

### Exceptions to Octet Rule

- \*Bond – Link between two atoms; molecule can have many bonds
- \*Chapter 9 contains no math
- \*You may bring aluminum foil to the final to form molecular shapes
- \*When doing x-ray crystallography, we only see atoms of molecule – we do not see electrons

### Molecular Geometries Observed – MUST KNOW THESE SHAPES

- \*When looking at molecular geometry, pretend that lone pairs of e<sup>-</sup> are not there
- \*Tetrahedral – 5 atoms
- \*Octahedral – 8 faces
- \*Bent – Any shape that is not linear (e.g., shape of water molecule is bent, meaning the H-O-H bond is not 180 degrees)

### Examples of more than an octet on the central atom

- \*Put least electronegative in center
- \*Put bonds around it
- \*Add atoms of most electronegative
- \*Put valence electrons
- \*Only place for extra e<sup>-</sup> is on center atom
- \*Six pair electrons (12 e<sup>-</sup>) is the max # e<sup>-</sup> on one atom
- \*Expanded octet – Any molecule that has more than an octet of e<sup>-</sup> on the central atom

### Examples of more than one octet on the central atom

Electron domain geometry – Places where e<sup>-</sup> are  
Molecular shape – physical shape of the molecule

SF<sub>6</sub>

Molecular shape = octahedral – only shape with 6 bonds

Electron domain geometry = octahedral

ClF<sub>3</sub>

Molecular shape = t-shaped

Electron domain geometry = trigonal bi-pyramid

## How Lewis Structure Theory Predicts Molecular Shapes

$\text{I}_3^-$  ion

Molecular shape = Linear

\* $\text{I}_3^-$  is more stable as a linear shape because the lone pairs of  $e^-$  repel each other so they want to be as far apart as possible

### Practice

- a.  $\text{CCl}_4$   
Electron domain geometry – tetrahedral  
Molecular geometry - tetrahedral
- b.  $\text{SF}_4$   
Electron domain geometry – trigonal bi-pyramid  
Molecular geometry – see-saw
- c.  $\text{Cl}_3^-$   
Electron domain geometry – trigonal bi-pyramid  
Molecular geometry – linear (more stable)
- d.  $\text{XeF}_4$   
Electron domain geometry – octahedral  
Molecular geometry – square planar

### VSEPR

\*Non-bonding electron pairs repel each other the most (strongest repel)

\*Lone pair repels bonded pair (medium repel)

\*Bonded electrons repel each other the least (weakest repel)

### VSEPR

\*H-O-H bond angle of water is smaller than H-N-H bond angle of  $\text{NH}_3$  because water has fewer electrons (fewer negative charges as lone pairs of  $e^-$  = less repelled)

### How do bond polarities sum to determine molecular polarity?

\*Things alike will dissolve in each other (polar molecules will dissolve in other polar molecules)

### Some molecules that contain polar bonds, but not all of the molecules are polar

\*If forces cancel = non-polar

\*If forces don't cancel = polar

\*If the molecule is polar it will be pulled in one direction

$\text{O} = \text{C} = \text{O}$

Non-polar

C will not move because forces cancel out (C feels equal force from both O atoms)

$\text{CCl}_4$

Non-polar

Forces cancel because bond angles are equal

$\text{CH}_3\text{Cl}$

Polar

Forces are not equal – C will move

**Why it costs a little energy to form hybrid orbitals**

\*When orbitals overlap – energy created

\*To obtain this state – must put energy in

\*When put energy in – will get more energy out (good investment)