

Periodic Trends

Schweitzer

How many valence electrons?

1

2

Multiple and vary

3

4

5

6

7

8

Periodic Table of the Elements

1 H Hydrogen 1.00794	2 He Helium 4.002602											18 Ar Argon 39.948	19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.955910	22 Ti Titanium 47.867	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938049	26 Fe Iron 55.8457	27 Co Cobalt 58.933200	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.409	31 Ga Gallium 69.723	32 Ge Germanium 72.64	33 As Arsenic 74.92160	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.798				
3 Li Lithium 6.941	4 Be Beryllium 9.012182											17 Cl Chlorine 35.453	16 S Sulfur 32.066	15 P Phosphorus 30.973761	14 Si Silicon 28.0855	13 Al Aluminum 26.981538	12 Mg Magnesium 24.3050	11 Na Sodium 22.989770	10 Ne Neon 20.1797	9 F Fluorine 18.9984032	8 O Oxygen 15.9994	7 N Nitrogen 14.00674	6 C Carbon 12.0107	5 B Boron 10.811	4 Be Beryllium 9.012182	3 Li Lithium 6.941	2 He Helium 4.002602							
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90585	40 Zr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybdenum 95.94	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.90447	54 Xe Xenon 131.29	55 Cs Cesium 132.90545	56 Ba Barium 137.327	57 to 71 Lanthanide series	58 Ce Cerium 140.116	59 Pr Praseodymium 140.90765	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92534	66 Dy Dysprosium 162.500	67 Ho Holmium 164.93032	68 Er Erbium 167.259	69 Tm Thulium 168.93421	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
87 Fr Francium (223)	88 Ra Radium (226)	89 to 103 Actinide series	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 (271)	111 Rg Roentgenium (272)	112 Uub Ununbium (285)	113 Uut Ununtrium (284)	114 Uuq Ununquadium (289)	115 Uup Ununpentium (288)	116 Uuh Ununhexium (292)	117 Uus Ununseptium	118 Uuo Ununoctium (222)																	

Atomic masses in parentheses are those of the most stable or common isotope.

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Note: The subgroup numbers 1-18 were adopted in 1954 by the International Union of Pure and Applied Chemistry. The names of elements 112-118 are the Latin equivalents of those

Octet Rule!

- All atoms are trying to obtain the octet rule. This means they will gain or lose electrons to achieve this octet.

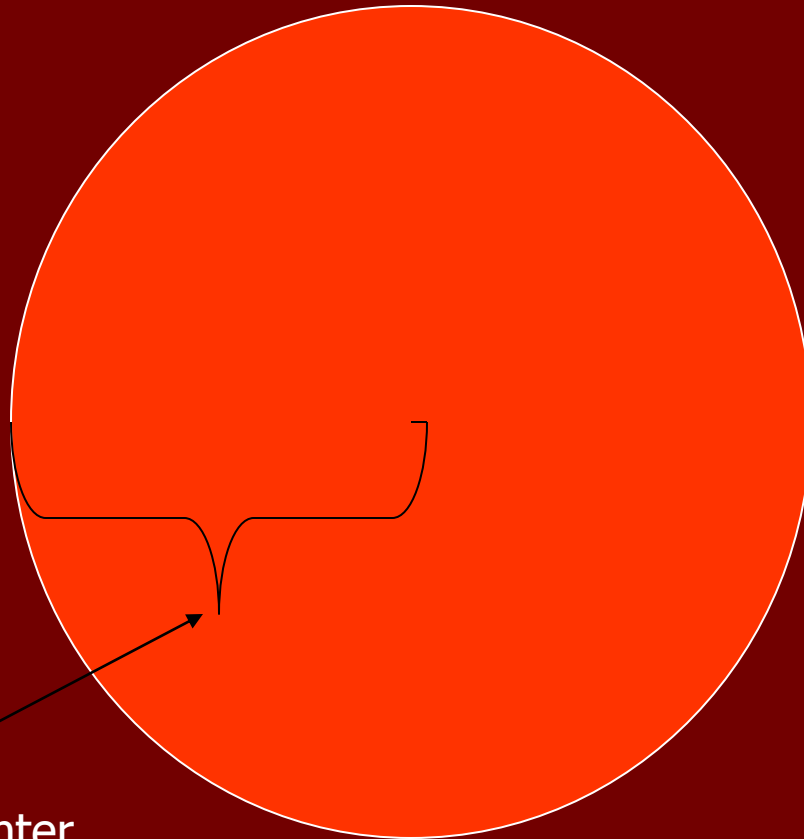


Periodic Table of the Elements

1 IA		New Original		Alkali metals										Transition metals										Lanthanide series										Actinide series										Poor metals										Nonmetals										Noble gases																																																																																																			
1		2		3										4										5										6										7										8										9										10										11										12										13										14										15										16										17										18									
IA		IIA		IIIB										IVB										VB										VIB										VIIB										VIII										VIII										IB										IIB										IIIA										IVA										VA										VIA										VIIA										VIIIA																			
1	H	3	Li	4	Be	11	Na	12	Mg	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	55	Rb	56	Sr	57	Y	72	Zr	73	Nb	74	Mo	75	Tc	76	Ru	77	Rh	78	Pd	79	Ag	80	Cd	81	In	82	Sn	83	Sb	84	Te	85	I	86	Xe																																																																																		

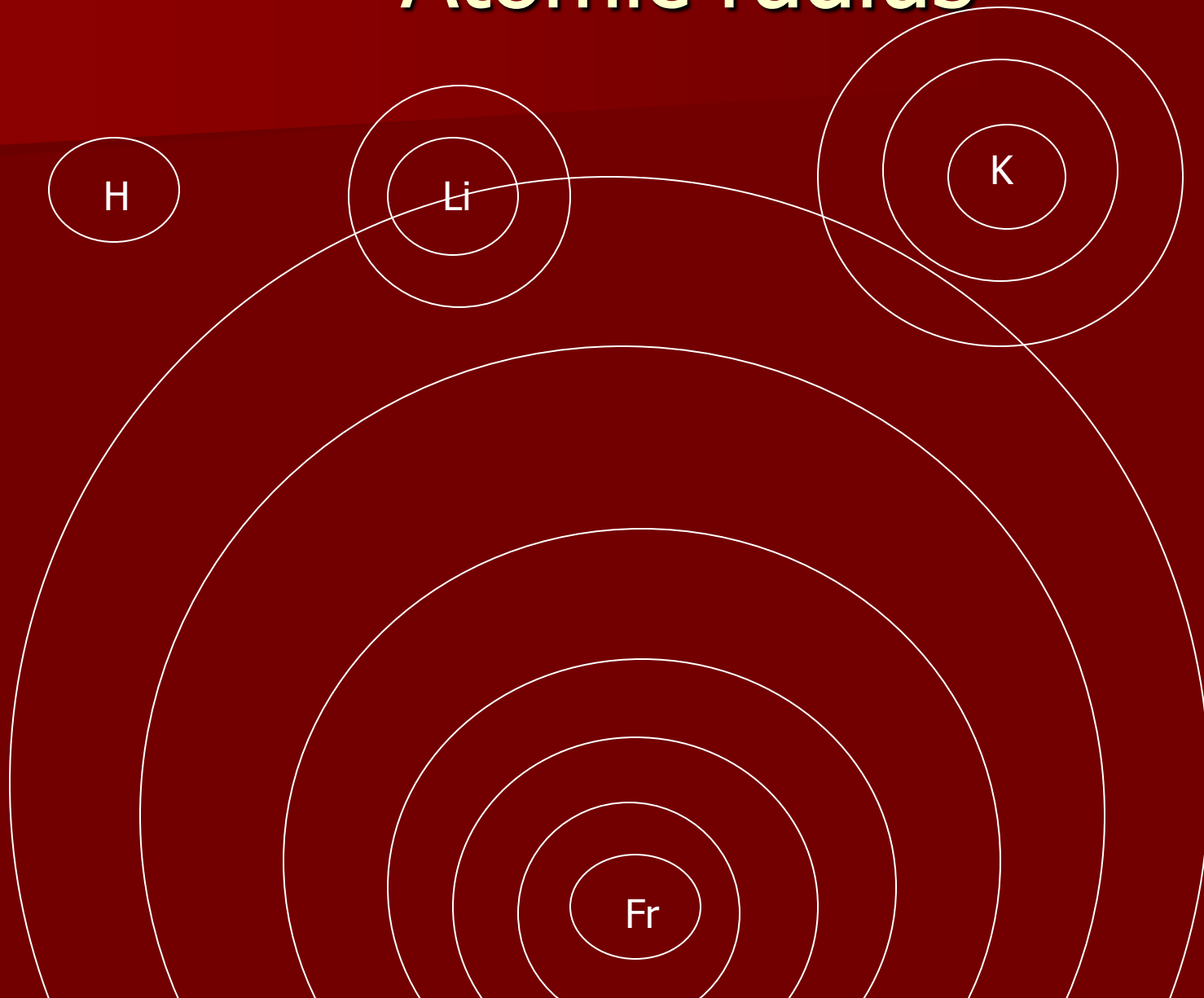
Atomic Radius

- Define Radius



Distance between center
and outer edge

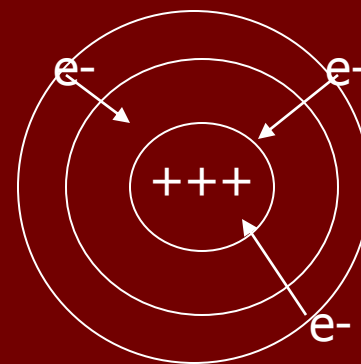
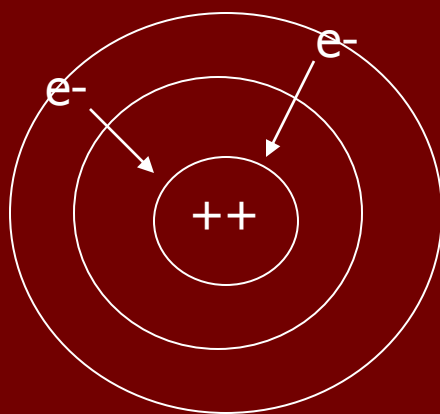
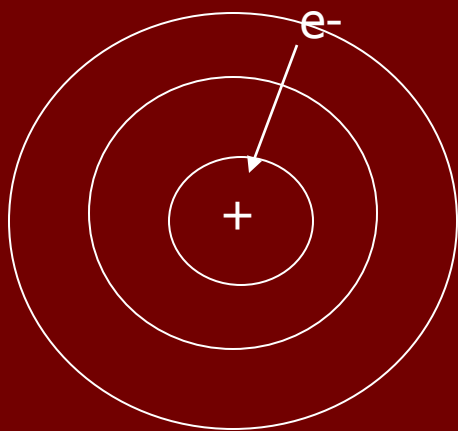
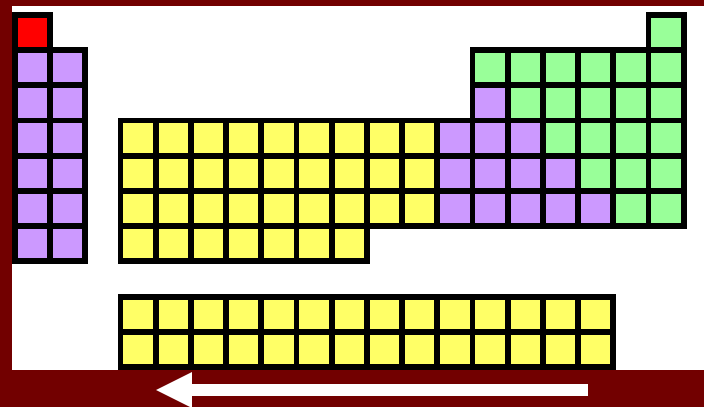
Atomic radius



Atomic radius

With in a period?

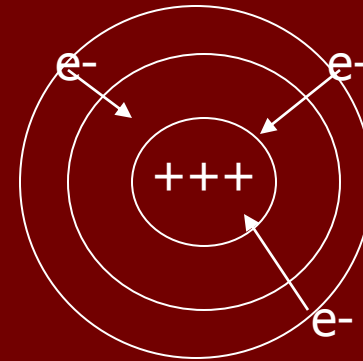
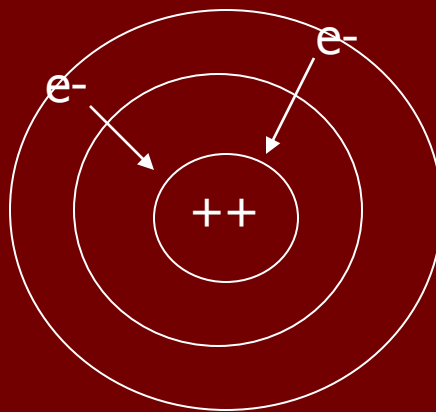
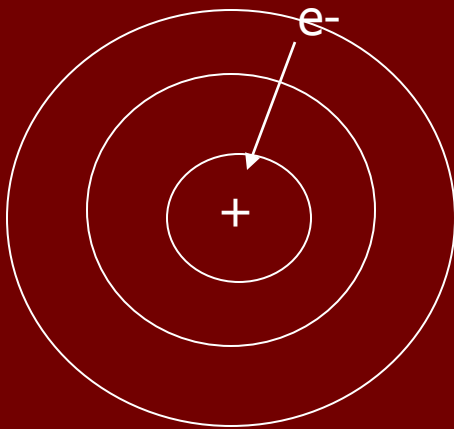
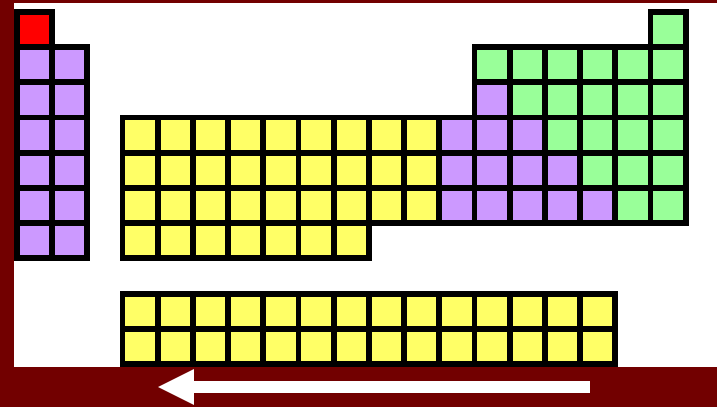
- As you add electrons with in a row the attraction increases pulling in the outer electrons reducing the atomic radius slightly



Atomic radius

With in a period?

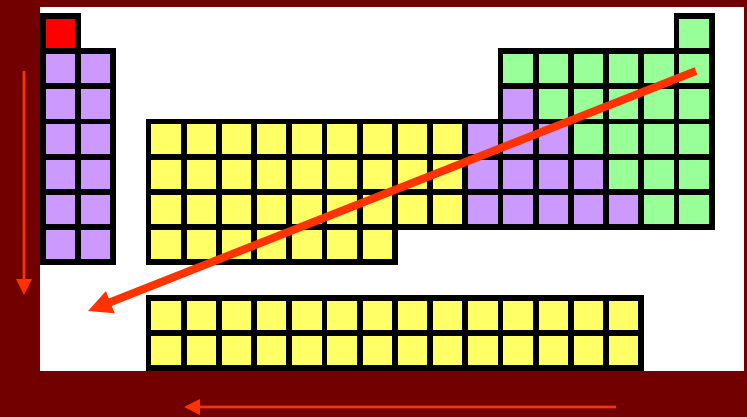
- As you add electrons with in a row the attraction increases pulling in the outer electrons reducing the atomic radius slightly



What do you think is the BIGGEST atom on the periodic table?

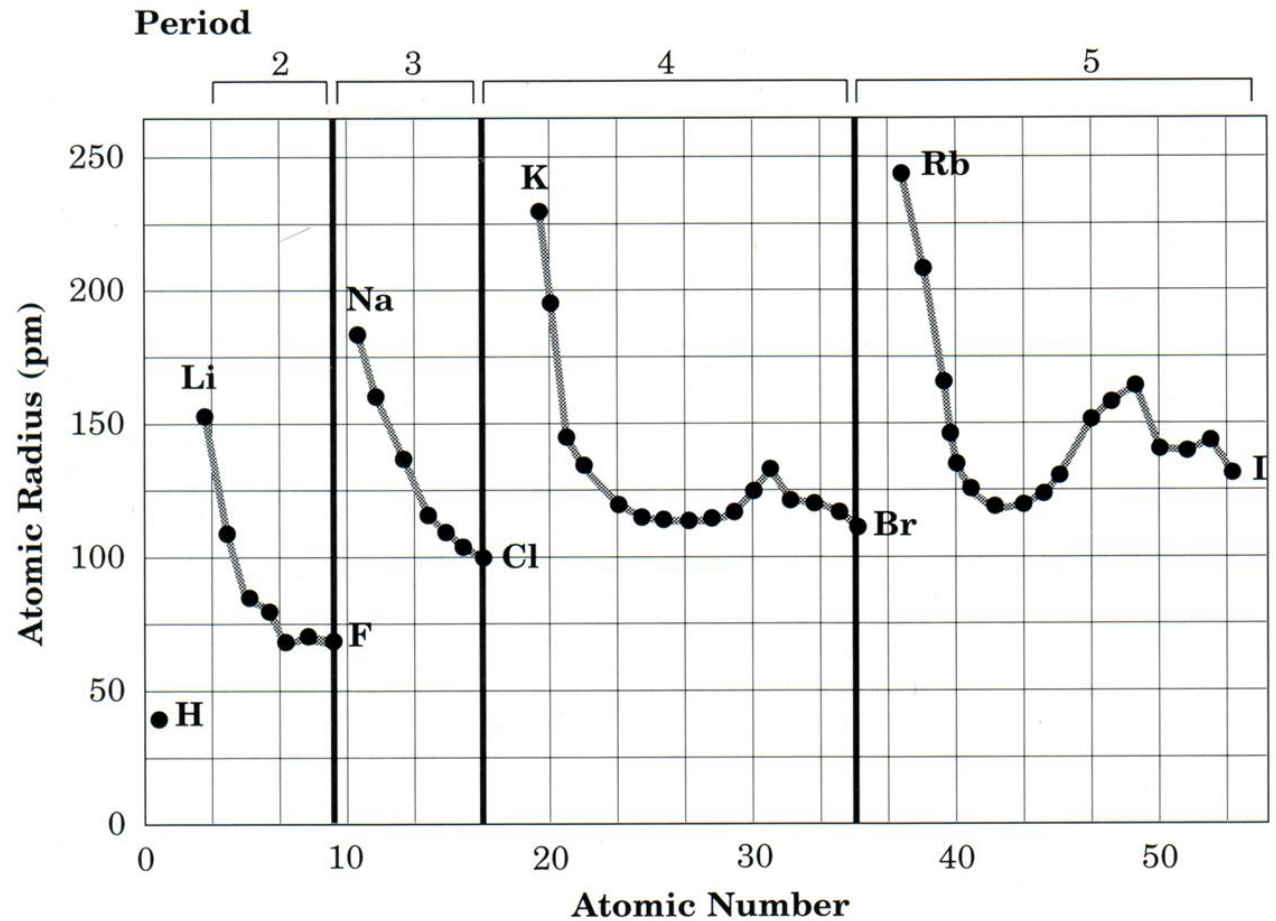
Atomic radius

- Increases as you go down
- Increases as you go to the left
- Therefore the biggest atoms are in the lower left and the smallest are in the upper right
- Hydrogen is the smallest.
(exception)

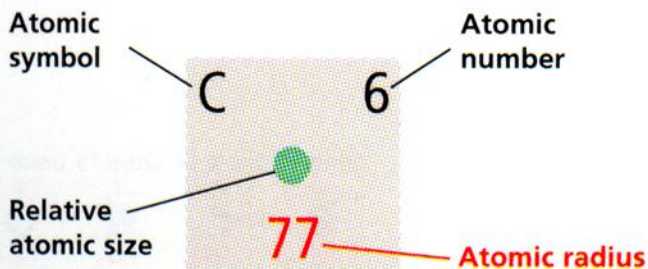


Atomic radius energy

■ graph



Atomic radius



1	H 1 37																	Group 18 He 2 32
2	Group 1 Li 3 152	Group 2 Be 4 111											Group 13 B 5 86	Group 14 C 6 77	Group 15 N 7 70	Group 16 O 8 73	Group 17 F 9 72	Group 18 Ne 10 71
3	Na 11 186	Mg 12 160											Al 13 143	Si 14 118	P 15 108	S 16 106	Cl 17 99	Ar 18 97
4	K 19 232	Ca 20 197	Group 3 Sc 21 162	Group 4 Ti 22 147	Group 5 V 23 134	Group 6 Cr 24 128	Group 7 Mn 25 127	Group 8 Fe 26 126	Group 9 Co 27 125	Group 10 Ni 28 124	Group 11 Cu 29 128	Group 12 Zn 30 134	Ga 31 135	Ge 32 128	As 33 125	Se 34 116	Br 35 114	Kr 36 110
5	Rb 37 248	Sr 38 215	Y 39 180	Zr 40 160	Nb 41 146	Mo 42 139	Tc 43 136	Ru 44 134	Rh 45 134	Pd 46 137	Ag 47 144	Cd 48 149	In 49 167	Sn 50 151	Sb 51 145	Te 52 142	I 53 133	Xe 54 130
6	Cs 55 265	Ba 56 217	La 57 183	Hf 72 159	Ta 73 146	W 74 139	Re 75 137	Os 76 135	Ir 77 136	Pt 78 139	Au 79 144	Hg 80 151	Tl 81 170	Pb 82 175	Bi 83 155	Po 84 164	At 85 140	Rn 86 141
7	Fr 87 270	Ra 88 220	Ac 89 188	Rf 104 —	Db 105 —	Sg 106 —	Bh 107 —	Hs 108 —	Mt 109 —									

Lanthanide series

Ce 58 182	Pr 59 182	Nd 60 181	Pm 61 183	Sm 62 180	Eu 63 208	Gd 64 180	Tb 65 177	Dy 66 178	Ho 67 176	Er 68 176	Tm 69 176	Yb 70 —	Lu 71 174
Th 90	Pa 91	U 92	Np 93	Pu 94	Am 95	Cm 96	Bk 97	Cf 98	Es 99	Fm 100	Md 101	No 102	Lr 103

Reactivity

- The easier electrons are gained or lost the more reactive.

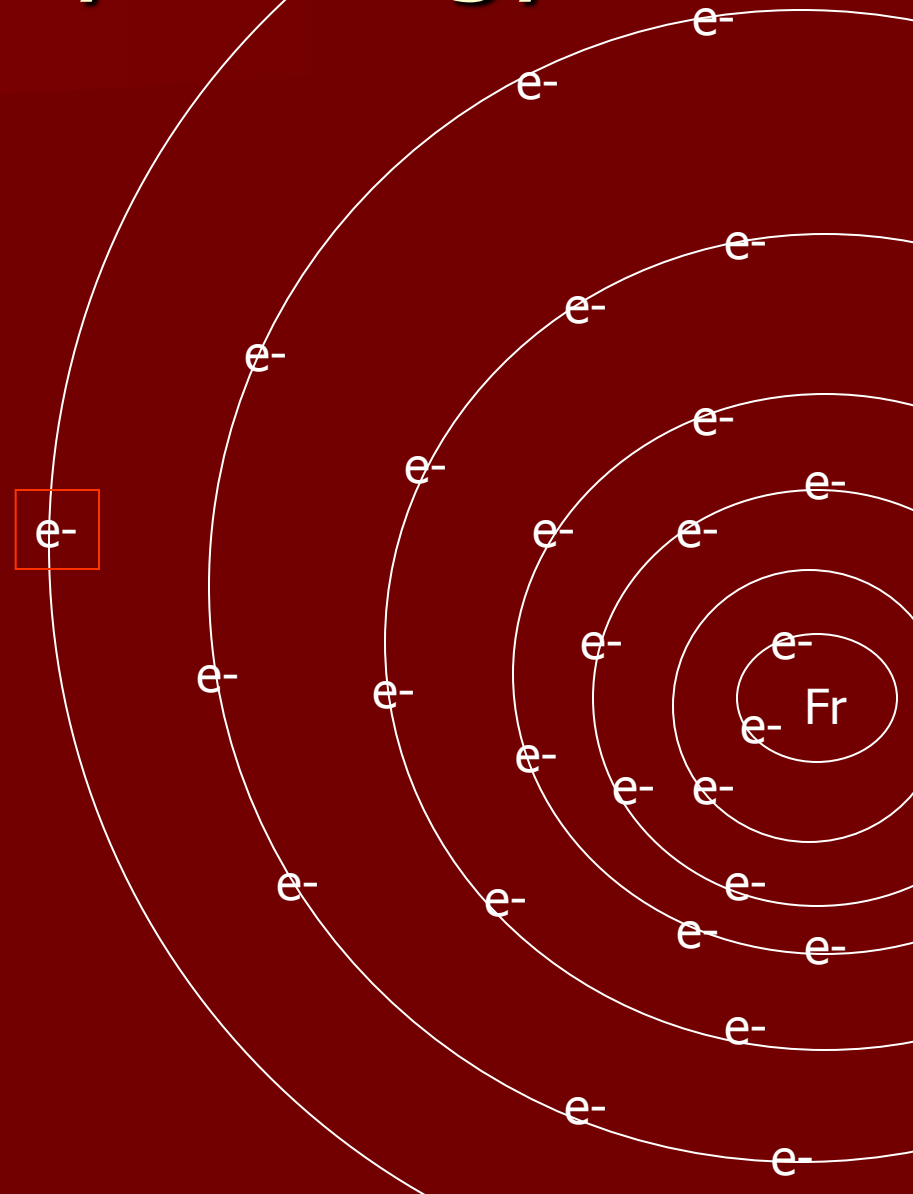
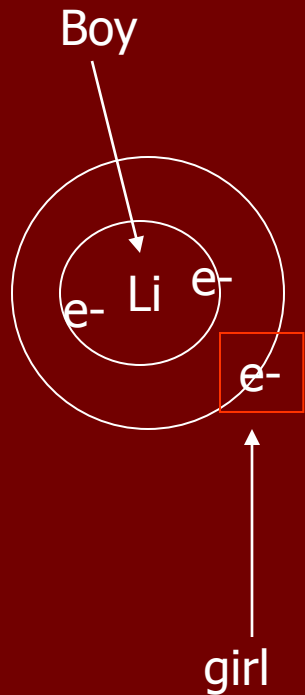


- First Metals like to lose electrons.
- Trying to attain a full outer shell.
- Non-metals are gaining electrons

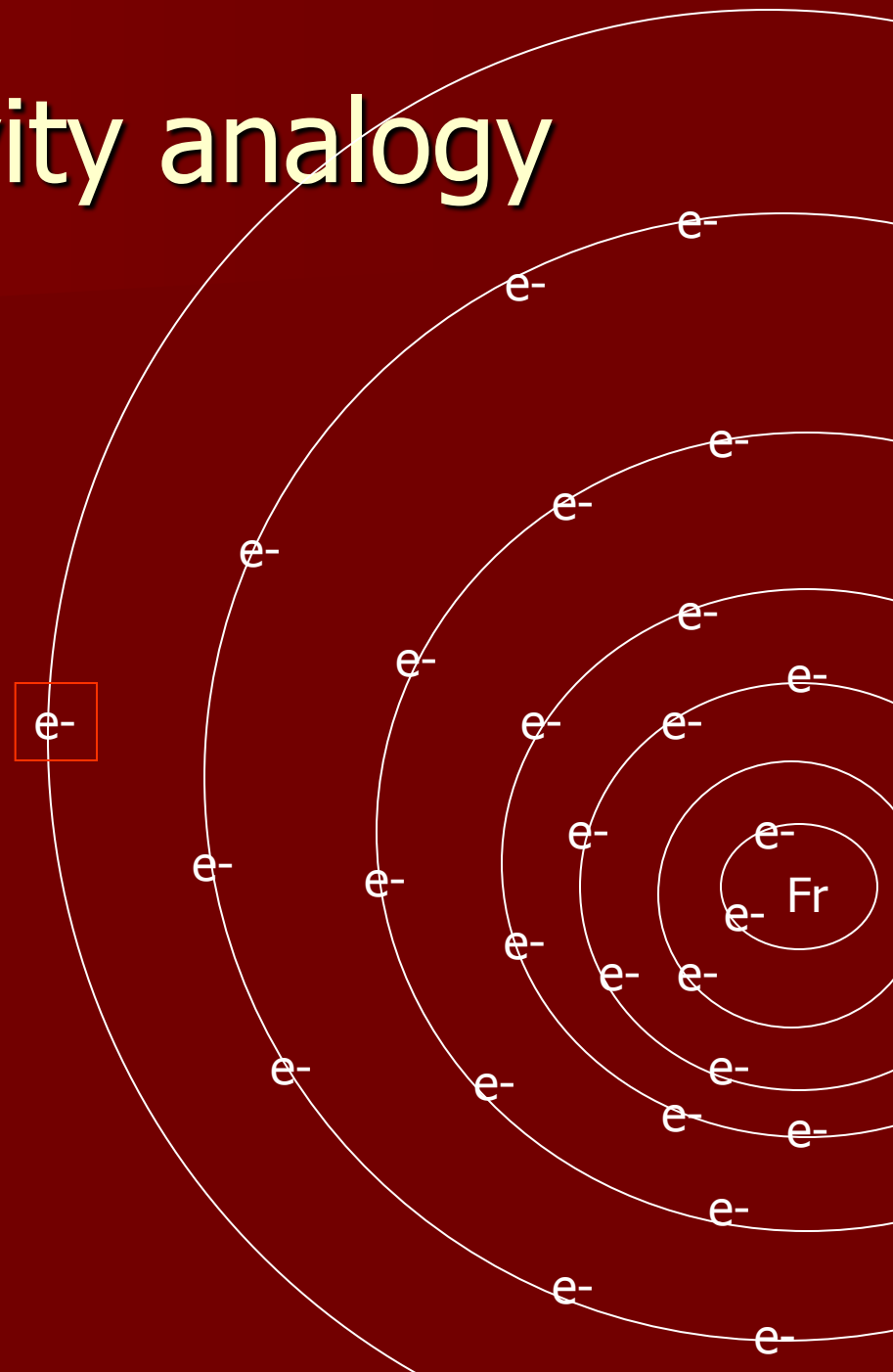
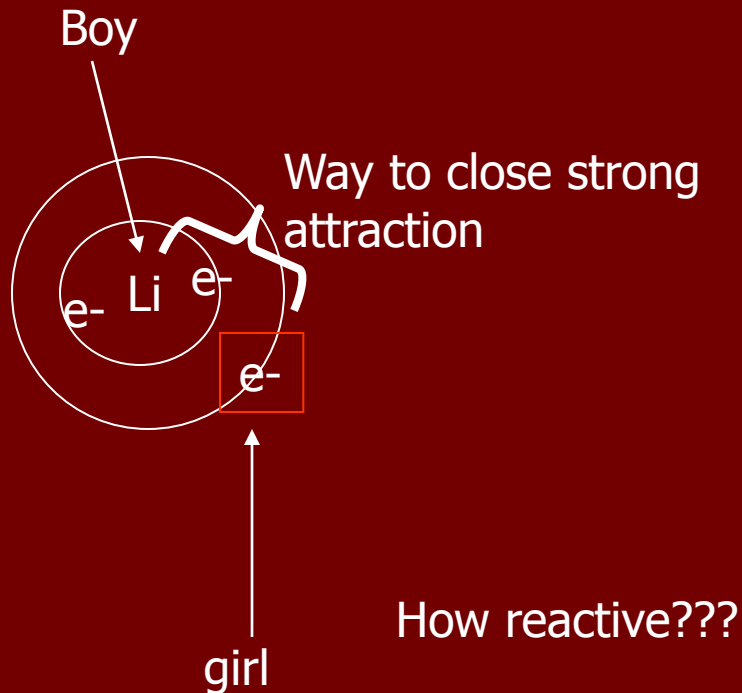


Metal reactivity analogy

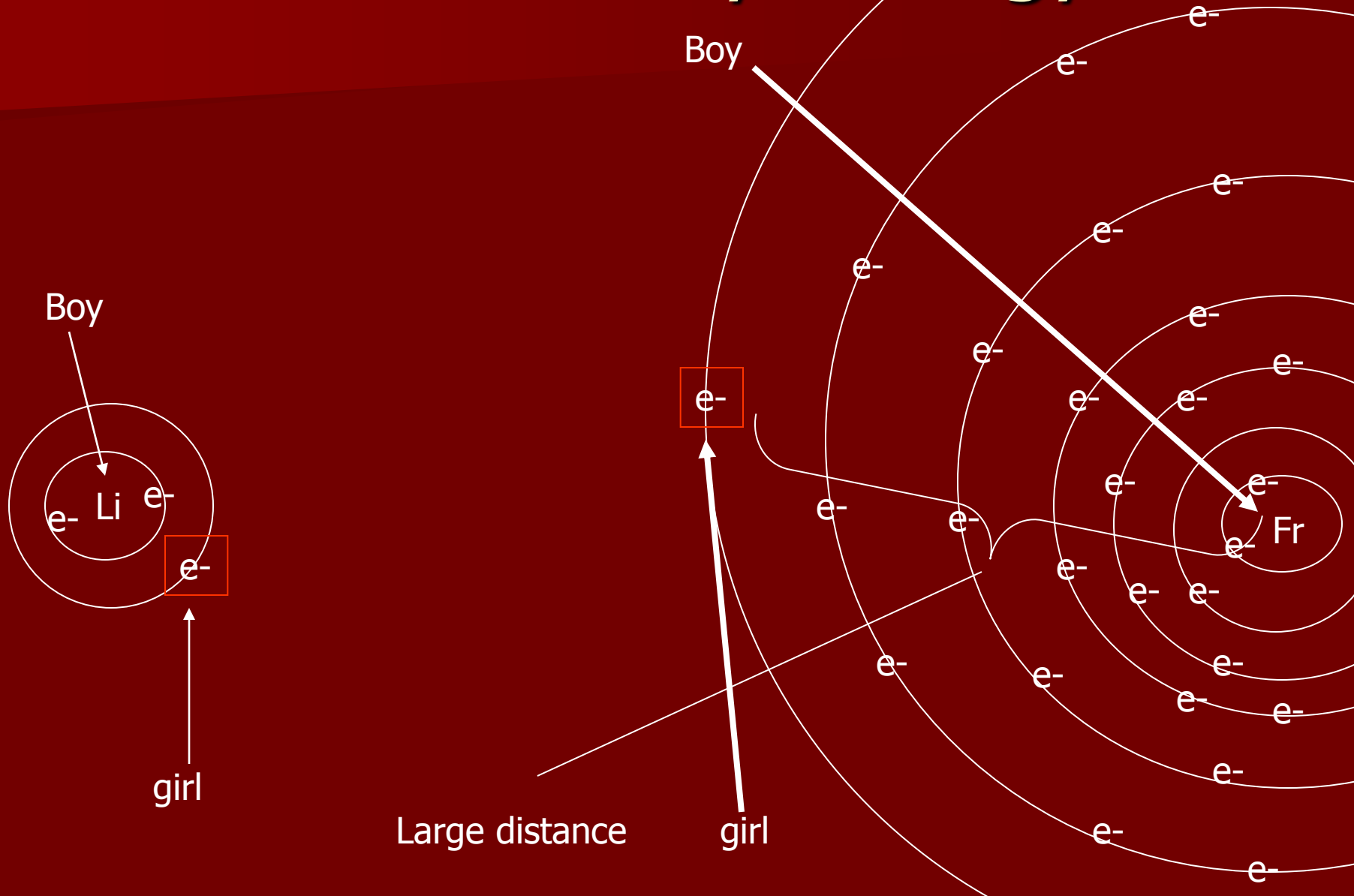
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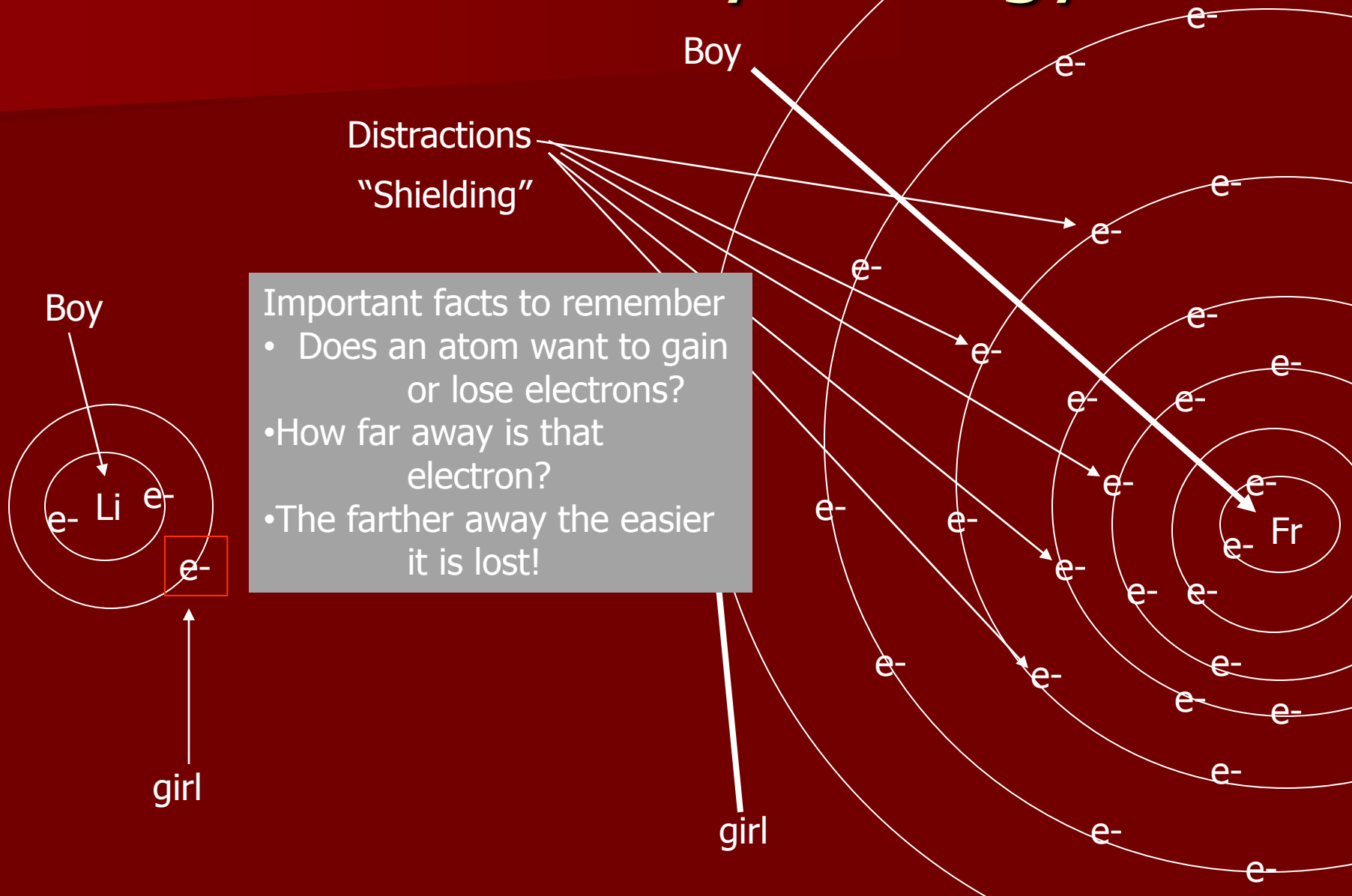
Metal reactivity analogy



Metal reactivity analogy



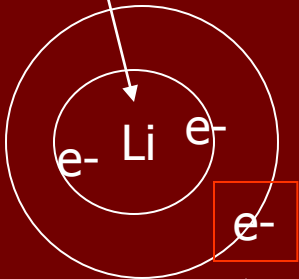
Metal reactivity analogy



Important facts to remember

- Does an atom want to gain or lose electrons?
- How far away is that electron?
- The farther away the easier it is lost!

Boy



girl

Boy

Distractions
"Shielding"

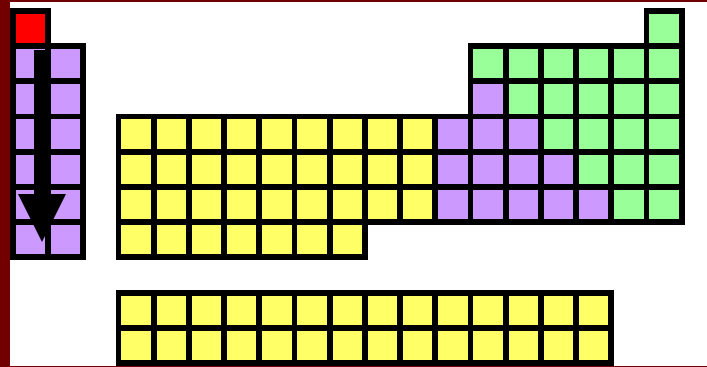
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Reactivity of metals

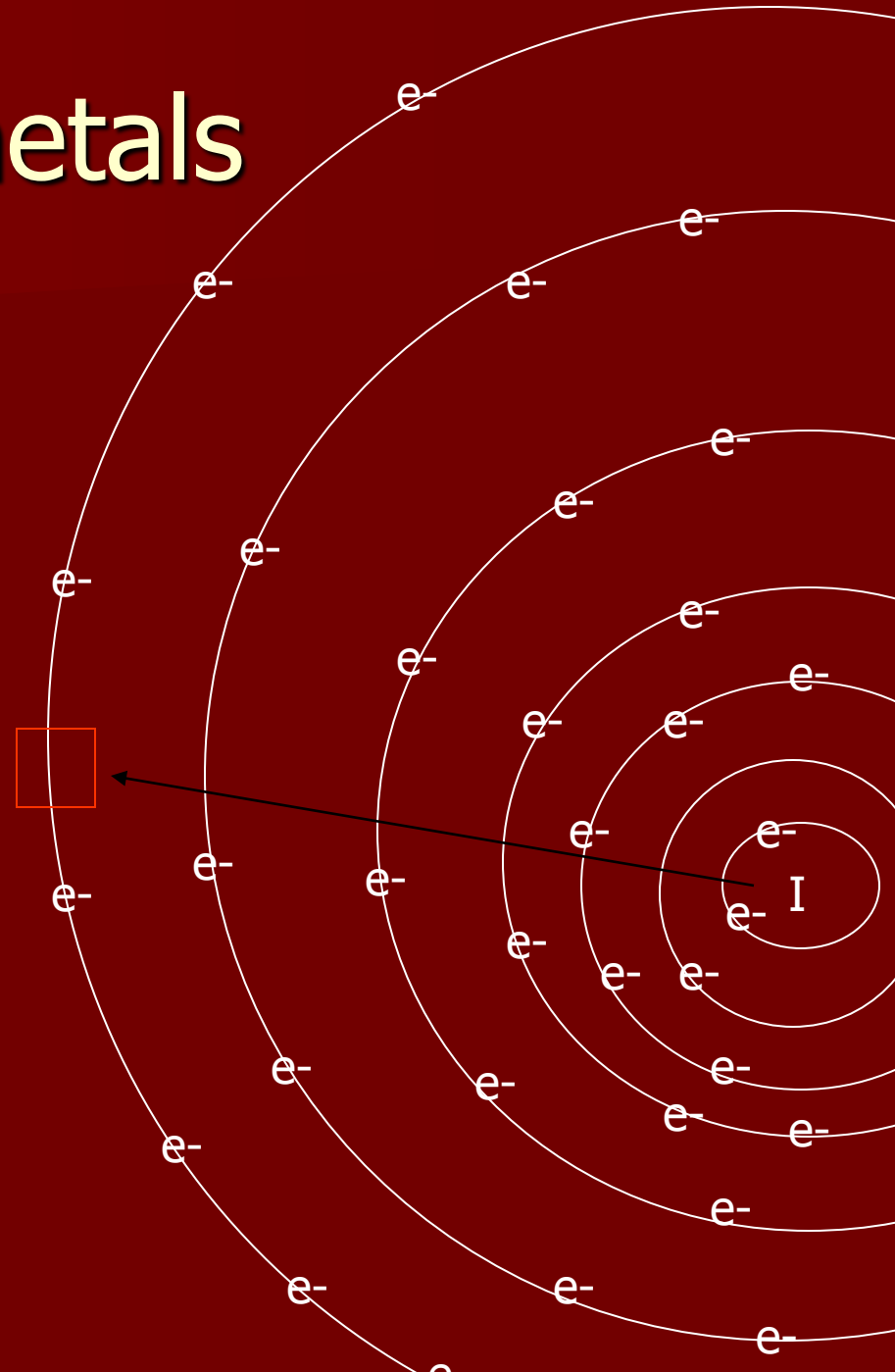
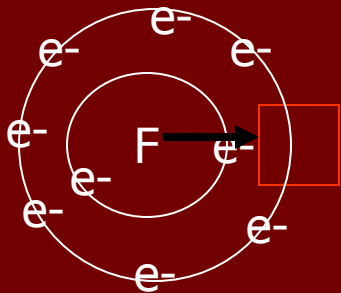
First, Metals want to lose electrons.

Therefore, the farther away the electron is the easier it is to lose and the more reactive it is.



Non-metals

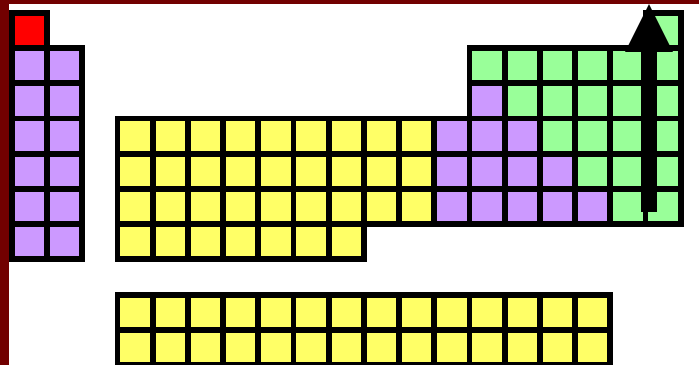
- The Biggest difference between metals and non-metals is that metals will be gaining electrons



Reactivity of non-metals

First, non-metals want to gain electrons.

Therefore, the closer the electron is the easier it is to gain and the more reactive it is.

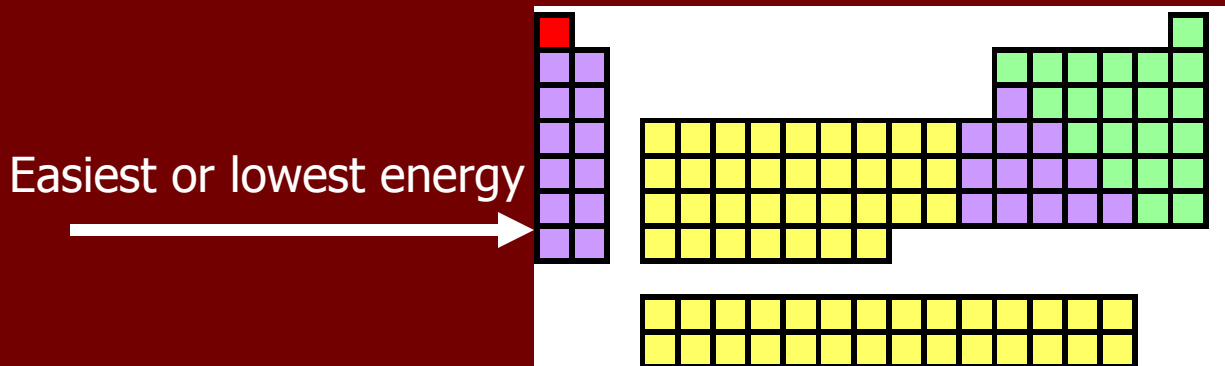


Ionization Energy

- Amount of energy needed to remove an electron.
- Amount of energy needed to remove succeeding electrons always requires more energy.
 - Pulling a negative away from a positive is more difficult.

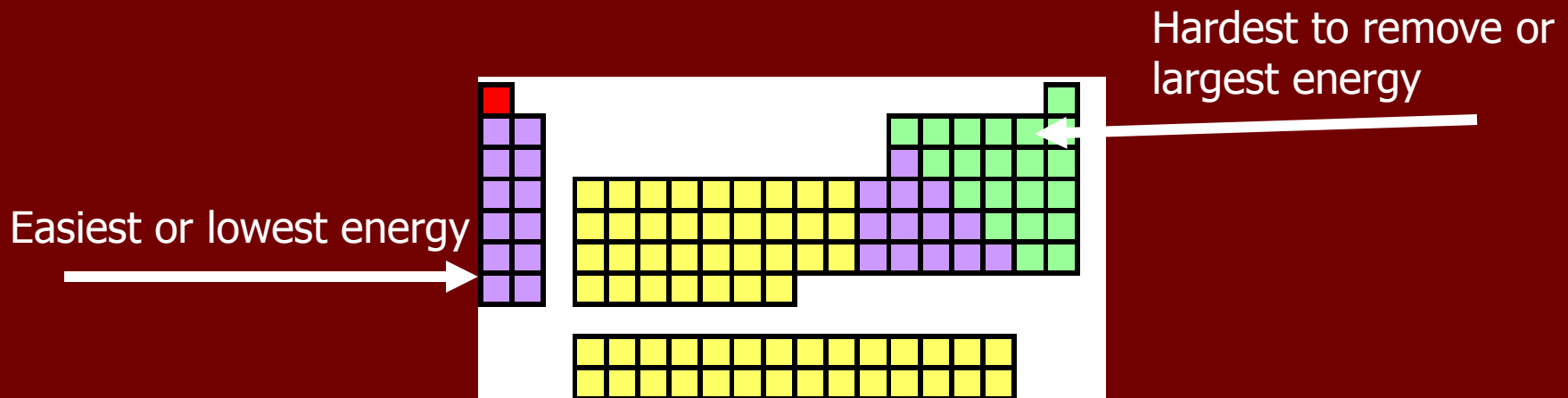
Ionization Energy

- With what we know about reactivity what electrons would be easiest to remove.
- Atoms that want to lose electron any ways
 - Metals
- Atoms where those electrons are the farthest away.



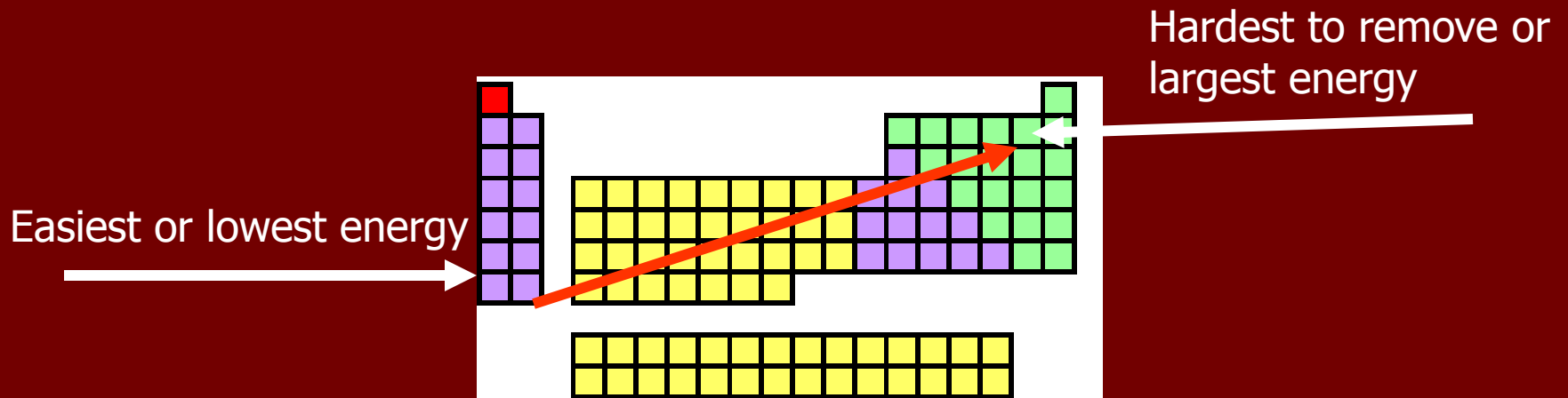
Ionization Energy

- With what we know about reactivity what electrons would be Hardest to remove.
- Atoms that want to gain electrons any ways
 - Non-Metals
- Atoms where those electrons are the closest.



Ionization energy

- What is the trend?



First Ionization energy

1	1 H 1312																	2 He 2372
2	3 Li 520	4 Be 900											5 B 801	6 C 1086	7 N 1402	8 O 1314	9 F 1681	10 Ne 2081
3	11 Na 496	12 Mg 738											13 Al 578	14 Si 787	15 P 1012	16 S 1000	17 Cl 1251	18 Ar 1521
4	19 K 419	20 Ca 590	21 Sc 633	22 Ti 659	23 V 651	24 Cr 653	25 Mn 717	26 Fe 762	27 Co 760	28 Ni 737	29 Cu 746	30 Zn 906	31 Ga 579	32 Ge 762	33 As 947	34 Se 941	35 Br 1140	36 Kr 1351
5	37 Rb 403	38 Sr 550	39 Y 600	40 Zr 640	41 Nb 652	42 Mo 684	43 Tc 702	44 Ru 710	45 Rh 720	46 Pd 804	47 Ag 731	48 Cd 868	49 In 558	50 Sn 709	51 Sb 834	52 Te 869	53 I 1008	54 Xe 1170
6	55 Cs 376	56 Ba 503	57 La 538	72 Hf 659	73 Ta 761	74 W 770	75 Re 760	76 Os 839	77 Ir 878	78 Pt 868	79 Au 890	80 Hg 1007	81 Tl 589	82 Pb 716	83 Bi 703	84 Po 812	85 At —	86 Rn 1038
7	87 Fr —	88 Ra 509	89 Ac 490	104 Rf —	105 Db —	106 Sg —	107 Bh —	108 Hs —	109 Mt —									

Atomic number: 6

Symbol: C

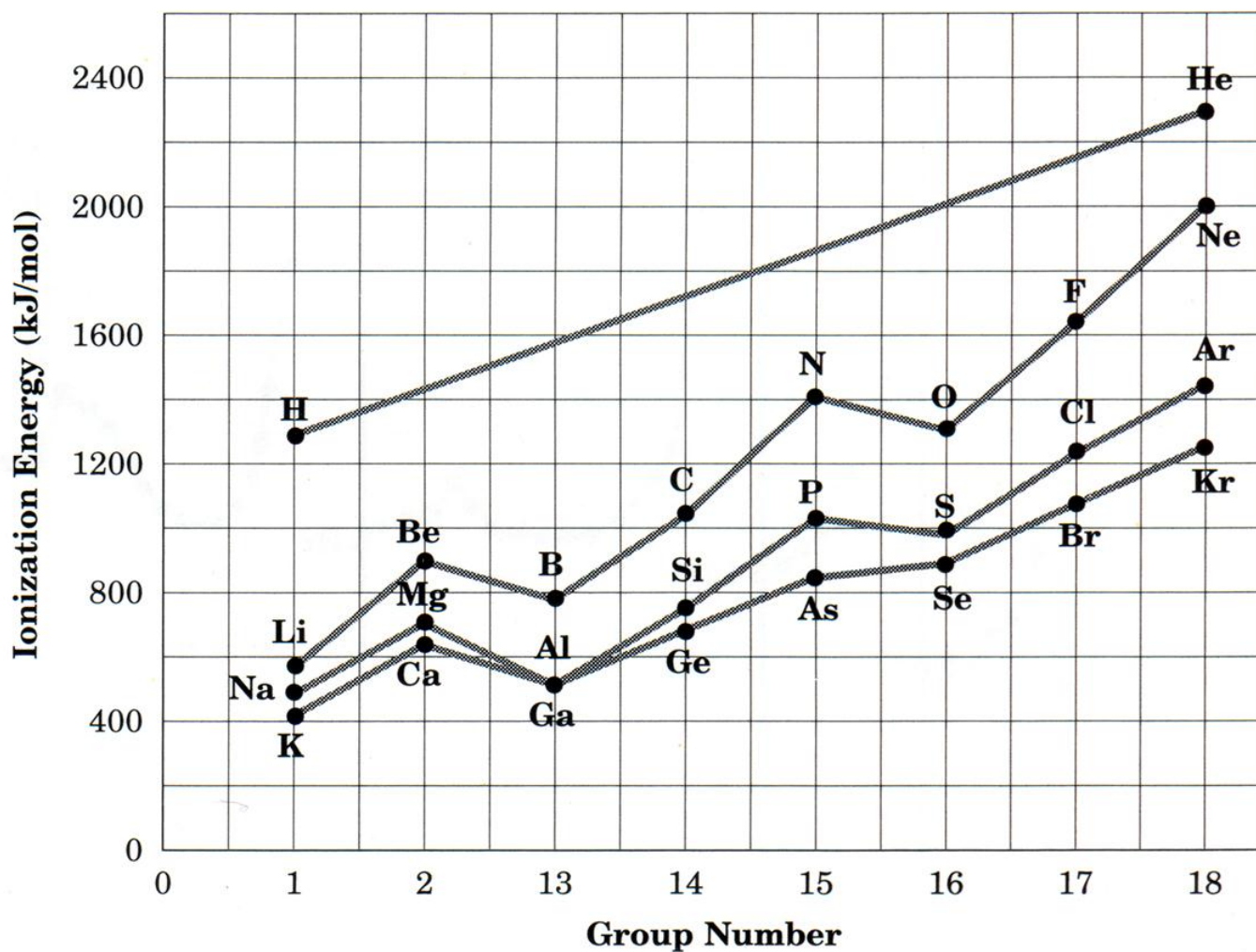
First ionization energy: 1086

Lanthanide series

58 Ce 534	59 Pr 527	60 Nd 533	61 Pm 536	62 Sm 545	63 Eu 547	64 Gd 592	65 Tb 566	66 Dy 573	67 Ho 581	68 Er 589	69 Tm 597	70 Yb 603	71 Lu 523
90 Th 587	91 Pa 570	92 U 598	93 Np 600	94 Pu 585	95 Am 578	96 Cm 581	97 Bk 601	98 Cf 608	99 Es 619	100 Fm 627	101 Md 635	102 No 642	103 Lr —

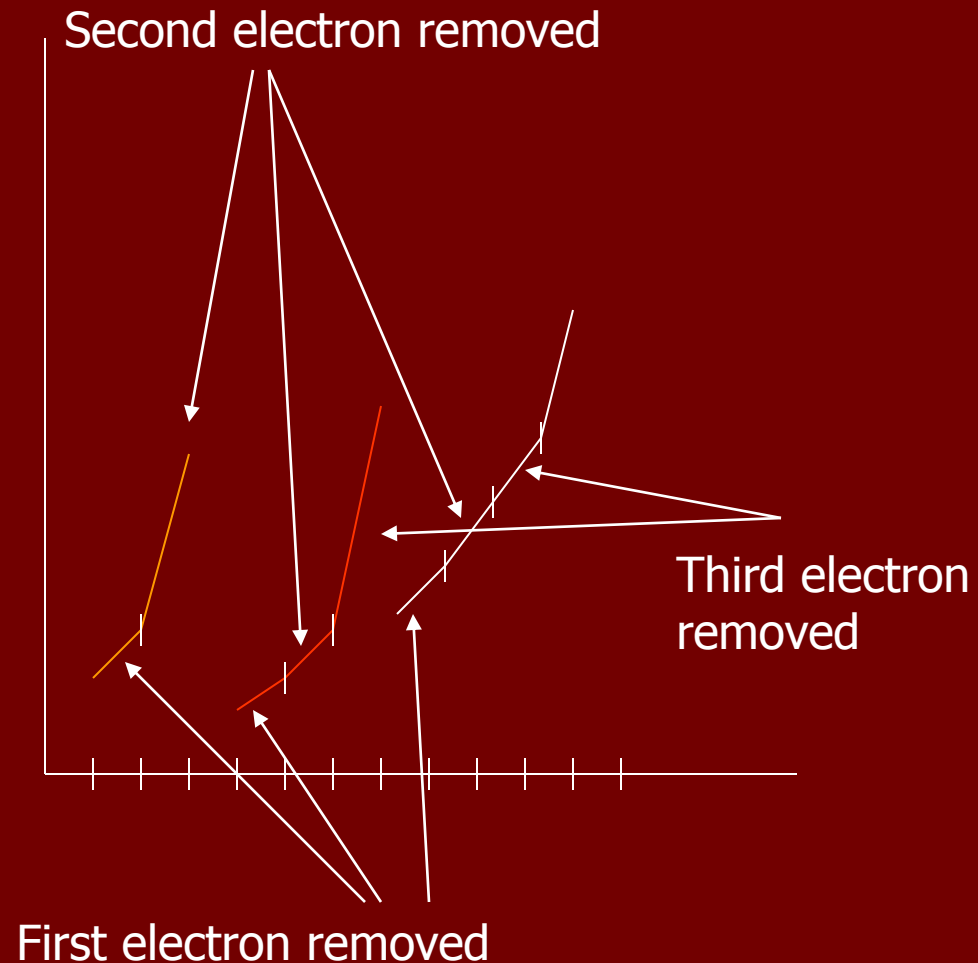
Actinide series

Ionization energy graph



Removing succeeding electrons

- First electrons are always the easiest electrons to remove.
- Why did the ionization energy spike at different times?



Removing succeeding electrons

- Na: 1 Valence electron
- Mg: 2 Valence electrons
- Al: 3 Valence electrons
- After clearing out a shell it is very difficult to break into a full shell.

