When I draw Lewis Structures, you may notice that I typically draw them using specific angles for bonds and lone pairs

For example,  not H–Ö–H

This is because it's conventional to draw molecules in a way that reflects their shape.

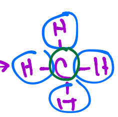
The lecture today prepares you to do this.

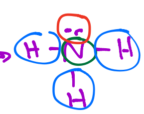
VSEPR Theory = valence shell electron pair repulsion

- Lewis structures only deal with valence e^- → always (well, typically) come in pairs (bonds or LP)
- VSEPR tells us that these pair want to be as far away from another pair as possible

We're going to be considering electron domain surrounding a central atom → symbolize the central atom as [A]

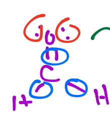
1. Each lone pair is an electron domain → we'll symbolize these as [E]
2. Each bonding domain counts as a domain → X
   - so basically where there is another atom

CH_4 →  AX_4

NH_3 →  AX_3E

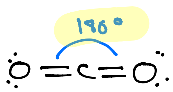
HCN →  AXE

AX_2

CH_2O  → AXE_2

AX_3

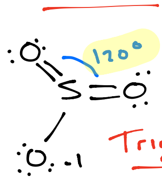
Every molecule class (AXE) has a specific orientation of LP + bonding regions that enables maximum separation. → This lets us determine molecular geometry

AX_2 → 

Linear

If the two Oxygen atoms are 180° apart, they are separated by the maximum distance

3 groups

AX_3 → 

120° between bond is maximum separation

Trigonal Planar

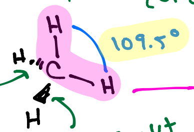
AX_2E

Bent (also called angular sometimes)

a little bit less than 120° because LP are bullies, they want more space than bonds

4 groups → this requires all three dimensions to maximize separation!

AX_4



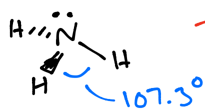
behind the plane of the paper

coming out toward you

2 bonds and the central atom are in the plane

Tetrahedral

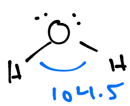
AX_3E



Trigonal Pyramidal

* It's not important to predict bond angle in AX_3E or AX_2E_2. But it IS important to know that they are less than 109.5

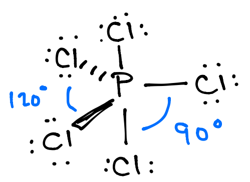
AX_2E



Bent

5 Groups

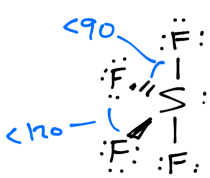
AX_5



Trigonal Bipyramidal

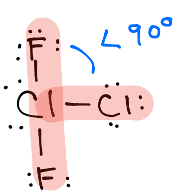
e⁻ always add to triangle plane if there are 5 e⁻ groups

AX_4E



Seesaw

AX_3E_2



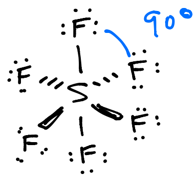
T-shaped

AX_2E_3

linear

6 groups

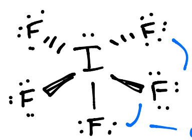
AX_6



Octahedral

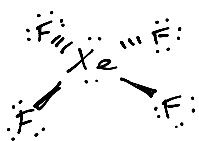
*It won't matter where the 1st LP goes because everything is perfectly equivalent

AX_5E



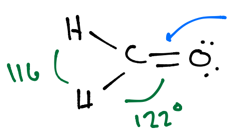
Square Pyramid

AX_4E_2



square planar

Double + Triple Bonds are pushy!



Again, knowing the exact bond angles IS important for idealized geometries (90°, 180°, 120°, 109.5) and you should be able to predict how the angle will respond to LP or double/triple bonds (e.g. less than 120°)

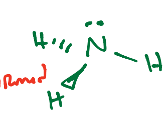
Electron Geometry vs. Molecule Geometry

Electron Geometry: this is the shape around an atom if we include the electron pairs in the name

Molecule Geometry: ignore lone pairs when naming.
– names are same as what we saw above

2 groups = linear
3 groups = trig. planar
4 groups = tetrahedral
5 groups = trig. pyramid
6 groups = octahedral

NH_3 →



Molecular Geometry = trigonal pyramidal

Electron geometry = tetrahedral