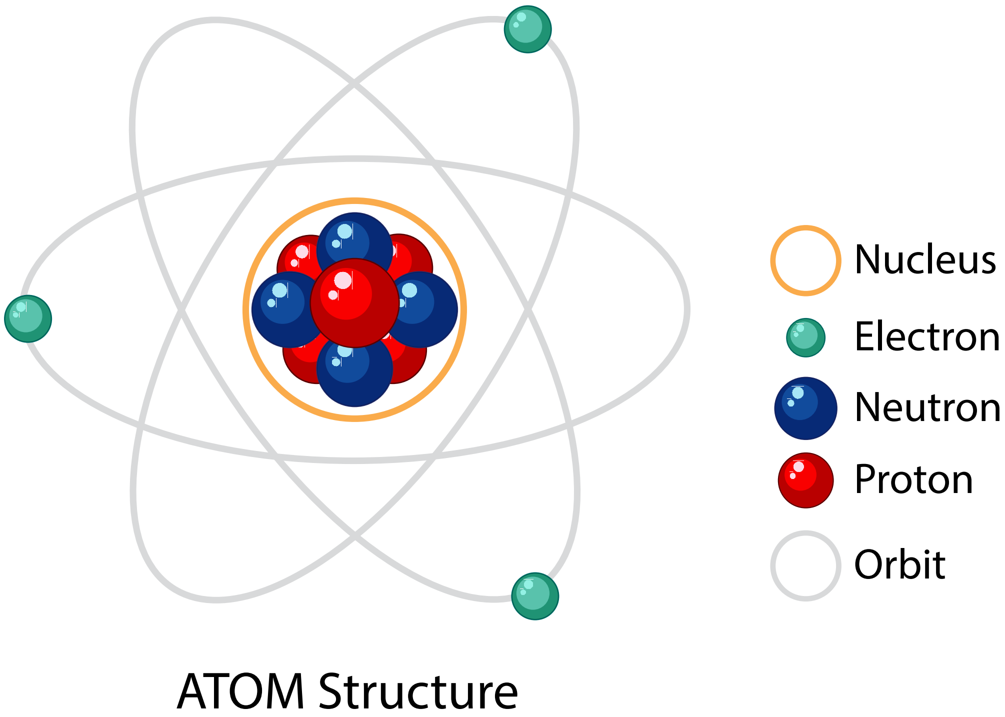
Smart Edition Nursing

Trends of the Periodic Table

Understanding the Basics of Atoms, Elements, and Periodic Trends



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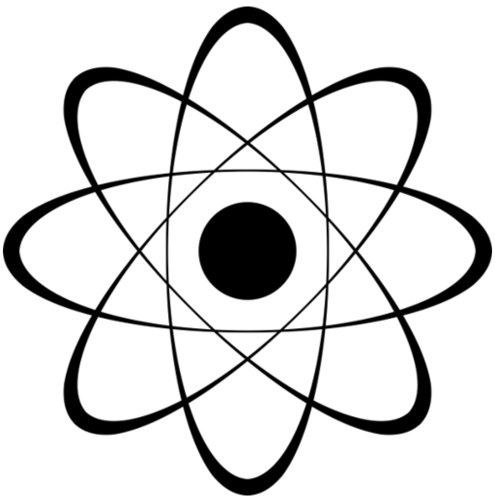
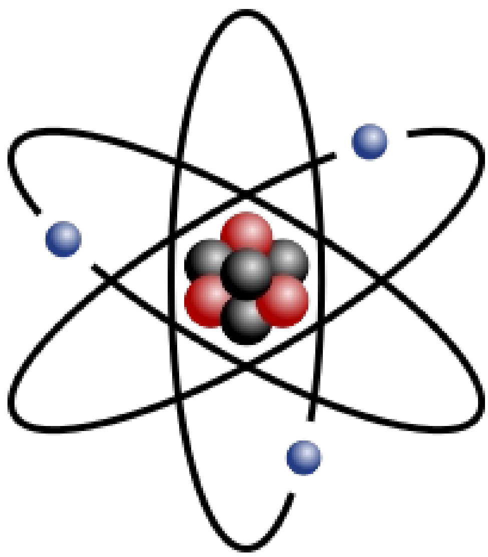
What is an Atom?

- The **smallest unit** of an element that retains the properties of that element.
- Composed of **three subatomic particles:**
  - Protons: Positively charged, located in the nucleus.
  - Neutrons: No charge, located in the nucleus.
  - Electrons: Negatively charged, orbiting the nucleus in electron shells.



Subatomic Particles



- **Protons (p^+):**
  - Determine the element's identity (e.g., Hydrogen has 1 proton).
  - The **atomic number** is equal to the number of protons.
- **Neutrons (n^0):**
  - Vary in isotopes, contributing to atomic mass.
- **Electrons (e^-):**
  - Occupy electron shells, important in chemical bonding.
  - In a **neutral atom**, the number of electrons equals the number of protons.

How to read a Periodic Table

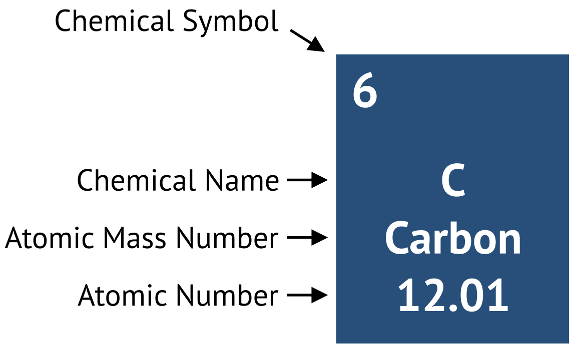
Periodic Table of Elements

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H hydrogen 1.01																	2 He helium 4.00
2	3 Li lithium 6.94	4 Be beryllium 9.01											5 B boron 10.81	6 C carbon 12.01	7 N nitrogen 14.01	8 O oxygen 16.00	9 F fluorine 19.00	10 Ne neon 20.18
3	11 Na sodium 22.99	12 Mg magnesium 24.31											13 Al aluminium 26.98	14 Si silicon 28.09	15 P phosphorus 30.97	16 S sulfur 32.07	17 Cl chlorine 35.45	18 Ar argon 39.95
4	19 K potassium 39.10	20 Ca calcium 40.08	21 Sc scandium 44.96	22 Ti titanium 47.87	23 V vanadium 50.94	24 Cr chromium 52.00	25 Mn manganese 54.94	26 Fe iron 55.85	27 Co cobalt 58.93	28 Ni nickel 58.69	29 Cu copper 63.55	30 Zn zinc 65.38	31 Ga gallium 69.723	32 Ge germanium 72.64	33 As arsenic 74.92	34 Se selenium 78.96	35 Br bromine 79.90	36 Kr krypton 83.80
5	37 Rb rubidium 85.47	38 Sr strontium 87.62	39 Y yttrium 88.91	40 Zr zirconium 91.22	41 Nb niobium 92.91	42 Mo molybdenum 95.96	43 Tc technetium [98]	44 Ru ruthenium 101.07	45 Rh rhodium 102.91	46 Pd palladium 106.42	47 Ag silver 107.87	48 Cd cadmium 112.41	49 In indium 114.82	50 Sn tin 118.71	51 Sb antimony 121.76	52 Te tellurium 127.60	53 I iodine 126.90	54 Xe xenon 131.29
6	55 Cs caesium 132.91	56 Ba barium 137.33	57-71 Lanthanides	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 platinum 195.08	79 Au gold 196.97	80 Hg mercury 200.59	81 Tl thallium 204.38	82 Pb lead 207.2	83 Bi bismuth 208.98	84 Po polonium [209]	85 At astatine [210]	86 Rn radon [222]
7	87 Fr francium [223]	88 Ra radium [226]	89-103 Actinides	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 Cn copernicium [285]	113 Nh Nihonium [286]	114 Fl Flerovium [289]	115 Mc Moscovium [289]	116 Lv Livermorium [293]	117 Ts Tennessine [294]	118 Og Oganesson [294]

57 La lanthanum 138.91	58 Ce cerium 140.12	59 Pr praseodymium 140.91	60 Nd neodymium 144.24	61 Pm promethium [145]	62 Sm samarium 150.36	63 Eu europium 151.96	64 Gd gadolinium 157.25	65 Tb terbium 158.93	66 Dy dysprosium 162.50	67 Ho holmium 164.93	68 Er erbium 167.26	69 Tm thulium 168.93	70 Yb ytterbium 173.05	71 Lu lutetium 174.97
89 Ac actinium [227]	90 Th thorium 232.04	91 Pa protactinium 231.04	92 U 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 hydrogen [257]	101 Md mendelevium [258]	102 No nobelium [259]	103 Lr lawrencium [262]

Alkali Metal | Alkaline Earth Metal | Transition Metal | Halogen | Noble Gas | Lanthanide | Actinide

Understanding Atomic and Mass Numbers



- **Atomic Number (Z):** Number of protons in the nucleus.
- **Mass Number (A):** Sum of protons and neutrons in the nucleus.
- Example: **Carbon-12**
  - Atomic number = 6 (6 protons)
  - Mass number = 12 (6 protons + 6 neutrons)

What are Isotopes?

- Atoms of the same element with **different numbers of neutrons.**
- Same atomic number but different mass numbers.
- Example: **Carbon-12 vs. Carbon-14**
  - Carbon-12: 6 protons, 6 neutrons.
  - Carbon-14: 6 protons, 8 neutrons.

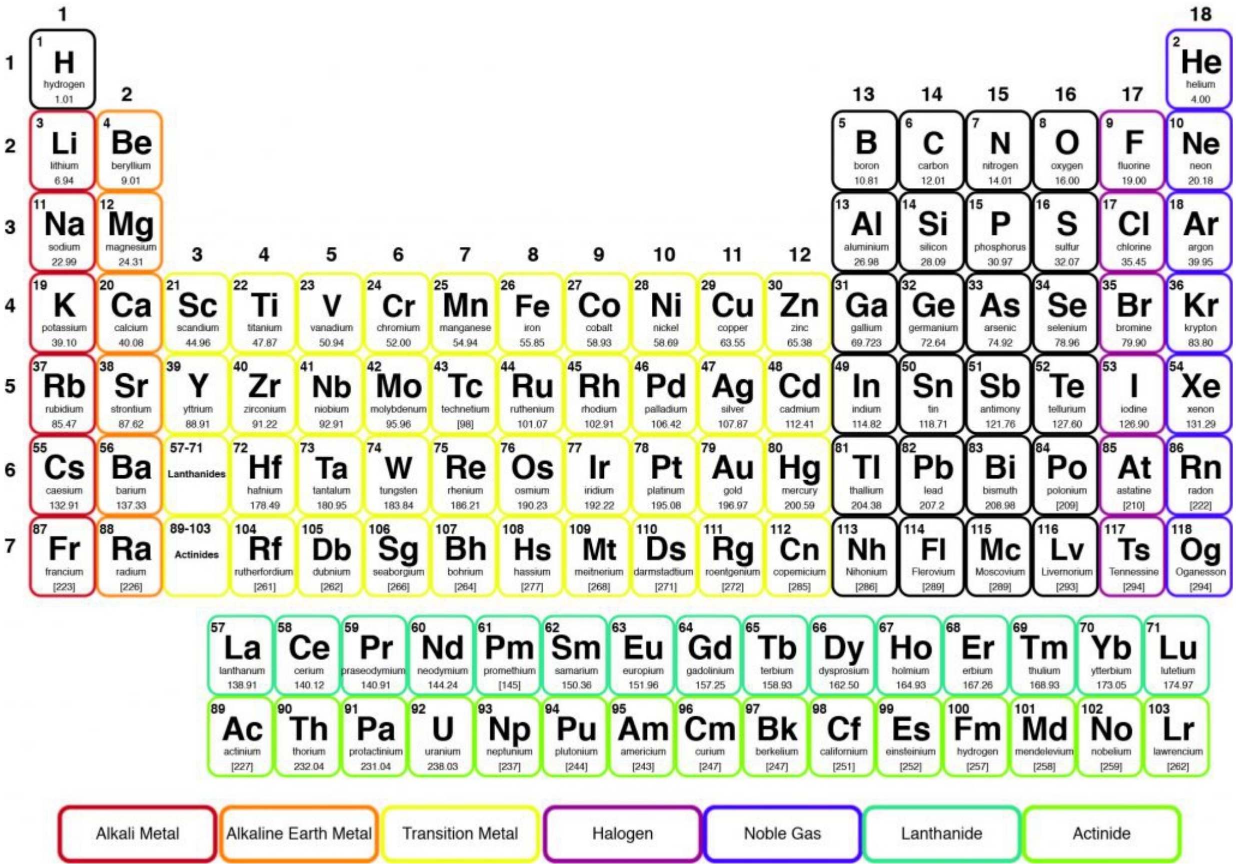
How to calculate protons, electrons and neutrons using of isotopes

Carbon-12 vs. Carbon-14

- Carbon-12:
  6 protons, 6 neutrons.
- Carbon-14:
  6 protons, 8 neutrons

Basic Structure of the Periodic Table

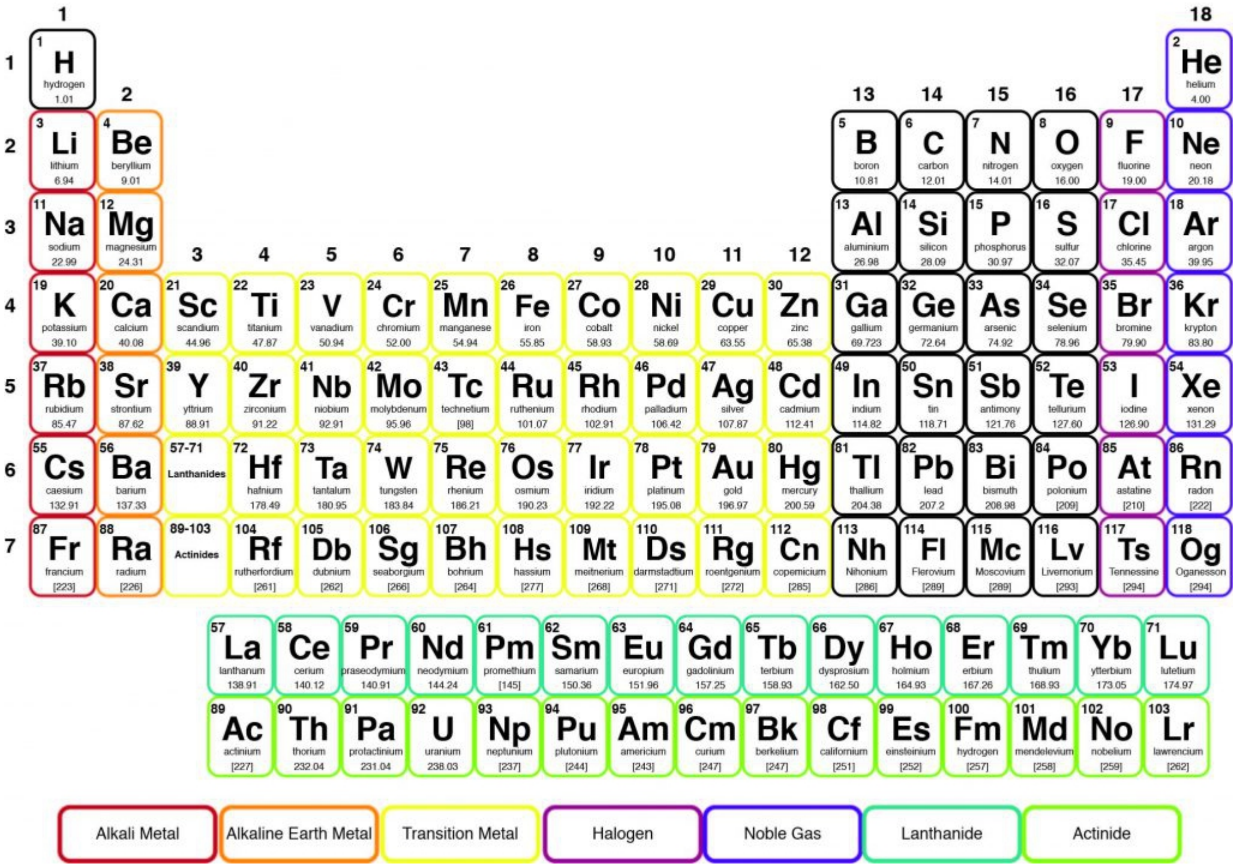
How are Elements Organized?



- Elements are organized by **increasing atomic number.**
- **Groups/Columns:**
  - Vertical columns, elements have similar chemical properties.
- **Periods/Rows:**
  - Horizontal rows, properties change progressively across a period.

Types of Elements

Metals, Nonmetals, and Metalloids



- **Metals:**
  - Good conductors of heat and electricity, malleable, ductile.
  - Located on the left side and center of the periodic table.
- **Nonmetals:**
  - Poor conductors, brittle in solid form, found on the right side.
- **Metalloids:**
  - Properties of both metals and nonmetals, found along the "staircase" line.

Understanding Ions and Bonding

Atomic Ions
Most common form on top

1A	2A	3B	4B	5B	6B	7B	8B			1B	2B	3A	4A	5A	6A	7A	0
H^+																	He
Li^+	Be^{2+}											B	C	N^{3-}	O^{2-}	F^-	Ne
Na^+	Mg^{2+}											Al^{3+}	Si	P^{3-}	S^{2-}	Cl^-	Ar
K^+	Ca^{2+}	Sc^{3+}	Ti^{3+} Ti^{4+}	V^{3+} V^{5+}	Cr^{3+} Cr^{2+}	Mn^{2+} Mn^{4+}	Fe^{2+} Fe^{3+}	Co^{2+} Co^{3+}	Ni^{2+} Ni^{3+}	Cu^{2+} Cu^+	Zn^{2+}	Ga^{3+}	Ge^{4+}	As^{3-}	Se^{2-}	Br^-	Kr
Rb^+	Sr^{2+}	Y^{3+}	Zr^{4+}	Nb^{5+} Nb^{3+}	Mo^{6+}	Tc^{7+}	Ru^{3+} Ru^{4+}	Rh^{3+}	Pd^{2+} Pd^{4+}	Ag^+	Cd^{2+}	In^{3+}	Sn^{4+} Sn^{2+}	Sb^{3+} Sb^{5+}	Te^{2-}	I^-	Xe
Cs^+	Ba^{2+}	La^{3+}	Hf^{4+}	Ta^{5+}	W^{6+}	Re^{7+}	Os^{4+}	Ir^{4+}	Pt^{4+} Pt^{2+}	Au^{3+} Au^+	Hg^{2+} Hg^+	Tl^+ Tl^{3+}	Pb^{2+} Pb^{4+}	Bi^{3+} Bi^{5+}	Po^{2+} Po^{4+}	At^-	Rn
Fr^+	Ra^{2+}	Ac^{3+}															

- **Cations:** Positively charged ions (e.g., Na), formed when an atom loses electrons.
- **Anions:** Negatively charged ions (e.g., Cl), formed when an atom gains electrons.
- **Ionic Bonds:** Formed between cations and anions, resulting in a neutral compound (e.g., NaCl).

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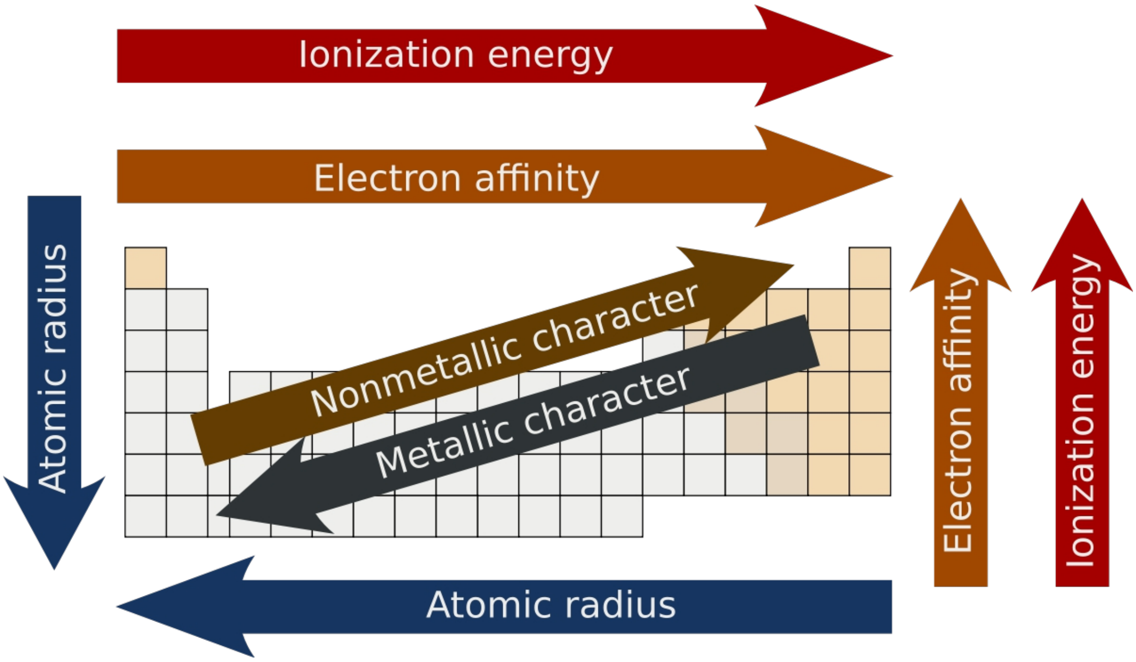
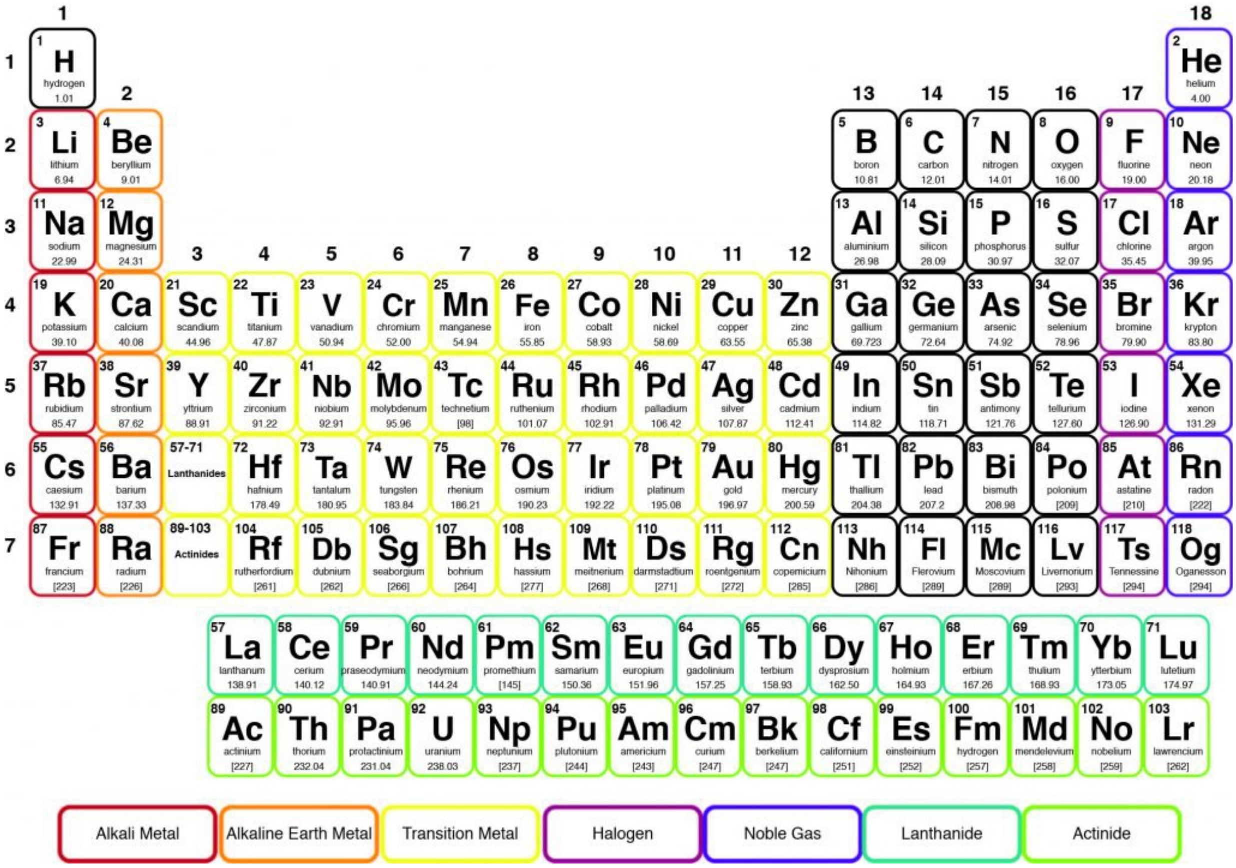
Key Periodic Table Trends



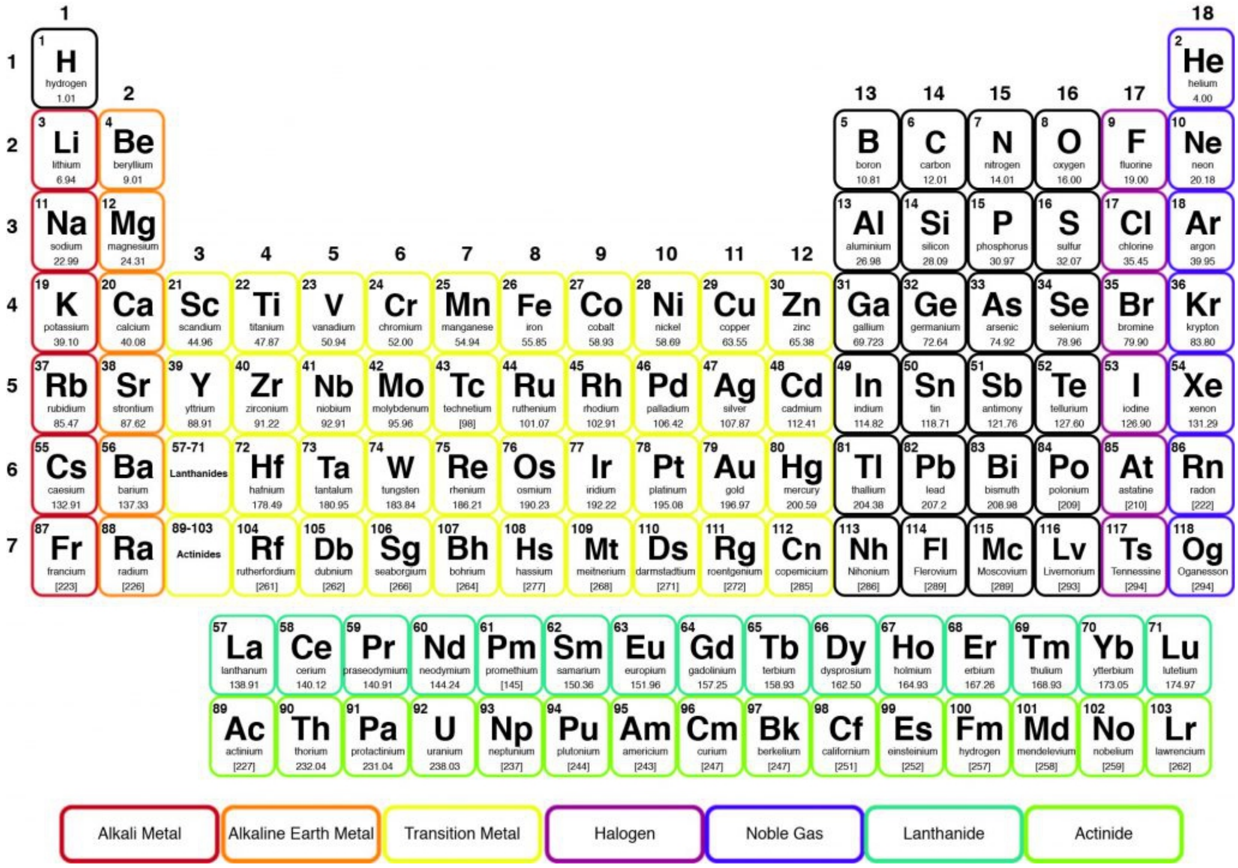
- **Atomic Radius:**
  - Decreases across a period (left to right) due to increased nuclear charge pulling electrons closer.
  - Increases down a group due to added electron shells.
- **Ionization Energy:**
  - Energy required to remove an electron.
  - Increases across a period, decreases down a group.
- **Electronegativity:**
  - Tendency of an atom to attract electrons in a bond.
  - Increases across a period, decreases down a group.

Understanding the Trends: Examples



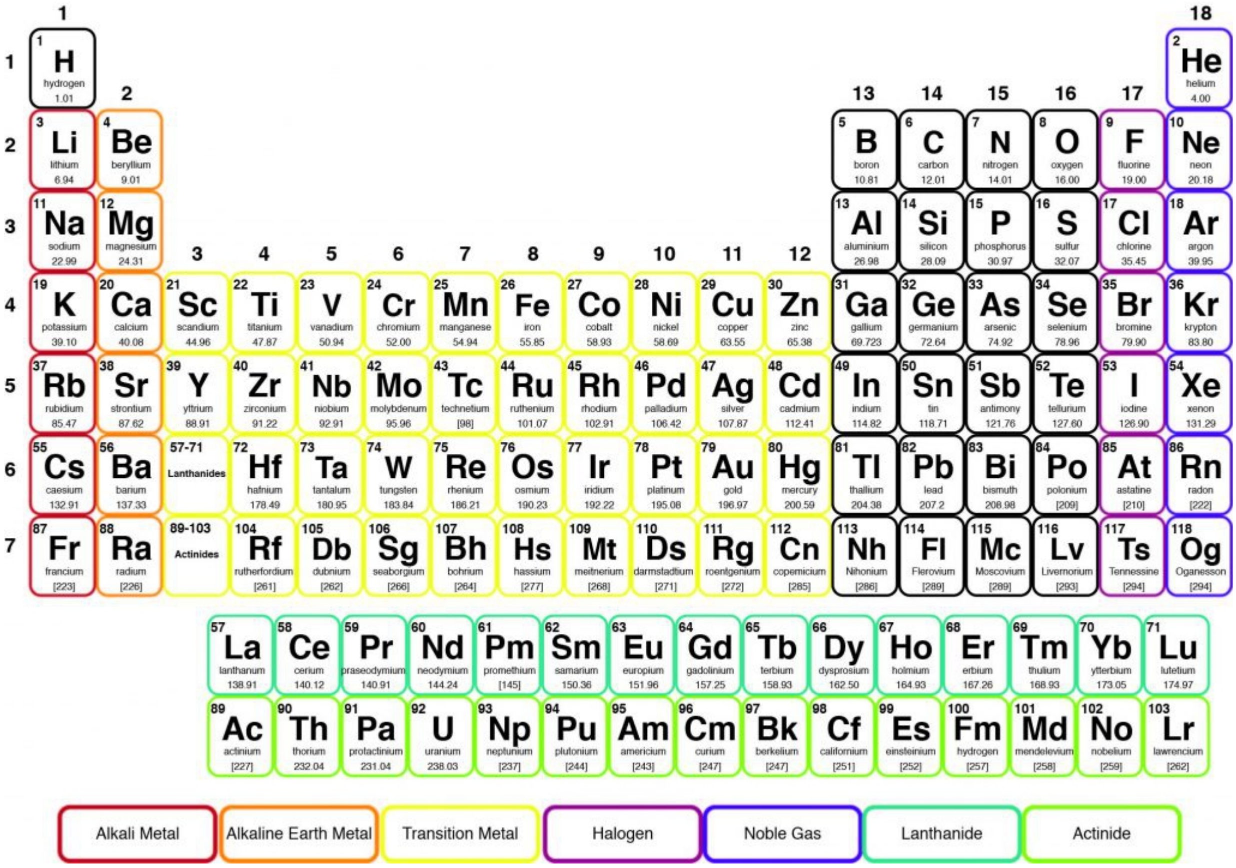
- **Atomic Radius Example:**
  - Compare: Sodium (Na) vs. Chlorine (Cl)
  - Sodium has a larger atomic radius than chlorine.
- **Ionization Energy Example:**
  - Compare: Lithium (Li) vs. Fluorine (F)
  - Fluorine has a higher ionization energy than lithium.
- **Electronegativity Example:**
  - Compare: Oxygen (O) vs. Sulfur (S)
  - Oxygen is more electronegative than sulfur.

Understanding the Trends: Examples



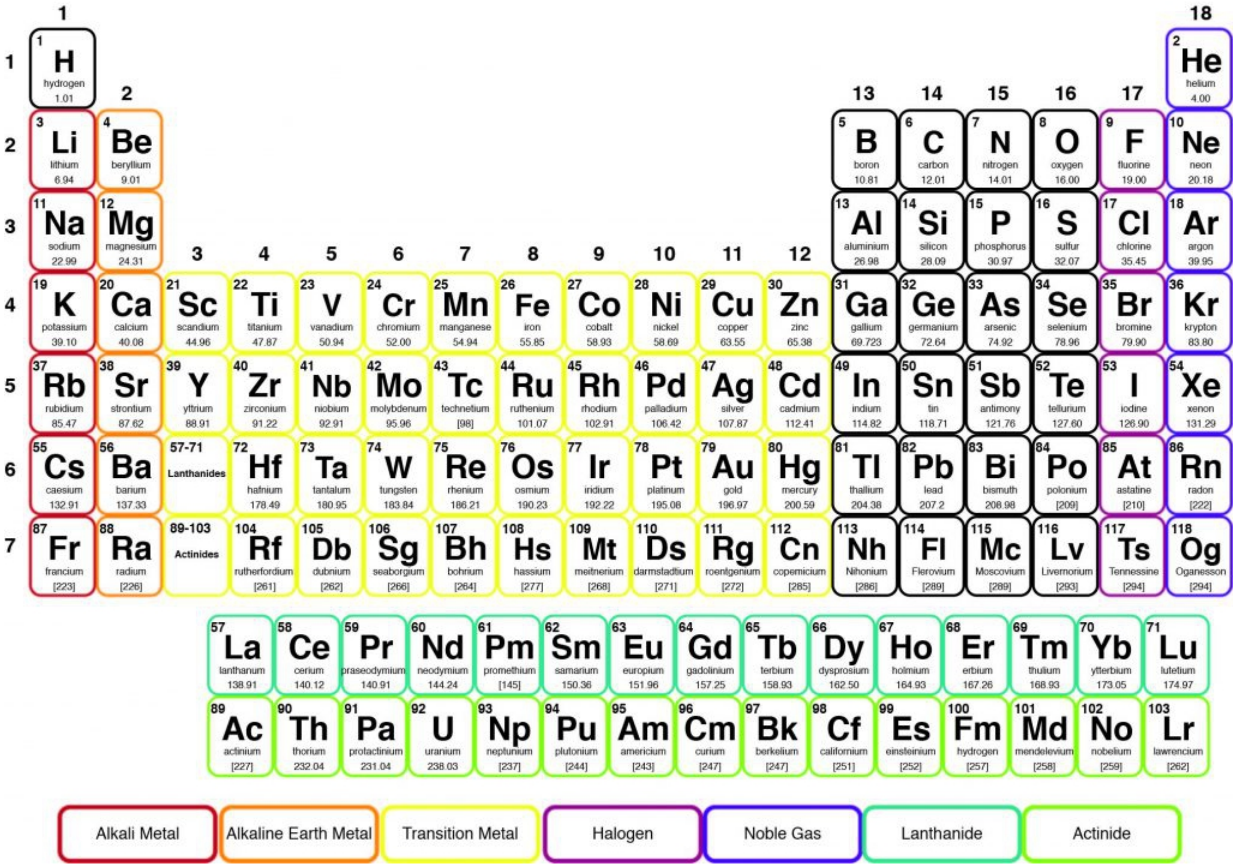
- **Atomic Radius Example:**
  - Compare: Sodium (Na) vs. Chlorine (Cl)
  - Sodium has a larger atomic radius than chlorine.
- **Atomic Radius Trend Across a Period:**
  - The atomic radius decreases from left to right across a period because the number of protons increases, pulling the electron cloud closer to the nucleus.
- **Atomic Radius Trend Down a Group:**
  - The atomic radius increases as you move down a group because additional electron shells are added, making the atom larger.

Understanding the Trends: Examples



- **Ionization Energy Example:**
  - Compare: Lithium (Li) vs. Fluorine (F)
  - Fluorine has a higher ionization energy than lithium.
- **Ionization Energy Trend Across a Period:**
  - Ionization energy increases from left to right across a period because the atoms are smaller and more tightly hold onto their electrons.
- **Ionization Energy Trend Down a Group:**
  - Ionization energy decreases as you move down a group because the outer electrons are farther from the nucleus and more easily removed.

Understanding the Trends: Examples



- **Electronegativity Example:**
- Compare: Oxygen (O) vs. Sulfur (S)
- Oxygen is more electronegative than sulfur.
- **Electronegativity Trend Across a Period:**
- Electronegativity increases from left to right across a period because atoms are smaller and more effective at attracting electrons.
- **Electronegativity Trend Down a Group:**
- Electronegativity decreases as you move down a group because the increased atomic size makes it harder for the nucleus to attract electrons.

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Summary of Key Concepts

- **Atoms** consist of protons, neutrons, and electrons.
- **Isotopes** are atoms of the same element with different neutrons.
- The periodic table is organized by **atomic number.**
- Elements are categorized into **metals, nonmetals,** and **metalloids.**
- Understand the formation of **cations, anions,** and **ionic bonds.**
- **Periodic trends** include atomic radius, ionization energy, and electronegativity.