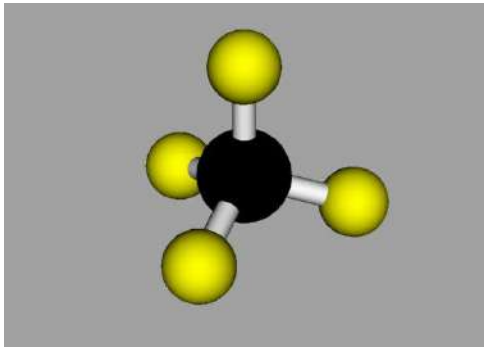
NOTES: 8.3 – VSEPR Theory

Molecular Shape

- Lewis structures (electron dot structures) show the structure of molecules…but only in 2 dimensions (flat)…

Molecular Shape



BUT, molecules are 3 dimensional!

- in 3D it is:

a tetrahedron!

= coming out of page

= going into page

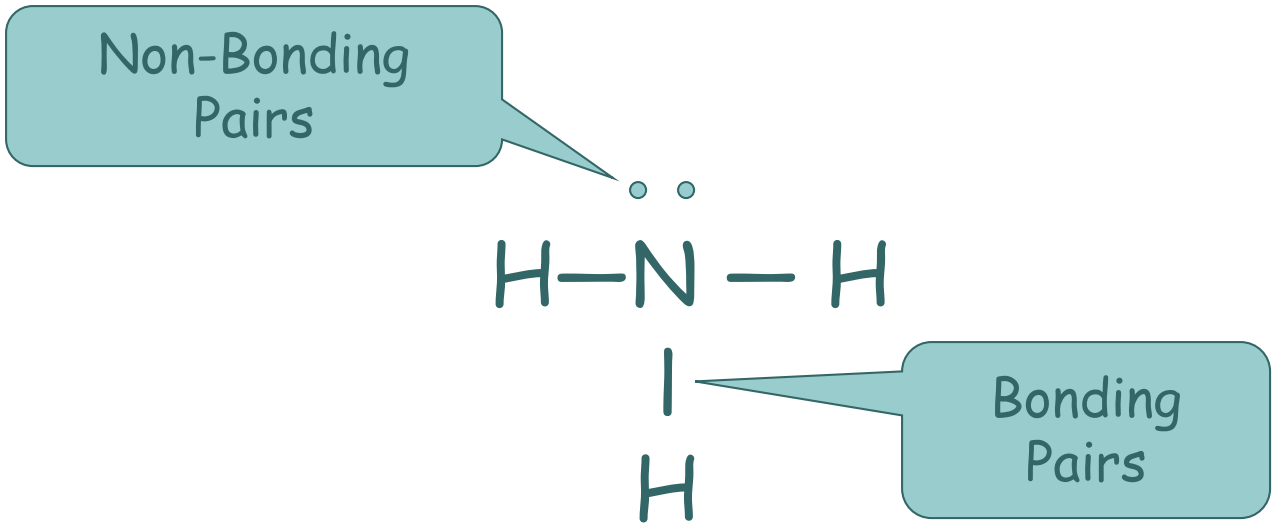
= flat on page

Why do molecules take on 3D shapes instead of being flat?

- **V**alence **S**hell **E**lectron **P**air **R**epulsion theory
- *"because electron pairs repel one another, molecules adjust their shapes so that the valence electron pairs are as far apart from another as possible."*

Why do molecules take on 3D shapes instead of being flat?

- **V**alence **S**hell **E**lectron **P**air **R**epulsion theory
- Remember: both shared and unshared electron pairs will repel one another.



VSEPR Theory

- Predicts molecular geometry by examining bonding and non-bonding electron pairs of electrons on a molecule

  ➔ **Bonding pair of electrons – electron pair used in a bond**

  ➔ **Non-bonding pair of electrons – lone pair of electrons not used in bonding**

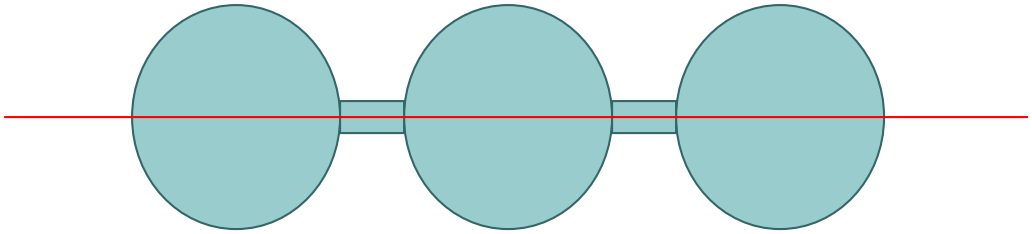
- The assumption is electron pairs will be spaced out **as far apart as possible** (negatives charges repel) giving rise to particular molecular geometries

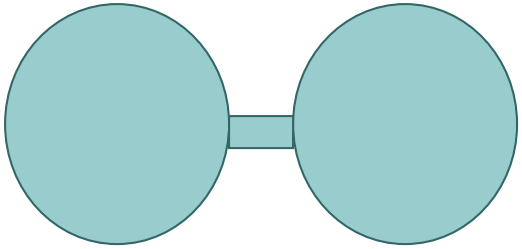
How to determine molecule shape:

- Draw electron dot or structural formula
- Count the number of bonding and non-bonding pairs of electrons around the central atom (number of places electrons are found)
- Multiple (double, triple) bonds count as one “location” or “region”
- Apply the correct geometry predicted by VSEPR Theory based on the number of bonding and non-bonding electron pairs

5 Basic Molecule Shapes

1) **Linear**

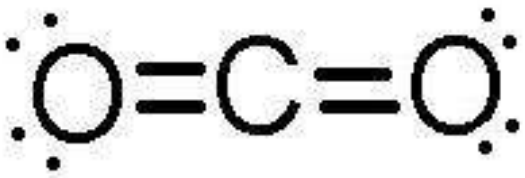




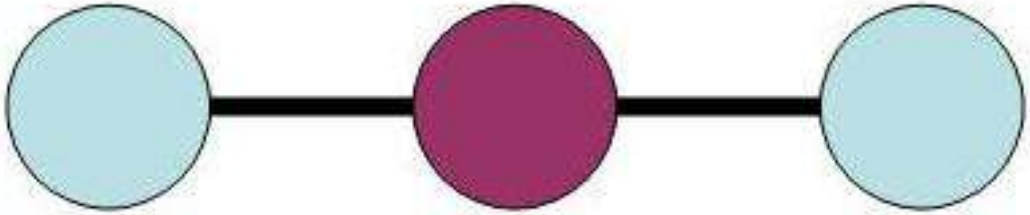
5 Basic Molecule Shapes

1) **Linear**

- Example: **CO_2**



Two pairs of electrons
Both bonding



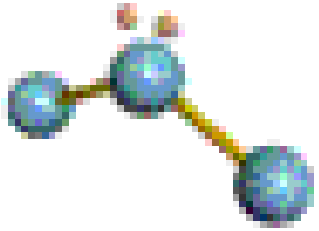
Linear

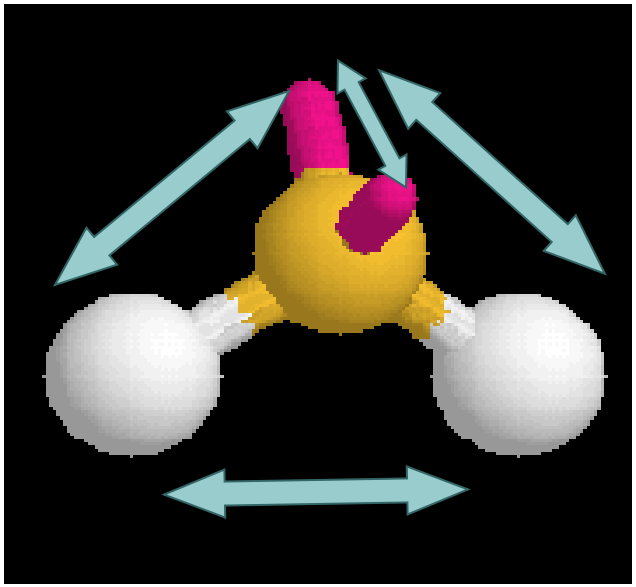
Bond angle 180°

eg $BeCl_2$

5 Basic Molecule Shapes

2) **Bent**



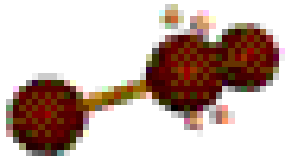


5 Basic Molecule Shapes

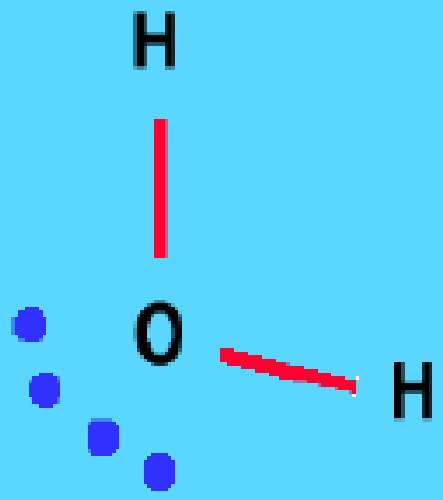
2) **Bent**

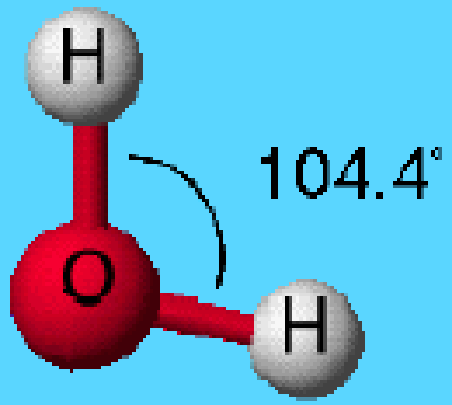
- Example: $\mathbf{H_2O}$

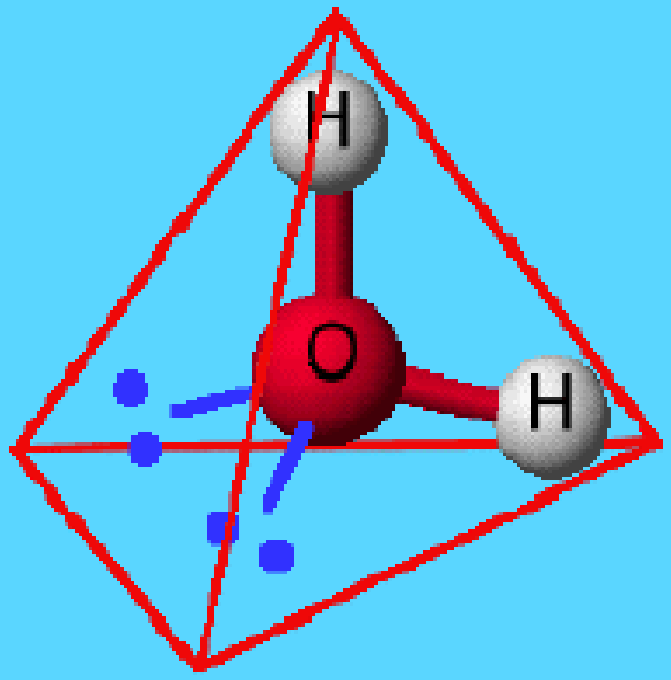
***Notice electron pair repulsion!!!**



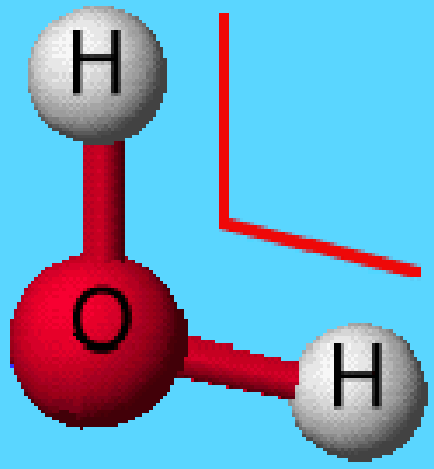
Water







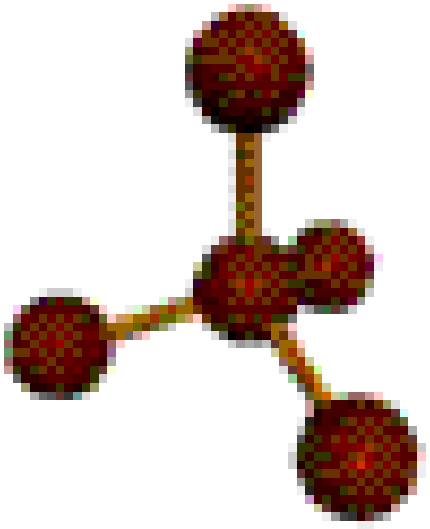
Tetrahedral Electron Pair Geometry



Bent Molecular Geometry

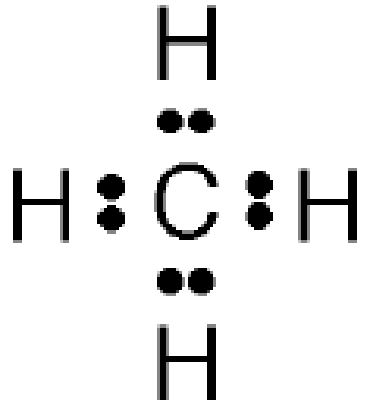
5 Basic Molecule Shapes

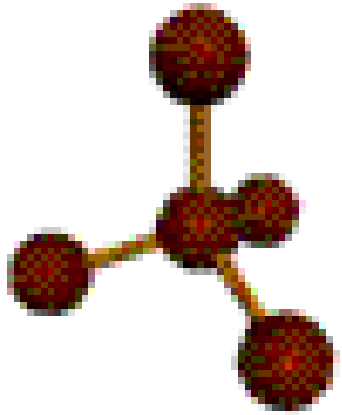
3) **tetrahedral**



5 Basic Molecule Shapes

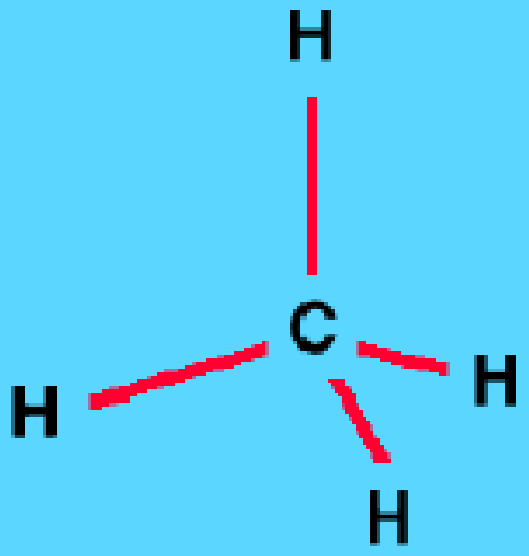
3) **tetrahedral**

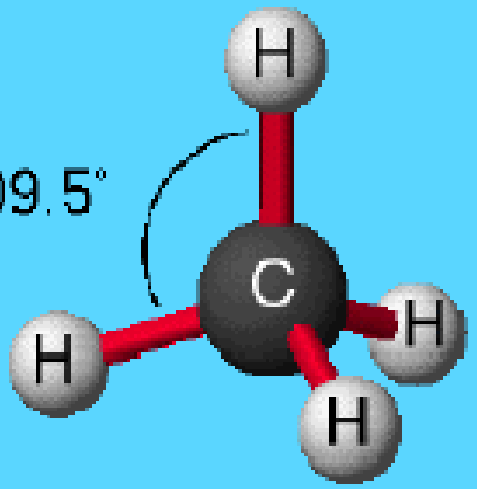


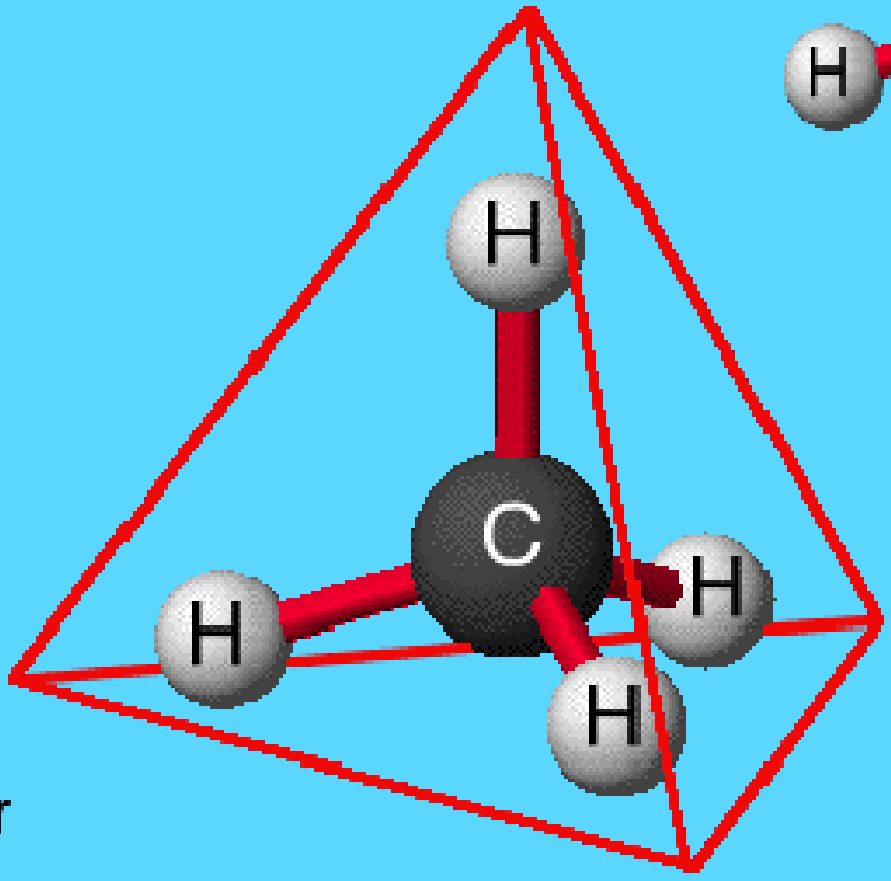


- example: **CH_4**

Methane



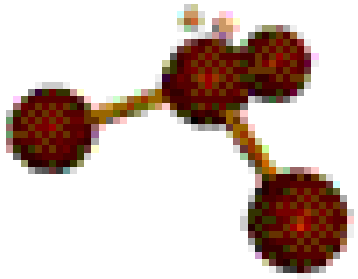


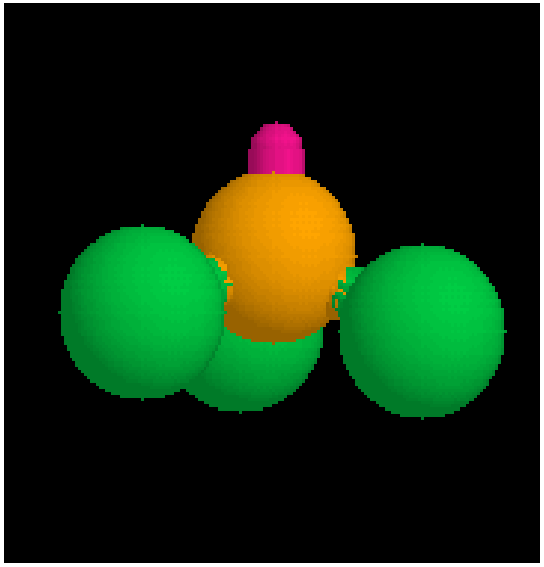


Tetrahedral E. P. G.
Tetrahedral Molecular
Geometry

5 Basic Molecule Shapes

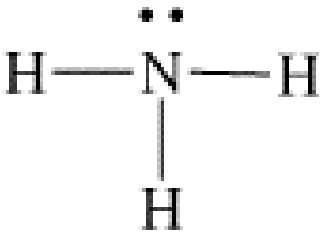
4) **Pyramidal**

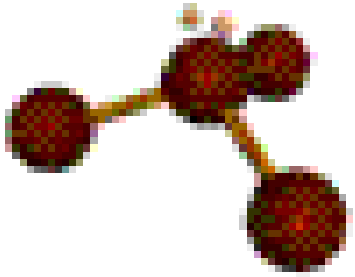




5 Basic Molecule Shapes

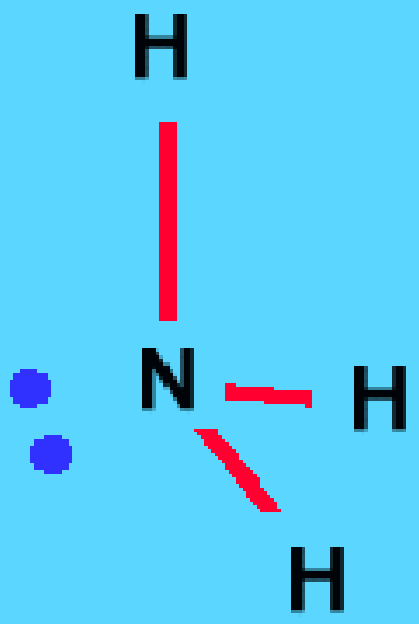
4) **Pyramidal**



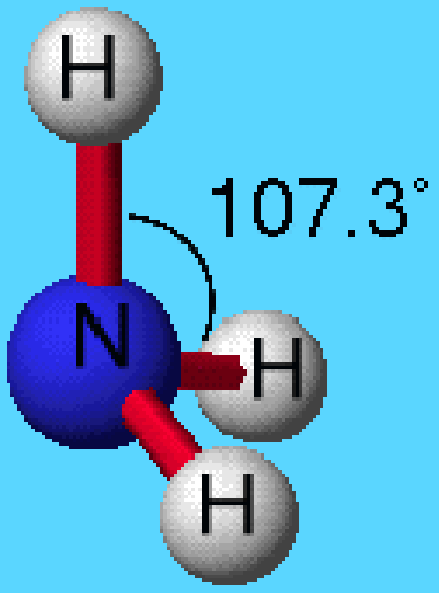


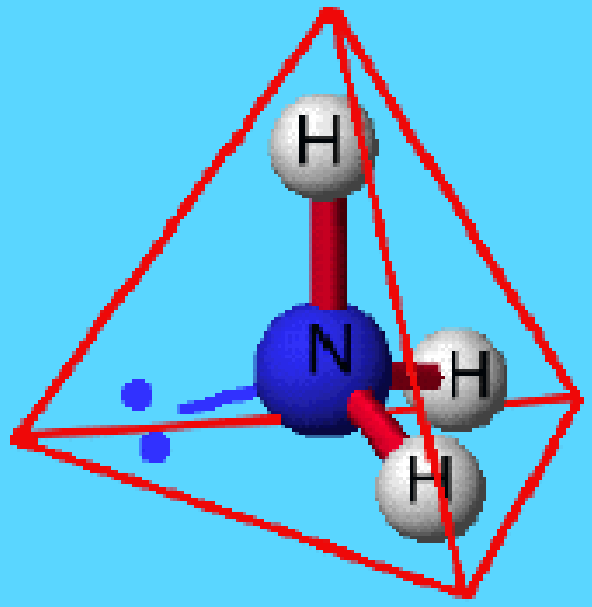
- Example: **NH_3**

  (note: unshared pair of electrons repels, but is not considered part of overall shape; no atom there to contribute to the shape)

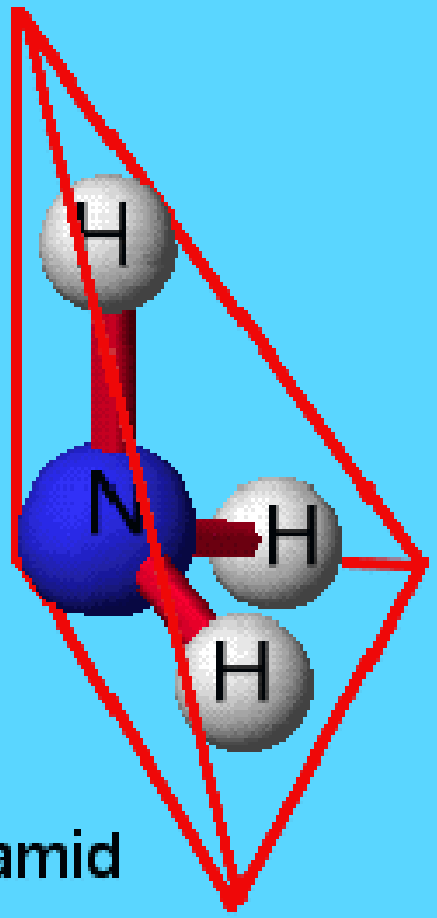


Ammonia





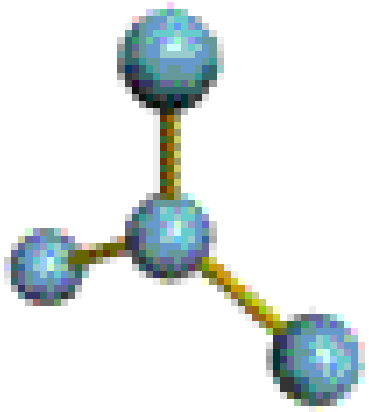
Tetrahedral Electron Pair Geometry

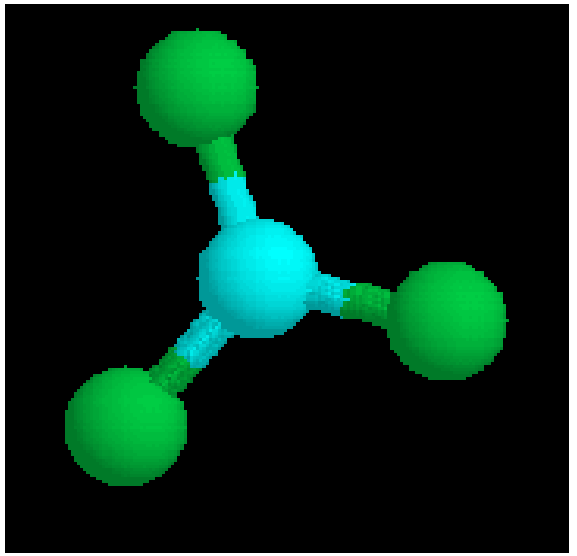


Trigonal Pyramid Molecular Geometry

5 Basic Molecule Shapes

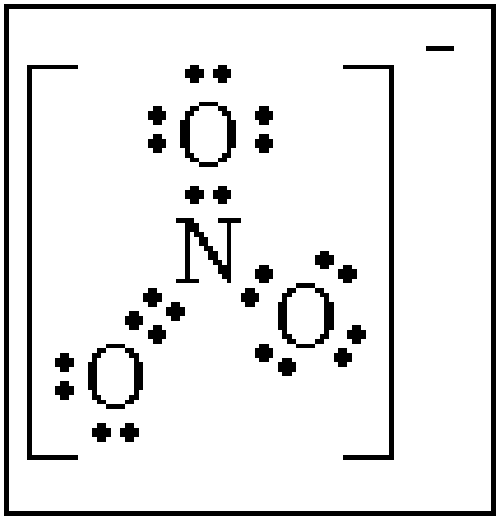
5) **Trigonal planar**

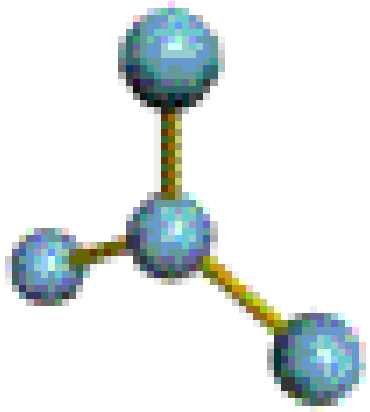




5 Basic Molecule Shapes

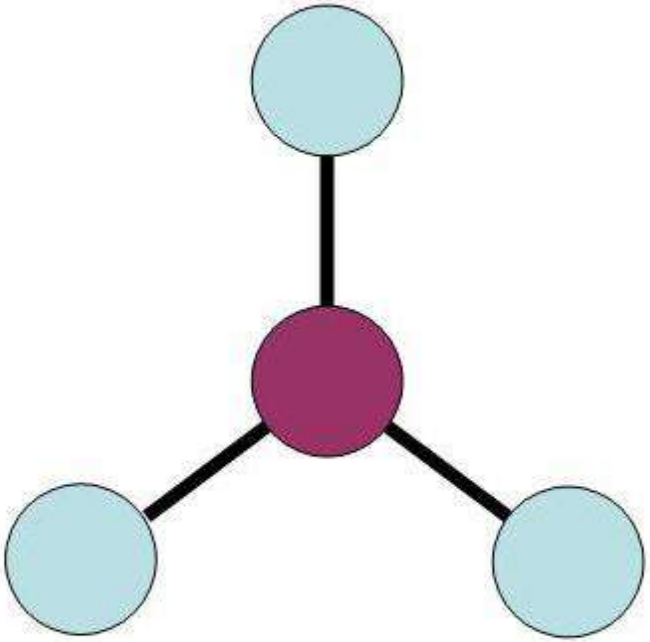
5) **Trigonal planar**





- Example: **NO_3^-**

Three pairs of electrons
All bonding



Trigonal planar

Bond angle 120°

eg BF_3

Online molecule shape tutorial!