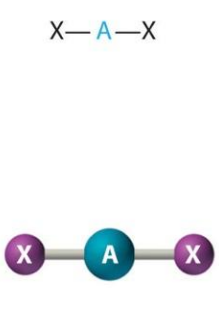
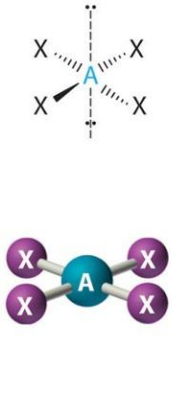
**SCH 4U**

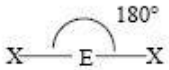
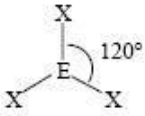
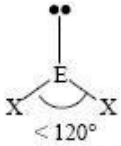
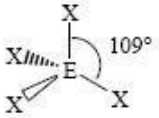
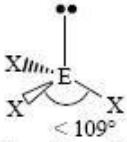
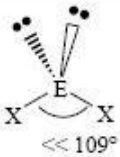
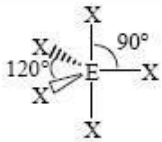
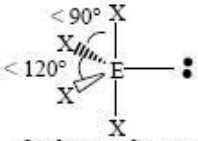
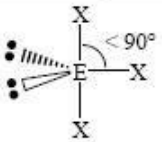
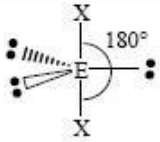
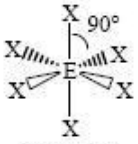
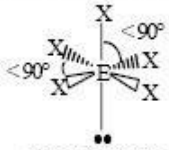
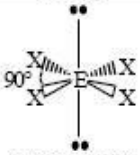
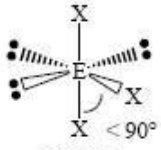
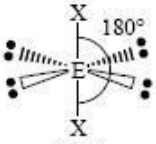
**MOLECULAR STRUCTURES: VSEPR THEORY**


## Valence-Shell Electron Pair Repulsion model

**(VSEPR)**- It predicts the shape of the molecules and ions by assuming *the valence-shell electron-pairs are arranged as far away from one another as possible to minimize e- pair repulsions*.

Electron group repulsion determines the shape of the molecule. It does not explain chemical bonding.

| **$AX_mE_n$ Notation** | $AX_2$ | $AX_2E$ | $AX_3$ | $AX_3E$ |
|---|---|---|---|---|
| **Geometry** | Linear | Bent (V-shaped) | Trigonal planar | Trigonal pyramidal |
| |  | | | |
| **Idealized Bond Angles** | 180° | <180° | 120° | <120° |
| **$AX_mE_n$ Notation** | $AX_4E_2$ | $AX_4$ | $AX_5$ | $AX_6$ |
| **Geometry** | Square planar | Tetrahedral | Trigonal bipyramidal | Octahedral |
| |  | | | |
| **Idealized Bond Angles** | 90° | 109.5° | 90°, 120° | 90° |

| VSEPR Geometries | | | | | |
|---|---|---|---|---|---|
| Steric No. | Basic Geometry 0 lone pair | 1 lone pair | 2 lone pairs | 3 lone pairs | 4 lone pairs |
| 2 |   Linear | | | | |
| 3 |   Trigonal Planar |   Bent or Angular | | | |
| 4 |   Tetrahedral |   Trigonal Pyramid |   Bent or Angular | | |
| 5 |   Trigonal Bipyramid |   Sawhorse or Seesaw |   T-shape |   Linear | |
| 6 |   Octahedral |   Square Pyramid |   Square Planar |   T-shape |   Linear |

## DRAWING MOLECULAR STRUCTURES:

1. DRAW the Lewis structure without regard to shape
   - make sure outer atoms have appropriate # of bonds to complete octet.
   - H and F form single bonds, O forms double bond to central atom.

2. DETERMINE the valence electron count.

3. DETERMINE the number of ***electron groups*** around the central atom.
   - electron groups consist of **BP** (single, double, triple) and **LP**.
   - name the electronic geometry $AX_n$

4. DRAW the 3-D shape of the molecule.
   - if $AX_5$, any LP replace atoms in equitorial positions
   - if $AX_6$, any LP replace atoms in axial positions

5. NAME the subgroup molecular geometry (see chart above).
   - state the polarity and bond angles.