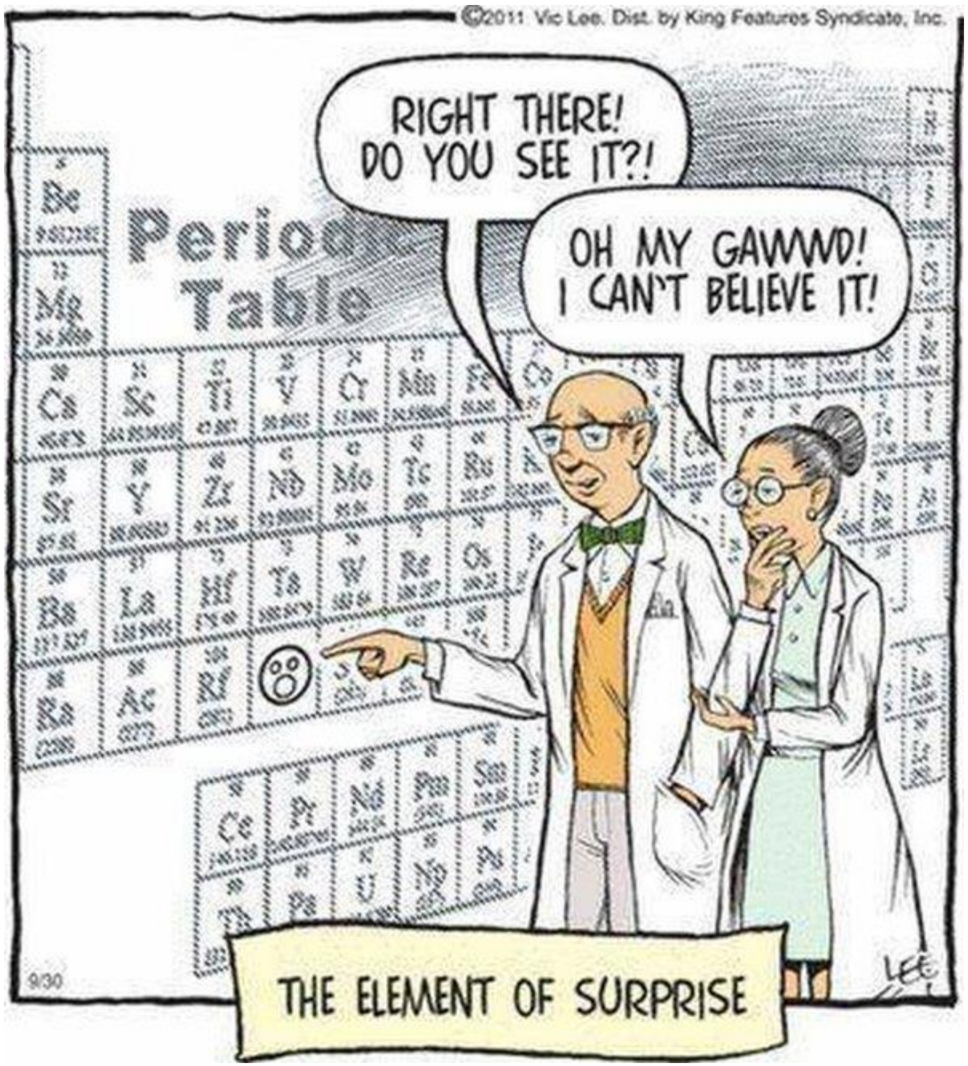
College Chemistry I

NWACC
NORTHWEST ARKANSAS COMMUNITY COLLEGE
Maximize Potential.
Exceed Expectations.



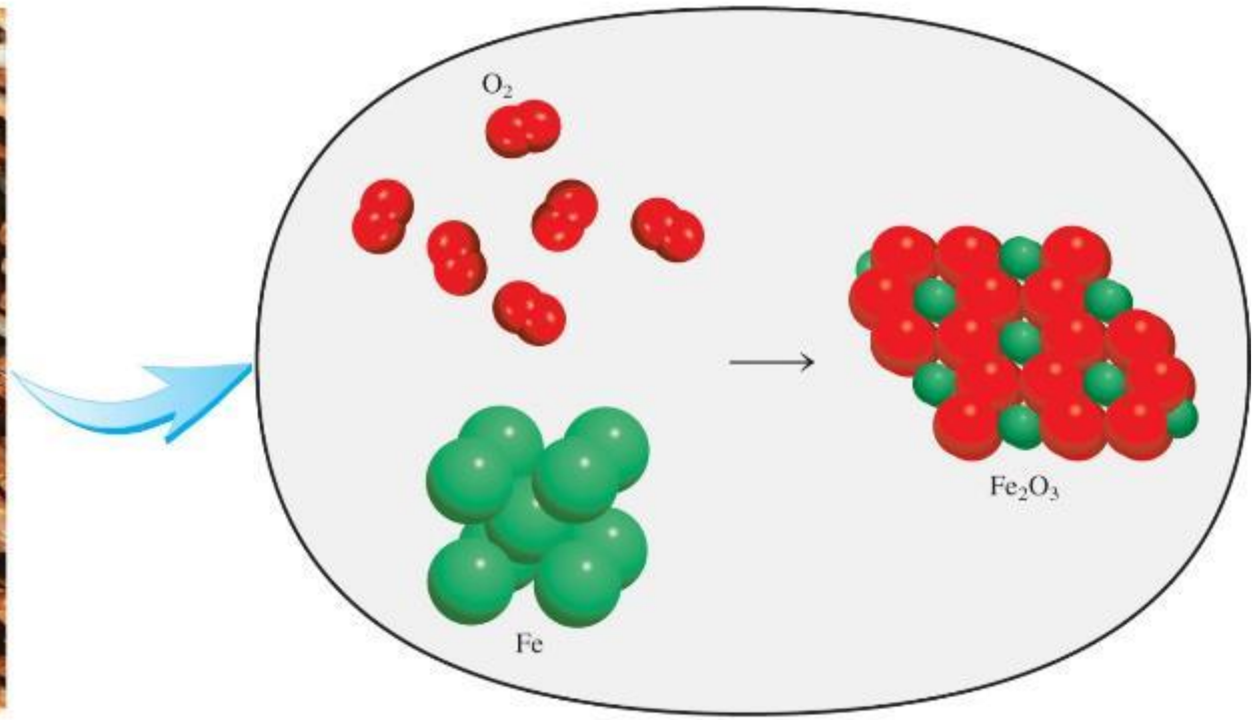
Dr. Glen Akridge

The Study of Chemistry

Macroscopic

Microscopic

© B.A.E. Inc./Alamy



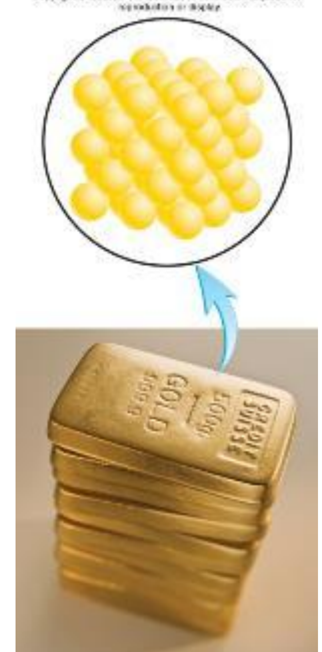
Defining Chemistry

Chemistry is the study of matter and the changes it undergoes.

Matter is anything that occupies space and has mass.

A ***substance*** is a form of matter that has a definite composition and distinct properties.

© McGraw-Hill Higher Education Inc./Stephen Frisch, Photographer



© Tetra Images/Getty Images

Mixtures

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

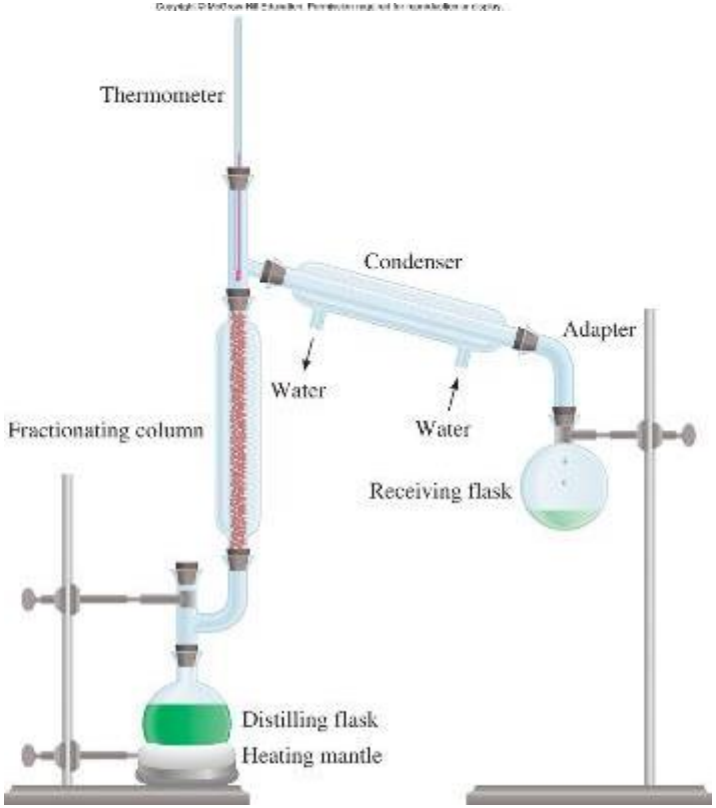
1. ***Homogenous mixture –*** composition of the mixture is the same throughout

2. ***Heterogeneous mixture –*** composition is not uniform throughout

iron filings in sand

Mixtures (2)

Physical means can be used to separate a mixture into its pure components.



distillation

magnet

Elements

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

- 118 elements have been identified
- 82 elements occur naturally on Earth

  gold, aluminum, lead, oxygen, carbon, sulfur

- 36 elements have been created by scientists

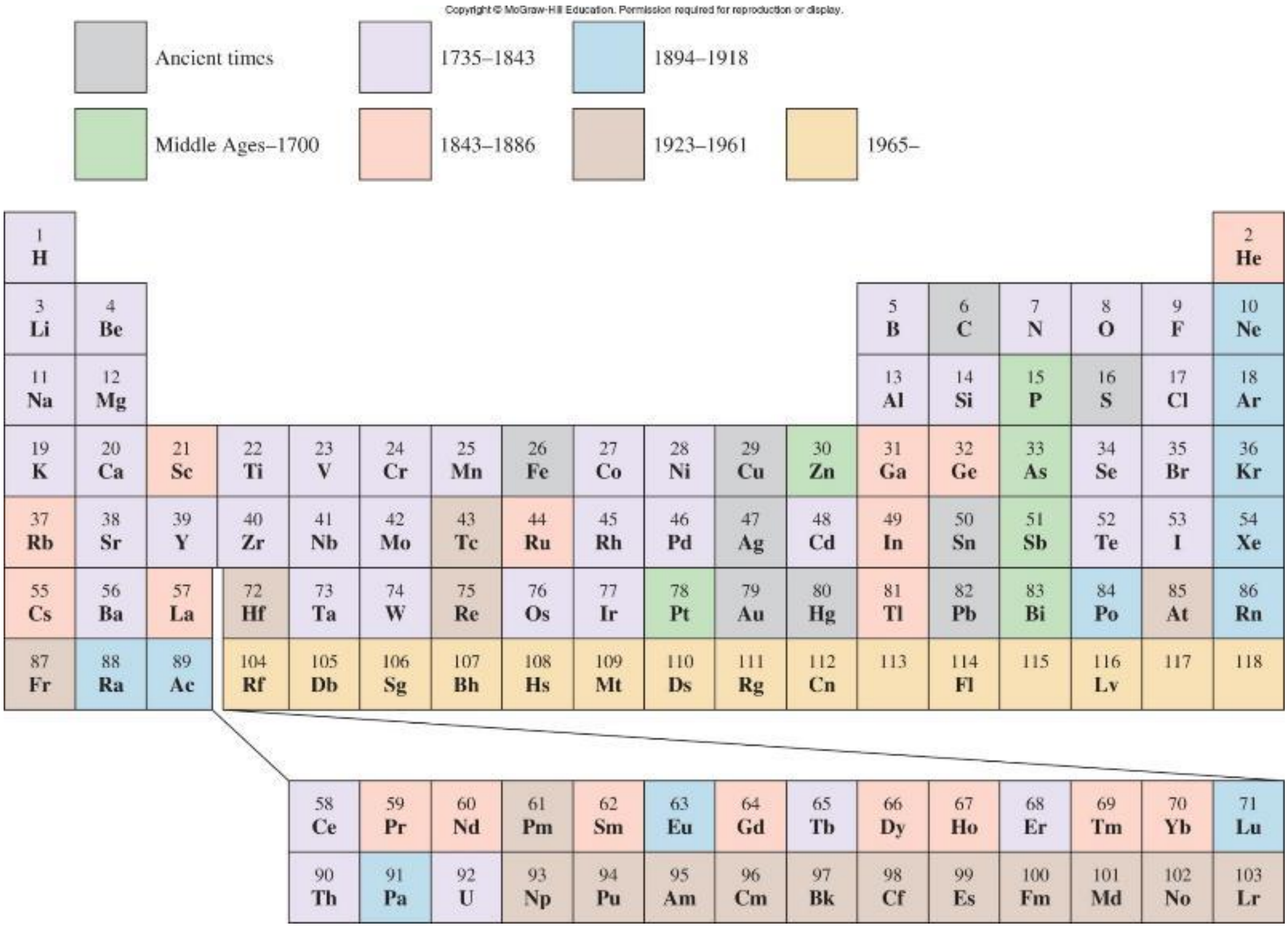
  technetium, americium, seaborgium

Elements (2)

Table 1.1 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

When the Elements Were Discovered

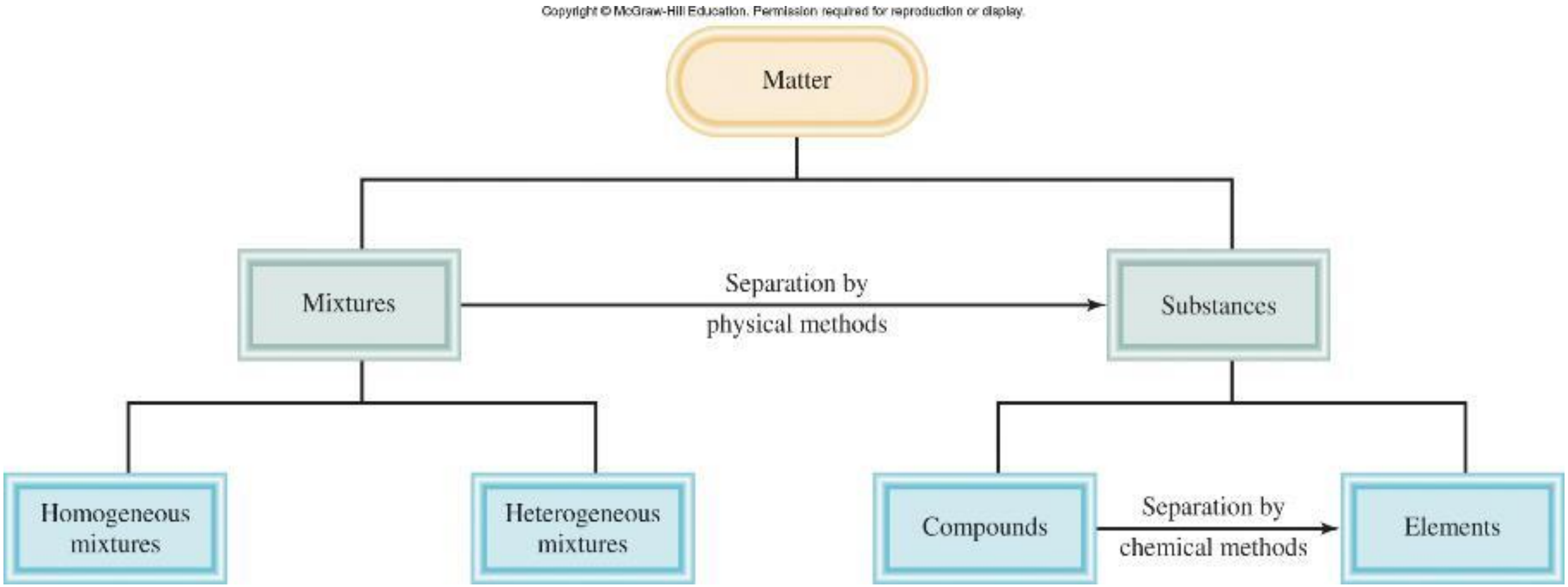


Compounds

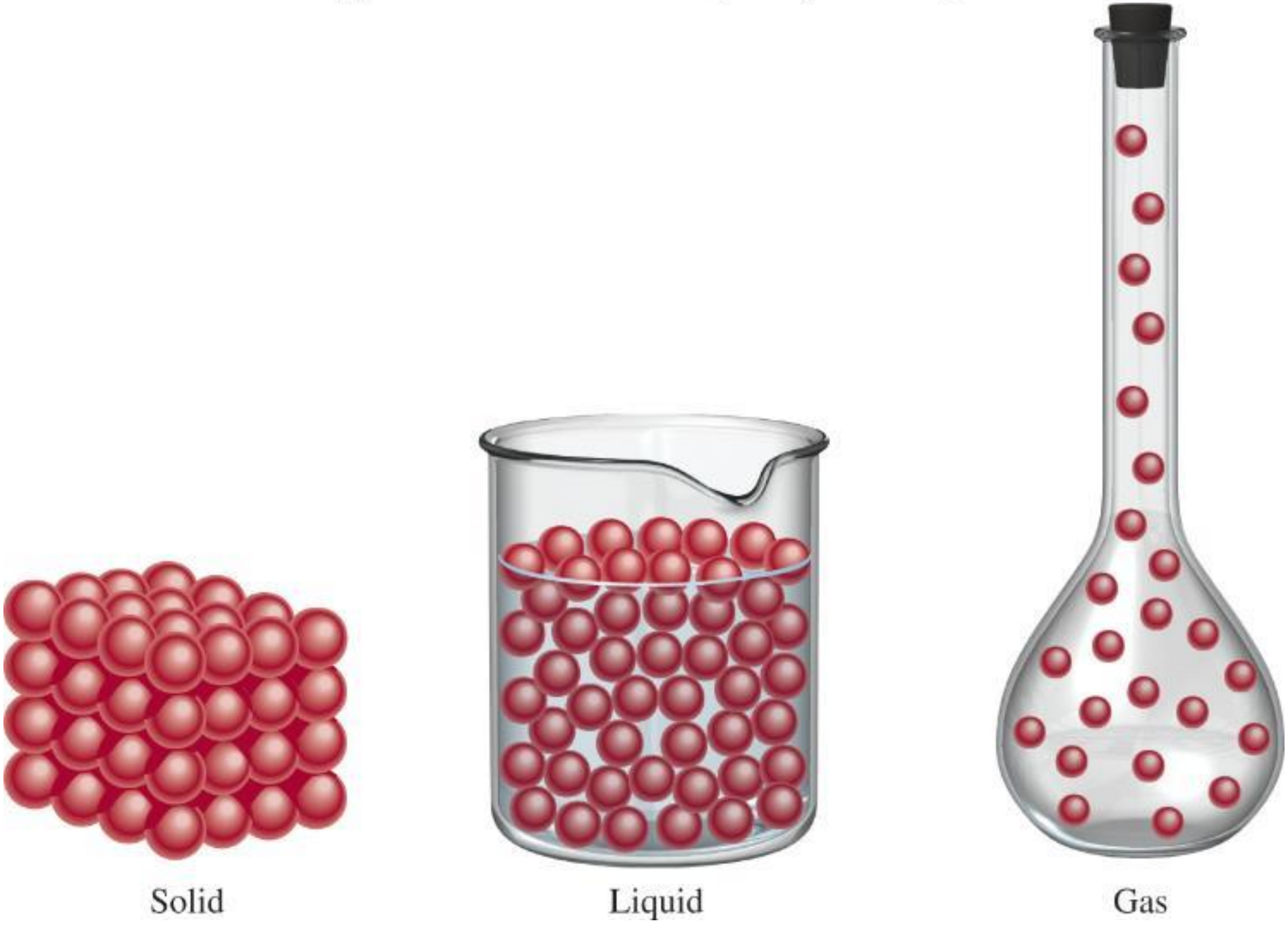
A ***compound*** is a substance composed of atoms of two or more elements chemically united in fixed proportions.

Compounds can only be separated into their pure components (elements) by ***chemical*** means.

Classifications of Matter



A Comparison: The Three States of Matter



International System of Units (SI)

Table 1.2 SI Base Units

Base Quantity	Name of Unit	Symbol
Length	meter	m
Mass	kilogram	Kg
Time	second	s
Electrical current	ampere	A
Temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

In this class we will typically use:

g, ml, L, K, ºC

The Prefixes Used with SI Units

Prefix	Symbol	Meaning	Scientific Notation
exa-	E	1,000,000,000,000,000,000	10^{18}
peta-	P	1,000,000,000,000,000	10^{15}
tera-	T	1,000,000,000,000	10^{12}
giga-	G	1,000,000,000	10^{9}
mega-	M	1,000,000	10^{6}
kilo-	k	1,000	10^{3}
hecto-	h	100	10^{2}
deka-	da	10	10^{1}
—	—	1	10^{0}
deci-	d	0.1	10^{-1}
centi-	c	0.01	10^{-2}
milli-	m	0.001	10^{-3}
micro-	μ	0.000 001	10^{-6}
nano-	n	0.000 000 001	10^{-9}
pico-	p	0.000 000 000 001	10^{-12}
femto-	f	0.000 000 000 000 001	10^{-15}
atto-	a	0.000 000 000 000 000 001	10^{-18}

Scientific Notation:

Used to make very large or very small numbers more manageable.

The number of atoms in 12 g of carbon:

602,200,000,000,000,000,000,000

$$6.022 \times 10^{23}$$

The mass of a single carbon atom in grams:

0.0000000000000000000000199

$$1.99 \times 10^{-23}\ \text{g}$$

$$\boxed{\mathrm{N} \times 10^{n}}$$

N is a number between 1 and 10

n is a positive or negative integer

Scientific Notation (2)

568.762

$\leftarrow$ move decimal left

$n > 0$

$568.762 = 5.68762 \times 10^{\mathbf{2}}$

0.00000772

$\longrightarrow$ move decimal right

$n < 0$

$0.00000772 = 7.72 \times 10^{\mathbf{-6}}$

Addition or Subtraction

1. Write each quantity with the same exponent *n*
2. Combine N_1 and N_2
3. The exponent, *n*, remains the same

$4.31 \times 10^{\mathbf{4}} + 3.9 \times 10^{\mathbf{3}} =$

$4.31 \times 10^{\mathbf{4}} + 0.39 \times 10^{\mathbf{4}} =$

$4.70 \times 10^{\mathbf{4}}$

Scientific Notation (3)

Multiplication

1. Multiply N_1 and N_2
2. Add exponents n_1 and n_2

$$\left(4.0 \times 10^{-5}\right) \times \left(7.0 \times 10^{3}\right) =$$
$$(4.0 \times 7.0) \times \left(10^{-5+3}\right) =$$
$$28 \times 10^{-2} =$$
$$2.8 \times 10^{-1}$$

Division

1. Divide N_1 and N_2
2. Subtract exponents n_1 and n_2

$$8.5 \times 10^{4} \div 5.0 \times 10^{9} =$$
$$(8.5 \div 5.0) \times 10^{4-9} =$$
$$1.7 \times 10^{-5}$$

Accuracy versus Precision

Accuracy – how close a measurement is to the *true* value

Precision – how close a set of measurements are to each other

(a) accurate & precise

(b) precise but not accurate

(c) not accurate & not precise

Dimensional Analysis Method of Solving Problems

1. Determine which unit conversion factor(s) are needed
2. Carry units through calculation
3. If all units cancel except for the ***desired unit(s)***, then the problem was solved correctly.

given quantity × conversion factor = desired quantity

$$\text{given unit} \times \frac{\text{desired unit}}{\text{given unit}} = \text{desired unit}$$

Example

A person's average daily intake of glucose (a form of sugar) is 0.0833 pound (lb). What is this mass in milligrams (mg)? $(1\ \text{lb} = 453.6\ \text{g.})$

© Leonard Lessin/Science Source