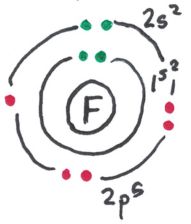
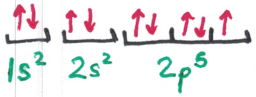
Notes on Unit 4 Chemistry

① Bohr vs. Lewis.

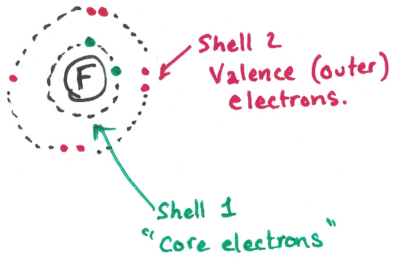
Bohr's model had shown the arrangement of all electrons in their shells

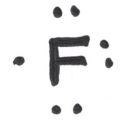
Example: Fluorine (9)





Lewis said only Valence electrons bond to other elements. Therefore, his dot structures only show these electrons





Valence electrons are found in the outermost shells.

Valence Examples

Element	Orbitals	Total Valence e^-	Group #
Na	[Ne] $3s^1$	1	1A
Si	[Ne] $3s^2 3p^2$	4	4A
As	[Ar] $3d^{10} 4s^2 4p^3$	5	5A
Te	[Kr] $4d^{10} 5s^2 5p^4$	6	6A

The group # shows # of valence e^-

Noble gasses have their outermost / valence shell FULL; Meaning 8 electrons.

Other elements want this stability

Lewis Dot Symbols

[He] $2s^2 2p^6$ — Period: 2; Group: 6; Valence

Group:	1A	2A	3A	4A	5A	6A	7A	8A
Period 2	Li•	•Be•	•B•	•C•	•N•	•O:	•F:	:Ne:
Period 3	Na•	•Mg•	•Al•	•Si•	•P•	•S:	•Cl:	:Ar:
Electrons 2	[He] $2s^1$	[He] $2s^2$	[He] $2s^2 2p^1$	[He] $2s^2 2p^2$	[He] $2s^2 2p^3$	[He] $2s^2 2p^4$	[He] $2s^2 2p^5$	[He] $2s^2 2p^6$
Electrons 3	[Ne] $3s^1$	[Ne] $3s^2$	[Ne] $3s^2 3p^1$	[Ne] $3s^2 3p^2$	[Ne] $3s^2 3p^3$	[Ne] $3s^2 3p^4$	[Ne] $3s^2 3p^5$	[Ne] $3s^2 3p^6$

Anions & Cations & Ions:

An ion is an atom with an irregular amount of electrons.

Positive ions mean fewer electrons

Negative ions mean more electrons

Fe	Fe^+	Fe^{+2}
26 electrons	25	24

N	N^{-3}
7 electrons	10 electrons

CATIONS (+)

ANIONS (−)

	1A	2A	3A	4A	5A	6A	7A	8A
1	H							He
2	Li	Be	B	C	N	O	F	Ne
3	Na	Mg	Al	Si	P	S	Cl	Ar
4	K	Ca	Ga	Ge	As	Se	Br	kr
	+1	+2	+3	+/-4 *	-3	-2	-1	Ø

Ions of Groups 1-8, periods 1-4

Monoatomic Ions

Single Atom

Li^{+}
Cl^{-}
Al^{+3}

* Some have multiple ions:

Fe^{+2} or Fe^{+3}

Cu^{+} or Cu^{+2}

- If no number, default is 1:
  - $-$ → (-1)
  - $+$ → (+1)

Polyatomic Ions:

Multiple atoms together has a charge and behaves as if its a single atom.

NH_4^{+} Ammonium

Some Polyatomics & charges

OH^{-} Hydroxide	NO_2^{-} Nitrite	SO_3^{2-} Sulfite
ClO^{-} Hypochlorite	NO_3^{-} Nitrate	SO_4^{2-} Sulfate
ClO_2^{-} Chlorite	CN^{-} cyanide	$Cr_2O_7^{2-}$ Dichromate
ClO_3^{-} Chlorate	MnO_4^{-} Permaganate	$C_2O_4^{2-}$ Oxalate
ClO_4^{-} Perchlorate	CO_3^{2-} carbonate	PO_4^{3-} Phosphate
CH_3COO^{-} Acetate		

Bonding

1. Ionic Bonding: (Metal + Non Metal)

- A bond between a positively charged ion (cation) and a negatively charged ion (anion)

$Li^{+} + Cl^{-} \rightarrow$ Lithium Chloride $LiCl$ $+1 + -1$

$Mg^{+2} + O^{-2} \rightarrow$ Magnesium Oxide MgO $+2 + -2$

$Ca^{+2} + Cl^{-} \rightarrow$ Calcium Chloride $CaCl_2$ $+2 + -1\,(x2)$

$Fe^{+3} + O^{-2} \rightarrow$ Iron (III) Oxide Fe_2O_3 $+3\,(x2) + -2\,(x3)$

$K^{+} + ClO_2^{-} \rightarrow$ Potassium Chlorite $KClO_2$ $+1 + -1$

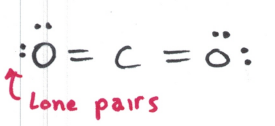
In ionic bonding, the larger, more electronegative element takes electrons from the other element: Giving one 8 (octet Rule)

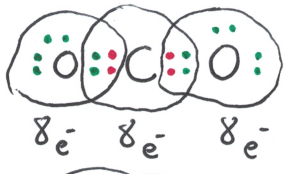
Be = O
Single Bond

Oxygen has 8

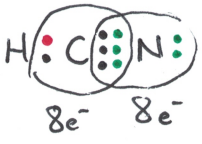
2. Covalent Bonding: (Non Metal & Non Metal)

- A bond between two or more atoms that "share" electrons to feel as if octet rule is satisfied.





All happy ☺

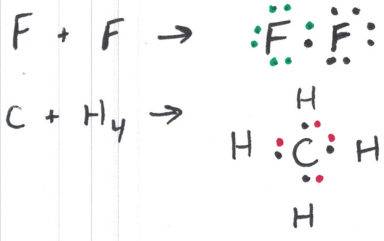


C & N are happy ☺

H, kinda happy with Ø.
Ø is stable, but H may leave for a better deal.

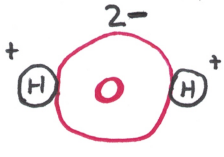
Non-Polar

Same charge or no charge.



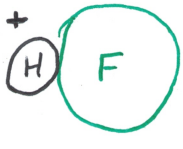
Polar

residual charge or dipole.



H_2O

Size disparity creates charged ends.



HF

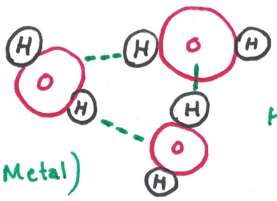
Dipole

charged ends

3. Hydrogen Bond (Hydrogen + non metal)

A type of dipole-dipole bond involving hydrogen and usually F, O, or N.

H_2O



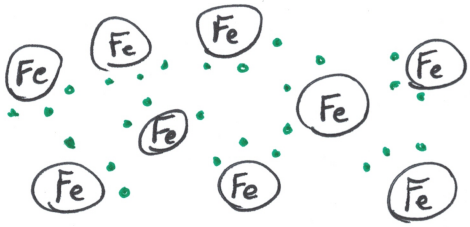
Interconnecting Hydrogen bonds in water.

Hydrogen bonding is generally weak; But critical for life.

4. Metallic Bond (Metal + Metal)

A bond between metals freely shares electrons between them

Metals: Good conductors of electricity
Good conductors of heat
Malleable (pressed into sheets)
Ductile (stretchable)



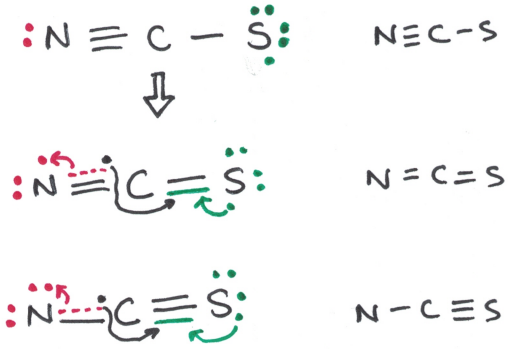
"Sea" of electrons.

Ionic Vs Covalent

	Ionic	Covalent
Elements:	Metal + NM	NM + NM.
Shape:	Lattice	Defined Shapes
Melt Point:	High	Low
Boil Point:	High	Low
State: (RT)	Solid	Liquid & Gas
Polarity:	High	Low.

Another example:

Thiocyanate NCS



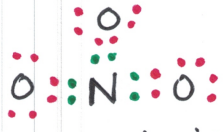
Lone pair electrons move to break/create bonds

Resonance Structures

- Electrons move around, creating "versions" of molecules.

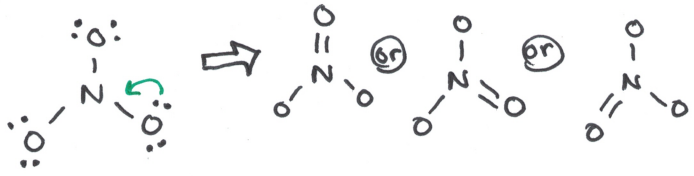
Example: NO_3^- Nitrate ion

Lewis DoT



- covalent bonds.
- Each Oxygen has 8
- Nitrogen ion has extra electron (-1)

Structure



The double bond will rotate among the oxygen

Since N needs 8, a lone pair from Oxygen may form a double bond

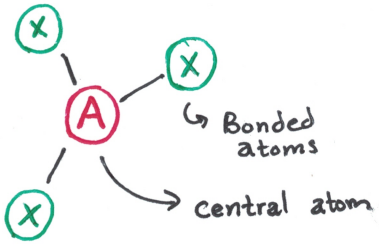
Therefore, We draw it with a dotted line.

VSEPR

"Valence Shell Electron Pair Repulsion"

- Electrons when grouped together create fields of energy and therefore they repel each other. This repelling causes shapes to form.

Nomenclature



How to Write

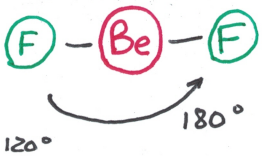
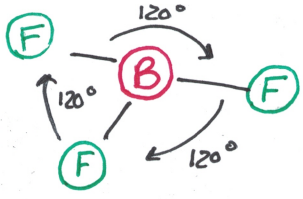
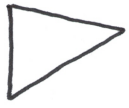
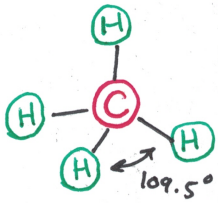
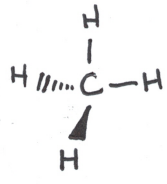
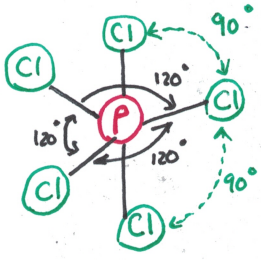
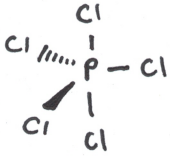
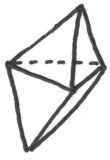
AX_3E_0 ← # of lone pair electrons on central atom

A: Central Atoms

3: Number of bonded atoms

To minimize repulsions, electrons move as far apart as possible.

Shapes of single-bond, no lone pair covalent bonding: (E_0)

				Shape
AX_2E_0	Linear	example: BeF_2		
AX_3E_0	Triangular planar	example: BF_3		
AX_4E_0	Tetrahedron	example: CH_4	 	
AX_5E_0	Triangular Bipyramidal	example: PCl_5	 	
AX_6E_0	Octahedron	example: SF_6