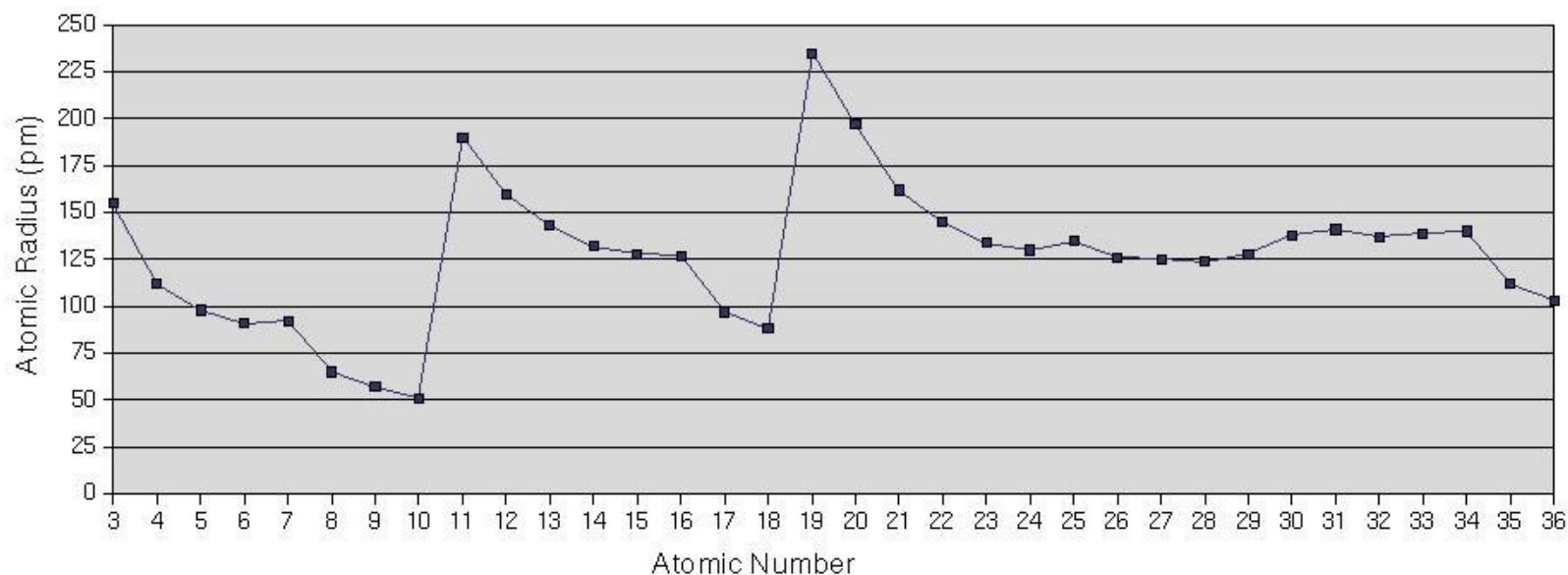


Section 3: Periodic Trends

Atomic Radius as a Function of Atomic Number



Periodic Trends

Atomic Radius *decreases*

Can you explain in terms of
nuclear charge & shielding

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

Atomic Radius *increases*

Periodic Trends

Atomic Radius *decreases*

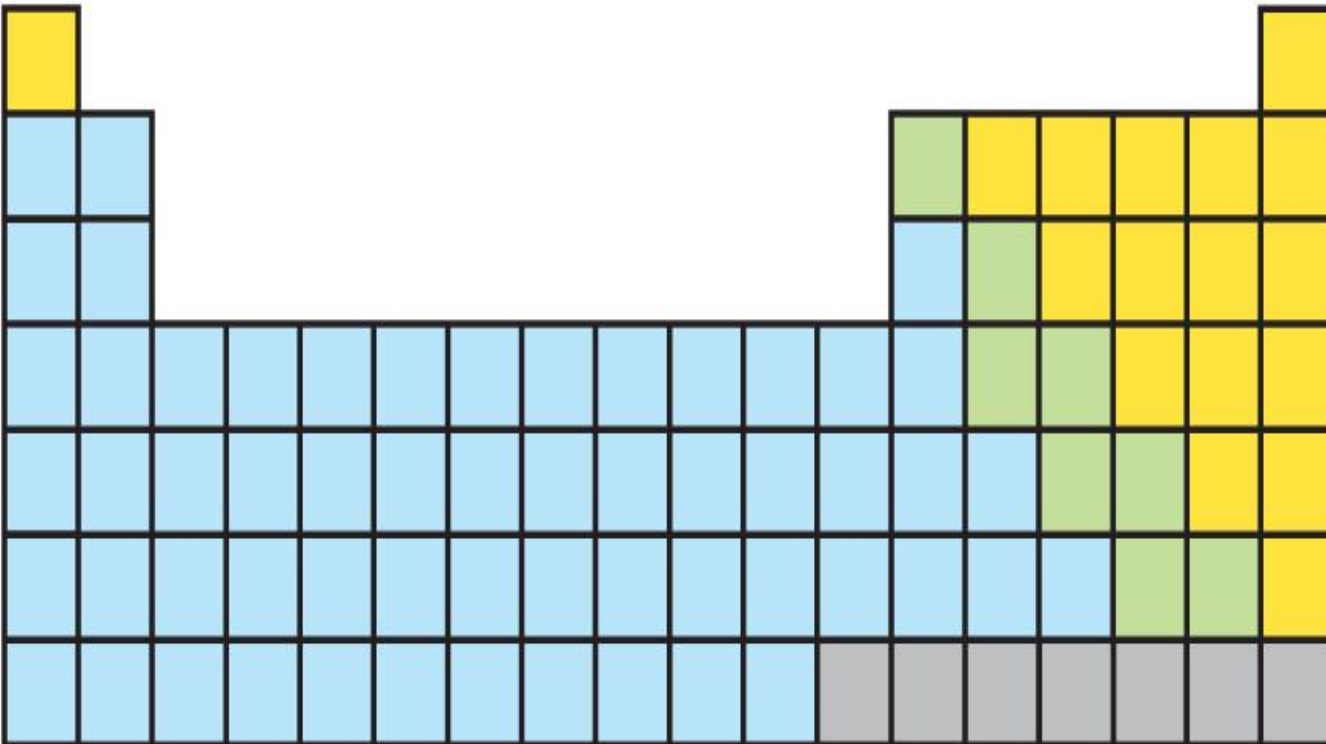
Ionization Energy ???

Electronegativity ???

Atomic Radius *increases*

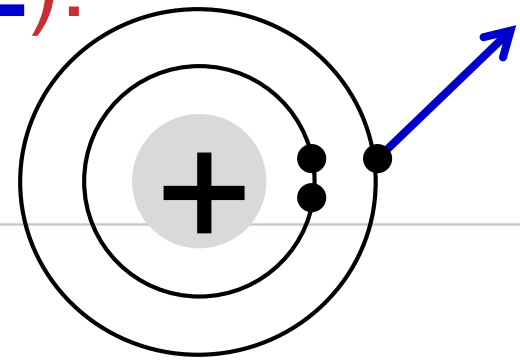
Ionization Energy ???

Electronegativity ???



Ionization Energy (IE):

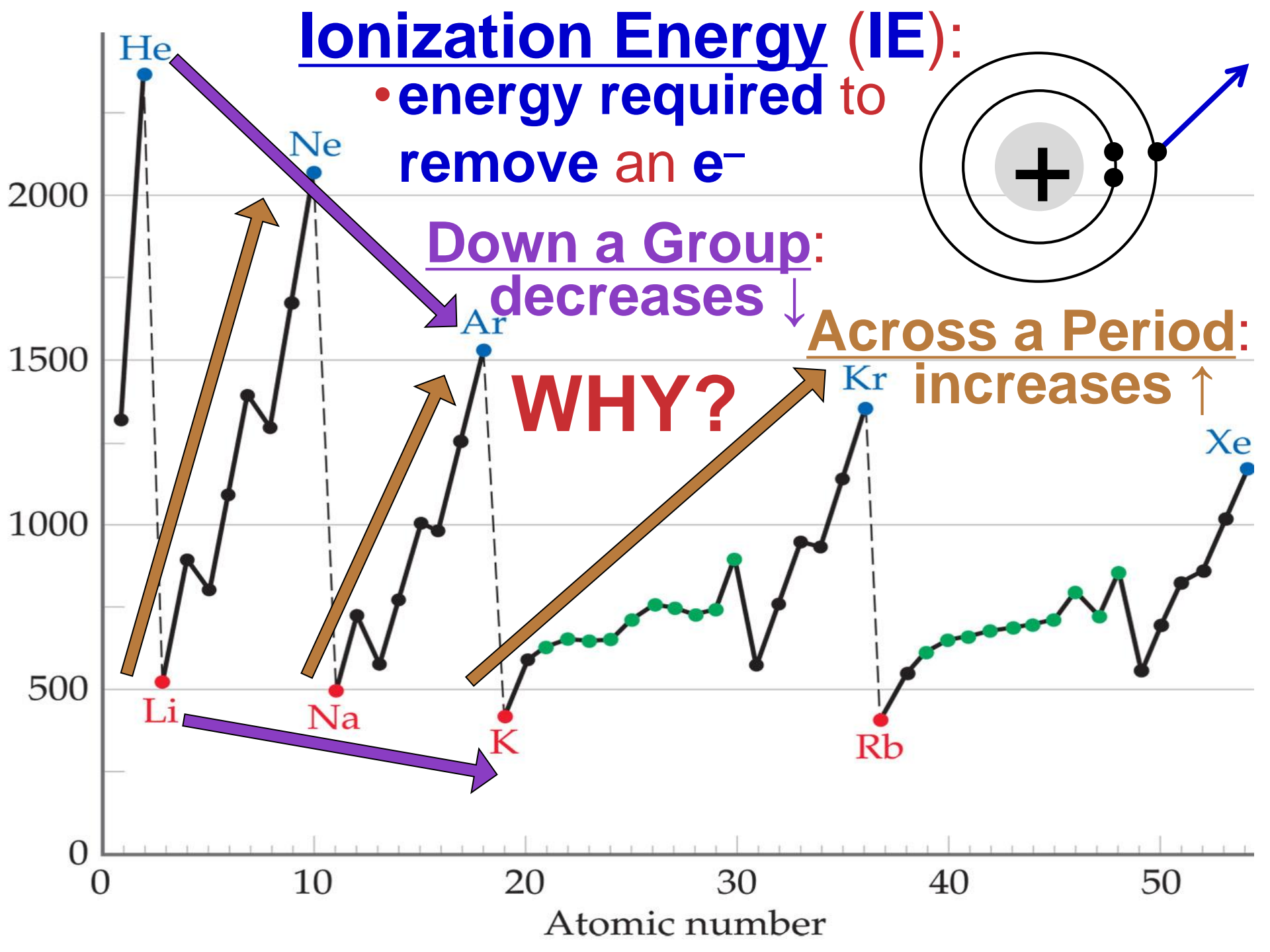
• energy required to remove an e^-



Down a Group:
decreases ↓

Across a Period:
increases ↑

WHY?



First IE Trends

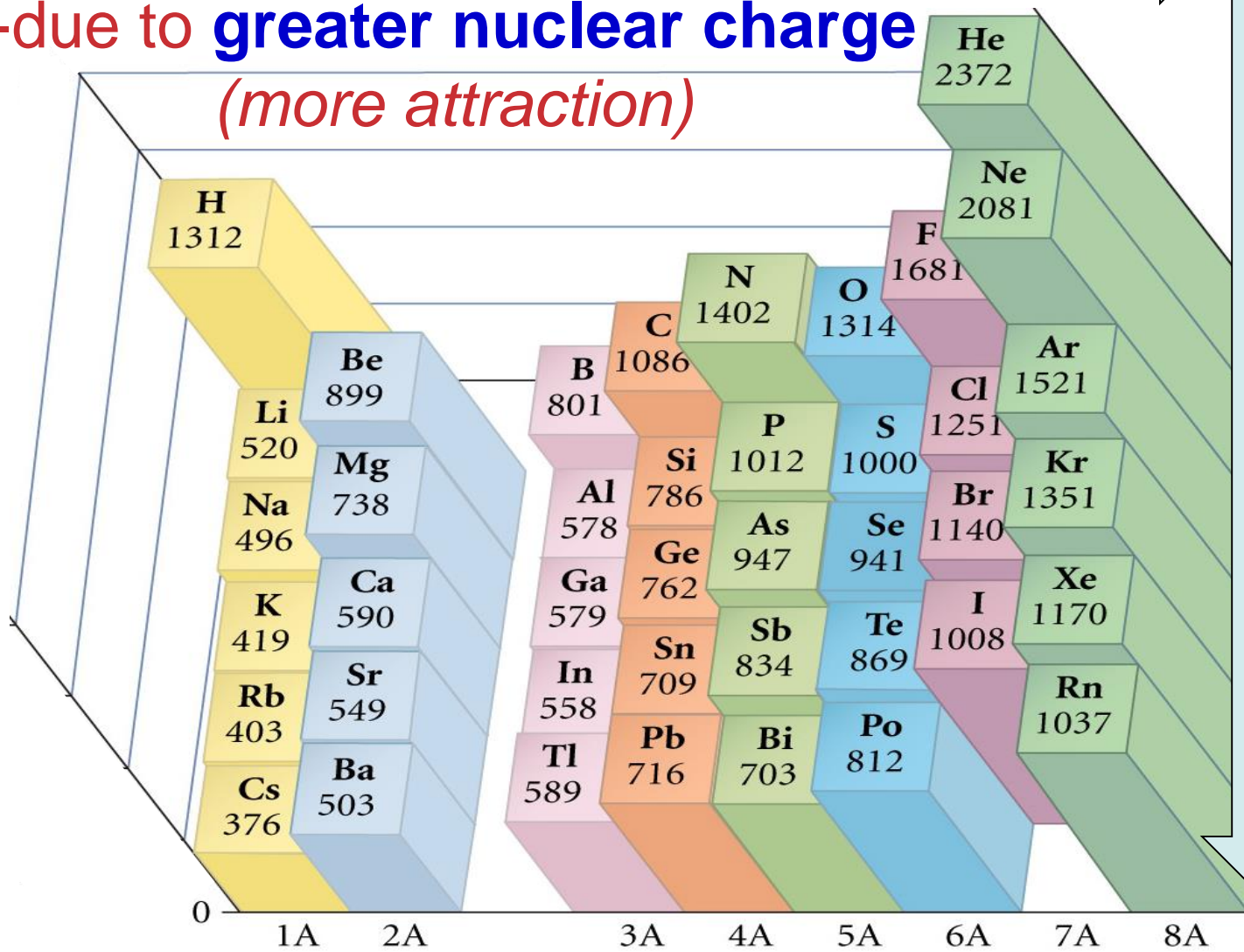
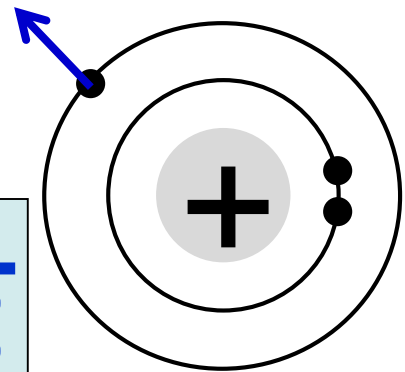
increases across a period

-due to greater nuclear charge

(more attraction)

decreases down a group

-due to more shielding
(less attraction)



Example of Ionization Energy Trend

- Arrange the following elements in order of increasing first ionization energy.

Mg, Na, Si, Al

IA												VIIA					
1 H 1.008													2 He 4.003				
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 15.99	9 F 19	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 28.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.94
19 K 39.1	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.9	36 Kr 83.8
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc -98	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226	89 Ac 227															
			58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173	71 Lu 175	
			90 Th 232	91 Pa 231	92 U 238	93 Np 237	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)	

Na < Mg < Al < Si

Electronegativity (EN) Trends

- atom's ability to attract bonded e⁻'s

increases across a period

-due to greater nuclear charge
(more attraction)

H 2.1									He --
Li 1.0	Be 1.6		B 2.0	C 2.5	N 3.0	O 3.5	F 4.0		Ne --
Na 0.9	Mg 1.3		Al 1.6	Si 1.9	P 2.2	S 2.5	Cl 3.0		Ar --
K 0.8	Ca 1.3		Ga 1.6	Ge 2.0	As 2.2	Se 2.6	Br 2.8		Kr --
Rb 0.8	Sr 1.0		In 1.8	Sn 2.0	Sb 2.1	Te 2.1	I 2.7	Xe 2.6	
Cs 0.8	Ba 0.9		Tl 2.0	Pb 2.3	Bi 2.0	Po 2.0	At 2.2		Rn --
Fr 0.7	Ra 0.9			Uuq					

decreases down a group

-due to more shielding
(less attraction)

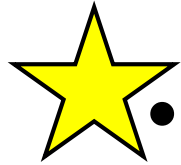
Example of Electronegativity Trend

- Arrange the following elements in order of increasing electronegativity: B, Na, F, O

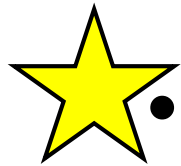
IA										IIA										IIIA										IVA										VA										VIA										VIIA										VIIIA									
1																			2	H																			He	1.008																			4.003																				
3																			4	Li	Be																			B	C	N	O	F	Ne	6.941	9.012																			10.81	12.01	14.01	15.99	19	20.18								
11																			12	Na	Mg																			Al	Si	P	S	Cl	Ar	22.99	24.31																			26.98	28.09	30.97	32.07	35.45	39.94								
19																			20	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	39.1	40.08	44.96	47.88	50.94	52	54.94	55.85	58.93	58.69	63.55	65.39	69.72	72.61	74.92	78.96	79.9	83.8																								
37																			38	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	85.47	87.62	88.91	91.22	92.91	95.94	-98	101.1	102.9	106.4	107.9	112.4	114.8	118.7	121.8	127.6	128.9	131.3																								
55																			56	Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	132.9	137.3	138.9	178.5	180.9	183.9	186.2	190.2	192.2	195.1	197	200.6	204.4	207.2	209	(209)	(210)	(222)																								
87																			88	Fr	Ra	Ac																										(223)	226	227																													
																				58	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu						140.1	140.9	144.2	(145)	150.4	152	157.3	158.9	162.5	164.9	167.3	168.9	173	175																										
																				90	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr						232	231	238	237	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(260)																										

Na < B < O < F

Overall Reactivity – Very Important!

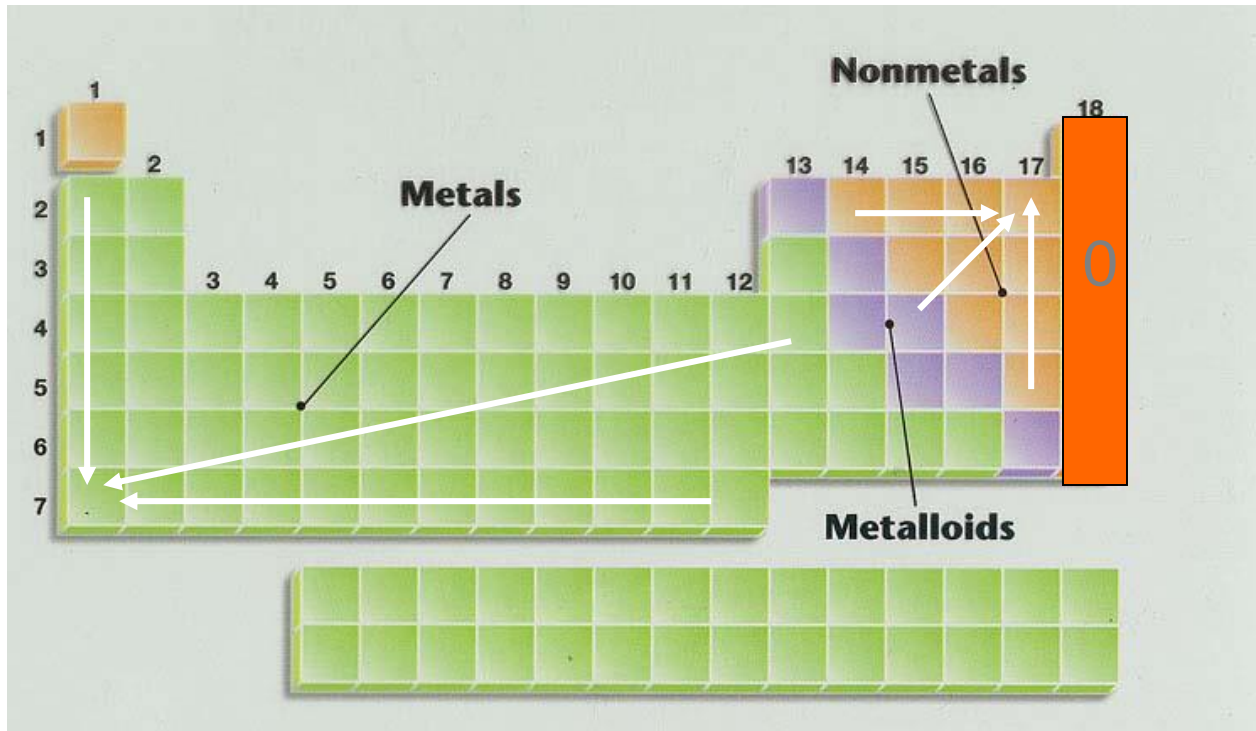


• The most reactive metals are the largest since they are the best electron givers.



• The most reactive nonmetals are the smallest ones since they are the best electron takers.

Overall Reactivity



Periodic Trends (Summary)

Atomic Radius *decreases*

Ionization Energy *increases*

Electronegativity *increases*

Can you explain all of this
in terms of p's and e's?

nuclear charge
shielding

Electronegativity *decreases*

Ionization Energy *decreases*

Atomic Radius *increases*

