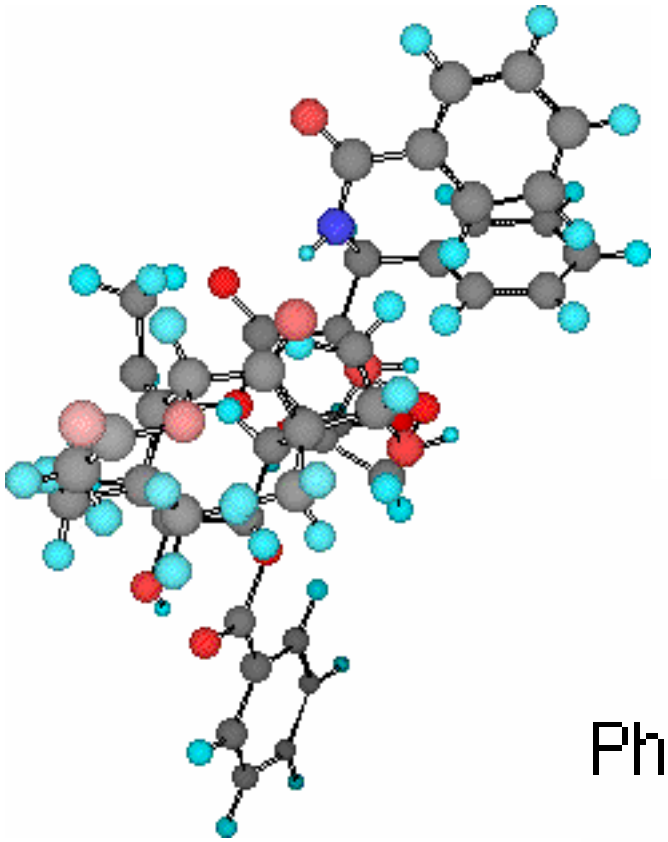
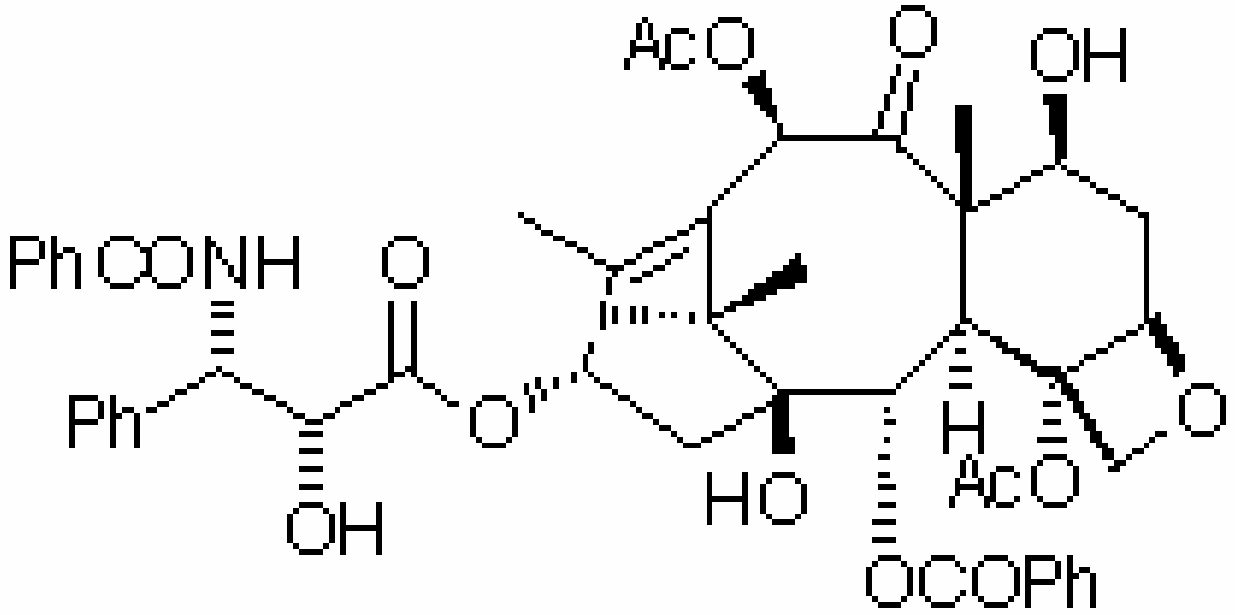
VSEPR

Reading: Gray: (4-5)
OGN: (3.7) and (3.8)

Bonding in Complex Molecules



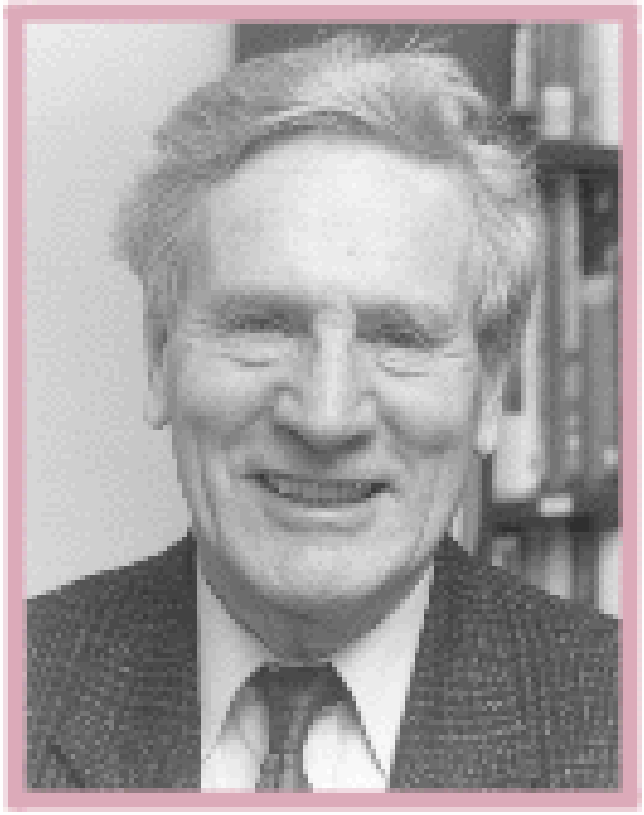
Taxol



Valence Shell Electron Pair Repulsion Theory (VSEPR)

- **Predicts the shapes of molecules**
- **Works very well for octets and for "expanded octets" (2^{nd} and 3^{rd} row elements)**
- **Doesn't work at all for transition metal complexes--too many groups and electrons to allow the use of sterics alone**

Valence Shell Electron Pair Repulsion Theory (VSEPR)



Ron Gillespie
McMaster College, Canada
1957

Sir Ronald Nyholm
University College
London, 1957

Rules of VSEPR Theory

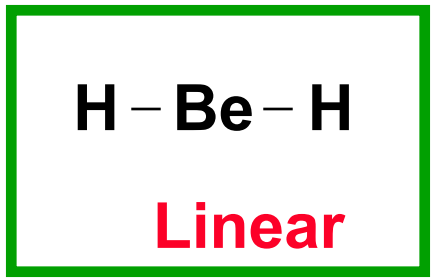
1) Draw the best Lewis dot structure of the molecule
2) Assign a steric number (SN) to the structure

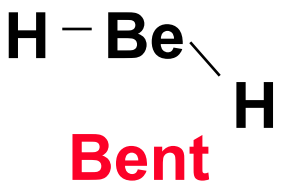
   SN = (# of bonded atoms) + (# of lone pairs)

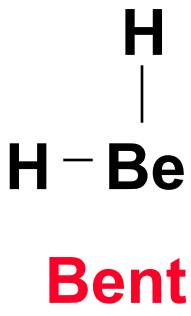
3) Place the atoms and lone pairs as far apart as possible (while still keeping them connected to the central atom)
4) Deduce the molecular geometry by ignoring the positions of the lone pairs
5) Remember, lone pairs are FAT

Examples of VSEPR

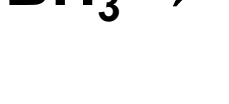
$BeH_2 \rightarrow H:Be:H$

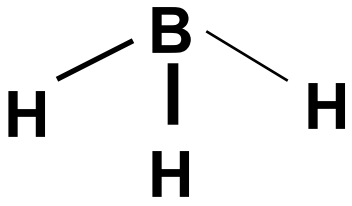


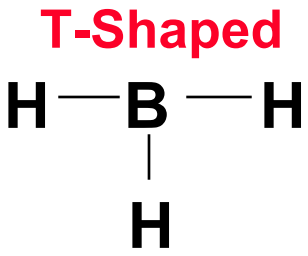


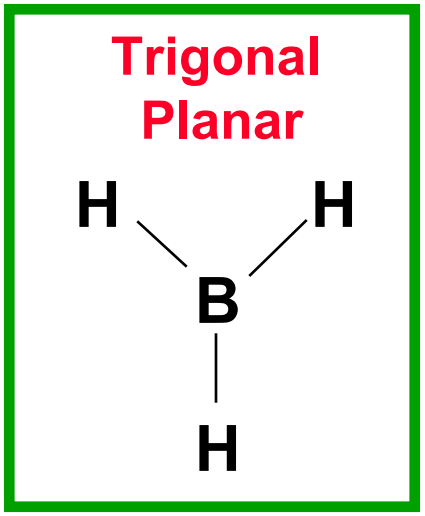


SN = 2 So Geometry is Linear

$BH_3 \rightarrow$ 

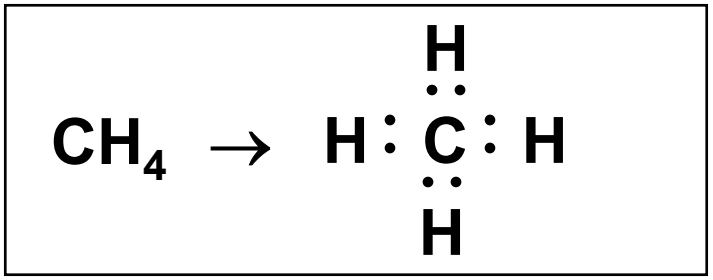




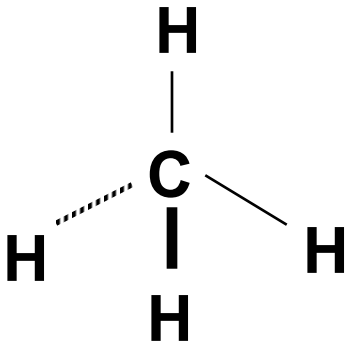


SN = 3 So Geometry is Trigonal Planar

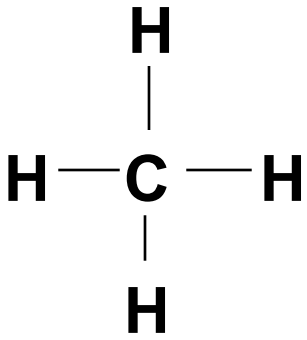
4 Atoms Bonded to A Central Atom



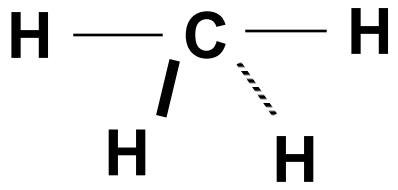
Tetrahedral



Square Planar

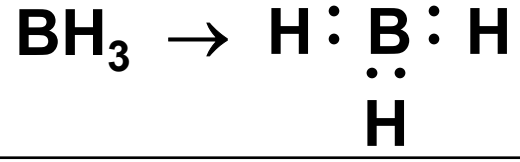


See-Saw (Sawhorse)

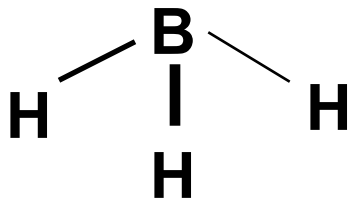


SN = 4 So Geometry is Tetrahedral

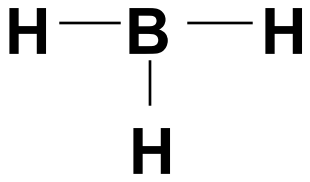
3 Atoms Bonded to A Central Atom

$BH_3 \rightarrow$ 

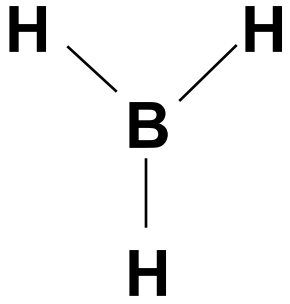
Trigonal Pyramidal



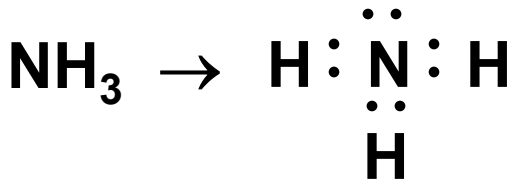
T-Shaped



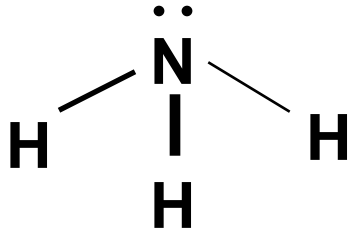
Trigonal Planar



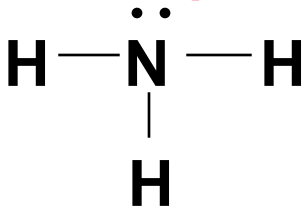
SN = 3 So Geometry is Trigonal Planar

$NH_3 \rightarrow$ 

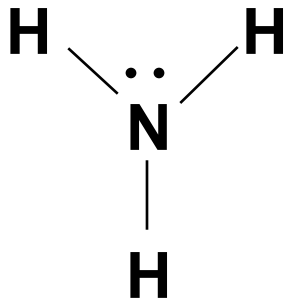
Trigonal Pyramidal



T-Shaped

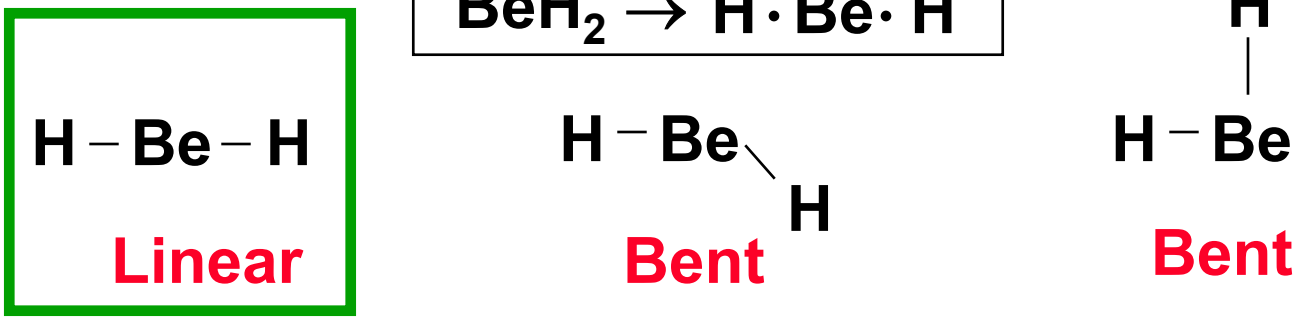


Trigonal Planar

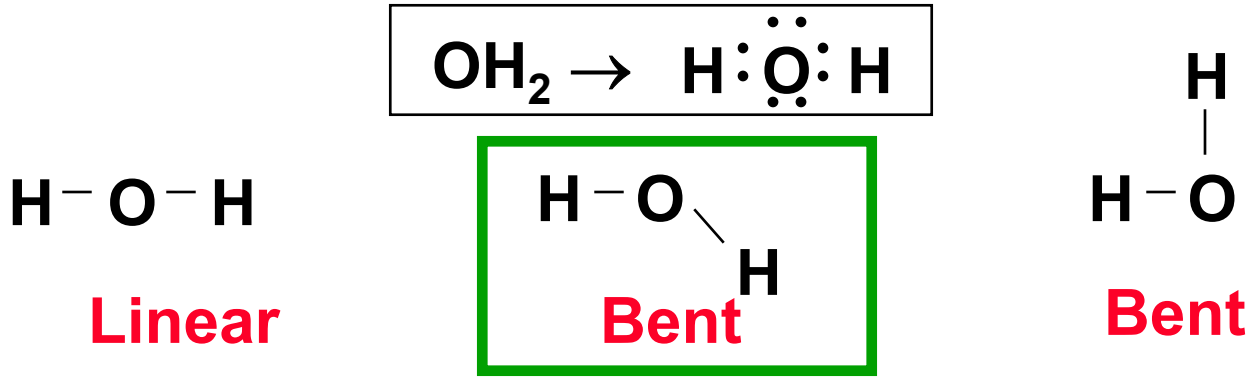


SN = 4 So Geometry is Trigonal Pyramidal

2 Atoms Bonded to a Central Atom

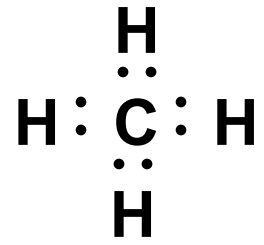


SN = 2 So Geometry is Linear

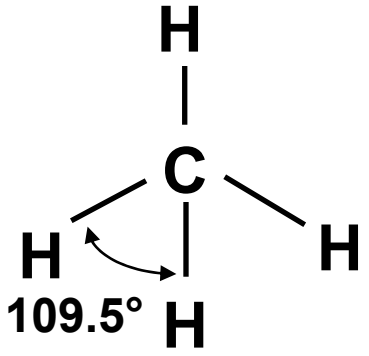


SN = 4 So Geometry is Bent

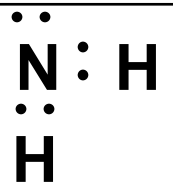
Lone Pairs Are FAT(#1)

$CH_4 \rightarrow$ 

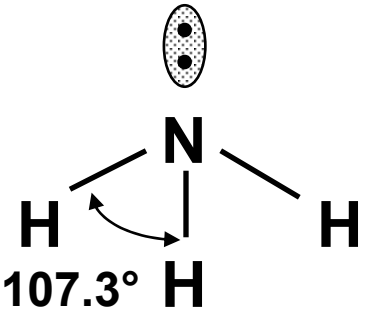
Tetrahedral



H-C-H Angle > H-N-H Angle

$NH_3 \rightarrow$ 

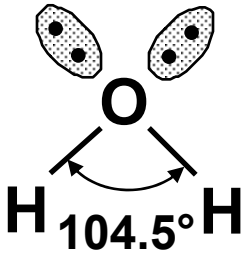
Trigonal Pyramidal



H-N-H Angle > H-O-H Angle

$OH_2 \rightarrow$ 

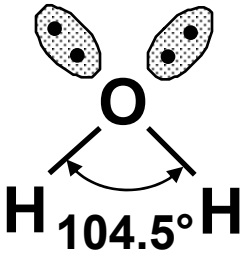
Bent



Lone Pairs are FAT (#2)

$OH_2 \rightarrow H:\ddot{O}:H$

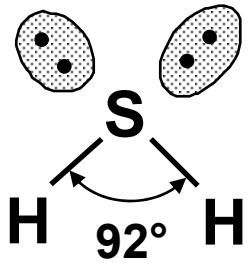
Bent



H-O-H Angle > H-S-H Angle

$SH_2 \rightarrow H:\ddot{S}:H$

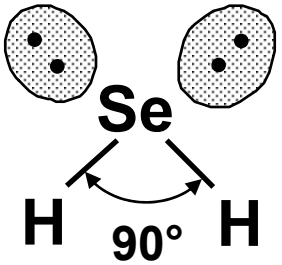
Bent



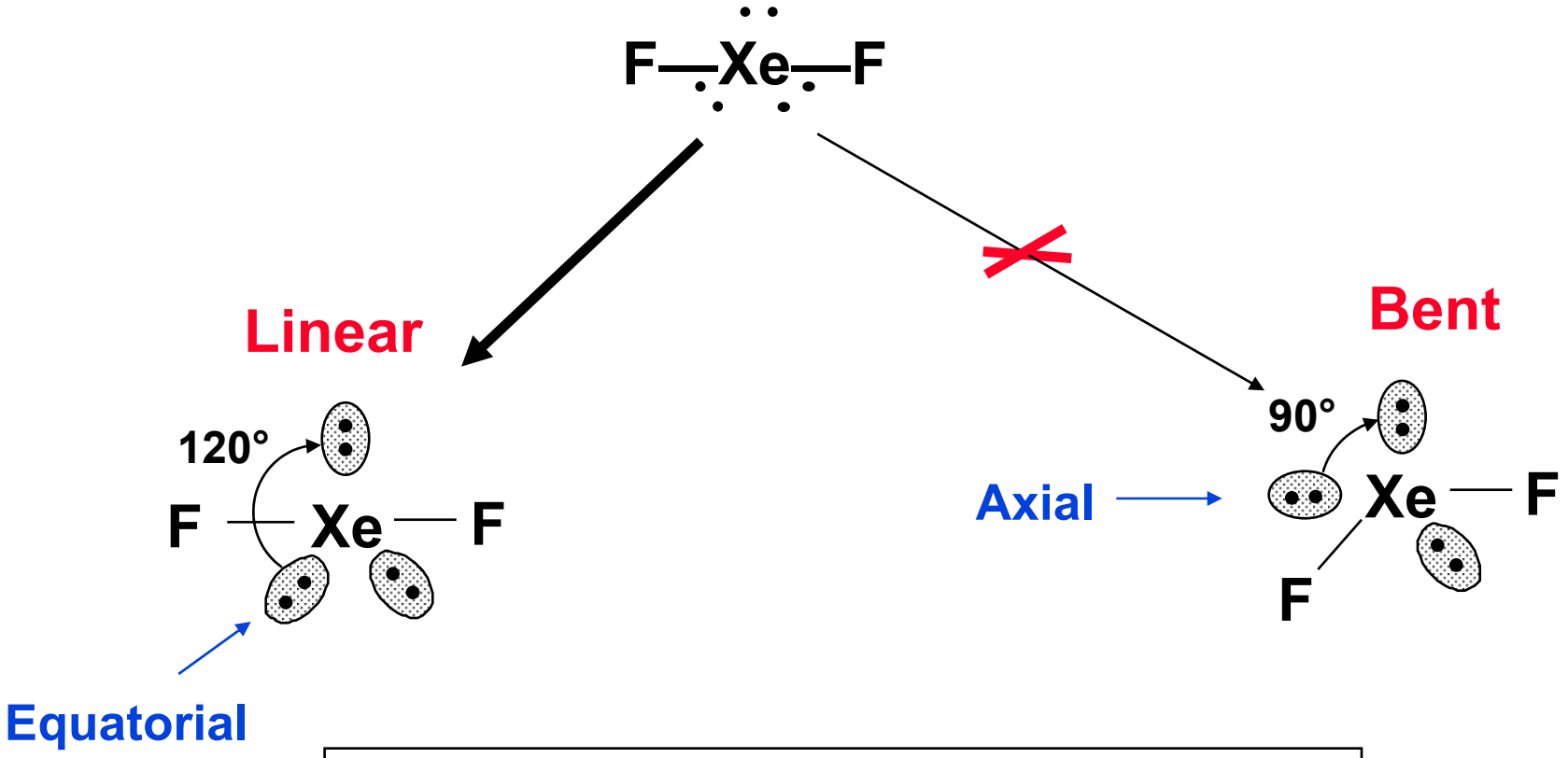
H-S-H Angle > H-Se-H Angle

$SeH_2 \rightarrow H:\ddot{S}e:H$

Bent



Lone Pairs are FAT (#3)



Lone Pairs ALWAYS go to the More "Roomy"Equatorial Positions

END

VSEPR

Reading: Gray: (4-5)
OGN: (3.7) and (3.8)