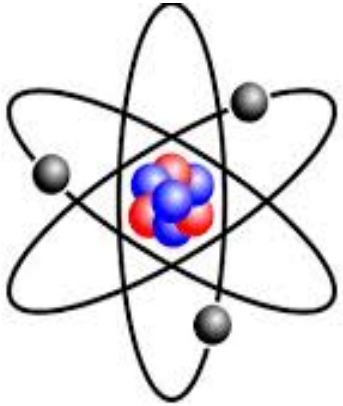
Term 2:
Matter & Materials

Mrs Ramuhashi

Matter

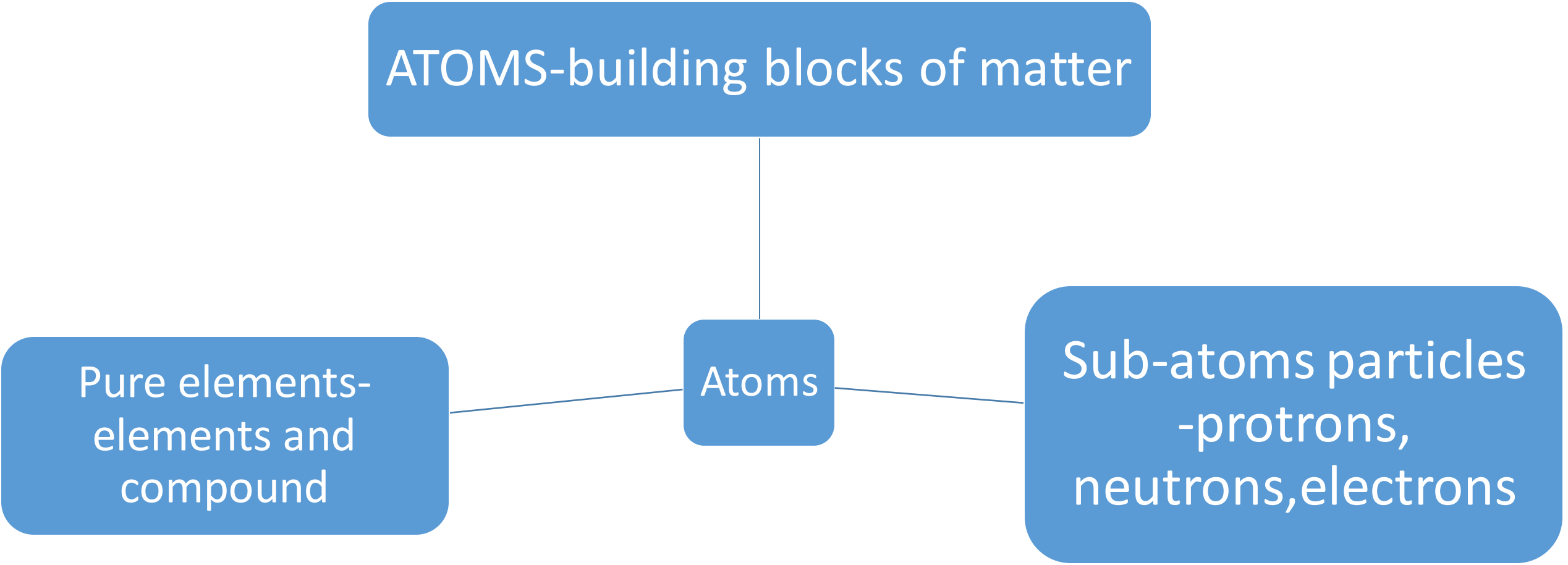
- Anything that has mass and occupies space (has volume)
  - Mass - mg, g, kg, tons
  - Volume - mm^3, cm^3, m^3
- All matter is made up of tiny particles called atoms

Atoms



- Smallest building blocks of matter
- Smallest units that make up elements
- Cannot be broken down into simpler substances
- Only visible through an electron microscope

Atoms


ATOMS-building blocks of matter
Atoms
Pure elements-elements and compound
Sub-atoms particles -protrons, neutrons,electrons

Matter

- Is made up of tiny particles
- Our bodies and everything we see, taste, or smell are made up by matter

Atoms

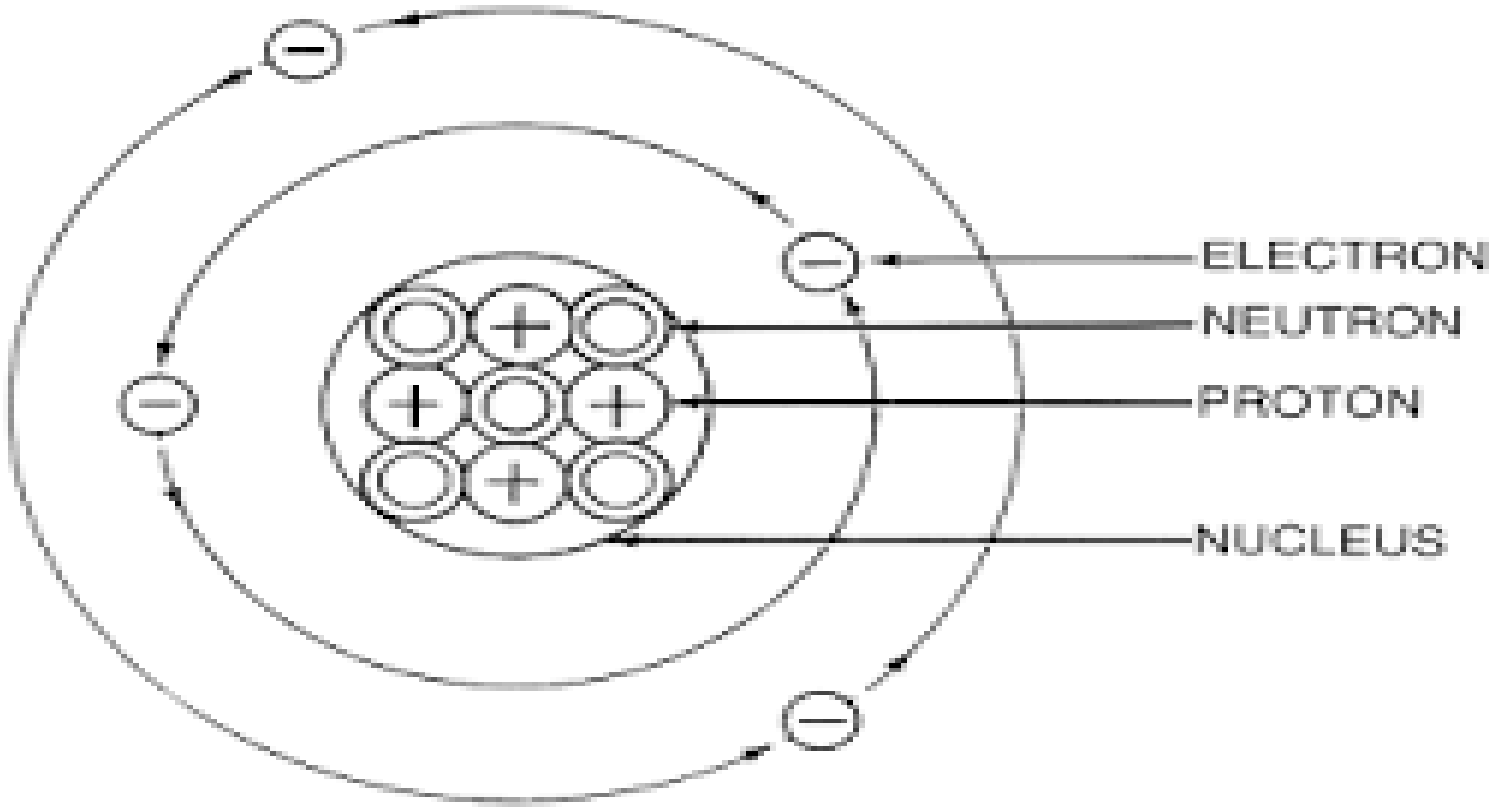
- Building blocks of all matter
- Are very small to see even with the best microscopes

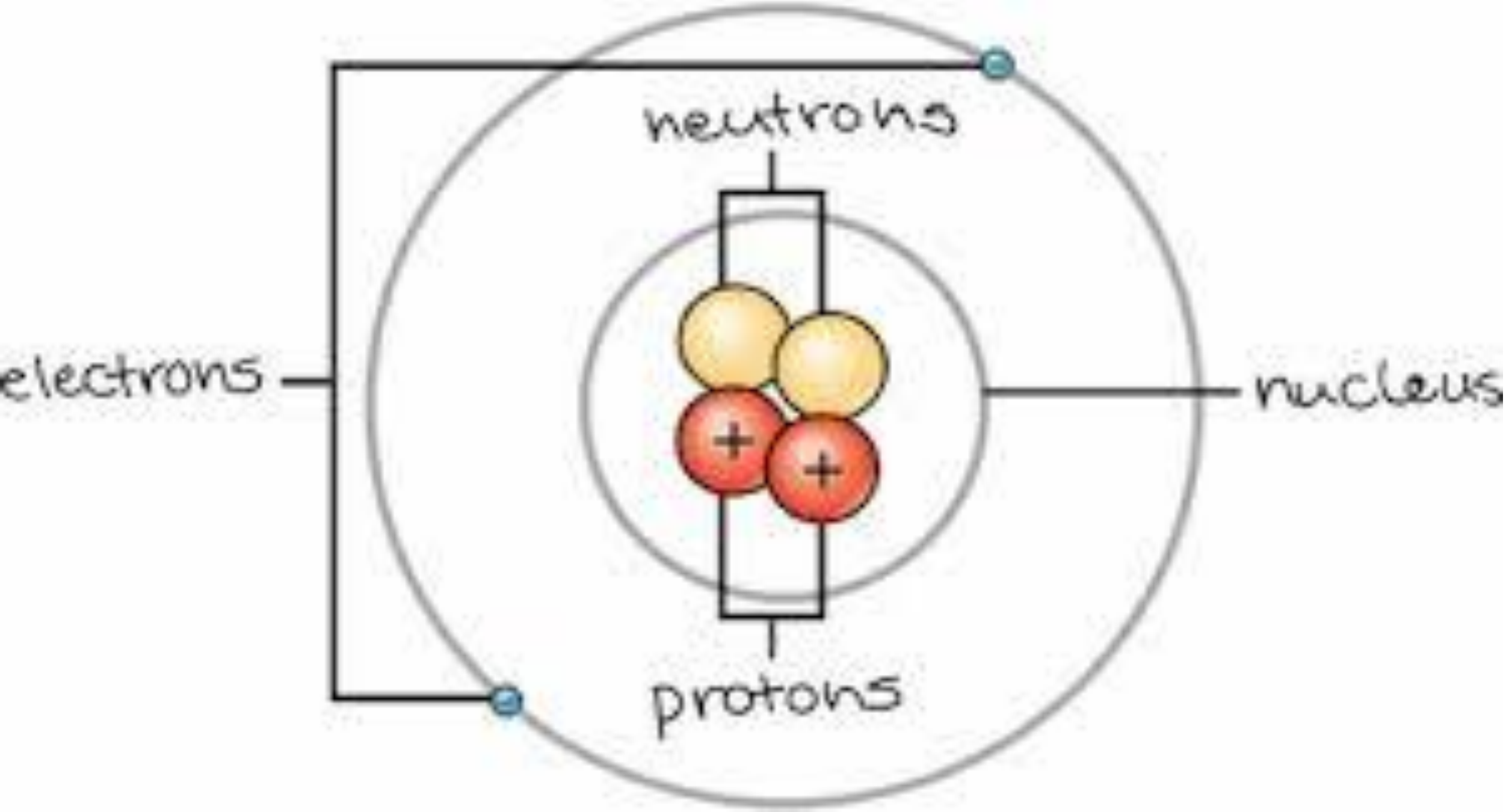
Elements

- Periodic table of elements (Pg 162)
- Elements are made up of atoms of the same kind and cannot be broken down into other elements

Atoms are made up of sub-atomic particles.

1. Electrons
2. Protons
3. Neutrons




neutrons
electrons
nucleus
protons

Nucleus – the central region in an atom

Neutrons are neutral

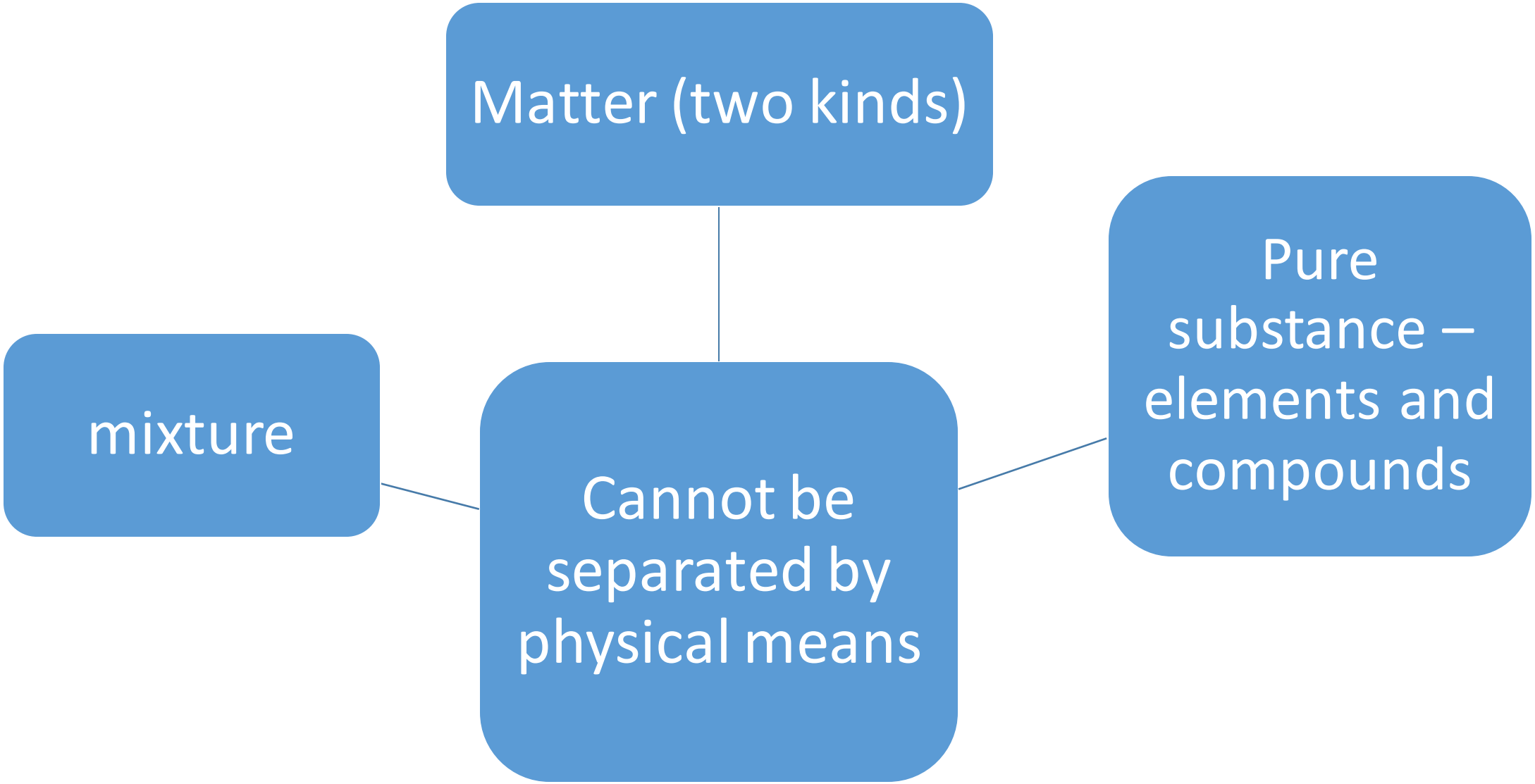
- No electric charge

Electrons are negative

- Has negative charge

Protons are positive

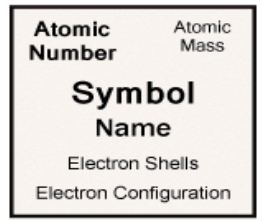
- Has positive charge


Matter (two kinds)
mixture
Cannot be separated by physical means
Pure substance – elements and compounds

Elements in a periodic table

The periodic table, also known as the periodic table of elements, is a tabular display of the chemical elements, which are arranged by atomic number, electron configuration, and recurring chemical properties.

Periodic Table of the Elements



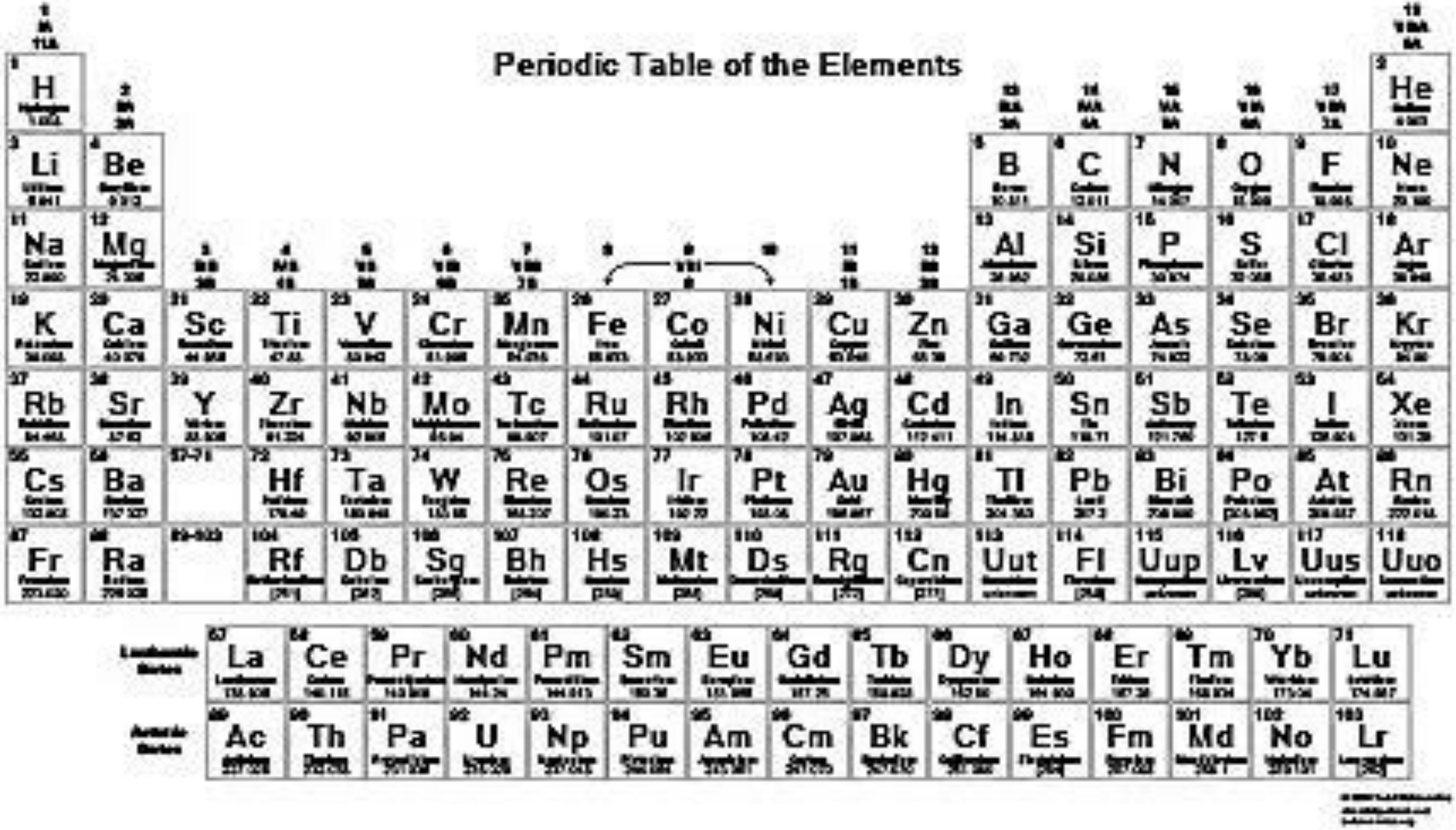
Element symbol represents state at room temperature.

Solid, Liquid or Gas

3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8	9 VIII 8	10	11 IB 1B	12 IIB 2B	13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A
										5 10.811 **B** Boron 2 3 $[He]2s^2 2p^1$	6 12.011 **C** Carbon 2 4 $[He]2s^2 2p^2$	7 14.007 **N** Nitrogen 2 5 $[He]2s^2 2p^3$	8 15.999 **O** Oxygen 2 6 $[He]2s^2 2p^4$	9 18.998 **F** Fluorine 2 7 $[He]2s^2 2p^5$	2 4.003 **He** Helium 2 $1s^2$
										13 26.982 **Al** Aluminum 2 8 3 $[Ne]3s^2 3p^1$	14 28.086 **Si** Silicon 2 8 4 $[Ne]3s^2 3p^2$	15 30.974 **P** Phosphorus 2 8 5 $[Ne]3s^2 3p^3$	16 32.066 **S** Sulfur 2 8 6 $[Ne]3s^2 3p^4$	17 35.453 **Cl** Chlorine 2 8 7 $[Ne]3s^2 3p^5$	10 20.180 **Ne** Neon 2 8 $[He]2s^2 2p^6$
21 44.956 **Sc** Scandium 2 8 9 2 $[Ar]3d^1 4s^2$	22 47.88 **Ti** Titanium 2 8 10 2 $[Ar]3d^2 4s^2$	23 50.942 **V** Vanadium 2 8 11 2 $[Ar]3d^3 4s^2$	24 51.996 **Cr** Chromium 2 8 13 1 $[Ar]3d^5 4s^1$	25 54.938 **Mn** Manganese 2 8 13 2 $[Ar]3d^5 4s^2$	26 55.845 **Fe** Iron 2 8 14 2 $[Ar]3d^6 4s^2$	27 58.933 **Co** Cobalt 2 8 15 2 $[Ar]3d^7 4s^2$	28 58.693 **Ni** Nickel 2 8 16 2 $[Ar]3d^8 4s^2$	29 63.546 **Cu** Copper 2 8 18 1 $[Ar]3d^{10} 4s^1$	30 65.38 **Zn** Zinc 2 8 18 2 $[Ar]3d^{10} 4s^2$	31 69.723 **Ga** Gallium 2 8 18 3 $[Ar]3d^{10} 4s^2 4p^1$	32 72.631 **Ge** Germanium 2 8 18 4 $[Ar]3d^{10} 4s^2 4p^2$	33 74.922 **As** Arsenic 2 8 18 5 $[Ar]3d^{10} 4s^2 4p^3$	34 78.971 **Se** Selenium 2 8 18 6 $[Ar]3d^{10} 4s^2 4p^4$	35 79.904 **Br** Bromine 2 8 18 7 $[Ar]3d^{10} 4s^2 4p^5$	36 84.798 **Kr** Krypton 2 8 18 8 $[Ar]3d^{10} 4s^2 4p^6$
39 88.906 **Y** Yttrium 2 8 18 9 2 $[Kr]4d^1 5s^2$	40 91.224 **Zr** Zirconium 2 8 18 10 2 $[Kr]4d^2 5s^2$	41 92.906 **Nb** Niobium 2 8 18 12 1 $[Kr]4d^4 5s^1$	42 95.95 **Mo** Molybdenum 2 8 18 13 1 $[Kr]4d^5 5s^1$	43 98.907 **Tc** Technetium 2 8 18 14 1 $[Kr]4d^5 5s^2$	44 101.07 **Ru** Ruthenium 2 8 18 15 1 $[Kr]4d^7 5s^1$	45 102.906 **Rh** Rhodium 2 8 18 16 1 $[Kr]4d^8 5s^1$	46 106.42 **Pd** Palladium 2 8 18 18 $[Kr]4d^{10}$	47 107.868 **Ag** Silver 2 8 18 18 1 $[Kr]4d^{10} 5s^1$	48 112.414 **Cd** Cadmium 2 8 18 18 2 $[Kr]4d^{10} 5s^2$	49 114.818 **In** Indium 2 8 18 18 3 $[Kr]4d^{10} 5s^2 5p^1$	50 118.711 **Sn** Tin 2 8 18 18 4 $[Kr]4d^{10} 5s^2 5p^2$	51 121.760 **Sb** Antimony 2 8 18 18 5 $[Kr]4d^{10} 5s^2 5p^3$	52 127.6 **Te** Tellurium 2 8 18 18 6 $[Kr]4d^{10} 5s^2 5p^4$	53 126.904 **I** Iodine 2 8 18 18 7 $[Kr]4d^{10} 5s^2 5p^5$	54 131.249 **Xe** Xenon 2 8 18 18 8 $[Kr]4d^{10} 5s^2 5p^6$
57-71	72 178.49 **Hf** Hafnium 2 8 18 32 10 2 $[Xe]4f^{14} 5d^2 6s^2$	73 180.948 **Ta** Tantalum 2 8 18 32 11 2 $[Xe]4f^{14} 5d^3 6s^2$	74 183.84 **W** Tungsten 2 8 18 32 12 2 $[Xe]4f^{14} 5d^4 6s^2$	75 186.207 **Re** Rhenium 2 8 18 32 13 2 $[Xe]4f^{14} 5d^5 6s^2$	76 190.23 **Os** Osmium 2 8 18 32 14 2 $[Xe]4f^{14} 5d^6 6s^2$	77 192.217 **Ir** Iridium 2 8 18 32 15 2 $[Xe]4f^{14} 5d^7 6s^2$	78 195.085 **Pt** Platinum 2 8 18 32 17 1 $[Xe]4f^{14} 5d^9 6s^1$	79 196.967 **Au** Gold 2 8 18 32 18 1 $[Xe]4f^{14} 5d^{10} 6s^1$	80 200.592 **Hg** Mercury 2 8 18 32 18 2 $[Xe]4f^{14} 5d^{10} 6s^2$	81 204.383 **Tl** Thallium 2 8 18 32 18 3 $[Xe]4f^{14} 5d^{10} 6s^2 6p^1$	82 207.2 **Pb** Lead 2 8 18 32 18 4 $[Xe]4f^{14} 5d^{10} 6s^2 6p^2$	83 208.980 **Bi** Bismuth 2 8 18 32 18 5 $[Xe]4f^{14} 5d^{10} 6s^2 6p^3$	84 [208.982] **Po** Polonium 2 8 18 32 18 6 $[Xe]4f^{14} 5d^{10} 6s^2 6p^4$	85 209.987 **At** Astatine 2 8 18 32 18 7 $[Xe]4f^{14} 5d^{10} 6s^2 6p^5$	86 222.018 **Rn** Radon 2 8 18 32 18 8 $[Xe]4f^{14} 5d^{10} 6s^2 6p^6$
89-103	104 [261] **Rf** Rutherfordium 2 8 18 32 32 10 2 $[Rn]5f^{14} 6d^2 7s^{2*}$	105 [262] **Db** Dubnium 2 8 18 32 32 11 2 $[Rn]5f^{14} 6d^3 7s^{2*}$	106 [266] **Sg** Seaborgium 2 8 18 32 32 12 2 $[Rn]5f^{14} 6d^4 7s^{2*}$	107 [264] **Bh** Bohrium 2 8 18 32 32 13 2 $[Rn]5f^{14} 6d^5 7s^{2*}$	108 [269] **Hs** Hassium 2 8 18 32 32 14 2 $[Rn]5f^{14} 6d^6 7s^{2*}$	109 [268] **Mt** Meitnerium 2 8 18 32 32 15 2 $[Rn]5f^{14} 6d^7 7s^{2*}$	110 [269] **Ds** Darmstadtium 2 8 18 32 32 16 2 $[Rn]5f^{14} 6d^8 7s^{2*}$	111 [272] **Rg** Roentgenium 2 8 18 32 32 17 2 $[Rn]5f^{14} 6d^9 7s^{2*}$	112 [277] **Cn** Copernicium 2 8 18 32 32 18 2 $[Rn]5f^{14} 6d^{10} 7s^{2*}$	113 unknown **Uut** Ununtrium 2 8 18 32 32 18 3 $[Rn]5f^{14} 6d^{10} 7s^2 7p^{1*}$	114 [289] **Fl** Flerovium 2 8 18 32 32 18 4 $[Rn]5f^{14} 6d^{10} 7s^2 7p^{2*}$	115 unknown **Uup** Ununpentium 2 8 18 32 32 18 5 $[Rn]5f^{14} 6d^{10} 7s^2 7p^{3*}$	116 [298] **Lv** Livermorium 2 8 18 32 32 18 6 $[Rn]5f^{14} 6d^{10} 7s^2 7p^{4*}$	117 unknown **Uus** Ununseptium 2 8 18 32 32 18 7 $[Rn]5f^{14} 6d^{10} 7s^2 7p^{5*}$	118 unknown **Uuo** Ununoctium 2 8 18 32 32 18 8 $[Rn]5f^{14} 6d^{10} 7s^2 7p^{6*}$

Lanthanide series														
57 138.905 **La** Lanthanum 2 8 18 18 9 2 $[Xe]5d^1 6s^2$	58 140.116 **Ce** Cerium 2 8 18 20 8 2 $[Xe]4f^1 5d^1 6s^2$	59 140.908 **Pr** Praseodymium 2 8 18 21 8 2 $[Xe]4f^3 6s^2$	60 144.243 **Nd** Neodymium 2 8 18 22 8 2 $[Xe]4f^4 6s^2$	61 144.913 **Pm** Promethium 2 8 18 23 8 2 $[Xe]4f^5 6s^2$	62 150.36 **Sm** Samarium 2 8 18 24 8 2 $[Xe]4f^6 6s^2$	63 151.964 **Eu** Europium 2 8 18 25 8 2 $[Xe]4f^7 6s^2$	64 157.25 **Gd** Gadolinium 2 8 18 25 9 2 $[Xe]4f^7 5d^1 6s^2$	65 158.925 **Tb** Terbium 2 8 18 27 8 2 $[Xe]4f^9 6s^2$	66 162.500 **Dy** Dysprosium 2 8 18 28 8 2 $[Xe]4f^{10} 6s^2$	67 164.930 **Ho** Holmium 2 8 18 29 8 2 $[Xe]4f^{11} 6s^2$	68 167.259 **Er** Erbium 2 8 18 30 8 2 $[Xe]4f^{12} 6s^2$	69 168.934 **Tm** Thulium 2 8 18 31 8 2 $[Xe]4f^{13} 6s^2$	70 173.055 **Yb** Ytterbium 2 8 18 32 8 2 $[Xe]4f^{14} 6s^2$	71 174.967 **Lu** Lutetium 2 8 18 32 9 2 $[Xe]4f^{14} 5d^1 6s^2$
Actinide series														
89 227.028 **Ac** Actinium 2 8 18 32 18 9 2 $[Rn]6d^1 7s^2$	90 232.038 **Th** Thorium 2 8 18 32 18 10 2 $[Rn]6d^2 7s^2$	91 231.036 **Pa** Protactinium 2 8 18 32 20 9 2 $[Rn]5f^2 6d^1 7s^2$	92 238.029 **U** Uranium 2 8 18 32 21 9 2 $[Rn]5f^3 6d^1 7s^2$	93 237.048 **Np** Neptunium 2 8 18 32 23 8 2 $[Rn]5f^4 6d^1 7s^2$	94 244.064 **Pu** Plutonium 2 8 18 32 24 8 2 $[Rn]5f^6 7s^2$	95 243.061 **Am** Americium 2 8 18 32 25 8 2 $[Rn]5f^7 7s^2$	96 247.070 **Cm** Curium 2 8 18 32 25 9 2 $[Rn]5f^7 6d^1 7s^2$	97 247.070 **Bk** Berkelium 2 8 18 32 27 8 2 $[Rn]5f^9 7s^2$	98 251.080 **Cf** Californium 2 8 18 32 28 8 2 $[Rn]5f^{10} 7s^2$	99 [254] **Es** Einsteinium 2 8 18 32 29 8 2 $[Rn]5f^{11} 7s^2$	100 257.095 **Fm** Fermium 2 8 18 32 30 8 2 $[Rn]5f^{12} 7s^2$	101 258.1 **Md** Mendelevium 2 8 18 32 31 8 2 $[Rn]5f^{13} 7s^2$	102 259.101 **No** Nobelium 2 8 18 32 32 8 2 $[Rn]5f^{14} 7s^2$	103 [262] **Lr** Lawrencium 2 8 18 32 32 9 2 $[Rn]5f^{14} 6d^1 7s^2$

Alkali Metal | Alkaline Earth | Transition Metal | Basic Metal | Metalloid | Nonmetal | Halogen | Noble Gas | Lanthanide | Actinide

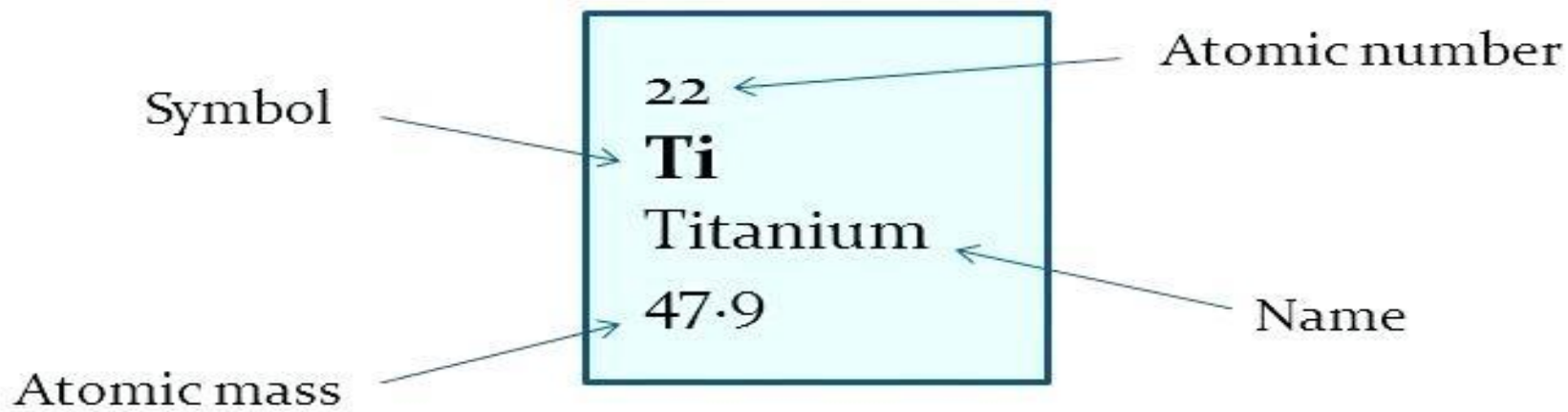

Periodic Table of the Elements
H
He
Li
Be
B
C
N
O
F
Ne
Na
Mg
Al
Si
P
S
Cl
Ar
K
Ca
Sc
Ti
V
Cr
Mn
Fe
Co
Ni
Cu
Zn
Ga
Ge
As
Se
Br
Kr
Rb
Sr
Y
Zr
Nb
Mo
Tc
Ru
Rh
Pd
Ag
Cd
In
Sn
Sb
Te
I
Xe
Cs
Ba
Hf
Ta
W
Re
Os
Ir
Pt
Au
Hg
Tl
Pb
Bi
Po
At
Rn
Fr
Ra
Rf
Db
Sg
Bh
Hs
Mt
Ds
Rg
Cn
Uut
Fl
Uup
Lv
Uus
Uuo
La
Ce
Pr
Nd
Pm
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Ac
Th
Pa
U
Np
Pu
Am
Cm
Bk
Cf
Es
Fm
Md
No
Lr

The first 20 elements of the periodic table :

1.H —Hydrogen
2.He—Helium
3.Li—Lithium
4.Be—Beryllium
5.B—Boron
6.C—Carbon
7.N—Nitrogen
8.O—Oxygen
9.F—Fluorine
10.Ne—Neon
11.Na—Sodium
12.Mg—Magnesium
13.Al—Aluminum
14.Si—Silicon
15.P—Phosphorus
16.S—Sulfur
17.Cl—Chlorine
18.Ar—Argon
19.K—Potassium
20.Ca—Calcium

Elements of the Periodic Table

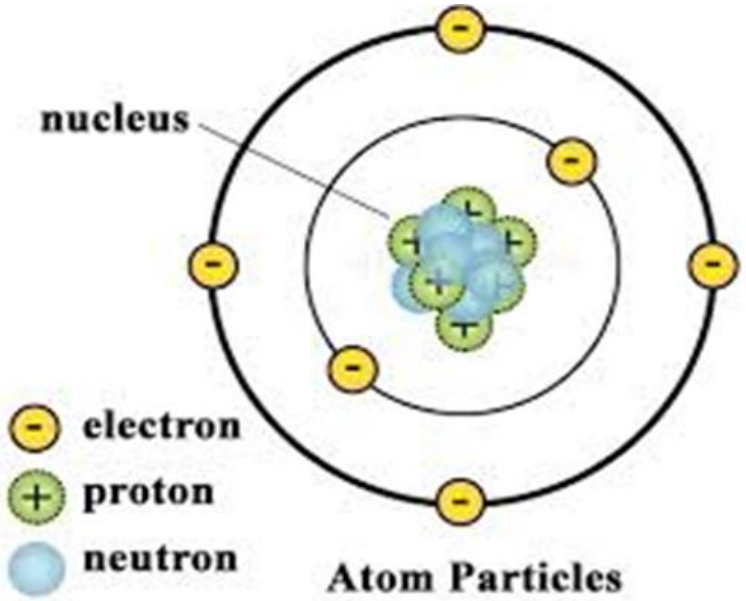
- Although there are many versions of the periodic table, most contain the following properties:

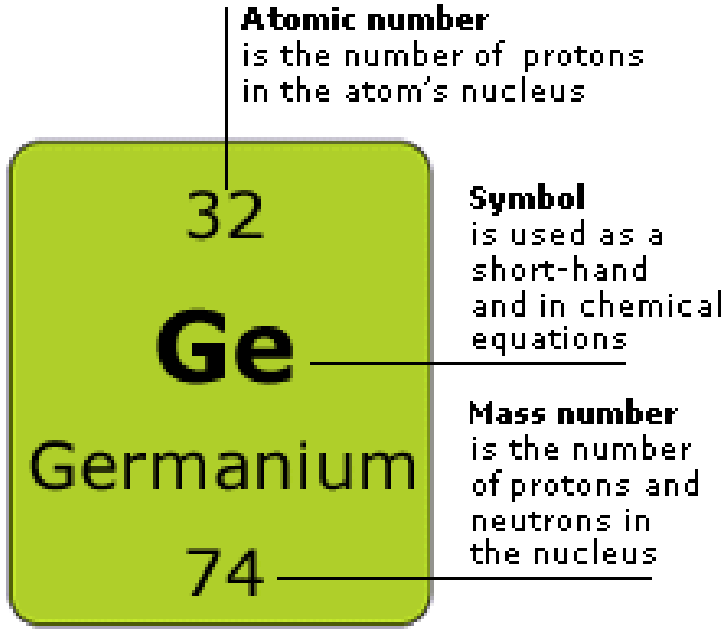


Determining the number of subatomic particles

Use information from the periodic table

- **Number of protons = atomic number**
- **Number of electrons = atomic number**
- **Number of particles in the nucleus = mass number**
- **Number of neutrons = mass number – atomic number**





ELEMENT

Has pure substances. Cannot be broken down into simpler substances. Use one or two letter symbol for an element's name e.g. H for hydrogen, C for calcium, Cl for chlorine

COMPOUND

- Has pure substances that has two or more kinds of atoms. Can be broken down into its elements by reaction or electrolysis. Each compound has chemical formula that shows which element are present in the compound and how many atoms of each element there are in one molecule e.g. the chemical formula for water H_20

NAME OF COMPOUND

- The chemical of a compound is worked out using the elements that make up the compound. e.g. sodium chloride or table salt (NaCl) is made of elements sodium(Na) and chlorine(Cl). Hydrogen sulphide(HS) is made of the elements hydrogen and sulfur.magnesium oxide(MgO) is made of elements magnesium and oxygen.

Activity 1 TERM 2

TOP CLASS NATURAL SCIENCE TEXTBOOK

Write answers in your classwork book

QUESTIONS FOR REVISION

PAGE 77

QUESTION 1
QUESTION 2
QUESTION 3

CHEMICAL REACTIOS

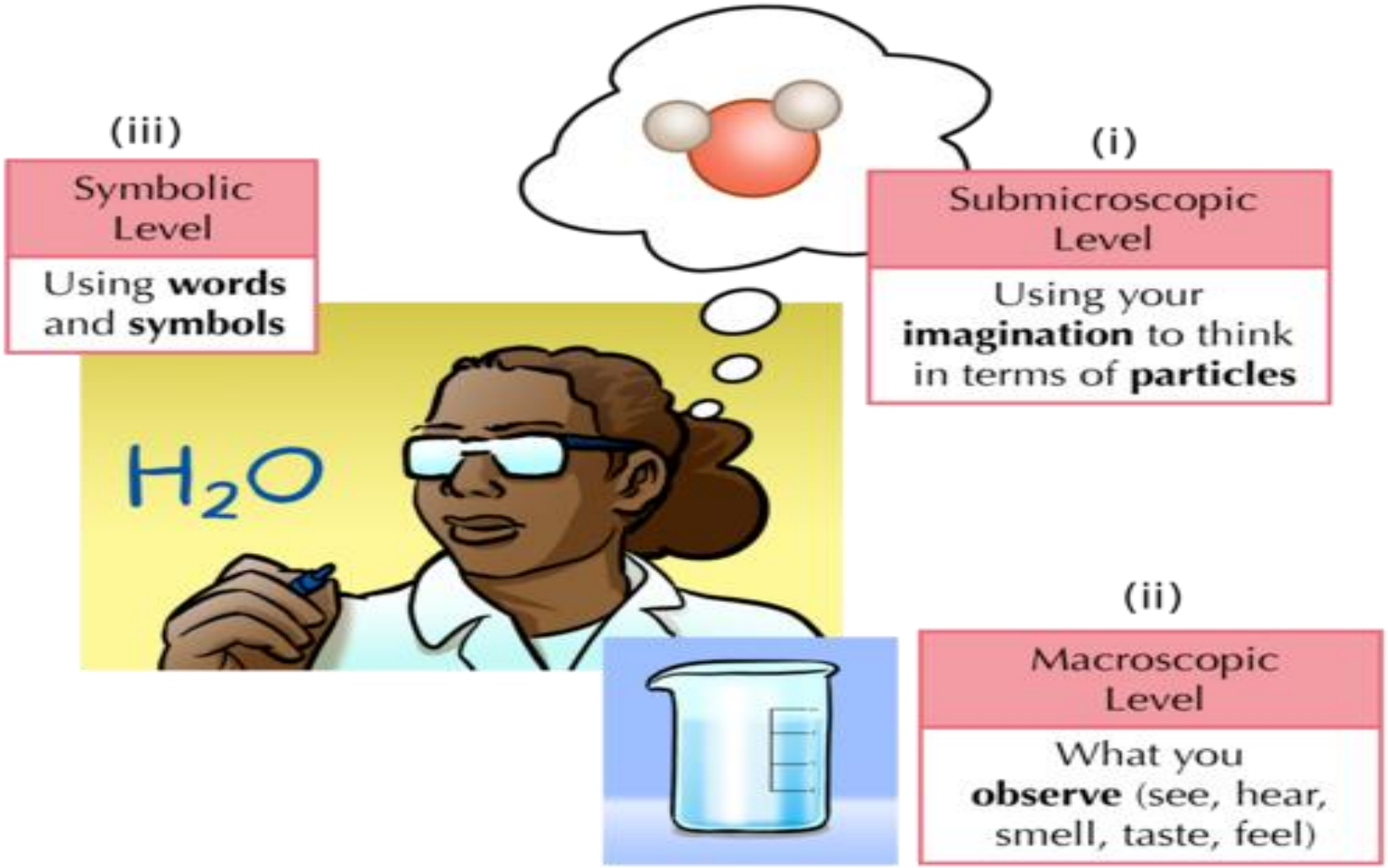
- During chemical reactions, materials are changed into new materials with new chemical and physical properties.
- The materials we start with are called **reactants**, and the new materials that form are called **products**.
- During a chemical reaction, atoms are rearranged. This requires that bonds be broken in the reactants and new bonds be formed in the products.

In this chapter we are going to build on these ideas. We will focus on two things:

- how to write chemical reaction equations; and
- how to balance chemical reaction equations.

compounds on three different levels

- Macroscopic
- Microscopic
- Submicroscopic



The water molecule on the top right shows what a particle of water would look like (i). We cannot see water particles with our eyes, therefore we have to imagine them. This is why the water molecule is inside a thought bubble. We call this a **submicroscopic representation**.

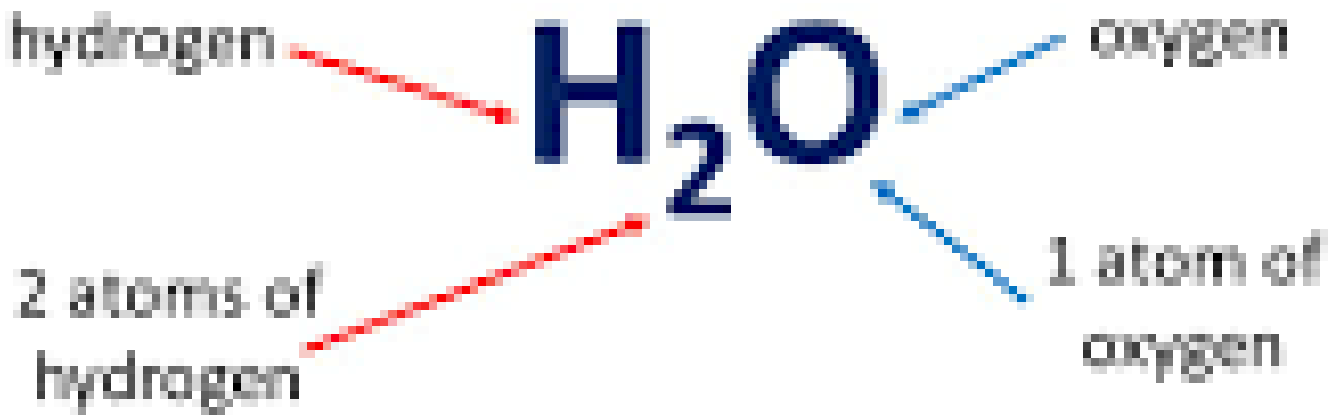
The beaker of water shows what water looks like to our eyes (ii). We call this a **macroscopic representation**, because it is observable. That means it can be observed by using our senses such as seeing, feeling, hearing, tasting or touching.

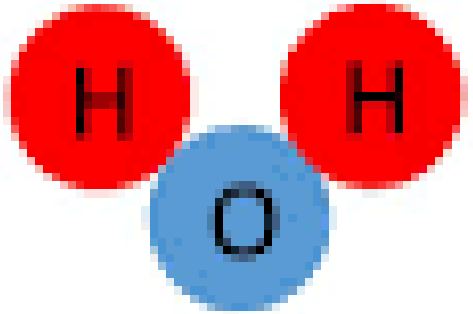
The chemical formula on the left uses chemical symbols to represent water (iii). We have learnt that chemical formulae are made up of element symbols. We can think of chemical symbols and formulae as a chemical 'language', because they tell a story. The 'story' told by the formula H_2O is that a water molecule consists of two atoms of H and one atom of O. The formula 'H_2O' is a **microscopic /symbolic representation**.

Chemical Formulae

- **Chemical formula**: tells you how many atoms of each element is in a molecule.

- Example: Water





Part 2 - Word Equations

To show what is happening during a chemical reaction we can write a word equation

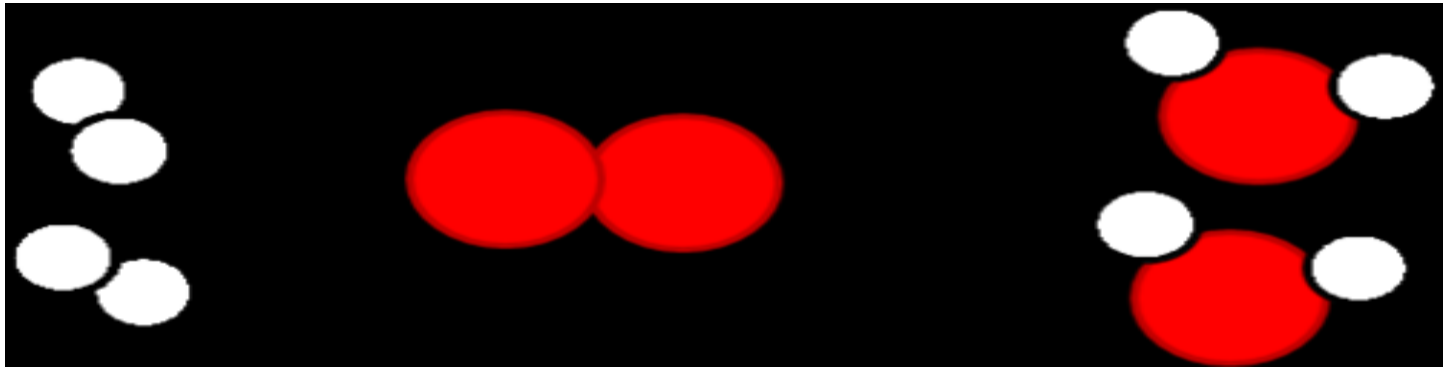
Eggs + flour + milk + butter → Cake

CHEMICAL EQUATIONS

1. Word equation

hydrogen + oxygen→ water

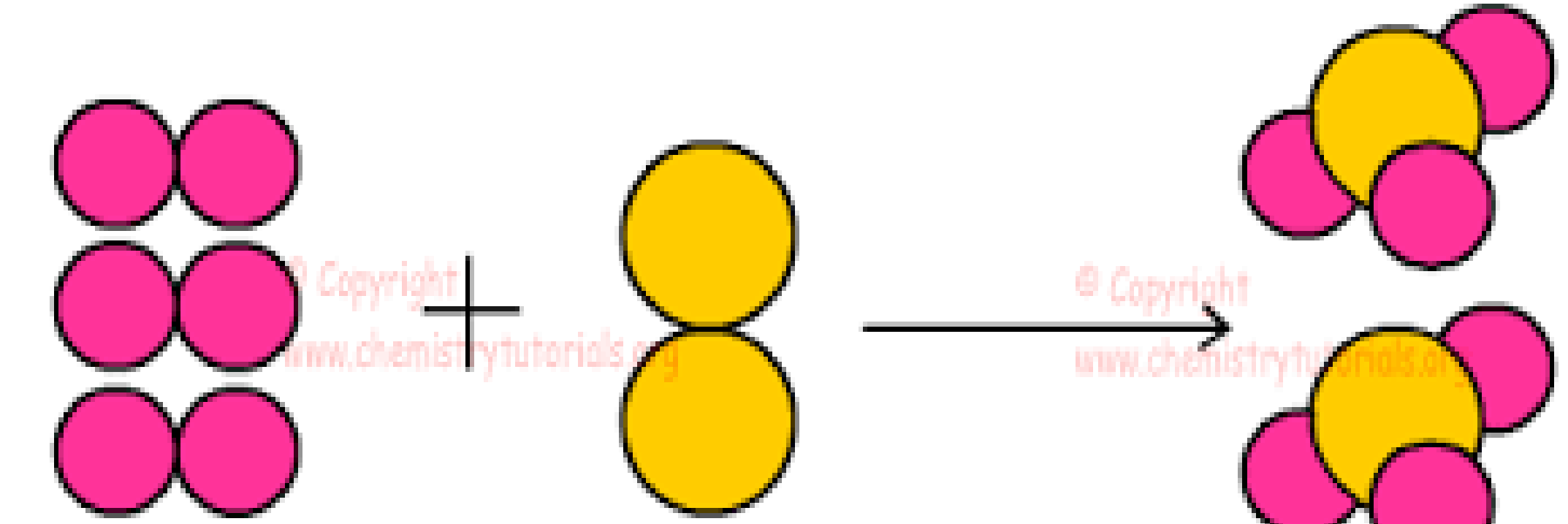
2. Picture equation

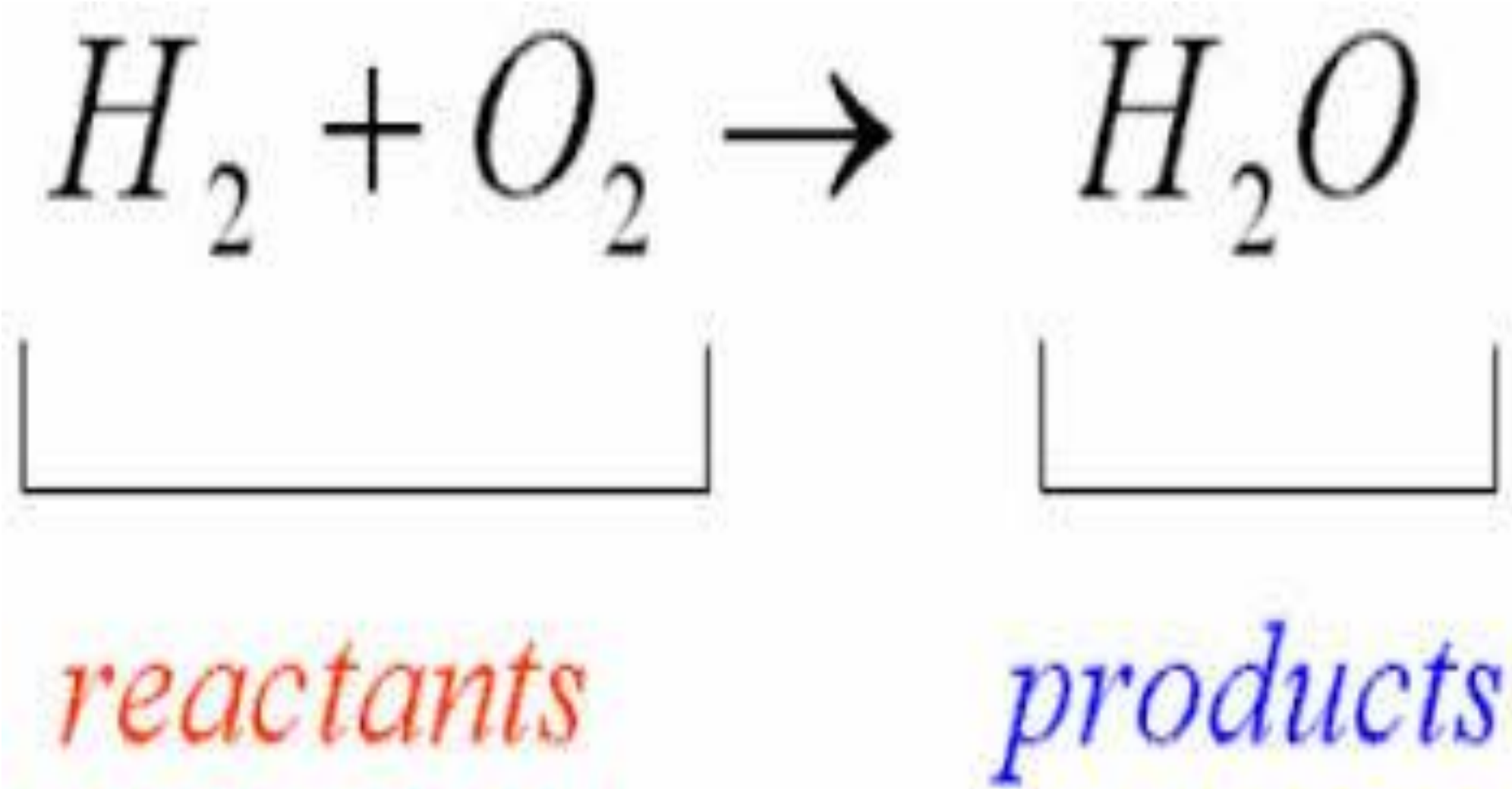


3. Chemical equation (balanced)

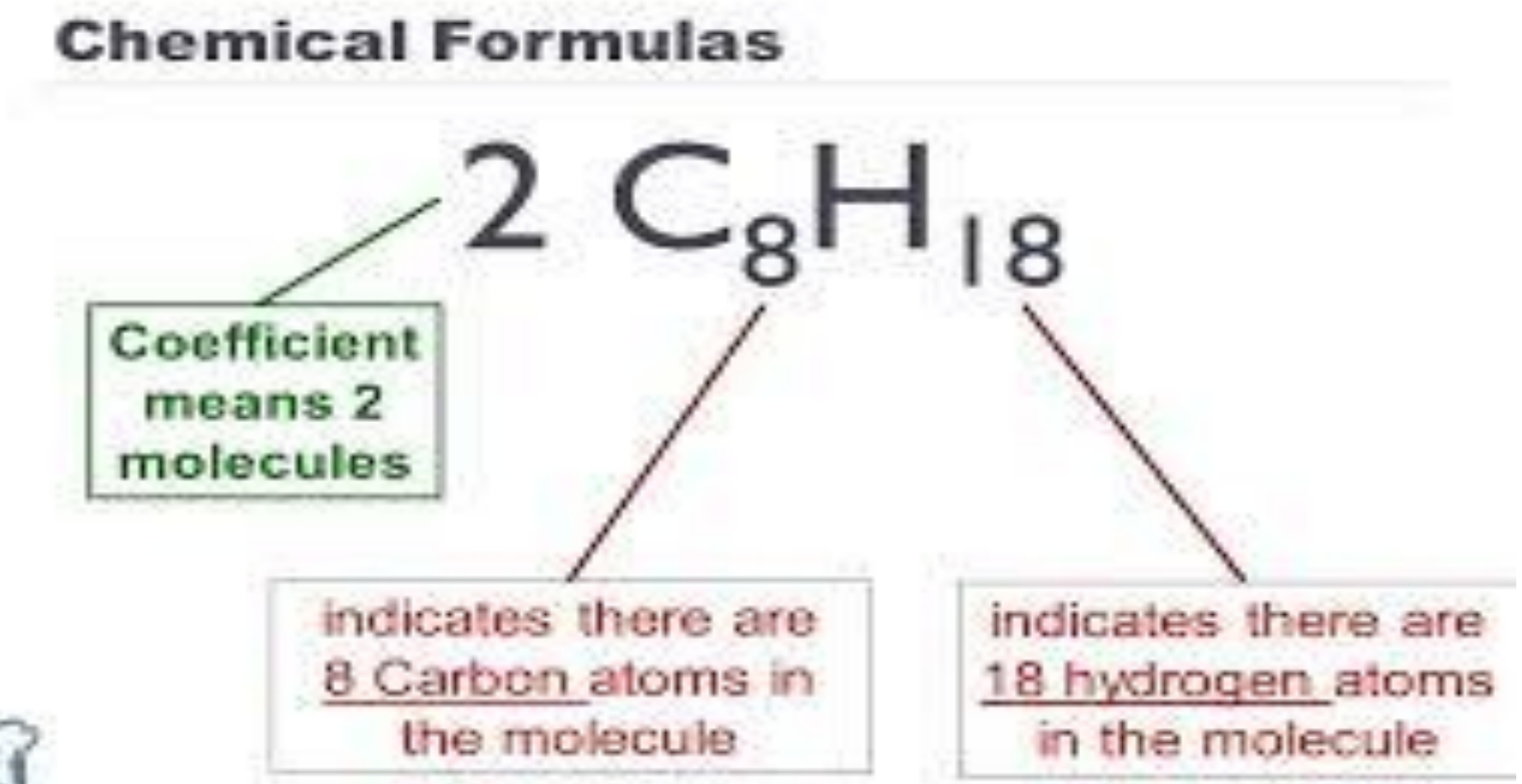
$$2\ H_2 + O_2 \rightarrow 2\ H_2O$$

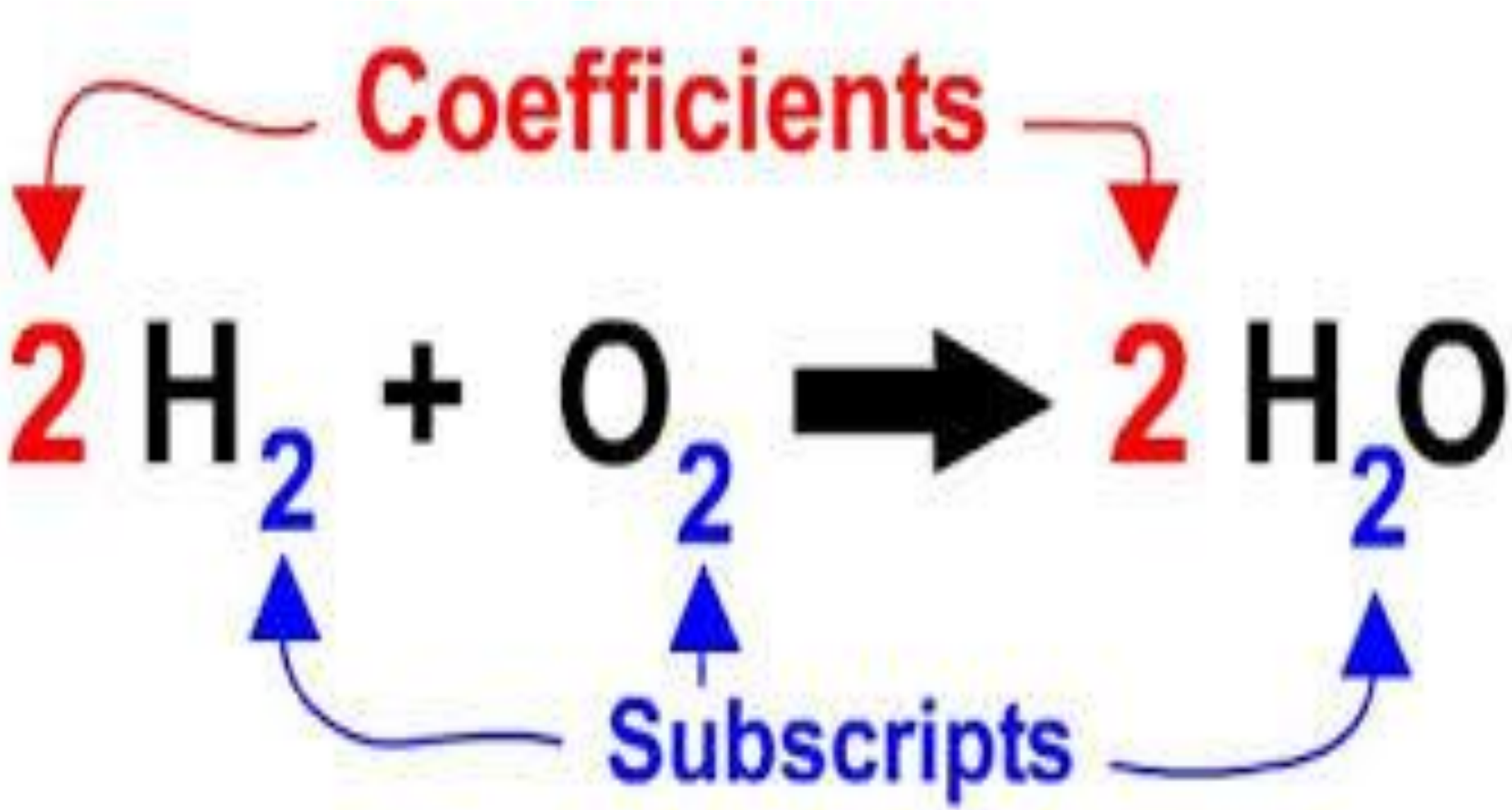
PICTURE,WORD AND CHEMICAL FORMULA




$H_2 + O_2 \rightarrow H_2O$
reactants
products

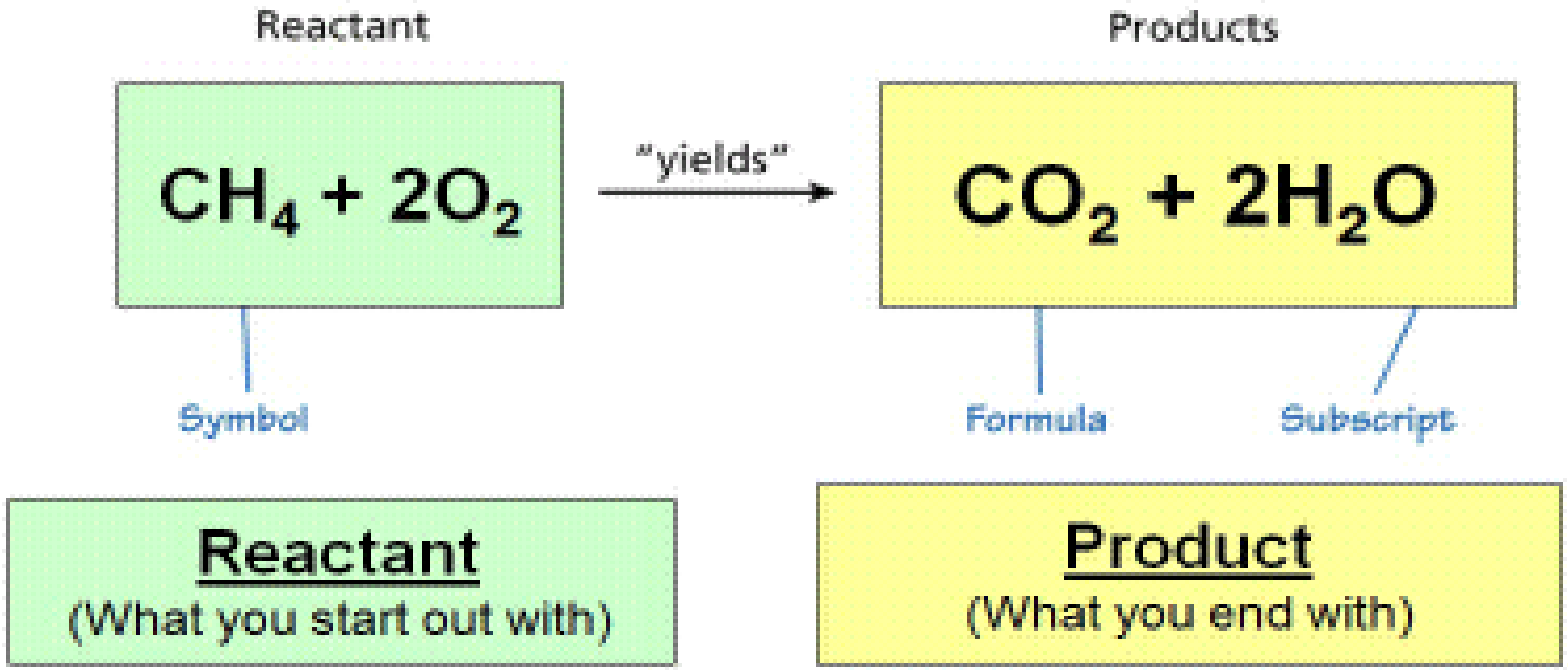
CHEMICAL FORMULAS




Coefficients
2 H2 + O2 → 2 H2O
Subscripts

What Are Chemical Equations?

- Chemical equations use chemical formulas and other symbols instead of words to summarize a reaction.



Compare to reading a book (L→R) on the story of the previous and post relationships.

Writing a Chemical Equation

Chemical symbols give a "before-and-after" picture of a chemical reaction

Reactants *Products*

$$MgO + C \longrightarrow CO + Mg$$

magnesium oxide reacts with carbon yields carbon monoxide and magnesium

Activity 2 TERM 2

TOP CLASS NATURAL SCIENCE TEXTBOOK

Write answers in your classwork book

QUESTIONS FOR REVISION

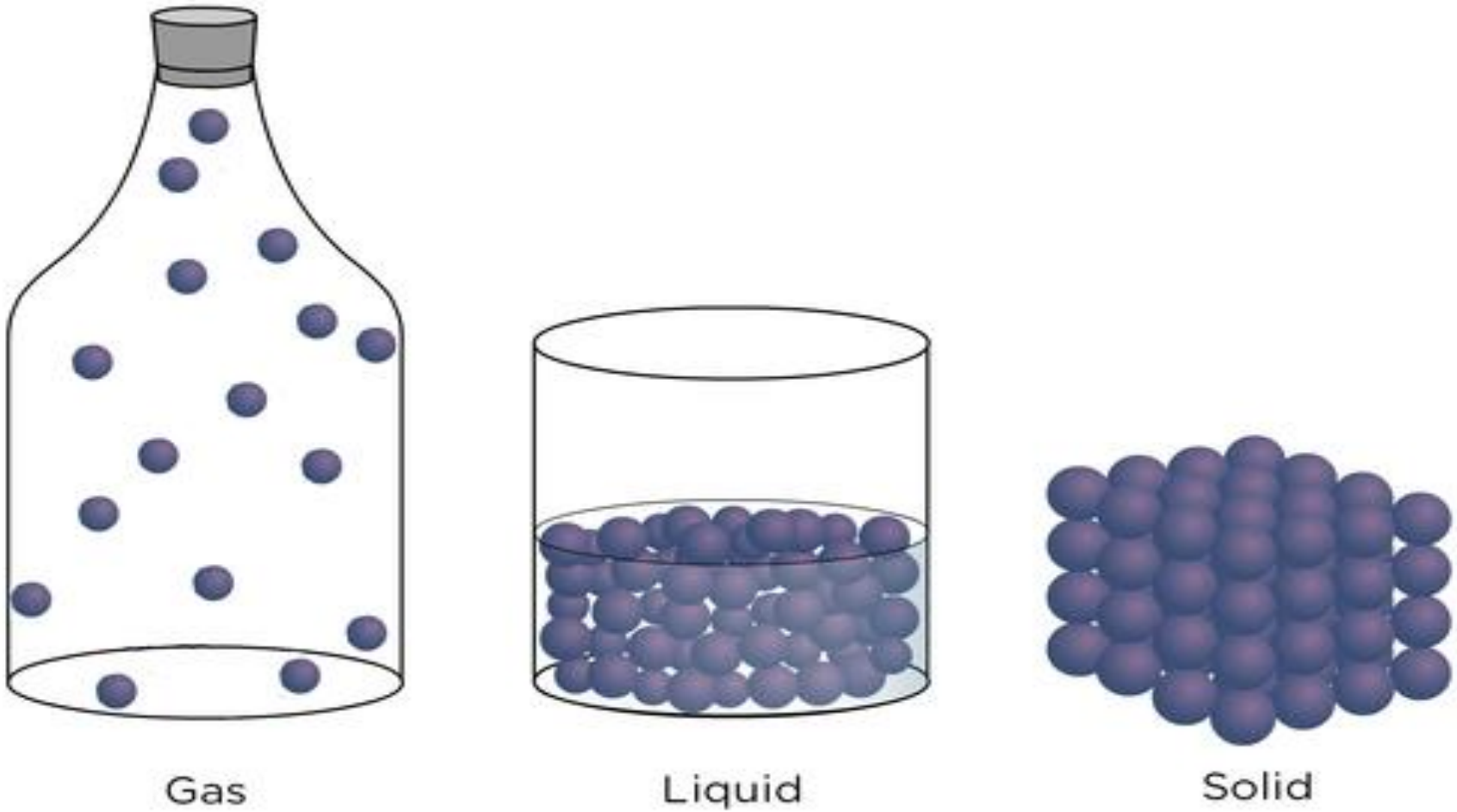
PAGE 94

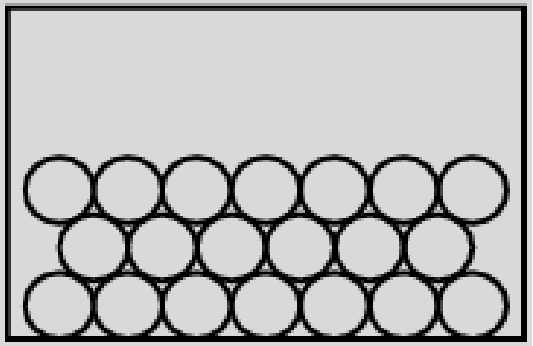
QUESTION 1
QUESTION 2
QUESTION 3

The particle model of matter

- Model used to explain the properties of matter
- Matter is made up of tiny particles
  - Atoms and molecules
- There are empty spaces between particles
  - There is nothing, not even air
- Particles are arranged differently in a solid, liquid and gas
- Particles are constantly moving
- There are forces of attraction and repulsion between particles

Three states of matter

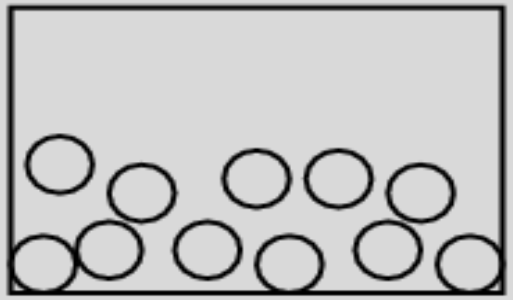




solid

In a **Solid**, particles:

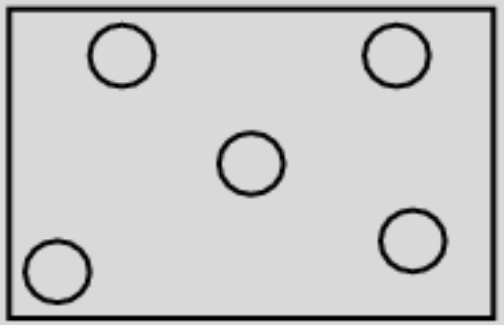
- Are packed closely together in a regular arrangement
- Have small spaces between them, cant be compressed
- Don't move around, vibrate in a fixed position
- Have strong forces holding them together



liquid

In a **liquid**, the particles:

- Are loosely arranged but still quite close together
- Move quite fast and slide past each other
- Have small spaces between them
- Have strong forces holding them together



gas

In a **gas**, the particles:

- Have no particular arrangement
- Move around very quickly and freely
- Fill any space freely
- Have large spaces between them

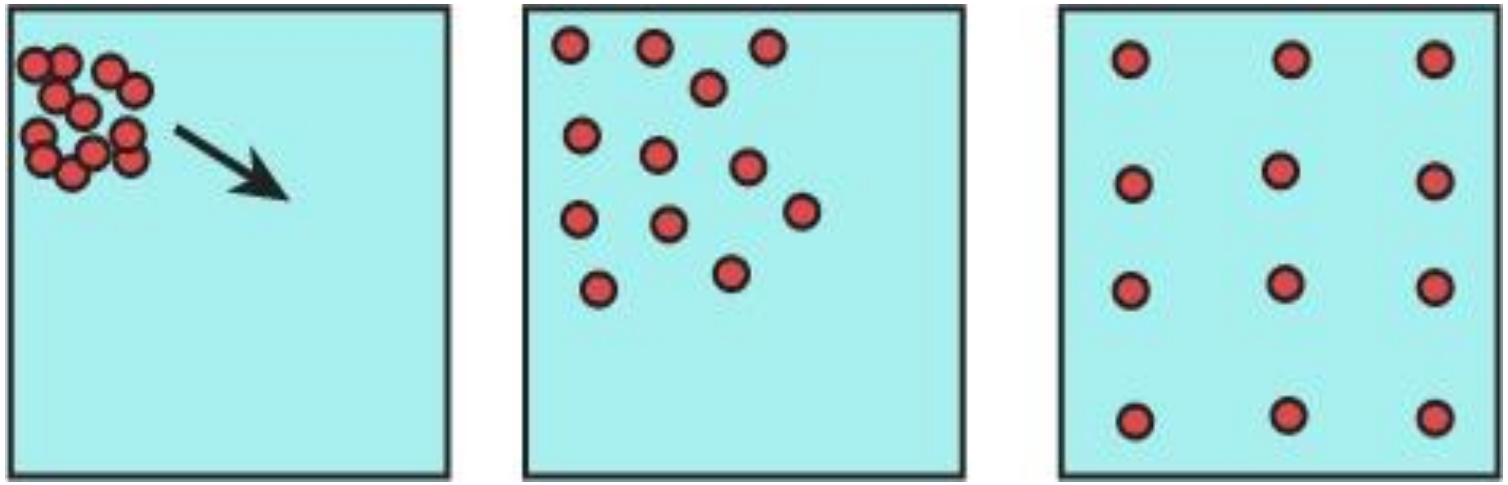
Energy and particle movement

- Adding energy (heat) makes particles move faster
- Kinetic energy – the energy found in moving objects or particles
- Removing energy (heat) makes particles slow down
- Pot of water on the stove
  - Water particles heat up, gain energy and eventually start to boil and evaporate

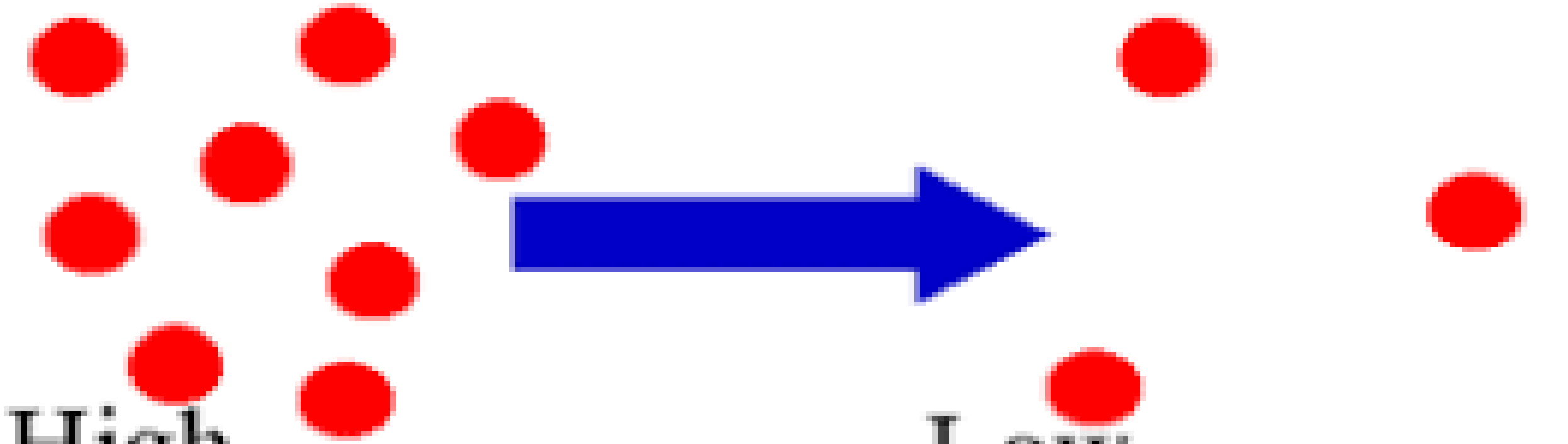
Movement of particles

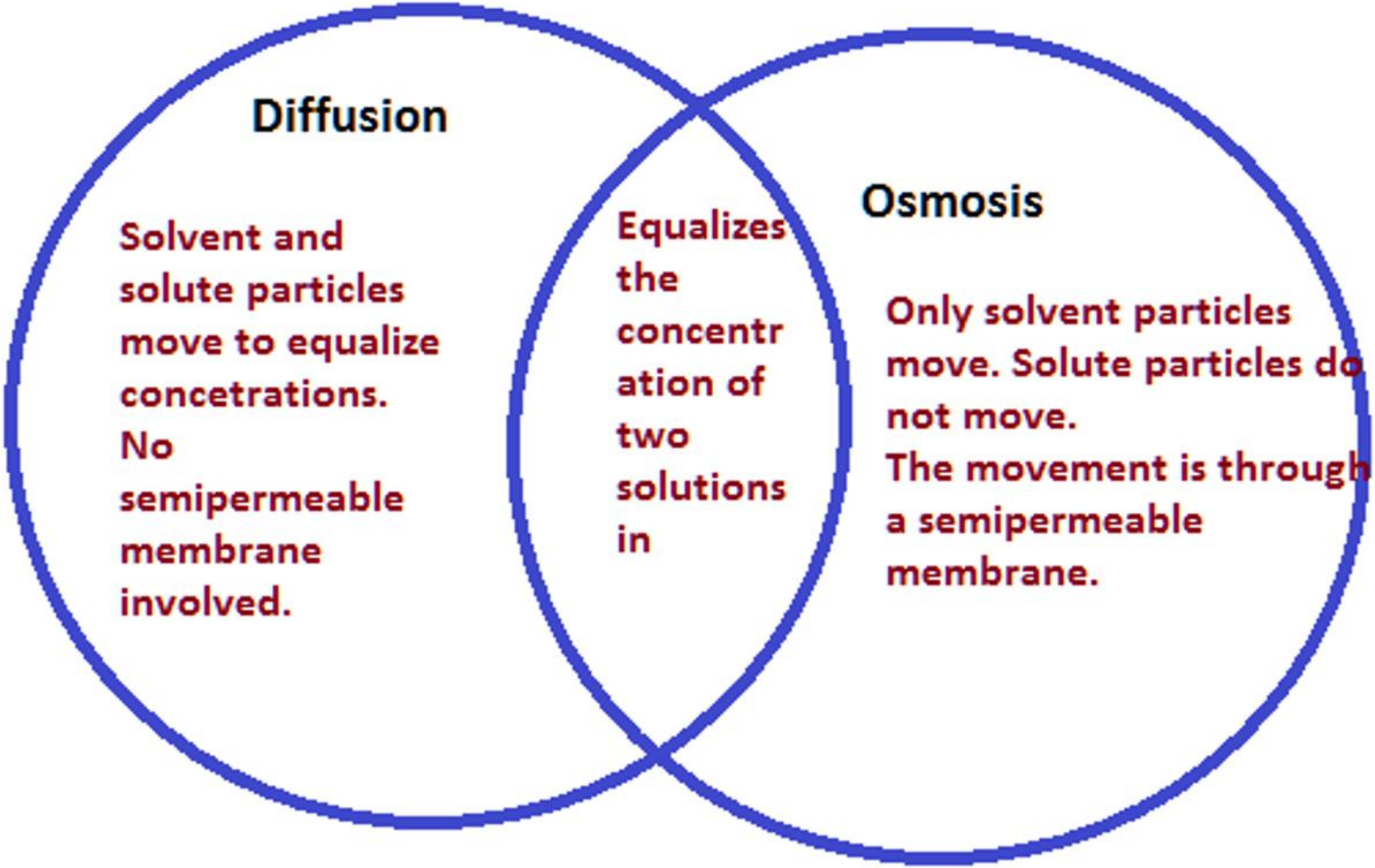
Diffusion

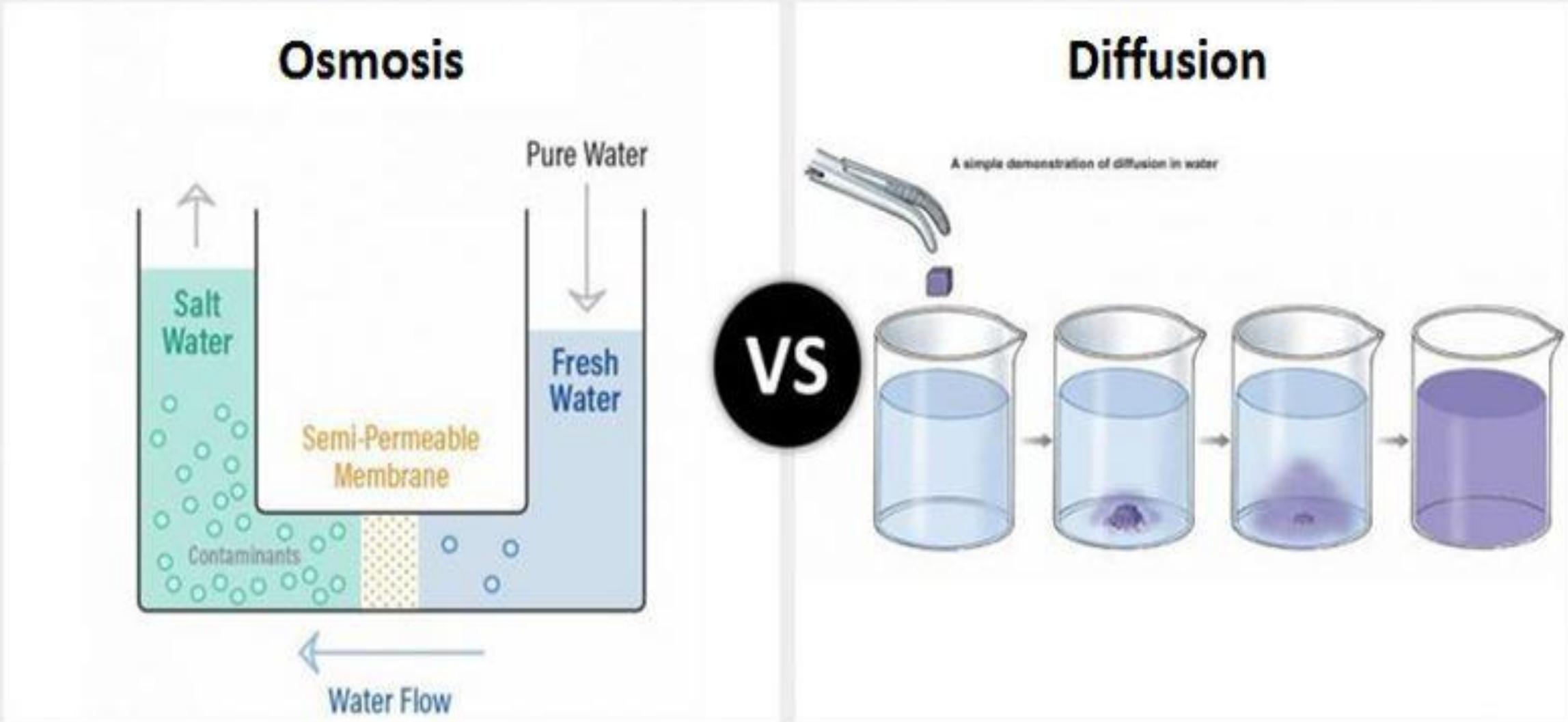
- The random movement of particles from a region of high concentration to a region of low concentration until equilibrium is reached
- Faster in gases than in liquids
  - Gas particles move faster than liquid particles



Diffusion




Diffusion
Solvent and solute particles move to equalize concetrations.
No semipermeable membrane involved.
Equalizes the concentr ation of two solutions in
Osmosis
Only solvent particles move. Solute particles do not move.
The movement is through a semipermeable membrane.



Osmosis vs. Diffusion

Mass, Volume, & Density

Mass- The amount of matter in an object.

Volume-The amount of space that something occupies.

Density-The property that describes the ratio of mass to volume.

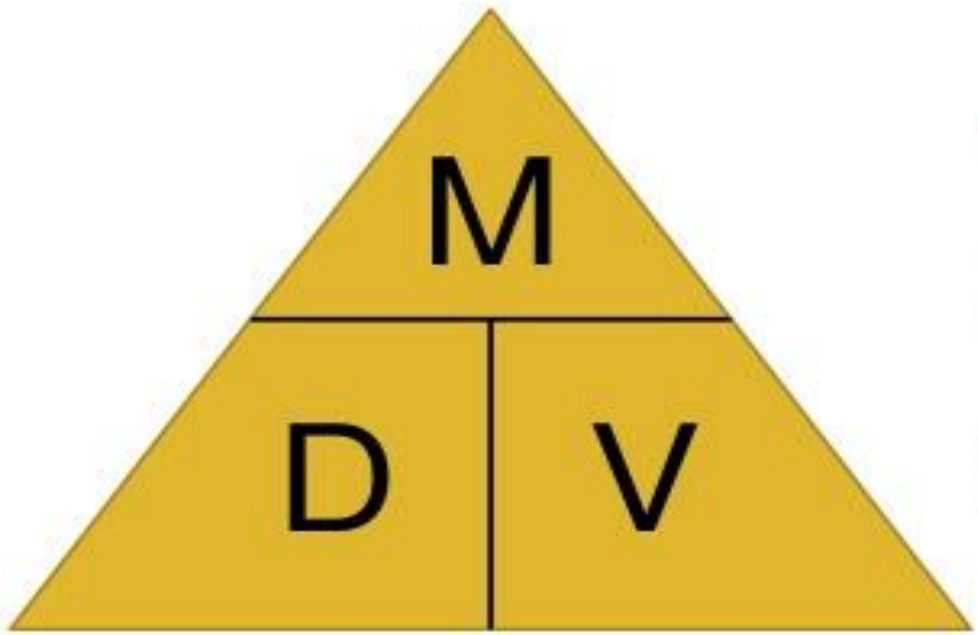
$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

$$\text{Mass} = \text{density} \times \text{volume}$$

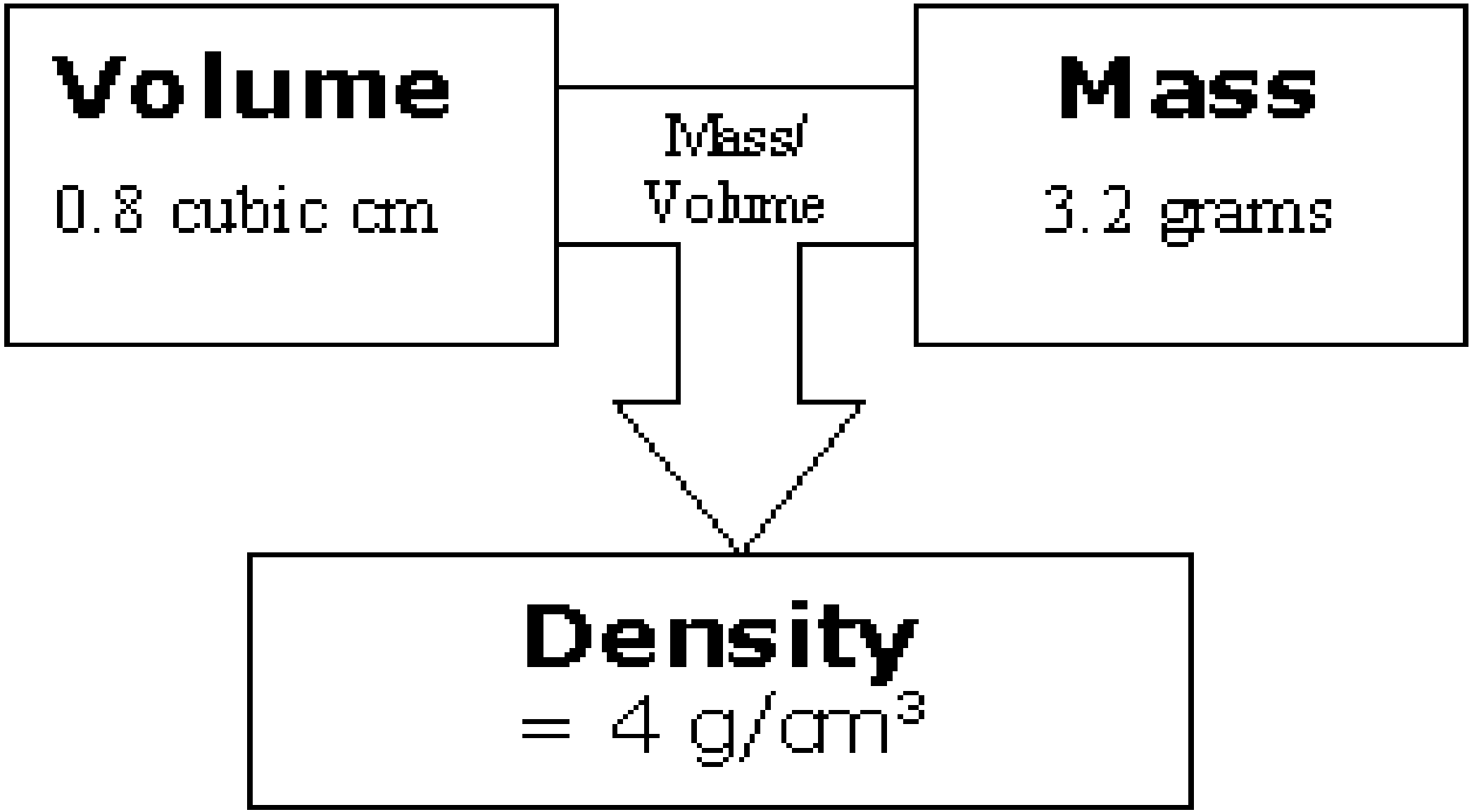
$$\text{Volume} = \frac{\text{mass}}{\text{density}}$$

How do I calculate Density?

The triangle of power!



- Density = Mass/Volume
- Mass = Density x Volume
- Volume = Mass /Density


Volume
0.8 cubic cm
Mass/
Volume
Mass
3.2 grams
Density
= 4 g/cm³

Pressure

- It is the pressure of particles pressing against something
- Gases can be compressed (blowing air into a balloon)
- Solids and liquids can’t be compressed (no enough space between particles)

Pressure from bumping particles

- Gas particles move around fast in all directions
  - Bump into each other (collide) and the sides of the container
  - When they hit the sides of a container they exert pressure

Increasing pressure of a gas

- Pump more gas into a container
  - More gas particles, more collisions, increases pressure
- Make the volume of the container smaller
  - Increases collisions

Activity 3 TERM 2

TOP CLASS NATURAL SCIENCE TEXTBOOK

Write answers in your classwork book

QUESTIONS FOR REVISION

PAGE 101

QUESTION 1
QUESTION 2
QUESTION 3