

The Periodic Table of Elements

	1											18						
1	1 H 1.008	2											13	14	15	16	17	2 He 4.003
2	3 Li 6.941	4 Be 9.012											5 B 10.811	6 C 12.001	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
3	11 Na 22.990	12 Mg 24.305	3	4	5	6	7	8	9	10	11	12	13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.066	17 Cl 35.453	18 Ar 39.948
4	19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.87	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.69	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80
5	37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.906	46 Pd 106.42	47 Ag 107.868	48 Cd 112.4	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.904	54 Xe 131.29
6	55 Cs 132.905	56 Ba 137.327	★ 71 Lu 174.967	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.967	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.980	84 Po (209)	85 At (210)	86 Rn (222)
7	87 Fr (223)	88 Ra (226)	★ ★ 103 Lr (262)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (269)	109 Mt (268)	110 Ds (269)	111 Rg (272)	112 Uub (285)	113 Uut (284)	114 Uuq (289)	115 Uup (288)	116 Uuh (292)	117 Uus	118 Uuo

★ Lanthanides

★ ★ Actinides

57 La 138.906	58 Ce 140.116	59 Pr 140.908	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.964	64 Gd 157.25	65 Tb 158.925	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04
89 Ac (227)	90 Th 232.038	91 Pa 231.036	92 U 238.029	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)

Periodic → *Periodic Law* → *Periodic Table*

- Something *periodic* occurs at regular or at least generally predictable intervals
- *Periodic law* - physical and chemical properties of the elements are functions of their atomic numbers that happen at regular intervals
- *Periodic Table of Elements* - a table of the elements, arranged by atomic number, that shows the patterns in their

p Can you think of anything that is periodic?

ELEMENT

All elements are on the Periodic Table

■ All matter is made of an element or a combination of elements

■ Hydrogen, Oxygen, Gold

■ A substance that consists of only one kind of atom and that cannot be chemically separated into other substances.

■ All elements are made up of only one kind of atom

■ There are over 100 known elements

3 Classes of Elements

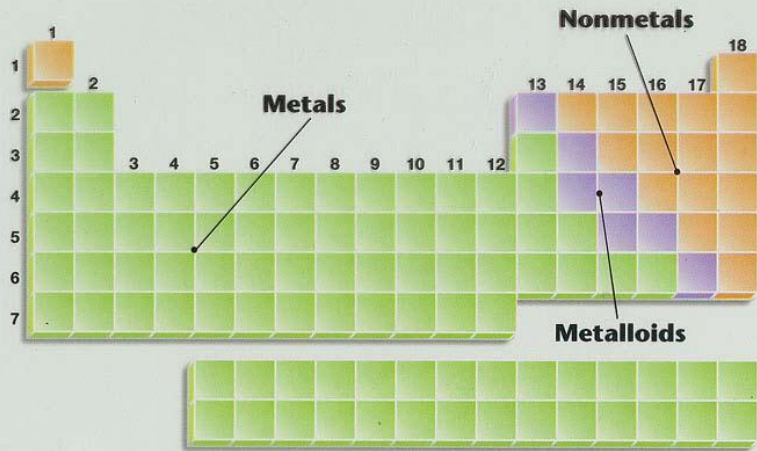
	1																		18
1	1 H 1.008	2																	2 He 4.003
2	3 Li 6.941	4 Be 9.012											5 B 10.811	6 C 12.001	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180	
3	11 Na 22.990	12 Mg 24.305	3	4	5	6	7	8	9	10	11	12	13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.066	17 Cl 35.453	18 Ar 39.948	
4	19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.87	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.69	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80	
5	37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.906	46 Pd 106.42	47 Ag 107.868	48 Cd 112.4	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.904	54 Xe 131.29	
6	55 Cs 132.905	56 Ba 137.327	★ 71 Lu 174.967	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.967	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.980	84 Po (209)	★★ 85 At (210)	86 Rn (222)	
7	87 Fr (223)	★ 88 Ra (226)	★ 103 Lr (262)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (269)	109 Mt (268)	110 Ds (269)	111 Rg (272)	112 Uub (285)	113 Uut (284)	114 Uuq (289)	115 Uup (288)	116 Uuh (292)	117 Uus	118 Uuo	

★ Lanthanides

★★ Actinides

57 La 138.906	58 Ce 140.116	59 Pr 140.908	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.964	64 Gd 157.25	65 Tb 158.925	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04
89 Ac (227)	90 Th 232.038	91 Pa 231.036	92 U 238.029	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)

Metals



Location

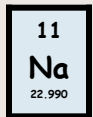
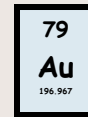
left of the zigzag line/staircase
on the periodic table
(exception → Hydrogen)

Chemical Properties

few electrons in their outer
energy level - lose electrons
easily

Physical Properties

ductile, good conductors,
malleable, shiny, most are solid
at room temperature



Non-Metals

Location

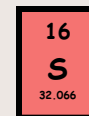
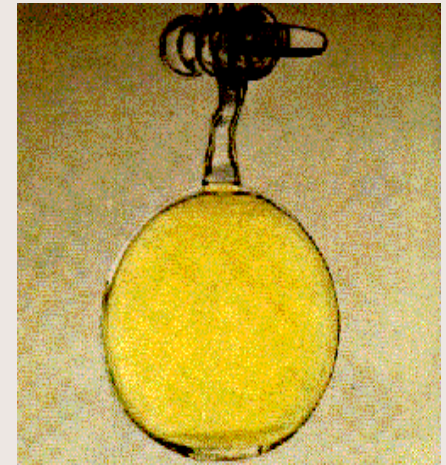
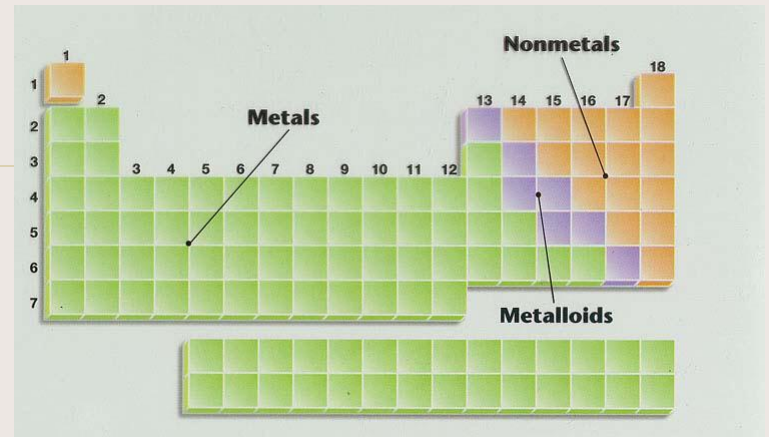
- Most to the right of the zigzag line/staircase on the periodic table

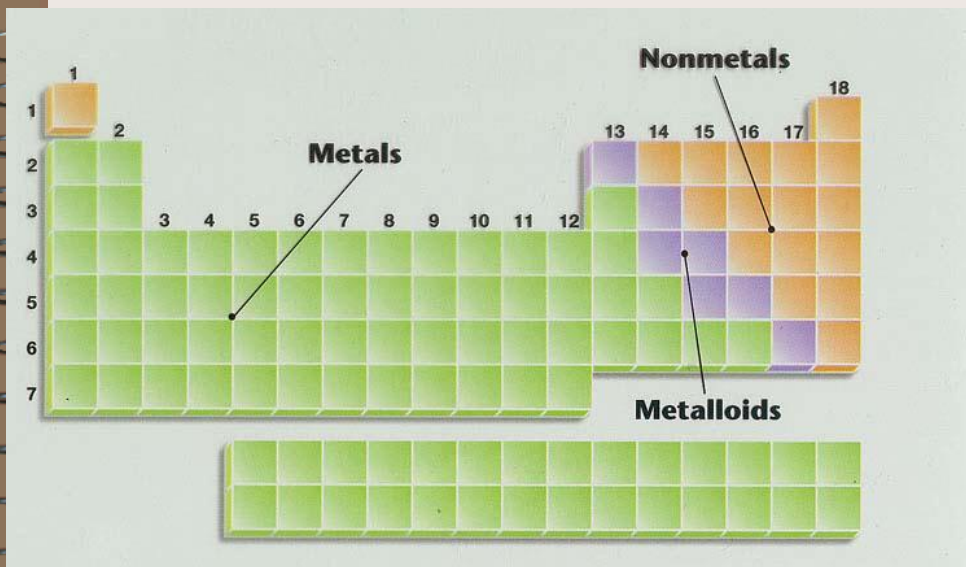
Chemical Properties

- almost full outer levels - tend to gain electrons; noble gases have completely full outer level

Physical Properties

- not ductile or malleable, not shiny, poor conductors, most are solid, but some are gas at room temperature





Metalloids

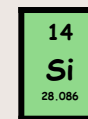


Image taken from:
<http://library.thinkquest.org/C0113863/bios.shtml>

Location

- Border the zigzag line/staircase on the periodic table

Chemical Properties

- Most atoms have $\frac{1}{2}$ full outer level

Physical Properties

- have properties of both metals and non-metals

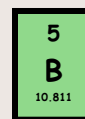
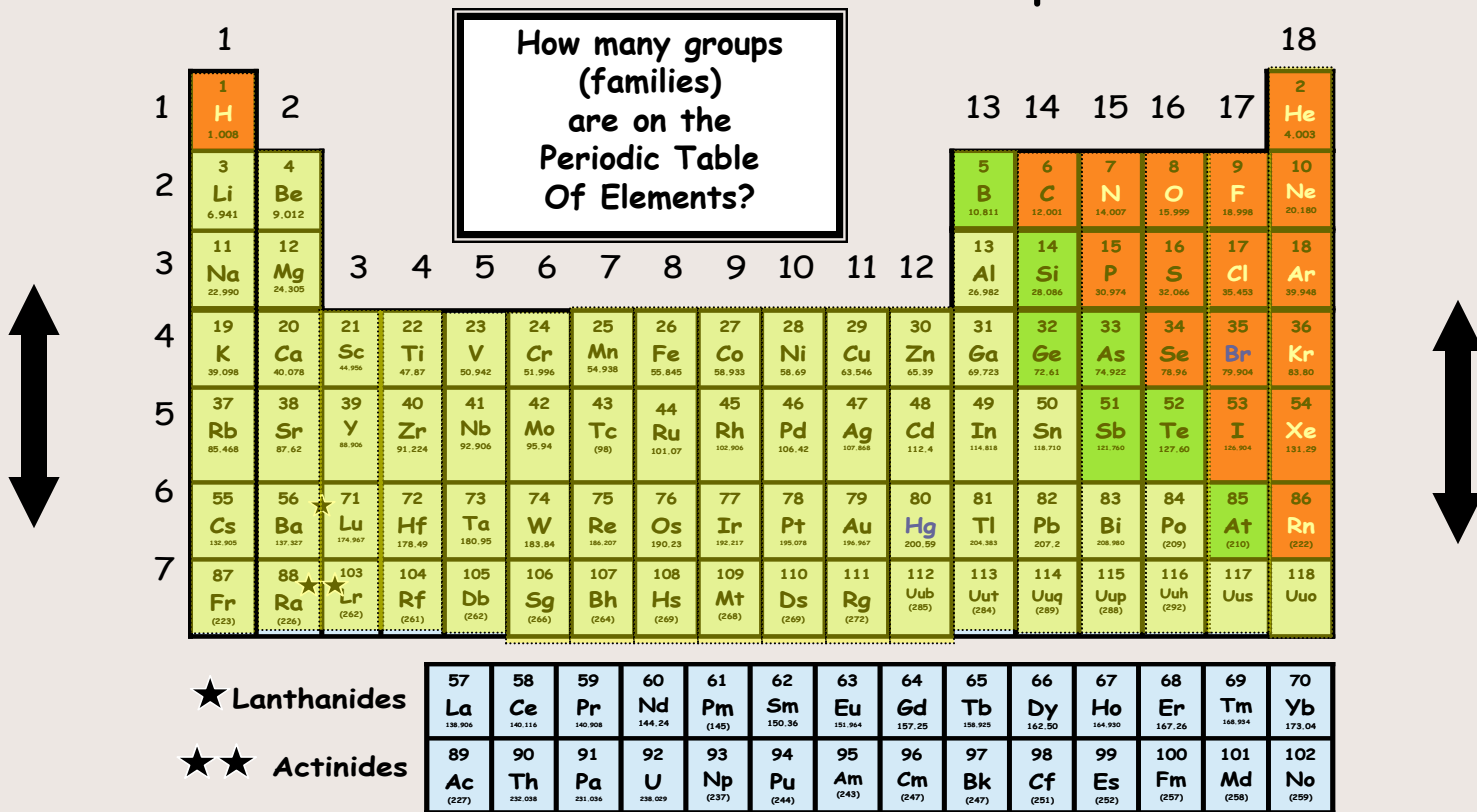


Image taken from:
<http://library.thinkquest.org/C0113863/bios.shtml>

Important Features of the Periodic Table: Group (Family)

- each column of elements on the periodic table



FROM TOP TO BOTTOM OR BOTTOM TO THE TOP

Group (Family) Properties

- Eighteen groups on the periodic table (numbered from left to right)
- Atomic numbers and atomic masses increase as you move from the top down in a group (family)
- Atoms of elements in same group have same number of electrons in outer orbitals/levels
- **Exceptions:**
 - Transition elements (3-12)
 - Hydrogen (could be 1 or 17)
 - Helium (actually has 2 valence electrons)
- groups have similar physical and chemical properties

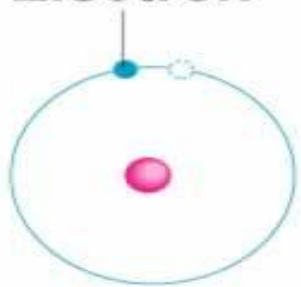
Valence Electrons

- Valence Shell - outermost shell of an atom
- Electrons in this shell used for making chemical bonds
- Atom wants its valence shell to be or seem like it is full

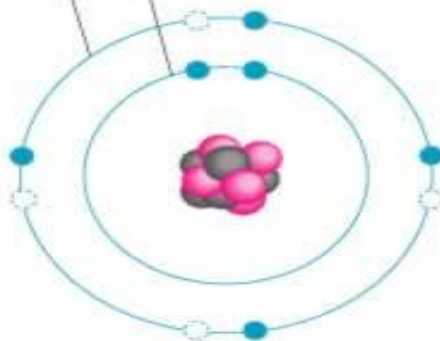
Outermost electron shell (can hold 8 electrons)

First electron shell (can hold 2 electrons)

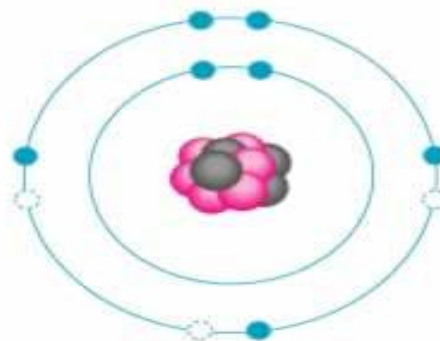
Electron



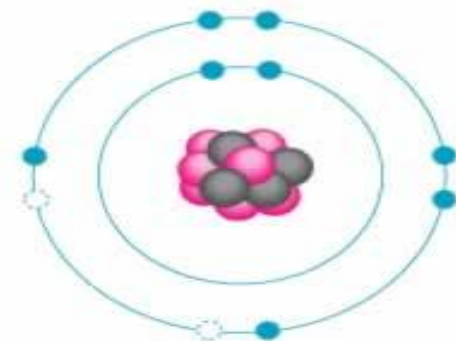
HYDROGEN (H)
Atomic number
= 1



CARBON (C)
Atomic number
= 6



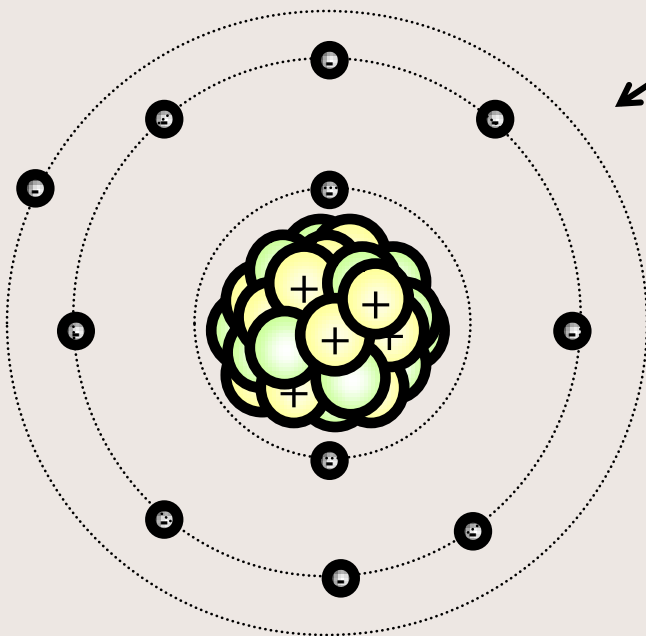
NITROGEN (N)
Atomic number
= 7



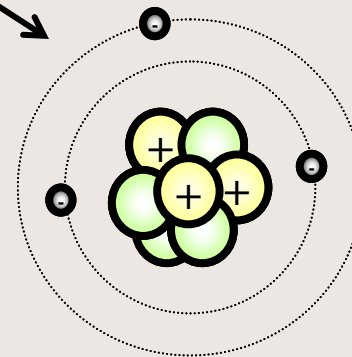
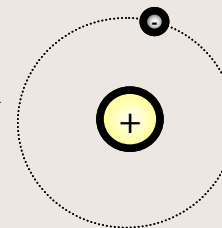
OXYGEN (O)
Atomic number
= 8

Examples of Group Elements with the same # of valence electrons

How many electrons do each of these atoms have in their outer orbital/level?

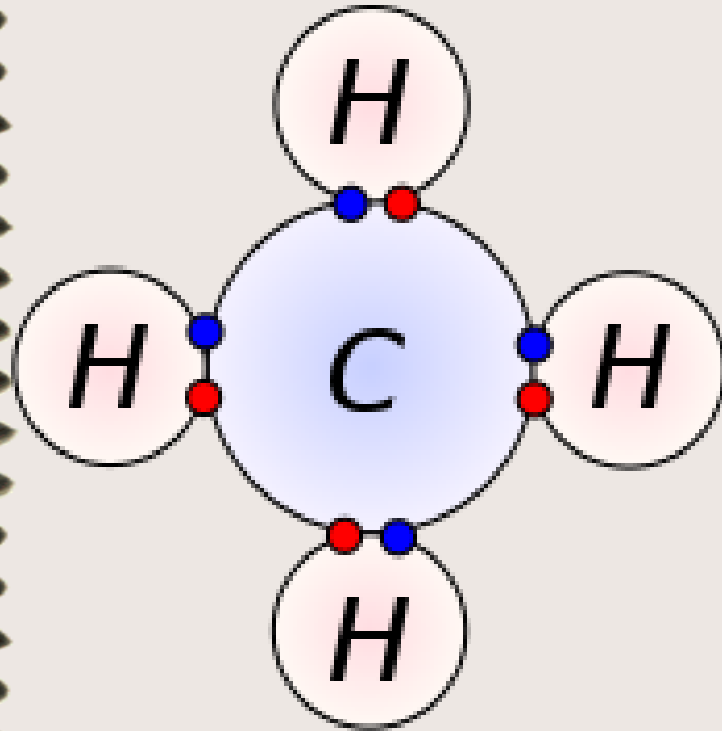


1
H 1.008
3
Li 6.941
11
Na 22.990
19
K 39.098
37
Rb 85.468
55
Cs 132.905
87
Fr (223)



What group (family) do these elements reside in?

Bonding

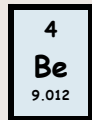
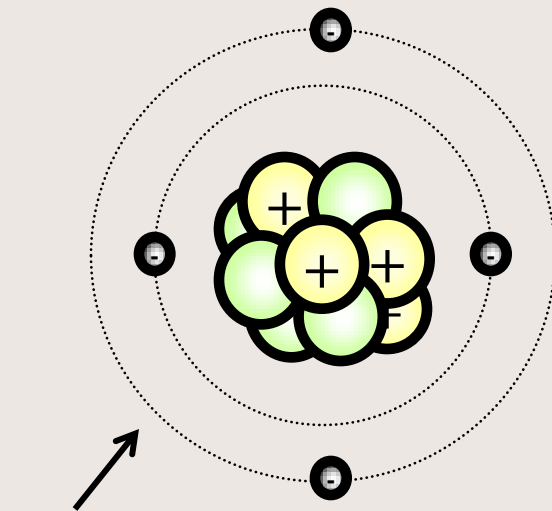


● Electron from hydrogen

● Electron from carbon

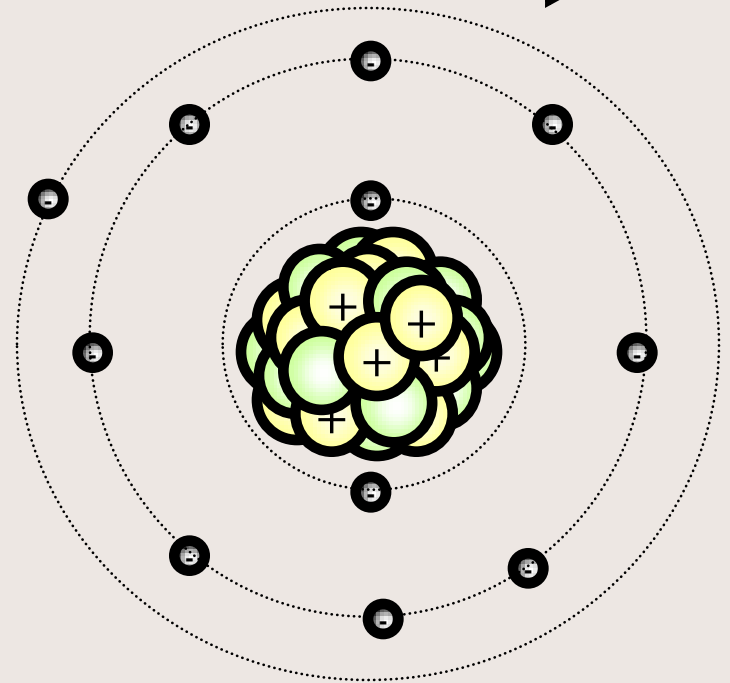
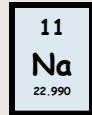
- 4 or less electrons in outer shell bond easily by losing electrons
- 4 or more electrons in outer shell bond less easily by taking electrons

Atoms with Few Electrons in their Outer Energy Level

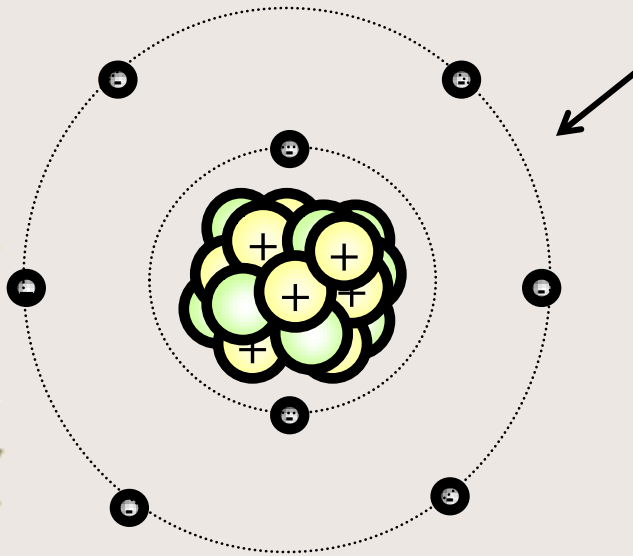


Notice: only 2 electrons in outer level

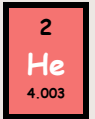
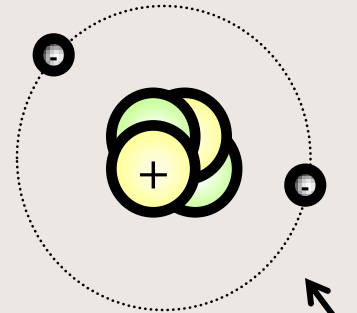
Notice: only 1 electron in outer level



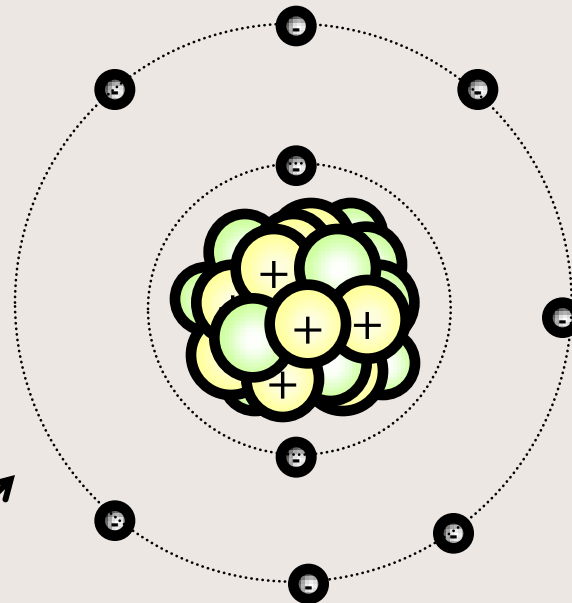
Atoms with Full or Almost Full Outer Energy Level



Notice: 2
electrons in
outer level -
FULL

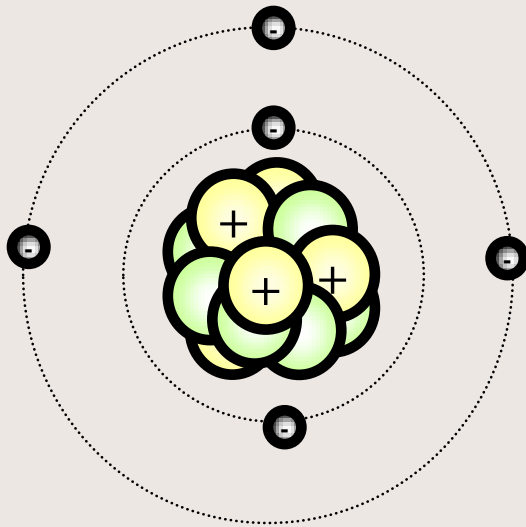


Notice: 6
electrons in
outer level -
almost full



Notice: 7
electrons in
outer level -
almost full

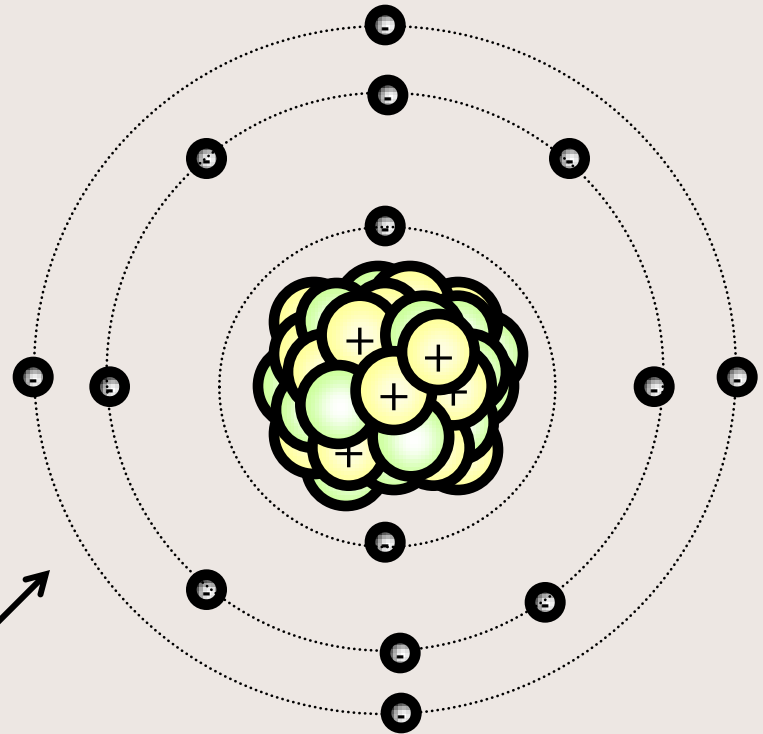
Atoms with $\frac{1}{2}$ (\approx) Complete Outer Energy Level



5
B
10.811

Notice: only 3
electrons in outer
level

Notice: only 4
electrons in outer
level



14
Si
28.086

Important Features of the Periodic Table: Period (Row)

- each horizontal row of elements on the periodic table

	1											13	14	15	16	17	18	
1	1 H 1.008	2										13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.066	17 Cl 35.453	18 Ar 39.948	
2	3 Li 6.941	4 Be 9.012											5 B 10.811	6 C 12.001	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
3	11 Na 22.990	12 Mg 24.305	3 4 5 6 7 8 9 10 11 12										13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.066	17 Cl 35.453	18 Ar 39.948
4	19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.87	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.69	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80
5	37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.906	46 Pd 106.42	47 Ag 107.868	48 Cd 112.4	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.905	54 Xe 131.29
6	55 Cs 132.905	56 Ba 137.327	71 Lu 174.967	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.227	78 Pt 195.078	79 Au 196.967	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.980	84 Po (209)	85 At (210)	86 Rn (222)
7	87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (269)	109 Mt (268)	110 Ds (269)	111 Rg (272)	112 Uub (285)	113 Uut (284)	114 Uuq (289)	115 Uup (288)	116 Uuh (292)	117 Uus (288)	118 Uuo

How many periods (rows) are on the Periodic Table Of Elements?

★ Lanthanides
★★ Actinides

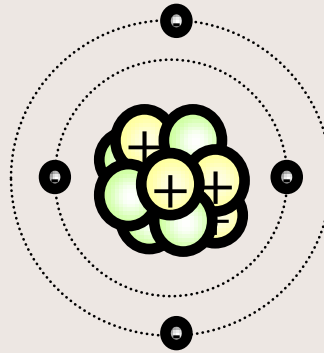
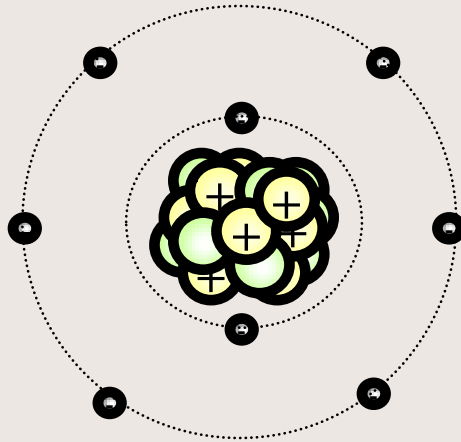
57 La 138.905	58 Ce 140.116	59 Pr 140.908	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.964	64 Gd 157.25	65 Tb 158.925	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04
89 Ac (227)	90 Th 232.038	91 Pa 231.036	92 U 238.029	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)

FROM LEFT TO RIGHT OR RIGHT TO LEFT

Period (Row) Properties

- Seven periods or rows
- Atomic numbers and atomic masses increase as you move from the left to the right in a period
- elements in same period have same number of orbitals/levels
- number of the period is number of orbitals
 - Example
 - Period 1 = 1 orbital
 - Period 2 = 2 orbitals
 - Period 3 = 3 orbitals
 - Etc...

Examples of Period (Row) elements having the same number of orbitals/levels in their atoms



In what period (row) do you think these atoms reside?

In what period (row) do you think these atoms reside?

