Periodic Table

Grades 9–12+ · 2 pages

All 118 elements with atomic number, symbol, name, standard atomic weight and common ion charges; families, trends, ions, filling order and constants.

1 THE PERIODIC TABLE OF THE ELEMENTS

periods across, groups down; color = the sublevel being filled

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 **H** 1+,1− Hydrogen 1.0080																	2 **He** Helium 4.0026
2	3 **Li** 1+ Lithium 6.94	4 **Be** 2+ Beryllium 9.0122											5 **B** Boron 10.81	6 **C** Carbon 12.011	7 **N** 3− Nitrogen 14.007	8 **O** 2− Oxygen 15.999	9 **F** 1− Fluorine 18.998	10 **Ne** Neon 20.180
3	11 **Na** 1+ Sodium 22.990	12 **Mg** 2+ Magnesium 24.305											13 **Al** 3+ Aluminum 26.982	14 **Si** Silicon 28.085	15 **P** 3− Phosphorus 30.974	16 **S** 2− Sulfur 32.06	17 **Cl** 1− Chlorine 35.45	18 **Ar** Argon 39.95
4	19 **K** 1+ Potassium 39.098	20 **Ca** 2+ Calcium 40.078	21 **Sc** 3+ Scandium 44.956	22 **Ti** 4+ Titanium 47.867	23 **V** Vanadium 50.942	24 **Cr** 2+,3+ Chromium 51.996	25 **Mn** 2+ Manganese 54.938	26 **Fe** 2+,3+ Iron 55.845	27 **Co** 2+,3+ Cobalt 58.933	28 **Ni** 2+ Nickel 58.693	29 **Cu** 1+,2+ Copper 63.546	30 **Zn** 2+ Zinc 65.38	31 **Ga** 3+ Gallium 69.723	32 **Ge** Germanium 72.630	33 **As** 3− Arsenic 74.922	34 **Se** 2− Selenium 78.971	35 **Br** 1− Bromine 79.904	36 **Kr** Krypton 83.798
5	37 **Rb** 1+ Rubidium 85.468	38 **Sr** 2+ Strontium 87.62	39 **Y** 3+ Yttrium 88.906	40 **Zr** 4+ Zirconium 91.222	41 **Nb** Niobium 92.906	42 **Mo** Molyb-denum 95.95	43 **Tc** Technetium [97]	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.91	46 **Pd** 2+ Palladium 106.42	47 **Ag** 1+ Silver 107.87	48 **Cd** 2+ Cadmium 112.41	49 **In** 3+ Indium 114.82	50 **Sn** 2+,4+ Tin 118.71	51 **Sb** Antimony 121.76	52 **Te** 2− Tellurium 127.60	53 **I** 1− Iodine 126.90	54 **Xe** Xenon 131.29
6	55 **Cs** 1+ Cesium 132.91	56 **Ba** 2+ Barium 137.33	57–71 see below	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.95	74 **W** Tungsten 183.84	75 **Re** Rhenium 186.21	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.22	78 **Pt** 2+,4+ Platinum 195.08	79 **Au** 1+,3+ Gold 196.97	80 **Hg** 2+ Mercury 200.59	81 **Tl** 1+,3+ Thallium 204.38	82 **Pb** 2+,4+ Lead 207.2	83 **Bi** 3+ Bismuth 208.98	84 **Po** Polonium [209]	85 **At** Astatine [210]	86 **Rn** Radon [222]
7	87 **Fr** 1+ Francium [223]	88 **Ra** 2+ Radium [226]	89–103 see below	104 **Rf** Ruther-fordium [267]	105 **Db** Dubnium [268]	106 **Sg** Seaborgium [269]	107 **Bh** Bohrium [270]	108 **Hs** Hassium [269]	109 **Mt** Meitnerium [277]	110 **Ds** Darm-stadtium [282]	111 **Rg** Roent-genium [282]	112 **Cn** Copernicium [286]	113 **Nh** Nihonium [286]	114 **Fl** Flerovium [290]	115 **Mc** Moscovium [290]	116 **Lv** Liver-morium [293]	117 **Ts** Tennessine [294]	118 **Og** Oganesson [295]

Lanthanides	57 **La** 3+ Lanthanum 138.91	58 **Ce** 3+,4+ Cerium 140.12	59 **Pr** 3+ Praseo-dymium 140.91	60 **Nd** 3+ Neodymium 144.24	61 **Pm** 3+ Promethium [145]	62 **Sm** 3+ Samarium 150.36	63 **Eu** 3+ Europium 151.96	64 **Gd** 3+ Gadolinium 157.25	65 **Tb** 3+ Terbium 158.93	66 **Dy** 3+ Dysprosium 162.50	67 **Ho** 3+ Holmium 164.93	68 **Er** 3+ Erbium 167.26	69 **Tm** 3+ Thulium 168.93	70 **Yb** 3+ Ytterbium 173.05	71 **Lu** 3+ Lutetium 174.97
Actinides	89 **Ac** 3+ Actinium [227]	90 **Th** 4+ Thorium 232.04	91 **Pa** Protac-tinium 231.04	92 **U** 4+,6+ Uranium 238.03	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** Mende-levium [258]	102 **No** Nobelium [259]	103 **Lr** Lawrencium [266]

– atomic number · common ion charge(s)
– symbol
– name
– standard atomic weight (IUPAC 2024, abridged)

s-block (groups 1–2, plus He) · d-block (transition metals, groups 3–12)
p-block (groups 13–18) · f-block (lanthanides and actinides)
heavy outline: metalloid (B, Si, Ge, As, Sb, Te) · [ ] italic: mass number of a long-lived isotope

2 READING THE TABLE

Period a row; the period number is the outer energy level (n) being filled

Group a column (1–18); same group, same outer-electron pattern, similar chemistry

Block s, p, d or f: the sublevel that receives the last electron

Valence e⁻ outer s + p electrons; groups 1–2 have 1–2, groups 13–18 have 3–8 (He: 2)

Metals, nonmetals, metalloids

- **Metals** (left and center): shiny, conduct, lose electrons to form cations.
- **Nonmetals** (upper right, plus H): gain or share electrons; many are gases.
- **Metalloids** (heavy outline) sit on the border and behave in between; Si and Ge are semiconductors.

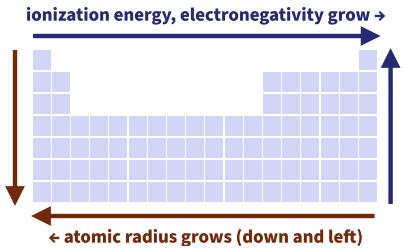
Families

Group	Family	Valence e⁻	Typical ion
1	alkali metals (not H)	1	1+
2	alkaline earth metals	2	2+
3–12	transition metals	varies	often 2+ or 3+
15	nitrogen family	5	3−
16	chalcogens (oxygen family)	6	2−
17	halogens	7	1−
18	noble gases	8 (He 2)	none

Rank by ionization energy WORKED

Na, Mg, Cl, Ar (period 3)

Na < Mg < Cl < Ar *left to right*



Up and to the right: bigger pull on electrons. Down and to the left: bigger atoms.

Trends

Property	Across a period →	Down a group ↓
atomic radius	decreases	increases
ionization energy	increases	decreases
electronegativity	increases (F highest)	decreases
metallic character	decreases	increases

Why

- Across: more protons, same shell → stronger pull, smaller atom.
- Down: one more shell each period → electrons farther out, easier to remove.
- Dips in ionization energy: B < Be (new p sublevel), O < N (first paired p electron).

MEMORY TRICK

Seven elements travel in pairs

H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2: start at element **7** (N), trace the shape of a **7** through O, F, Cl, Br, I, then add H. (Traditional picture.)

MEMORY TRICK

Fluorine is the corner bully

The pull rises toward the **upper right**, so F (3.98) has the greatest electronegativity; noble gases are left out of the scale.

3 IONS, ELECTRONS & CONSTANTS

Polyatomic ions

Ion	Name	Ion	Name
NH_4^+	ammonium	OH^-	hydroxide
NO_3^-	nitrate	NO_2^-	nitrite
SO_4^{2-}	sulfate	SO_3^{2-}	sulfite
PO_4^{3-}	phosphate	CO_3^{2-}	carbonate
HCO_3^-	hydrogen carbonate	$C_2H_3O_2^-$	acetate
ClO_3^-	chlorate	ClO_4^-	perchlorate
MnO_4^-	permanganate	CN^-	cyanide
CrO_4^{2-}	chromate	$Cr_2O_7^{2-}$	dichromate
O_2^{2-}	peroxide	Hg_2^{2+}	mercury(I)

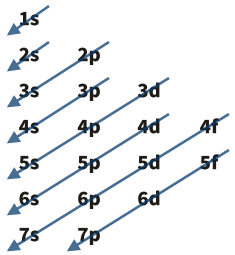
Naming metal ions

- One common charge (groups 1–2, Al, Zn, Ag): just the element name: Na^+ sodium ion.
- Several charges: Roman numeral = charge: Fe^{2+} iron(II), Fe^{3+} iron(III), Cu^+ copper(I).
- Anions end in **-ide**: Cl^- chloride, O^{2-} oxide, N^{3-} nitride.

MEMORY TRICK

-ate has more O than -ite

Nitr**ate** NO_3^- vs nitr**ite** NO_2^-: "**ate** ate one more oxygen." Same charge, one fewer O for -ite.



Follow each arrow, top to bottom: 1s 2s 2p 3s 3p 4s 3d 4p 5s 4d 5p 6s 4f 5d 6p 7s 5f 6d 7p.

Electron configurations WORKED

Fe (26): [Ar] $4s^2$ $3d^6$

Fe^{3+}: [Ar] $3d^5$ *lose 4s first*

Cr: [Ar] $4s^1$ $3d^5$; Cu: [Ar] $4s^1$ $3d^{10}$ *half or full d*

Avogadro	$N_A = 6.02214076 \times 10^{23}$ mol^{-1} (exact)
Gas constant	R = 0.08206 L·atm/(mol·K) = 8.314 J/(mol·K)
Molar volume	22.41 L/mol at 0 °C, 1 atm
Pressure	1 atm = 760 mmHg = 101.325 kPa
Water	c = 4.184 J/(g·°C); $K_w = 1.0 \times 10^{-14}$ at 25 °C
Light	$c = 2.998 \times 10^8$ m/s; $h = 6.626 \times 10^{-34}$ J·s

About the numbers

Atomic weights: IUPAC CIAAW abridged standard atomic weights (2024 revision). Elements with no stable isotopes show a bracketed mass number (from PubChem, NIH). Names use U.S. spelling (aluminum, cesium).