Outline

- Ionic Compounds
- Molecular Compounds
- Molecular Shape
- Molecular Polarity

Ionic Compounds

Atoms gain/lose electrons to obtain complete energy levels (octet)

Anions formed by gaining electrons in highest energy level

O	$1s^2 2s^2 2p^4$	O^{2-}	$1s^2 2s^2 2p^6$

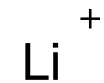
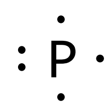
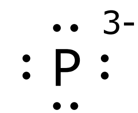
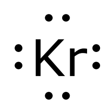
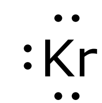
Cations formed by losing electrons in highest energy level

Al	$1s^2 2s^2 2p^6 3s^2 3p^1$	Al^{3+}	$1s^2 2s^2 2p^6$

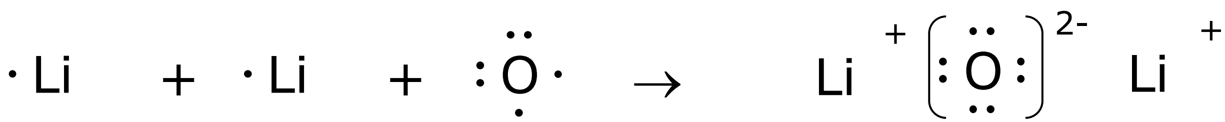
Atoms represented as Lewis Symbols…

…element symbol and valence electrons (as dots)

…“complete level” given by 0 or 8 electrons

Element…	Group…	Lewis Symbol…	Forms…
lithium	I		
phosphorous	V		
krypton	VIII		

Ions combine to form compound…



Attraction between oppositely charged ions is <u>ionic bond</u>

Molecular Compounds

Atoms share electrons to obtain complete energy levels (octet)

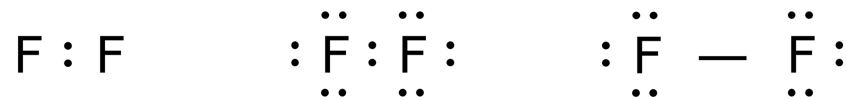
Attraction between nuclei and shared electrons is covalent bond

Molecules can be represented with Lewis structures…

1. Count all valence electrons
2. Identify central atom
3. Connect atoms together using dashes (pair of electrons)
4. Add remaining electrons to produce octets, outer atoms first
5. Make multiple bonds to complete missing octets

Fluorine, F_2

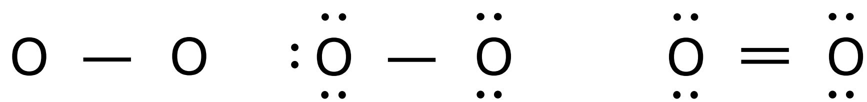
$7 + 7 = 14$ e^-’s



single bond

Oxygen, O_2

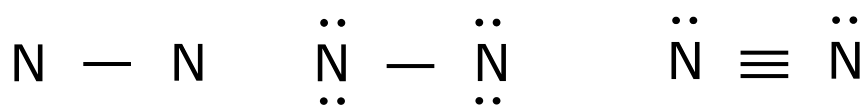
$6 + 6 = 12$ e^-’s



double bond

Nitrogen, N_2

$5 + 5 = 10$ e^-’s



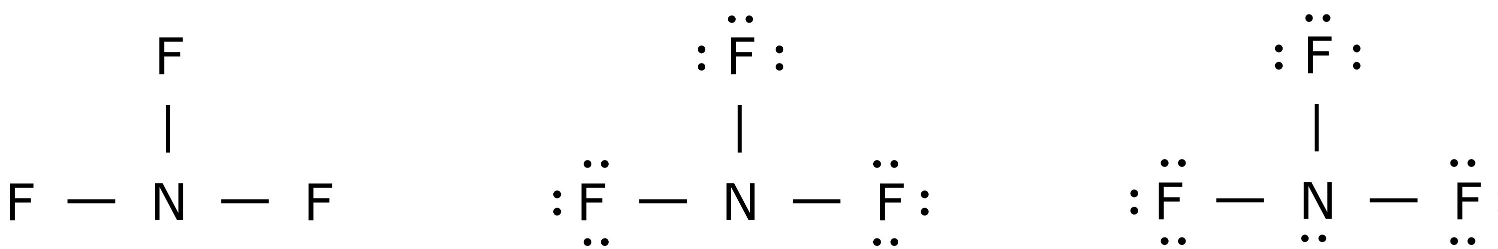
triple bond

Nitrogen trifluoride, NF_3

$5 + 3(7) = 26\ e^-$'s

N Needs 3 e^-'s (Greatest Need = Central Atom)

F Needs $1e^-$

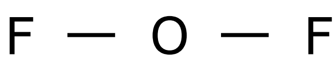


(6 e^-'s used) (24 e^-'s used) (26 e^-'s used)

Oxygen difluoride, OF_2

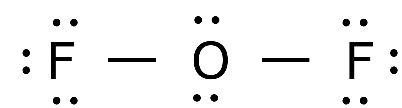
$6 + 2(7) = 20\ e^{-}$'s

O	Needs 2 e^{-}'s	(Greatest Need = Central Atom)
F	Needs 1e^{-}	



(4 e^{-}'s used)

(16 e^{-}'s used)



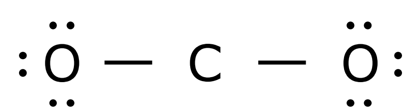
(20 e^{-}'s used)

Carbon dioxide, CO_2

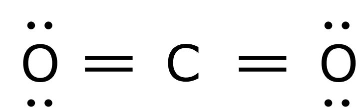
$4 + 2(6) = 16\ e^{-}$’s

C	Needs 4 e^{-}’s	(Greatest Need = Central Atom)
O	Needs 2e^{-}’s	

(4 e^{-}’s used)



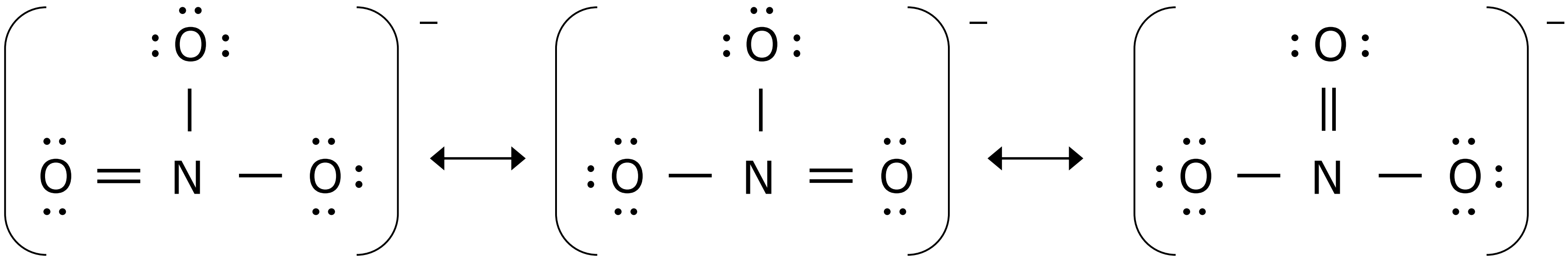
(16 e^{-}’s used)



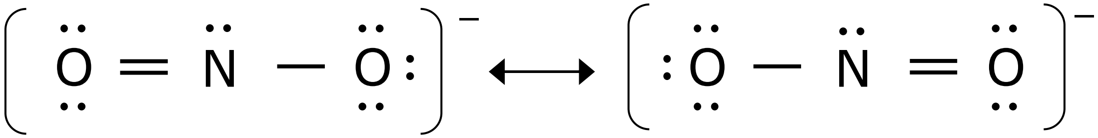
(16 e^{-}’s used)

Resonance is when two or more valid Lewis Structures exist…

NO_3^-



NO_2^-



The real structure is called the resonance hybrid

Molecular Shape

We will use VSEPR theory to predict molecular shape…

Valence Shell Electron Pair Repulsion

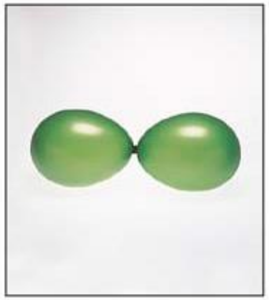
Lone pairs and bonding pairs are regions of electron density (REDs)

REDs spread out around central atoms to minimize repulsion

Arrangement of REDs is electron (pair) geometry

Positions of the atoms depends on number of REDs

Arrangement of atoms is molecular geometry



2 REDs produces linear electron pair geometry

3 REDs produces trigonal planar…

4 REDs produces tetrahedral…

BeH_2

H — Be — H

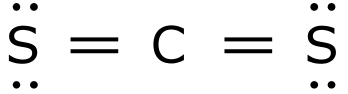
2 REDs, 0 LP

H — Be — H

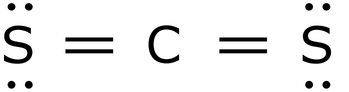
eg: linear

mg: linear, $\angle$HBeH 180°

CS_2



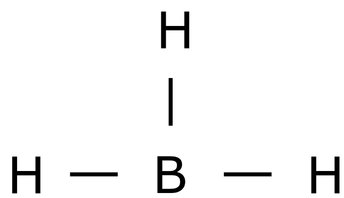
2 REDs, 0 LP

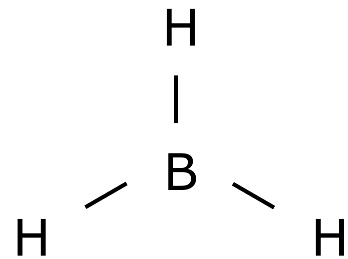


eg: linear

mg: linear, $\angle$OCO 180°

BH_3



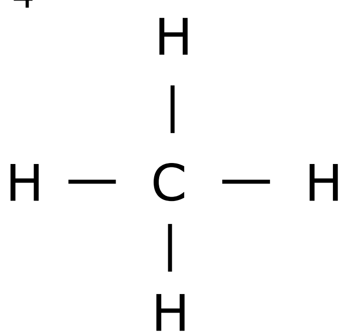


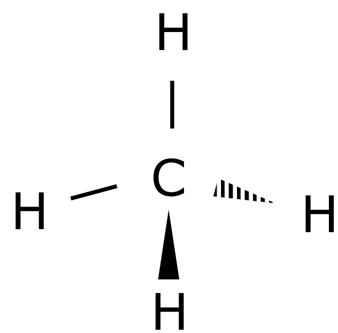
3 REDs, 0 LP

eg: trigonal planar

mg: trigonal planar, ∠HBH 120°

CH_4



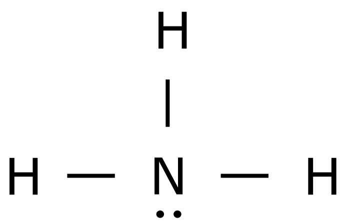


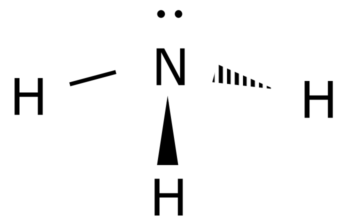
4 REDs, 0 LP

eg: tetrahedral

mg: tetrahedral, ∠HCH 109.5°

NH_3





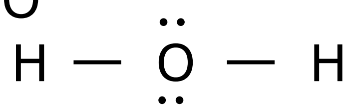
4 REDs, 1 LP

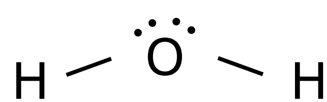
eg: tetrahedral

mg: trigonal pyramidal, ∠HNH

109.5^{o}

H_2O





4 REDs, 2 LP

eg: tetrahedral

mg: bent, ∠HOH 109.5^{o}

Molecular Polarity

Electrongativity (EN)

An atom's attraction for shared electrons

Highest: F (4.0) Lowest: Fr (0.7)

Indicates the type of bonding between atoms

EN Difference	Bonding
< 0.4	Nonpolar Covalent
0.4 – 2.0	Polar Covalent
> 2.0	Ionic

Predict the bonding…

Cl (3.0) and Cl (3.0)	3.0 – 3.0 = 0	nonpolar covalent
H (2.1) and Br (2.8)	2.8 – 2.1 = 0.7	polar covalent
Na (0.9) and F (4.0)	4.0 – 0.9 = 3.1	ionic

A polar bond has a dipole moment

A dipole moment arrow shows positive/negative ends of bond and magnitude of polarity

A polar molecule has a net dipole moment