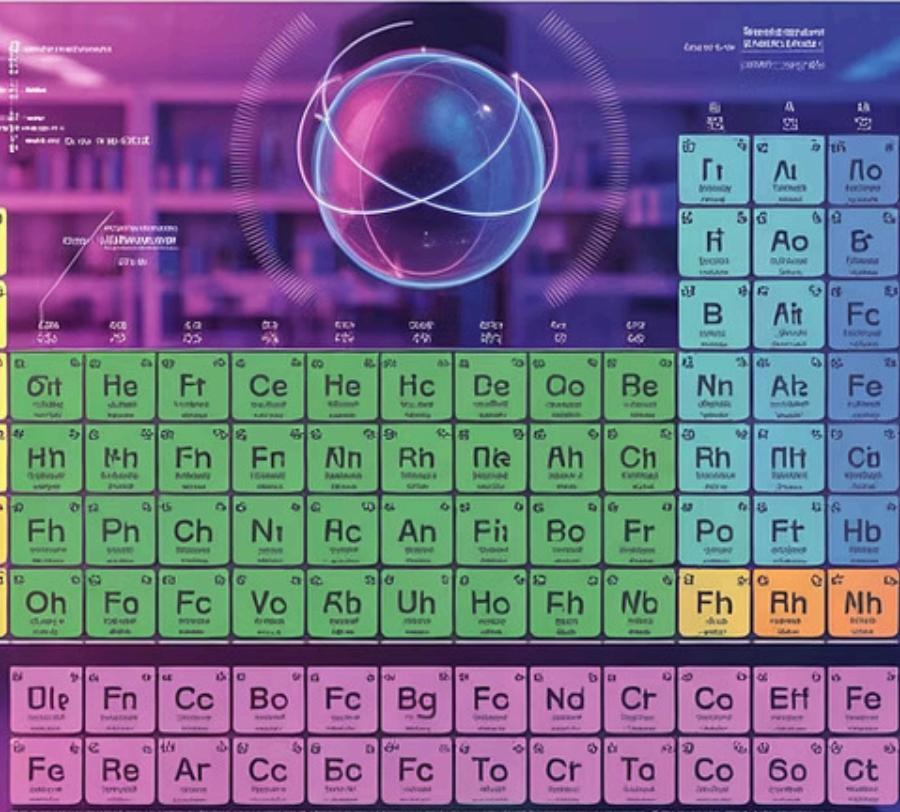


Periodic Element The Building Blocks of Tomorrow

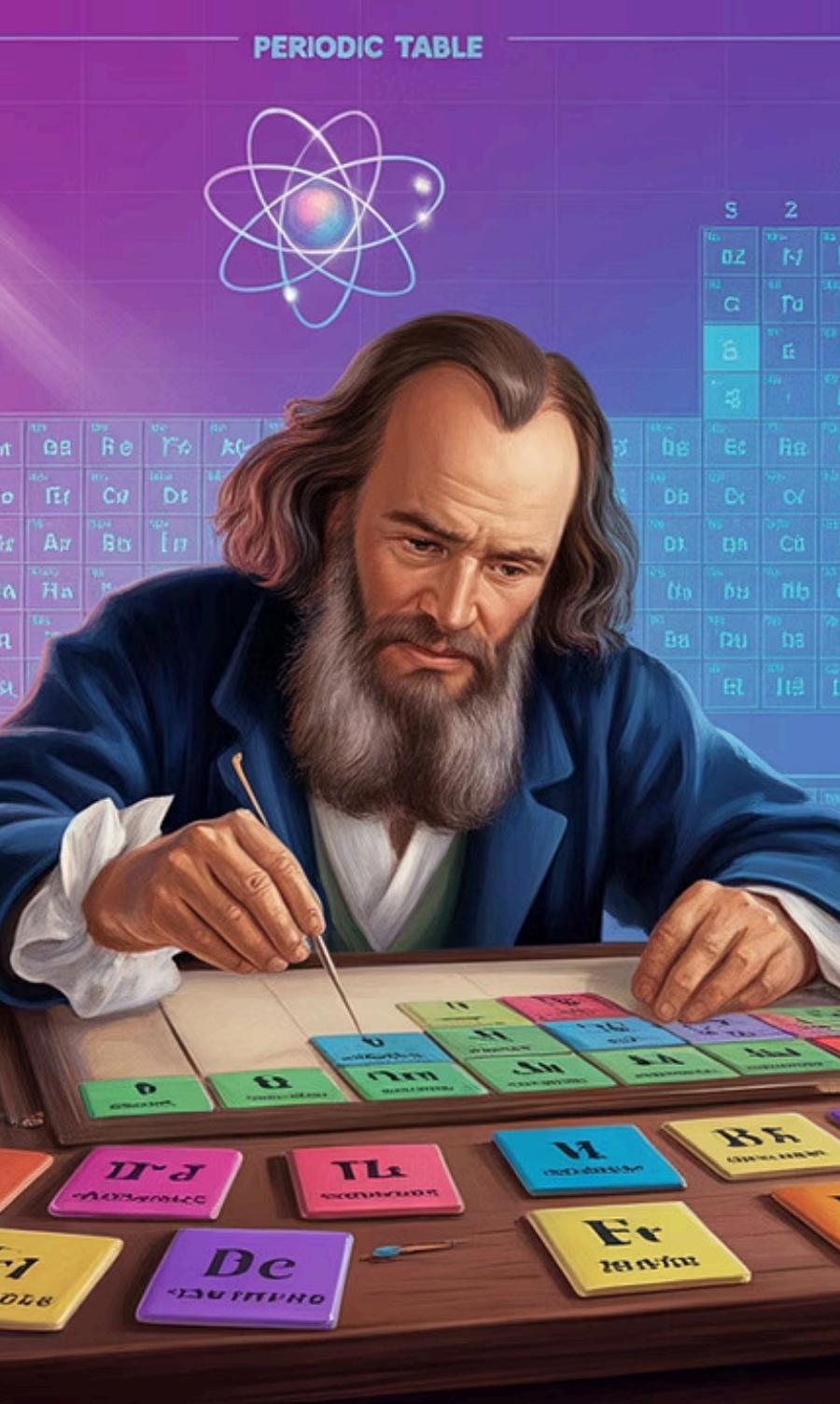


Chemistry Fundamentals

Lecture 9: Periodic Table Overview

Mohamed
Kamal

PERIODIC TABLE



The Periodic Table - Chemistry's Most Important Tool

Historical Development

Mendeleev (1869) arranged by atomic mass, modern table by atomic number

Fundamental Principle

Properties repeat periodically when elements arranged by atomic number

Modern Organization

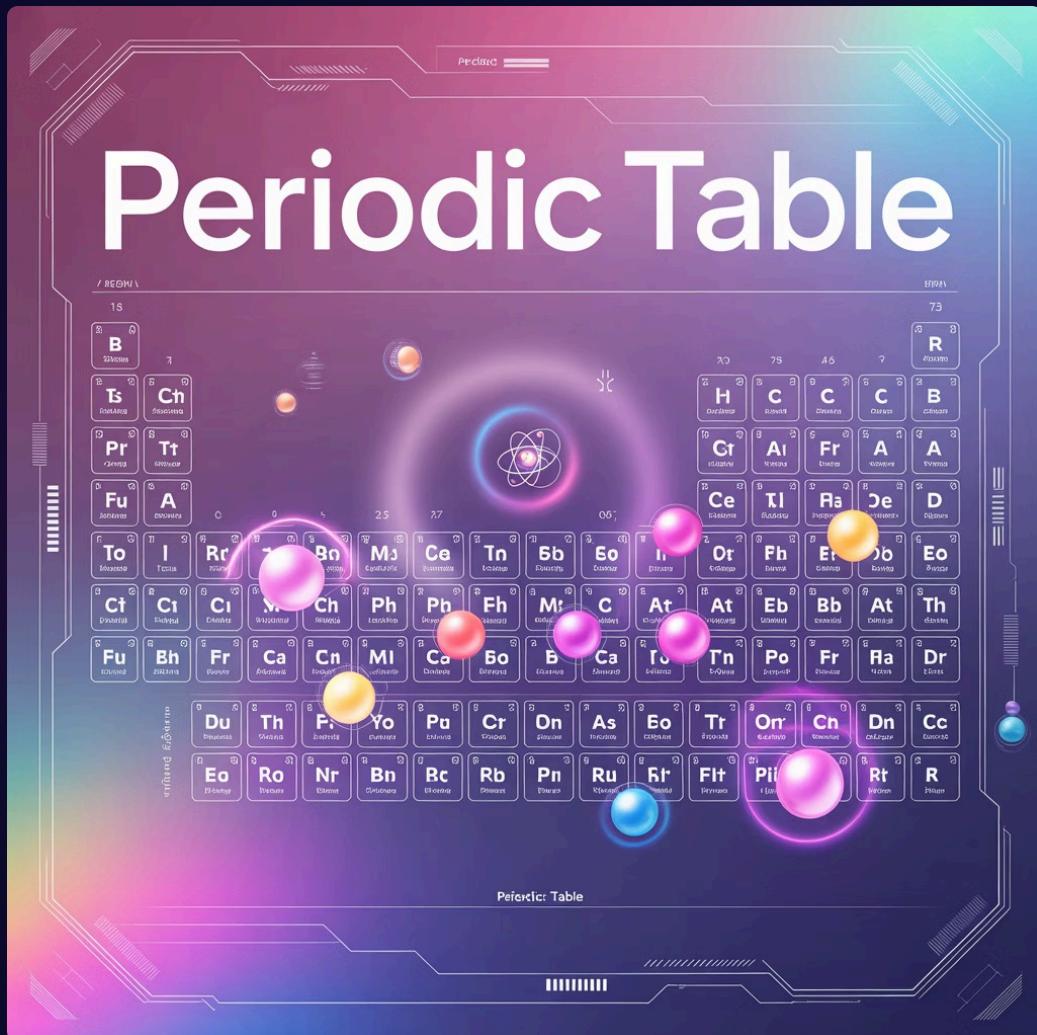
118 confirmed elements arranged in 7 periods and 18 groups

The periodic table serves as a universal language in chemistry, with each square containing the element's symbol, name, atomic number, and atomic mass. It remains a living document as new elements continue to be discovered.

Periods - Horizontal Rows of Elements

Periods are horizontal rows of elements with the same number of electron shells. The period number (1-7) indicates the number of electron energy levels.

- Period 1: H and He (2 elements) - 1 electron shell
- Period 2: Li through Ne (8 elements) - 2 electron shells
- Period 3: Na through Ar (8 elements) - 3 electron shells
- Period 4: K through Kr (18 elements) - 4 electron shells



Across each period, properties change systematically, with atomic size generally decreasing from left to right as each period fills a new electron shell.

Groups (Families) - Vertical Columns of Elements

Groups are vertical columns of elements with similar properties, numbered 1-18 in modern IUPAC notation.



Group 1: Alkali Metals

Highly reactive metals (except H)



Group 2: Alkaline Earth Metals

Reactive but less than Group 1



Group 17: Halogens

Highly reactive nonmetals



Group 18: Noble Gases

Extremely unreactive elements

Elements in the same group share similar chemical behavior, number of valence electrons, bonding patterns, and physical properties. If you know one element's properties, you can predict others in the same group.

PERIODIC TABLE — ELEMENTS OF INNOVATION											
02	Clc	03	Ch	03	Sic	06	St	23	Fr	03	Eo
Moscovium	Rutherfordium	Neobrium	Magnesium	Moscovium	Dubnium	Nihonium	Francium	Moscovium	Bohrium	Ce	
07	Pc	07	Fd	07	Fh	07	Ck	07	Mk	07	Wh
Florium	Flubium	Miodoto	Petrov	Petrov	Petrov	Petrov	Petrov	Petrov	Moscovium	Bombilla	
09	Ro	09	Ch	10	Flh	10	Th	08	Ch	07	Th
Rutherfordium	Moscovium	Magnesium	Florium	Florium	Florium	Florium	Florium	Florium	Florium	Bombilla	
16	Ra	03	Ch	02	Fb	02	Cc	03	Ch	06	Fd
Rutherfordium	Meldeium	Rutherfordium	Rutherfordium	Rutherfordium	Rutherfordium	Rutherfordium	Ceion	Moscovium	Moscovium	Moscovium	Florium
42	Art	07	Eh	02	Be	07	To	03	Cu	05	Pe
Bombilla	Rutherfordium	Quintessence	Nielsbohrium	Nielsbohrium	Nielsbohrium	Nielsbohrium	Thorium	Moscovium	Moscovium	Moscovium	Florium

Major Regions of the Periodic Table

Metals (Left Side)

Groups 1-12 plus some in 13-16

Properties: Shiny, conduct electricity, malleable, ductile

Examples: Na, Mg, Al, Fe, Cu, Zn

Nonmetals (Right Side)

Groups 14-18

Properties: Dull, insulators, brittle when solid

Examples: C, N, O, F, S, Cl

Metalloids (Diagonal Band)

B, Si, Ge, As, Sb, Te

Properties: Intermediate between metals and nonmetals

Applications: Semiconductors in electronics

Periodic Table of the Elements

1 IA 1A 1 H Hydrogen 1.008	2 IIA 2A 2 Be Beryllium 9.012																				18 VIIIA 8A 2 He Helium 4.003	
3 Li Lithium 6.941	4 Be Beryllium 9.012																					
11 Na Sodium 22.990	12 Mg Magnesium 24.305	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIIB 7B	8	9	10	11 IB 1B	12 IIB 2B											
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.88	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.933	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.39	31 Ga Gallium 69.732	32 Ge Germanium 72.61	33 As Arsenic 74.922	34 Se Selenium 78.972	35 Br Bromine 79.904	36 Kr Krypton 84.80					
37 Rb Rubidium 84.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.95	43 Tc Technetium 98.907	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.71	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 126.904	54 Xe Xenon 131.29					
55 Cs Cesium 132.905	56 Ba Barium 137.327	57-71	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.85	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.967	80 Hg Mercury 200.59	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [208.982]	85 At Astatine 209.987	86 Rn Radon 222.018					
87 Fr Francium 223.020	88 Ra Radium 226.025	89-103	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [268]	110 Ds Darmstadtium [269]	111 Rg Roentgenium [272]	112 Cn Copernicium [277]	113 Uut Ununtrium unknown	114 Fl Flerovium [289]	115 Uup Ununpentium unknown	116 Lv Livermorium [298]	117 Uus Ununseptium unknown	118 Uuo Ununoctium unknown					

Lanthanide Series

Actinide Series

57 La Lanthanum 138.906	58 Ce Cerium 140.115	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.24	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.966	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.50	67 Ho Holmium 164.930	68 Er Erbium 167.26	69 Tm Thulium 168.934	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967					
89 Ac Actinium 227.028	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [254]	100 Fm Fermium 257.095	101 Md Mendelevium 258.1	102 No Nobelium 259.101	103 Lr Lawrencium [262]					

Alkali Metal

Alkaline Earth

Transition Metal

Basic Metal

Semimetal

Nonmetal

Halogen

Noble Gas

Lanthanide

Actinide

Alkali Metals - Group 1 Elements

Members: Li, Na, K, Rb, Cs, Fr

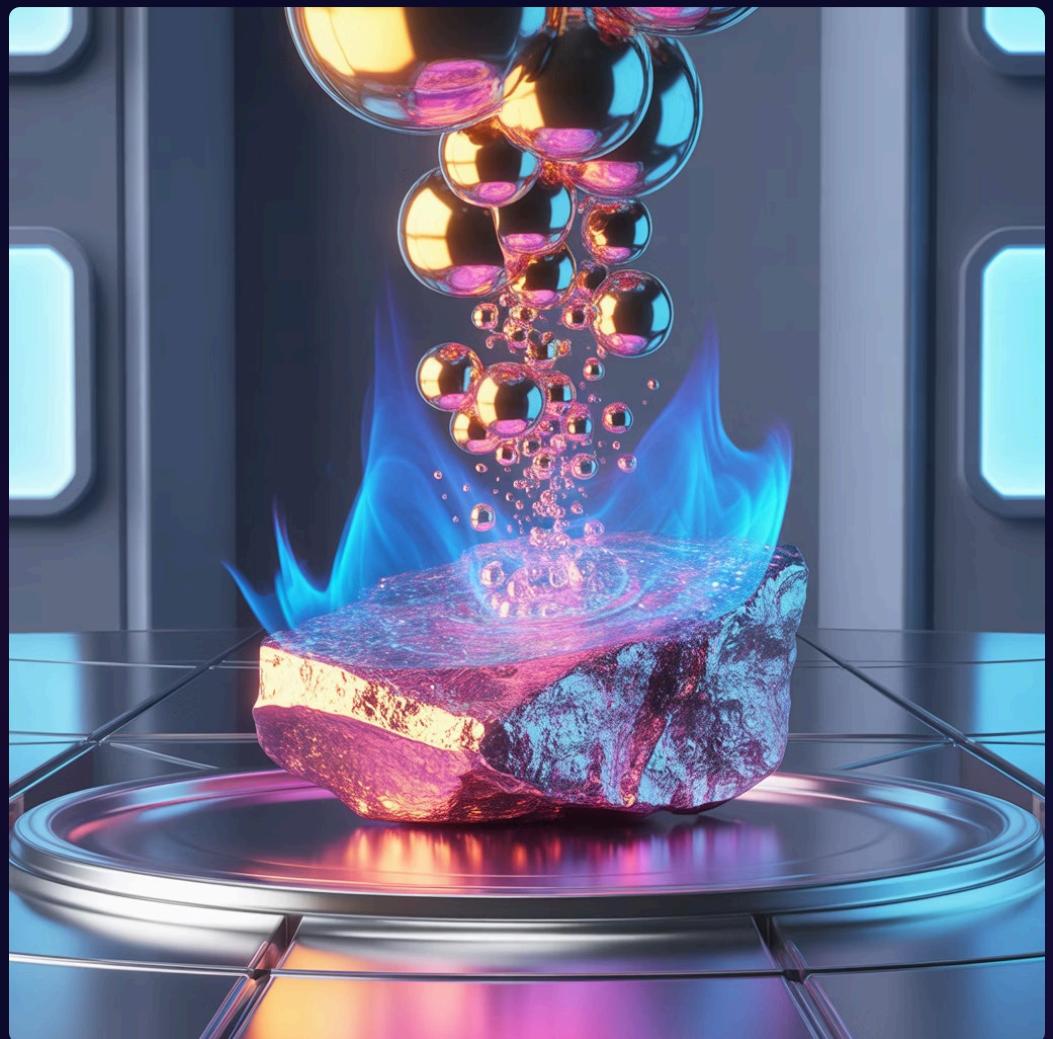
Common Properties:

- One valence electron (lose easily)
- Soft, low-density metals
- React vigorously with water
- Form ionic compounds with nonmetals

Chemical Behavior: $M \rightarrow M^+ + e^-$

Examples:

- $2Na + 2H_2O \rightarrow 2NaOH + H_2$
- $2K + Cl_2 \rightarrow 2KCl$

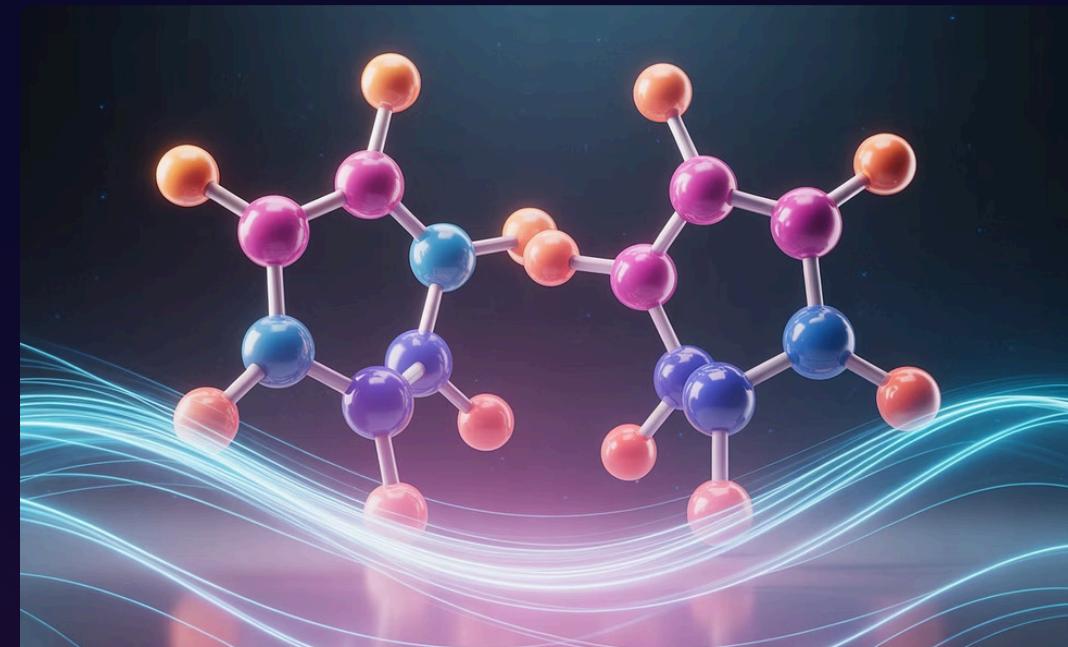


Trends Down Group: Increasing size, reactivity, and metallic character

Applications: Na in table salt, K in fertilizers, Li in batteries

Safety: Must be stored under oil to prevent reaction with moisture

Halogens - Group 17 Elements



Physical States

F_2 , Cl_2 (gases), Br_2 (liquid), I_2 (solid) at room temperature

Members: F, Cl, Br, I, At

Common Properties: Seven valence electrons (gain one easily), highly reactive nonmetals, form ionic compounds with metals

Chemical Behavior: $\text{X}_2 + 2\text{e}^- \rightarrow 2\text{X}^-$

Examples: $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$, $\text{H}_2 + \text{Br}_2 \rightarrow 2\text{HBr}$

Trends Down Group: Decreasing reactivity, increasing size

Applications: Cl_2 in water treatment, I_2 in medicine, F^- in toothpaste

Molecular Structure

Exist as diatomic molecules (F_2 , Cl_2 , Br_2 , I_2)

Noble Gases - Group 18 Elements

Members: He, Ne, Ar, Kr, Xe, Rn

Common Properties:

- Complete valence electron shells
- Extremely unreactive (hence "noble")
- Exist as monatomic gases
- Colorless, odorless at room temperature

Historical Note: Called "inert gases" until 1962 when first compounds discovered

Electron Configuration: Stable octet (except He with 2 electrons)



Limited Reactivity: Only heaviest members (Kr, Xe, Rn) form compounds

Applications:

- He: Balloons, cooling systems
- Ne: Neon signs
- Ar: Welding atmosphere, light bulbs

Trends: Increasing size and slight increase in reactivity down group

Periodic Trends and Patterns

Atomic Size

Decreases left to right across period, increases down group

Example: Li: 152pm, Be: 111pm, B: 88pm, C: 77pm, N: 70pm, O: 66pm, F: 64pm

Ionization Energy

Energy to remove electron

Increases left to right across period, decreases down group

Electronegativity

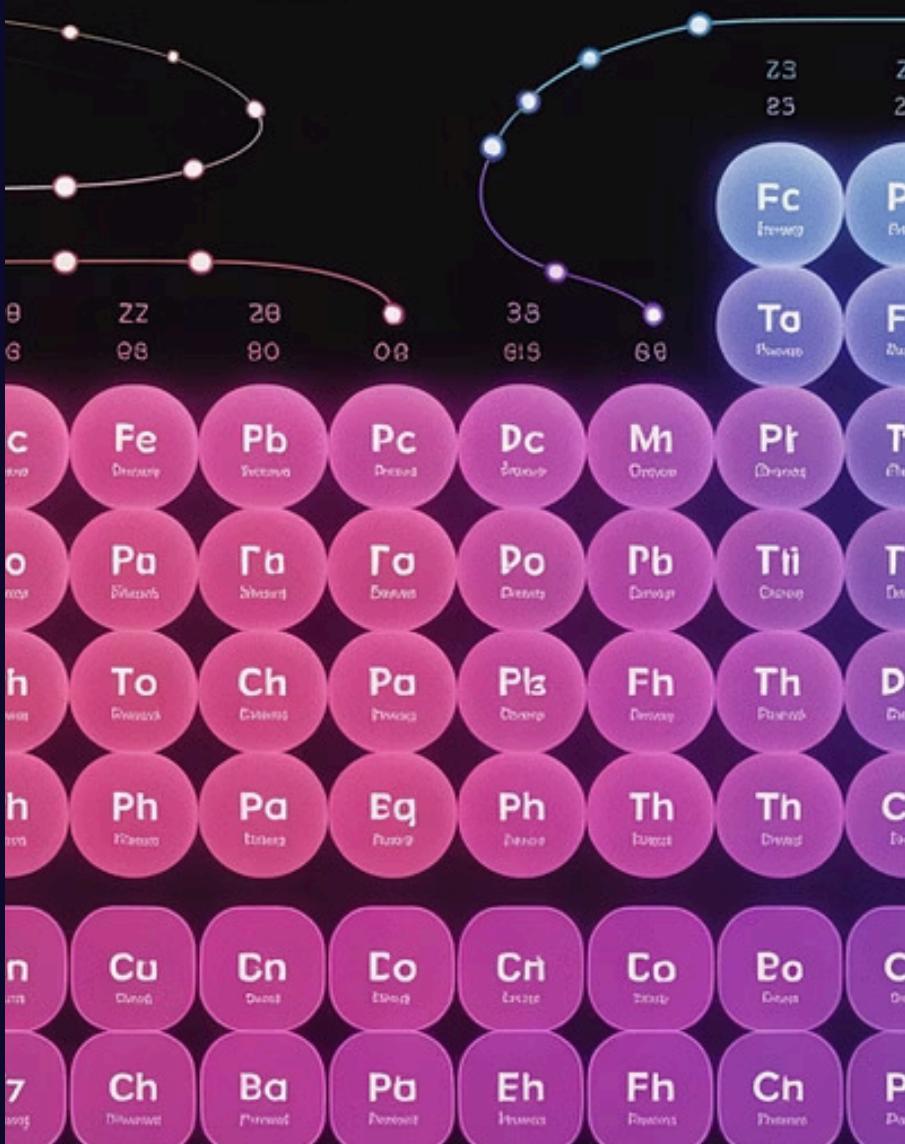
Attraction for electrons in bonds

Increases left to right across period, decreases down group

Metallic Character: Decreases left to right across period, increases down group

Predictive Power: Use trends to estimate properties of unknown elements

Periodic Table Trends



Next Lecture:
Electron
Configuration
Basics

Mohamed
Kamal

