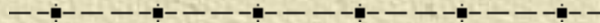


Investigating Matter (part II)



Physical Properties

Quantitative → *Think « quantity »*

- ✦ Gold has a *density* of $19,3 \text{ g/cm}^3$ at 20°C
- ✦ Gold has a melting point of 1062° C
- ✦ Etc.

Anything measurable

Qualitative → *Think « quality »*

- ✦ Gold has a shiny texture
- ✦ At room temperature, gold is in the « solid » state
- ✦ Etc.

Anything that is observable, but that cannot be measured

Physical Property	Description
Qualitative	
State	Solid, liquid, gas
Colour	Colour
Malleability	Ability to be beaten into sheets
Ductility	Ability to be drawn into wires
Crystallinity	Shape of crystals
Magnetism	Attraction to magnets
Quantitative	
Solubility	Ability to dissolve in water
Conductivity	Ability to conduct heat/electricity
Viscosity	Resistance to flow
Density	Ratio → mass to volume
Melting/Freezing point	Temperature of melting/freezing
Boiling/condensing point	Temperature of boiling/condensation

Pure Substances

- ✦ A substance that is made up of only one kind of matter
- ✦ Ex : H₂O, O₂, Gold (Au), etc.

Elements

- ✦ A pure substance made up of only one atom
- ✦ This cannot be broken down/separated into anything smaller
- ✦ Ex : Carbon (C), hydrogen (H)

Periodic Table of Elements

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18																												
1 H Hydrogen 1.00794	Atomic # Symbol Name Atomic Mass																2 He Helium 4.002602																												
3 Li Lithium 6.941	4 Be Beryllium 9.012182	<table border="1"> <tr> <td>C Solid</td> <td colspan="4">Metals</td> <td colspan="2">Nonmetals</td> </tr> <tr> <td>Hg Liquid</td> <td>Alkali metals</td> <td>Alkaline earth metals</td> <td>Lanthanoids</td> <td>Transition metals</td> <td>Poor metals</td> <td>Other nonmetals</td> </tr> <tr> <td>H Gas</td> <td></td> <td></td> <td>Actinoids</td> <td></td> <td></td> <td>Noble gases</td> </tr> <tr> <td>Rf Unknown</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>										C Solid	Metals				Nonmetals		Hg Liquid	Alkali metals	Alkaline earth metals	Lanthanoids	Transition metals	Poor metals	Other nonmetals	H Gas			Actinoids			Noble gases	Rf Unknown							5 B Boron 10.811	6 C Carbon 12.0107	7 N Nitrogen 14.0067	8 O Oxygen 15.9994	9 F Fluorine 18.9984032	10 Ne Neon 20.1797
C Solid	Metals				Nonmetals																																								
Hg Liquid	Alkali metals	Alkaline earth metals	Lanthanoids	Transition metals	Poor metals	Other nonmetals																																							
H Gas			Actinoids			Noble gases																																							
Rf Unknown																																													
11 Na Sodium 22.98976928	12 Mg Magnesium 24.3050	13 Al Aluminium 26.9815386	14 Si Silicon 28.0855	15 P Phosphorus 30.973762	16 S Sulfur 32.065	17 Cl Chlorine 35.453	18 Ar Argon 39.948																																						
19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.955912	22 Ti Titanium 47.887	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938045	26 Fe Iron 55.845	27 Co Cobalt 58.933195	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.64	33 As Arsenic 74.92160	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.798																												
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90585	40 Zr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybdenum 95.96	43 Tc Technetium (97.9072)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.90447	54 Xe Xenon 131.293																												
55 Cs Caesium 132.9054519	56 Ba Barium 137.327	57-71		72 Hf Hafnium 178.49	73 Ta Tantalum 180.94788	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.084	79 Au Gold 196.966569	80 Hg Mercury 200.59	81 Tl Thallium 204.3833	82 Pb Lead 207.2	83 Bi Bismuth 208.98040	84 Po Polonium (208.9824)	85 At Astatine (209.9871)	86 Rn Radon (222.0176)																											
87 Fr Francium (223)	88 Ra Radium (226)	89-103		104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (266)	107 Bh Bohrium (264)	108 Hs Hassium (277)	109 Mt Meitnerium (268)	110 Ds Darmstadtium (271)	111 Rg Roentgenium (272)	112 Uub Ununbium (285)	113 Uut Ununtrium (284)	114 Uuq Ununquadium (289)	115 Uup Ununpentium (288)	116 Uuh Ununhexium (292)	117 Uus Ununseptium	118 Uuo Ununoctium (294)																											

For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.

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57 La Lanthanum 138.90547	58 Ce Cerium 140.116	59 Pr Praseodymium 140.90765	60 Nd Neodymium 144.242	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92535	66 Dy Dysprosium 162.500	67 Ho Holmium 164.93032	68 Er Erbium 167.259	69 Tm Thulium 168.93421	70 Yb Ytterbium 173.054	71 Lu Lutetium 174.9668
89 Ac Actinium (227)	90 Th Thorium 232.03806	91 Pa Protactinium 231.03588	92 U Uranium 238.02891	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (260)

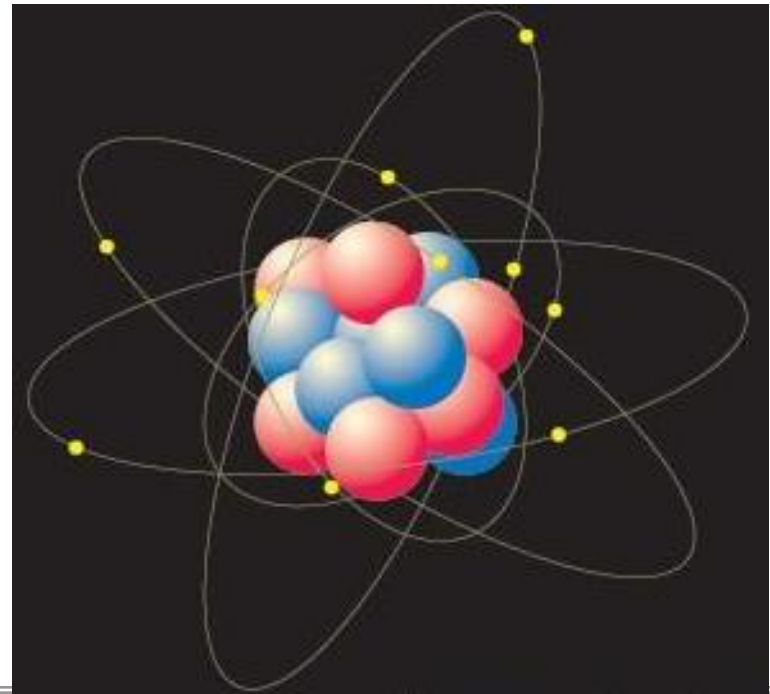


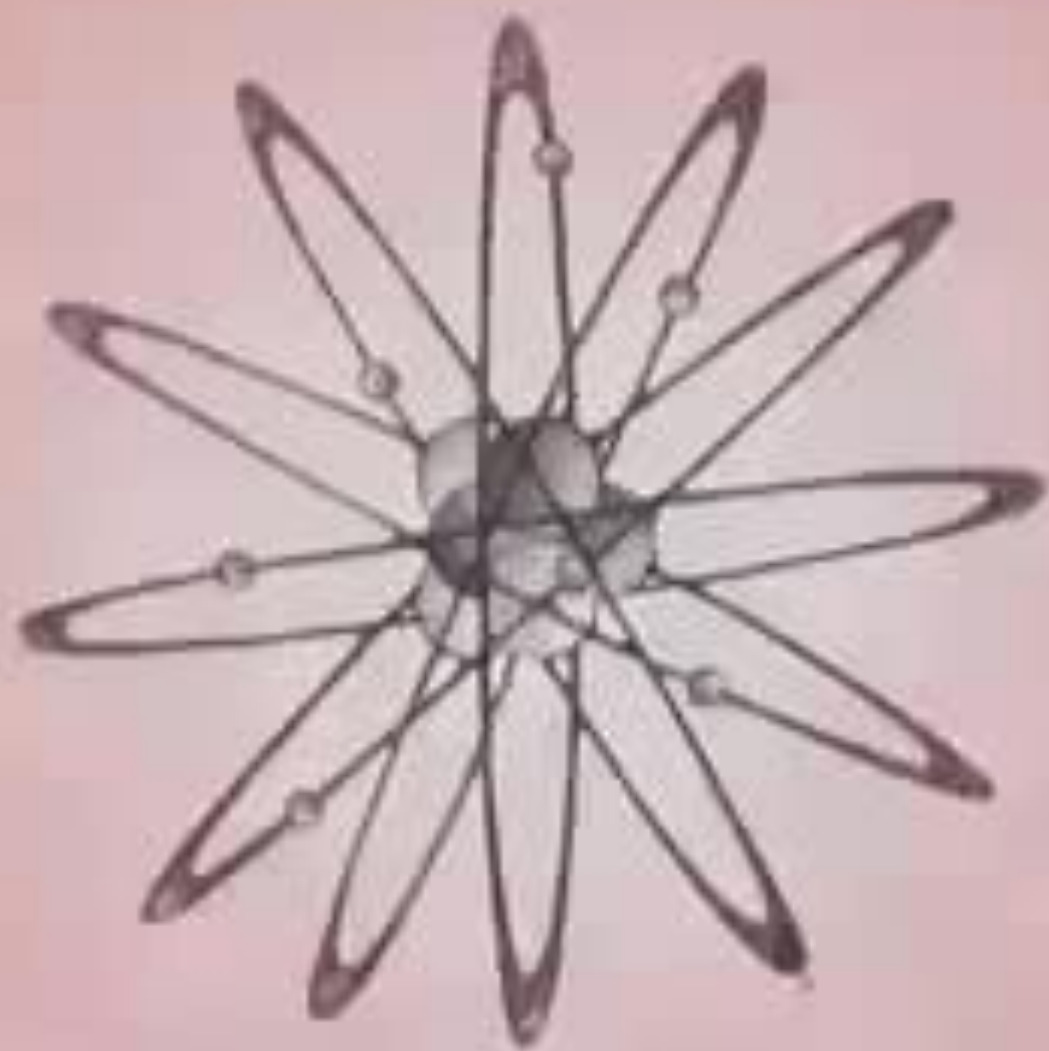
Compound

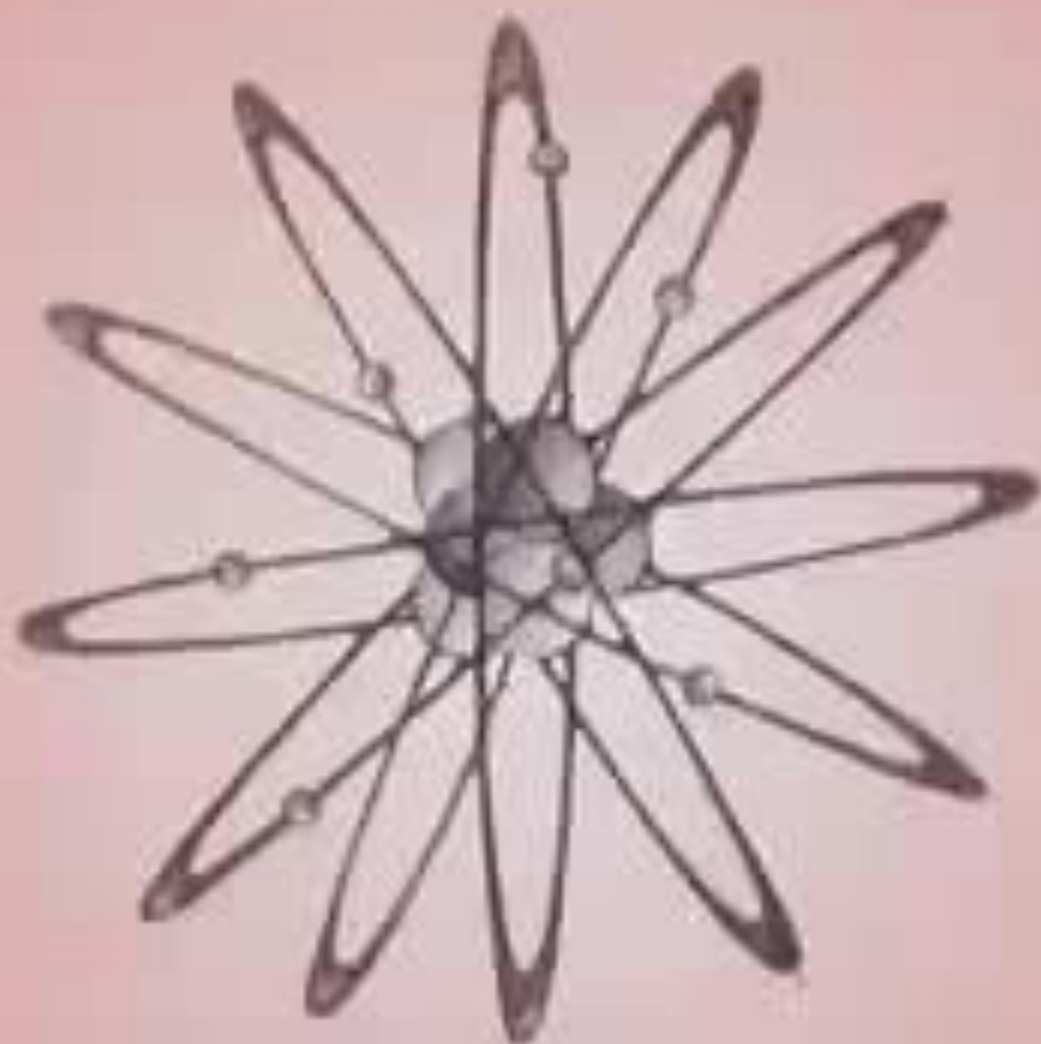
- ✦ A pure substance made up of more than one atom
- ✦ Ex : water (H_2O), carbon dioxide (CO_2)

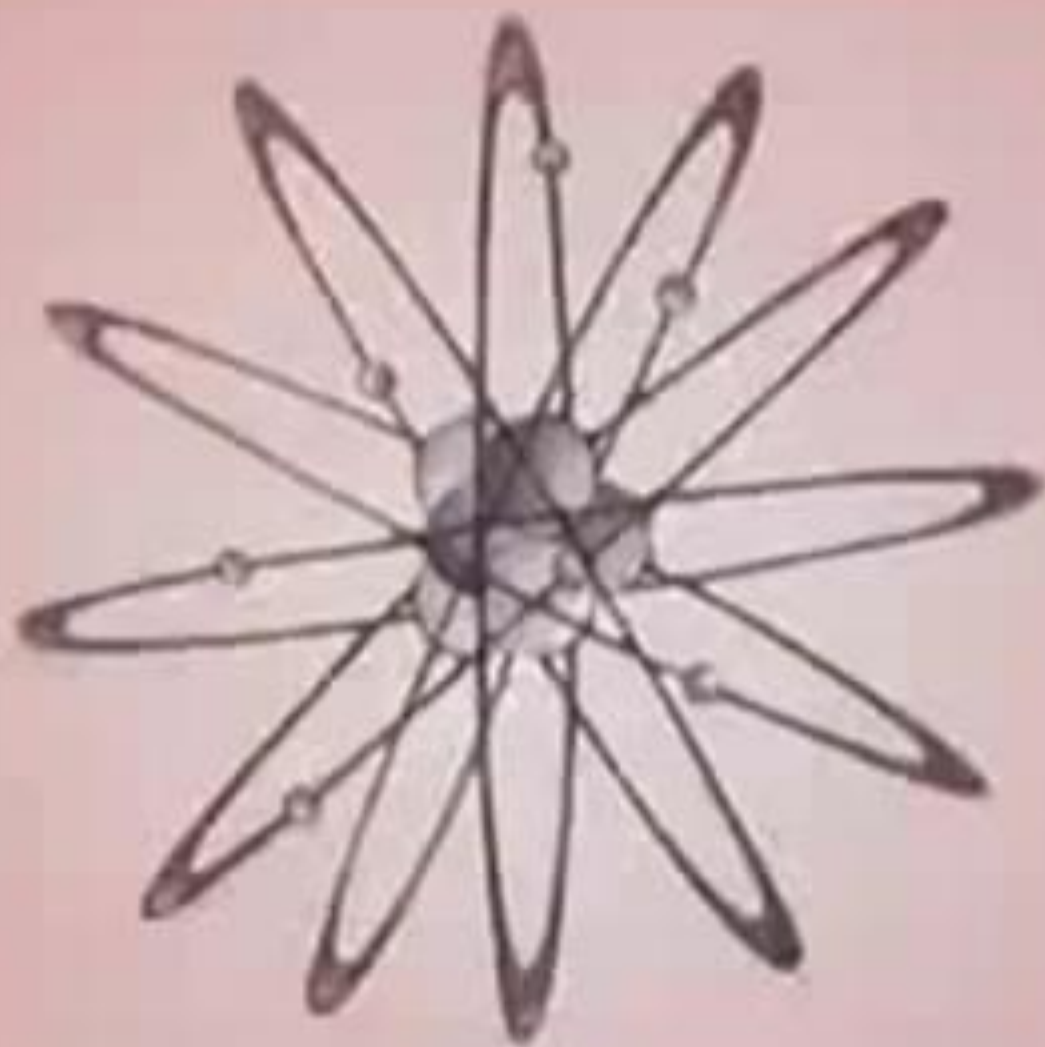
The Atom

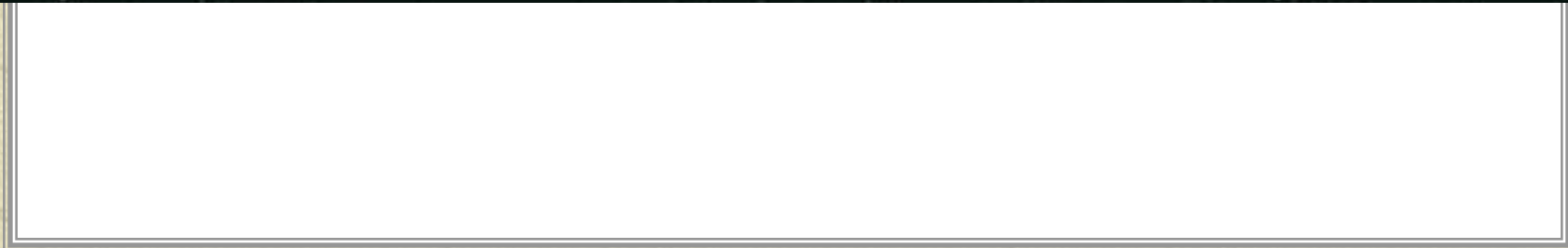
- ✦ The smallest particle of an element that retains the properties of that element
- ✦ Made up of a nucleus (proton(s) + neutron(s)) and of electron(s)

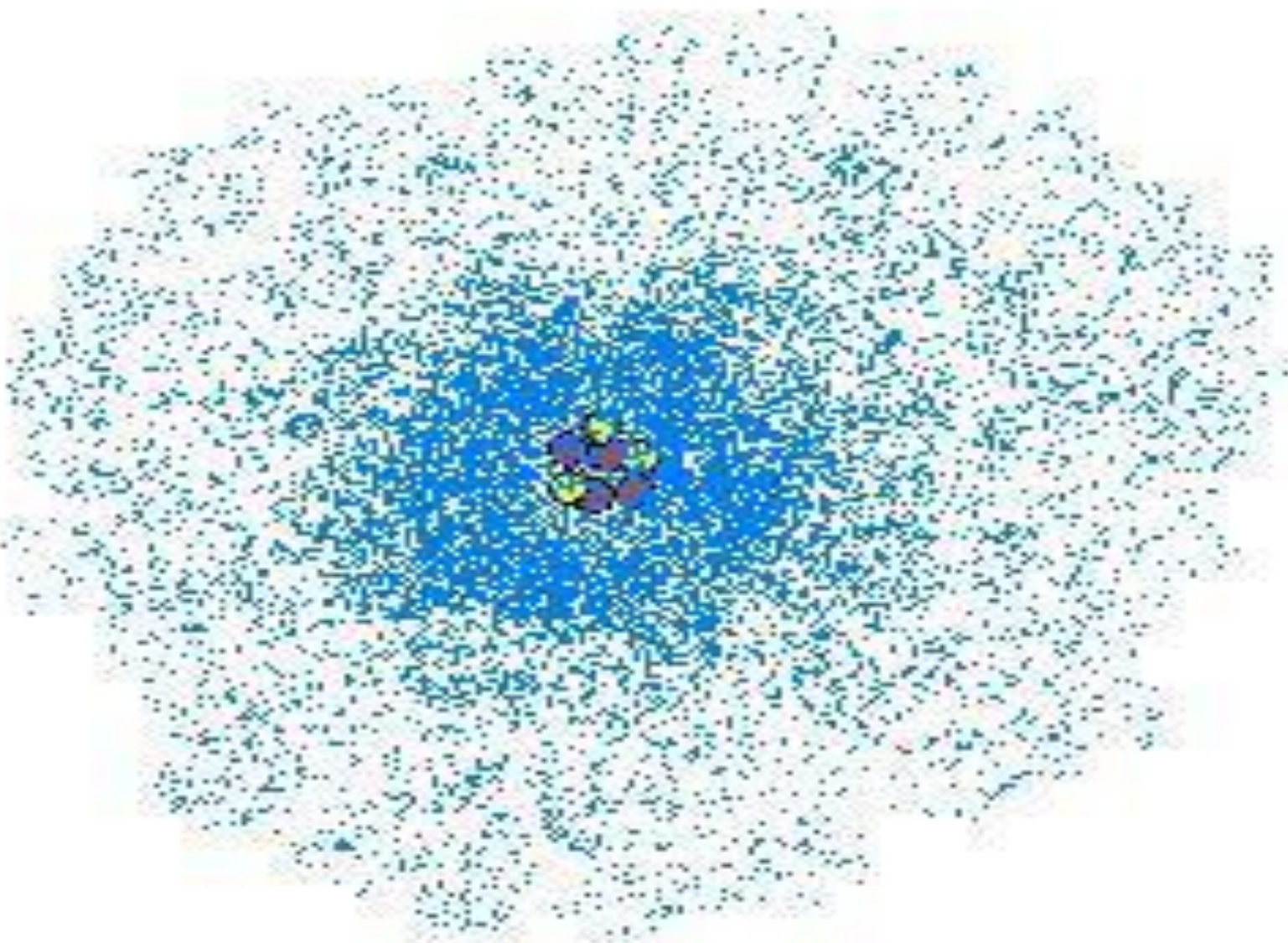






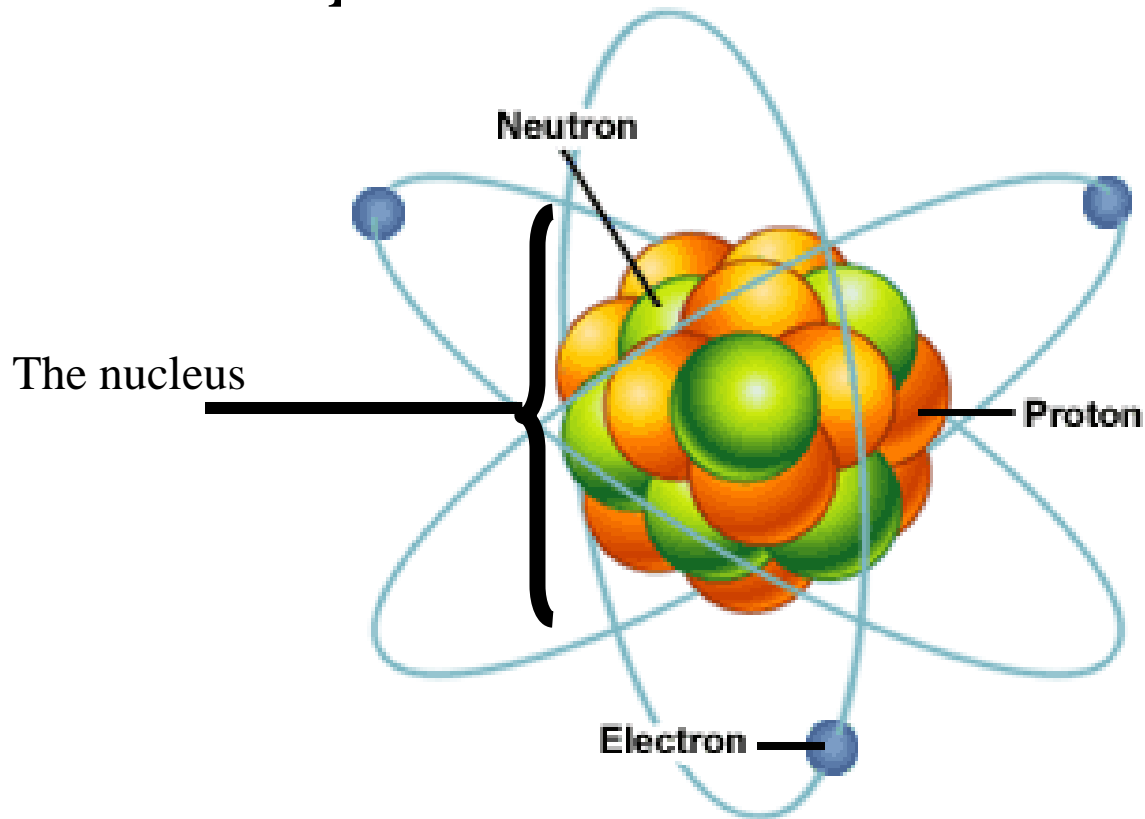




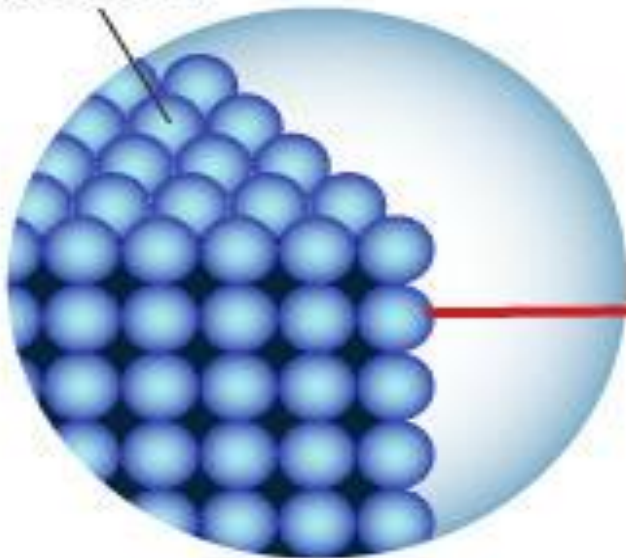


The nucleus

- ✦ Located at the centre of the atom
- ✦ Made up of neutron(s) and proton(s)

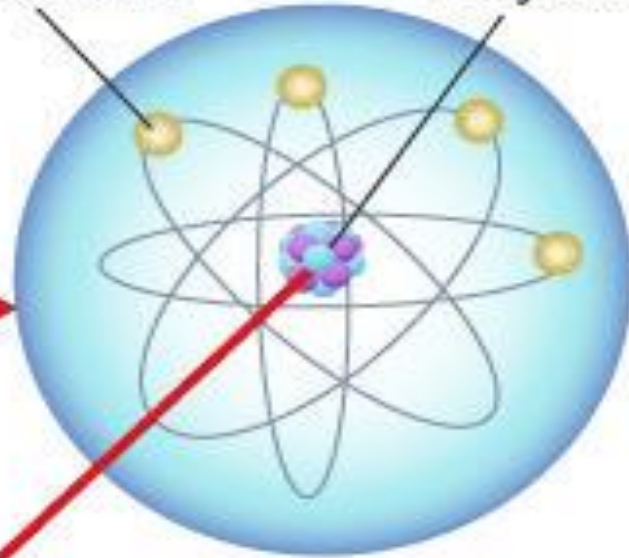


Atome



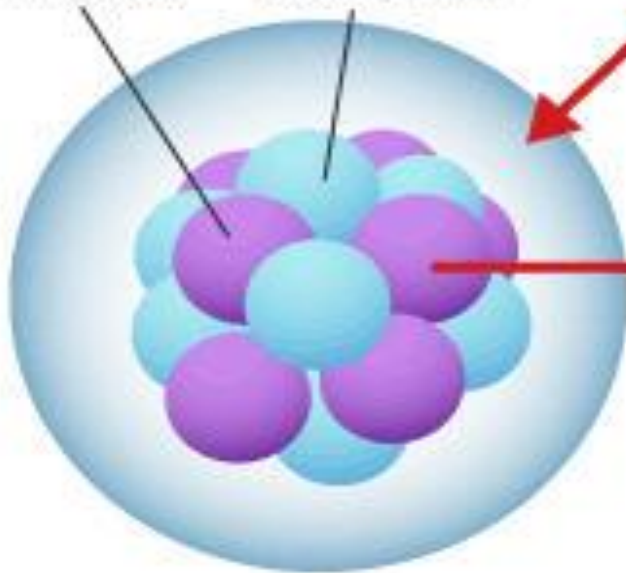
Electron

Noyau

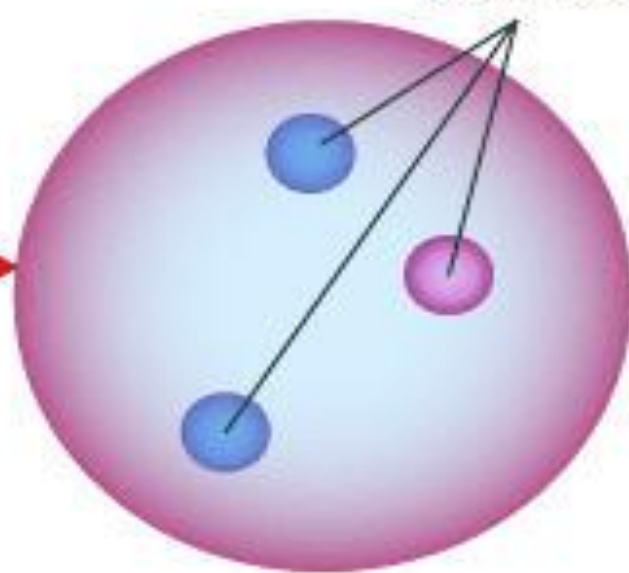


Proton

Neutron



Quarks



Protons and neutrons

- ✦ Protons → positive charge
- ✦ Neutrons → neutral (no) charge
- ✦ Make up the nucleus
- ✦ Represents 99,9% of the atomic mass
- ✦ The nucleus is very dense but very small

Electron

- ✦ Subatomic particle that is negatively charged
 - Orbits the nucleus on an « electronic shell »
- ✦ The region an electron occupies represents 99.99% of the atom's volume

