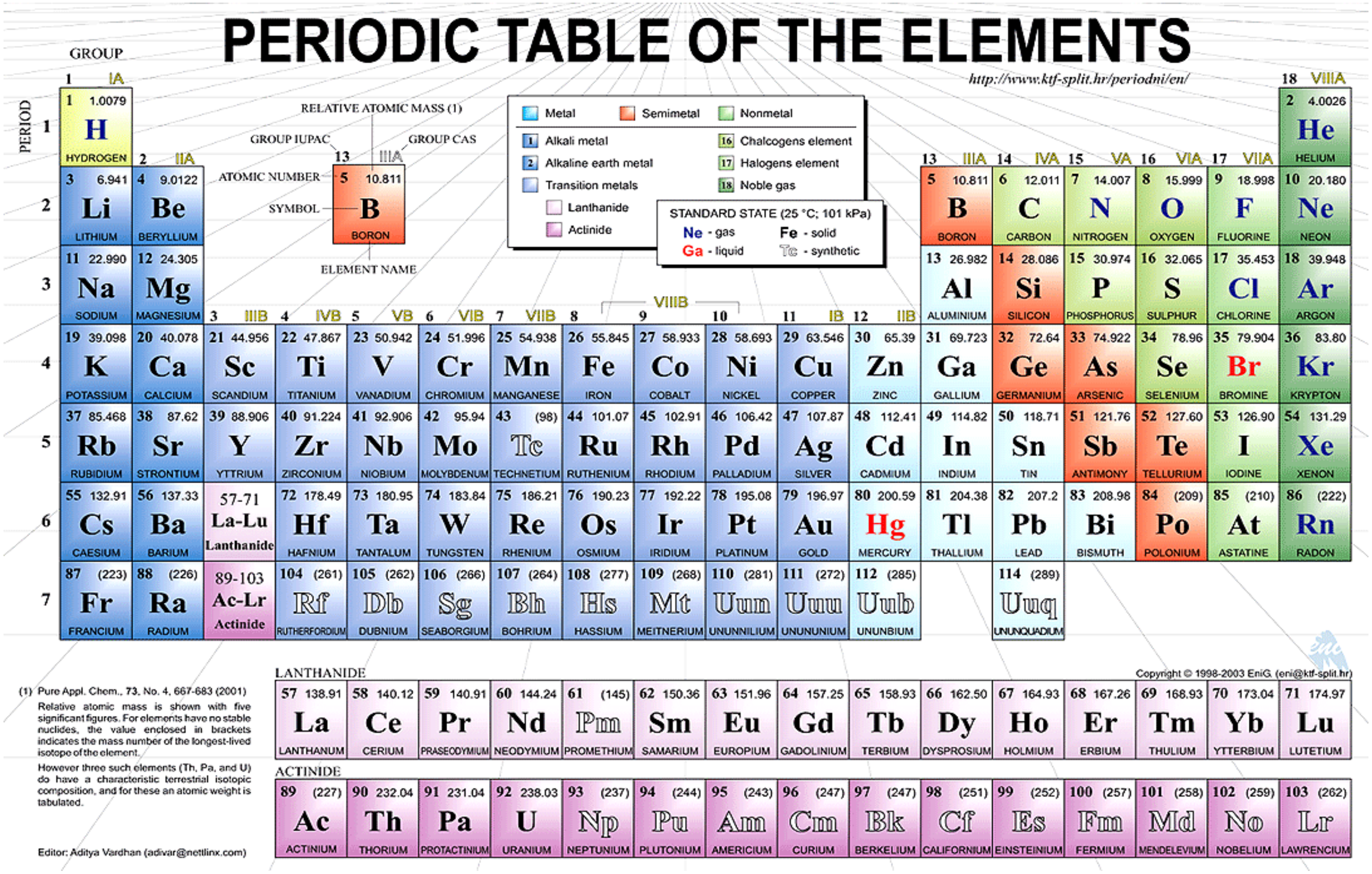
Unit Five: The Periodic Table
Ref: 10.11 11.2 11.4



PERIODIC TABLE OF THE ELEMENTS

http://www.ktf-split.hr/periodni/en/

PERIOD / GROUP	1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	1 1.0079 H HYDROGEN																	2 4.0026 He HELIUM
2	3 6.941 Li LITHIUM	4 9.0122 Be BERYLLIUM											5 10.811 B BORON	6 12.011 C CARBON	7 14.007 N NITROGEN	8 15.999 O OXYGEN	9 18.998 F FLUORINE	10 20.180 Ne NEON
3	11 22.990 Na SODIUM	12 24.305 Mg MAGNESIUM											13 26.982 Al ALUMINIUM	14 28.086 Si SILICON	15 30.974 P PHOSPHORUS	16 32.065 S SULPHUR	17 35.453 Cl CHLORINE	18 39.948 Ar ARGON
4	19 39.098 K POTASSIUM	20 40.078 Ca CALCIUM	21 44.956 Sc SCANDIUM	22 47.867 Ti TITANIUM	23 50.942 V VANADIUM	24 51.996 Cr CHROMIUM	25 54.938 Mn MANGANESE	26 55.845 Fe IRON	27 58.933 Co COBALT	28 58.693 Ni NICKEL	29 63.546 Cu COPPER	30 65.39 Zn ZINC	31 69.723 Ga GALLIUM	32 72.64 Ge GERMANIUM	33 74.922 As ARSENIC	34 78.96 Se SELENIUM	35 79.904 Br BROMINE	36 83.80 Kr KRYPTON
5	37 85.468 Rb RUBIDIUM	38 87.62 Sr STRONTIUM	39 88.906 Y YTTRIUM	40 91.224 Zr ZIRCONIUM	41 92.906 Nb NIOBIUM	42 95.94 Mo MOLYBDENUM	43 (98) Tc TECHNETIUM	44 101.07 Ru RUTHENIUM	45 102.91 Rh RHODIUM	46 106.42 Pd PALLADIUM	47 107.87 Ag SILVER	48 112.41 Cd CADMIUM	49 114.82 In INDIUM	50 118.71 Sn TIN	51 121.76 Sb ANTIMONY	52 127.60 Te TELLURIUM	53 126.90 I IODINE	54 131.29 Xe XENON
6	55 132.91 Cs CAESIUM	56 137.33 Ba BARIUM	57-71 La-Lu Lanthanide	72 178.49 Hf HAFNIUM	73 180.95 Ta TANTALUM	74 183.84 W TUNGSTEN	75 186.21 Re RHENIUM	76 190.23 Os OSMIUM	77 192.22 Ir IRIDIUM	78 195.08 Pt PLATINUM	79 196.97 Au GOLD	80 200.59 Hg MERCURY	81 204.38 Tl THALLIUM	82 207.2 Pb LEAD	83 208.98 Bi BISMUTH	84 (209) Po POLONIUM	85 (210) At ASTATINE	86 (222) Rn RADON
7	87 (223) Fr FRANCIUM	88 (226) Ra RADIUM	89-103 Ac-Lr Actinide	104 (261) Rf RUTHERFORDIUM	105 (262) Db DUBNIUM	106 (266) Sg SEABORGIUM	107 (264) Bh BOHRIUM	108 (277) Hs HASSIUM	109 (268) Mt MEITNERIUM	110 (281) Uun UNUNNILIUM	111 (272) Uuu UNUNUNIUM	112 (285) Uub UNUNBIUM		114 (289) Uuq UNUNQUADIUM				

RELATIVE ATOMIC MASS (1)
GROUP IUPAC
GROUP CAS
13 IIIA
ATOMIC NUMBER — 5 10.811
SYMBOL — B
ELEMENT NAME — BORON

🟦 Metal	🟥 Semimetal	🟩 Nonmetal
1 Alkali metal	16 Chalcogens element	
2 Alkaline earth metal	17 Halogens element	
Transition metals	18 Noble gas	
Lanthanide		
Actinide		

STANDARD STATE (25 °C; 101 kPa)
Ne - gas Fe - solid
Ga - liquid Tc - synthetic

LANTHANIDE

57 138.91 La LANTHANUM	58 140.12 Ce CERIUM	59 140.91 Pr PRASEODYMIUM	60 144.24 Nd NEODYMIUM	61 (145) Pm PROMETHIUM	62 150.36 Sm SAMARIUM	63 151.96 Eu EUROPIUM	64 157.25 Gd GADOLINIUM	65 158.93 Tb TERBIUM	66 162.50 Dy DYSPROSIUM	67 164.93 Ho HOLMIUM	68 167.26 Er ERBIUM	69 168.93 Tm THULIUM	70 173.04 Yb YTTERBIUM	71 174.97 Lu LUTETIUM

ACTINIDE

89 (227) Ac ACTINIUM	90 232.04 Th THORIUM	91 231.04 Pa PROTACTINIUM	92 238.03 U URANIUM	93 (237) Np NEPTUNIUM	94 (244) Pu PLUTONIUM	95 (243) Am AMERICIUM	96 (247) Cm CURIUM	97 (247) Bk BERKELIUM	98 (251) Cf CALIFORNIUM	99 (252) Es EINSTEINIUM	100 (257) Fm FERMIUM	101 (258) Md MENDELEVIUM	102 (259) No NOBELIUM	103 (262) Lr LAWRENCIUM

(1) Pure Appl. Chem., 73, No. 4, 667-683 (2001)
Relative atomic mass is shown with five significant figures. For elements have no stable nuclides, the value enclosed in brackets indicates the mass number of the longest-lived isotope of the element.
However three such elements (Th, Pa, and U) do have a characteristic terrestrial isotopic composition, and for these an atomic weight is tabulated.

Editor: Aditya Vardhan (adivar@netlinx.com)

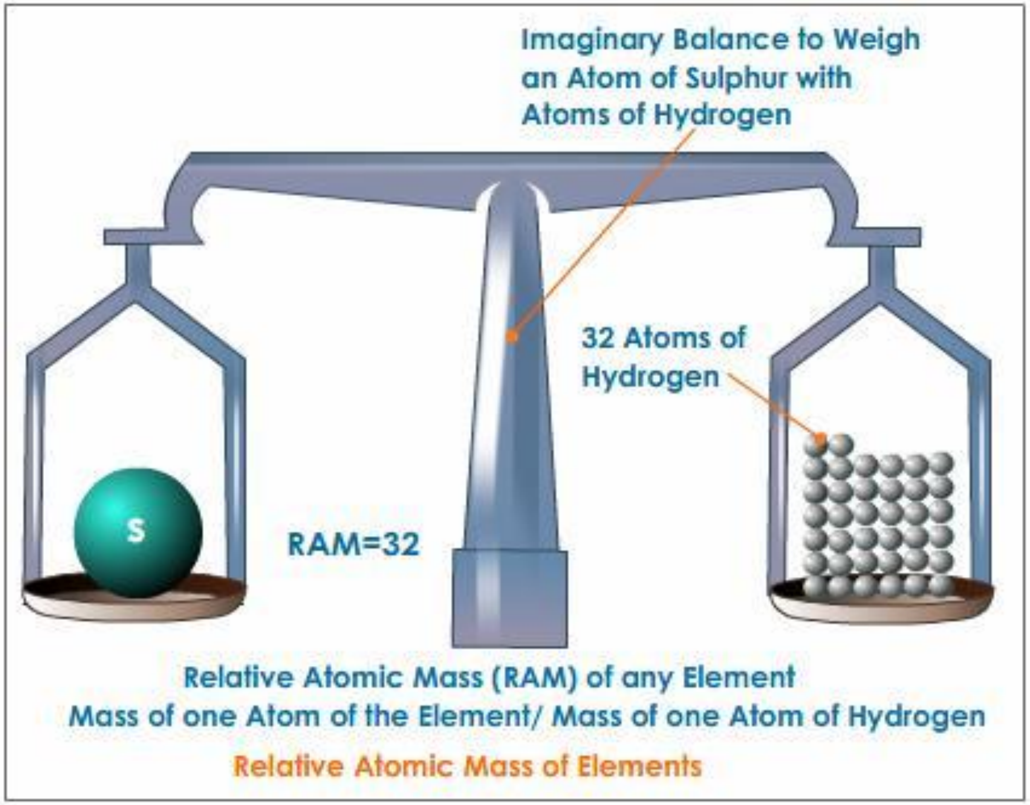
History of P.T.

Chlorine

Bromine

Iodine

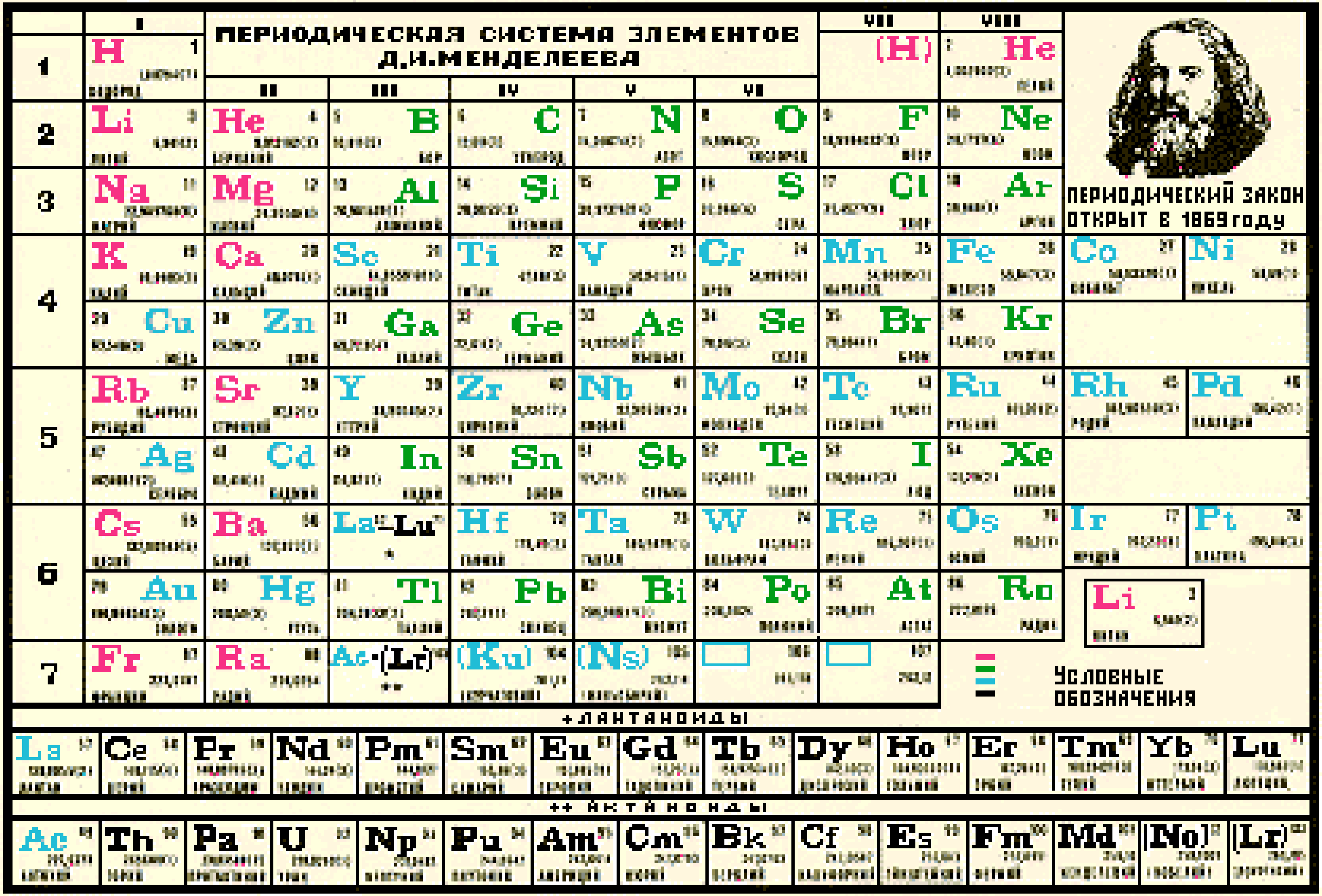
- **Dobrenier**- (1829) Triads groups of three elements of similar chemical and physical properties.



- **Cannizzarro (1860)** Method for determining atomic weights of elements

- **Mendeleev** (1869) Organized elements according to atomic weights _**BUT**_ switched numerous elements around to “fit” characteristics of a different group! (Te & I) Left gaps where he hypothesized new elements would be found and Fit IN (gallium & the Nobel Gases)

Modern Russian Table



ПЕРИОДИЧЕСКАЯ СИСТЕМА ЭЛЕМЕНТОВ Д.И.МЕНДЕЛЕЕВА

	I	II	III	IV	V	VI	VII	VIII
1	H						(H)	He
2	Li	He	B	C	N	O	F	Ne
3	Na	Mg	Al	Si	P	S	Cl	Ar
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe Co Ni
	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru Rh Pd
	Ag	Cd	In	Sn	Sb	Te	I	Xe
6	Cs	Ba	La–Lu *	Hf	Ta	W	Re	Os Ir Pt
	Au	Hg	Tl	Pb	Bi	Po	At	Rn
7	Fr	Ra	Ac–(Lr) **	(Ku)	(Ns)	☐ 106	☐ 107	

ПЕРИОДИЧЕСКИЙ ЗАКОН ОТКРЫТ В 1869 году

УСЛОВНЫЕ ОБОЗНАЧЕНИЯ

* ЛАНТАНОИДЫ

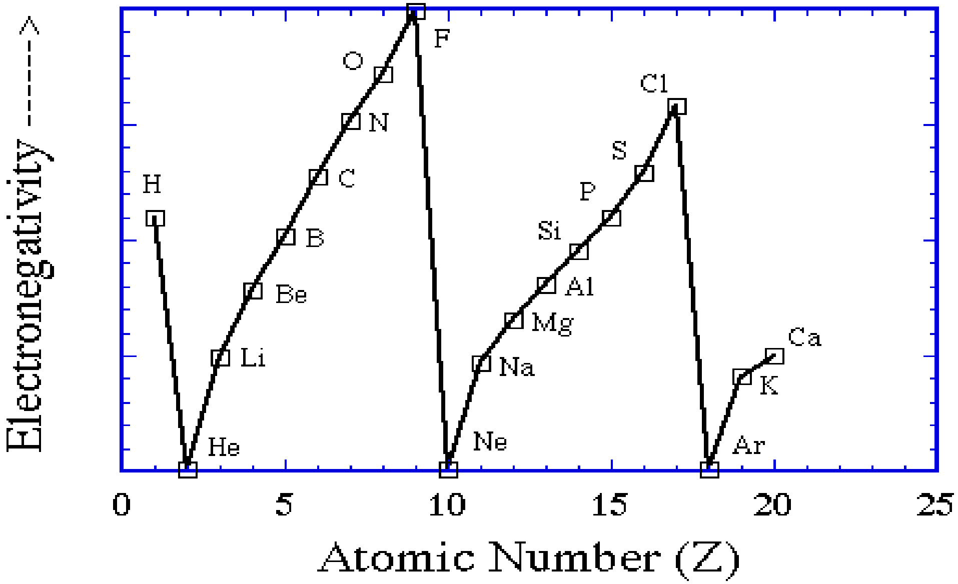
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu

** АКТИНОИДЫ

Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	(No)	(Lr)

Mendeleevs Table (1871)

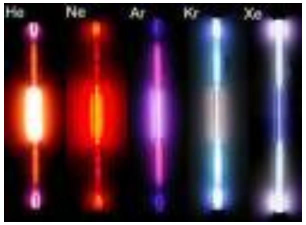
- Periodic Law- The physical and chemical properties of the elements are periodic functions of their atomic numbers (repeat at regular intervals)



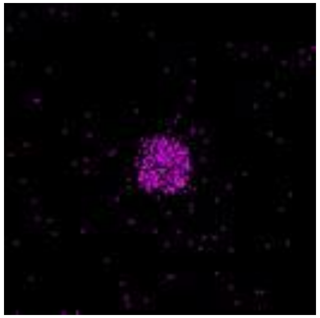
Periodicity- Patterns evolve

History Continues

- **Strutt and Ramsey-** (1894) Found Noble Gaes and add a new “group” to Periodic Table- Mendeleev hypothesized would be there



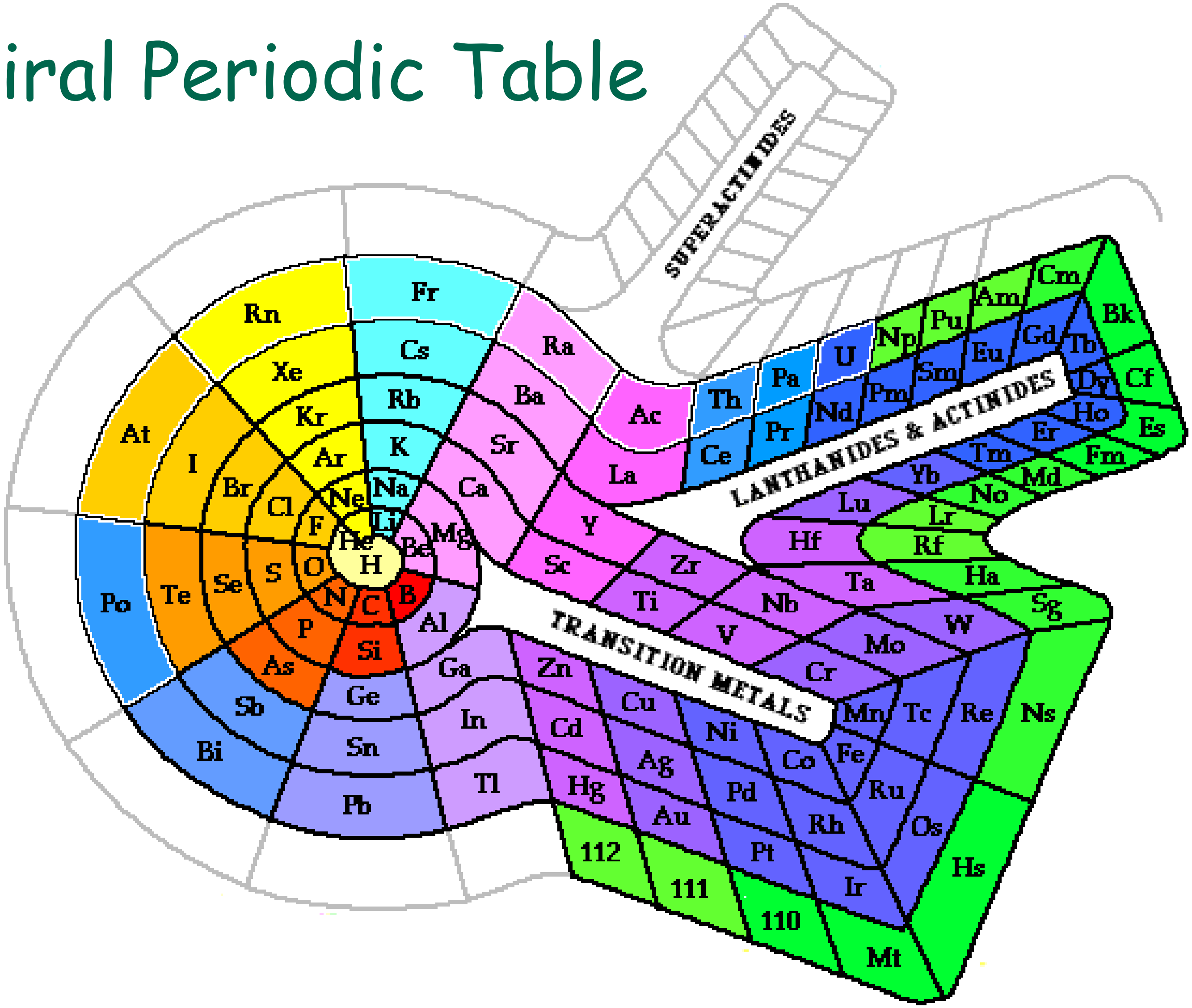
- **Mosely (1911)** used x-rays to count protons in nucleus added Atomic Number to table Gave Experimental justifications for Mendeleevs Table (switching elements around)



- Seaborg (1944) took U, Pa, Th out of main block elements and created two series!!! The physical and chemical properties trend runs horizontal along the series

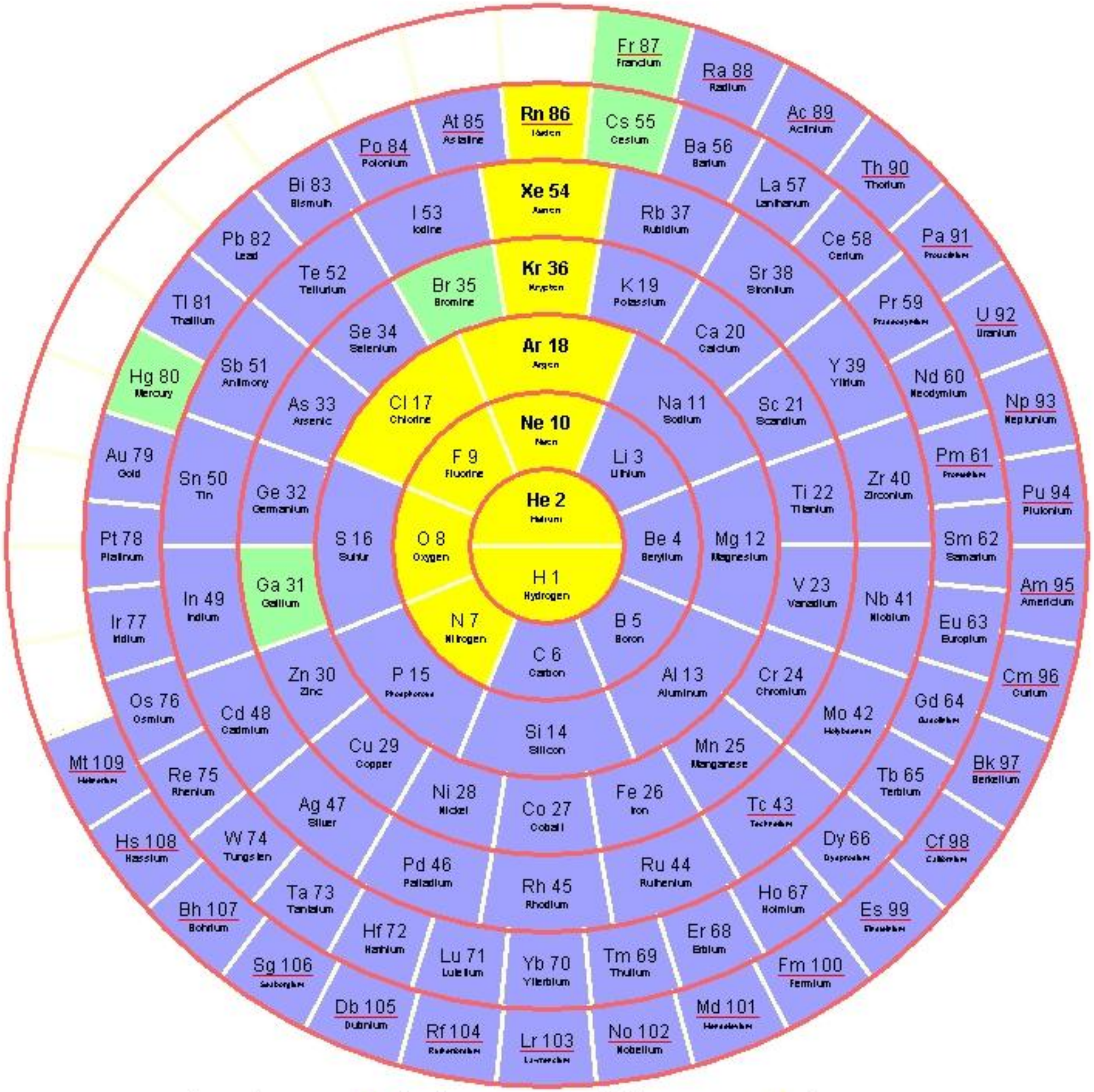
***element 106 is named after him!!!**

A Spiral Periodic Table



"Mayan" Periodic Table

Mayan Periodic Chart of the Elements



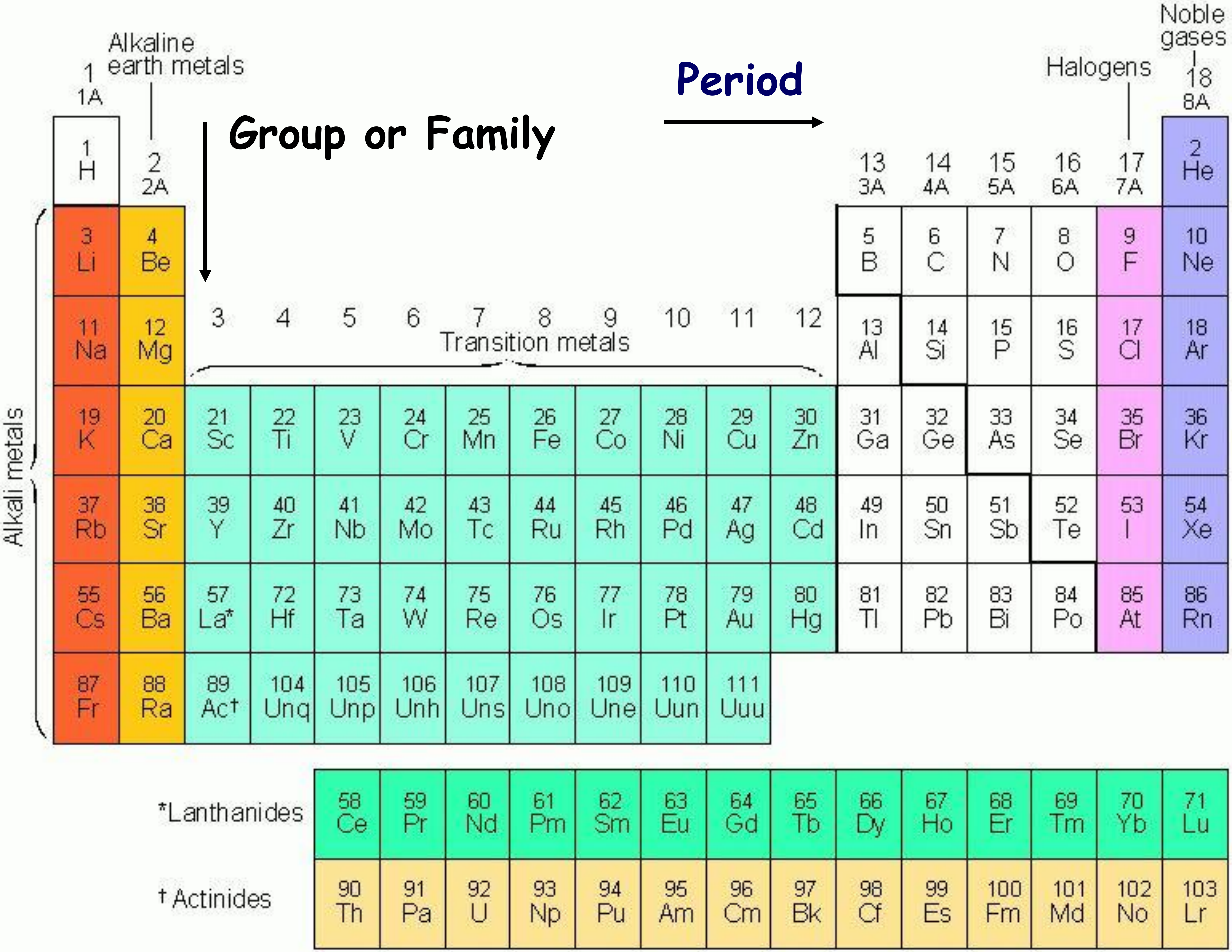
Legend: 🟩 Liquid 🟪 Solid 🟨 Gas

Radioactive elements are underlined in red

by Mitch Fincher mitchfincher@yahoo.com 2000/09/05

Group or Family

Period



1 1A	2 2A	3	4	5	6	7	8	9	10	11	12	13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La*	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac†	104 Unq	105 Unp	106 Unh	107 Uns	108 Uno	109 Une	110 Uun	111 Uuu							

*Lanthanides	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
† Actinides	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

The Properties of Group ONE:

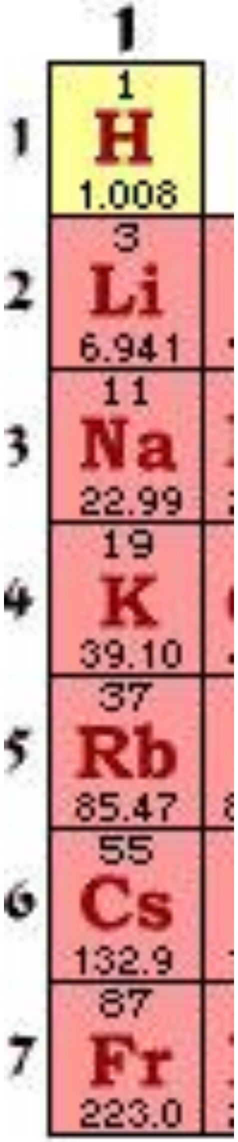
the Alkali Metals

Easily lose valence electron (Reducing agents) S^1 filling electrons

Slivery metals so soft can be cut with a knife

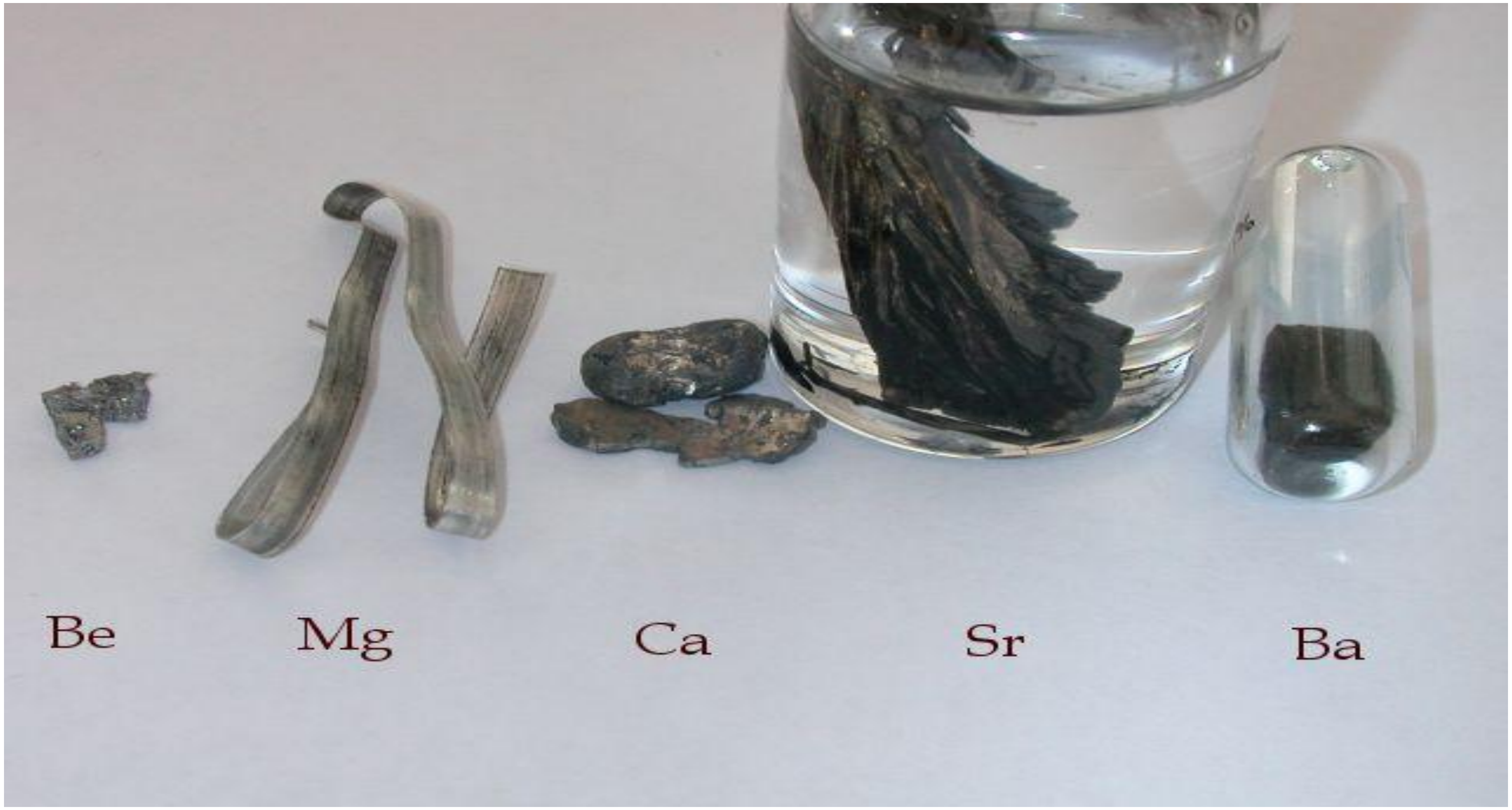
React with halogens to form salts

React violently with water- must be stored under kerosene



Groups of the Table

- Group 2- Alkaline Metals- very reactive loosely held 2 valence electrons never found free in nature used in the body as minerals (calcium)-



Reactivity of Metals

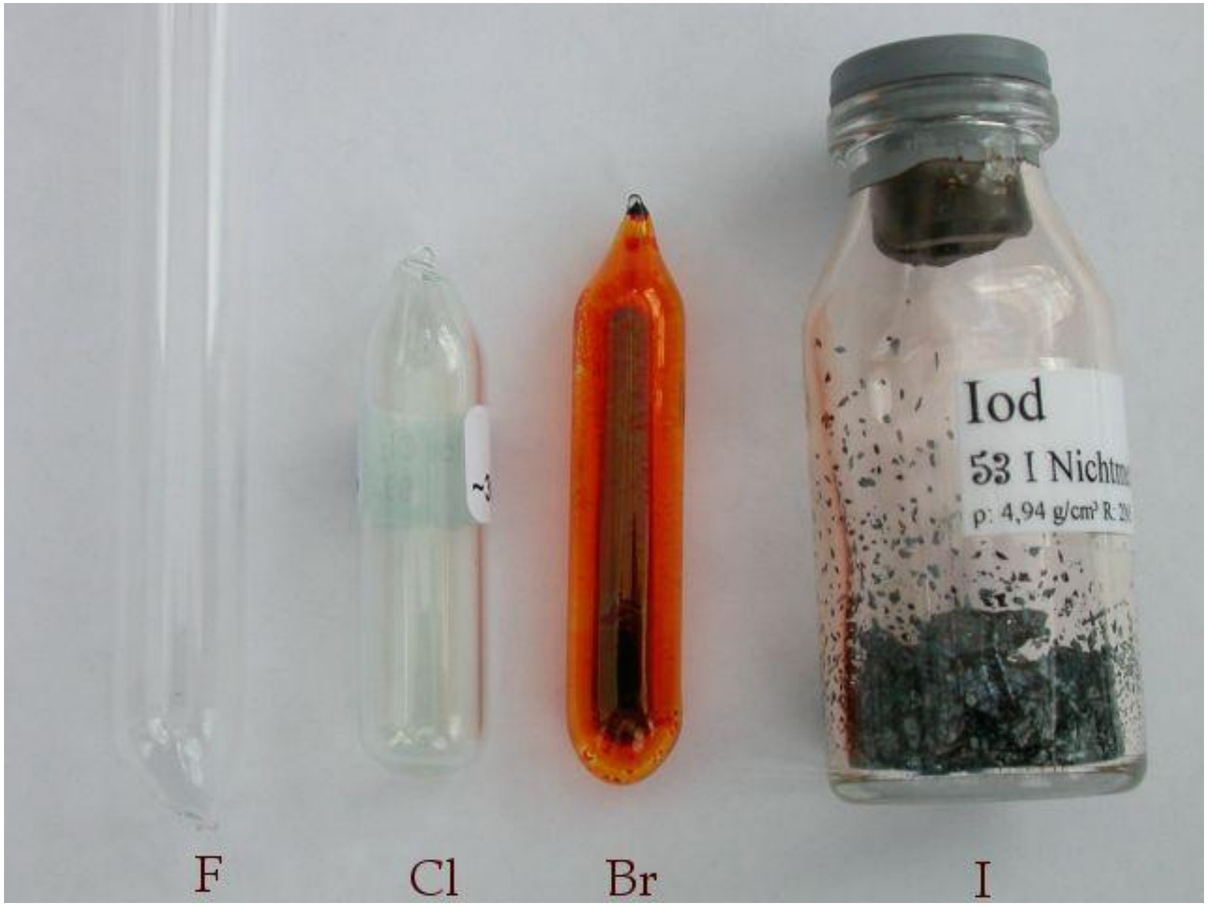
- *Explain why barium and strontium metal must be stored under kerosene, while the other members of the group do not?*

Groups 3-12 – Transitional Metals- ”typical” metals malleable, conductive, ductile- jewelry-Coins- fairly un-reactive (Au, Ag, Cu,Pt)

Group 17- Halogens- most reactive non-metals- react with metals to form salts

used in lights- p filling

STINKY Stinky stinky

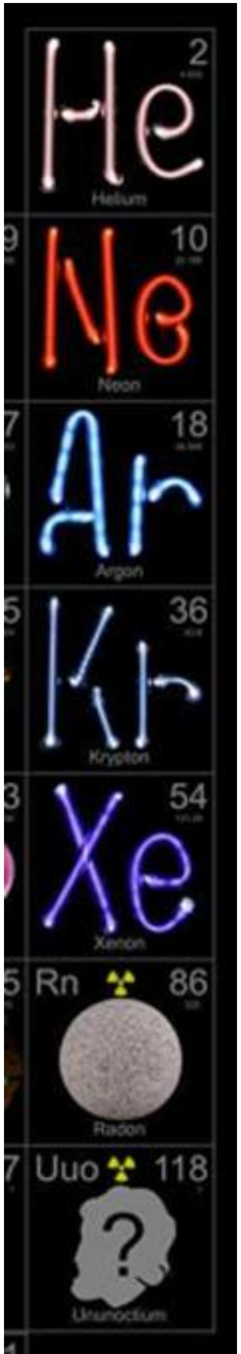


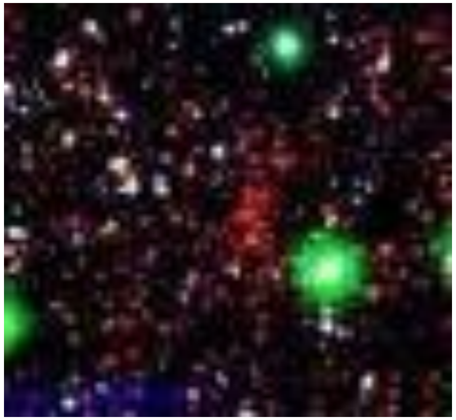
Reactivity of Non-Metals

- *Looking at the densities of the halogens, what do you hypothesize the reactivity trend to be within the group? Explain!*

Group 18- Noble Gases-

Un-reactive gases- lights have octet- 8 valence electrons





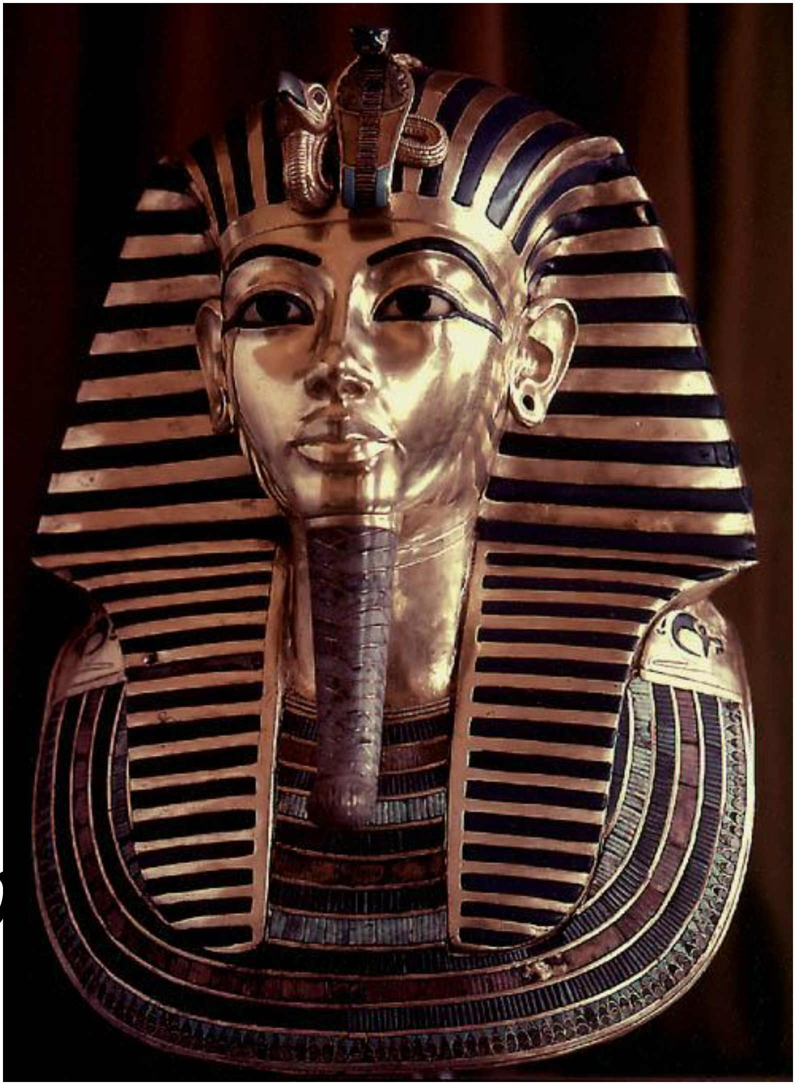
Series

- Lanthanide series- trends for groups run horizontally rare earth metals- hard to separate from each other clump together phosphorus compounds used in OLDER TVs (f filling)

- Actinide Series- mostly man made- RADIOACTIVE- BOMBS (f filling) smoke detectors

Properties of Metals

- ☐ **Metals are good conductors of heat and electricity**
- ☐ **Metals are malleable** ***(can be shaped)***
- ☐ **Metals are ductile** ***(can be drawn into wires)***
- ☐ **Metals have high tensile strength**
- ☐ **Metals have luster** ***(shiny)***

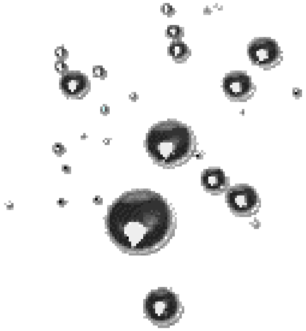


Examples of Metals

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

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

Zinc, Zn, is more stable than potassium



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

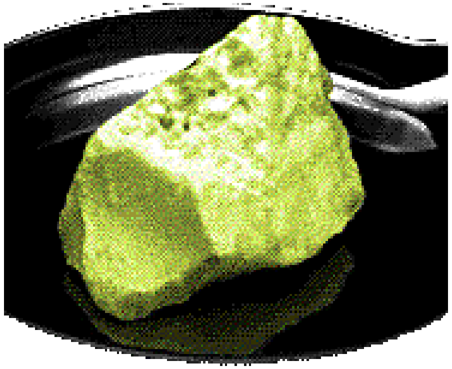
Properties of Nonmetals

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

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

Examples of Nonmetals

Sulfur, S, was once known as "brimstone"



Microspheres of phosphorus, P, a reactive nonmetal

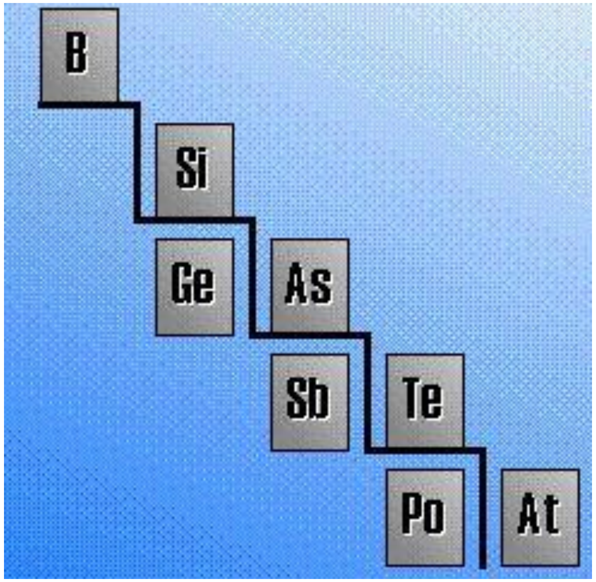
Graphite is not the only pure form of carbon, C. Diamond is also carbon; the color comes from impurities caught within the crystal structure

Allotropes

- Substances with the same chemical make-up but have different physical appearances in the same state of matter.

- Carbon has allotropic forms depending on particle packing … pretty crystal with an orderly arrangement diamond that is hard used in jewelry or cutting devices

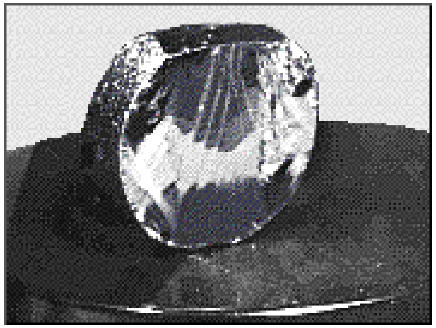
Properties of Metalloids



Metalloids straddle the border between metals and nonmetals on the periodic table.

- 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

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

"Electrostatic" Force: the Coulomb Law

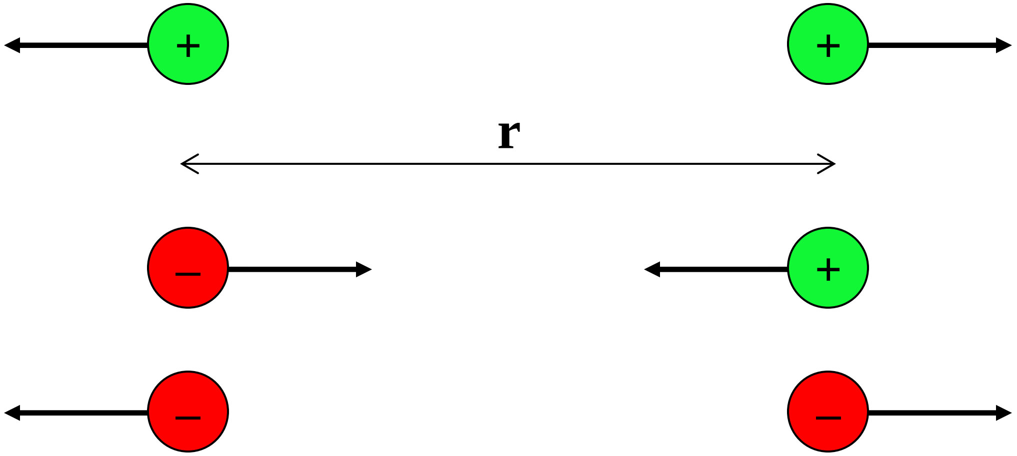
- Two charges, Q_1 and Q_2, separated by distance r exert a force on each other:

$$F = (k \cdot Q_1 \cdot Q_2) / r^2$$

- k is a constant (9×10^9),
- Q is in Coulombs,
- r in meters
  - One unit of charge (proton) has $Q = 1.6\times10^{-19}$ Coulombs

Coulomb Law Illustrated

- Like charges repel
- Unlike charges attract



If charges are of same magnitude (and same separation), all the forces will be the same magnitude, with different directions.

Coulomb Force Law, Qualitatively

$$F = (k \cdot Q_1 \cdot Q_2) / r^2$$

- Double one of the charges
  - force doubles
- Change sign of one of the charges
  - force changes direction
- Change sign of *both* charges
  - force stays the same
- Double the distance between charges
  - force four times weaker
- Double *both* charges
  - force four times stronger

The Reason for EVERY TREND

- Down a Group-
- Elements are gaining shells therefore the hold on the valence electron farther from nucleus and is SHEILDED by the inner shells nuclear force (hold on electrons by nucleus) is less

- Across a Period-
- Elements have the same number of shells BUT number of protons is increasing in the nucleus creating a greater nuclear force pulling electrons toward the nucleus- Zeff

ALL Periodic Table Trends

- **Influenced by three factors:**

1. <u>Energy Level</u>

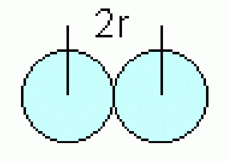
- **Higher energy levels are further away from the nucleus.**

2. <u>Charge on nucleus</u> (# protons)

- **More charge pulls electrons in closer. (+ and – attract each other)**
- **Z_{eff}= Z - S   Z=p^+ S= non-valence e^-**

- **3. <u>Shielding effect</u>   (blocking effect?)**

Determination of Atomic Radius:



Half of the distance between nuceli in covalently bonded diatomic molecule

"covalent atomic radii"

Periodic Trends in Atomic Radius

- **Across a Period Radius → decreases**

  Increased effective nuclear charge due to decreased shielding **(hold from nucleus on e-)**

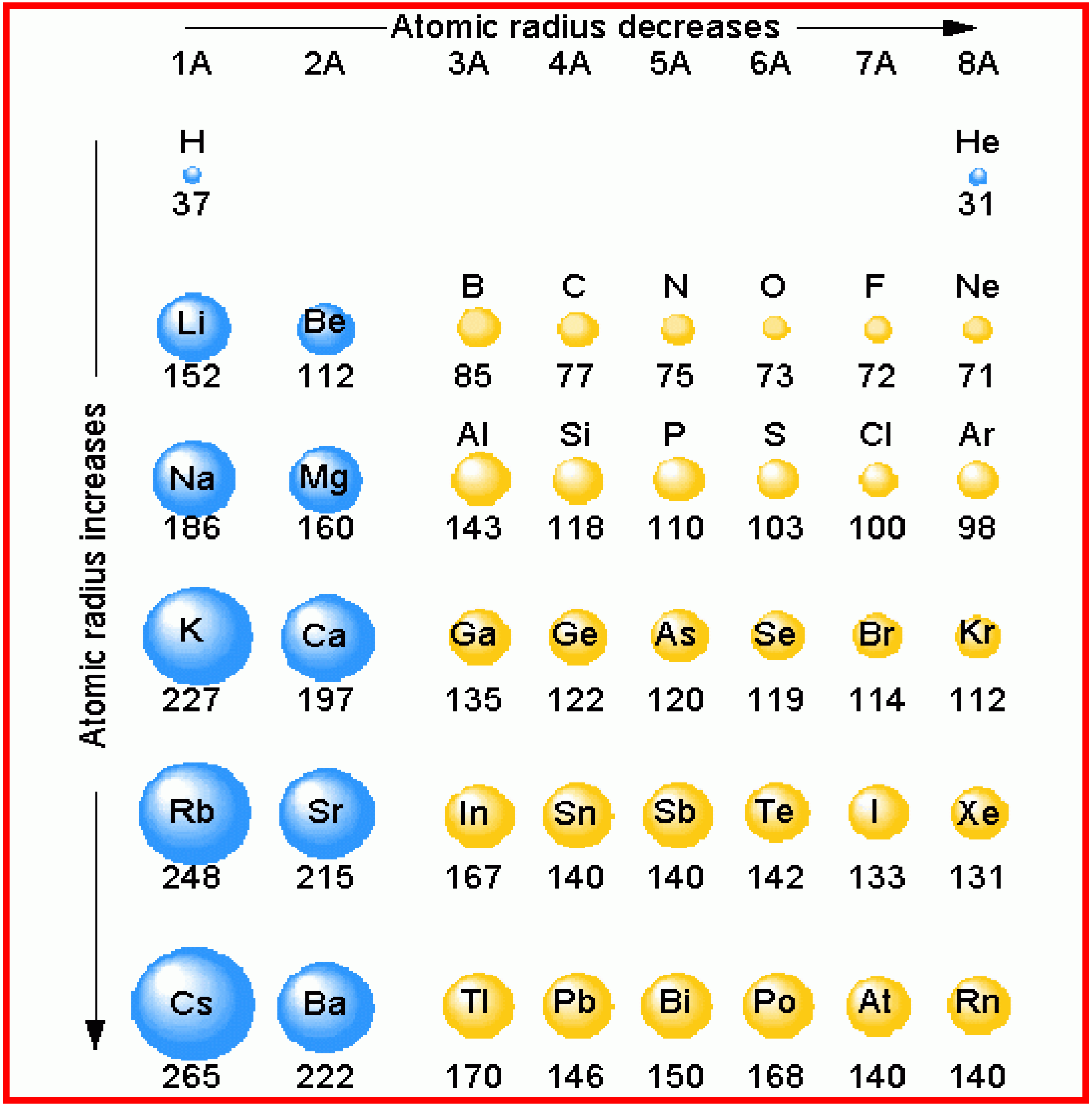
- **Down a Group ↓ Radius increases**

Addition of principal quantum levels (shells)

DO YOU GET IT? QUESTION:

- Explain which atom has a larger atomic radii:
- Magnesium or Barium
- Calcium or Bromine

Table of Atomic Radii



1A	2A	3A	4A	5A	6A	7A	8A
H 37							He 31
Li 152	Be 112	B 85	C 77	N 75	O 73	F 72	Ne 71
Na 186	Mg 160	Al 143	Si 118	P 110	S 103	Cl 100	Ar 98
K 227	Ca 197	Ga 135	Ge 122	As 120	Se 119	Br 114	Kr 112
Rb 248	Sr 215	In 167	Sn 140	Sb 140	Te 142	I 133	Xe 131
Cs 265	Ba 222	Tl 170	Pb 146	Bi 150	Po 168	At 140	Rn 140

Ionization Energy - the energy required to remove an electron from an atom

- Increases for successive electrons taken from the same atom
- Tends to increase across a period

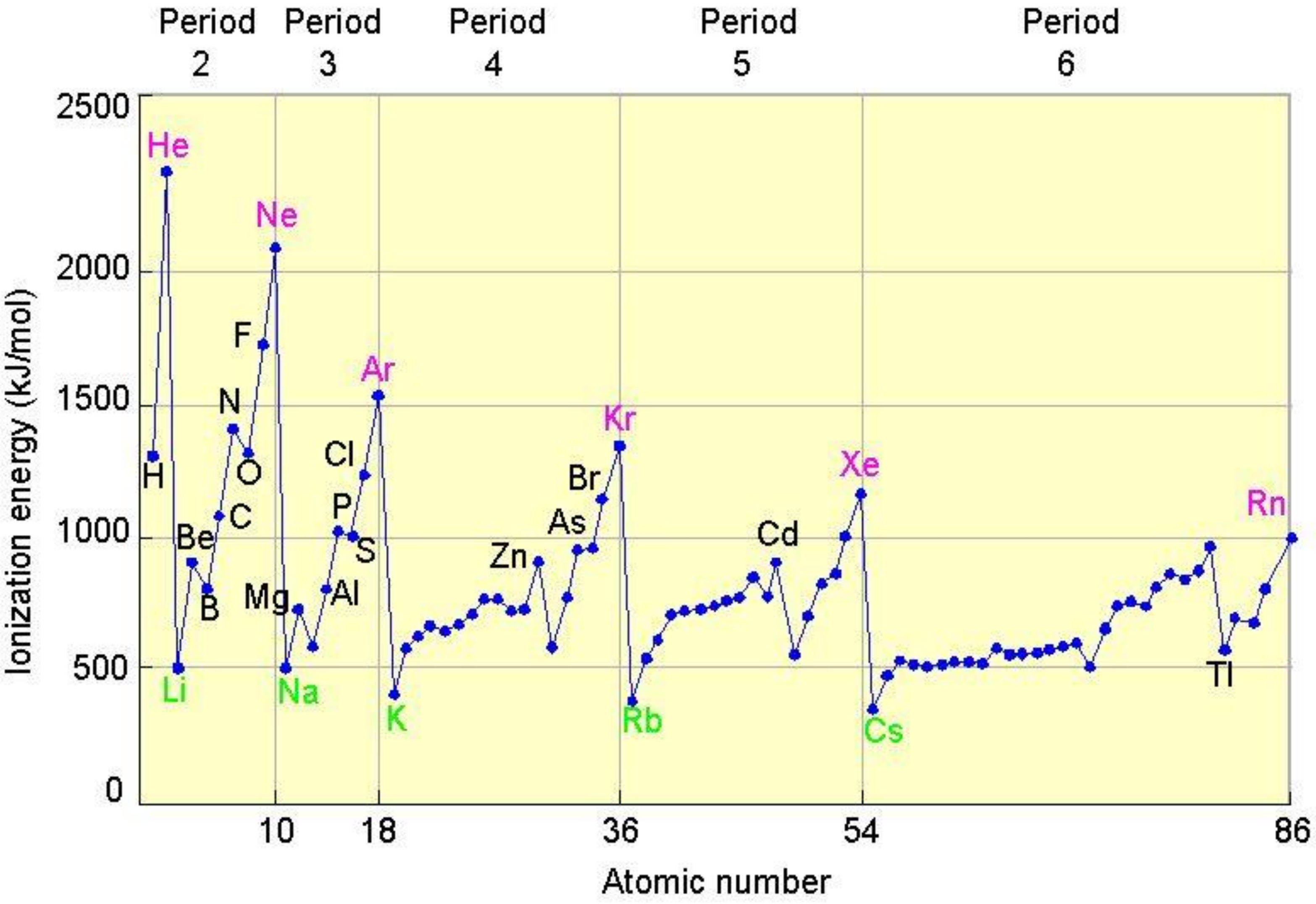
  Electrons in the same quantum level do not shield as effectively as electrons in inner levels

  Irregularities at half filled and filled sublevels due to extra repulsion of electrons paired in orbitals, making them easier to remove

- Tends to decrease down a group

  Outer electrons are farther from the nucleus

Table of 1st Ionization Energies

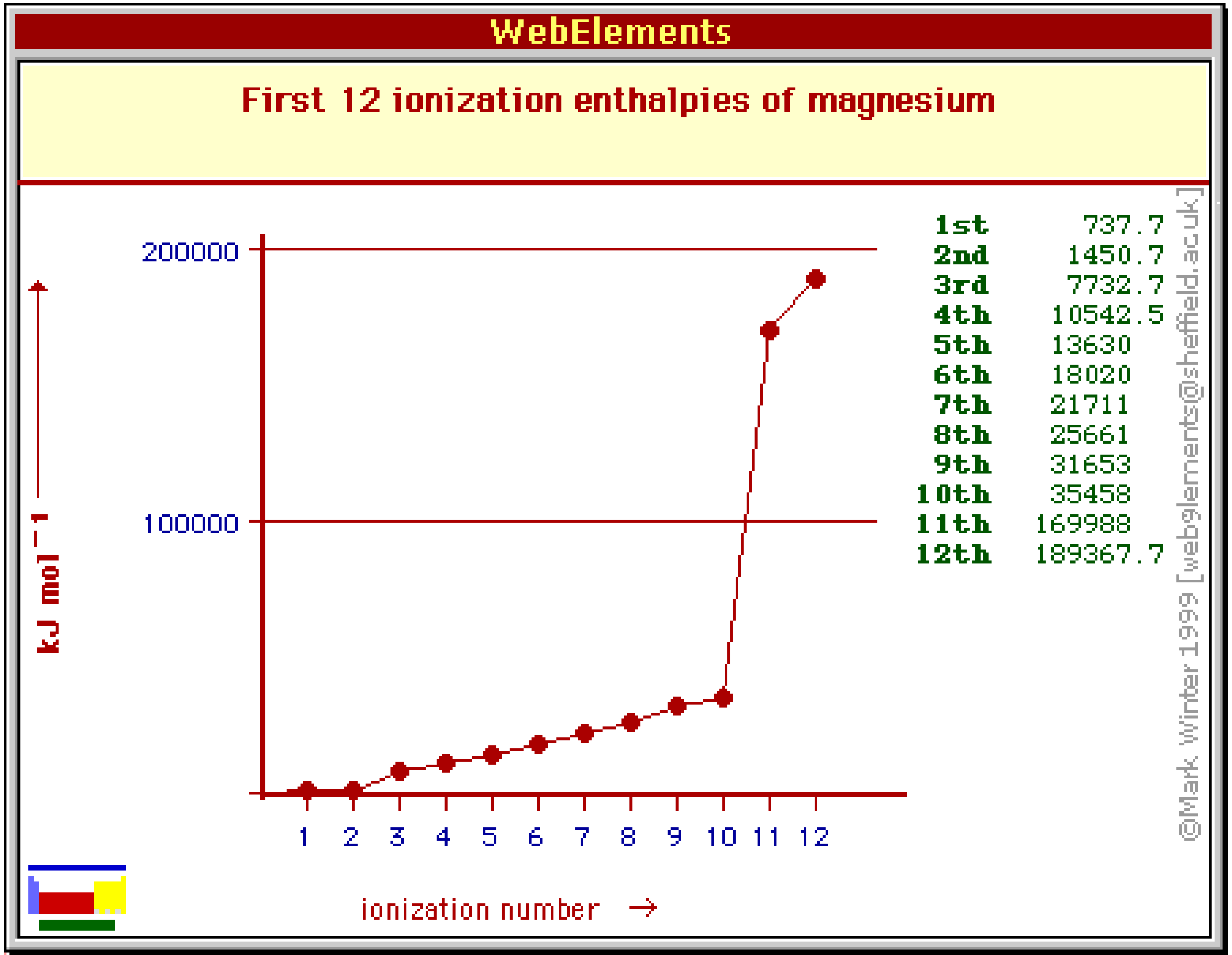


Ionization of Magnesium

$$\mathrm{Mg} + 738\ \mathrm{kJ} \rightarrow \mathrm{Mg}^{+} + e^{-}$$

$$\mathrm{Mg}^{+} + 1451\ \mathrm{kJ} \rightarrow \mathrm{Mg}^{2+} + e^{-}$$

$$\mathrm{Mg}^{2+} + 7733\ \mathrm{kJ} \rightarrow \mathrm{Mg}^{3+} + e^{-}$$



WebElements

First 12 ionization enthalpies of magnesium

1st	737.7
2nd	1450.7
3rd	7732.7
4th	10542.5
5th	13630
6th	18020
7th	21711
8th	25661
9th	31653
10th	35458
11th	169988
12th	189367.7

Electronegativity

A measure of the ability of an atom in a chemical bond to attract electrons toward itself

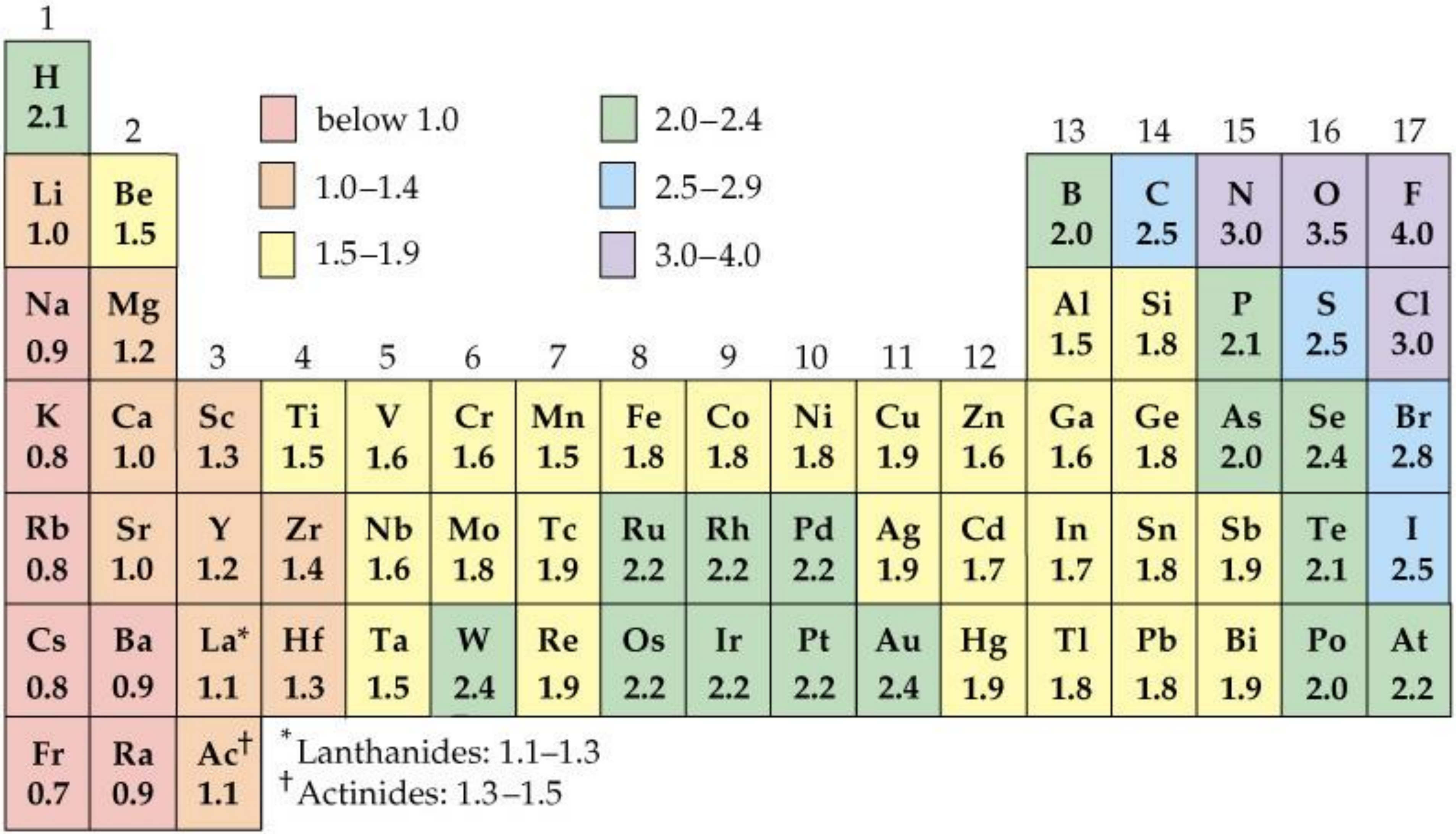
- Across period → tend to increase –ZEFF more effective
  (attraction nucleus has for more e-)

- Down a Group ↓ decrease or remain the same (atom becomes bigger harder to hold e in outer ring because of shielding effect from nucleus)

Do you get it? QUESTION:

- Explaine which element has a greater electronegativity?
- Lithium or Francium
- Magnesium or Chlorine

Periodic Table of Electronegativities



- 🟥 below 1.0
- 🟧 1.0–1.4
- 🟨 1.5–1.9
- 🟩 2.0–2.4
- 🟦 2.5–2.9
- 🟪 3.0–4.0

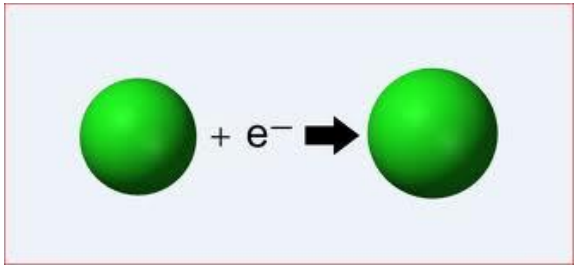
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
H 2.1																
Li 1.0	Be 1.5											B 2.0	C 2.5	N 3.0	O 3.5	F 4.0
Na 0.9	Mg 1.2											Al 1.5	Si 1.8	P 2.1	S 2.5	Cl 3.0
K 0.8	Ca 1.0	Sc 1.3	Ti 1.5	V 1.6	Cr 1.6	Mn 1.5	Fe 1.8	Co 1.8	Ni 1.8	Cu 1.9	Zn 1.6	Ga 1.6	Ge 1.8	As 2.0	Se 2.4	Br 2.8
Rb 0.8	Sr 1.0	Y 1.2	Zr 1.4	Nb 1.6	Mo 1.8	Tc 1.9	Ru 2.2	Rh 2.2	Pd 2.2	Ag 1.9	Cd 1.7	In 1.7	Sn 1.8	Sb 1.9	Te 2.1	I 2.5
Cs 0.8	Ba 0.9	La* 1.1	Hf 1.3	Ta 1.5	W 2.4	Re 1.9	Os 2.2	Ir 2.2	Pt 2.2	Au 2.4	Hg 1.9	Tl 1.8	Pb 1.8	Bi 1.9	Po 2.0	At 2.2
Fr 0.7	Ra 0.9	Ac† 1.1														

*Lanthanides: 1.1–1.3

†Actinides: 1.3–1.5

Electron Affinity

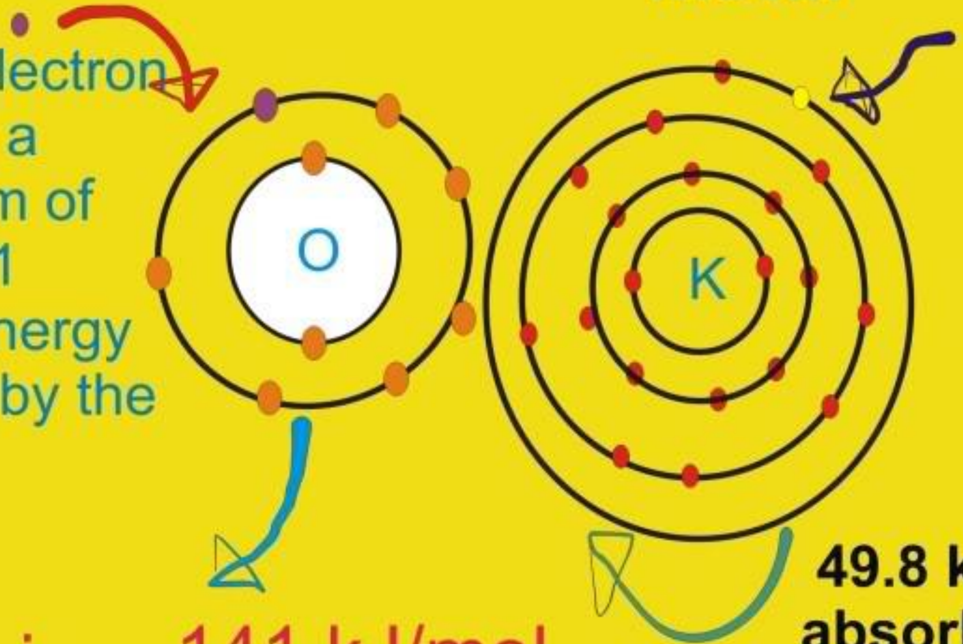
- Energy change when an e- is added to a neutral atom



- Metals- positive values-do not want to acquire more electrons endothermic process requiring energy to accept the e-

- *Non-metals- negative or zero affinity values- want to acquire more e- to achieve octet- gives off energy when acquired- exothermic-*

Electron Affinity of Non-Metals vs Metals



Non Metal

When an electron is added to a neutral atom of Oxygen 141 kJ/mol of energy is given off by the atom

Exothermic

-141 kJ/mol given off

Metal

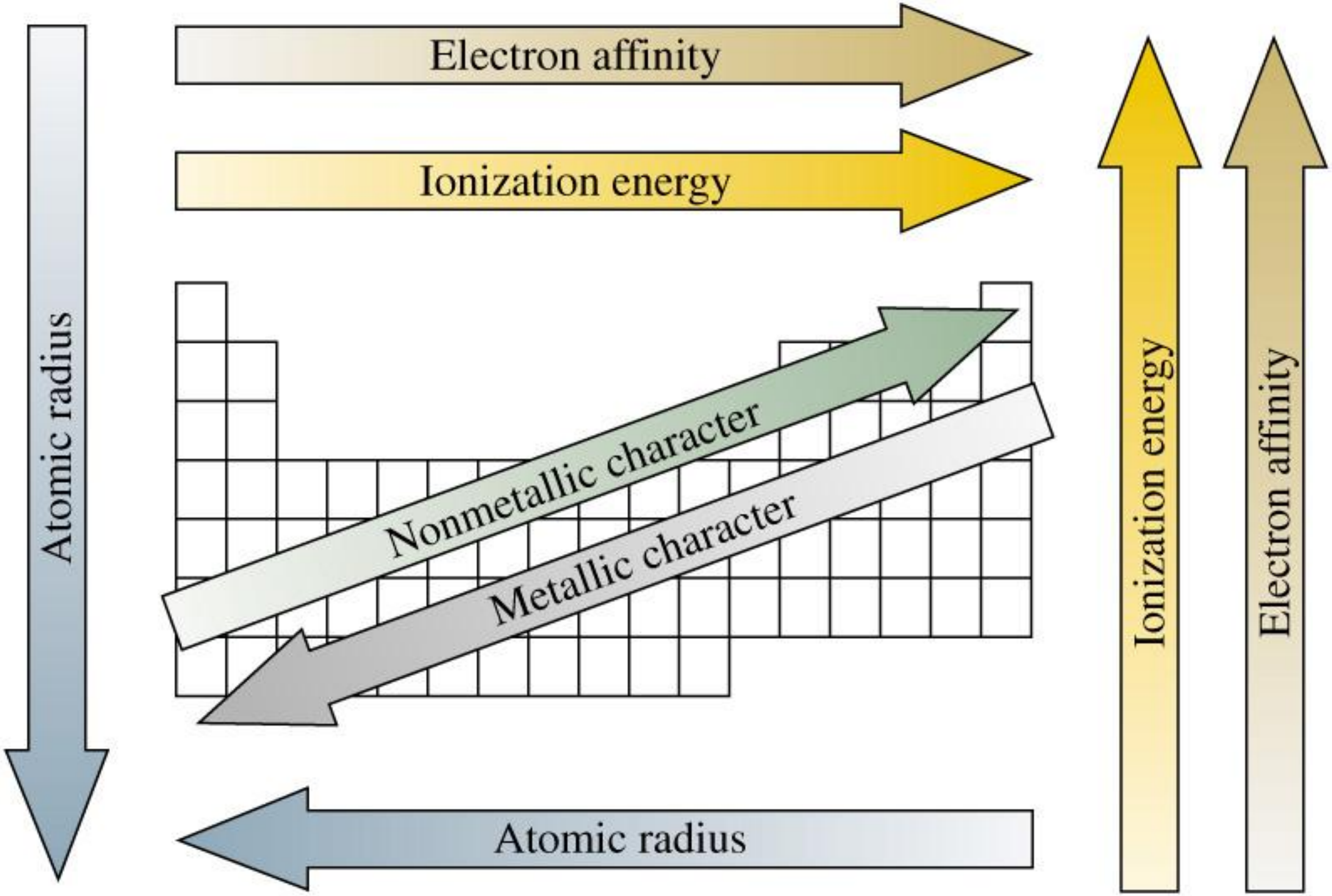
When an electron is added to a neutral Potassium atom 49.8 kJ/mol of energy is absorbed

49.8 kJ/mol absorbed

Endothermic

Why is Group Two- Alkaline Earth metal the most positive?

Summation of Periodic Trends



For Review:

Valence electrons

- Outermost electrons of the atom
- Responsible for reactivity of the atom
- Metals have low numbers, will tend to loose electrons to become stable with octet
- Nonmetals high number of valence electrons- tend to gain more to become stable with octet

Predicting Ionic Charges/ Oxidation Numbers

Group One –

Have one valence electron

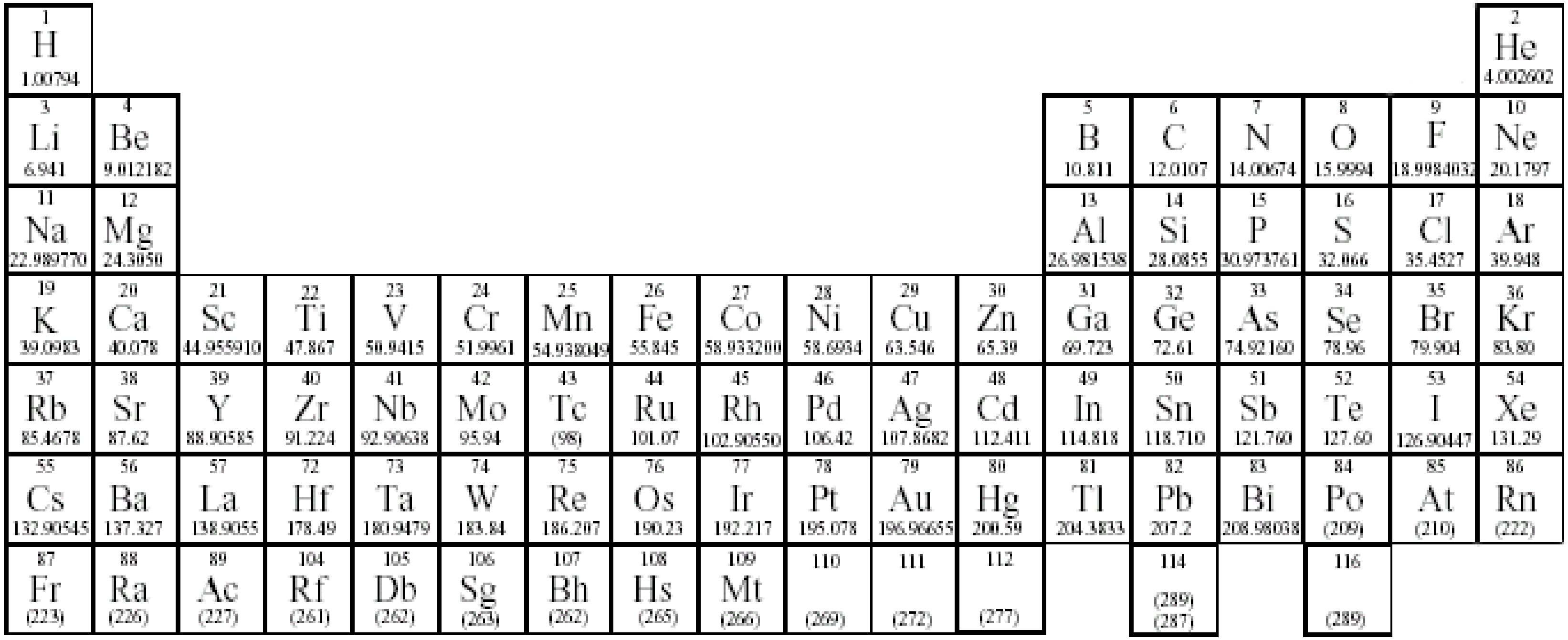
Easily lost

Creating a positive charge

Na→ Na^{+1} + 1 e^{-}

K^{+1}

Cs^{+1}



1 H 1.00794																	2 He 4.002602
3 Li 6.941	4 Be 9.012182											5 B 10.811	6 C 12.0107	7 N 14.00674	8 O 15.9994	9 F 18.9984032	10 Ne 20.1797
11 Na 22.989770	12 Mg 24.3050											13 Al 26.981538	14 Si 28.0855	15 P 30.973761	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.955910	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.933200	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.90550	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.90447	54 Xe 131.29
55 Cs 132.90545	56 Ba 137.327	57 La 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.96655	80 Hg 200.59	81 Tl 204.3833	82 Pb 207.2	83 Bi 208.98038	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 (269)	111 (272)	112 (277)		114 (289) (287)		116 (289)		

Group 17

Have seven val e-

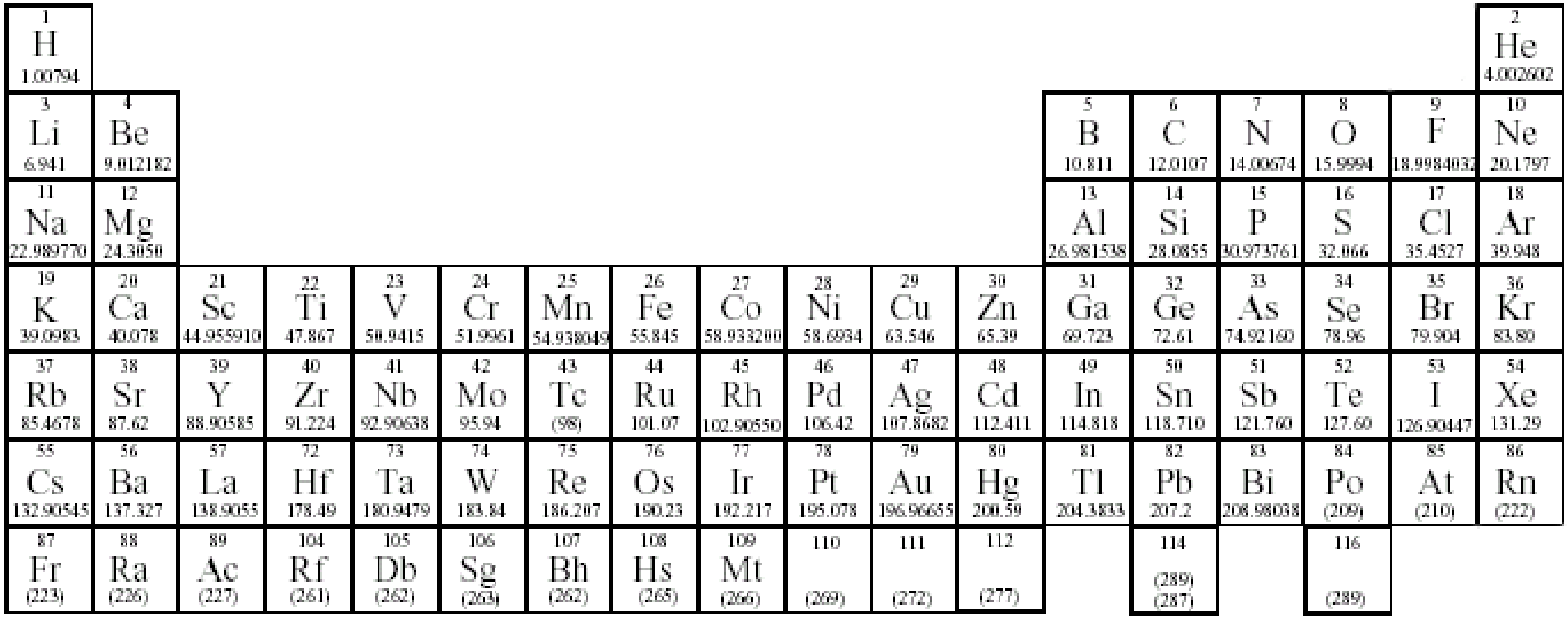
Easily gain one

Creating a negative charge

F + 1 e^- → F^{-1}

Cl^{-1}

Br^{-1}



1 H 1.00794																	2 He 4.002602
3 Li 6.941	4 Be 9.012182											5 B 10.811	6 C 12.0107	7 N 14.00674	8 O 15.9994	9 F 18.9984032	10 Ne 20.1797
11 Na 22.989770	12 Mg 24.3050											13 Al 26.981538	14 Si 28.0855	15 P 30.973761	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.955910	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.933200	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.90550	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.90447	54 Xe 131.29
55 Cs 132.90545	56 Ba 137.327	57 La 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.96655	80 Hg 200.59	81 Tl 204.3833	82 Pb 207.2	83 Bi 208.98038	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 (269)	111 (272)	112 (277)		114 (289) (287)		116 (289)		

Creating Ions

- Oxidation Numbers- number that indicates how many electrons an atom gains or looses to become stable
- Draw sketch of PT with valence electrons (HOP SKOTCH)
- All elements want to achieve an octet , how will each group do that two choices gain or loose / share valence electrons

Ionic Radii

Cations

- Positively charged ions formed when an atom of a metal loses one or more electrons
- Smaller than the corresponding atom (loss of e makes NF increase

Anions

- ☐ Negatively charged ions formed when nonmetallic atoms gain one or more electrons
- ☐ Larger than the corresponding atom (gain of e makes NF less)

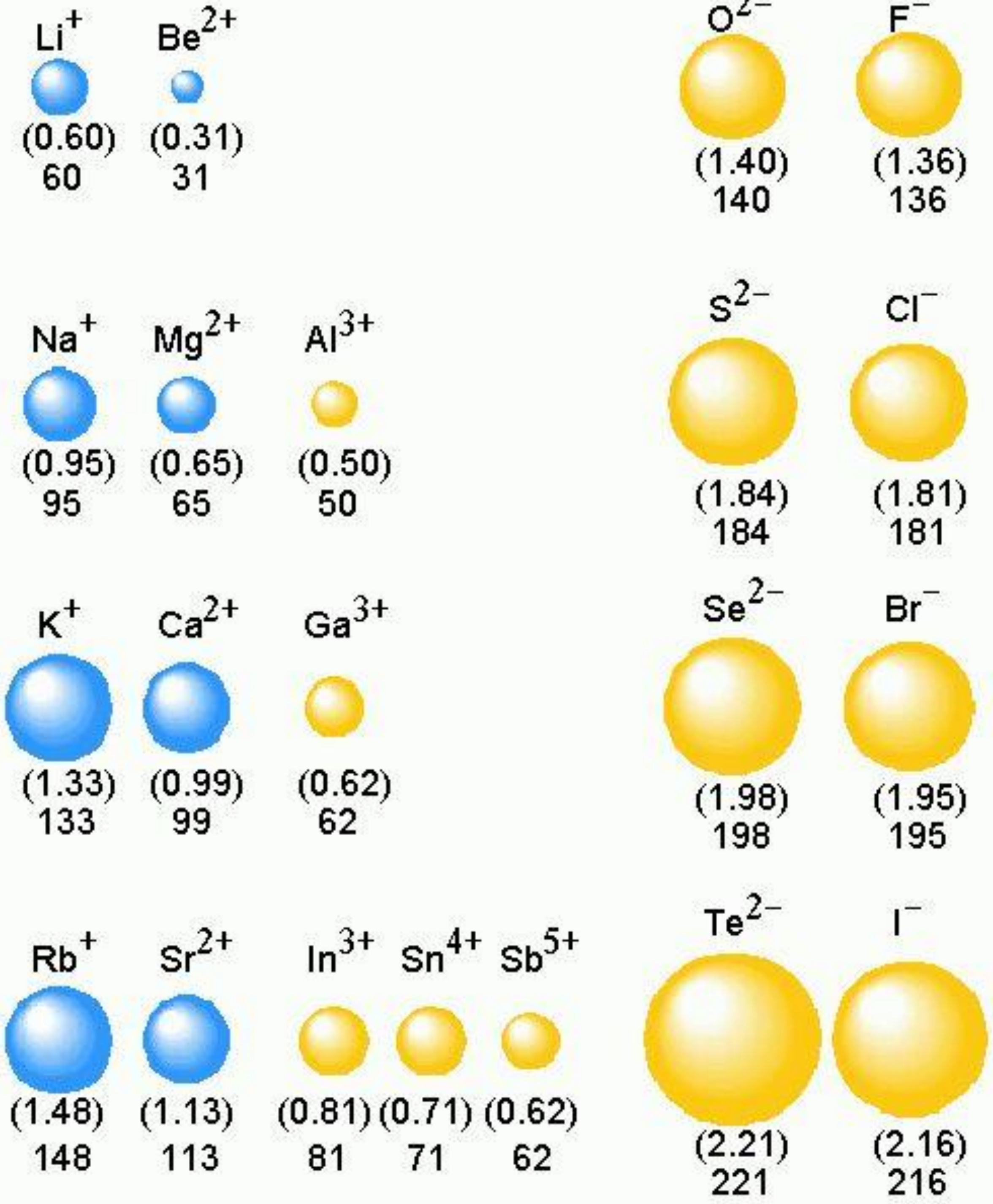
DO you get it? Questions:

- Create the ions of the following and compare the size of the atom to the ion created:

- Magnesium

- Sulfur

Table of Ion Sizes



Periodic Table of the Elements

Density

http://chemistry.about.com

About Chemistry

Solid or Liquid: g/cm³ at 20°C and 1 atm

Gas: g/liter at 0°C and 1 atm

1A	2A	3B	4B	5B	6B	7B	8B			1B	2B	3A	4A	5A	6A	7A	8A
1 **H** 0.089																	2 **He** 0.179
3 **Li** 0.53	4 **Be** 1.85											5 **B** 2.34	6 **C** 2.26	7 **N** 1.25	8 **O** 1.43	9 **F** 1.70	10 **Ne** 0.90
11 **Na** 0.97	12 **Mg** 1.74											13 **Al** 2.70	14 **Si** 2.33	15 **P** 1.82	16 **S** 2.07	17 **Cl** 3.21	18 **Ar** 1.78
19 **K** 0.89	20 **Ca** 1.54	21 **Sc** 2.99	22 **Ti** 4.51	23 **V** 6.0	24 **Cr** 7.15	25 **Mn** 7.3	26 **Fe** 7.87	27 **Co** 8.86	28 **Ni** 8.90	29 **Cu** 8.96	30 **Zn** 7.14	31 **Ga** 5.91	32 **Ge** 5.32	33 **As** 5.72	34 **Se** 4.80	35 **Br** 3.12	36 **Kr** 3.73
37 **Rb** 1.53	38 **Sr** 2.64	39 **Y** 4.47	40 **Zr** 6.52	41 **Nb** 8.57	42 **Mo** 10.2	43 **Tc** 11	44 **Ru** 12.1	45 **Rh** 12.4	46 **Pd** 12.0	47 **Ag** 10.5	48 **Cd** 8.69	49 **In** 7.31	50 **Sn** 7.26	51 **Sb** 6.68	52 **Te** 6.24	53 **I** 4.93	54 **Xe** 5.89
55 **Cs** 1.93	56 **Ba** 3.62	57-71 Lanthanides	72 **Hf** 13.3	73 **Ta** 16.4	74 **W** 19.3	75 **Re** 20.8	76 **Os** 22.6	77 **Ir** 22.5	78 **Pt** 21.5	79 **Au** 19.3	80 **Hg** 13.53	81 **Tl** 11.8	82 **Pb** 11.3	83 **Bi** 9.79	84 **Po** 9.2	85 **At** unknown	86 **Rn** 9.73
87 **Fr** unknown	88 **Ra** 5.0	89-103 Actinides															

***** Elements > 104 exist only for very short half-lifes and the data is unknown.*****

Lanthanides	57 **La** 6.15	58 **Ce** 6.77	59 **Pr** 6.77	60 **Nd** 7.01	61 **Pm** 7.26	62 **Sm** 7.52	63 **Eu** 5.24	64 **Gd** 7.90	65 **Tb** 8.23	66 **Dy** 8.55	67 **Ho** 8.80	68 **Er** 9.07	69 **Tm** 9.32	70 **Yb** 6.90	71 **Lu** 9.84
Actinides	89 **Ac** 10.0	90 **Th** 11.7	91 **Pa** 15.4	92 **U** 19.1	93 **Np** 20.2	94 **Pu** 19.7	95 **Am** 13.6	96 **Cm** 13.5	97 **Bk** 14.8	98 **Cf** unknown	99 **Es** unknown	100 **Fm** unknown	101 **Md** unknown	102 **No** unknown	103 **Lr** unknown

Periodic Table of the Elements

Melting Point

°C and 1 atm

tp = triple point

sp = sublimation point

http://chemistry.about.com

About Chemistry

1A	2A	3B	4B	5B	6B	7B	8B			1B	2B	3A	4A	5A	6A	7A	8A
1 **H** -259.1																	2 **He** -268.93
3 **Li** 180.5	4 **Be** 1287											5 **B** 2075	6 **C** 3825 sp	7 **N** -210	8 **O** -218.79	9 **F** -219.67	10 **Ne** -248.609
11 **Na** 97.8	12 **Mg** 650											13 **Al** 660.32	14 **Si** 1414	15 **P** 44.15	16 **S** 115.21	17 **Cl** -101.5	18 **Ar** -189.36
19 **K** 63.5	20 **Ca** 842	21 **Sc** 1541	22 **Ti** 1668	23 **V** 1910	24 **Cr** 1907	25 **Mn** 1246	26 **Fe** 1538	27 **Co** 1495	28 **Ni** 1455	29 **Cu** 1084.62	30 **Zn** 419.53	31 **Ga** 29.76	32 **Ge** 938.25	33 **As** 817 tp	34 **Se** 221	35 **Br** -7.2	36 **Kr** -157.36
37 **Rb** 39.3	38 **Sr** 777	39 **Y** 1522	40 **Zr** 1855	41 **Nb** 2477	42 **Mo** 2623	43 **Tc** 2157	44 **Ru** 2334	45 **Rh** 1964	46 **Pd** 1554.8	47 **Ag** 961.78	48 **Cd** 321.07	49 **In** 156.6	50 **Sn** 231.93	51 **Sb** 630.63	52 **Te** 449.51	53 **I** 113.7	54 **Xe** -111.74
55 **Cs** 28.44	56 **Ba** 727	57-71 Lanthanides	72 **Hf** 2233	73 **Ta** 3017	74 **W** 3422	75 **Re** 3185	76 **Os** 3033	77 **Ir** 2446	78 **Pt** 1768.2	79 **Au** 1064.18	80 **Hg** -38.83	81 **Tl** 304	82 **Pb** 327.46	83 **Bi** 271.4	84 **Po** 254	85 **At** 302	86 **Rn** -71
87 **Fr** 27	88 **Ra** 696	89-103 Actinides															

***** Elements > 104 exist only for very short half-lifes and the data is unknown.*****

Lanthanides	57 **La** 920	58 **Ce** 799	59 **Pr** 931	60 **Nd** 1016	61 **Pm** 1042	62 **Sm** 1072	63 **Eu** 822	64 **Gd** 1313	65 **Tb** 1356	66 **Dy** 1412	67 **Ho** 1472	68 **Er** 1529	69 **Tm** 1545	70 **Yb** 824	71 **Lu** 1663
Actinides	89 **Ac** 1050	90 **Th** 1750	91 **Pa** 1572	92 **U** 1135	93 **Np** 664	94 **Pu** 640	95 **Am** 1176	96 **Cm** 1345	97 **Bk** 996	98 **Cf** 900	99 **Es** 860	100 **Fm** 1527	101 **Md** 827	102 **No** unknown	103 **Lr** unknown