

States	Solid	Liquid	Gas
Movement	vibrate in fixed position	random and slide past one another	random, & speed all direction
Arrangement	very closely packed	closely packed (less than solid)	far apart in a disorderly manner
Force of Attraction	very strong	(moderately) strong	(very) weak
Representation			
Volume & density explanation	definite volume highest density fixed shape	definite volume high density no fix shape	no fix volume low density no fix shape

no change in mass as # of particles remain the same!

Heating:

EXPANSION

Cooling

CONTRACTION

- ① particles gain energy and vibrate more vigorously about their fixed position
- ② distance between particles increases
- ③ volume of substance increases
- ④ substance expands

- ① particles lose energy and vibrate less vigorously about their fixed position
- ② distance between particles decreases
- ③ volume of substance decreases
- ④ substance contracts

Brownian motion

- random movement of microscopic particles suspended in a liquid/gas
- prove that matter is made up of small, discrete particles which are in constant random motion

diffusion

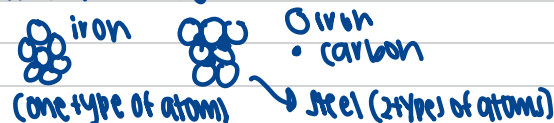
particles move from a region of higher concentration to region of lower conc.
e.g. ink in water, tea bag in water
Helium in balloon to outside

Melting Boiling
particles gain enough energy to overcome the forces of attraction, and change state.

Freezing Condensation
particles lose enough energy to be pulled closer by the forces of attraction, and change state

Atoms and molecules.

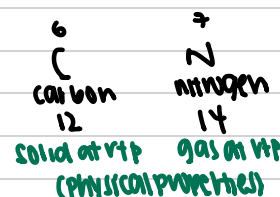
Made up of one or more elements



- too small to see with naked eye
- nano meter $\sim 10^{-9}$

Red blood cell $\sim 7000\text{nm}$
atom $\sim 0.1\text{nm}$
nanoparticles $1\text{nm} \rightarrow 1\mu\text{m}$
 $\downarrow \sim 70,000$ larger.

11 $\rightarrow$ atomic number
Na $\rightarrow$ chemical symbol
23



structure of atom.

Dalton

one atom
one element

Thomson (Plum)

 e^- are components scattered randomly in spherical (+ve charge)

planetary model

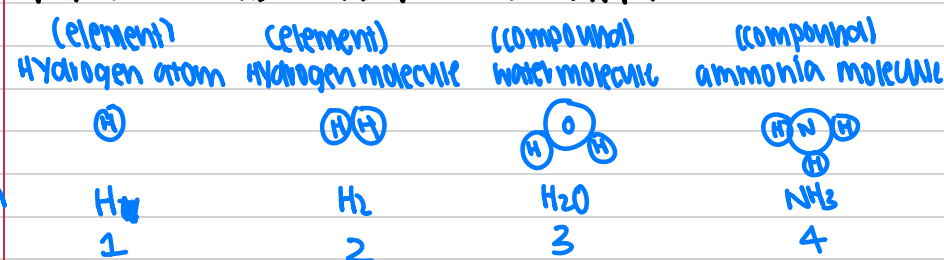
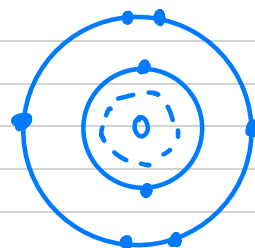
nucleus made of proton & neutron.
 e^- (neg. charged) move at high speed around nucleus
neutron, particle with no charge
proton, positively charged particle in the nucleus

* mostly empty space

	relative charge	relative mass	position in nucleus
proton	+1	1	in nucleus
neutron	0	1	in nucleus
electron	-1	$\frac{1}{1840}$	around nucleus

Identifying an element

- Each element in the periodic table has a unique proton #.
- they have the same number of electron.
- In periodic table, arrange in $\uparrow$ & $\downarrow$ #.
- Physical and chemical properties are affected by # of proton.



Types of elements present
 Na_2CO_3
of elements present
no # = 1

Type of atoms	# of proton	# of electron	# of neutrons	Charge
Hydrogen	1	1	0, 1 or 2	0
Helium	2	2	1 or 2	0
Lithium	3	3	3 or 4	0

* # of proton = # of electron $\rightarrow$ atom is neutral

of neutrons and protons may not be equal in some atoms

Isotopes: same element, same # of protons; diff # of neutrons
Carbon-12: 6 protons; 6 electrons; 6 neutrons
C-13: 6 protons; 6 electrons; 7 neutrons
C-14: 6 protons; 6 electrons; 8 neutrons

Benefits: Medical purpose (MRI) (X-rays)
Nuclear energy
Physical/chemical change studies
Nanotechnology (purification of water)

Issues: social & ethical issues
accidents in power plant
using as weapons
hazards when handling