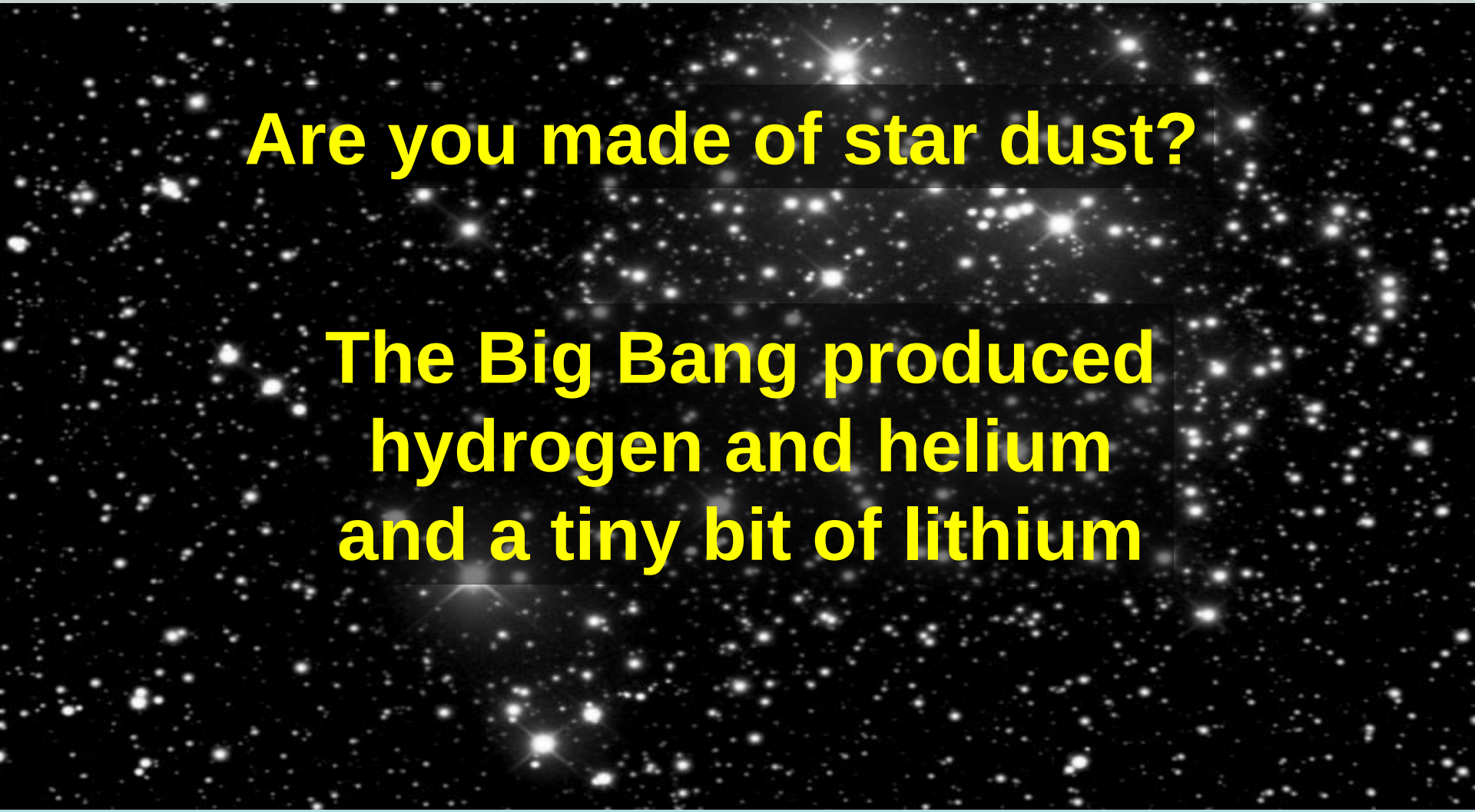
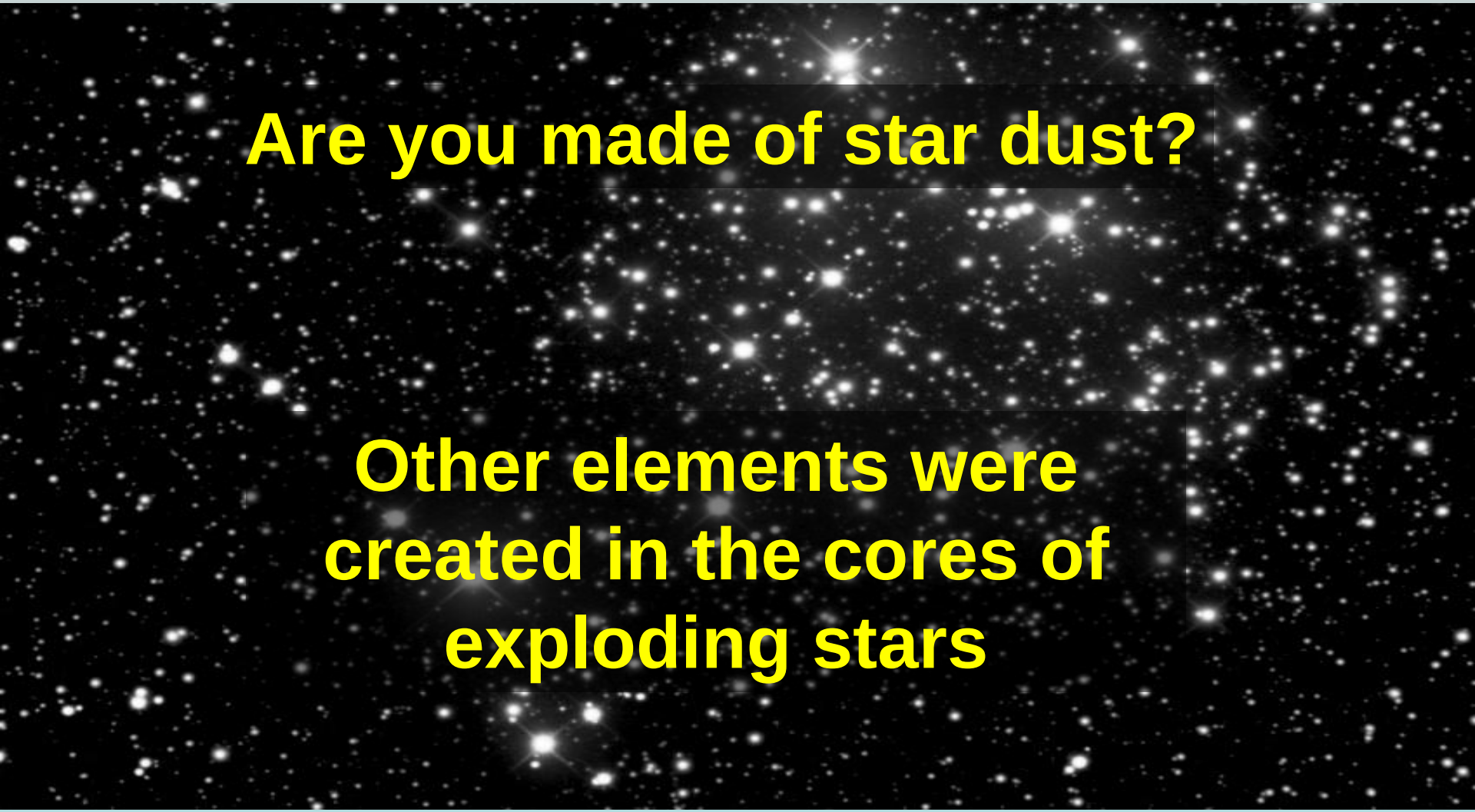
CHAPTER 5

Elements and the Periodic Table

The Periodic Table


Are you made of star dust?

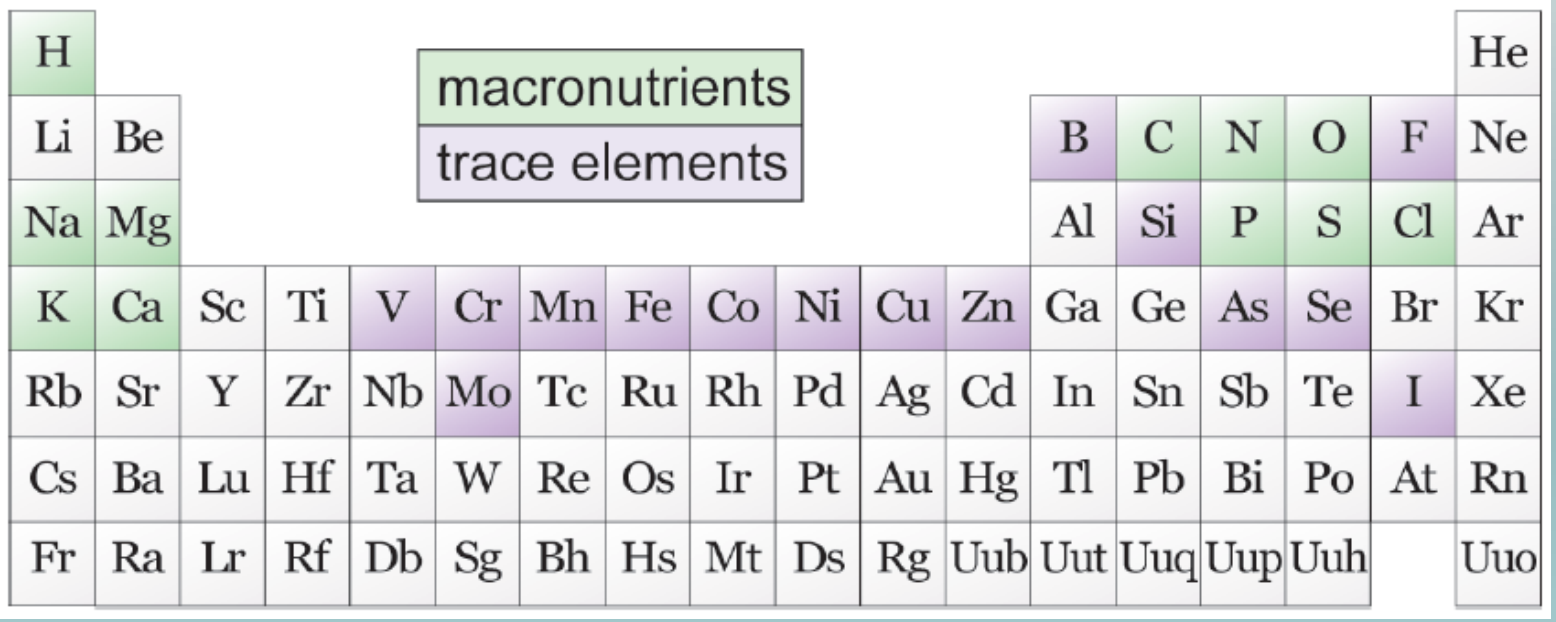

Are you made of star dust?
The Big Bang produced hydrogen and helium and a tiny bit of lithium


Are you made of star dust?
Other elements were created in the cores of exploding stars

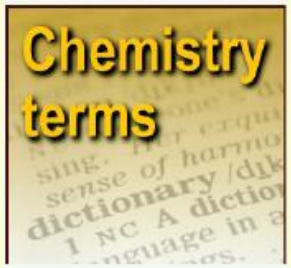
Element	% by mole
Hydrogen	63.0
Oxygen	26.0
Carbon	9.0
Nitrogen	1.25
Calcium	0.25
Phosphorus	0.19
Potassium	0.06
Sulfur	0.06
Sodium	0.04
Chlorine	0.025
Magnesium	0.013
Iron	0.00004
Iodine	0.000002

99% of atoms in a human body come from only 4 elements

Essential elements



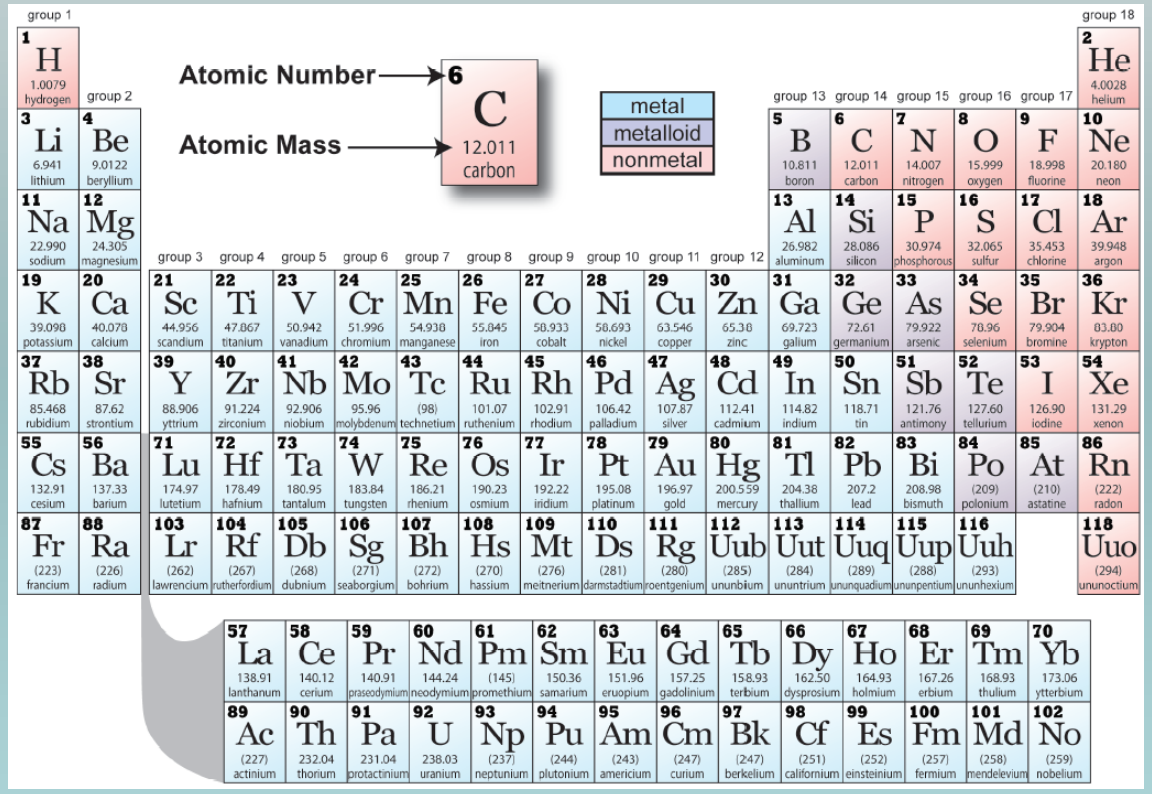
H																He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Lr	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Uub	Uut	Uuq	Uup	Uuh		Uuo



macronutrients: elements needed in large quantities by your body.

trace elements: elements that are needed in very small quantities to maintain optimum health.

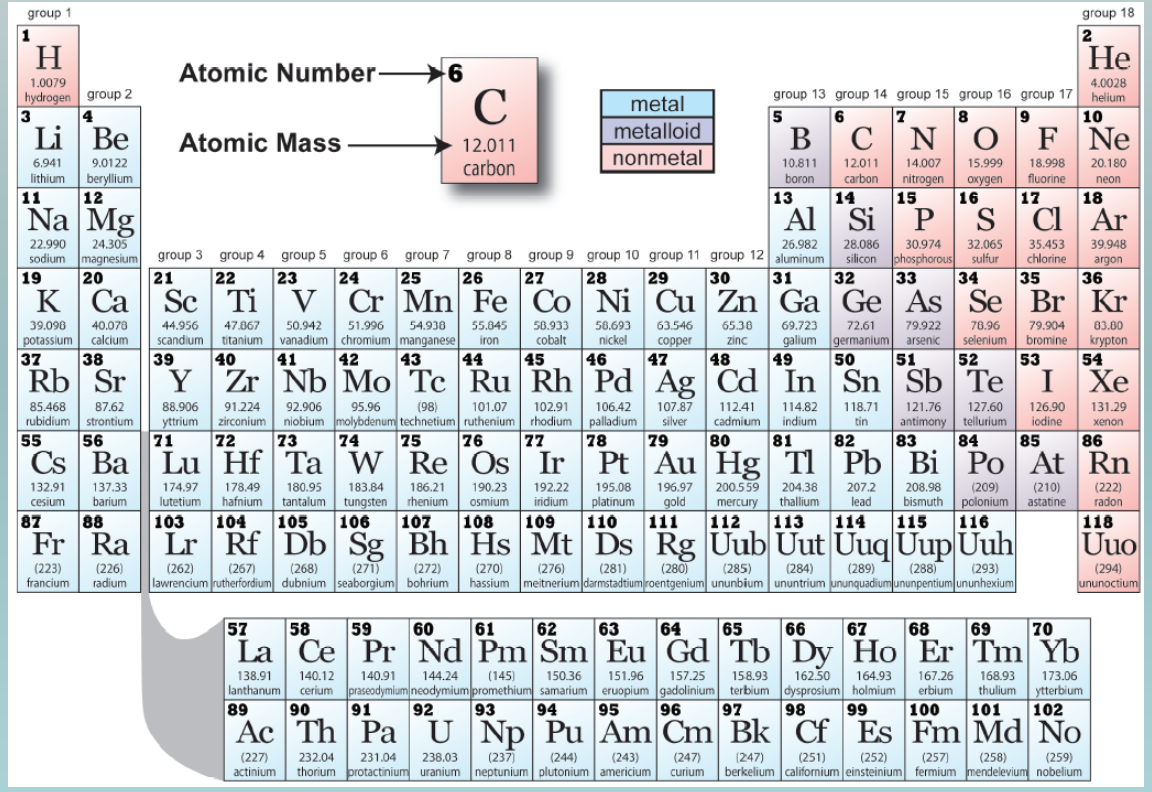
Metals, nonmetals and metalloids



ionic compound:
one non-metal atom bonded with one metal atom

molecular compound:
two non-metal atoms bonded with each other

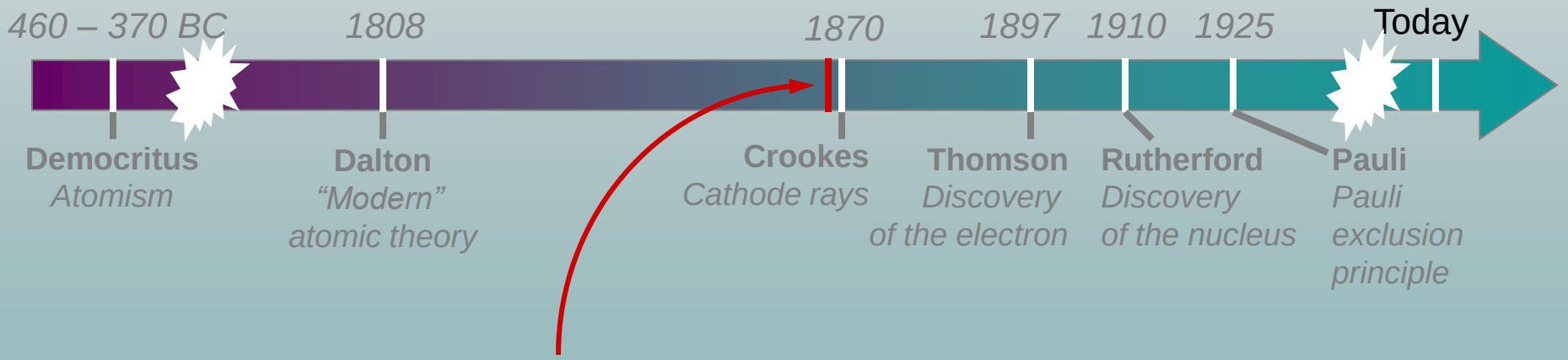
Metals, nonmetals and metalloids



ionic compound:
one non-metal atom bonded with one metal atom

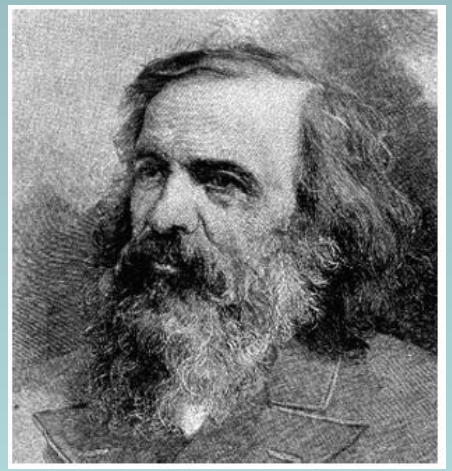
molecular compound:
two non-metal atoms bonded with each other

What does “periodic” in “periodic table” mean?



1869

Mendeleev looks for a logical way to organize the elements known at the time.

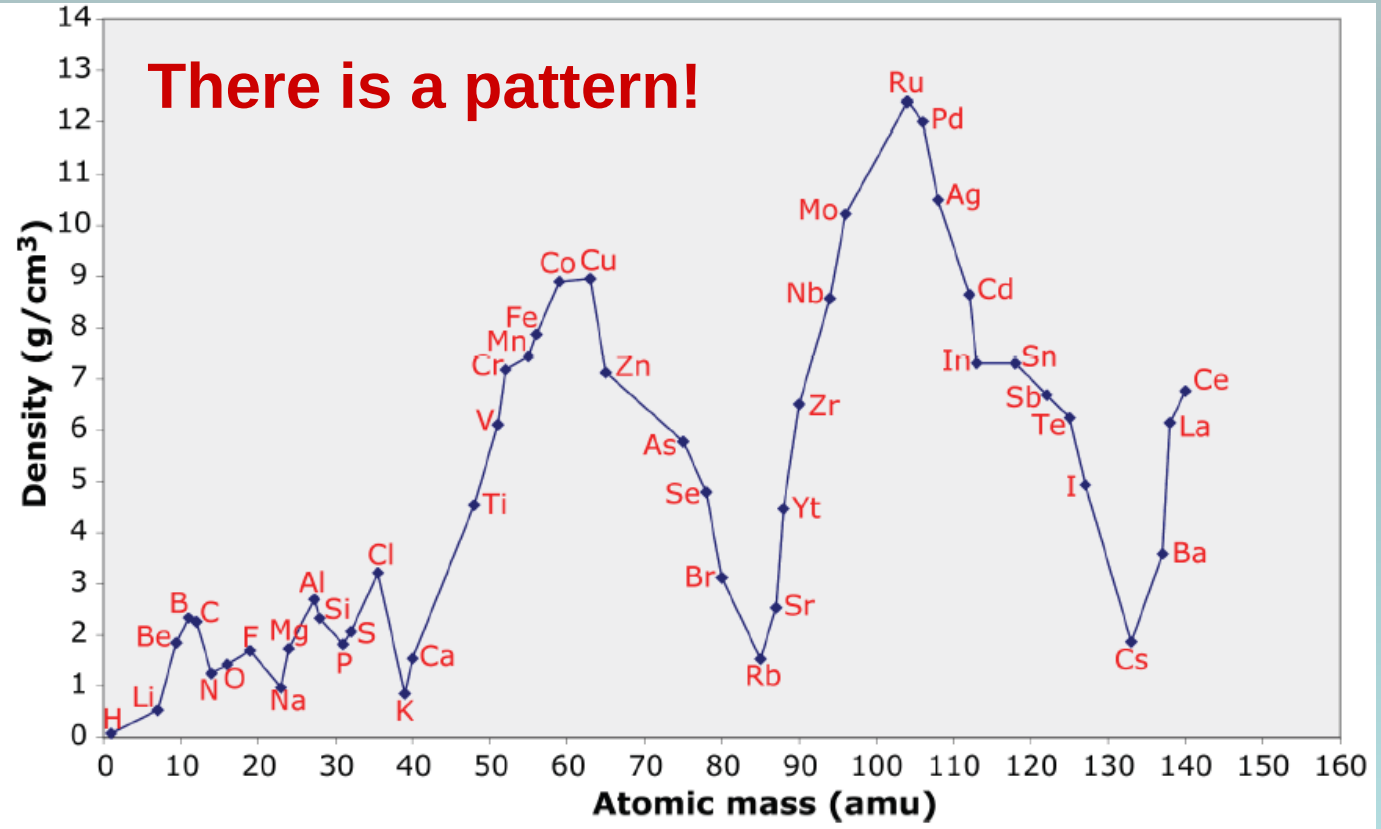


Dimitri Mendeleev

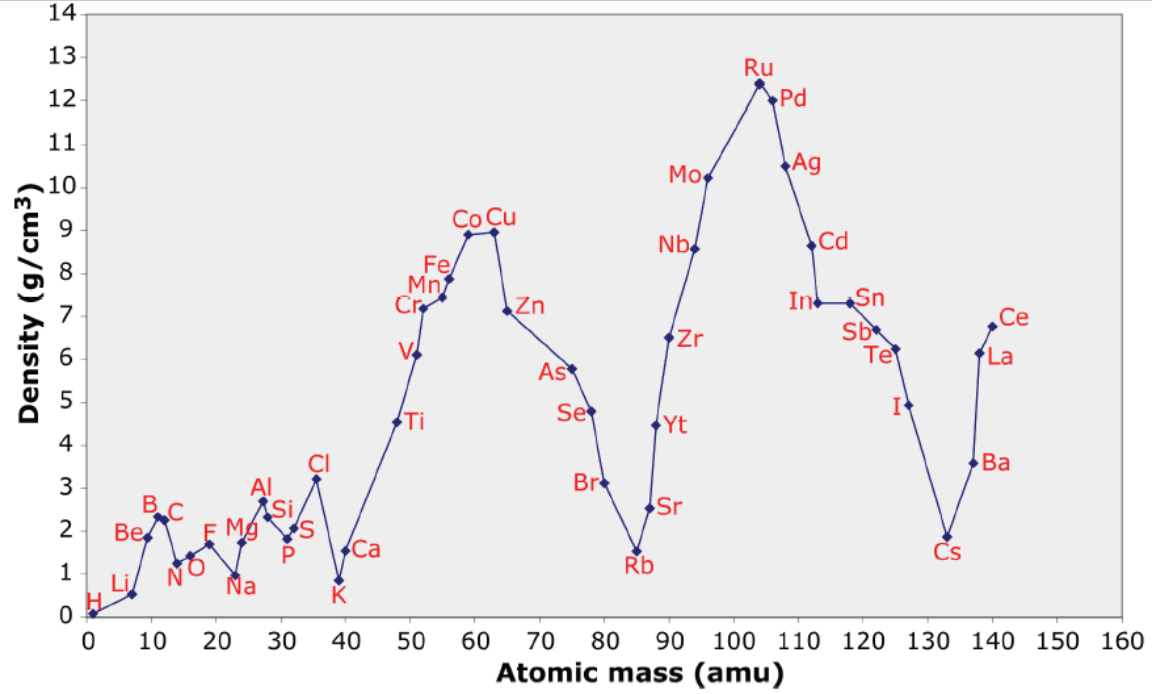
Note that at this time, very little is known about atoms.

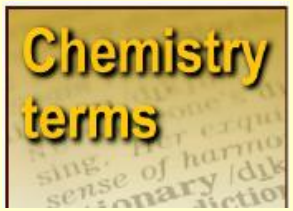
Protons and atomic numbers were not discovered yet.

Mendeleev uses density (a physical property) of atoms, and organizes them in order of increasing atomic mass.



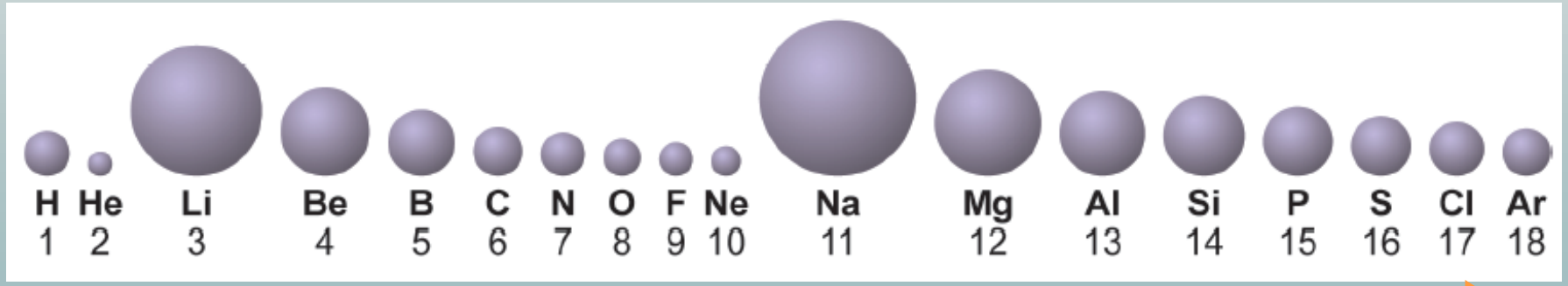
The **periodic** table contains patterns that repeat at regular intervals





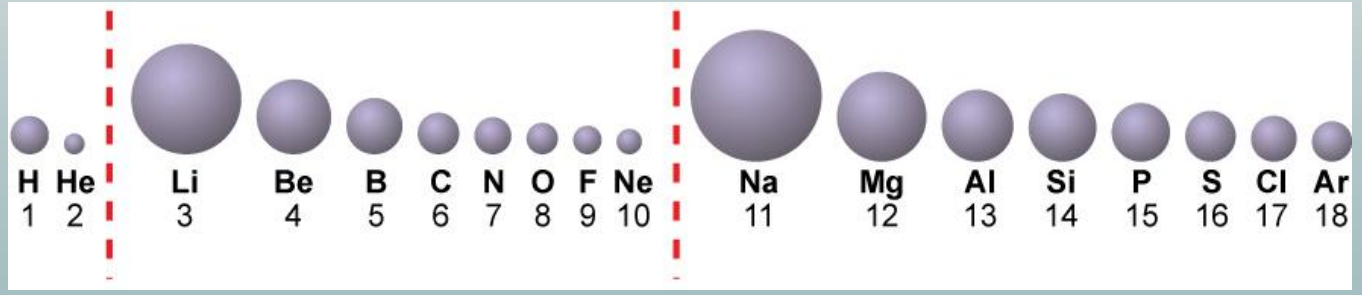
periodic: repeating at regular intervals.

Atomic radius



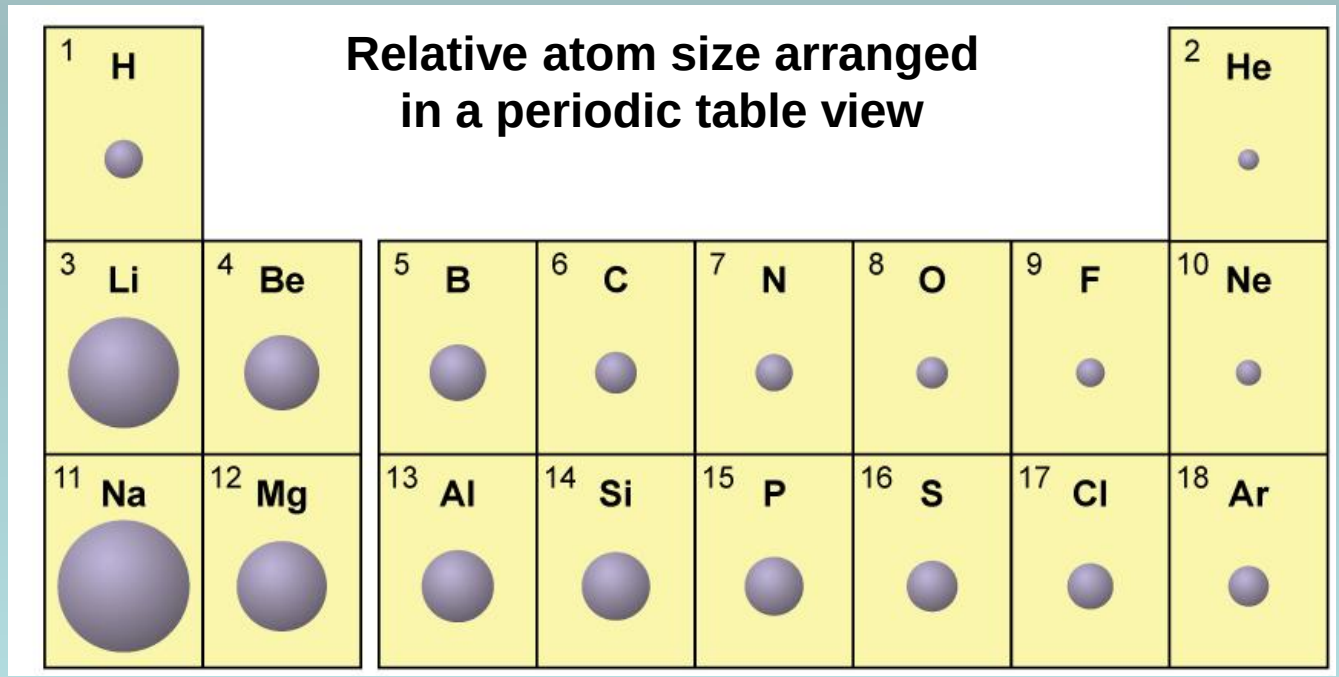
Like for density, there is a **repeating pattern** in atomic radii.

Atomic radius



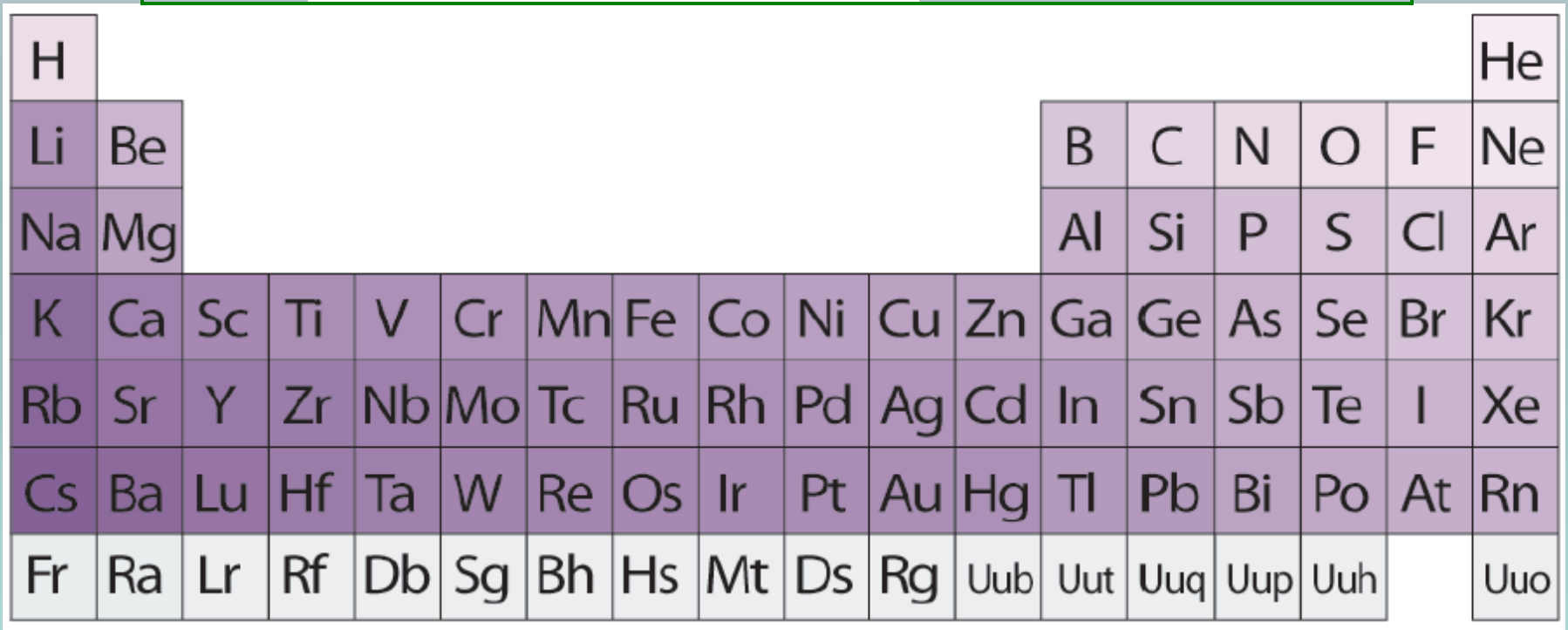
A new period

A new period



Atomic radius

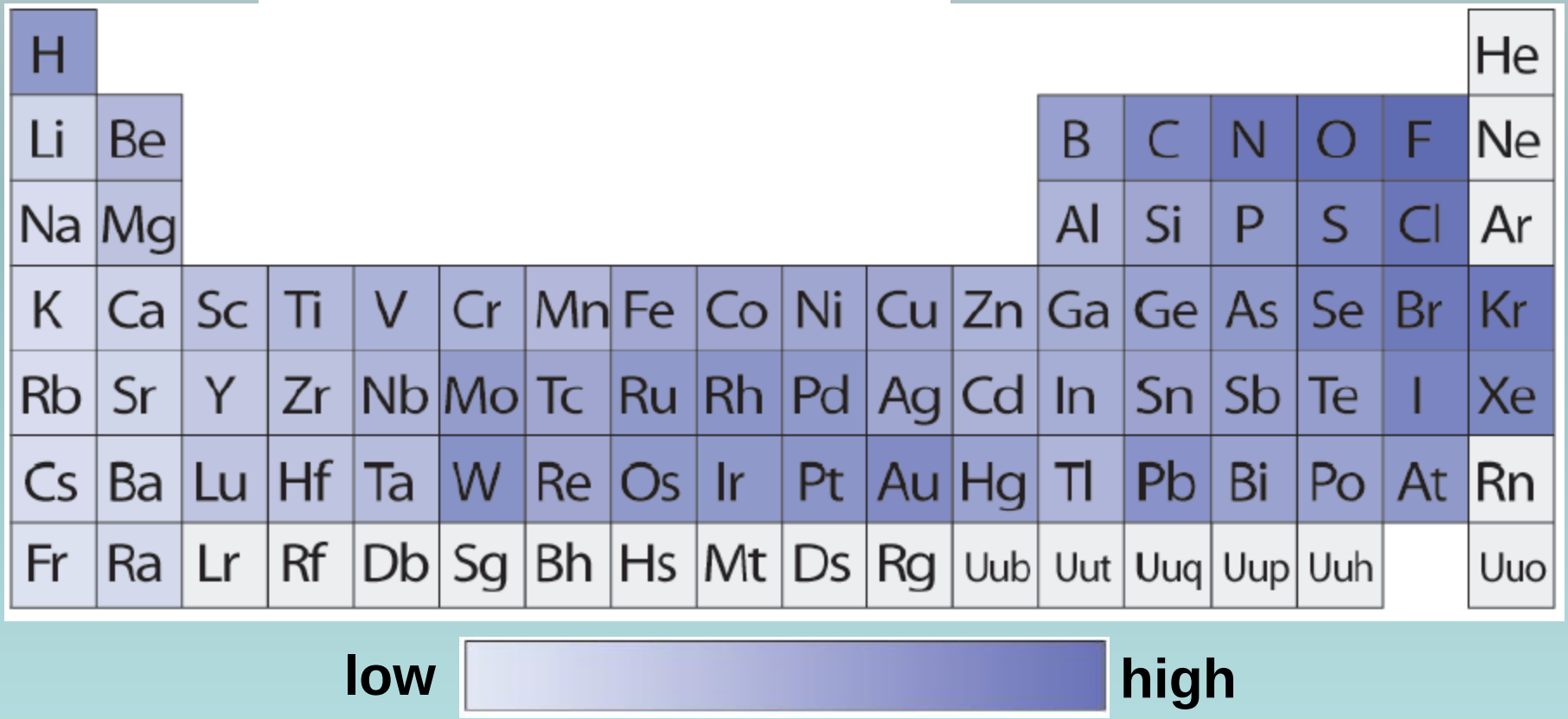
atomic radius: the distance from the center of an atom to its “outer edge.”



small **large**

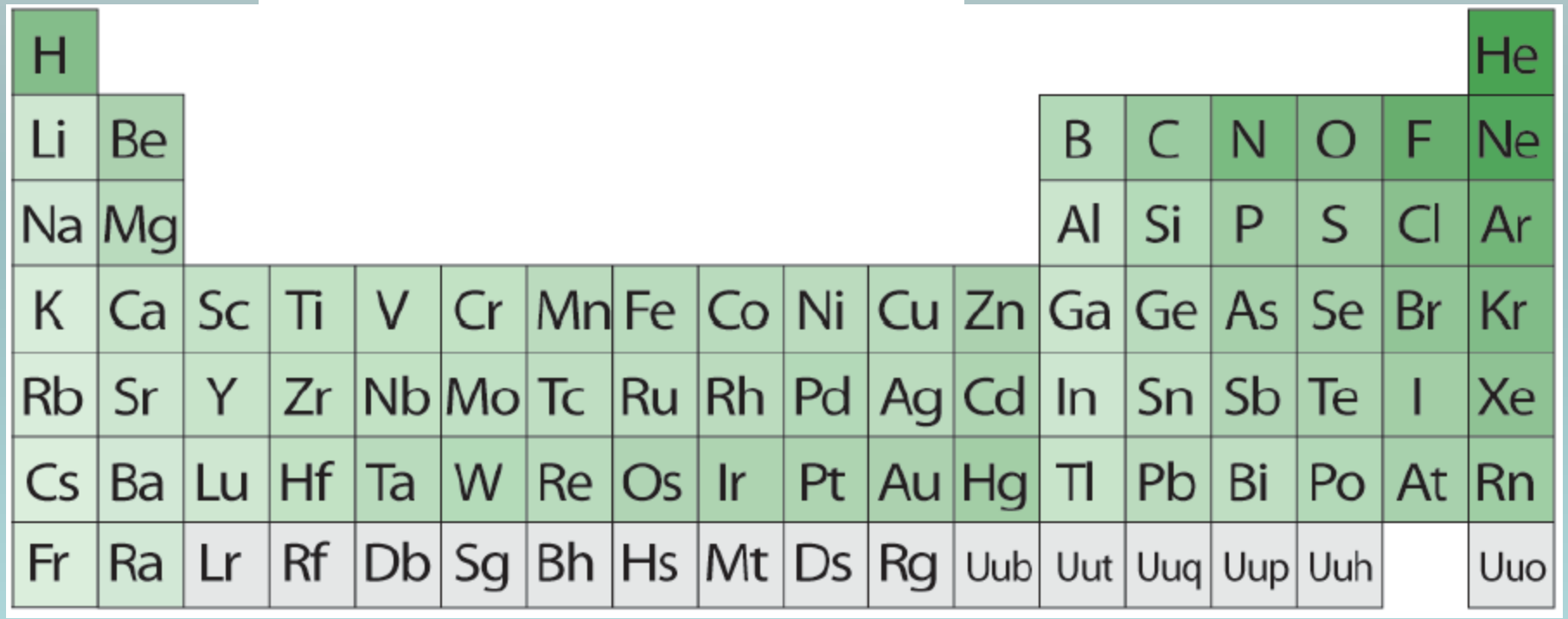
Electronegativity

electronegativity: the ability of an atom to attract another atom's electrons when bound to that other atom.



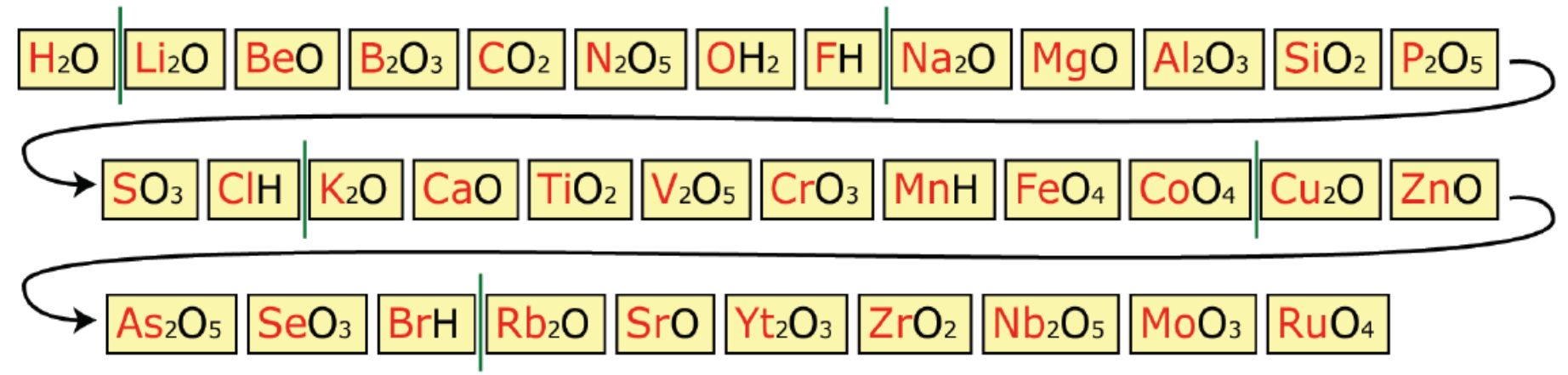
Ionization energy

ionization energy: the energy required to remove an electron from an atom.



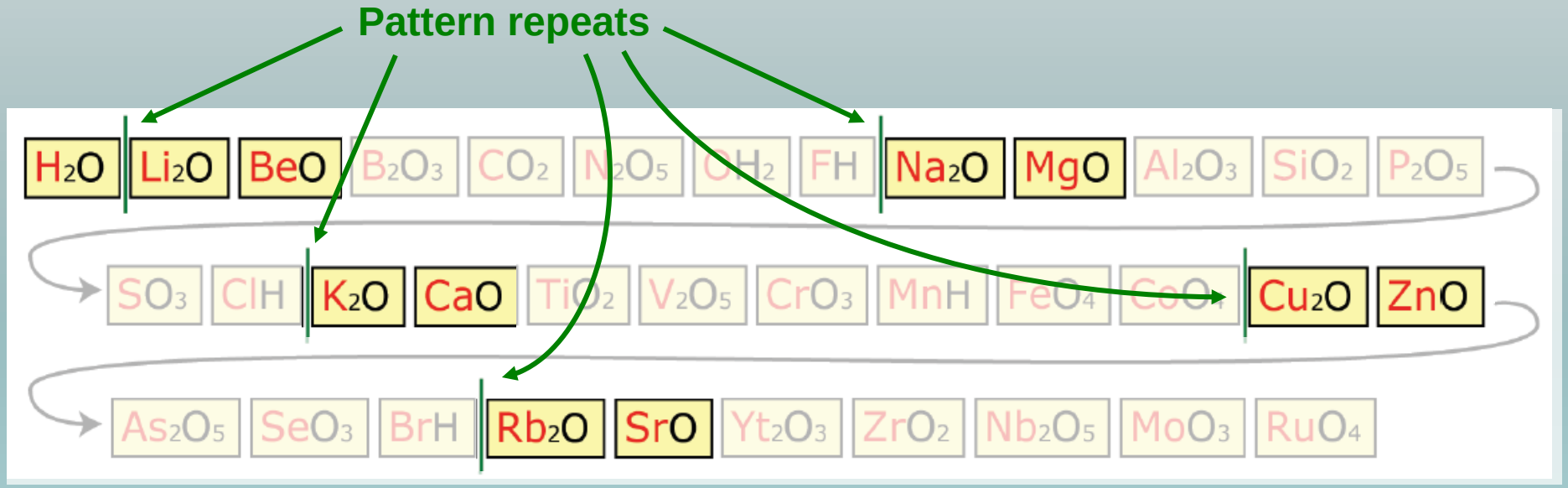
low **high**

The first periodic table



Mendeleev placed the elements in order of increasing atomic mass and then noticed a repeating pattern in the oxide and hydride formula.

The first periodic table



Mendeleev placed the elements in order of increasing atomic mass and then noticed a repeating pattern in the oxide and hydride formula.

A new pattern was discovered!

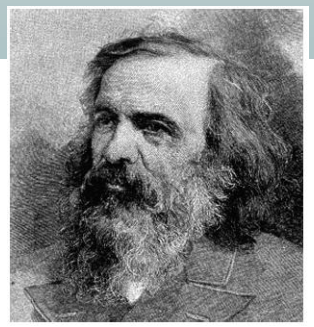
The first periodic table

Oxides and hydrides sorted into rows:

H_2O								
Li_2O	BeO	B_2O_3	CO_2	N_2O_5	OH_2	FH		
Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	ClH		
K_2O	CaO		TiO_2	V_2O_5	CrO_3	MnH	FeO_4	CoO_4
Cu_2O	ZnO			As_2O_5	SeO_3	BrH		
Rb_2O	SrO	Yt_2O_3	ZrO_2	Nb_2O_5	MoO_3		RuO_4	

The first periodic table as suggested by Mendeleev in 1869

Mendeleev left empty spaces for elements not yet discovered



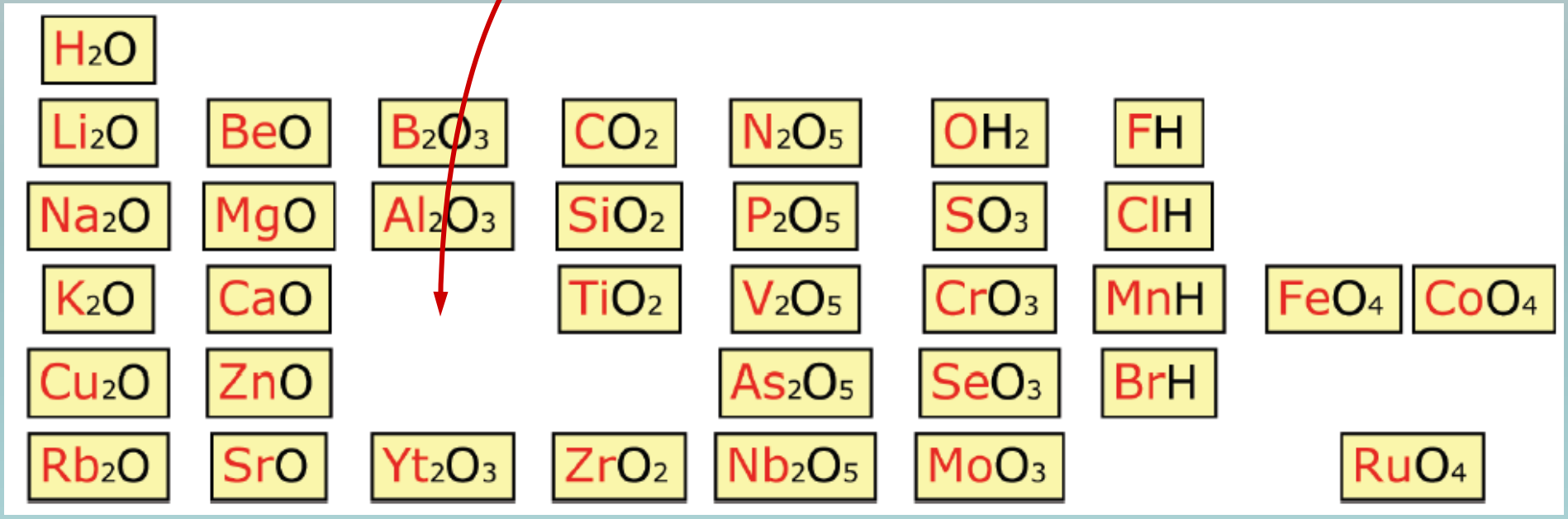
H_2O						
Li_2O	BeO	B_2O_3	CO_2	N_2O_5	OH_2	FH
Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	ClH
K_2O	CaO		TiO_2	V_2O_5	CrO_3	MnH
Cu_2O	ZnO			As_2O_5	SeO_3	BrH
Rb_2O	SrO	Yt_2O_3	ZrO_2	Nb_2O_5	MoO_3	

FeO_4 CoO_4

RuO_4

The first periodic table as suggested by Mendeleev in 1869

Gallium was discovered 6 years later!



The first periodic table as suggested by Mendeleev in 1869

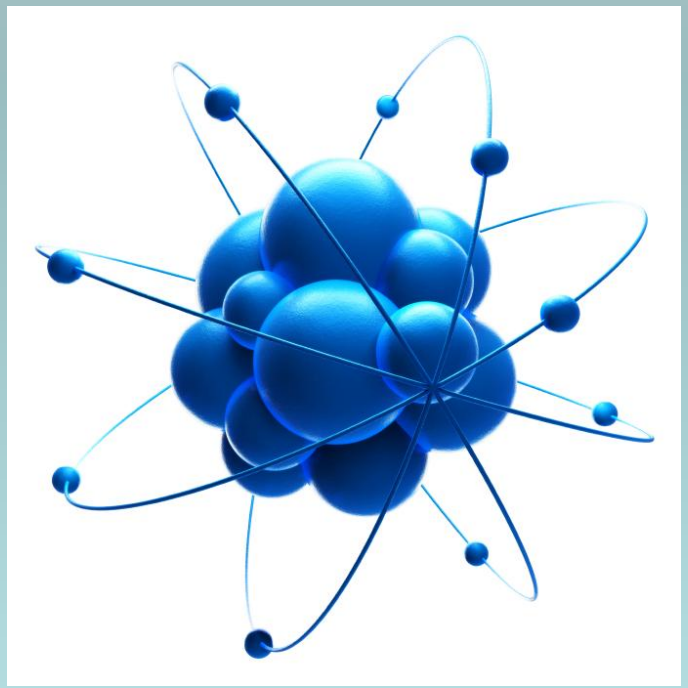
The modern periodic table

The modern periodic table arranges elements in order of **increasing atomic number**, not atomic mass.

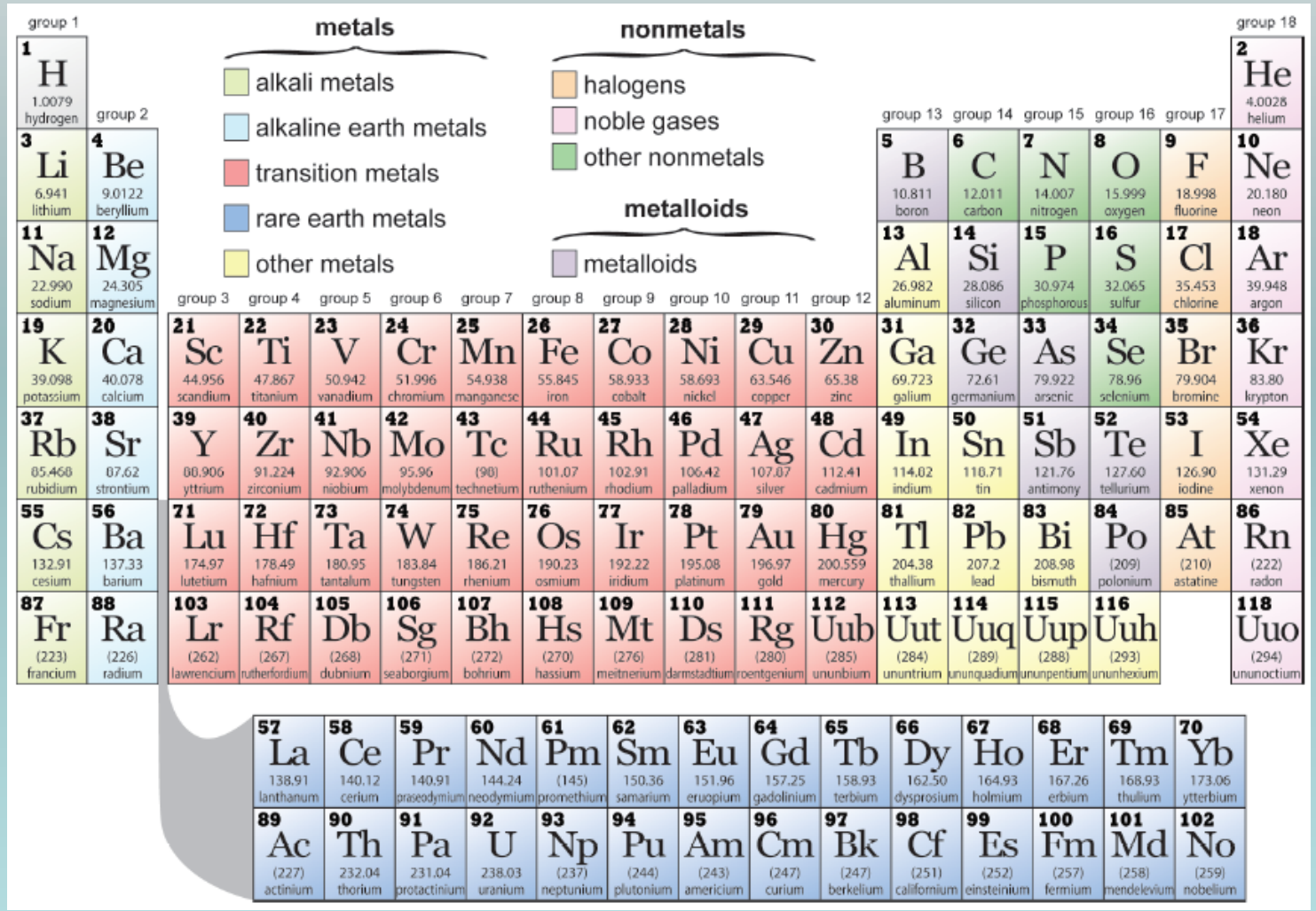
Scientists have been adding elements to the periodic table, as more are discovered or created.

The last naturally occurring element to be discovered is Francium (Fr) in 1939.

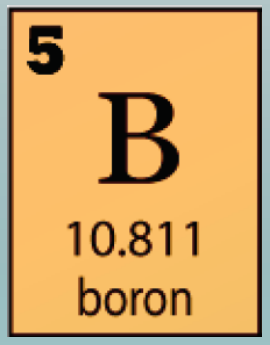
70 years after Mendeleev, who had called it *eka-caesium*



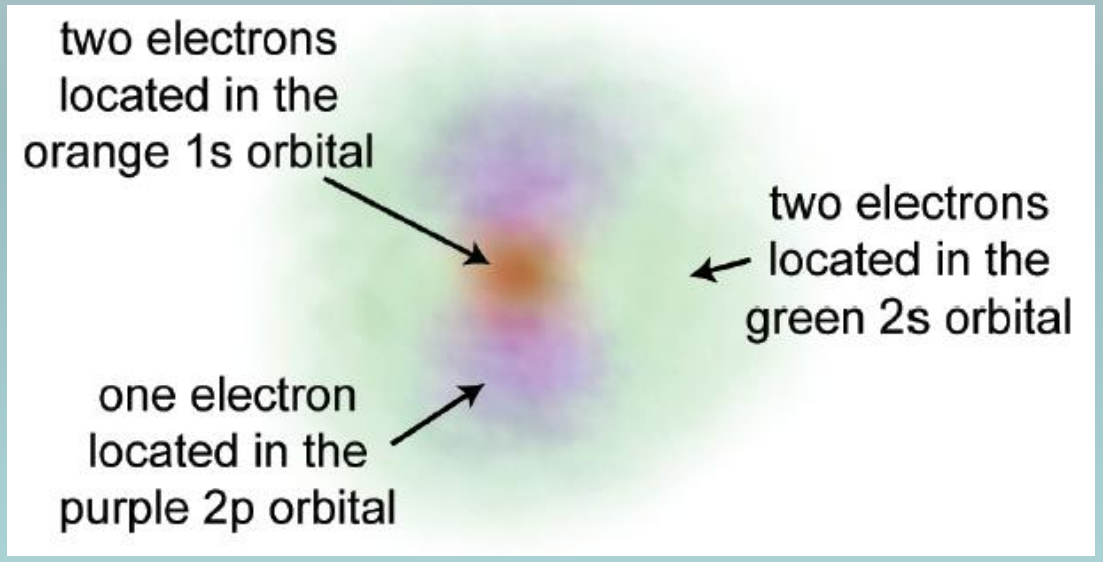
The modern periodic table



Electron structure was discovered after the periodic table was developed…



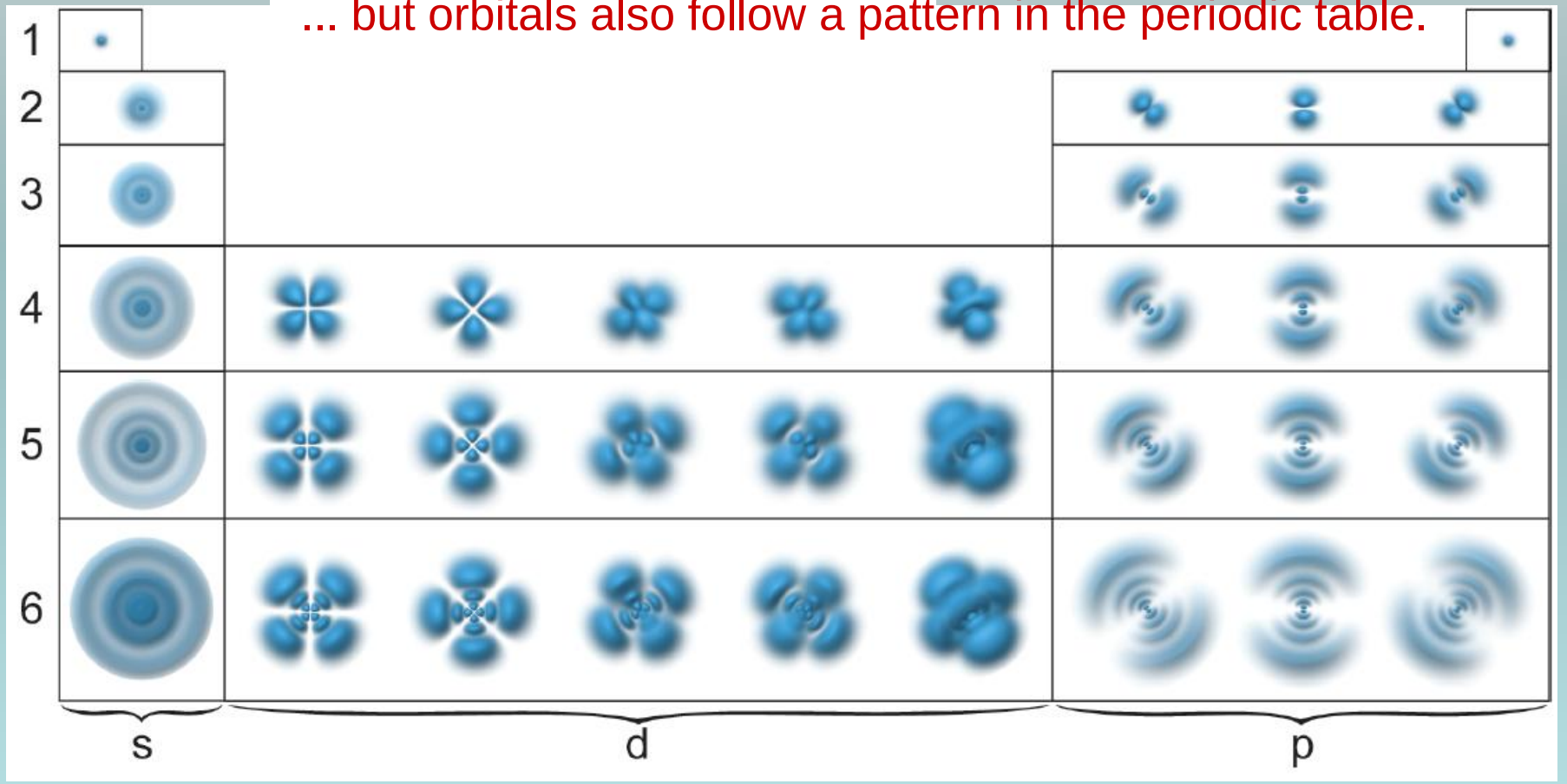
Electron configuration: $1s^2 2s^2 2p^1$

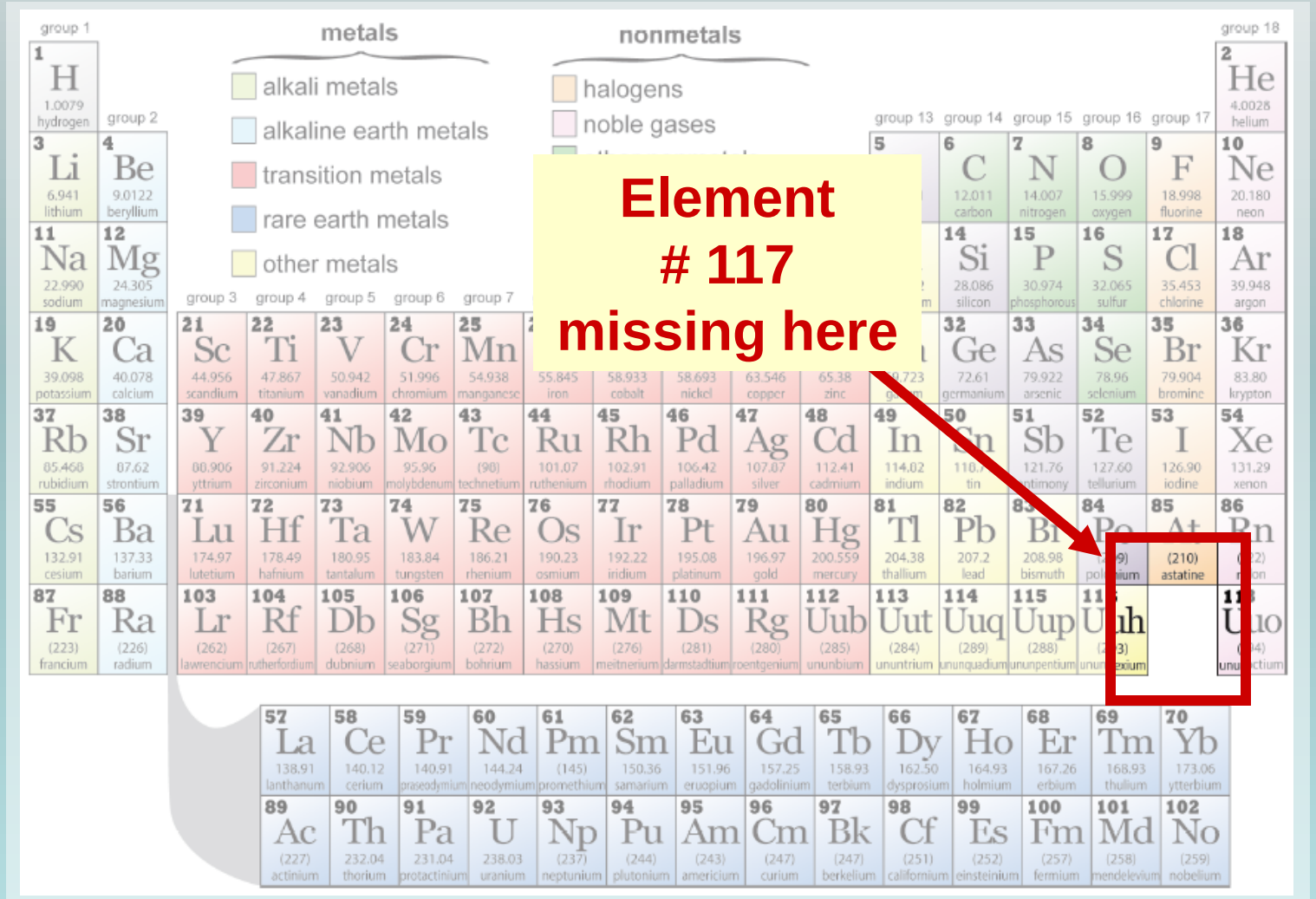


Overlapping orbitals of boron

Electron structure was discovered after the periodic table was developed…

... but orbitals also follow a pattern in the periodic table.



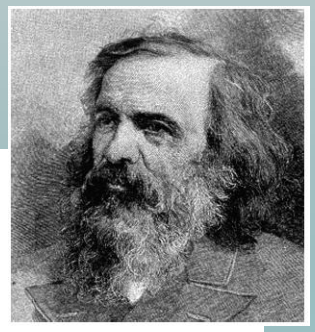

metals
alkali metals
alkaline earth metals
transition metals
rare earth metals
other metals
nonmetals
halogens
noble gases
Element
117
missing here
group 1
group 2
group 3
group 4
group 5
group 6
group 7
group 13
group 14
group 15
group 16
group 17
group 18
1 H 1.0079 hydrogen
2 He 4.0028 helium
3 Li 6.941 lithium
4 Be 9.0122 beryllium
5 B 10.811 boron
6 C 12.011 carbon
7 N 14.007 nitrogen
8 O 15.999 oxygen
9 F 18.998 fluorine
10 Ne 20.180 neon
11 Na 22.990 sodium
12 Mg 24.305 magnesium
13 Al 26.982 aluminum
14 Si 28.086 silicon
15 P 30.974 phosphorous
16 S 32.065 sulfur
17 Cl 35.453 chlorine
18 Ar 39.948 argon
19 K 39.098 potassium
20 Ca 40.078 calcium
21 Sc 44.956 scandium
22 Ti 47.867 titanium
23 V 50.942 vanadium
24 Cr 51.996 chromium
25 Mn 54.938 manganese
26 Fe 55.845 iron
27 Co 58.933 cobalt
28 Ni 58.693 nickel
29 Cu 63.546 copper
30 Zn 65.38 zinc
31 Ga 69.723 gallium
32 Ge 72.61 germanium
33 As 74.922 arsenic
34 Se 78.96 selenium
35 Br 79.904 bromine
36 Kr 83.80 krypton
37 Rb 85.468 rubidium
38 Sr 87.62 strontium
39 Y 88.906 yttrium
40 Zr 91.224 zirconium
41 Nb 92.906 niobium
42 Mo 95.96 molybdenum
43 Tc (90) technetium
44 Ru 101.07 ruthenium
45 Rh 102.91 rhodium
46 Pd 106.42 palladium
47 Ag 107.87 silver
48 Cd 112.41 cadmium
49 In 114.82 indium
50 Sn 118.71 tin
51 Sb 121.76 antimony
52 Te 127.60 tellurium
53 I 126.90 iodine
54 Xe 131.29 xenon
55 Cs 132.91 cesium
56 Ba 137.33 barium
71 Lu 174.97 lutetium
72 Hf 178.49 hafnium
73 Ta 180.95 tantalum
74 W 183.84 tungsten
75 Re 186.21 rhenium
76 Os 190.23 osmium
77 Ir 192.22 iridium
78 Pt 195.08 platinum
79 Au 196.97 gold
80 Hg 200.59 mercury
81 Tl 204.38 thallium
82 Pb 207.2 lead
83 Bi 208.98 bismuth
84 Po (209) polonium
85 At (210) astatine
86 Rn (222) radon
87 Fr (223) francium
88 Ra (226) radium
103 Lr (262) lawrencium
104 Rf (267) rutherfordium
105 Db (268) dubnium
106 Sg (271) seaborgium
107 Bh (272) bohrium
108 Hs (270) hassium
109 Mt (276) meitnerium
110 Ds (281) darmstadtium
111 Rg (280) roentgenium
112 Uub (285) ununbium
113 Uut (284) ununtrium
114 Uuq (289) ununquadium
115 Uup (288) ununpentium
116 Uuh (293) ununhexium
118 Uuo (294) ununoctium
57 La 138.91 lanthanum
58 Ce 140.12 cerium
59 Pr 140.91 praseodymium
60 Nd 144.24 neodymium
61 Pm (145) promethium
62 Sm 150.36 samarium
63 Eu 151.96 europium
64 Gd 157.25 gadolinium
65 Tb 158.93 terbium
66 Dy 162.50 dysprosium
67 Ho 164.93 holmium
68 Er 167.26 erbium
69 Tm 168.93 thulium
70 Yb 173.06 ytterbium
89 Ac (227) actinium
90 Th 232.04 thorium
91 Pa 231.04 protactinium
92 U 238.03 uranium
93 Np (237) neptunium
94 Pu (244) plutonium
95 Am (243) americium
96 Cm (247) curium
97 Bk (247) berkelium
98 Cf (251) californium
99 Es (252) einsteinium
100 Fm (257) fermium
101 Md (258) mendelevium
102 No (259) nobelium

2009-2010

Element #117 was discovered through a Russian-US collaboration.
The discovery still needs to be confirmed.
It is temporarily named ununseptium (Uus).

Discoveries are made all the time!

Elements in **the first periodic table** were arranged in order of increasing atomic mass



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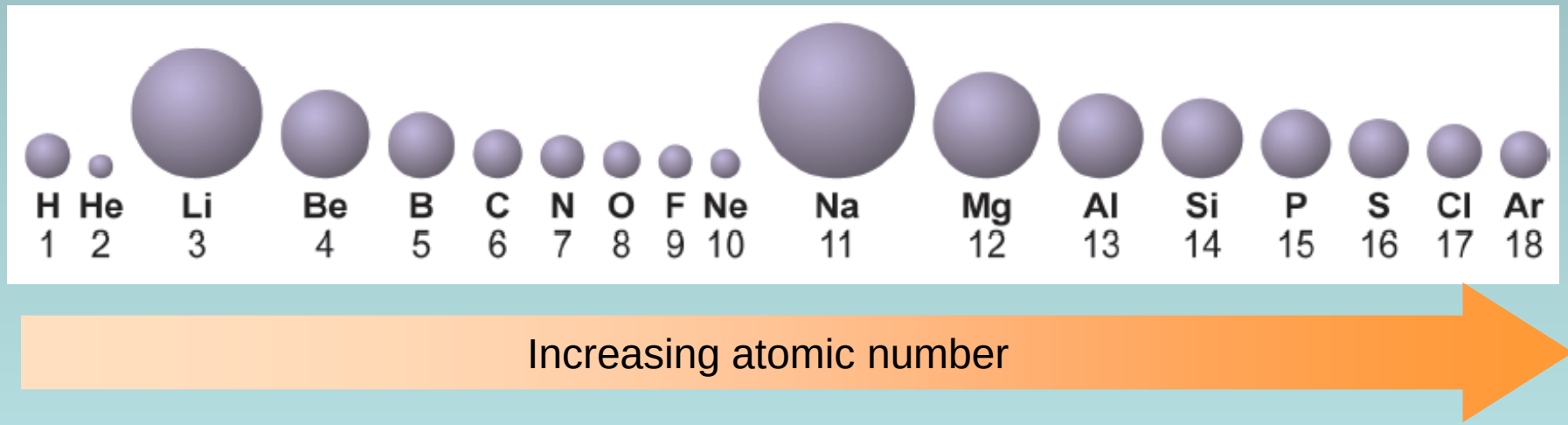
Cu_2O	ZnO			As_2O_5	SeO_3	BrH		
Rb_2O	SrO	Yt_2O_3	ZrO_2	Nb_2O_5	MoO_3		RuO_4	

The first periodic table as suggested by Mendeleev in 1869

Elements in **the modern periodic table** are arranged in order of increasing atomic number

The modern periodic table shows trends or repeating patterns in atomic radii, electronegativity and ionization energy



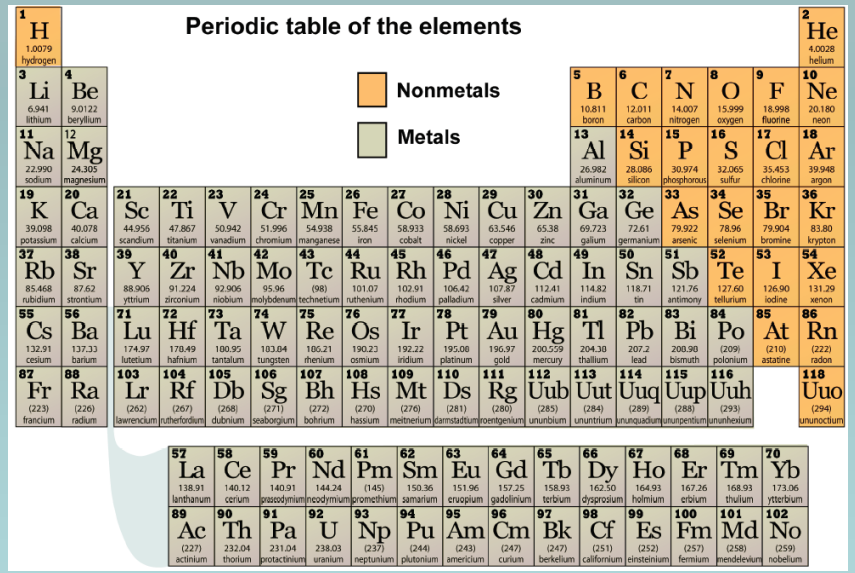
Elements and the Periodic Table

Properties of Groups of Elements

There are millions and millions of different kinds of matter (compounds) composed of the same 92 elements.

These elements are organized in a periodic table.

It is called “periodic” because there is a repeating pattern.



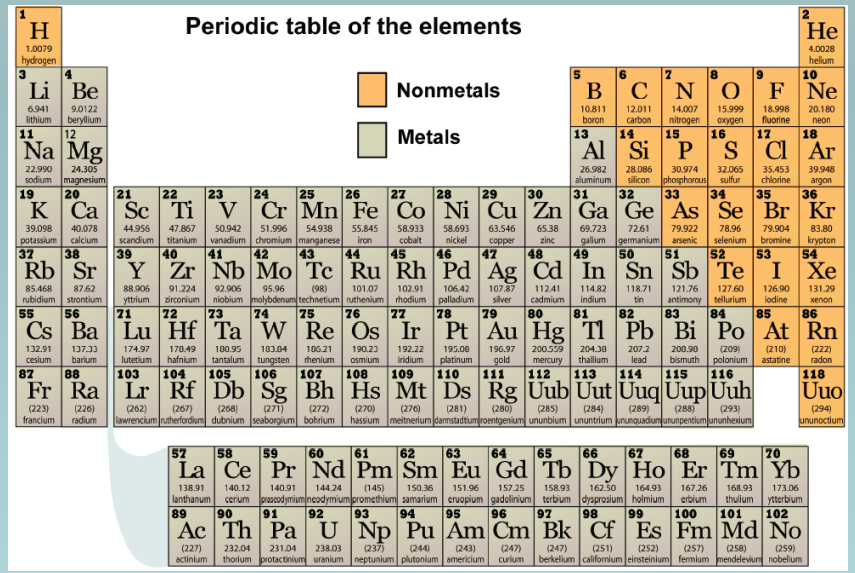
There are millions and millions of different kinds of matter (compounds) composed of the same 92 elements.

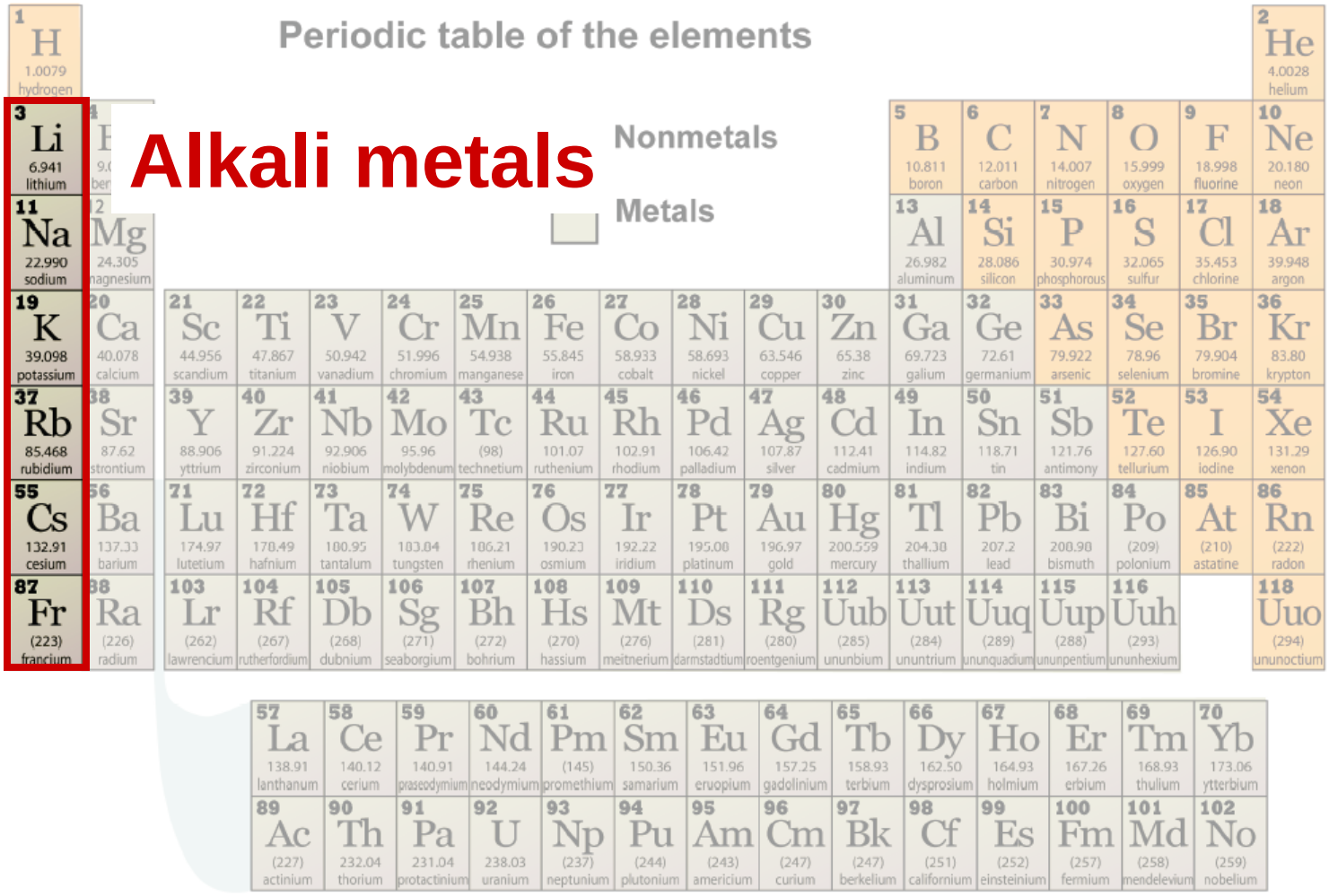
These elements are organized in a periodic table.

It is called “periodic” because there is a repeating pattern.

Elements that belong to the same column have similar chemical properties.

Here, we are going to go over these groups of elements




Periodic table of the elements
Alkali metals
Nonmetals
Metals
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4 Be 9.012 beryllium
5 B 10.811 boron
6 C 12.011 carbon
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17 Cl 35.453 chlorine
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19 K 39.098 potassium
20 Ca 40.078 calcium
21 Sc 44.956 scandium
22 Ti 47.867 titanium
23 V 50.942 vanadium
24 Cr 51.996 chromium
25 Mn 54.938 manganese
26 Fe 55.845 iron
27 Co 58.933 cobalt
28 Ni 58.693 nickel
29 Cu 63.546 copper
30 Zn 65.38 zinc
31 Ga 69.723 galium
32 Ge 72.61 germanium
33 As 79.922 arsenic
34 Se 78.96 selenium
35 Br 79.904 bromine
36 Kr 83.80 krypton
37 Rb 85.468 rubidium
38 Sr 87.62 strontium
39 Y 88.906 yttrium
40 Zr 91.224 zirconium
41 Nb 92.906 niobium
42 Mo 95.96 molybdenum
43 Tc (98) technetium
44 Ru 101.07 ruthenium
45 Rh 102.91 rhodium
46 Pd 106.42 palladium
47 Ag 107.87 silver
48 Cd 112.41 cadmium
49 In 114.82 indium
50 Sn 118.71 tin
51 Sb 121.76 antimony
52 Te 127.60 tellurium
53 I 126.90 iodine
54 Xe 131.29 xenon
55 Cs 132.91 cesium
56 Ba 137.33 barium
71 Lu 174.97 lutetium
72 Hf 178.49 hafnium
73 Ta 180.95 tantalum
74 W 183.84 tungsten
75 Re 186.21 rhenium
76 Os 190.23 osmium
77 Ir 192.22 iridium
78 Pt 195.08 platinum
79 Au 196.97 gold
80 Hg 200.559 mercury
81 Tl 204.38 thallium
82 Pb 207.2 lead
83 Bi 208.98 bismuth
84 Po (209) polonium
85 At (210) astatine
86 Rn (222) radon
87 Fr (223) francium
88 Ra (226) radium
103 Lr (262) lawrencium
104 Rf (267) rutherfordium
105 Db (268) dubnium
106 Sg (271) seaborgium
107 Bh (272) bohrium
108 Hs (270) hassium
109 Mt (276) meitnerium
110 Ds (281) darmstadtium
111 Rg (280) roentgenium
112 Uub (285) ununbium
113 Uut (284) ununtrium
114 Uuq (289) ununquadium
115 Uup (288) ununpentium
116 Uuh (293) ununhexium
118 Uuo (294) ununoctium
57 La 138.91 lanthanum
58 Ce 140.12 cerium
59 Pr 140.91 praseodymium
60 Nd 144.24 neodymium
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63 Eu 151.96 eruopium
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99 Es (252) einsteinium
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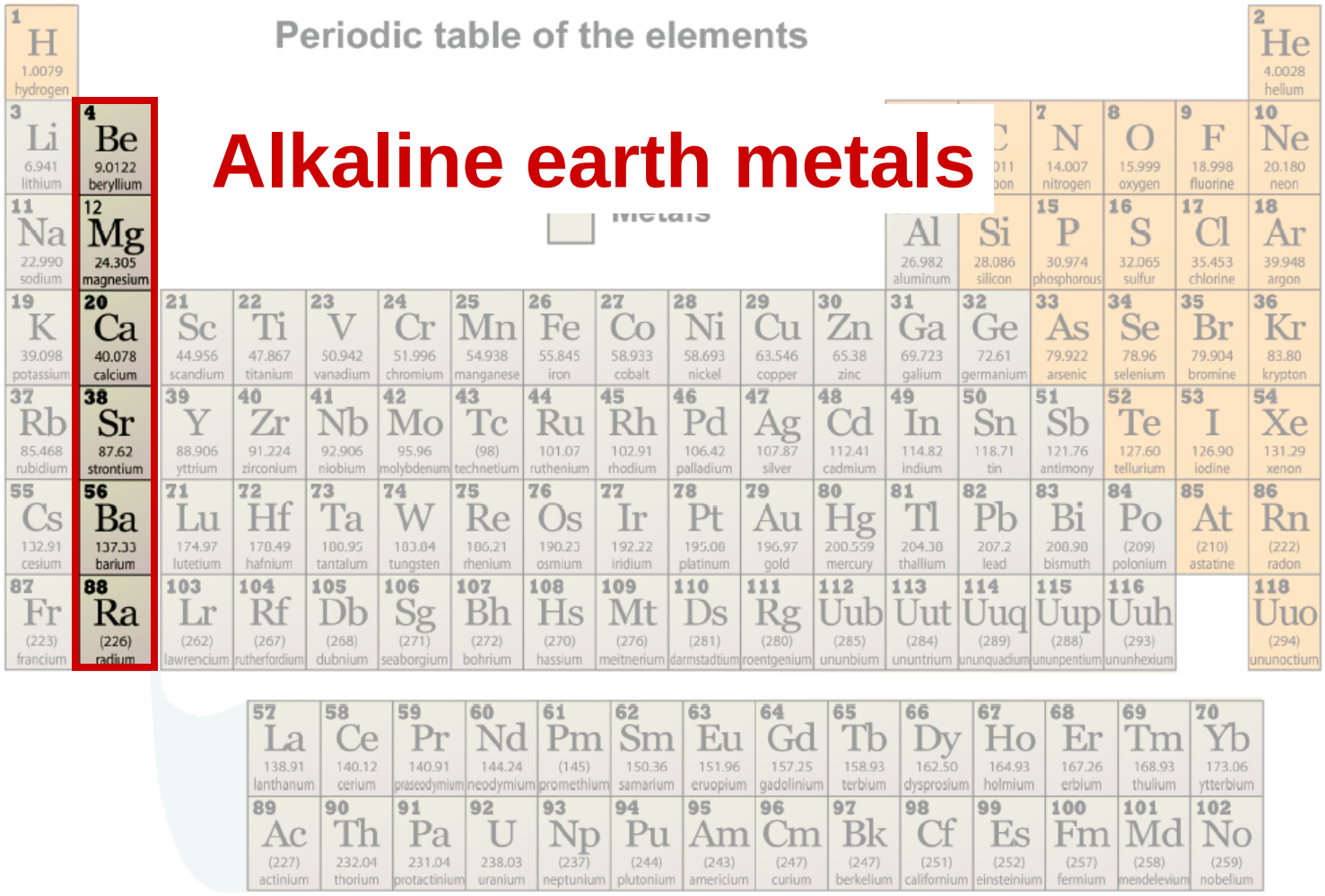
101 Md (258) mendelevium
102 No (259) nobelium


Periodic table of the elements
Alkaline earth metals
Metals
1 H 1.0079 hydrogen
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3 Li 6.941 lithium
4 Be 9.0122 beryllium
7 N 14.007 nitrogen
8 O 15.999 oxygen
9 F 18.998 fluorine
10 Ne 20.180 neon
11 Na 22.990 sodium
12 Mg 24.305 magnesium
13 Al 26.982 aluminum
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15 P 30.974 phosphorous
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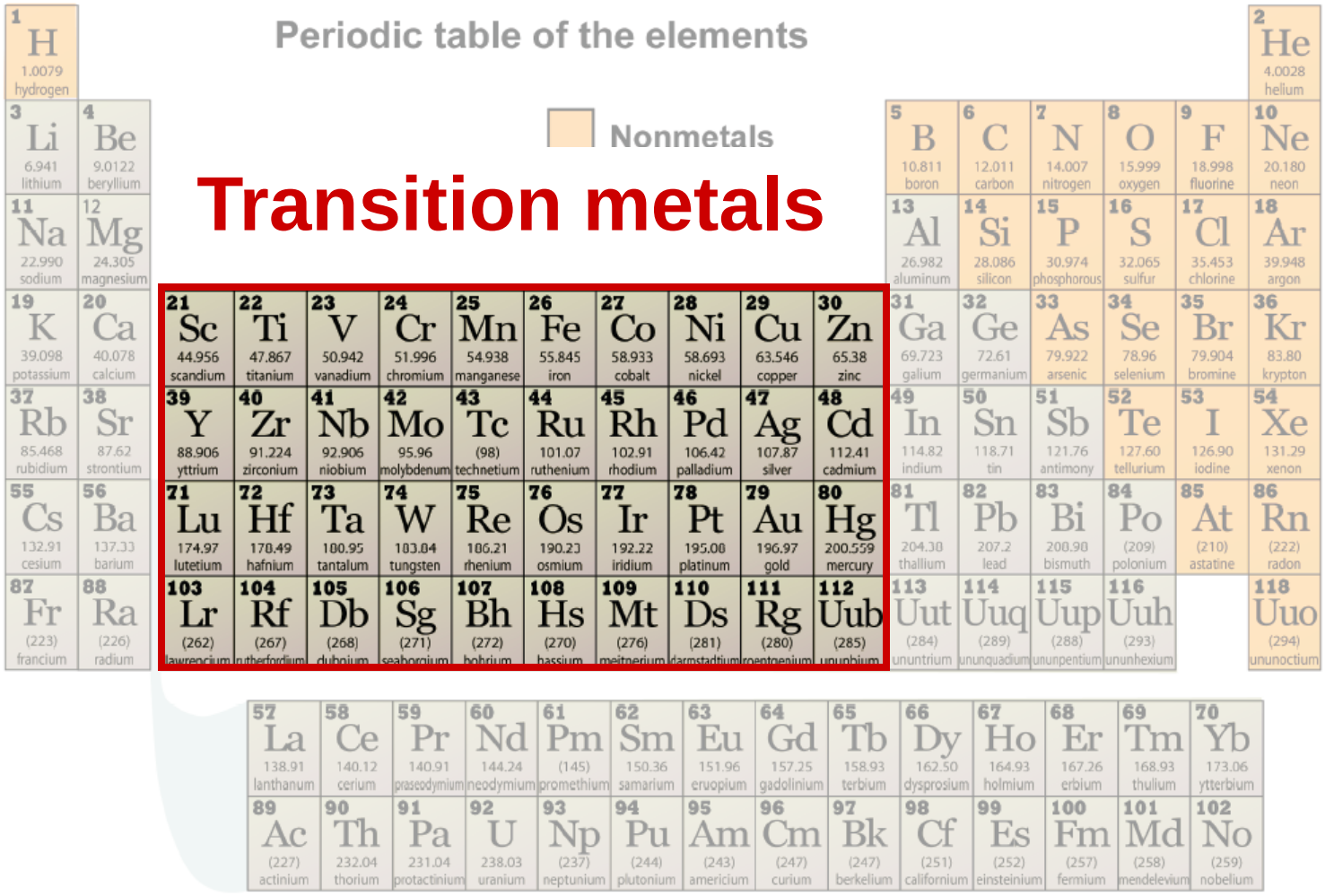
Periodic table of the elements
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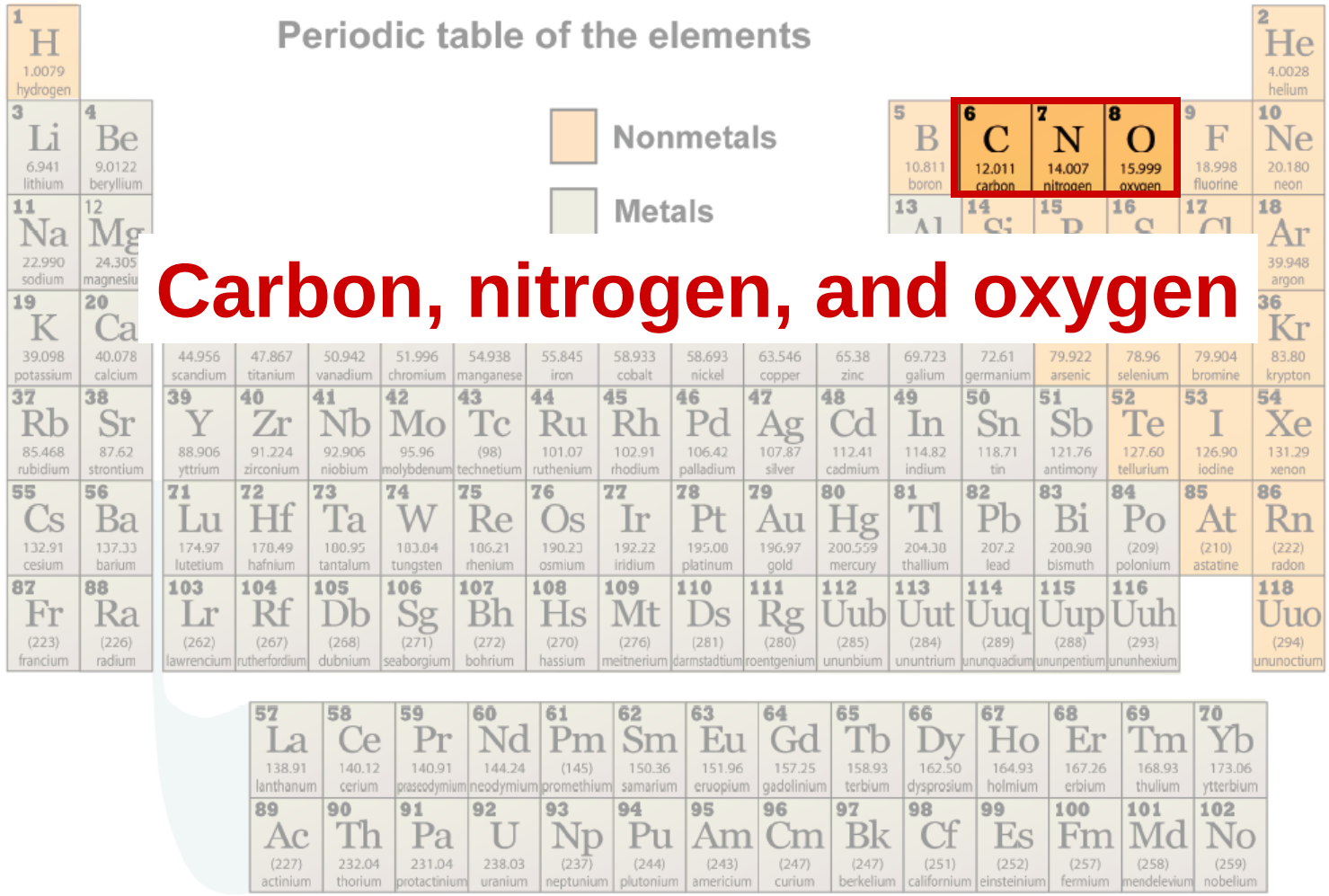
Periodic table of the elements
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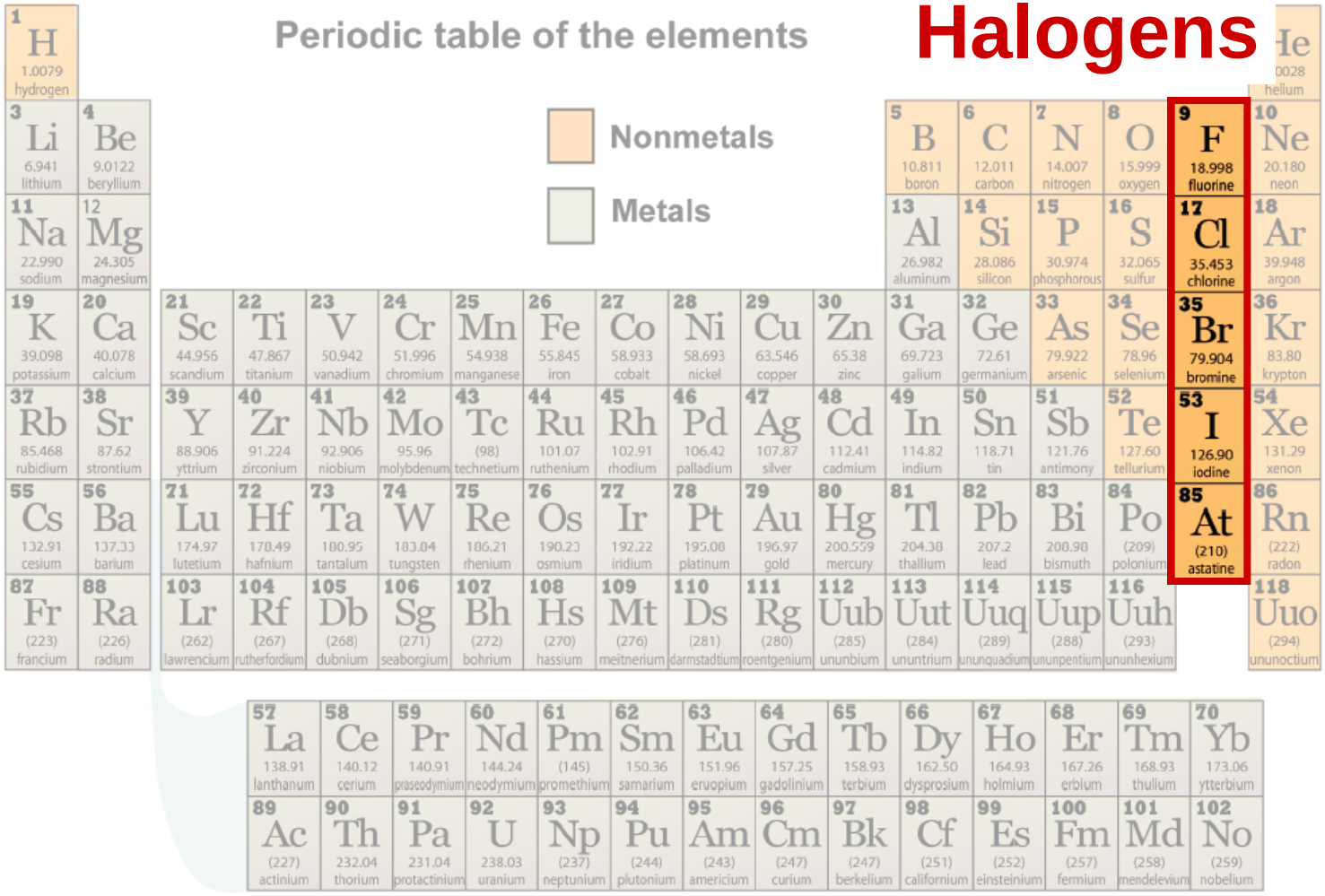
Metals
Carbon, nitrogen, and oxygen

Halogens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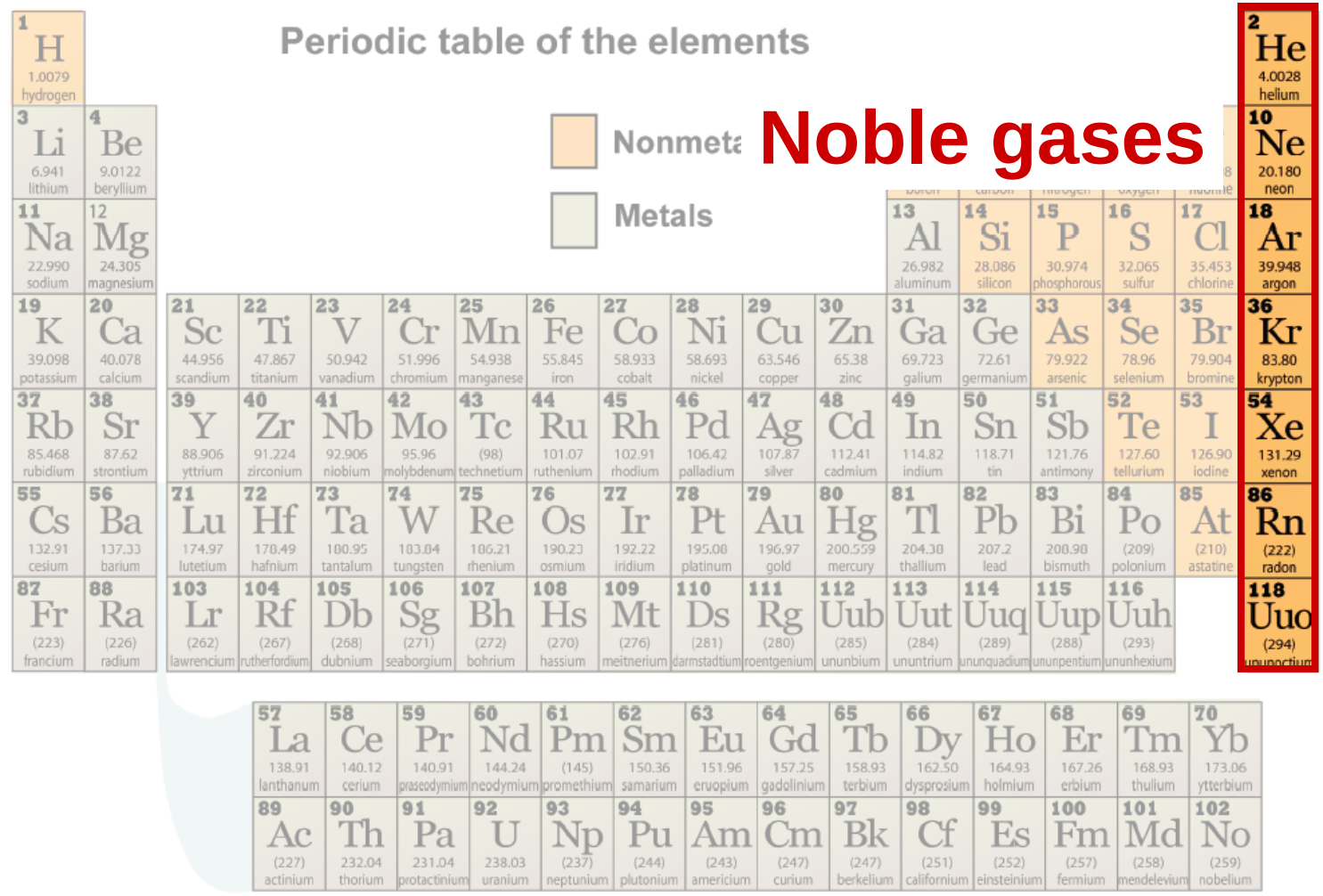
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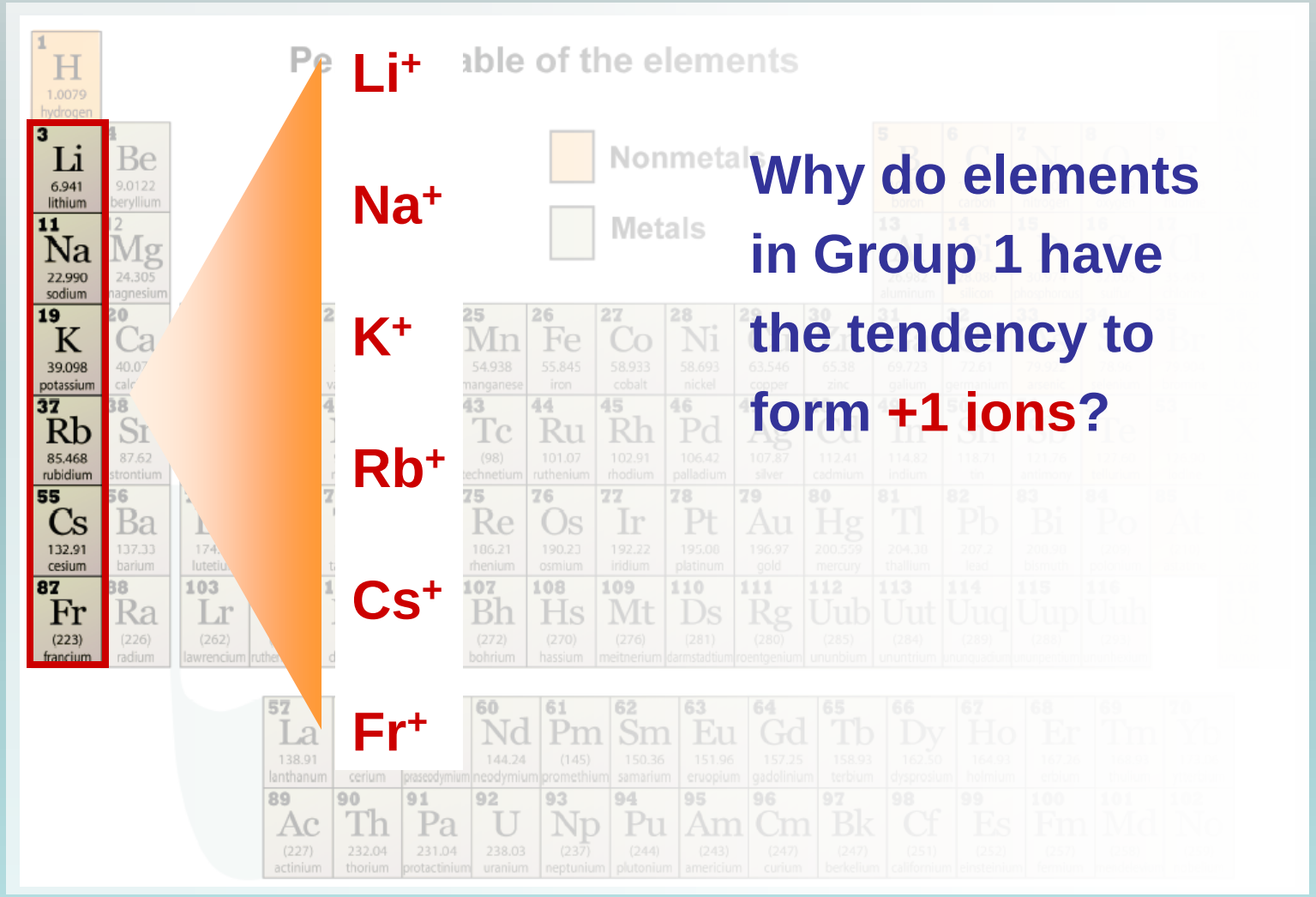
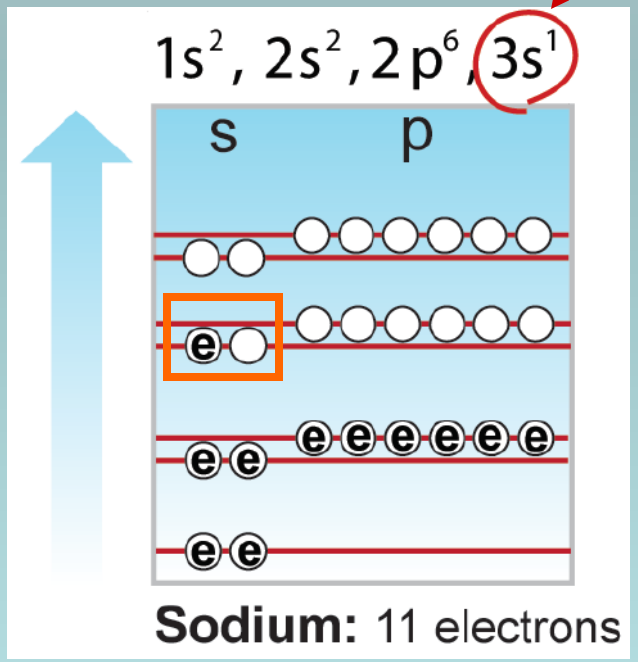
Alkali metals

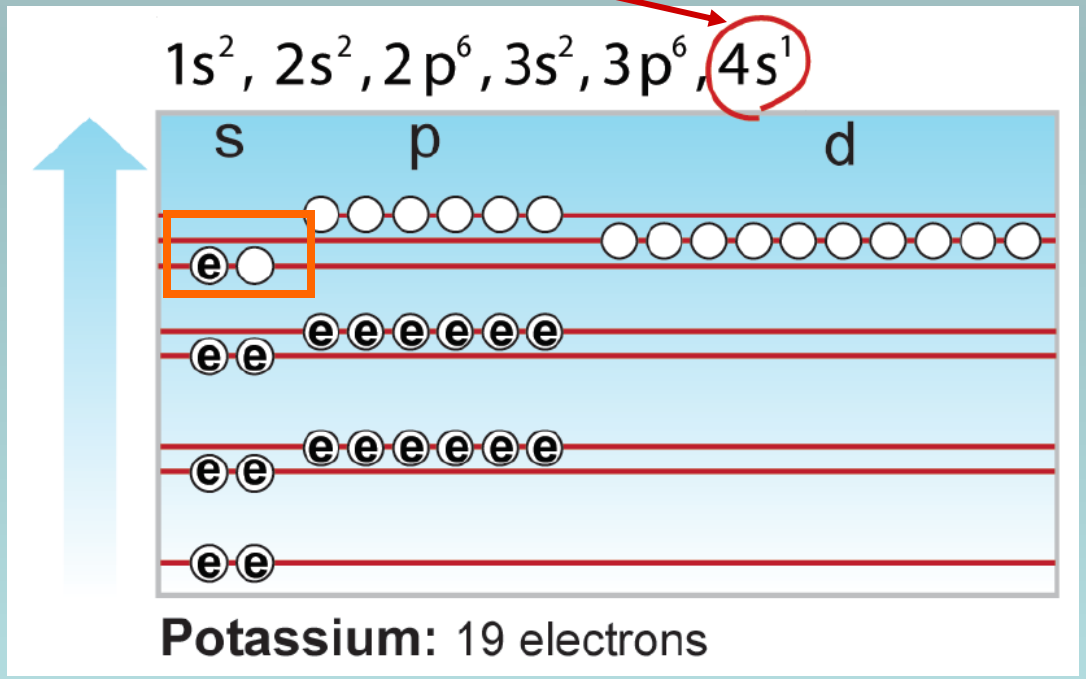


Alkali metals

Electron configuration

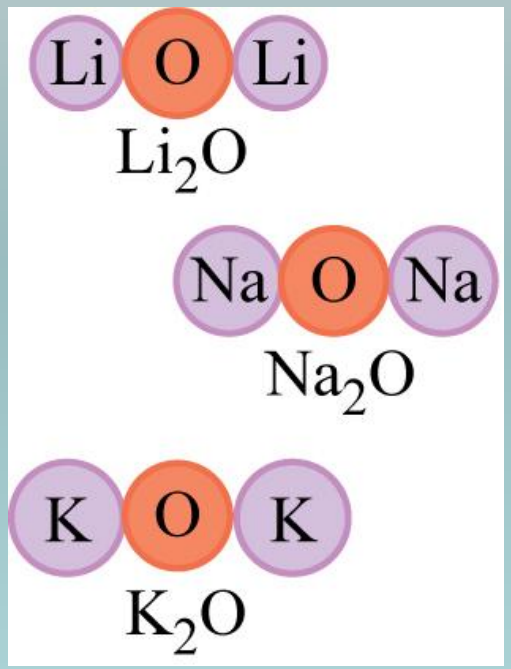
Alkali metals have a single electron in the highest unfilled energy level.



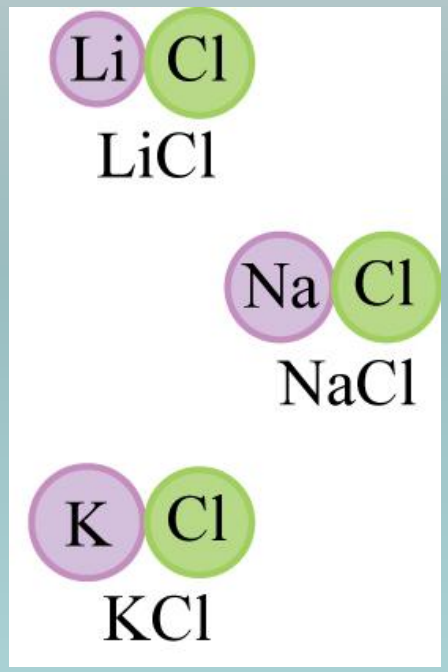


Alkali metals

2:1 ratio with oxygen

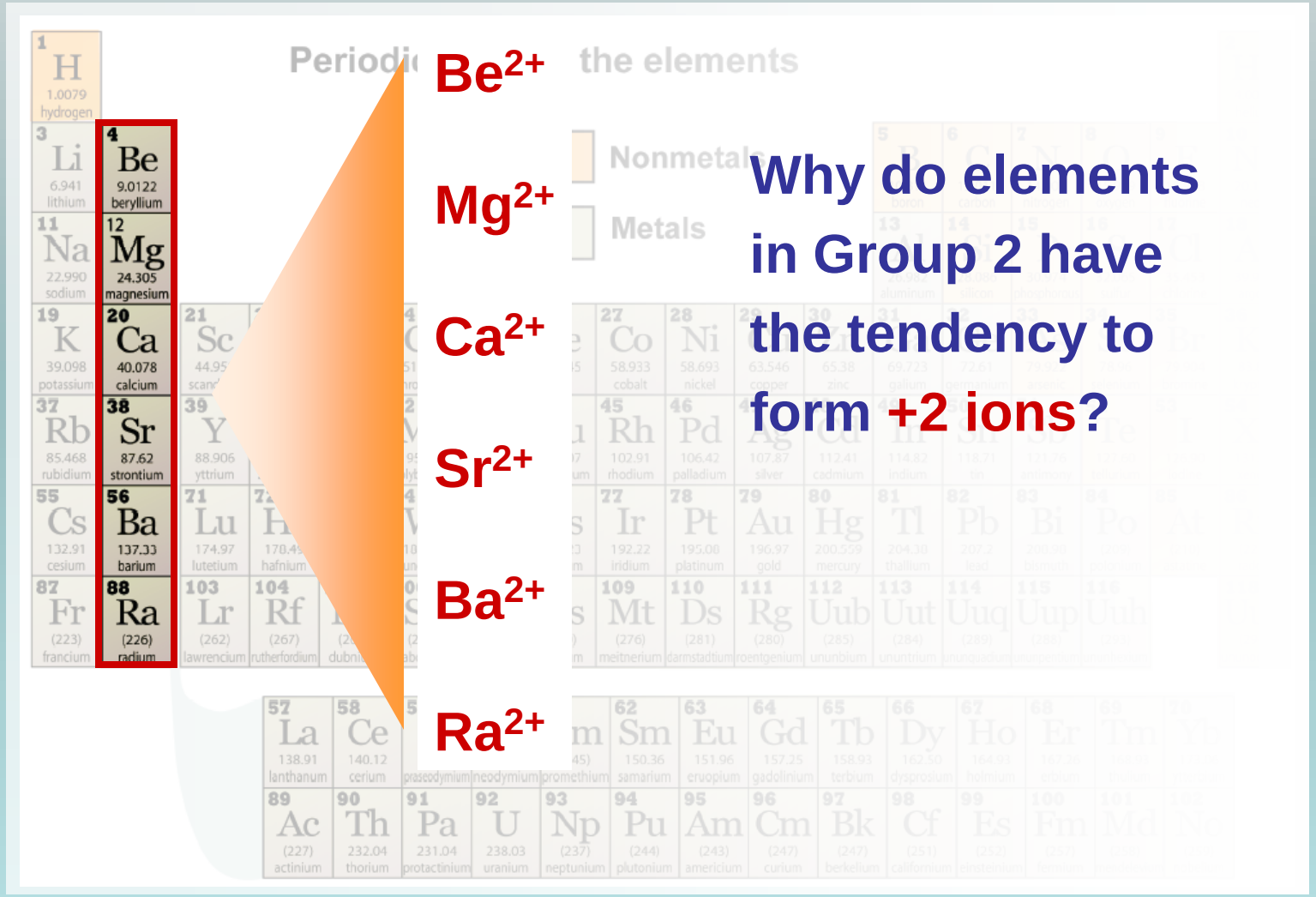


1:1 ratio with chlorine



We will see why this happens after we discuss oxygen and chlorine.

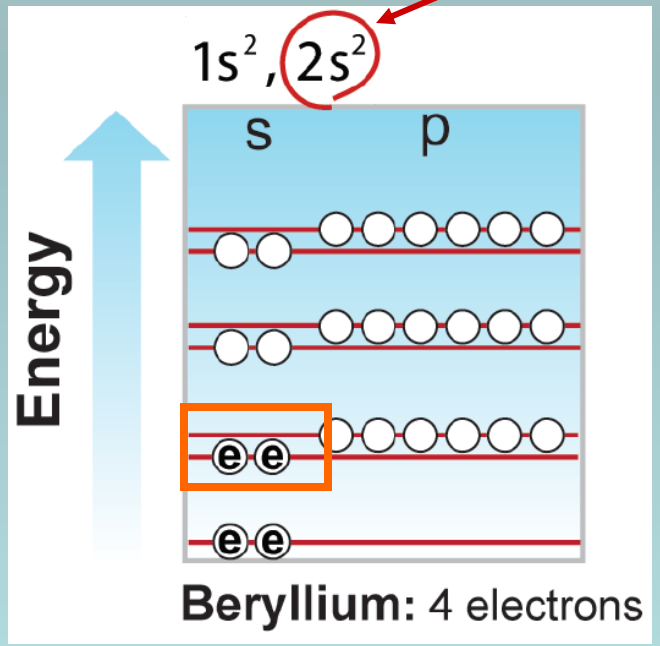
Alkaline earth metals

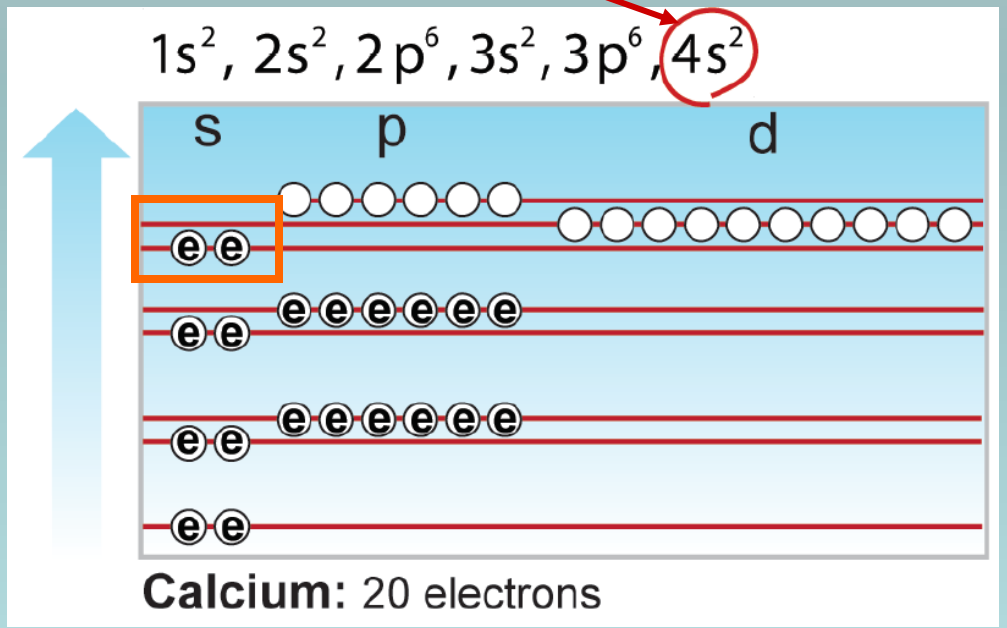


Alkaline earth metals

Electron configuration

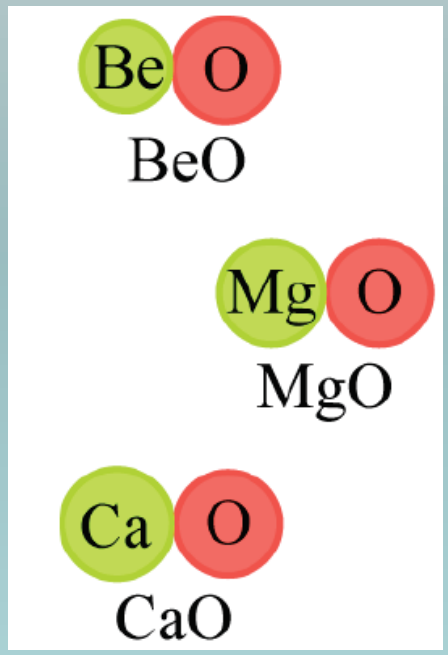
Alkaline earth metals have two electrons in the highest unfilled energy level.



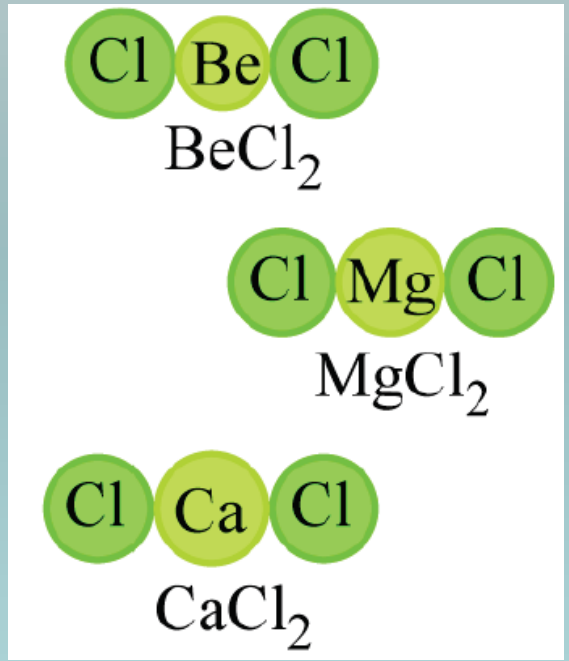


Alkaline earth metals

1:1 ratio with oxygen

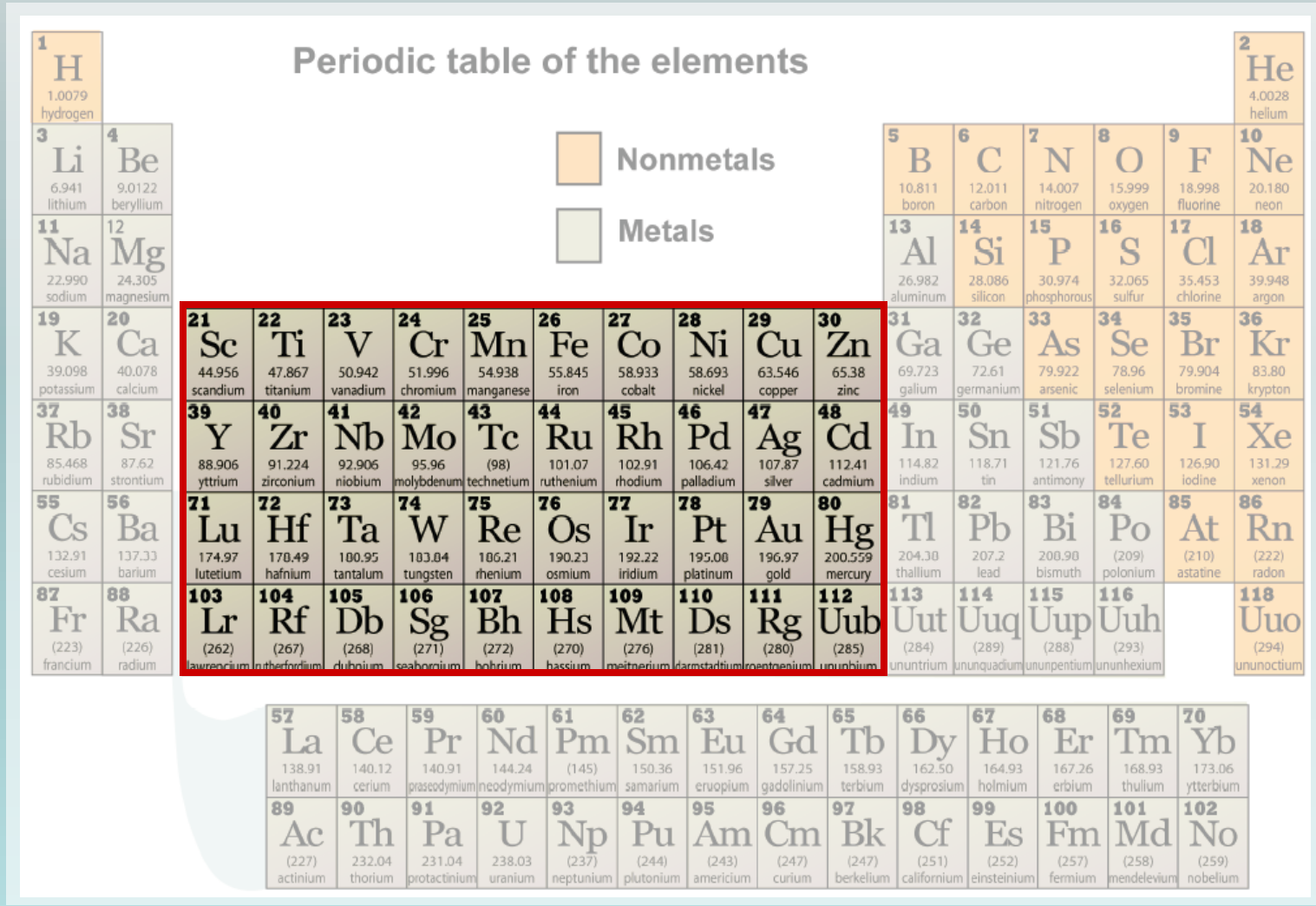


1:2 ratio with chlorine

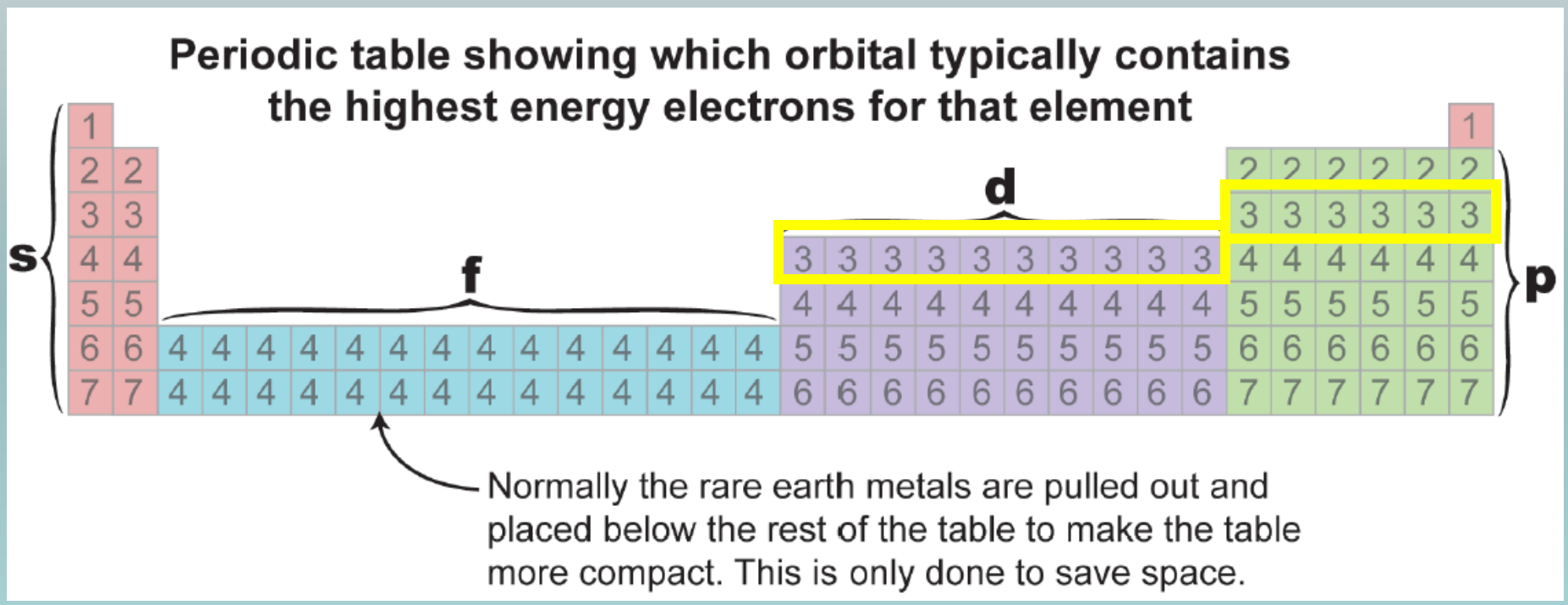


We will see why this happens after we discuss oxygen and chlorine.

Transition metals



Transition metals

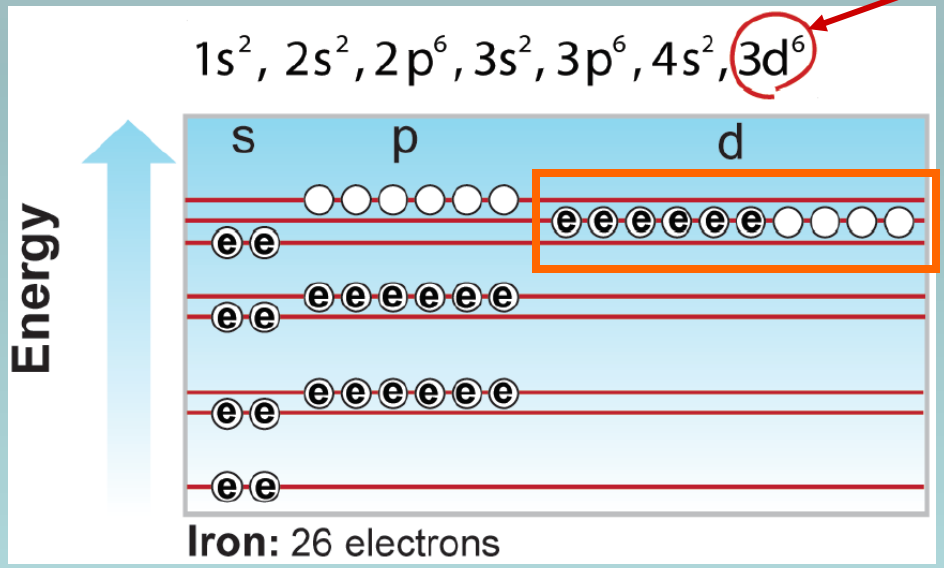


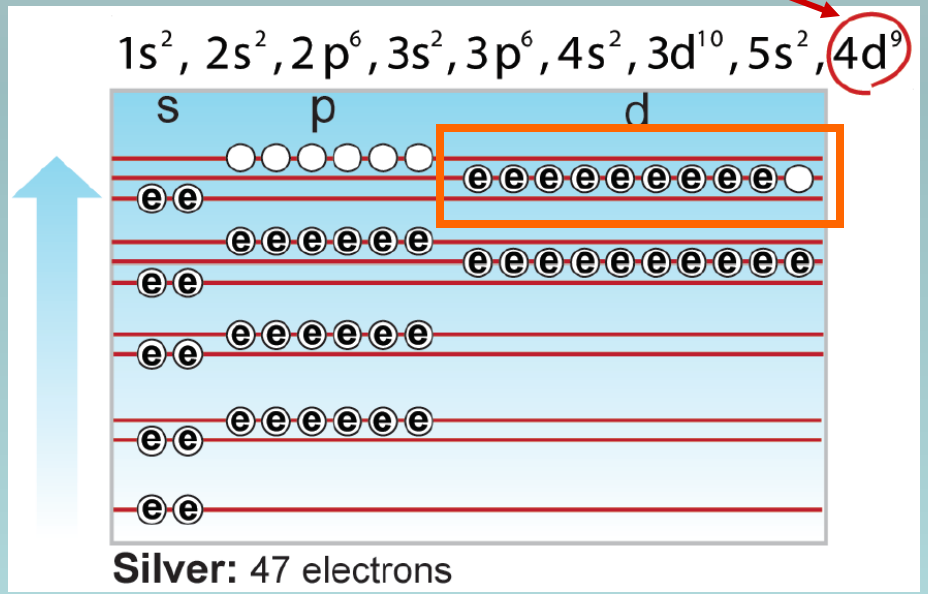
Note how the 3p orbital gets filled before 3d

Transition metals

Electron configuration

Transition metals all have electrons in partly filled *d* orbitals.





Transition metals

Bonding properties are complicated. For bonding with oxygen:

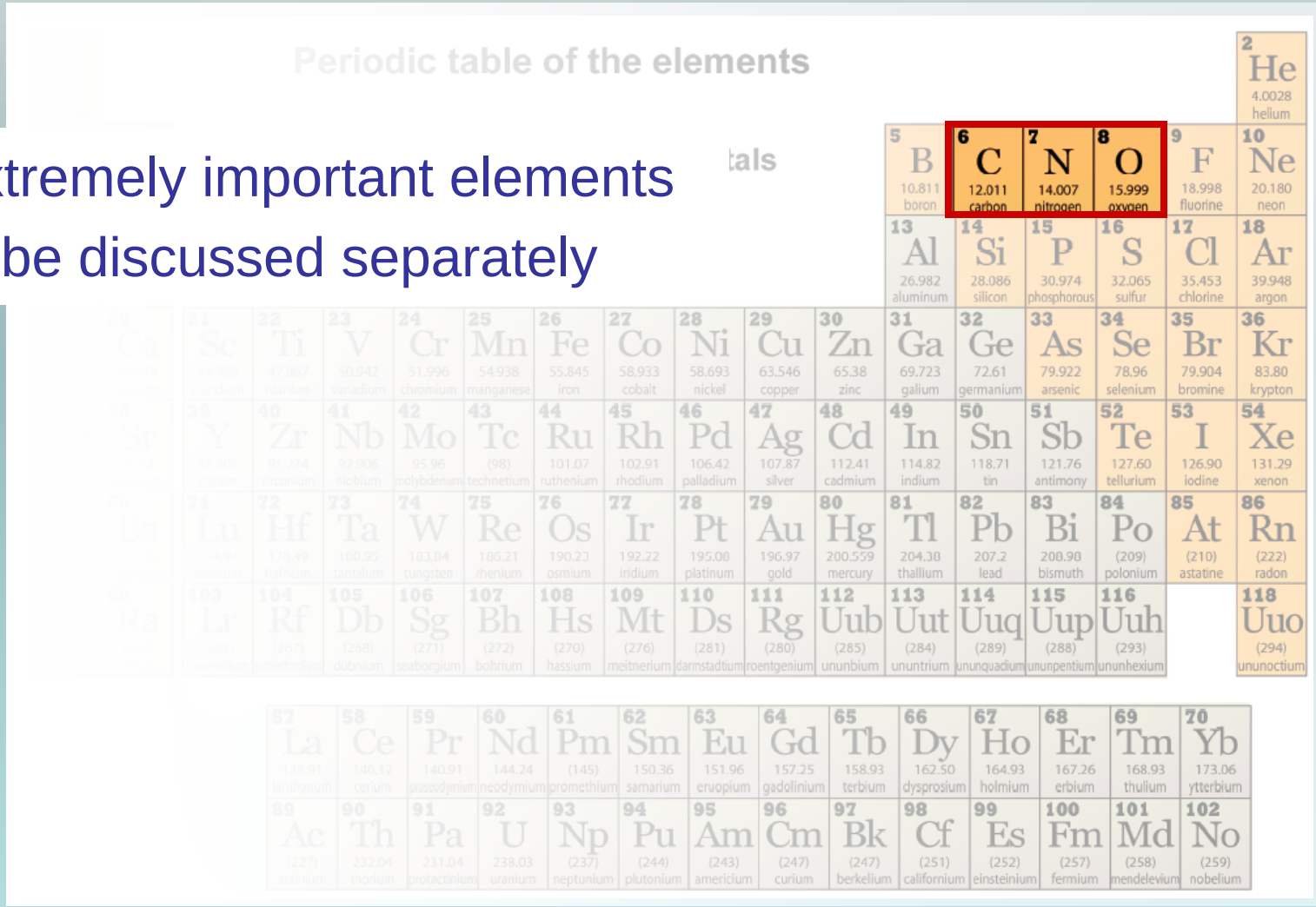
1:1, 2:3, 3:4 ratios for iron

2:1 ratio for silver

Carbon, nitrogen, oxygen

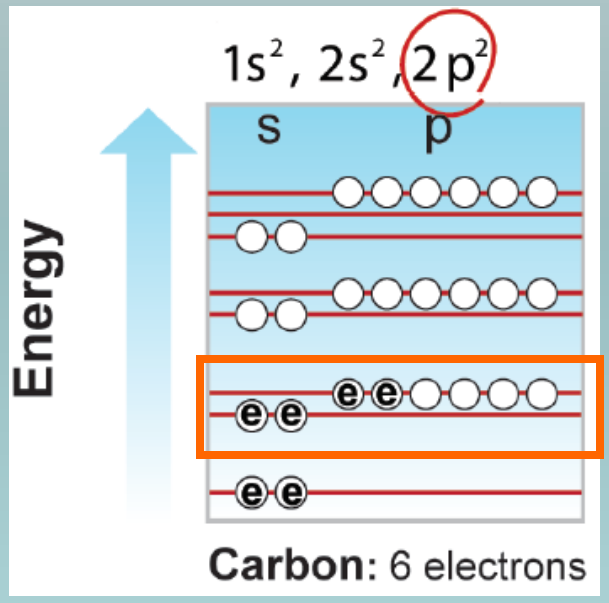
Extremely important elements

to be discussed separately



Carbon, nitrogen, oxygen

The electron structures makes these elements
very flexible in their chemistry.



Carbon can accept or donate electrons

Carbon, nitrogen, oxygen

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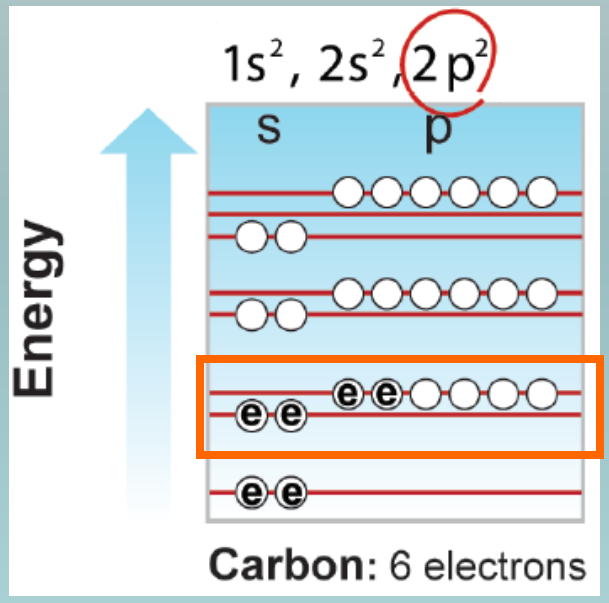
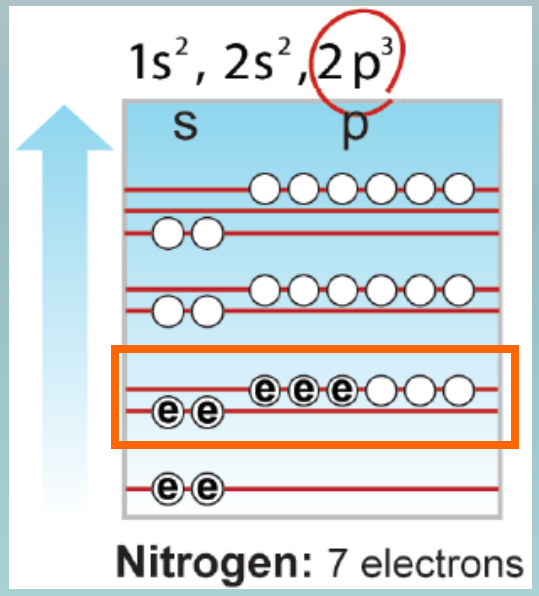
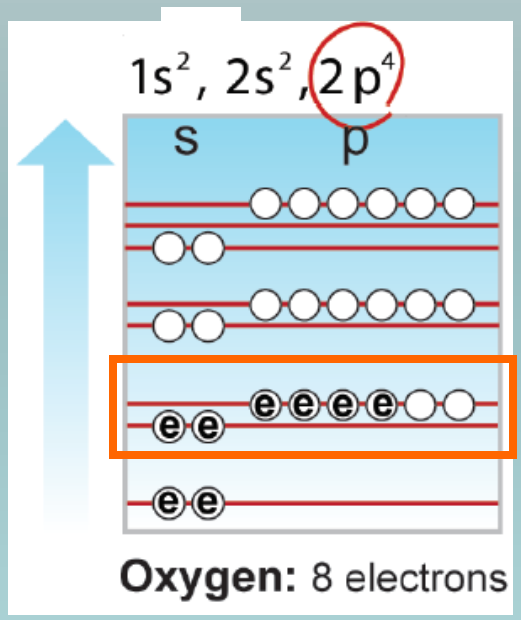
very flexible in their chemistry.





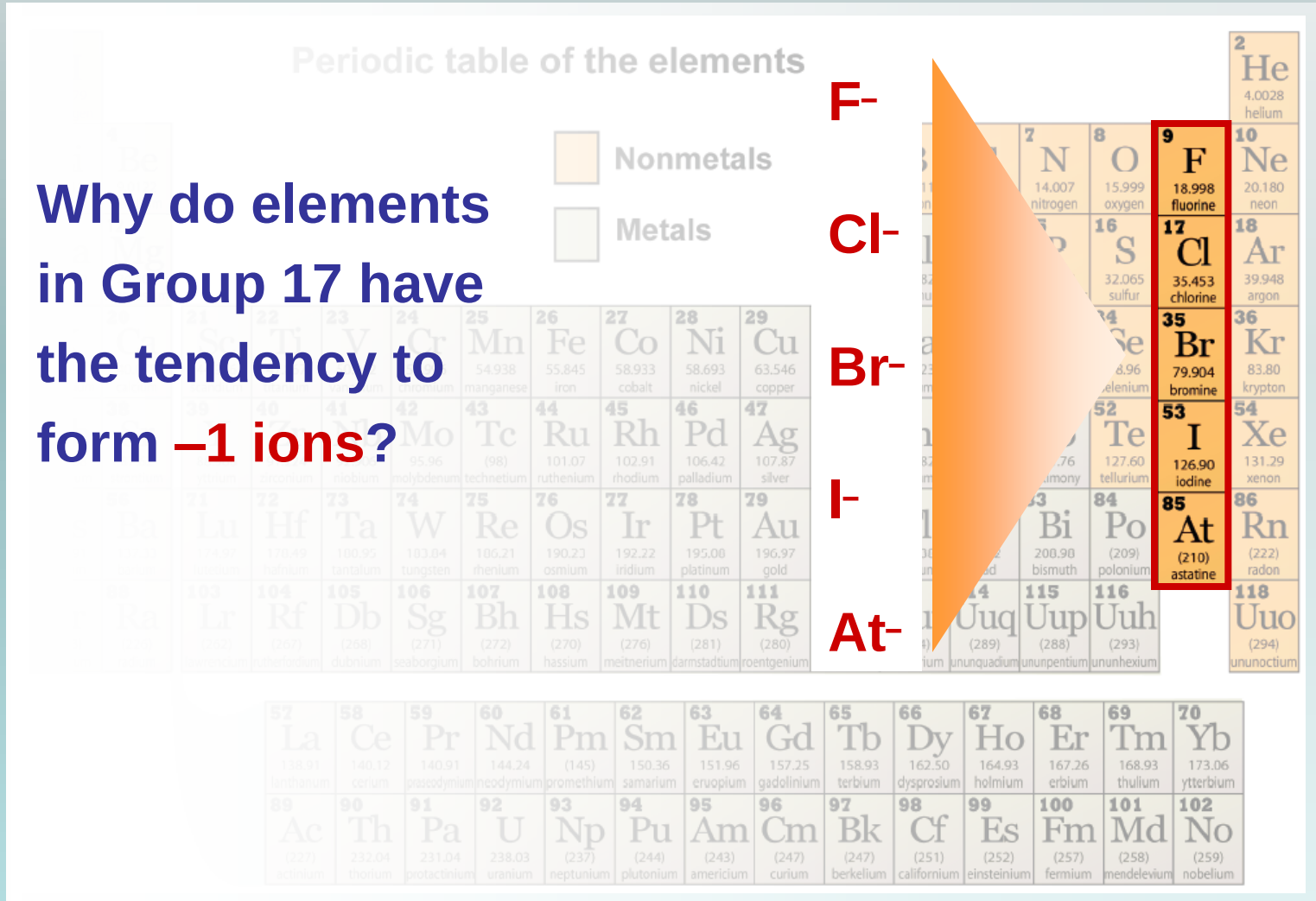


Carbon can accept or donate electrons

Nitrogen and oxygen tend to accept electrons

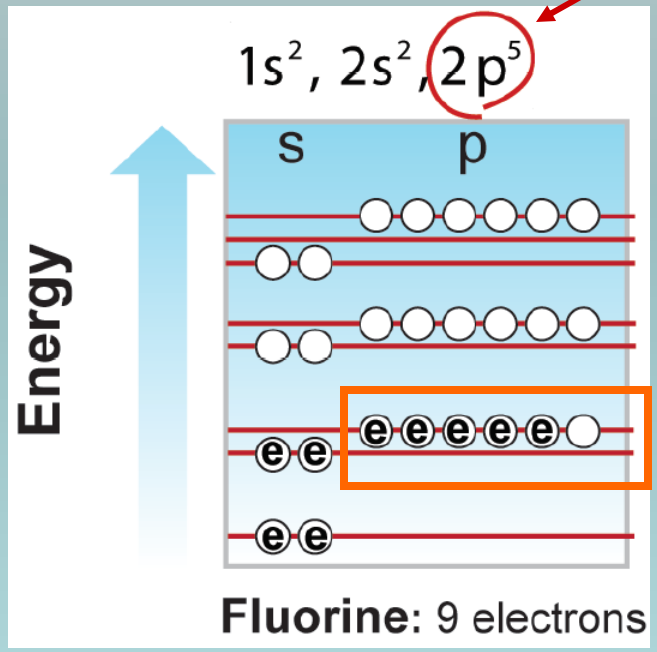
Halogens

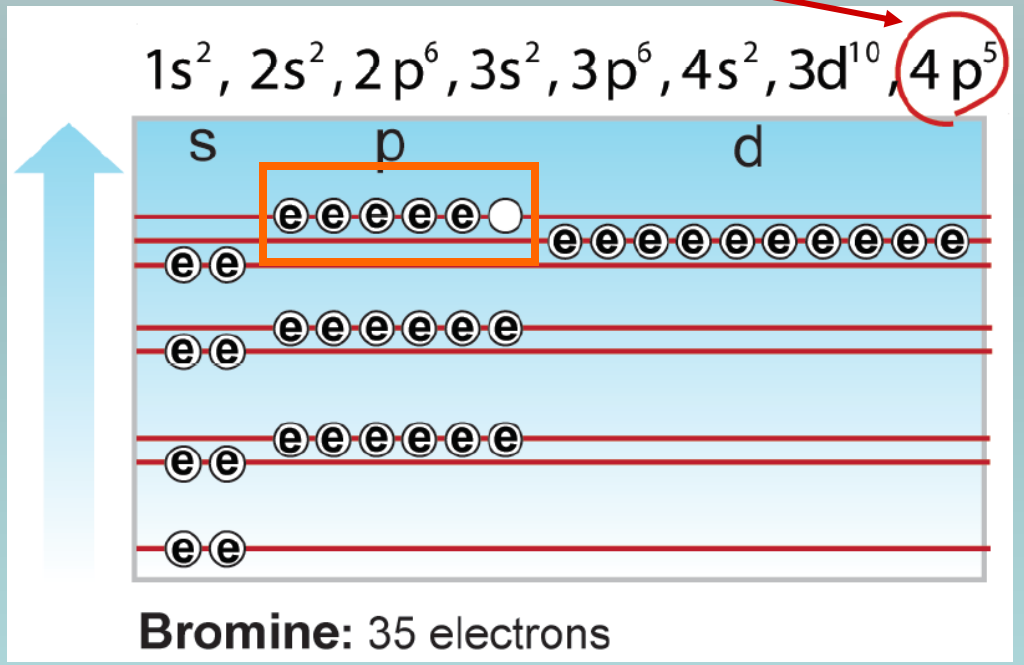
Why do elements in Group 17 have the tendency to form –1 ions?



Halogens

Halogens have a single open quantum state in the highest energy *p* orbital.





Halogens

In their pure forms:

Halogens form diatomic molecules (Cl_2, F_2)
They are highly reactive, and toxic to many organisms.

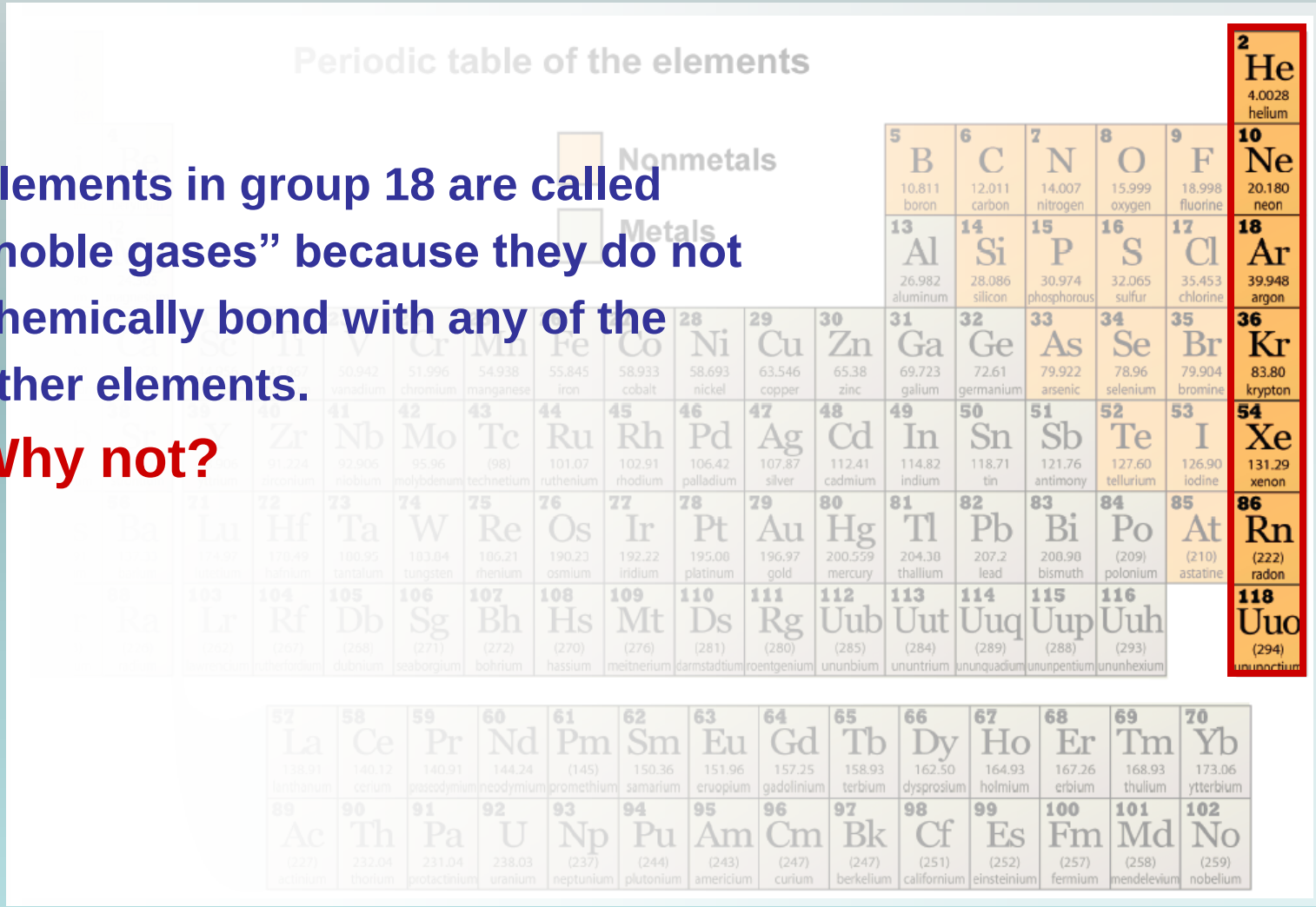
When combined with a metal:

The resulting compound is generally an ionic salt.

Noble gases

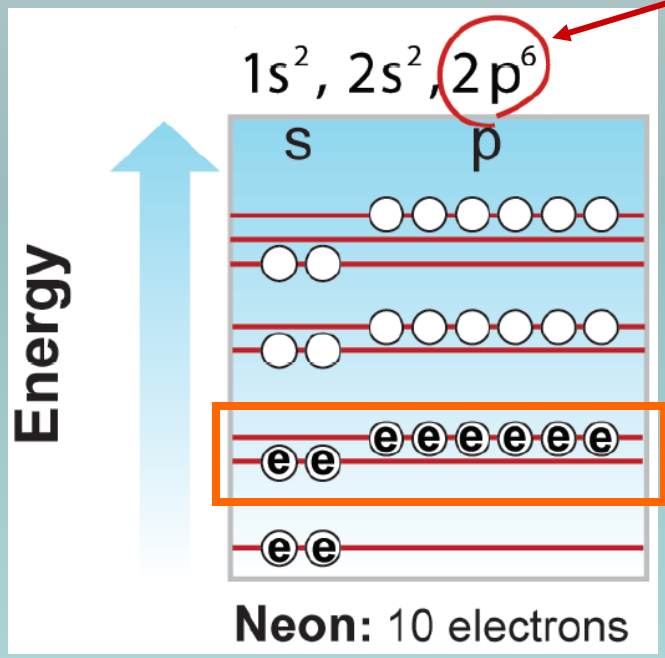
Elements in group 18 are called "noble gases" because they do not chemically bond with any of the other elements.

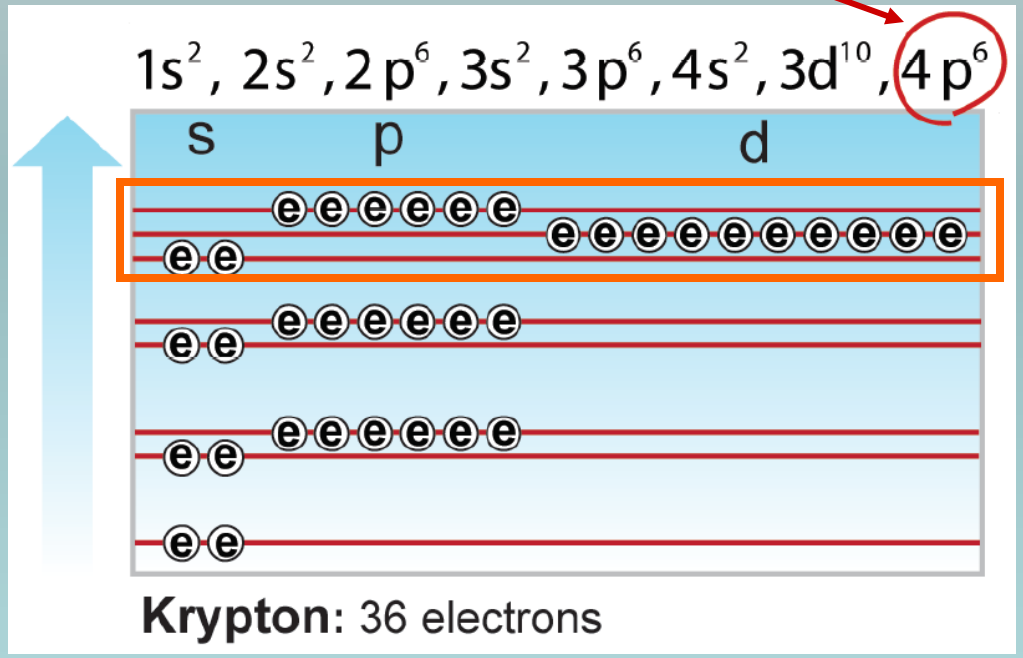
Why not?



Noble gases

The highest energy levels are completely filled.

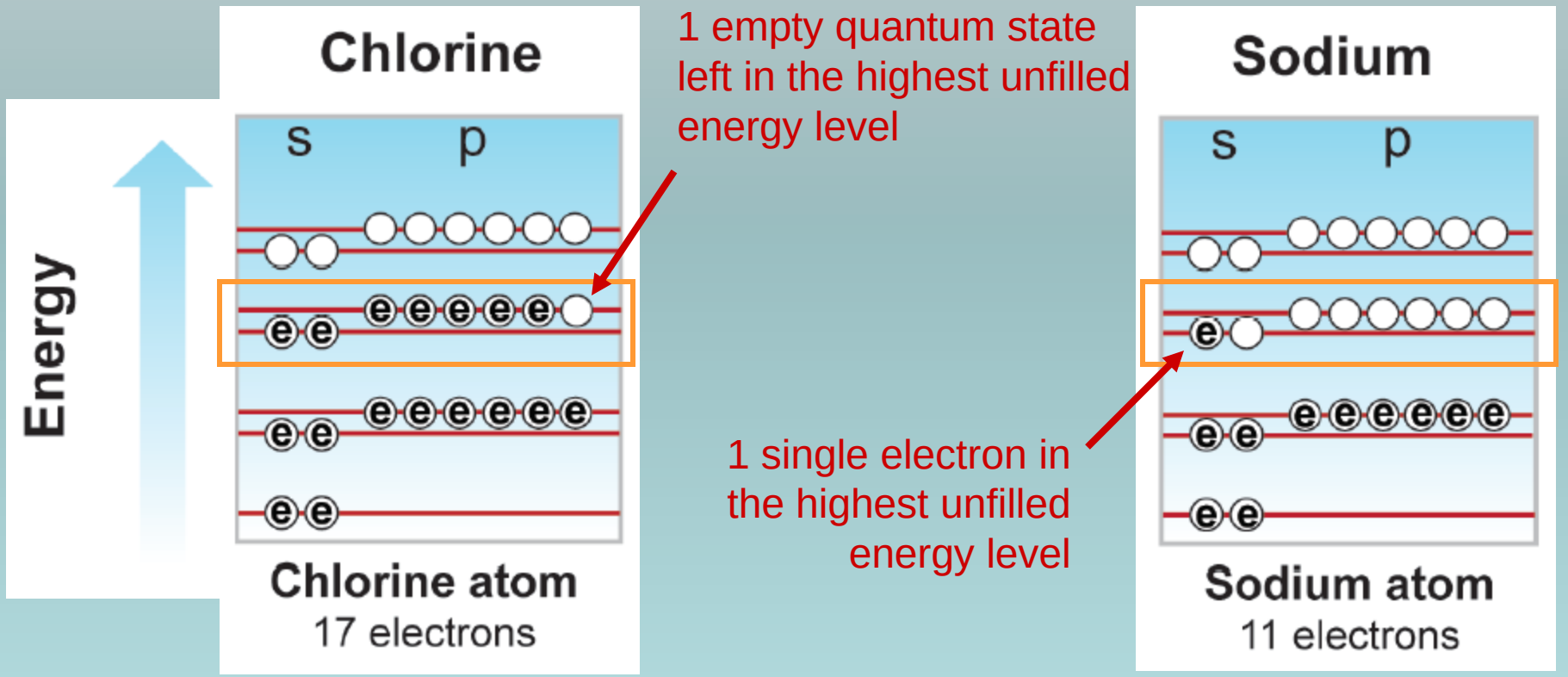




Electrons in completely filled energy levels do not make bonds.

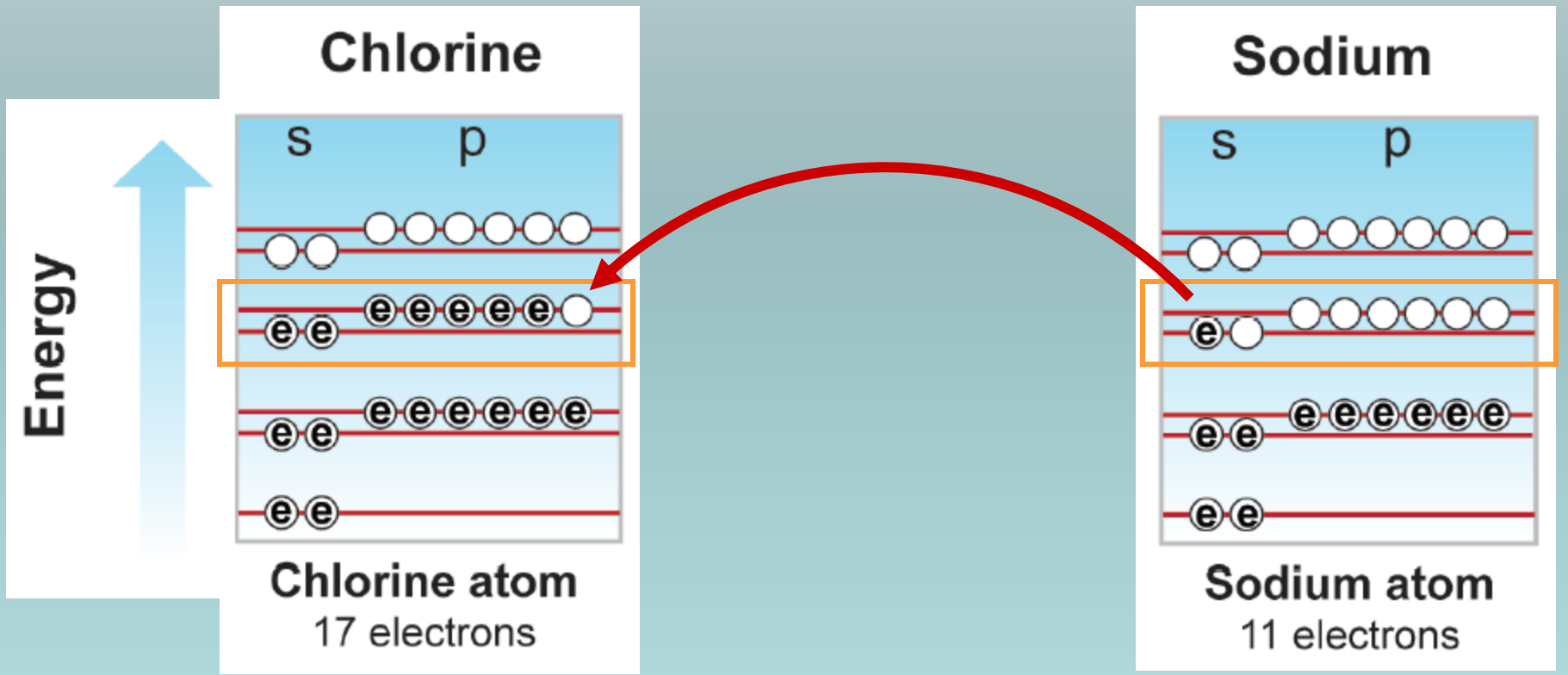
Bond formation

Remember: Electrons are responsible for bonding properties.



Bond formation

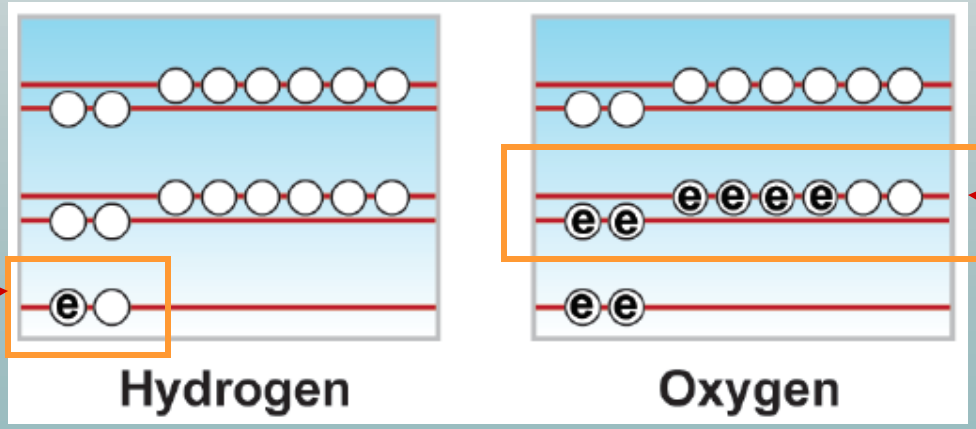
By forming the ionic compound sodium chloride, both chloride and sodium ions achieve a noble gas electron structure!



18 electrons like argon

10 electrons like neon

Bond formation



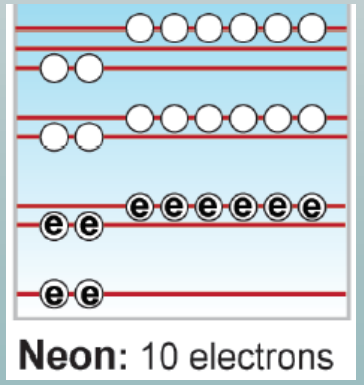
1 single electron in the highest unfilled energy level

2 empty quantum states left in the highest unfilled energy level

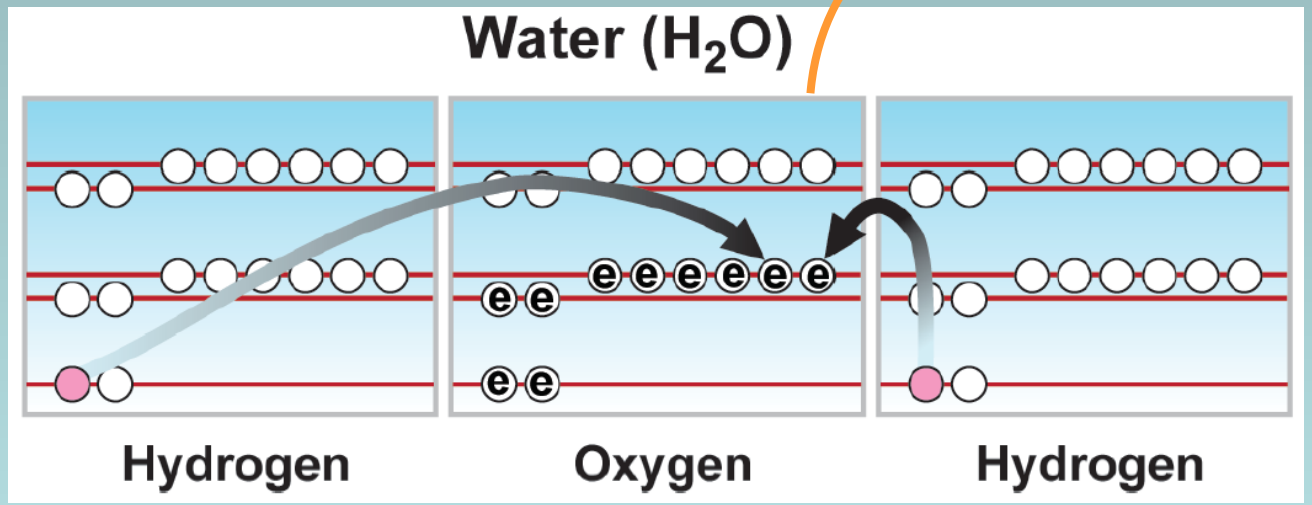
Can you form a molecule with hydrogen and oxygen atoms?

Bond formation

Each hydrogen atom donates one electron to the oxygen atom

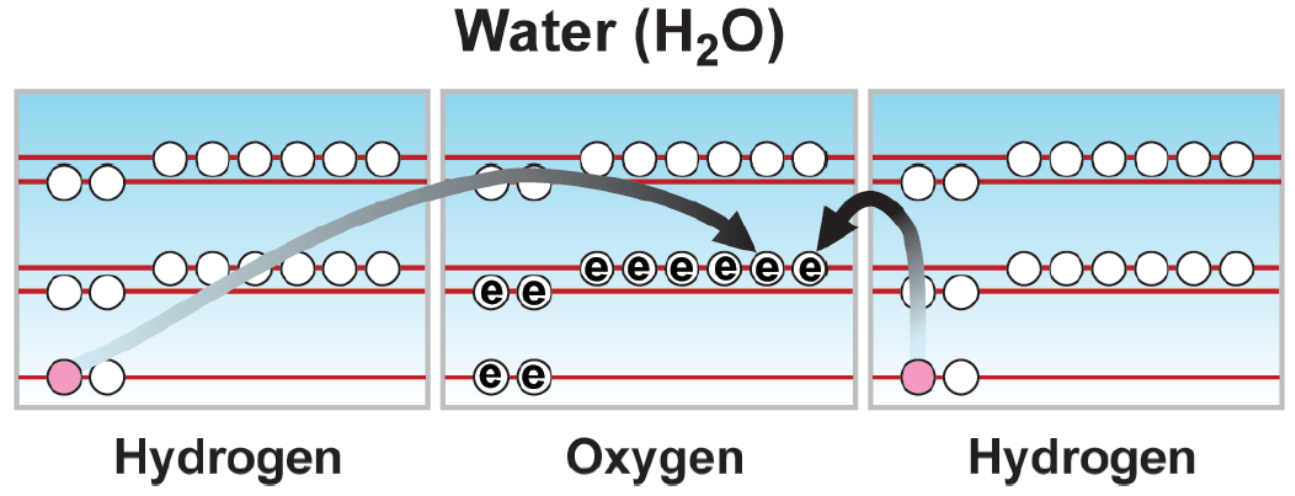


Oxygen now has 10 electrons, like neon (a noble gas)



Elements that belong to the same period in the periodic table have similar chemical properties.

This is because they have **similar electron configurations**, and **electrons are responsible for bonding properties**.



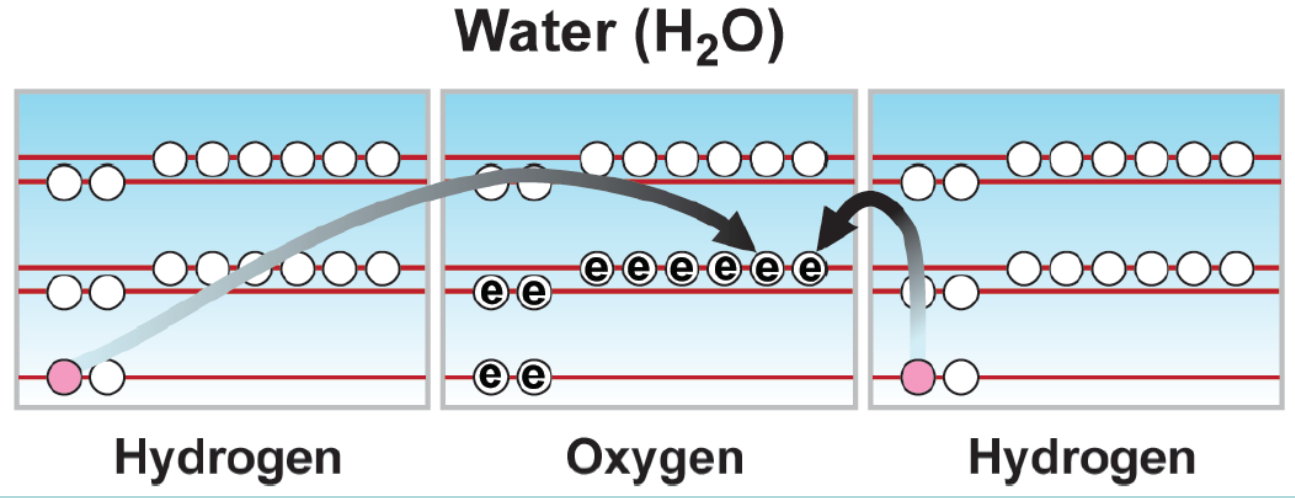
A noble gas electron structure is obtained through bond formation.

Elements and the Periodic Table

Valence

Only the electrons in the highest unfilled energy level form chemical bonds.

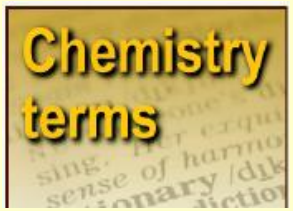
Does that mean we don't need to worry about electrons in filled energy levels?



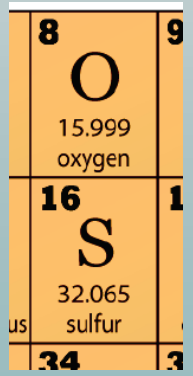
Only the electrons in the highest unfilled energy level form chemical bonds.

Does that mean we don't need to worry about electrons in filled energy levels?

Yes!

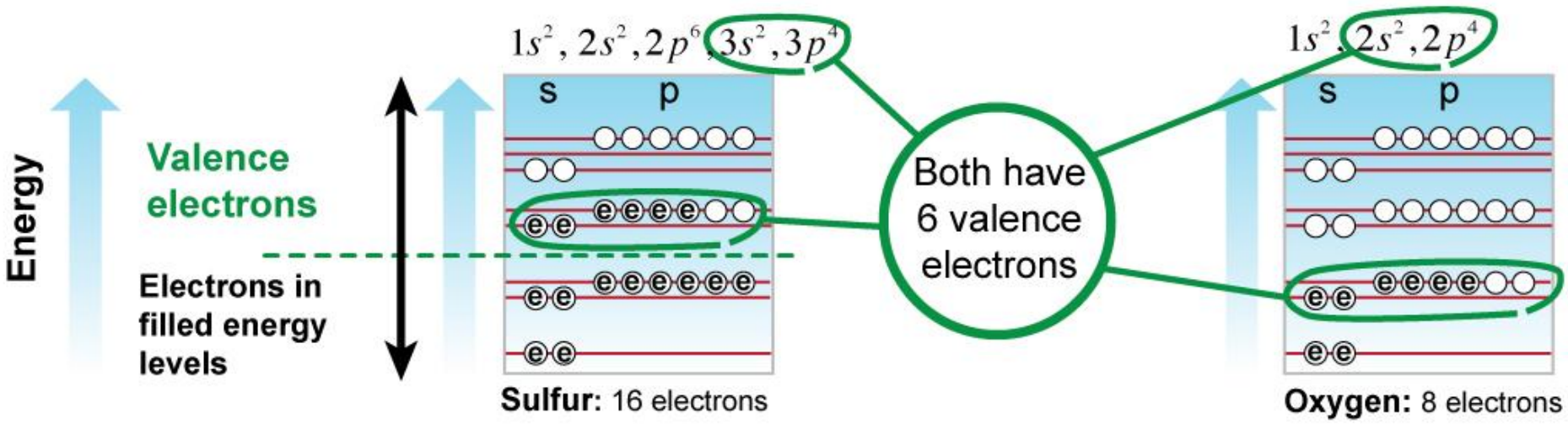


valence electrons: electrons in the highest unfilled energy level, responsible for making chemical bonds.

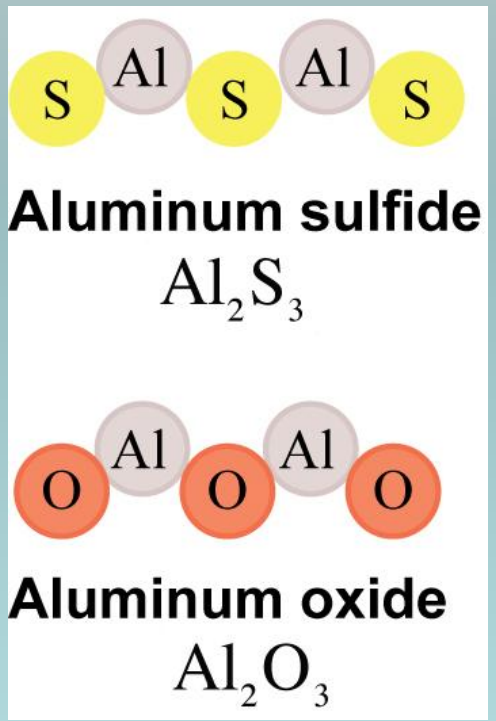


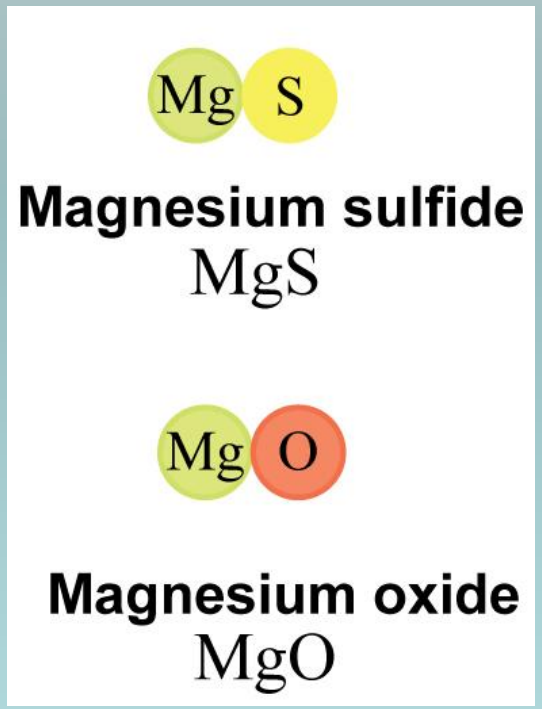
Oxygen and sulfur belong to the same group in the periodic table

Remember that elements that belong to the same group have similar chemical properties!

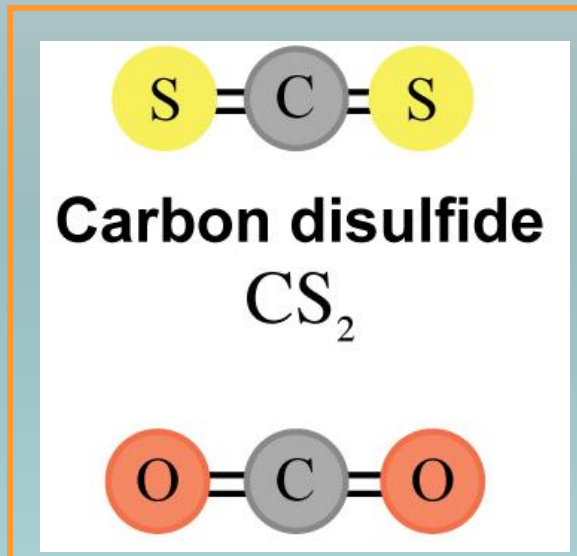


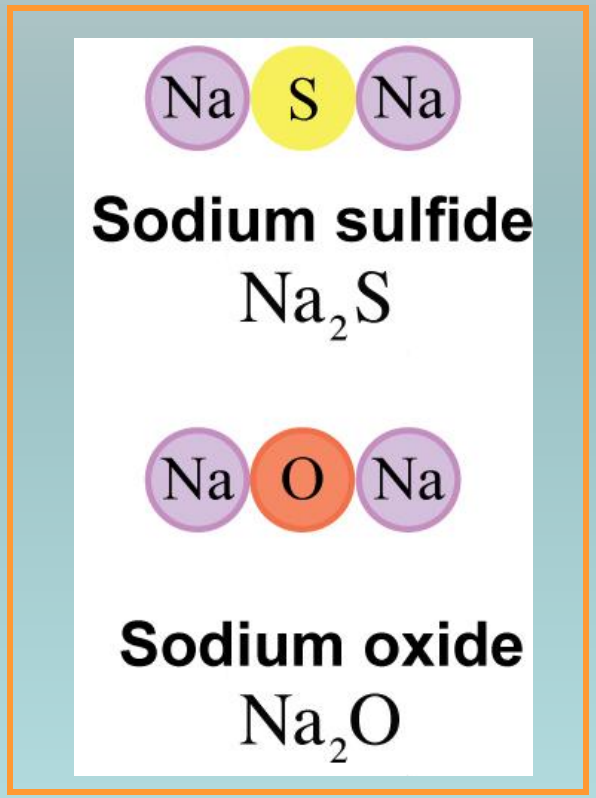
Sulfur and oxygen have the same number of valence electrons. They form similar chemical compounds.



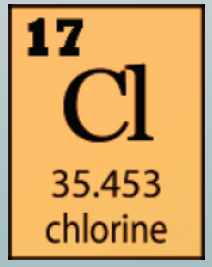


Sulfur and oxygen have the same number of valence electrons.
They form similar chemical compounds.





Determining valence electrons



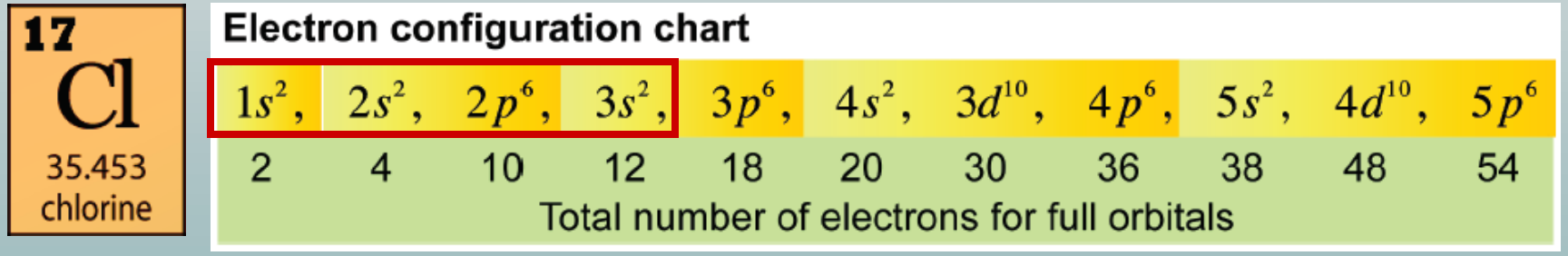
Electron configuration chart

$1s^2$,	$2s^2$,	$2p^6$,	$3s^2$,	$3p^6$,	$4s^2$,	$3d^{10}$,	$4p^6$,	$5s^2$,	$4d^{10}$,	$5p^6$
2	4	10	12	18	20	30	36	38	48	54

Total number of electrons for full orbitals

1. Write down the electron configuration.

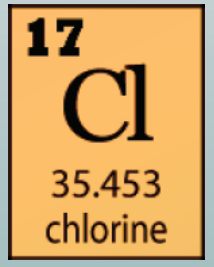
Determining valence electrons



1. Write down the electron configuration.

$Cl = 1s^2 2s^2 2p^6 3s^2 3p^5$

Determining valence electrons



Electron configuration chart

$1s^2$,	$2s^2$,	$2p^6$,	$3s^2$,	$3p^6$,	$4s^2$,	$3d^{10}$,	$4p^6$,	$5s^2$,	$4d^{10}$,	$5p^6$
2	4	10	12	18	20	30	36	38	48	54

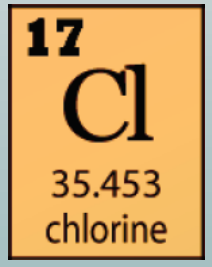
Total number of electrons for full orbitals

1. Write down the electron configuration.
2. Count how many electrons are in the highest *s* and *p* orbitals (it should be between 1 and 8).

$$Cl = 1s^2 2s^2 2p^6 \underbrace{3s^2}\ \underbrace{3p^5}$$

Level 3 is the highest energy level

Determining valence electrons



Electron configuration chart

$1s^2$,	$2s^2$,	$2p^6$,	$3s^2$,	$3p^6$,	$4s^2$,	$3d^{10}$,	$4p^6$,	$5s^2$,	$4d^{10}$,	$5p^6$
2	4	10	12	18	20	30	36	38	48	54

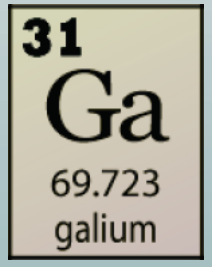
Total number of electrons for full orbitals

1. Write down the electron configuration.
2. Count how many electrons are in the highest *s* and *p* orbitals (it should be between 1 and 8).
3. These are the valence electrons.

2 + 5 = 7 valence electrons

$$Cl = 1s^2 2s^2 2p^6 3s^2 3p^5$$

Determining valence electrons



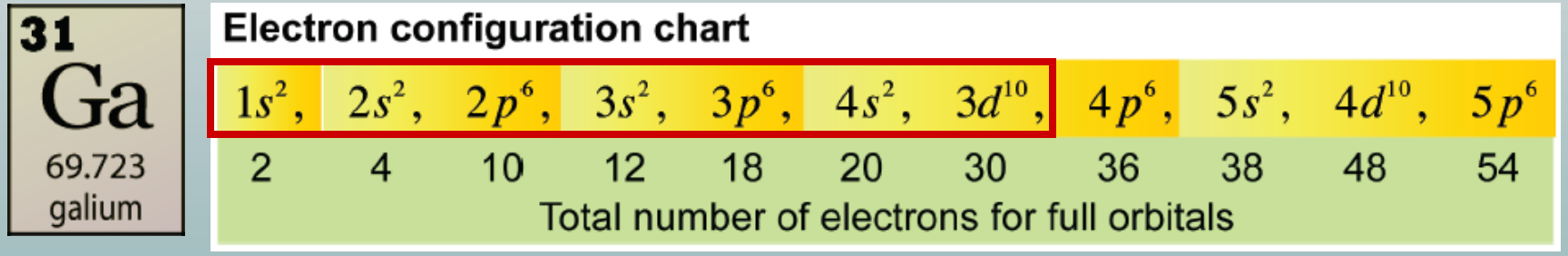
Electron configuration chart

$1s^2$,	$2s^2$,	$2p^6$,	$3s^2$,	$3p^6$,	$4s^2$,	$3d^{10}$,	$4p^6$,	$5s^2$,	$4d^{10}$,	$5p^6$
2	4	10	12	18	20	30	36	38	48	54

Total number of electrons for full orbitals

1. Write down the electron configuration.

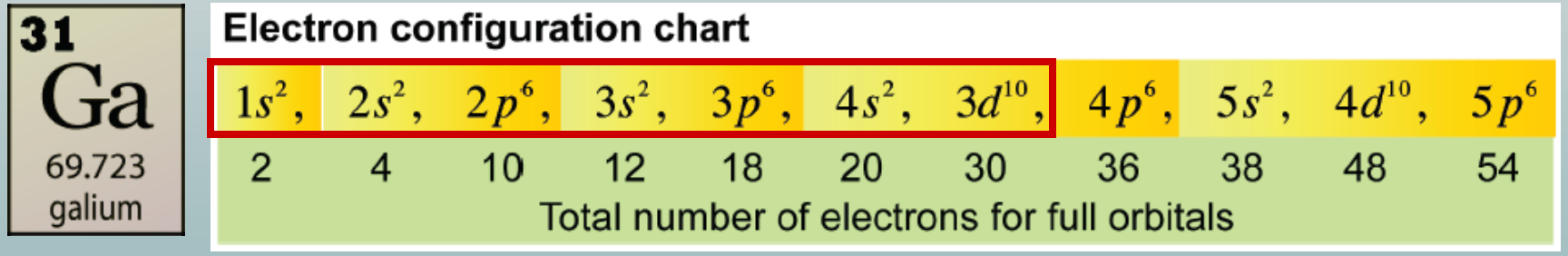
Determining valence electrons



1. Write down the electron configuration.

$Ga = 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^1$

Determining valence electrons

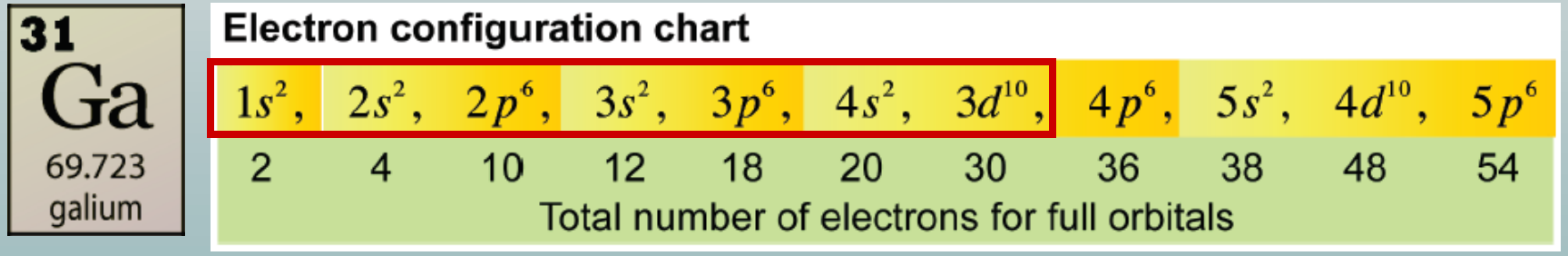


1. Write down the electron configuration.
2. Count how many electrons are in the highest *s* and *p* orbitals (it should be between 1 and 8).

$$Ga = 1s^2 2s^2 2p^6 3s^2 3p^6 \underbrace{4s^2}\ 3d^{10} \underbrace{4p^1}$$

Level 4 is the highest energy level

Determining valence electrons



1. Write down the electron configuration.
2. Count how many electrons are in the highest *s* and *p* orbitals (it should be between 1 and 8).
3. These are the valence electrons.

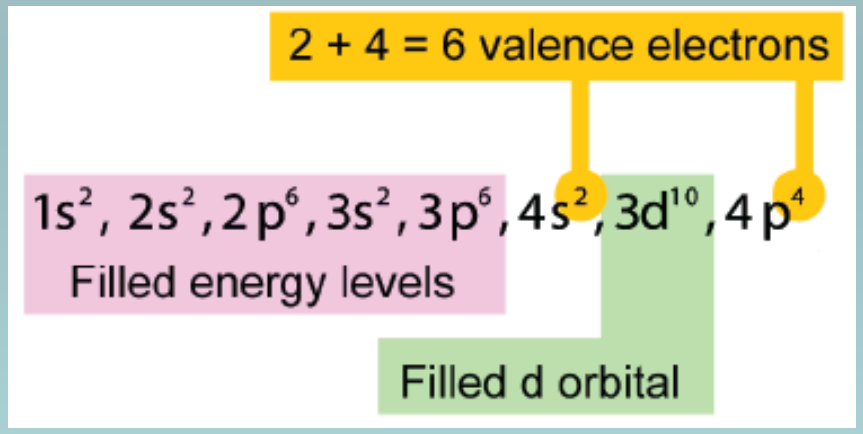
2 + 1 = 3 valence electrons

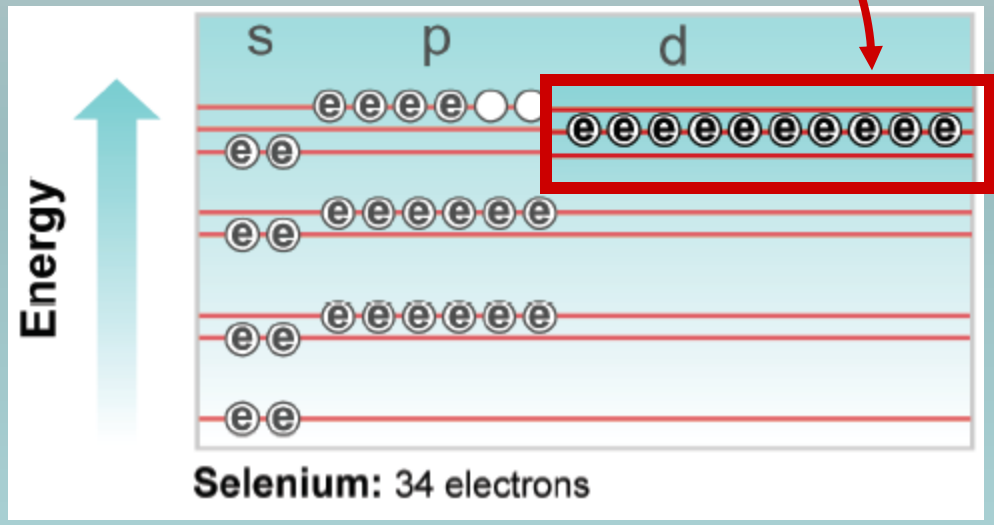
$$Ga = 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^1$$

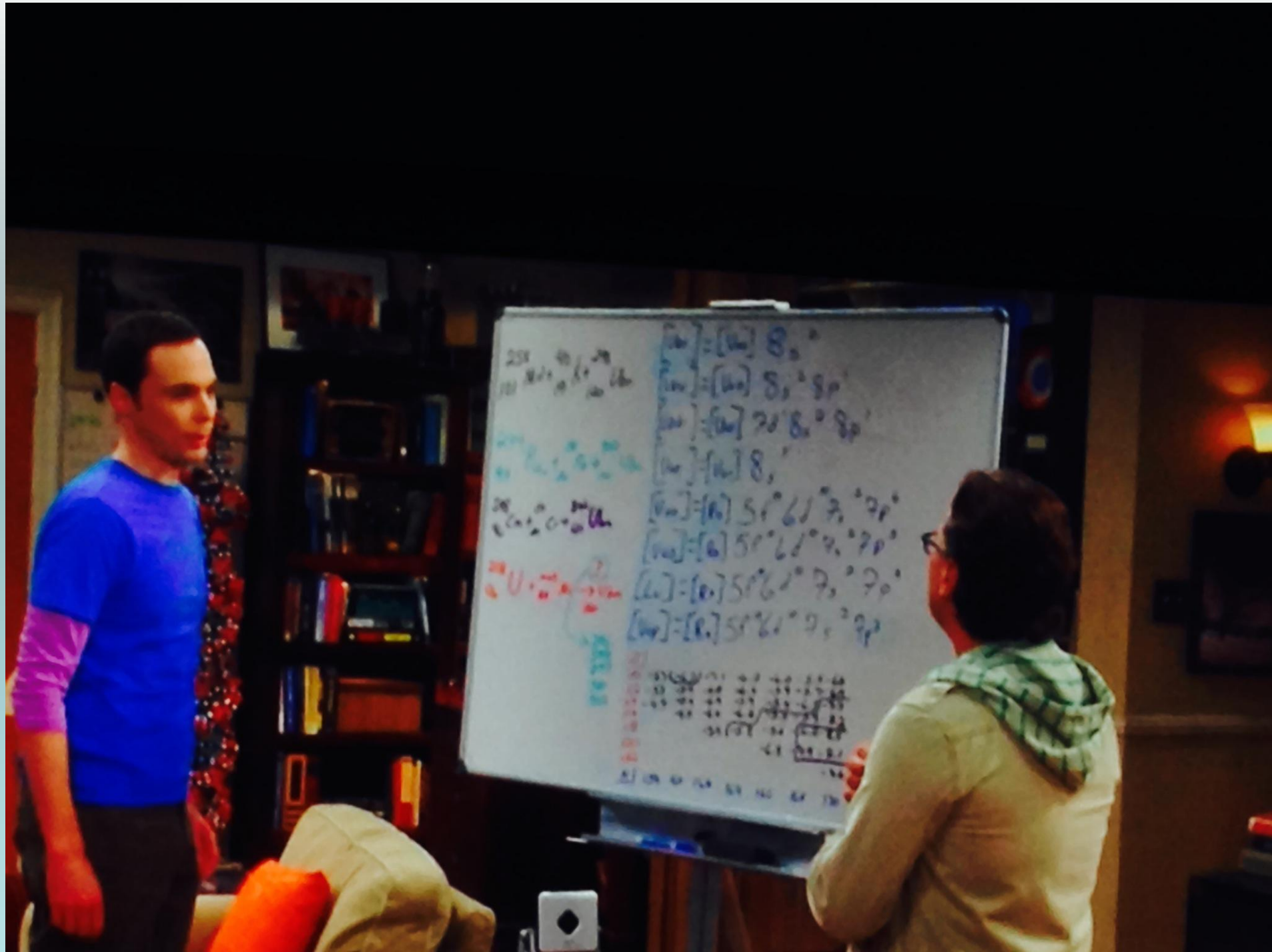
Lewis dot diagram

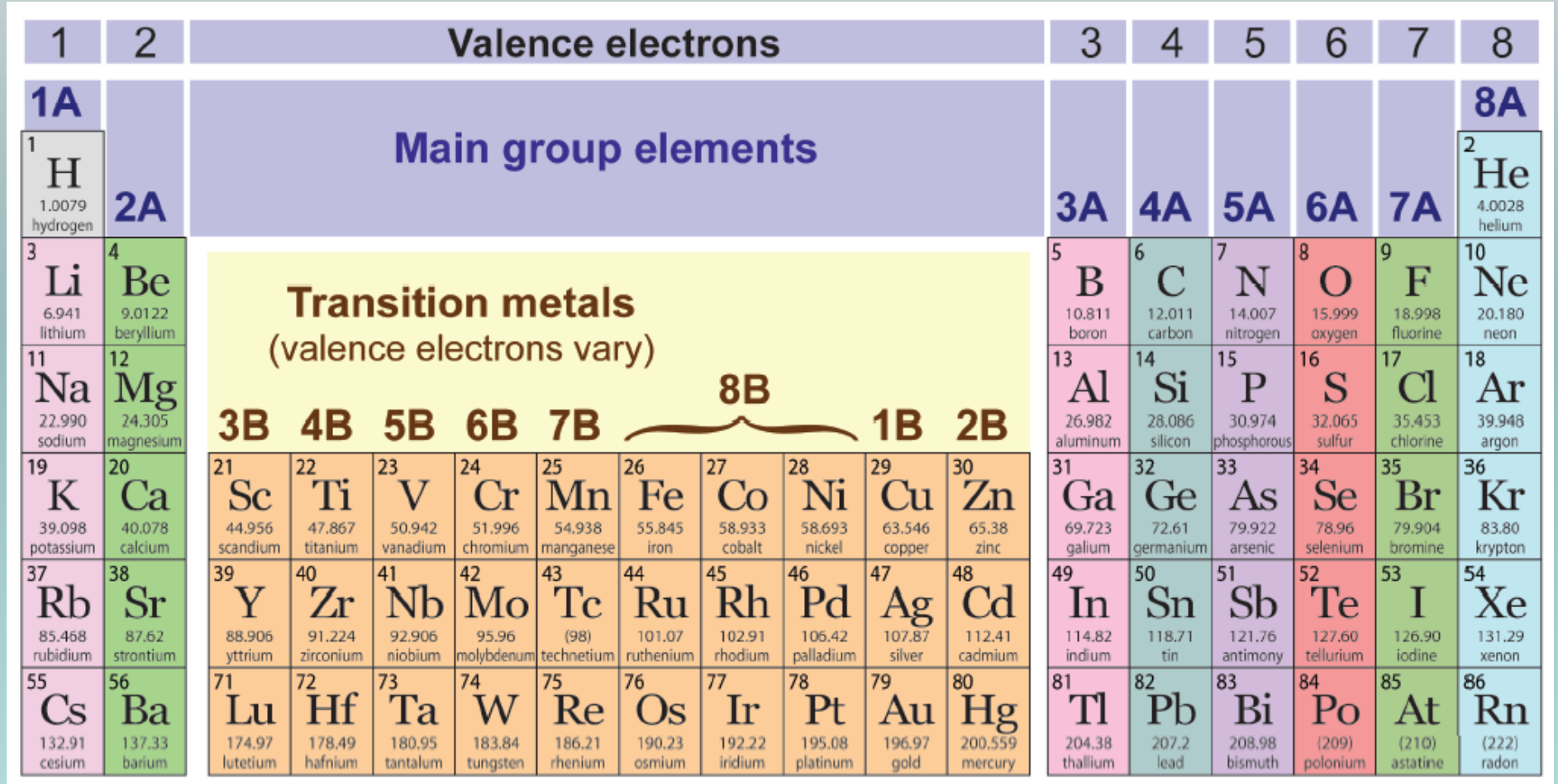
Filled *d* orbitals do not contribute valence electrons!

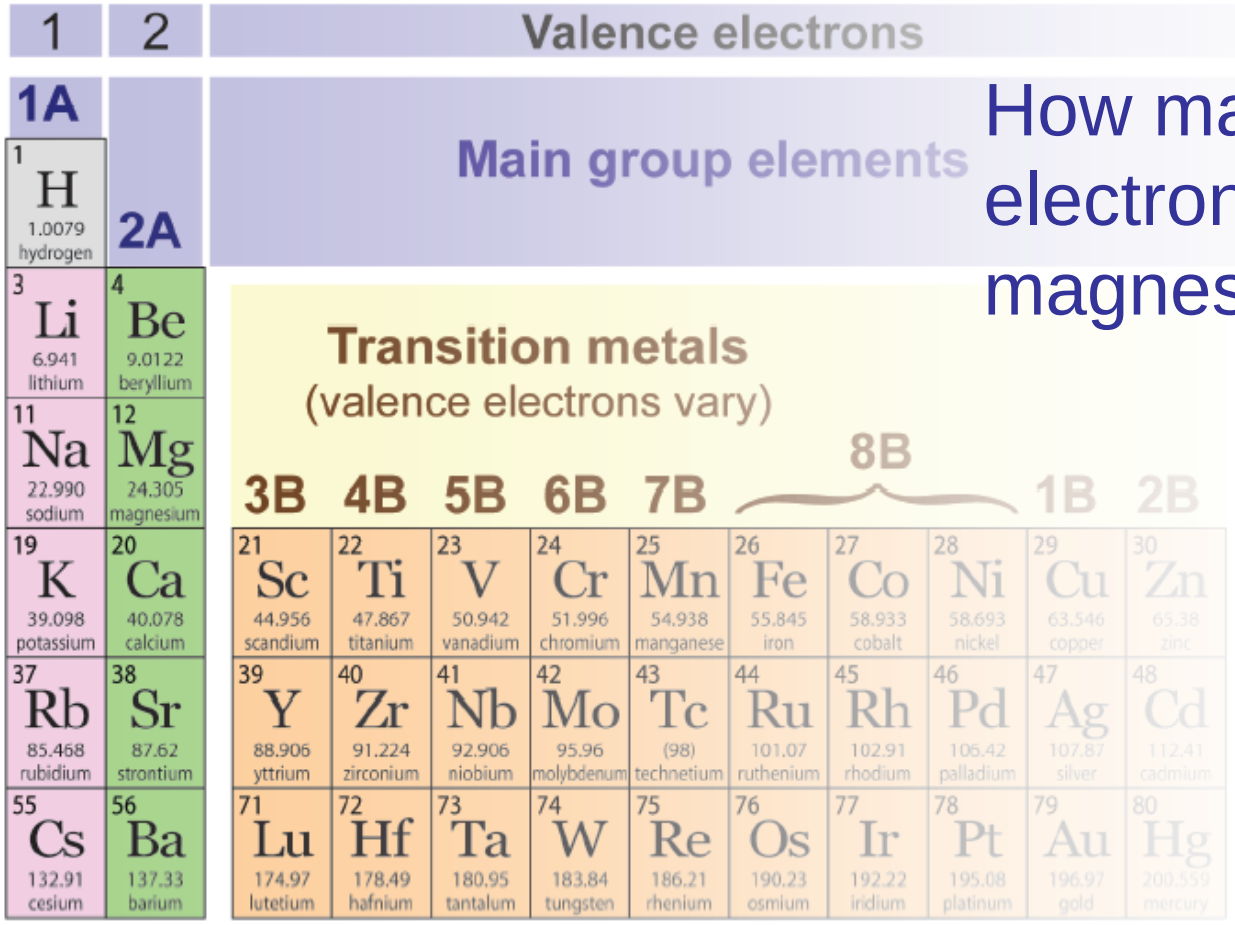
Valence electrons for selenium



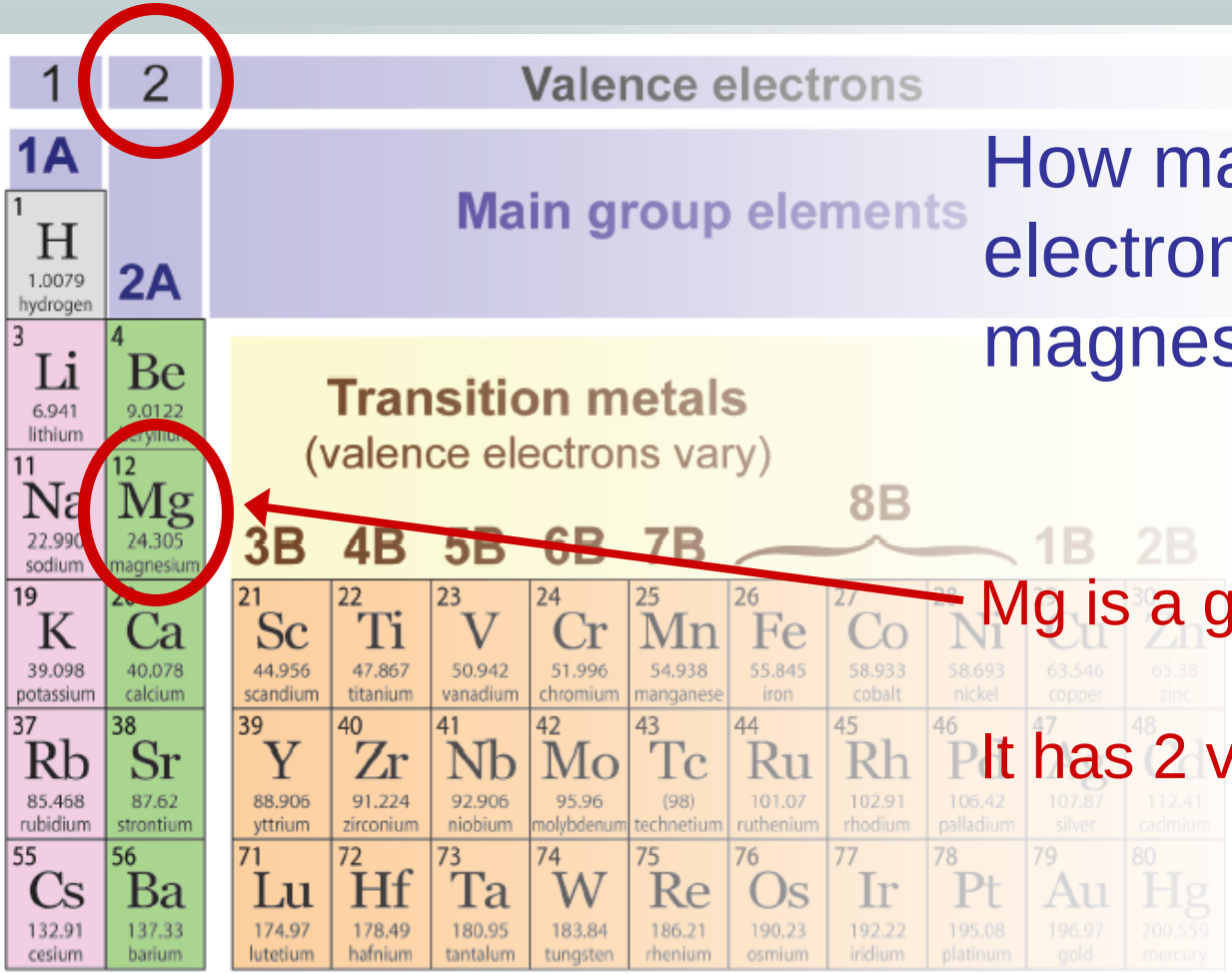





1
2
Valence electrons
3
4
5
6
7
8
1A
2A
Main group elements
3A
4A
5A
6A
7A
8A
1 H 1.0079 hydrogen
2 He 4.0028 helium
3 Li 6.941 lithium
4 Be 9.0122 beryllium
5 B 10.811 boron
6 C 12.011 carbon
7 N 14.007 nitrogen
8 O 15.999 oxygen
9 F 18.998 fluorine
10 Ne 20.180 neon
11 Na 22.990 sodium
12 Mg 24.305 magnesium
13 Al 26.982 aluminum
14 Si 28.086 silicon
15 P 30.974 phosphorous
16 S 32.065 sulfur
17 Cl 35.453 chlorine
18 Ar 39.948 argon
19 K 39.098 potassium
20 Ca 40.078 calcium
Transition metals
(valence electrons vary)
3B 4B 5B 6B 7B 8B 1B 2B
21 Sc 44.956 scandium
22 Ti 47.867 titanium
23 V 50.942 vanadium
24 Cr 51.996 chromium
25 Mn 54.938 manganese
26 Fe 55.845 iron
27 Co 58.933 cobalt
28 Ni 58.693 nickel
29 Cu 63.546 copper
30 Zn 65.38 zinc
31 Ga 69.723 galium
32 Ge 72.61 germanium
33 As 79.922 arsenic
34 Se 78.96 selenium
35 Br 79.904 bromine
36 Kr 83.80 krypton
37 Rb 85.468 rubidium
38 Sr 87.62 strontium
39 Y 88.906 yttrium
40 Zr 91.224 zirconium
41 Nb 92.906 niobium
42 Mo 95.96 molybdenum
43 Tc (98) technetium
44 Ru 101.07 ruthenium
45 Rh 102.91 rhodium
46 Pd 106.42 palladium
47 Ag 107.87 silver
48 Cd 112.41 cadmium
49 In 114.82 indium
50 Sn 118.71 tin
51 Sb 121.76 antimony
52 Te 127.60 tellurium
53 I 126.90 iodine
54 Xe 131.29 xenon
55 Cs 132.91 cesium
56 Ba 137.33 barium
71 Lu 174.97 lutetium
72 Hf 178.49 hafnium
73 Ta 180.95 tantalum
74 W 183.84 tungsten
75 Re 186.21 rhenium
76 Os 190.23 osmium
77 Ir 192.22 iridium
78 Pt 195.08 platinum
79 Au 196.97 gold
80 Hg 200.559 mercury
81 Tl 204.38 thallium
82 Pb 207.2 lead
83 Bi 208.98 bismuth
84 Po (209) polonium
85 At (210) astatine
86 Rn (222) radon



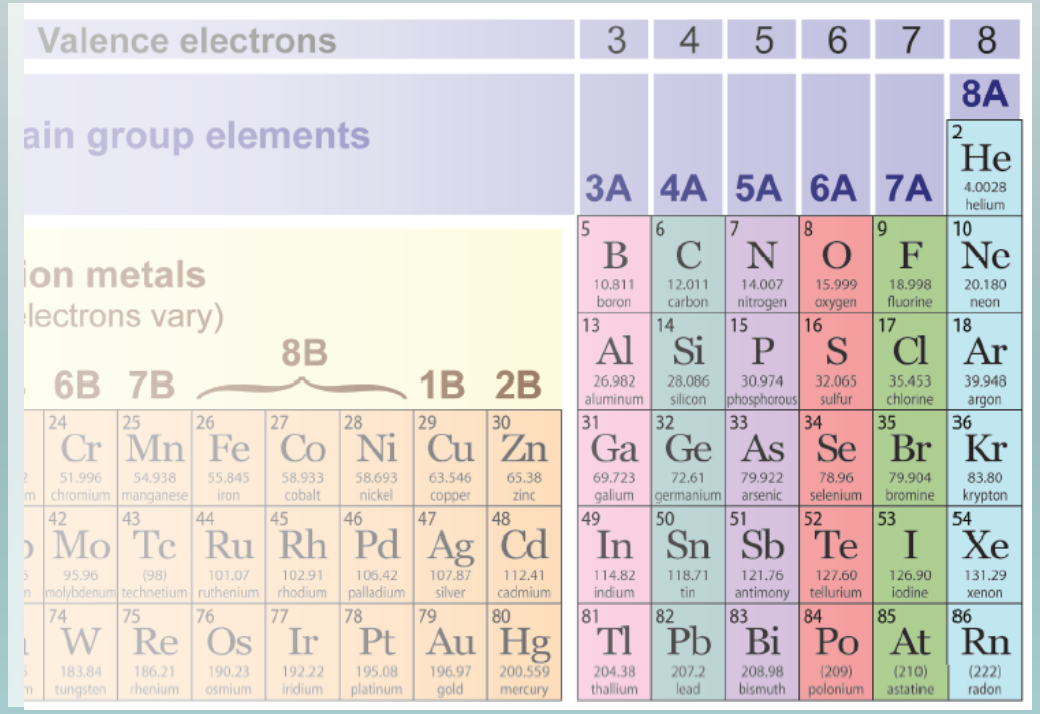
How many valence electrons does magnesium (Mg) have?



How many valence electrons does magnesium (Mg) have?

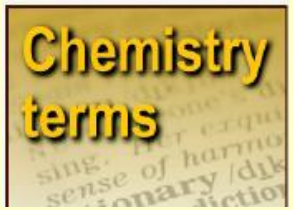
Mg is a group 2A element.

It has 2 valence electrons

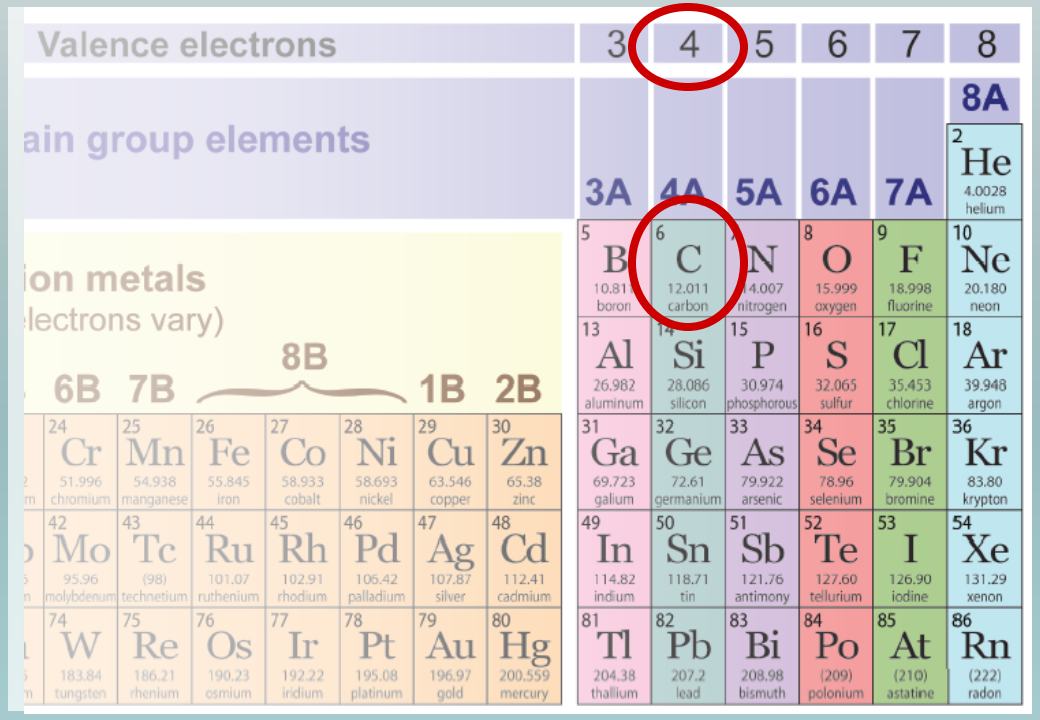


How many valence electrons does carbon have?

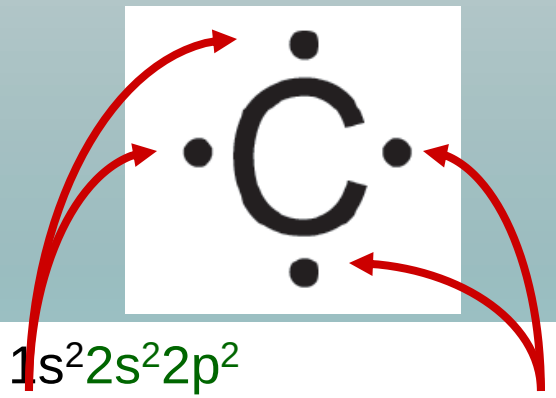
C



Lewis dot diagram: a diagram showing one dot for each valence electron an atom has, these dots surround the element symbol of the atom.

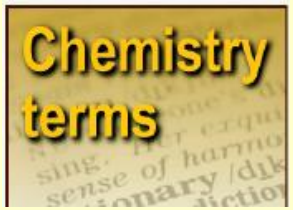


Lewis dot diagram for carbon



$1s^2 2s^2 2p^2$

4 valence electrons



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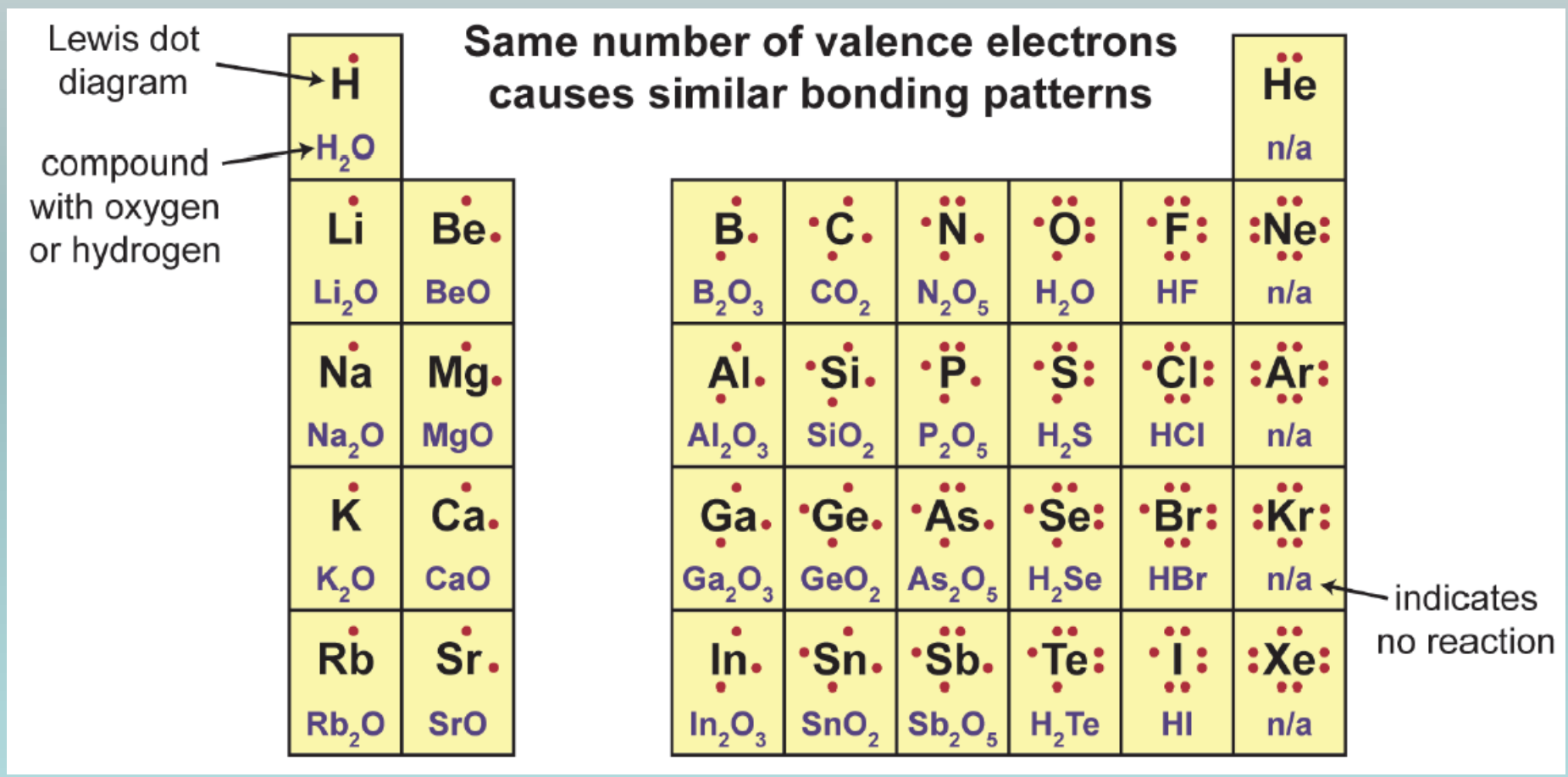
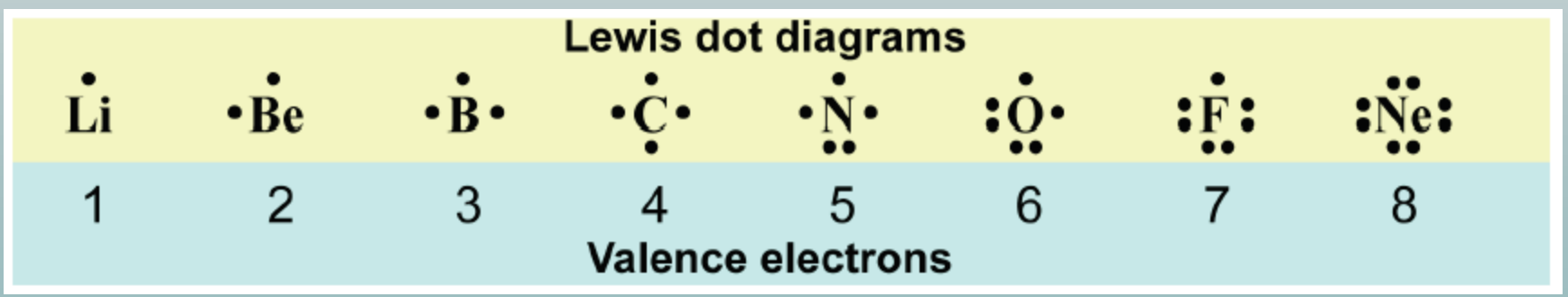
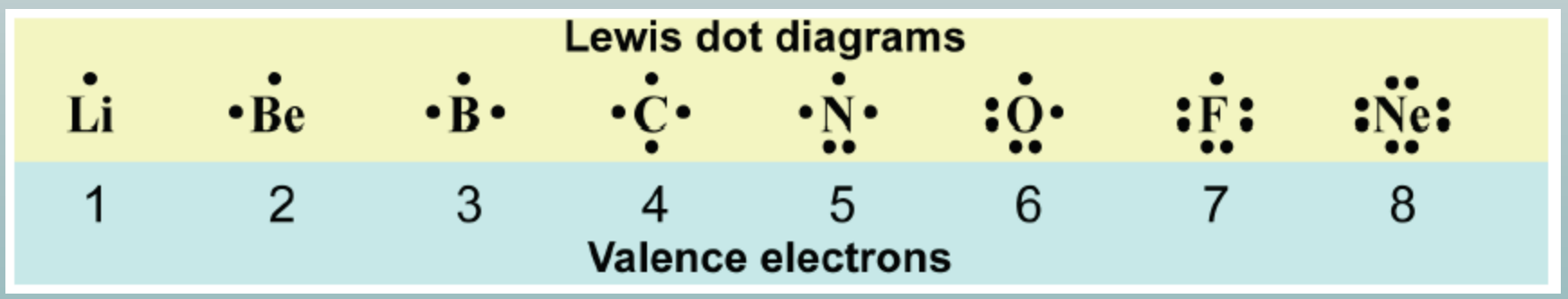
Lewis dot diagram



Lewis dot diagram



Valence electrons are the most loosely bound electrons in an atom. They are easiest to share or transfer.



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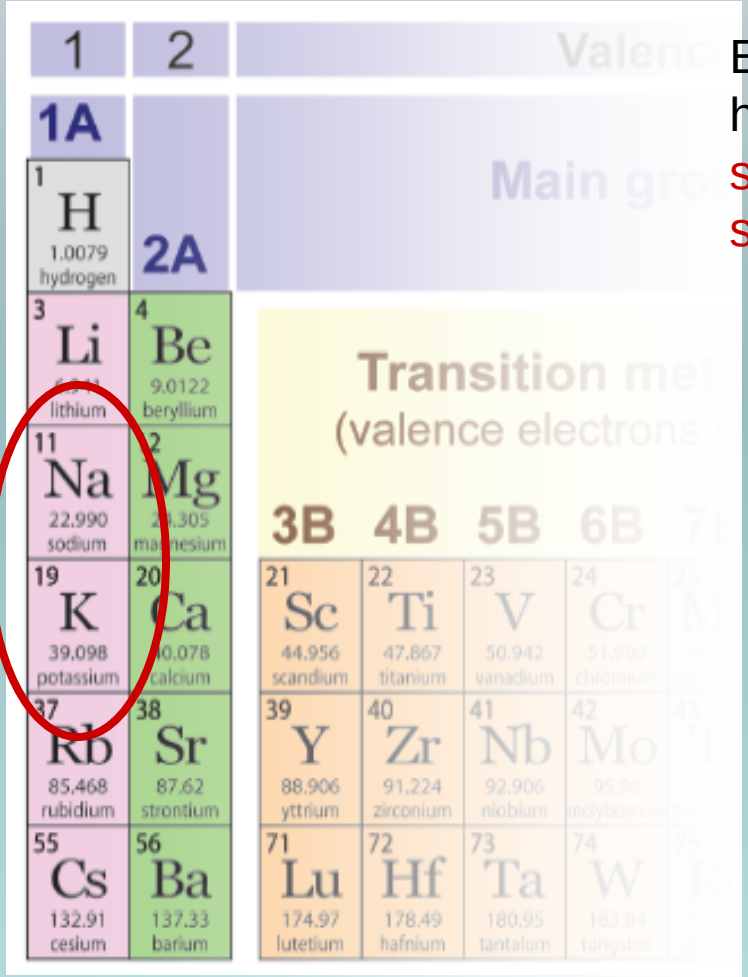
Is the periodic table just an organizational system?

Can it be used as a tool?



Elements from the same group (column) have similar chemical properties,
so they interact with neighboring atoms in a similar way.

Normal glass can be made stronger by replacing Na with K on its surface

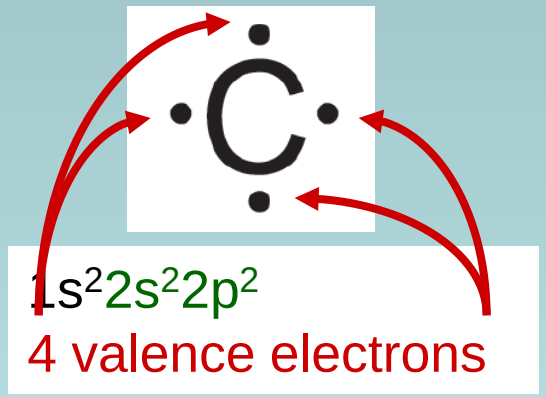
- Elements that belong to the same group in the periodic table have the same number of valence electrons

- Only valence electrons are involved in chemical bonding

- The Lewis dot diagram is a way to show valence electrons for an atom

Carbon has
4 valence electrons

Lewis dot diagram for carbon



$1s^2 2s^2 2p^2$

4 valence electrons