

PERIODIC TABLE of the ELEMENTS



DEPARTMENT OF
SCIENCE AND TECHNOLOGY

Proudly sponsored by the
**SHUTTLEWORTH
FOUNDATION**
(supporting social innovation)
Tel: +47 21 976 1200 | Fax: +47 21 976 1201 | www.shuttleworthfoundation.org

VIII A 18



H Hydrogen 1
1.01

Legend:
ALKALI METALS
ALKALI EARTH METALS
TRANSITION METALS
OTHER METALS
GROUP 10 METALS
HALOGENS
NOBLE GASSES
RARE EARTH METALS

At room temperature the element is:
Gas
Liquid
Natural solid
Man-made solid [synthetic]

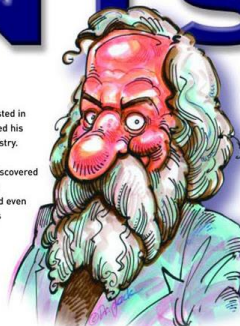
Symbol: H
Element name: Hydrogen
Atomic number: 1
Atomic mass: 1.01

DMITRI MENDELEYEV (1834 - 1907)

The Russian chemist, Dmitri Mendeleev, was the first to observe that if elements were listed in order of atomic mass, they showed regular (periodical) repeating properties. He formulated his discovery in a periodic table of elements, now regarded as the backbone of modern chemistry.

The crowning achievement of Mendeleev's periodic table lay in his prophecy of then, undiscovered elements. In 1869, the year he published his periodic classification, the elements gallium, germanium and scandium were unknown. Mendeleev left spaces for them in his table and even predicted their atomic masses and other chemical properties. Six years later, gallium was discovered and his predictions were found to be accurate. Other discoveries followed and their chemical behaviour matched that predicted by Mendeleev.

This remarkable man, the youngest in a family of 17 children, has left the scientific community with a classification system so powerful that it became the cornerstone in chemistry teaching and the prediction of new elements ever since. In 1955, element 101 was named after him: Md, Mendeleevium.



IA 1	IIA 2	IIIB 3	IVB 4	VB 5	VIB 6	VII B 7	VIII 8	VIII 9	VIII 10	IB 11	IIB 12	IIIA 13	IVA 14	VA 15	VI A 16	VII A 17	VIII A 18						
H Hydrogen 1 1.01	Li Lithium 3 6.94	Be Beryllium 4 9.01	B Boron 5 10.81	C Carbon 6 12.01	N Nitrogen 7 14.01	O Oxygen 8 16.00	F Fluorine 9 19.00	Ne Neon 10 20.18	Na Sodium 11 22.99	Mg Magnesium 12 24.31	Al Aluminium 13 26.98	Si Silicon 14 28.09	P Phosphorus 15 30.97	S Sulphur 16 32.06	Cl Chlorine 17 35.45	Ar Argon 18 39.95	He Helium 2 4.00						
K Potassium 19 39.10	Ca Calcium 20 40.08	Sc Scandium 21 44.96	Ti Titanium 22 47.88	V Vanadium 23 50.94	Cr Chromium 24 52.00	Mn Manganese 25 54.94	Fe Iron 26 55.85	Co Cobalt 27 58.93	Ni Nickel 28 58.69	Cu Copper 29 63.55	Zn Zinc 30 65.39	Ga Gallium 31 69.72	Ge Germanium 32 72.61	As Arsenic 33 74.92	Se Selenium 34 78.96	Br Bromine 35 79.90	Kr Krypton 36 83.80						
Rb Rubidium 37 85.47	Sr Strontium 38 87.62	Y Yttrium 39 88.91	Zr Zirconium 40 91.22	Nb Niobium 41 92.91	Mo Molybdenum 42 95.94	Tc Technetium 43 (98)	Ru Ruthenium 44 101.07	Rh Rhodium 45 102.91	Pd Palladium 46 106.42	Ag Silver 47 107.87	Cd Cadmium 48 112.41	In Indium 49 114.82	Sn Tin 50 118.71	Sb Antimony 51 121.76	Te Tellurium 52 127.60	I Iodine 53 126.90	Xe Xenon 54 131.29						
Cs Caesium 55 132.91	Ba Barium 56 137.33	Lanthanide Series	Hf Hafnium 72 178.49	Ta Tantalum 73 180.95	W Tungsten 74 183.85	Re Rhenium 75 186.21	Os Osmium 76 190.23	Ir Iridium 77 192.22	Pt Platinum 78 195.08	Au Gold 79 196.97	Hg Mercury 80 200.59	Tl Thallium 81 204.38	Pb Lead 82 207.20	Bi Bismuth 83 208.98	Po Polonium 84 (209)	At Astatine 85 (210)	Rn Radon 86 (222)						
Fr Francium 87 (223)	Ra Radium 88 (226)	Actinide Series	Rf Rutherfordium 104 (261)	Db Dubnium 105 (262)	Sg Seaborgium 106 (263)	Bh Bohrium 107 (262)	Hs Hassium 108 (265)	Ht Tennessine 109 (265)	La Lanthanum 57 138.91	Ce Cerium 58 140.12	Pr Praseodymium 59 140.90	Nd Neodymium 60 144.24	Pm Promethium 61 (145)	Sm Samarium 62 150.36	Eu Europium 63 151.96	Gd Gadolinium 64 157.25	Tb Terbium 65 158.92	Dy Dysprosium 66 162.50	Ho Holmium 67 164.93	Er Erbium 68 167.26	Tm Thulium 69 168.93	Yb Ytterbium 70 173.04	Lu Lutetium 71 174.96
									Ac Actinium 89 227.02	Th Thorium 90 232.03	Pa Protactinium 91 231.03	U Uranium 92 238.02	Np Neptunium 93 (237)	Pu Plutonium 94 (244)	Am Americium 95 (243)	Cm Curium 96 (247)	Bk Berkelium 97 (247)	Cf Californium 98 (251)	Es Einsteinium 99 (254)	Fm Fermium 100 (257)	Md Mendelevium 101 (258)	No Nobelium 102 (259)	Lr Lawrencium 103 (260)



Facult  de
Sciences et
Technologies



FEST
Facult  de Sciences et
Technologies

Periodic System of the Elements

1	IIA 2											IIIA 13	IVA 14	VA 15	VIA 16	VIIA 17	VIIIA 18
1 1.0 1H																	4.0 2He
2 6.9 3Li	9.0 4Be											10.8 5B	12.0 6C	14.0 7N	16.0 8O	19.0 9F	20.2 10Ne
3 23.0 11Na	24.3 12Mg	IIIB 3	IVB 4	VB 5	VIB 6	VIIIB 7	VIII 8 9 10		IB 11	IIB 12	27.0 13Al	28.1 14Si	31.0 15P	32.1 16S	35.5 17Cl	39.9 18Ar	
4 39.1 19K	40.1 20Ca	45.0 21Sc	47.9 22Ti	50.9 23V	52.0 24Cr	54.9 25Mn	55.8 26Fe	58.9 27Co	58.7 28Ni	63.5 29Cu	65.4 30Zn	69.7 31Ga	72.6 32Ge	74.9 33As	79.0 34Se	79.9 35Br	83.8 36Kr
5 85.5 37Rb	87.6 38Sr	88.9 39Y	91.2 40Zr	92.9 41Nb	95.9 42Mo	97.9 43Tc	101.1 44Ru	102.9 45Rh	106.4 46Pd	107.9 47Ag	112.4 48Cd	114.8 49In	118.7 50Sn	121.8 51Sb	127.6 52Te	126.9 53I	131.3 54Xe
6 132.9 55Cs	137.3 56Ba	138.9 57La	178.5 72Hf	180.9 73Ta	183.9 74W	186.2 75Re	190.2 76Os	192.2 77Ir	195.1 78Pt	197.0 79Au	200.6 80Hg	204.4 81Tl	207.2 82Pb	209.0 83Bi	209 84Po	210 85At	222 86Rn
7 223 87Fr	226 88Ra	227 89Ac	261 104Ku	262 105Ha													
			57La	58Ce	59Pr	60Nd	61Pm	62Sm	63Eu	64Gd	65Tb	66Dy	67Ho	68Er	69Tm	70Yb	71Lu
			89Ac	90Th	91Pa	92U	93Np	94Pu	95Am	96Cm	97Bk	98Cf	99Es	100Fm	101Md	102No	103Lr



Lamineries
MATTHEY SA



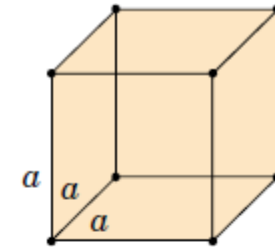
Periodic Table

1 (IA)		2 (IIA)		Key to Table										13 (IIIA)		14 (IVA)		15 (VA)		16 (VIA)		17 (VIIA)		18 (VIIIA)													
Hydrogen		Lithium		Beryllium		Scandium		Titanium		Vanadium		Chromium		Manganese		Iron		Cobalt		Nickel		Copper		Zinc		Aluminum		Silicon		Phosphorus		Sulfur		Chlorine		Argon	
H ₁		Li ₃		Be ₄		Sc ₂₁		Ti ₂₂		V ₂₃		Cr ₂₄		Mn ₂₅		Fe ₂₆		Co ₂₇		Ni ₂₈		Cu ₂₉		Zn ₃₀		Al ₁₃		Si ₁₄		P ₁₅		S ₁₆		Cl ₁₇		Ar ₁₈	
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18			
1		2		3		4		5		6		7		8		9		10		11		12		13		14		15									

Cubic

$$a = b = c$$

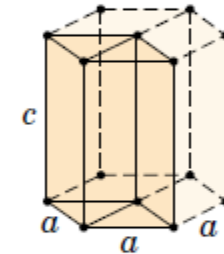
$$\alpha = \beta = \gamma = 90^\circ$$



Hexagonal

$$a = b \neq c$$

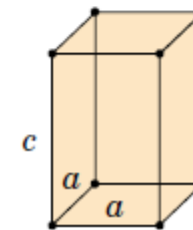
$$\alpha = \beta = 90^\circ, \gamma = 120^\circ$$



Tetragonal

$$a = b \neq c$$

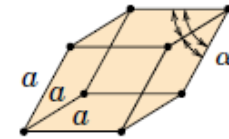
$$\alpha = \beta = \gamma = 90^\circ$$



Rhombohedral
(Trigonal)

$$a = b = c$$

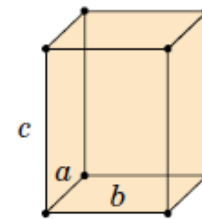
$$\alpha = \beta = \gamma \neq 90^\circ$$



Orthorhombic

$$a \neq b \neq c$$

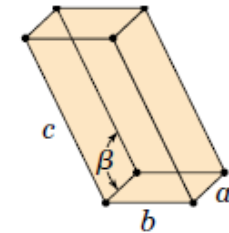
$$\alpha = \beta = \gamma = 90^\circ$$



Monoclinic

$$a \neq b \neq c$$

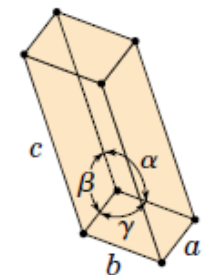
$$\alpha = \gamma = 90^\circ \neq \beta$$



Triclinic

$$a \neq b \neq c$$

$$\alpha \neq \beta \neq \gamma \neq 90^\circ$$



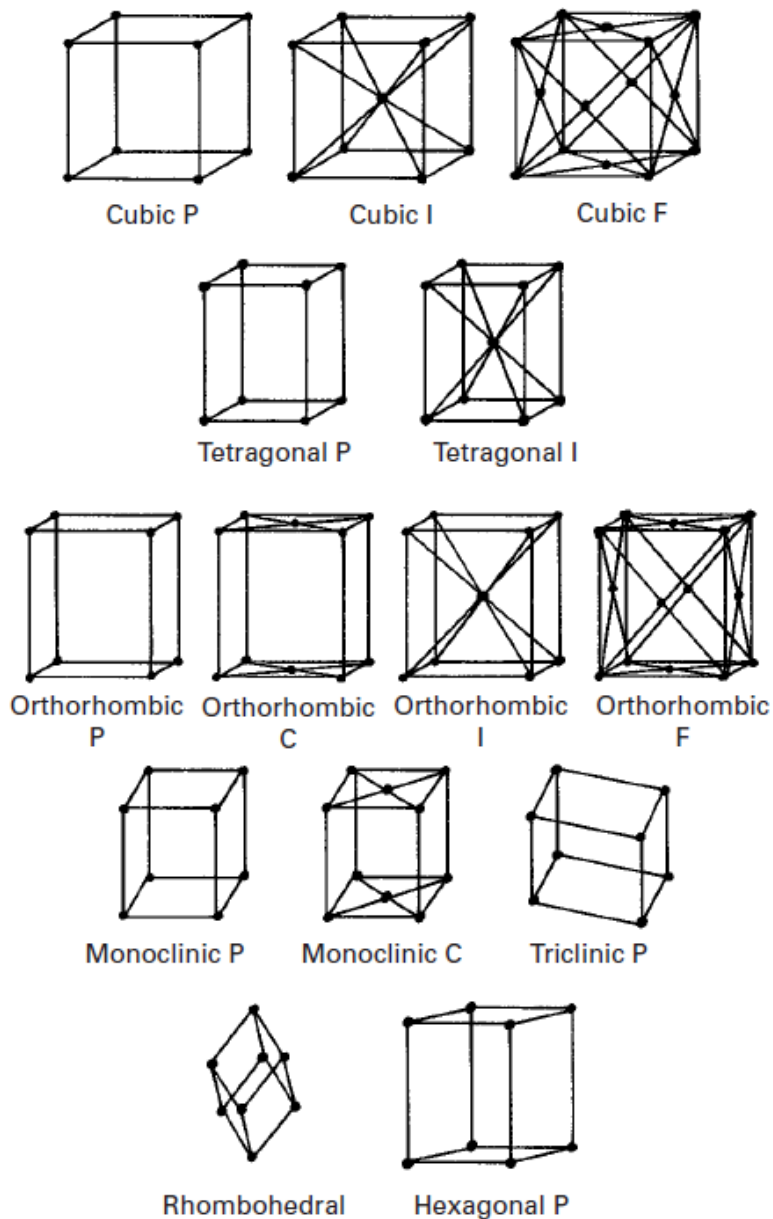


Fig. 1.7 The 14 Bravais space lattices (P = primitive or simple; I = body-centered cubic; F = face-centered cubic; C = base-centered cubic).

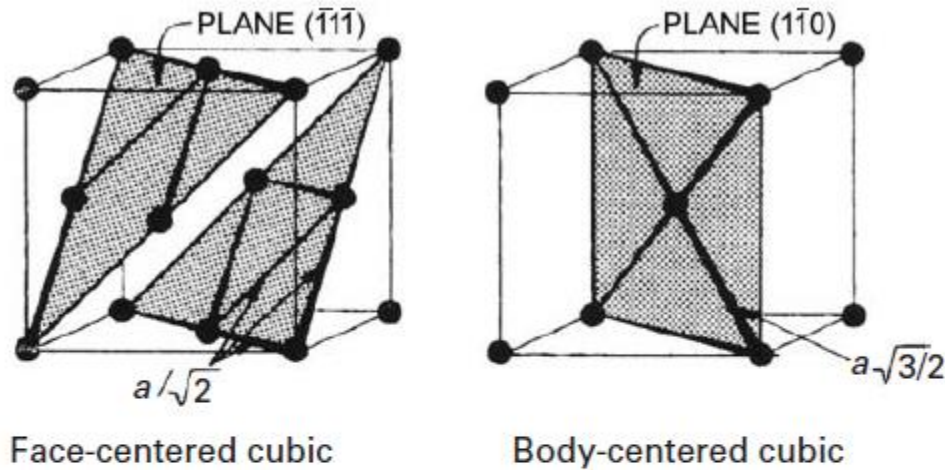
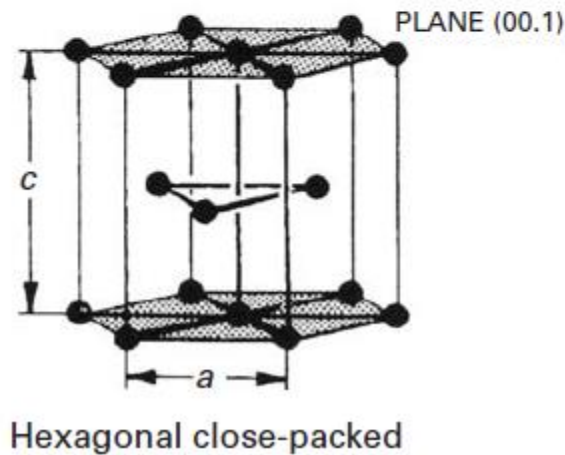


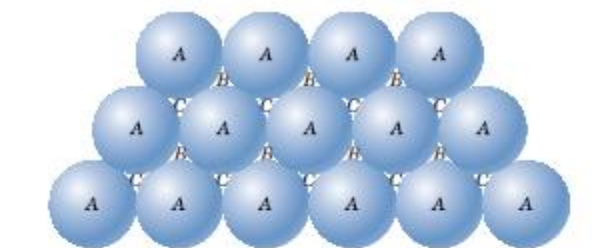
Fig. 1.12 Most closely packed planes in (a) FCC; (b) BCC; (c) HCP.



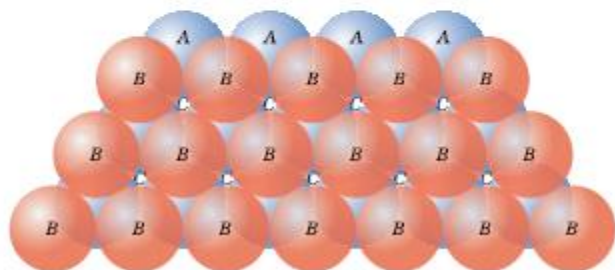
FCC : Cu, Ag, Au, Ni, Al

BCC : Na, K, Fe alpha, Va, Cr

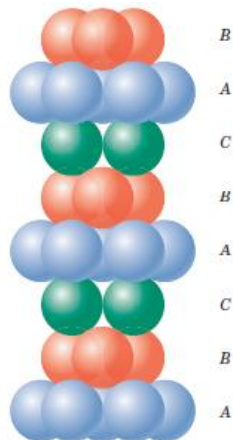
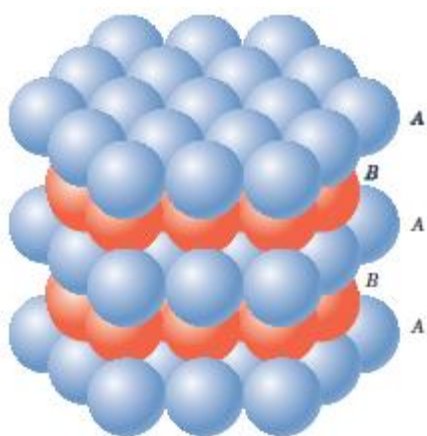
HCP : Mg, Ti, Be, Zn, Cd



(a)



(b)



(a)

(b)

Fig. 1.13 (a) Layer of most closely packed atoms corresponding to (111) in FCC and (00.1) in HCP. (b) Packing sequence of most densely packed planes in AB and AC sequence. (c) Photograph of ball model showing the ABAB sequence of the HCP structure. (d) Photograph of ball model showing the ABCABC sequence of the FCC structure.

