

ELEMENT CLASSES



CA Standards

Students know how to use the periodic table to identify alkali metals, alkaline earth metals, transition metals, metals, semimetals (metalloids), nonmetals, halogens and noble gases.

Legend																		18 VIIIA
1 IA	H 1 1.00794 2.1 1+ Hydrogen											13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	He 2 4.002602 - - Helium	
2	Li 3 6.941 1.0 1+ Lithium	Be 4 9.012182 1.5 2+ Beryllium											B 5 10.811 2.0 3+ Boron	C 6 12.0107 2.5 4+,- Carbon	N 7 14.0067 3.0 3+,- Nitrogen	O 8 15.9994 3.5 2- Oxygen	F 9 18.998403 4.0 1- Fluorine	Ne 10 20.1797 - - Neon
3	Na 11 22.989769 0.9 1+ Sodium	Mg 12 24.3050 1.2 2+ Magnesium	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIII	9 VIII	10 VIII	11 IB	12 IIB	Al 13 26.981539 1.5 3+ Aluminum	Si 14 28.0855 1.8 4+ Silicon	P 15 30.973762 2.1 5+ Phosphorus	S 16 32.065 1.8 4+ Sulfur	Cl 17 35.453 3.0 1- Chlorine	Ar 18 39.948 - - Argon
4	K 19 39.0983 0.8 1+ Potassium	Ca 20 40.078 1.0 2+ Calcium	Sc 21 44.95592 1.3 3+ Scandium	Ti 22 47.867 1.5 4+ Titanium	V 23 50.9415 1.6 5+ Vanadium	Cr 24 51.9961 1.6 3+ 2+ Chromium	Mn 25 54.938045 1.5 2+ 3+ Manganese	Fe 26 55.845 1.8 2+ 3+ Iron	Co 27 58.933195 1.8 2+ 3+ Cobalt	Ni 28 58.6934 1.8 2+ Nickel	Cu 29 63.546 1.9 2+ 1+ Copper	Zn 30 65.409 1.6 2+ Zinc	Ga 31 69.723 1.6 3+ Gallium	Ge 32 72.64 1.6 4+ Germanium	As 33 74.92160 2.0 3+ 3- Arsenic	Se 34 78.96 2.4 4+ Selenium	Br 35 79.904 2.8 1- Bromine	Kr 36 83.798 - - Krypton
5	Rb 37 85.4678 0.8 1+ Rubidium	Sr 38 87.62 1.0 2+ Strontium	Y 39 88.90585 1.3 3+ Yttrium	Zr 40 91.224 1.4 4+ Zirconium	Nb 41 92.90638 1.6 5+ Niobium	Mo 42 95.94 1.8 6+ Molybdenum	Tc 43 98.9062 1.9 7+ Technetium	Ru 44 101.07 2.2 3+ 4+ Ruthenium	Rh 45 102.90550 2.2 3+ Rhodium	Pd 46 106.42 2.2 2+ Palladium	Ag 47 107.8682 1.9 1+ Silver	Cd 48 112.411 1.7 2+ Cadmium	In 49 114.818 1.7 3+ Indium	Sn 50 118.710 1.8 4+ 2+ Tin	Sb 51 121.760 1.9 3+ 3- Antimony	Te 52 127.60 2.1 4+ Tellurium	I 53 126.90447 2.5 1- Iodine	Xe 54 131.293 - - Xenon
6	Cs 55 132.90545 0.7 1+ Cesium	Ba 56 137.327 0.9 2+ Barium	La 57 138.94788 1.1 3+ Lanthanum	Hf 72 178.49 1.3 4+ Hafnium	Ta 73 180.9479 1.5 5+ Tantalum	W 74 183.84 1.7 6+ Tungsten	Re 75 186.207 1.9 7+ Rhenium	Os 76 190.23 2.2 4+ Osmium	Ir 77 192.217 2.2 4+ Iridium	Pt 78 195.084 2.2 4+ Platinum	Au 79 196.96657 2.4 3+ Gold	Hg 80 200.59 1.9 2+ Mercury	Tl 81 204.3833 1.8 1+ Thallium	Pb 82 207.2 1.8 2+ 1+ Lead	Bi 83 208.98040 1.9 3+ Bismuth	Po 84 208.9824 2.0 2+ Polonium	At 85 209.9871 2.2 1- Astatine	Rn 86 222.0176 - - Radon
7	Fr 87 223.0197 0.7 1+ Francium	Ra 88 226.0254 0.9 2+ Radium	Ac 89 227.0278 1.1 3+ Actinium	Rf 104 261.11 - - Rutherfordium	Db 105 262.11 - - Dubnium	Sg 106 263.12 - - Seaborgium	Bh 107 262.12 - - Bohrium	Hs 108 264 - - Hassium	Mt 109 266.1378 - - Meitnerium	Ds 110 269 - - Darmstadtium	Rg 111 272 - - Roentgenium	Uub 112 277 - - Ununbium	Uut 113 284 - - Ununtrium	Uuq 114 289 - - Ununquadium	Uup 115 288 - - Ununpentium	Uuh 116 292 - - Ununhexium	Uus 117 - - - Ununseptium	Uuo 118 294 - - Ununoctium

Lanthanides	6	Ce 58 140.116 1.1 3+ Cerium	Pr 59 140.90765 1.1 3+ Praseodymium	Nd 60 144.242 1.1 3+ Neodymium	Pm 61 144.9127 1.1 3+ Promethium	Sm 62 150.36 1.2 3+ Samarium	Eu 63 151.964 1.2 3+ Europium	Gd 64 157.25 1.2 3+ Gadolinium	Tb 65 158.92535 1.2 3+ Terbium	Dy 66 162.500 1.2 3+ Dysprosium	Ho 67 164.93032 1.2 3+ Holmium	Er 68 167.259 1.2 3+ Erbium	Tm 69 168.93421 1.2 3+ Thulium	Yb 70 173.03806 1.1 3+ Ytterbium	Lu 71 174.967 1.2 3+ Lutetium
Actinides	7	Th 90 232.0381 1.3 4+ Thorium	Pa 91 231.03588 1.5 5+ Protactinium	U 92 238.02891 1.4 6+ Uranium	Np 93 237.0482 1.3 5+ Neptunium	Pu 94 244.0642 1.3 4+ Plutonium	Am 95 243.0614 1.3 3+ Americium	Cm 96 247 1.3 3+ Curium	Bk 97 247.0703 1.3 3+ Berkelium	Cf 98 251.0796 1.3 3+ Californium	Es 99 252.03 1.3 - Einsteinium	Fm 100 257.0951 1.3 - Fermium	Md 101 258.01 1.3 - Mendelevium	No 102 259.1009 1.3 - Nobelium	Lr 103 260.1053 - - Lawrencium

Li 3 6.941 1.0 1+ Lithium
Na 11 22.989769 0.9 1+ Sodium
K 19 39.0983 0.8 1+ Potassium
Rb 37 85.4678 0.8 1+ Rubidium
Cs 55 132.90545 0.7 1+ Cesium
Fr 87 223.0197 0.7 1+ Francium

Alkali Metals

- ❖ All alkali metals have 1 valence electron
- ❖ Alkali metals are NEVER found pure in nature; they are too reactive
- ❖ Reactivity of these elements increases down the group



Potassium, K
reacts with
water and
must be
stored in
kerosene

Alkaline Earth Metals

- All alkaline earth metals have 2 valence electrons
- Alkaline earth metals are less reactive than alkali metals
- Alkaline earth metals are not found pure in nature; they are too reactive
- The word "alkaline" means "basic"
 - common bases include salts of the metals
 - $\text{Ca}(\text{OH})_2$
 - $\text{Mg}(\text{OH})_2$

Be 4 9.012182 1.5 2+ Beryllium
Mg 12 24.3050 1.2 2+ Magnesium
Ca 20 40.078 1.0 2+ Calcium
Sr 38 87.62 1.0 2+ Strontium
Ba 56 137.327 0.9 2+ Barium
Ra 88 226.0254 0.9 2+ Radium

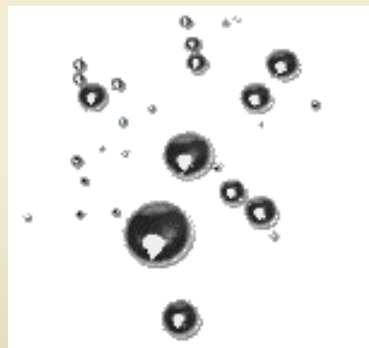
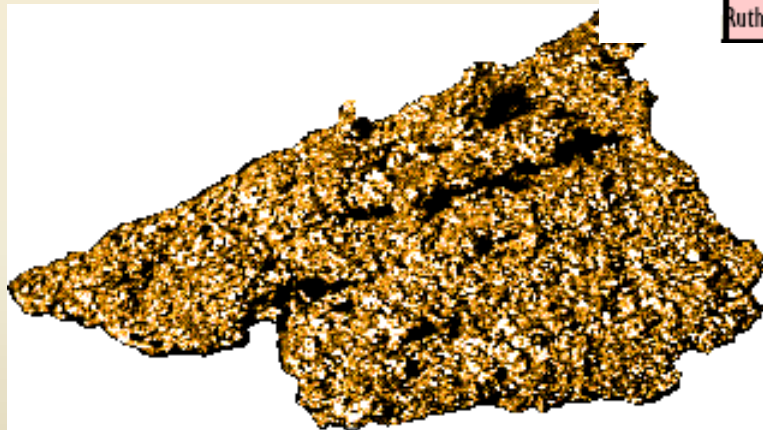
Properties of Metals

- ❑ Metals are good conductors of heat and electricity
- ❑ Metals are malleable
- ❑ Metals are ductile
- ❑ Metals have high tensile strength
- ❑ Metals have luster



Transition Metals

Sc 21 44.95592 1.3 3+ Scandium	Ti 22 47.867 1.5 4+ Titanium	V 23 50.9415 1.6 5+ Vanadium	Cr 24 51.9961 1.6 3+ 2+ Chromium	Mn 25 54.938045 1.5 2+ 3+ Manganese	Fe 26 55.845 1.8 2+ 3+ Iron	Co 27 58.933195 1.8 2+ 3+ Cobalt	Ni 28 58.6934 1.8 2+ Nickel	Cu 29 63.546 1.9 2+ 1+ Copper	Zn 30 65.409 1.6 2+ Zinc
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Rf 104 261.11 - - Rutherfordium	Db 105 262.11 - - Dubnium	Sg 106 263.12 - - Seaborgium	Bh 107 262.12 - - Bohrium	Hs 108 264 - - Hassium	Mt 109 266.1378 - - Meitnerium	Ds 110 269 - - Darmstadtium	Rg 111 272 - - Roentgenium	Uub 112 277 - - Ununbium	



Copper, Cu, is a relatively soft metal, and a very good electrical conductor.

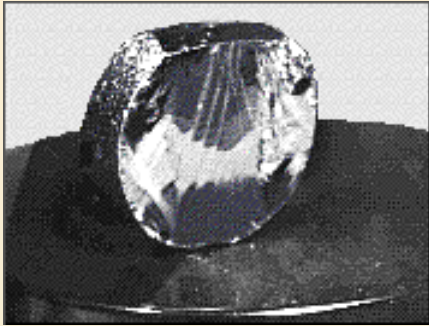
Mercury, Hg, is the only metal that exists as a liquid at room temperature

Properties of Metalloids

- ❖ They have properties of both metals and nonmetals.
- ❖ Metalloids are more brittle than metals, less brittle than most nonmetallic solids
- ❖ Metalloids are semiconductors of electricity
- ❖ Some metalloids possess metallic luster

B 5 10.811 2.0 3+ Boron				
	Si 14 28.0855 1.8 4+ Silicon			
	Ge 32 72.64 1.6 4+ Germanium	As 33 74.92160 2.0 3+ 3- Arsenic		
		Sb 51 121.760 1.9 3+ 3- Antimony	Te 52 127.60 2.1 4+ Tellurium	
				Po 84 208.9824 2.0 2+ Polonium

Silicon, Si - A Metalloid



- ❑ Silicon has metallic luster
- ❑ Silicon is brittle like a nonmetal
- ❑ Silicon is a semiconductor of electricity

Other metalloids include:

- Boron, B
- Germanium, Ge
- Arsenic, As
- Antimony, Sb
- Tellurium, Te



Nonmetals

- ❑ Nonmetals are poor conductors of heat and electricity
- ❑ Nonmetals tend to be brittle
- ❑ Many nonmetals are gases at room temperature

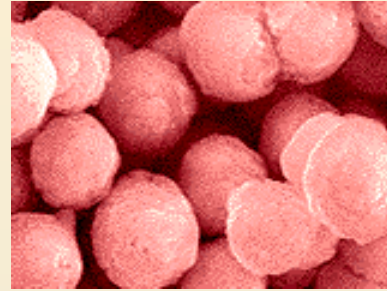
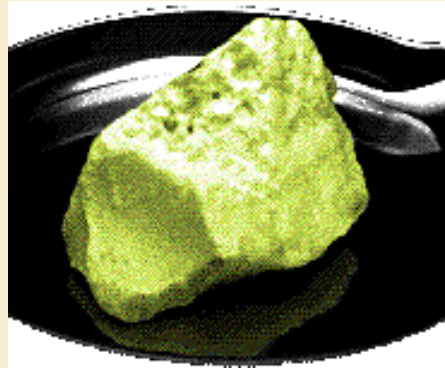


Carbon, the graphite in “pencil lead” is a great example of a nonmetallic element.

C 6 12.0107 2.5 4+,4- Carbon	N 7 14.0067 3.0 3+,3- Nitrogen	O 8 15.9994 3.5 2- Oxygen
	P 15 30.973762 2.1 5+ Phosphorus	S 16 32.065 1.8 4+ Sulfur
		Se 34 78.96 2.4 4+ Selenium

Examples of Nonmetals

Sulfur, S, was once known as "brimstone"



Microspheres of phosphorus, P, a reactive nonmetal

Graphite is not the only pure form of carbon, C. Diamond is also carbon; the color comes from impurities caught within the crystal structure



Halogens

- ❑ Halogens all have 7 valence electrons
- ❑ Halogens are never found pure in nature; they are too reactive
- ❑ Halogens in their pure form are diatomic molecules (F_2 , Cl_2 , Br_2 , and I_2)



Chlorine is a yellow-green poisonous gas

F 9 18.998403 4.0 1- Fluorine
Cl 17 35.453 3.0 1- Chlorine
Br 35 79.904 2.8 1- Bromine
I 53 126.90447 2.5 1- Iodine
At 85 209.9871 2.2 1- Astatine

Noble Gases

- Noble gases have 8 valence electrons (except helium, which has only 2)
- Noble gases are *ONLY* found pure in nature - they are chemically unreactive
- Colorless, odorless and unreactive; they were among the last of the natural elements to be discovered

He 2 4.002602 - - Helium
Ne 10 20.1797 - - Neon
Ar 18 39.948 - - Argon
Kr 36 83.798 - - Krypton
Xe 54 131.293 - - Xenon
Rn 86 222.0176 - - Radon
Uuo 118 294 - - Ununoctium