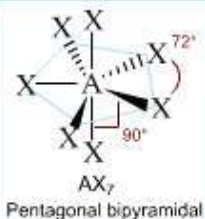
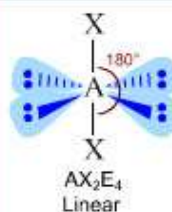
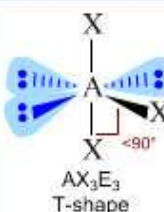
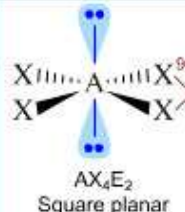
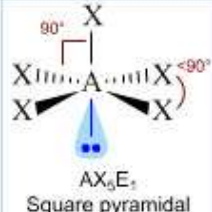
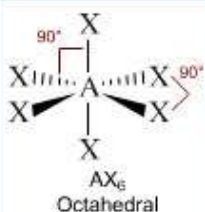
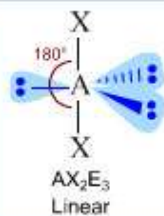
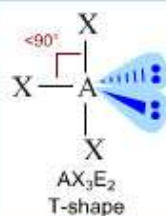
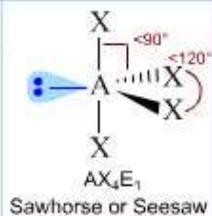
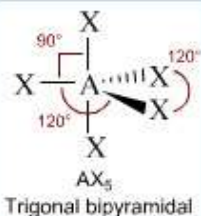
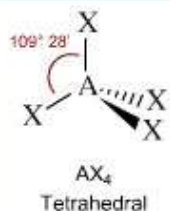
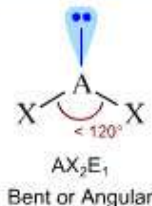
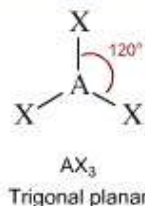
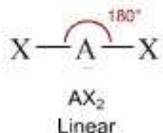


# **VSEPR**

**Valence Shell Electron Pair Repulsion Theory**

# VSEPR



# Linear

## Bent or Angular

## Trigonal Planar

## Trigonal Pyramidal

# Tetrahedral

## Trigonal Bipyramidal

# Seesaw

## T-shape

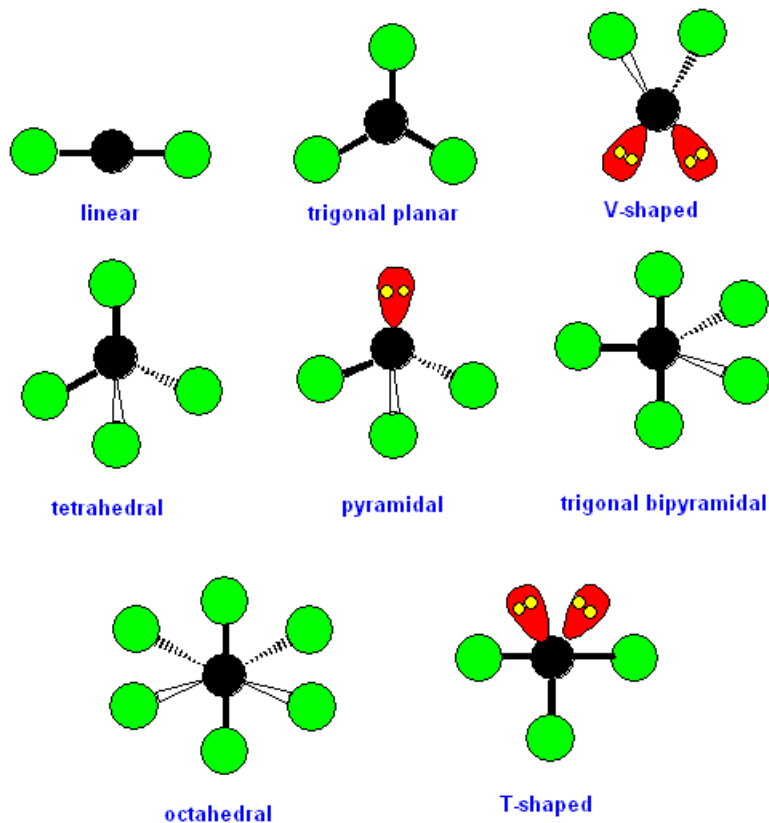
## Octahedral

## Square Pyramidal

## Square Planar

## Pentagonal Bipyramidal

# VSEPR



- Used to predict the shapes of molecules
- Arrangement of atoms around a central atom in a molecule depends on the **repulsion between all electron pairs in the valence shell** of the central atom
- Electron pairs around the central nucleus **repel** each other
- Atoms have electrons in orbitals that **are as far apart** as possible
- Shape is determined by the number of bonding and lone pairs of electrons

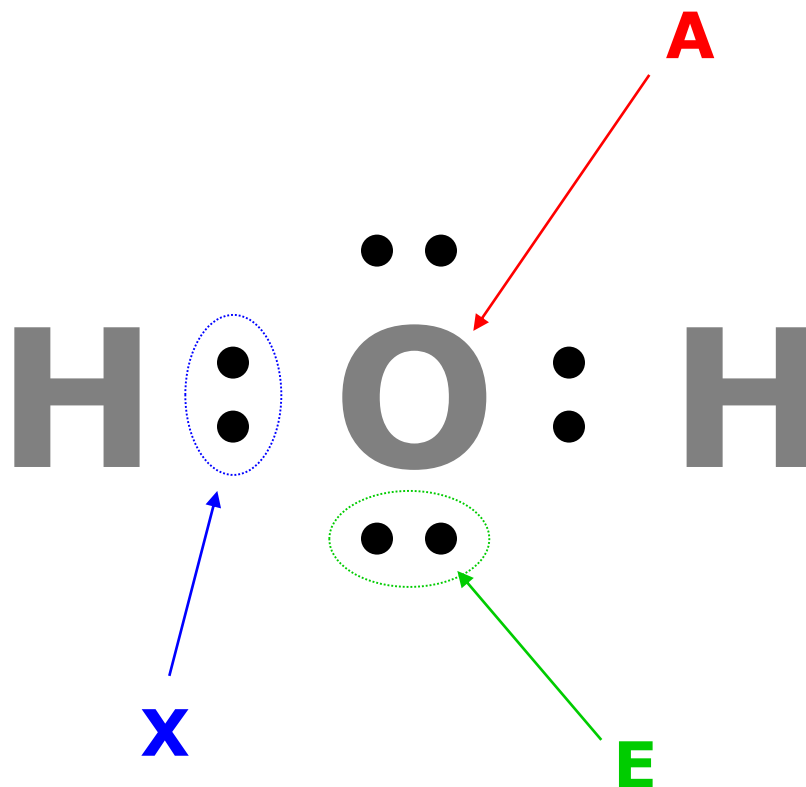
# VSEPR

## Legend:

**A** = Central atom

**X** = Bonding pair

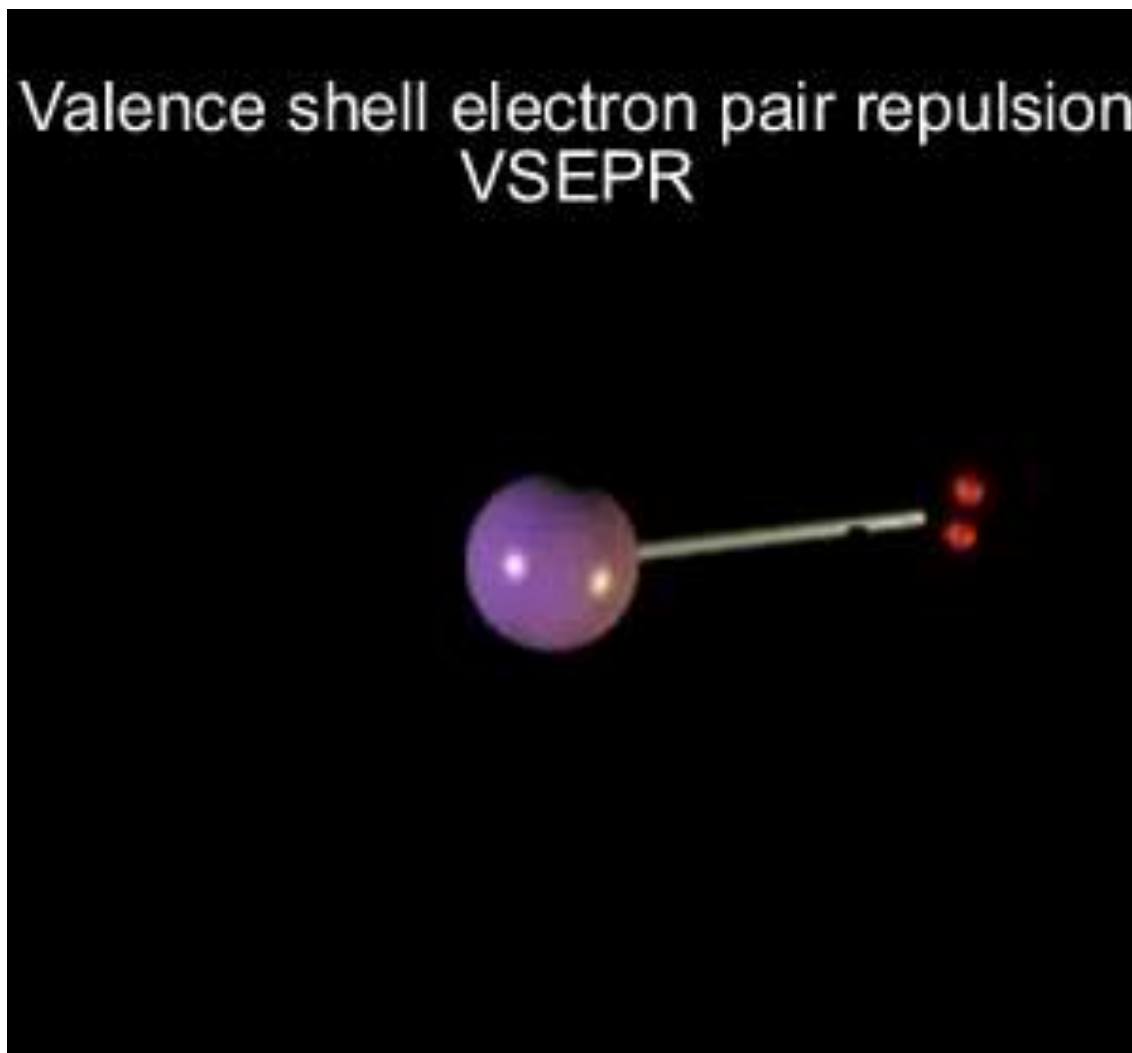
**E** = Lone pair



Bonding pairs and lone pairs repel each other, resulting in 3-D shapes that keep the pairs as far apart as possible.

# 6 CORE GEOMETRIES

Valence shell electron pairs repel each other until repulsions are minimized, forming 6 core geometries\*



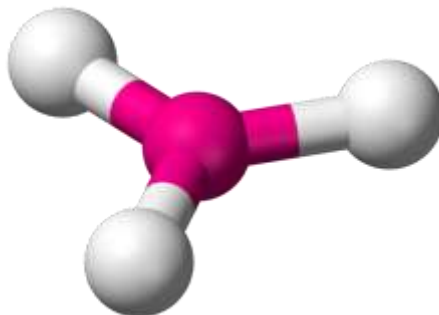
\*one is not shown in the animation above

# 6 CORE GEOMETRIES

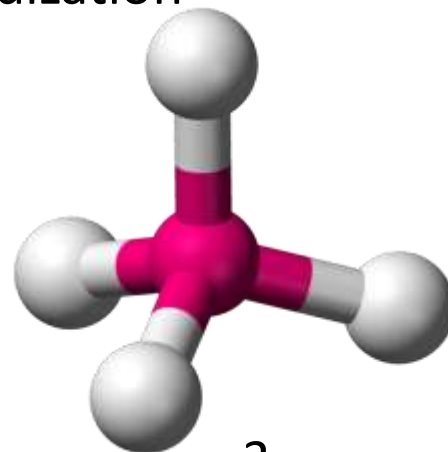
There are 6 shapes based on orbital hybridization



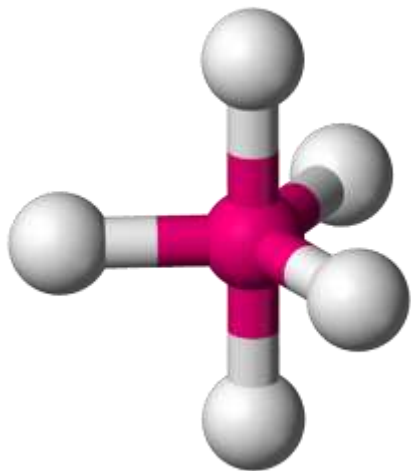
$sp$



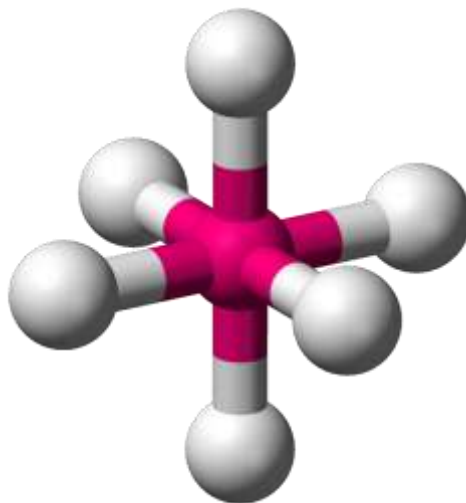
$sp^2$



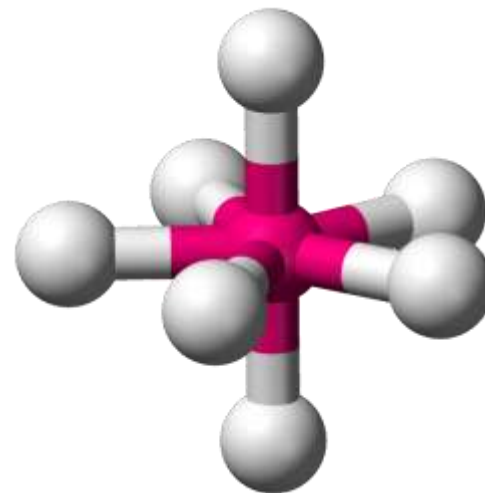
$sp^3$



$sp^3d$



$sp^3d^2$



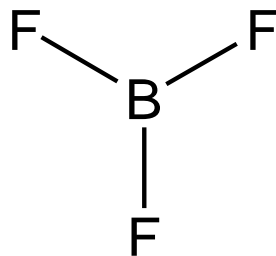
$sp^3d^3$

# 6 CORE GEOMETRIES

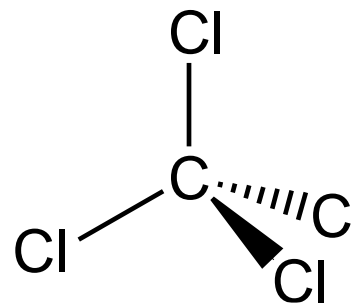
Examples of VSEPR diagrams:



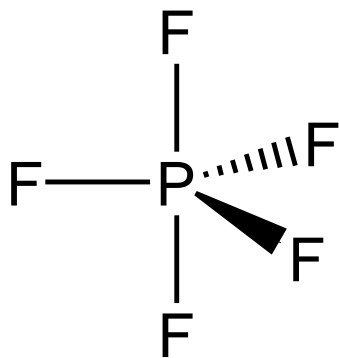
$sp$



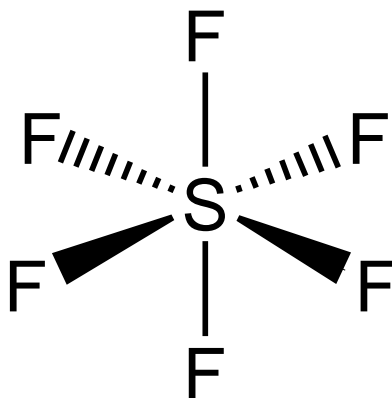
$sp^2$



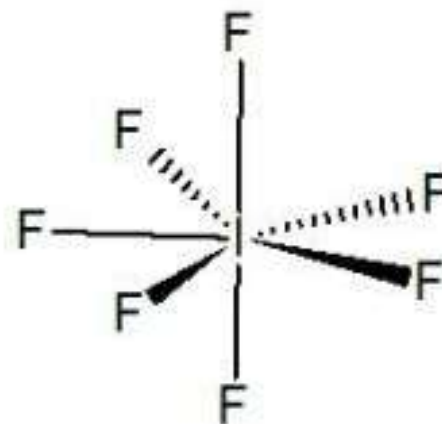
$sp^3$



$sp^3d$



$sp^3d^2$



$sp^3d^3$

# DIATOMIC MOLECULES

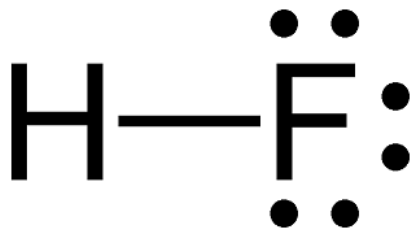
Any diatomic molecule forms a **linear** shape



Examples:

**HF, O<sub>2</sub>**

Lewis structure



3-D geometry



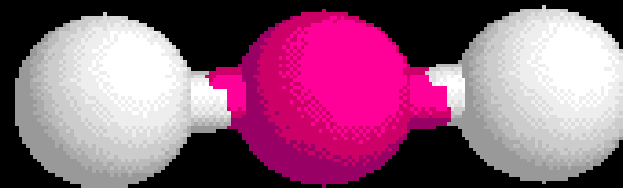
VSEPR diagram





# sp HYBRIDIZATION

Shape: **Linear**

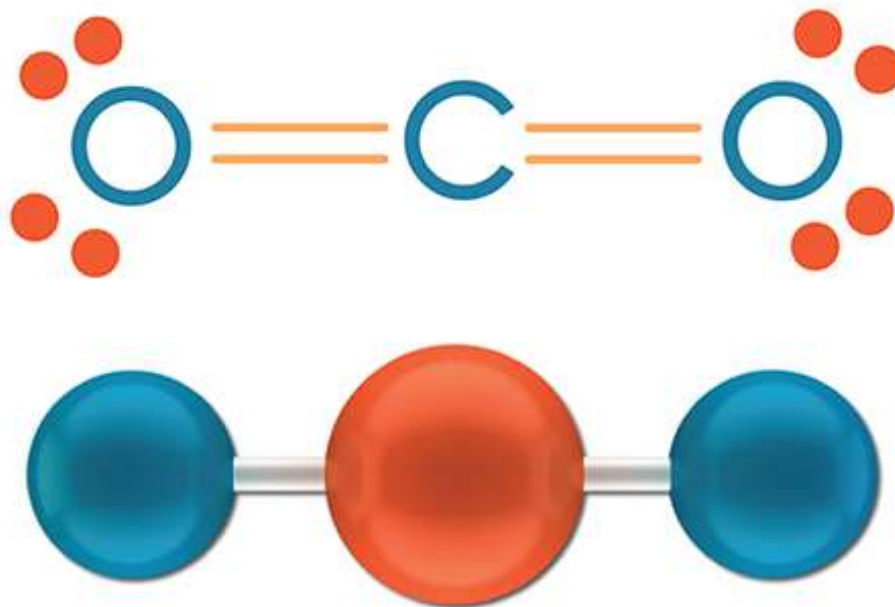


# sp: LINEAR

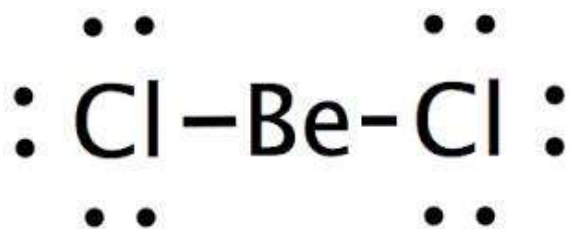
**Linear** shape

Examples:

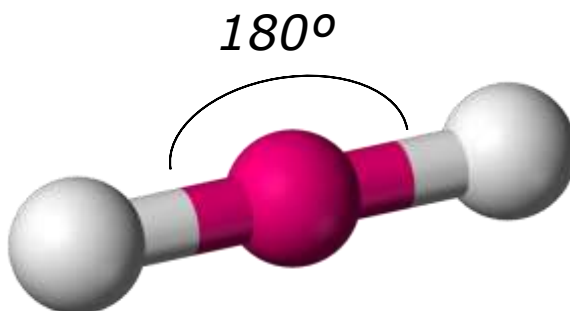
**BeCl<sub>2</sub>, HgCl<sub>2</sub>, CO<sub>2</sub>**



Lewis structure



3-D geometry

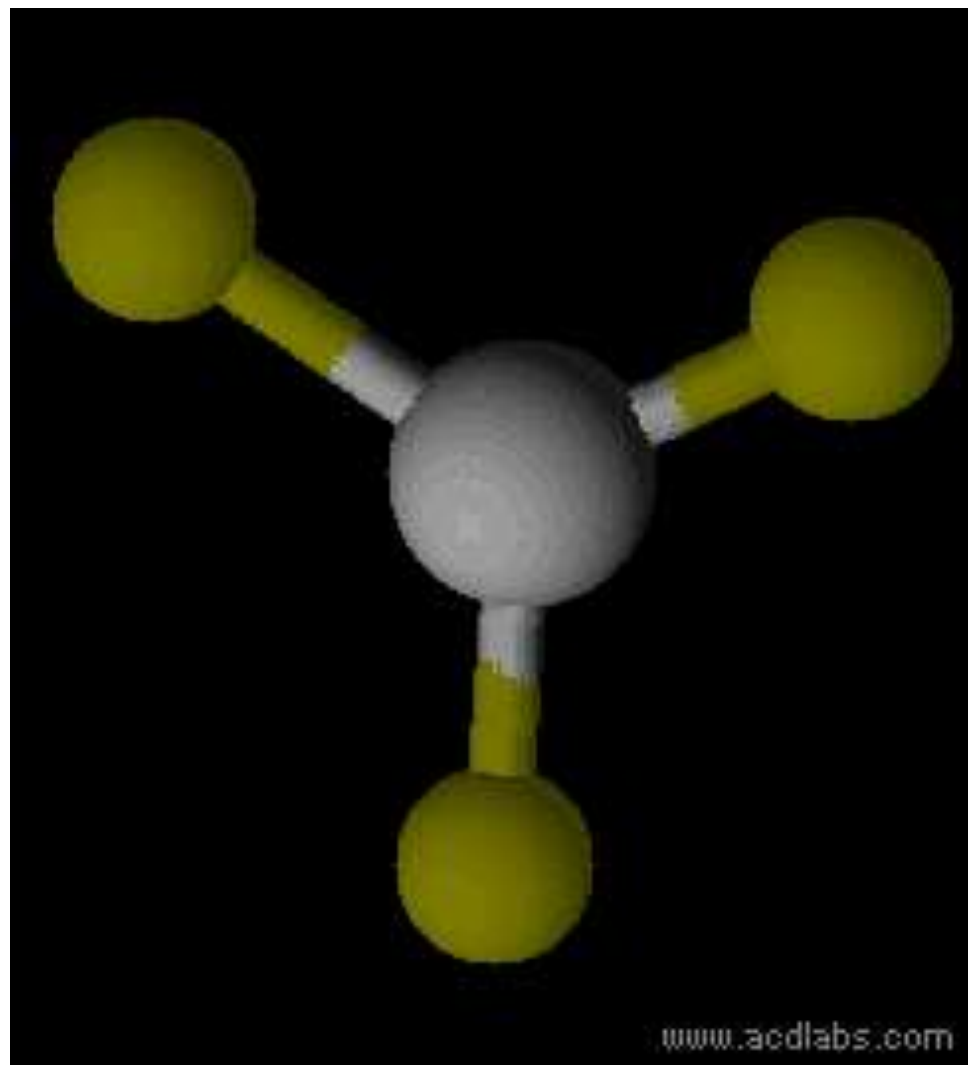
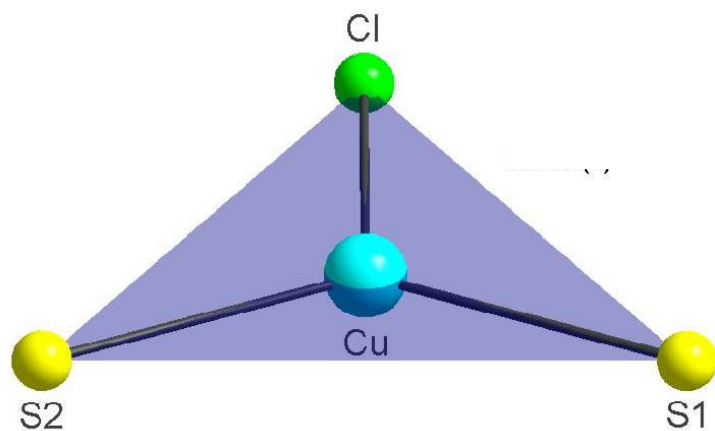


VSEPR diagram



# $sp^2$ HYBRIDIZATION

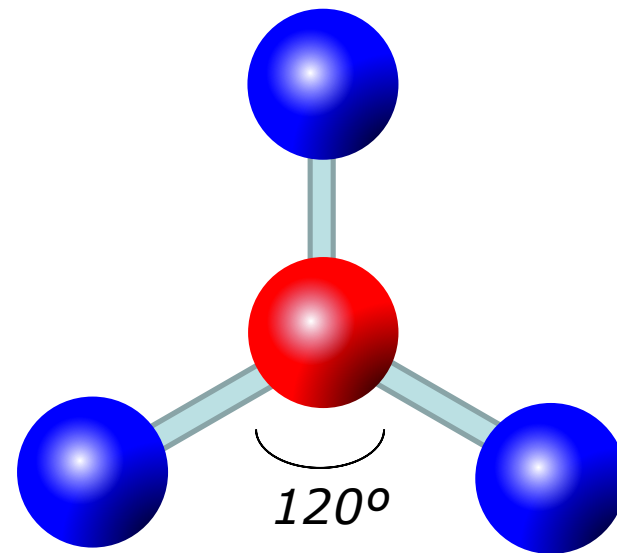
Shape: **Triangle**



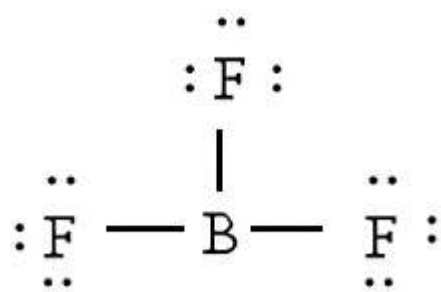
# $sp^2$ : TRIGONAL PLANAR

**Trigonal planar** shape

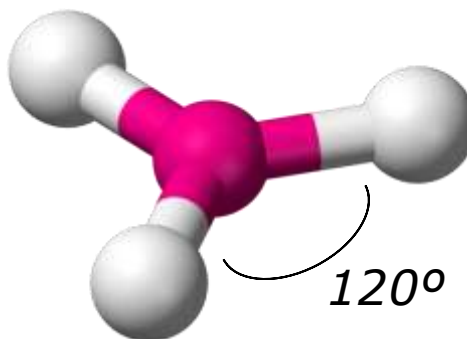
Examples:



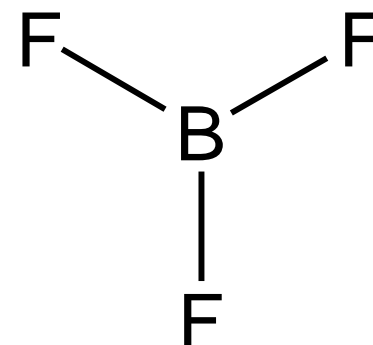
Lewis structure



3-D geometry



VSEPR diagram



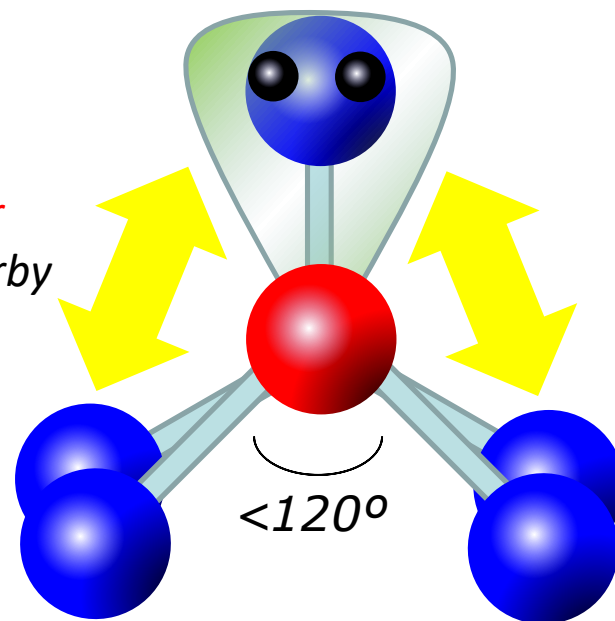
# $sp^2$ : ANGULAR/BENT/V-SHAPE

## Bent shape

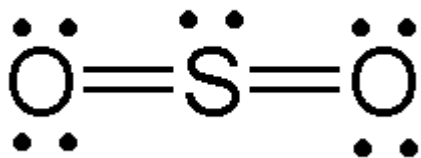
Examples:



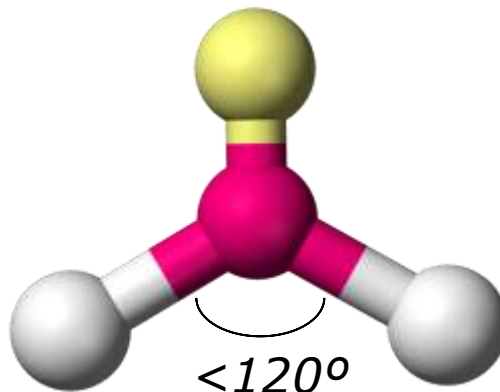
A lone pair is less confined in space and *exerts greater repulsions* on nearby bonding pairs.



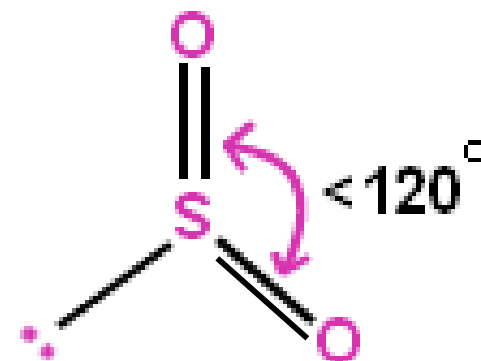
Lewis structure



3-D geometry

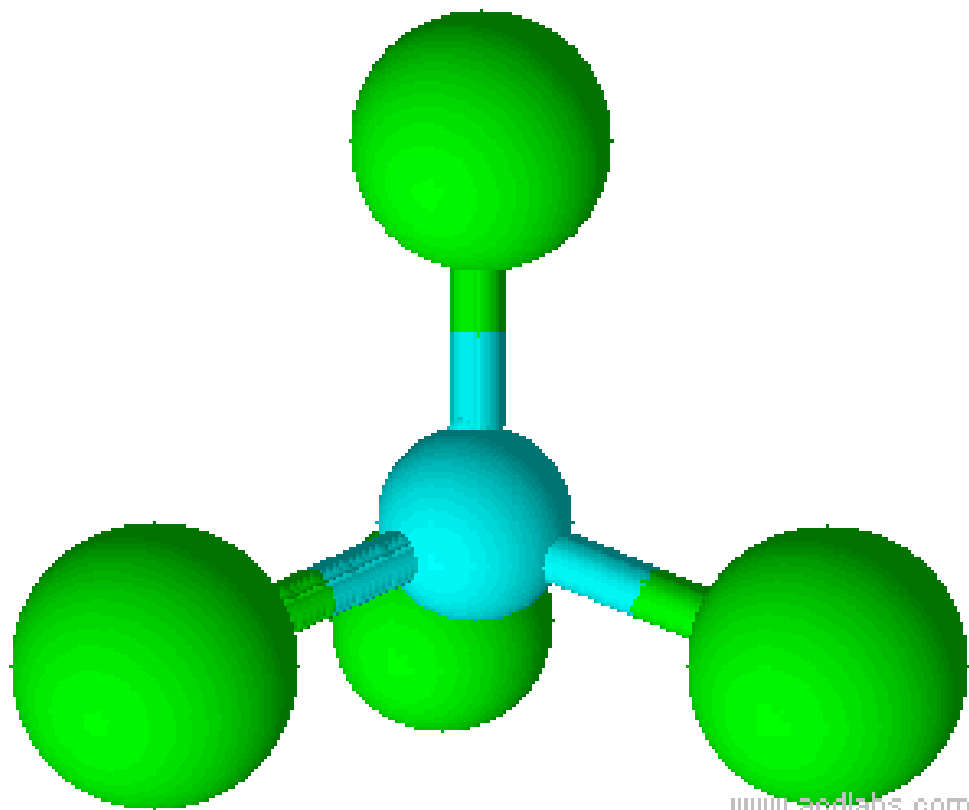
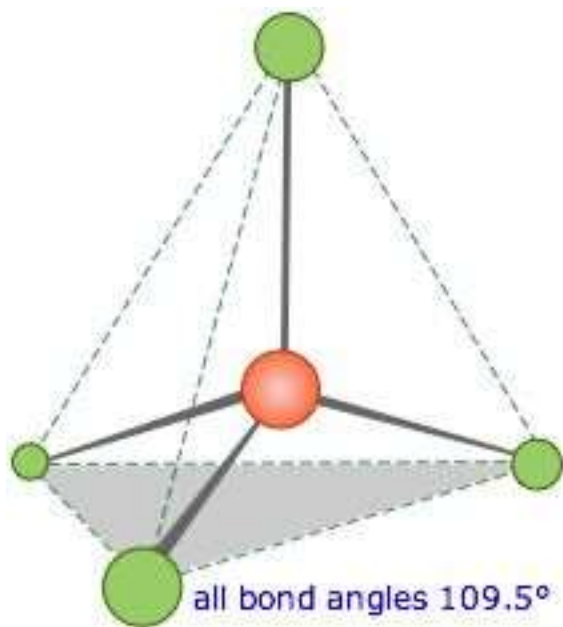


VSEPR diagram



# $sp^3$ HYBRIDIZATION

Shape: **Tetrahedral**

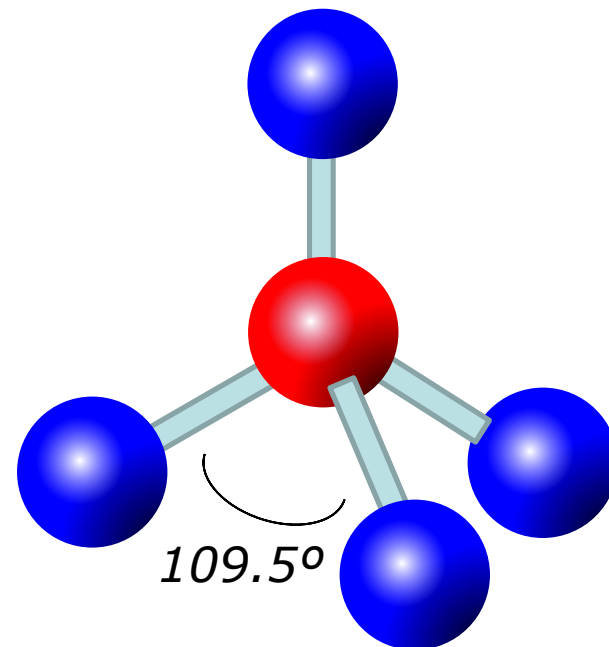


[www.900labs.com](http://www.900labs.com)

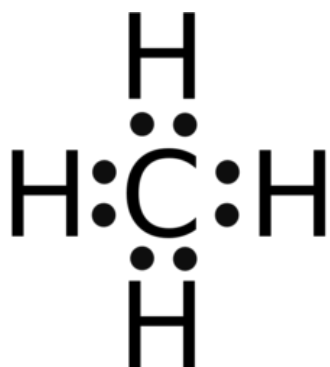
# $sp^3$ : TETRAHEDRAL

**Tetrahedral** shape

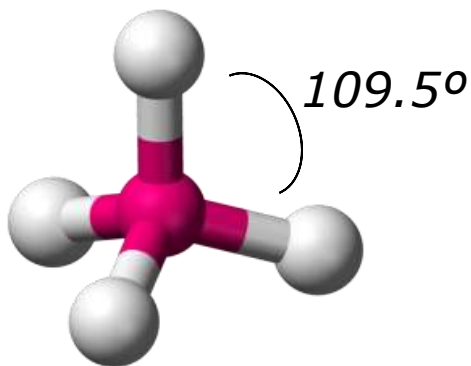
Examples:



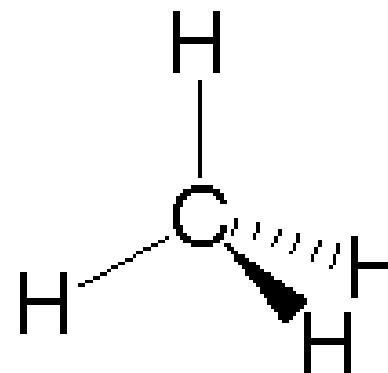
Lewis structure



3-D geometry



VSEPR diagram

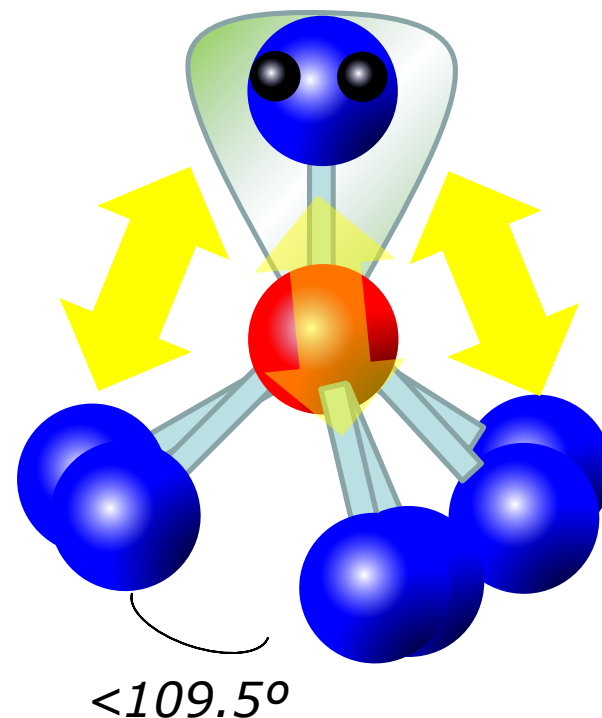


# $sp^3$ : TRIGONAL PYRAMIDAL

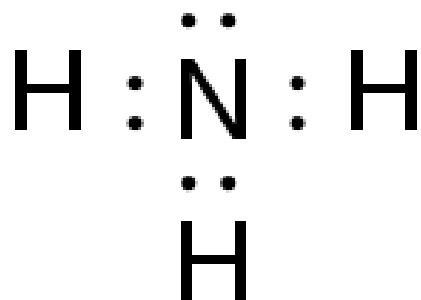
**Trigonal pyramidal** shape

Examples:

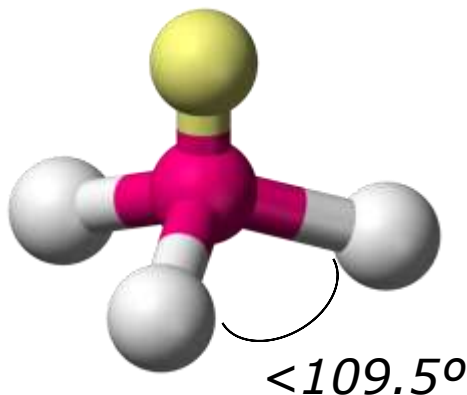
$NH_3$ ,  $PCl_3$



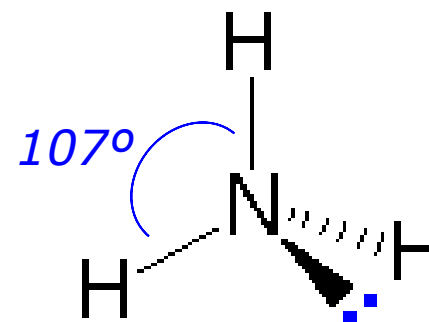
Lewis structure



3-D geometry



VSEPR diagram



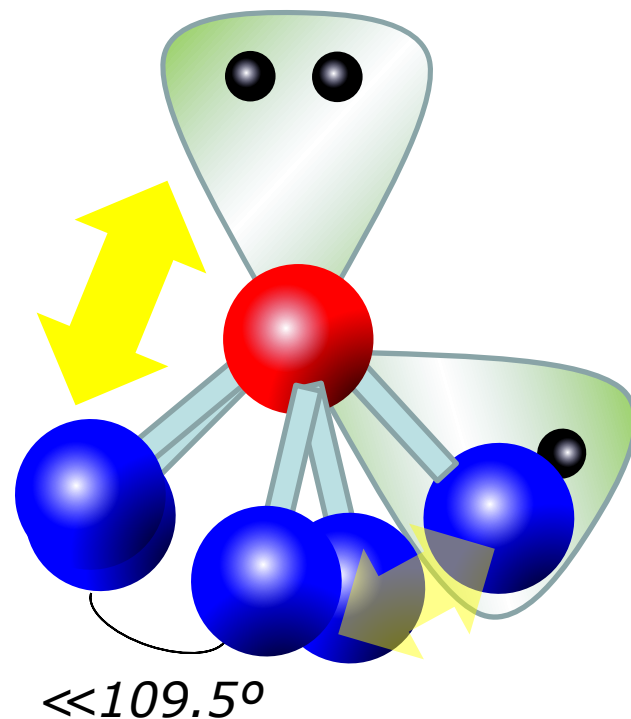


# $sp^3$ : ANGULAR/BENT/V-SHAPE

**Bent** shape

Examples:

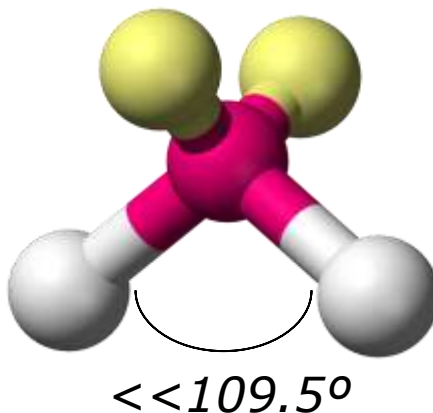
$OF_2$ ,  $H_2O$



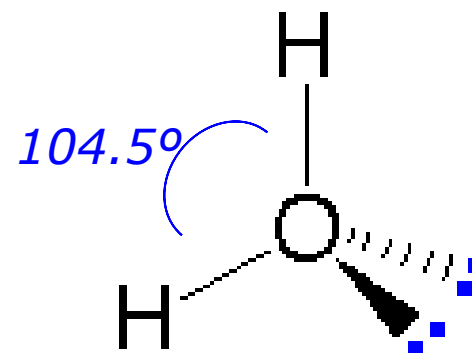
Lewis structure



3-D geometry

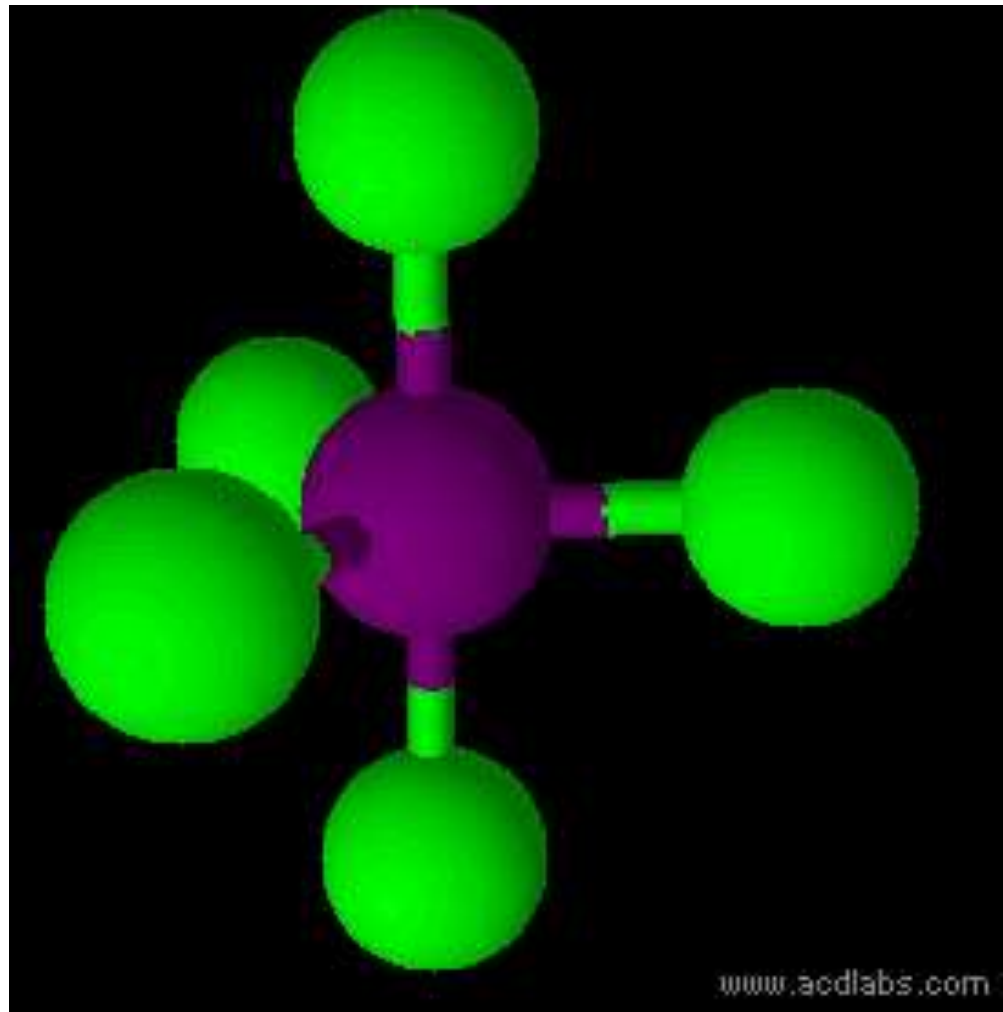
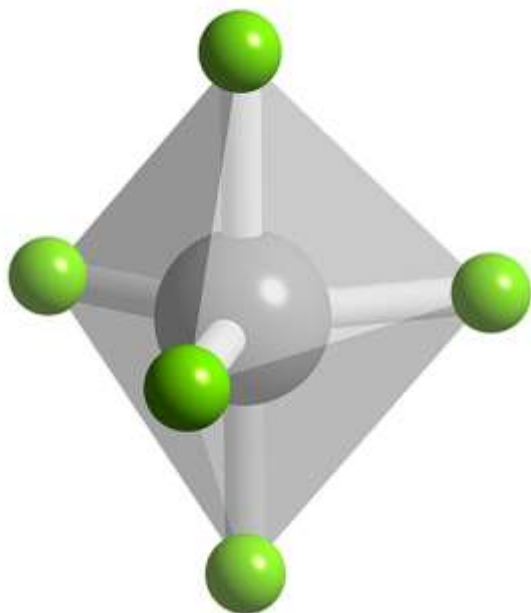


VSEPR diagram



# $sp^3d$ HYBRIDIZATION

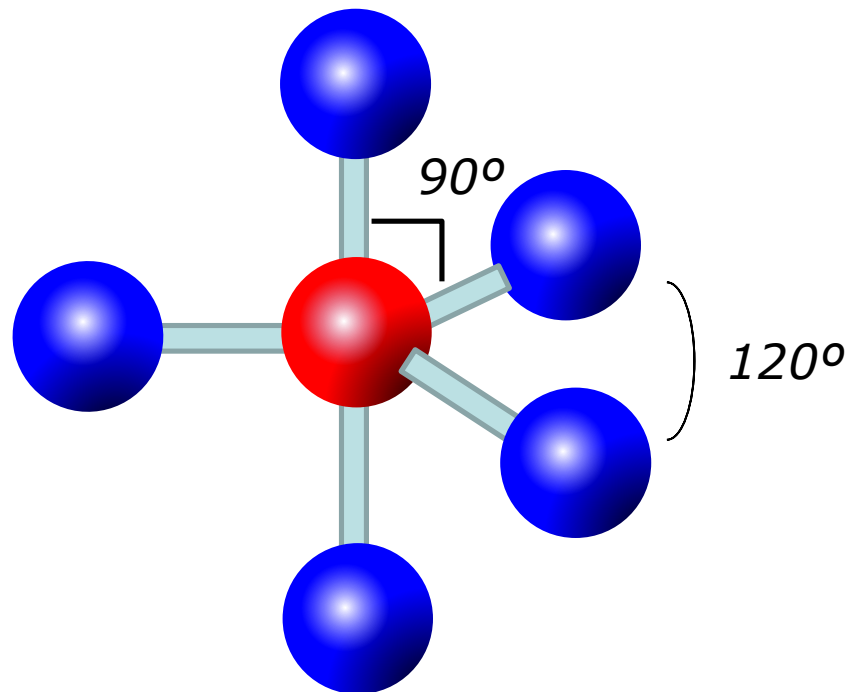
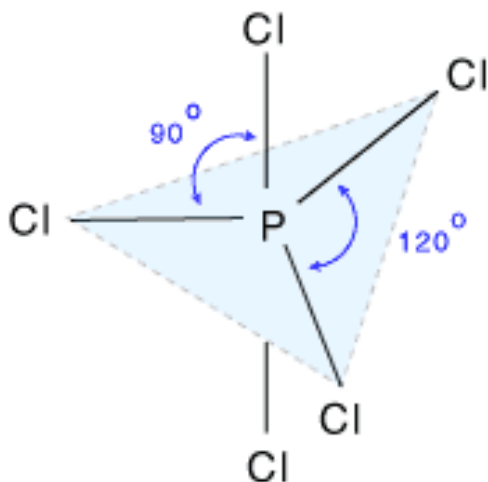
Shape: **Trigonal bipyramid**



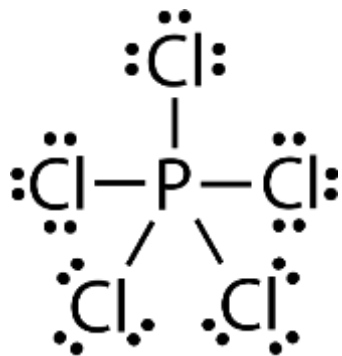
# $sp^3d$ : TRIGONAL BIPYRAMIDAL

## Trigonal bipyramidal shape

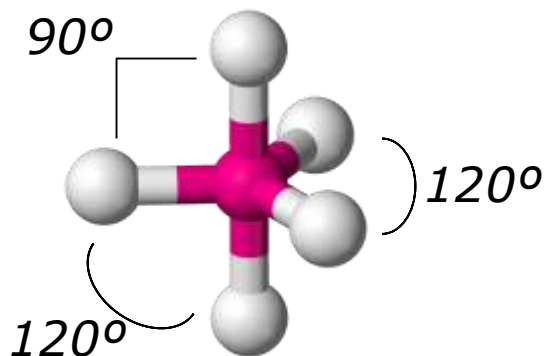
Example:



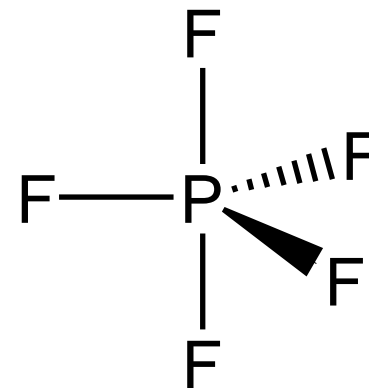
Lewis structure



3-D geometry



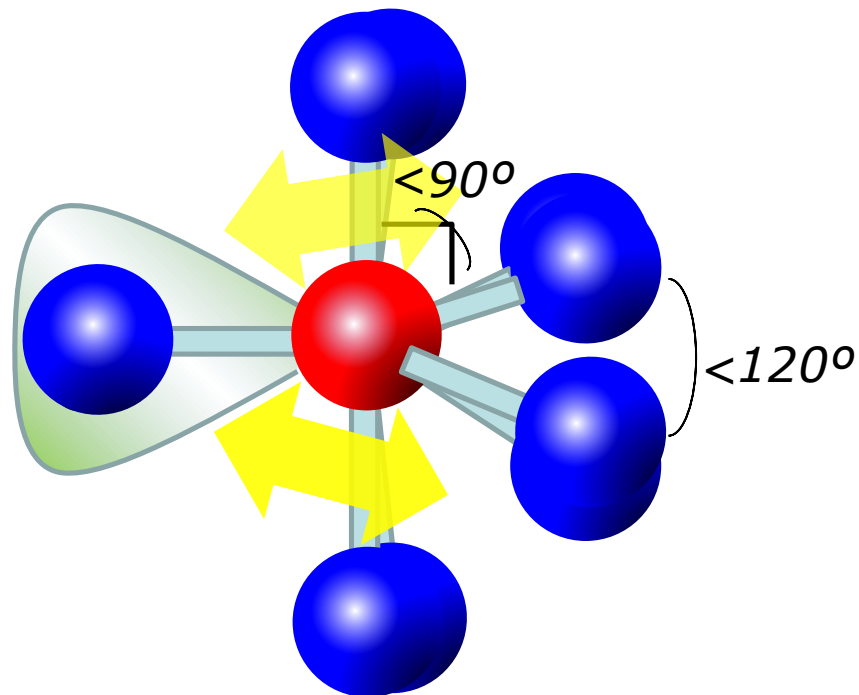
VSEPR diagram



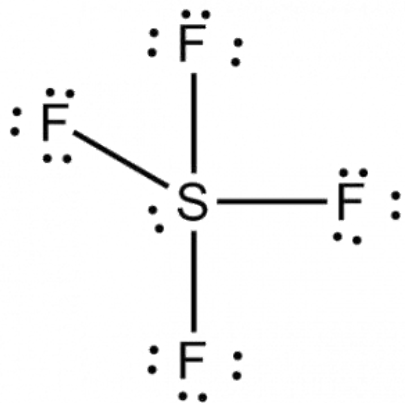
# $sp^3d$ : SEESAW

**Seesaw** shape

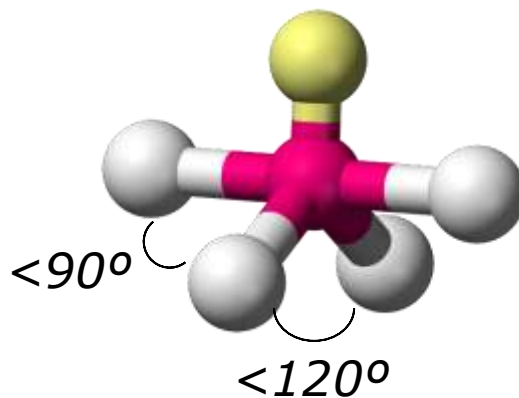
Example:



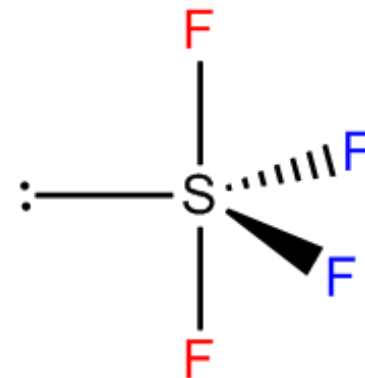
Lewis structure



3-D geometry



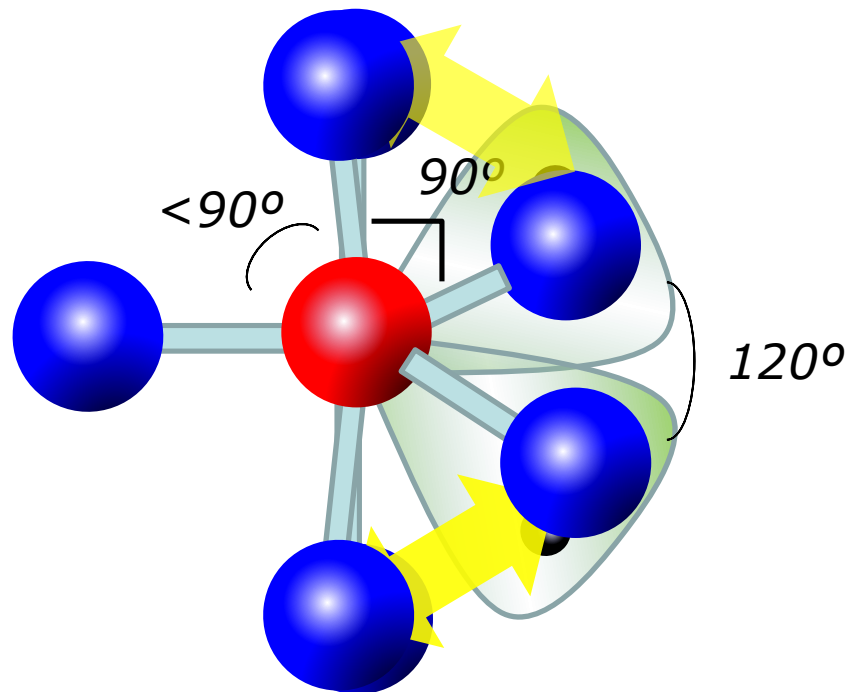
VSEPR diagram



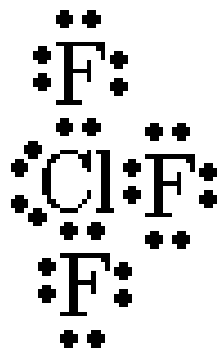
# $sp^3d$ : T-SHAPE

## T-shape

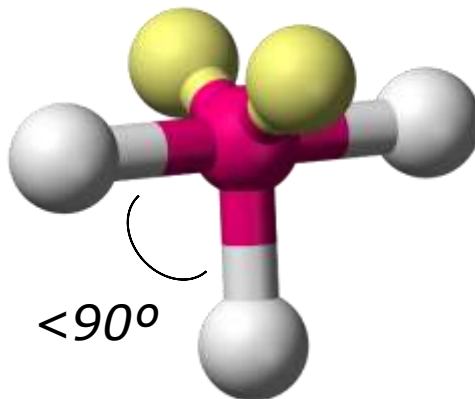
Example:



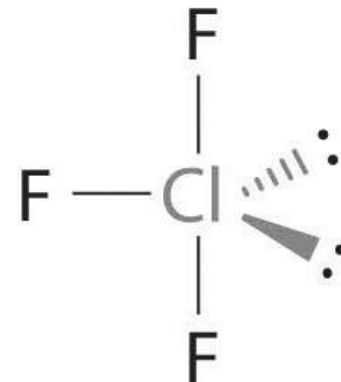
Lewis structure



3-D geometry



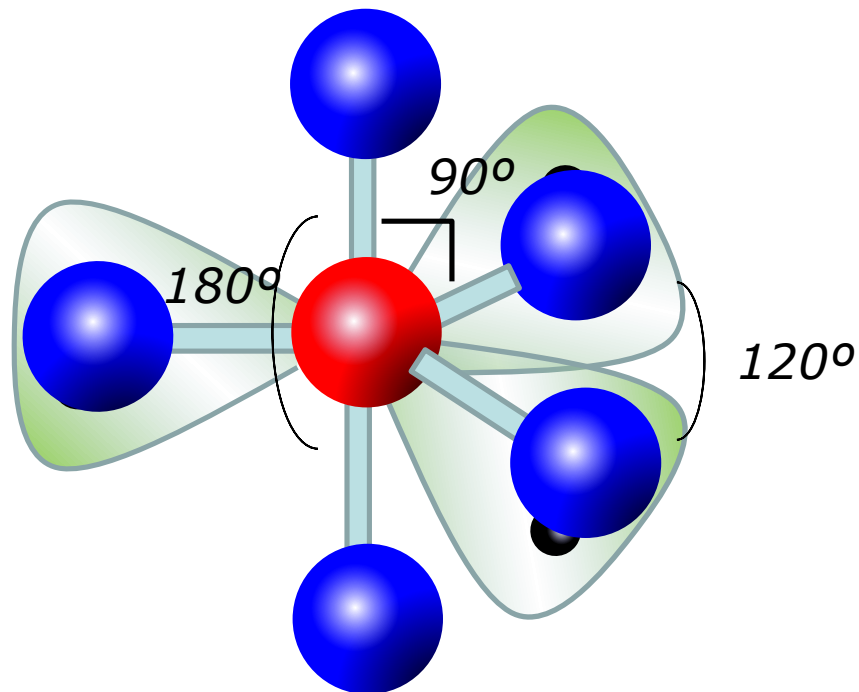
VSEPR diagram



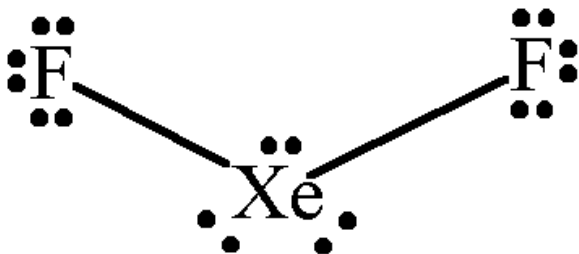
# $sp^3d$ : LINEAR

**Linear** shape

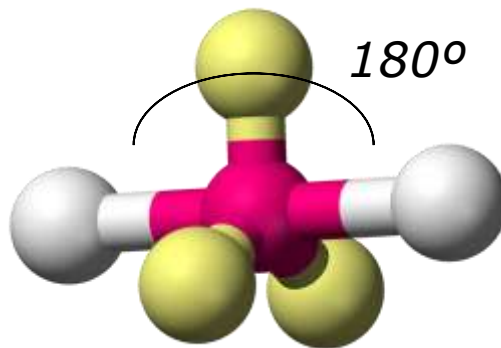
Example:



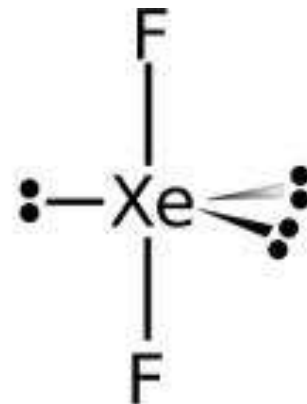
Lewis structure



3-D geometry

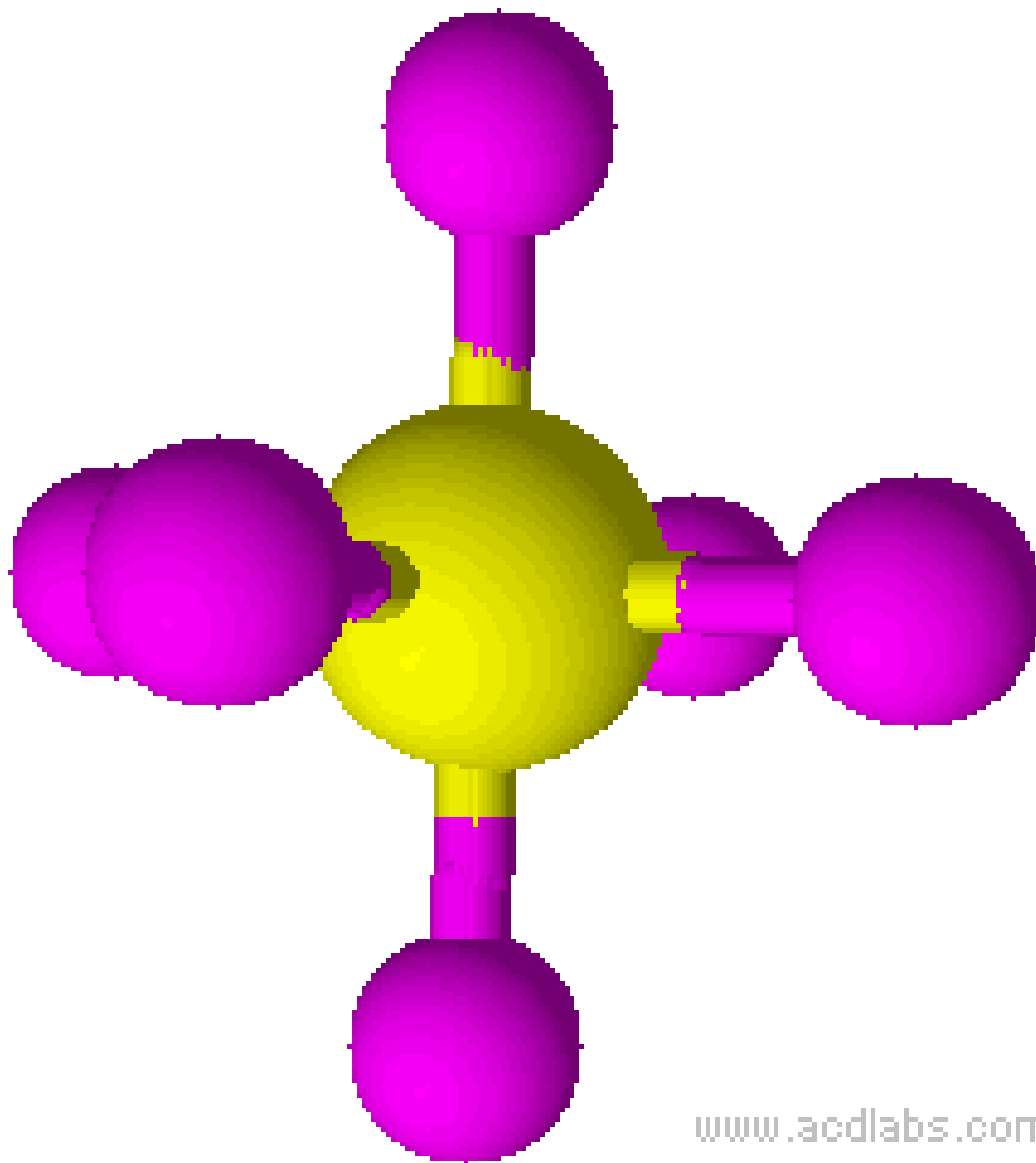
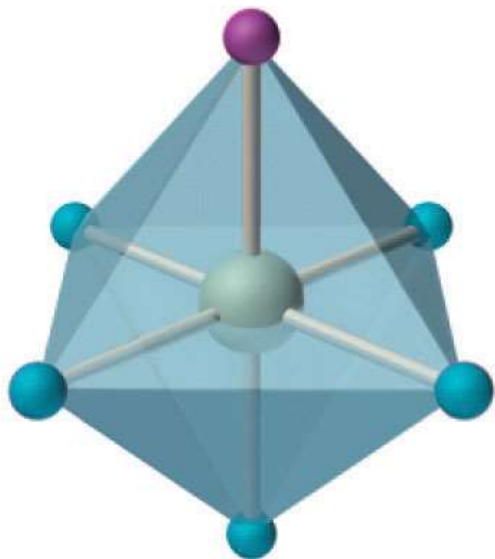


VSEPR diagram



# $sp^3d^2$ HYBRIDIZATION

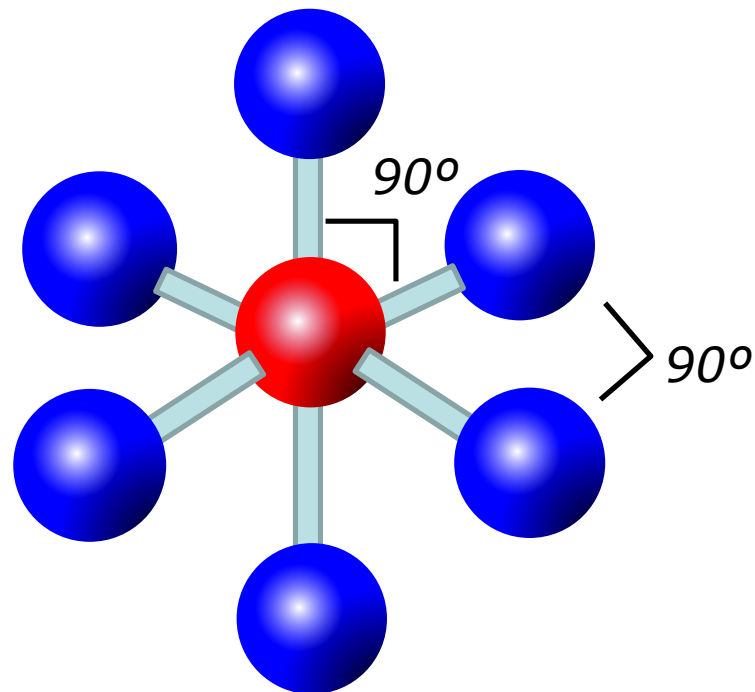
Shape: **Octahedron**



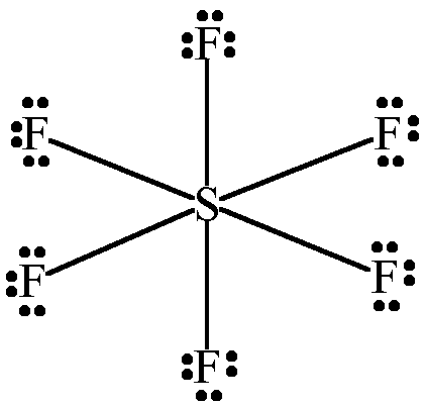
# $sp^3d^2$ : OCTAHEDRAL

## Octahedral shape

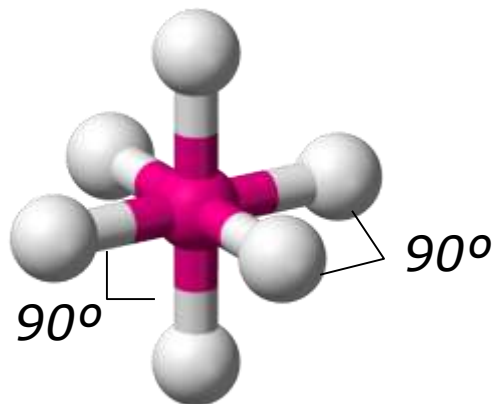
Example:



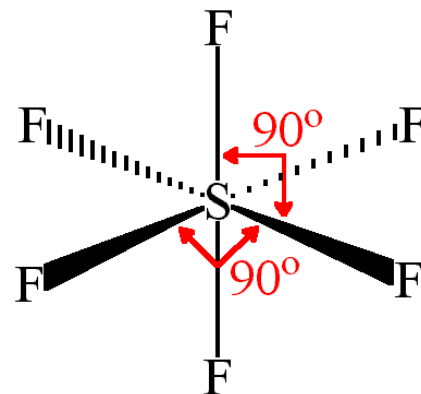
Lewis structure



3-D geometry



VSEPR diagram



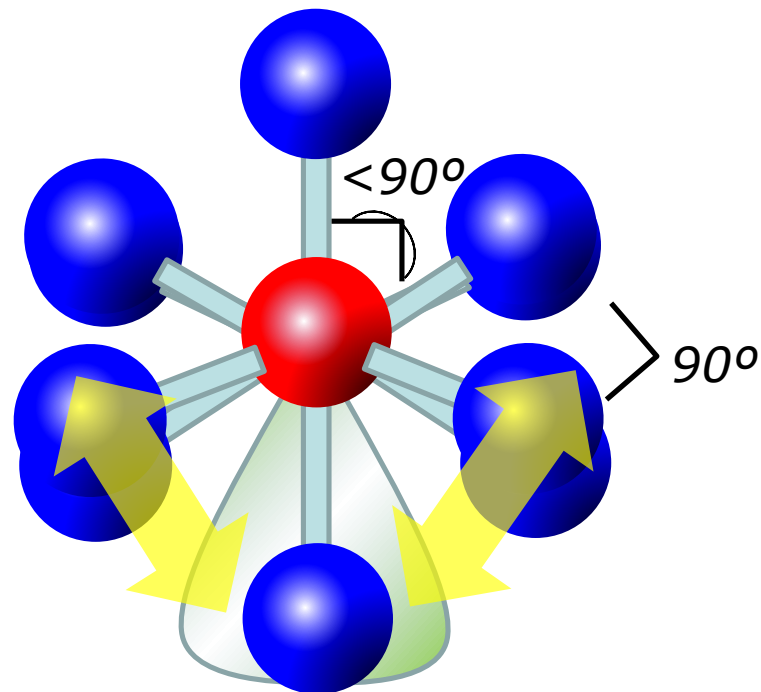


# $sp^3d^2$ : SQUARE PYRAMIDAL

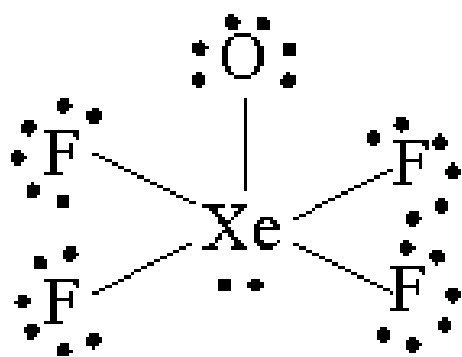
**Square pyramidal** shape

Example:

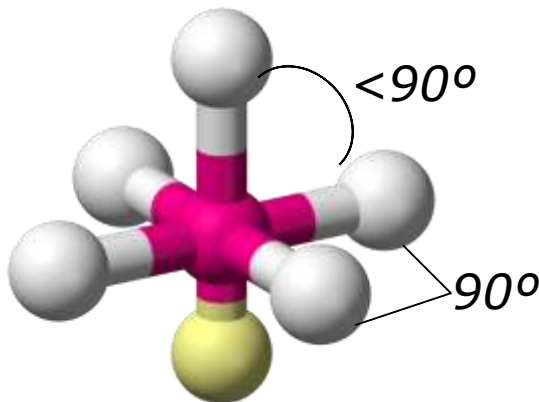
**$\text{XeOF}_4$ ,  $\text{ClF}_5$ ,  $\text{BrF}_5$**



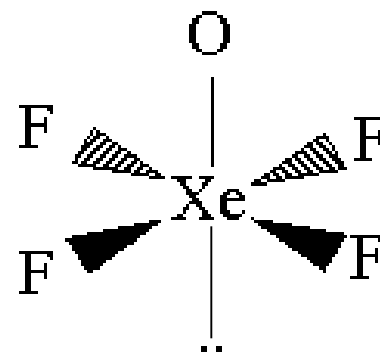
Lewis structure



3-D geometry



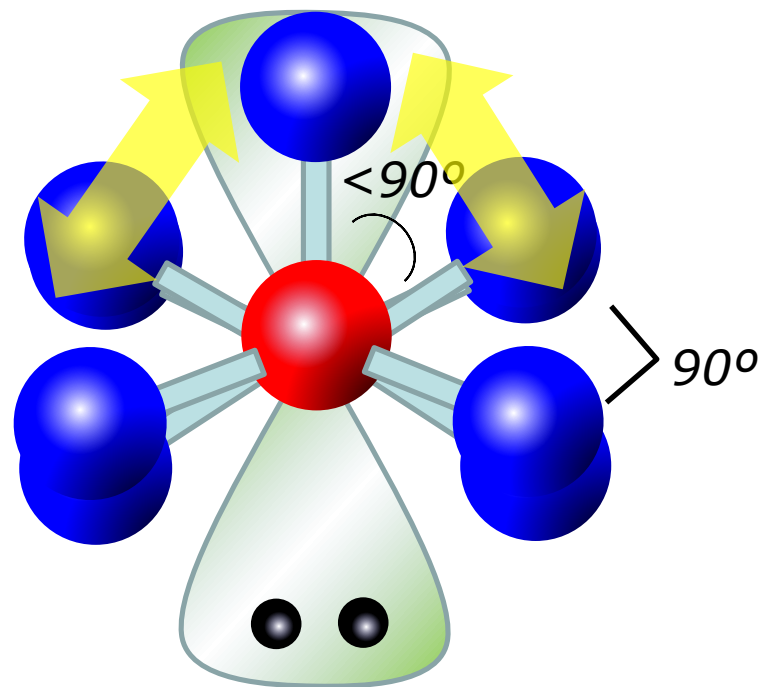
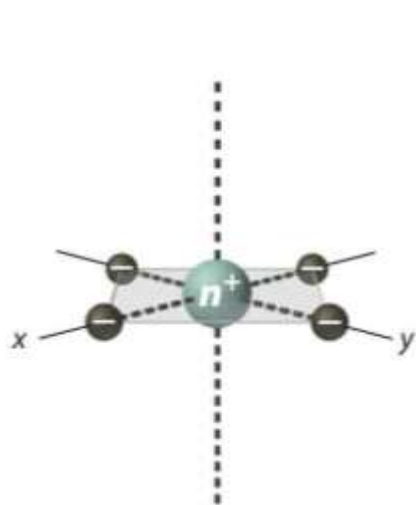
VSEPR diagram



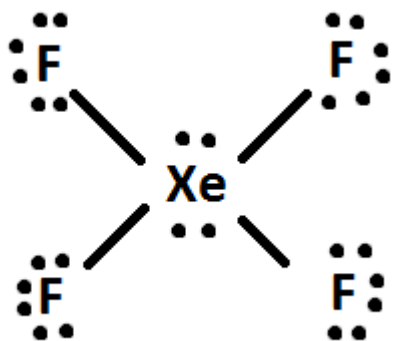
# $sp^3d^2$ : SQUARE PLANAR

**Square planar** shape

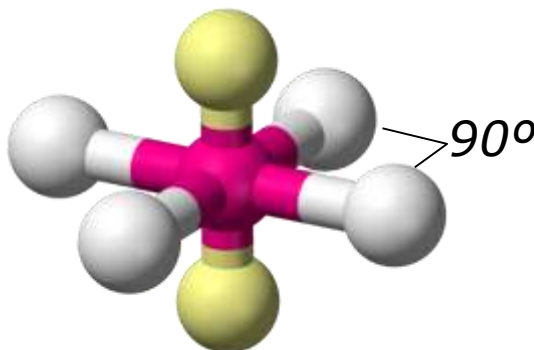
Example:



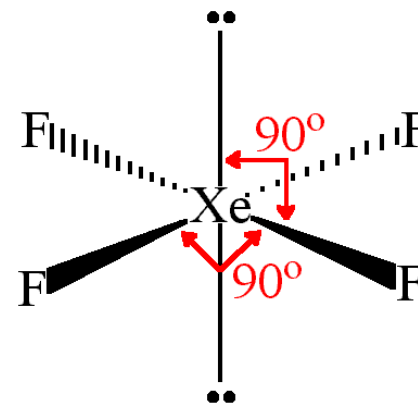
Lewis structure



3-D geometry

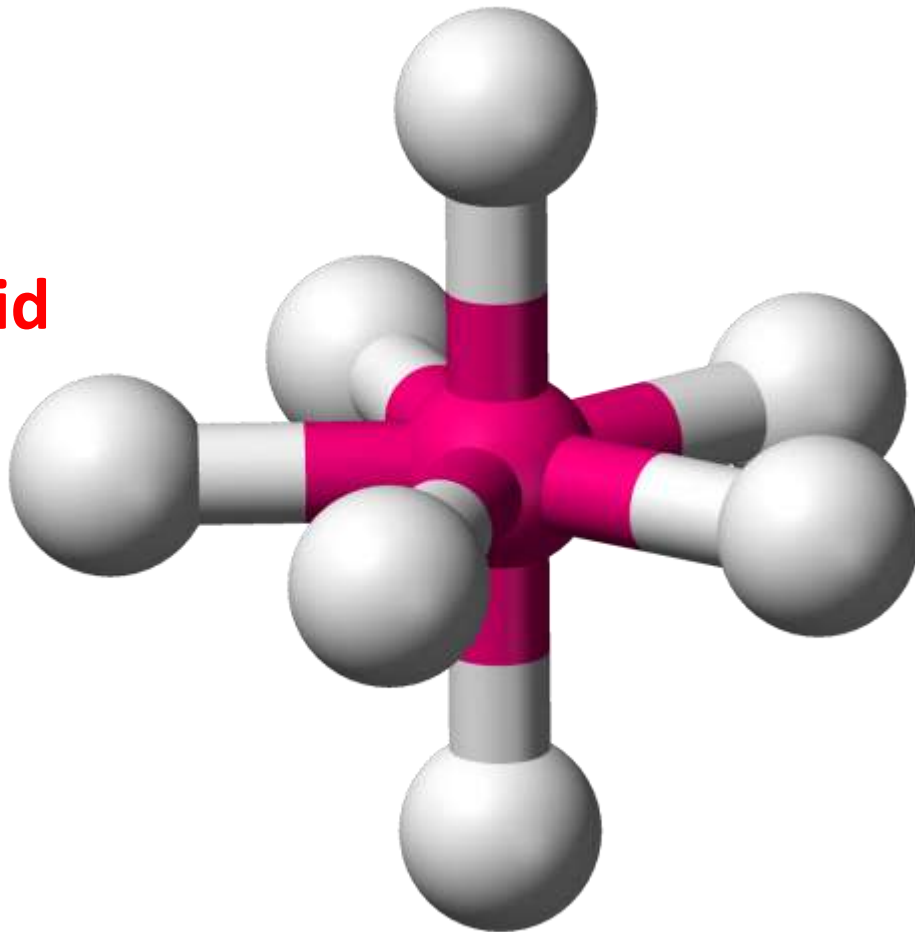
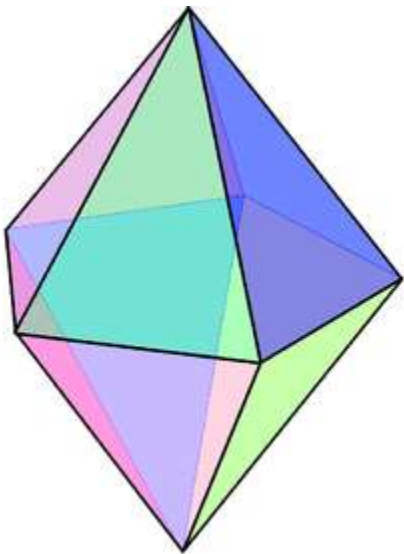


VSEPR diagram



# $sp^3d^3$ HYBRIDIZATION

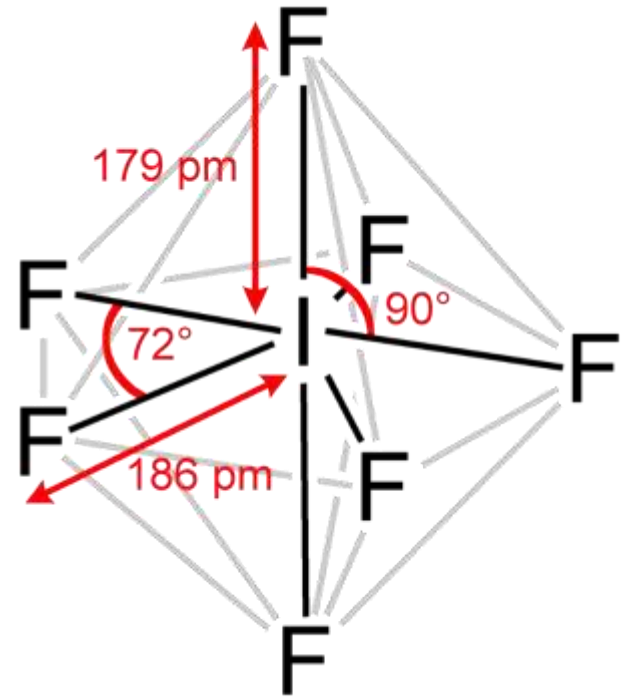
Shape: **Pentagonal bipyramid**



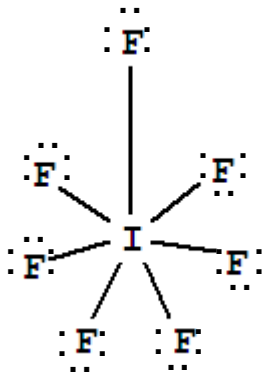
# $sp^3d^3$ : PENTAGONAL BIPYRAMID

**Pentagonal bipyramid** shape

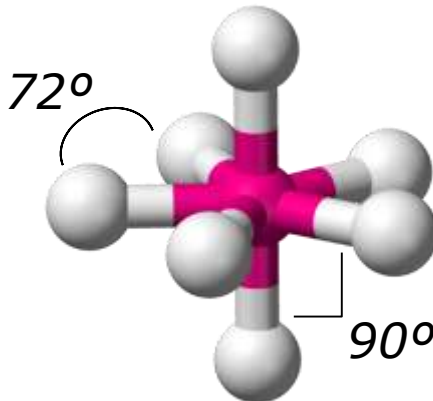
Example:



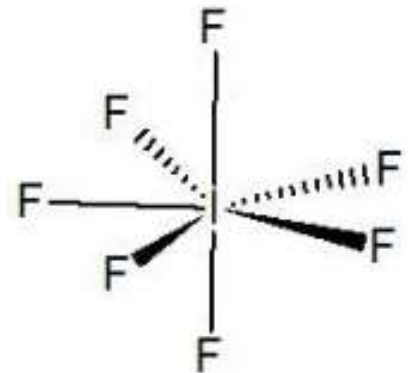
Lewis structure



3-D geometry

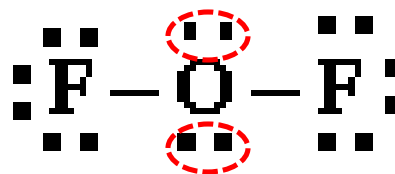


VSEPR diagram

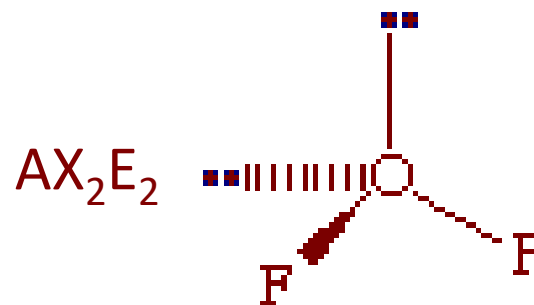


# HOT TO DRAW VSEPR

Example:  $\text{OF}_2$



2 lone pairs, 2 bonding pairs



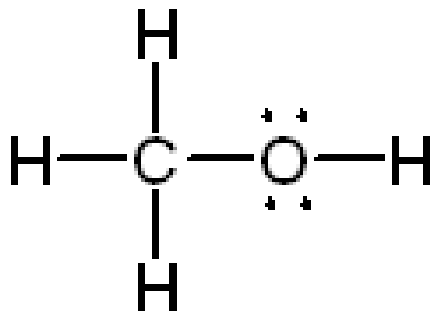
Angular/bent

1. Draw the Lewis structure
2. Count the electron pairs surrounding the central atom and maximize their distance from each other
3. Determine the name of the structure from the number of bonding and lone pairs of electrons

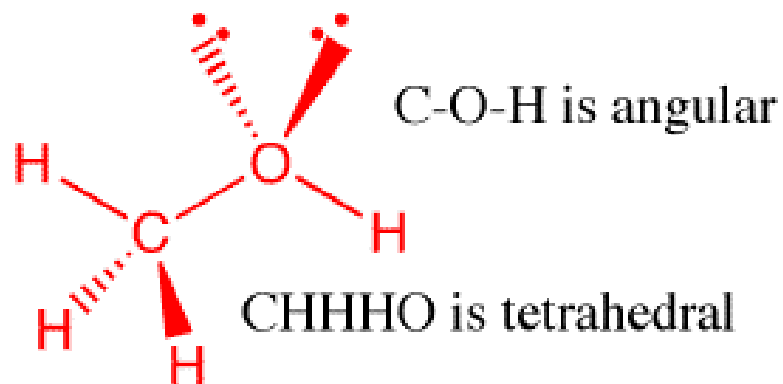
# MOLECULAR VSEPR DIAGRAMS

- Predict the arrangement around each central atom individually
- Example:  $\text{CH}_3\text{OH}$

Lewis structure:



VSEPR diagram:

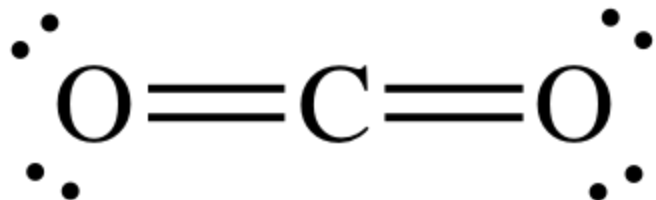


# MULTIPLE BONDS & VSEPR

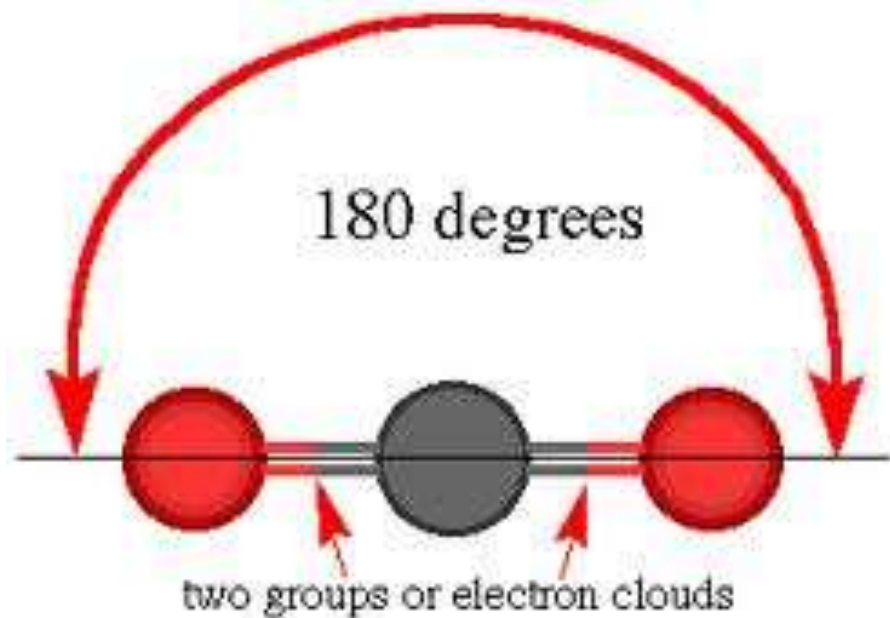
## Multiple Bonds & VSEPR

- Treat multiple bonds as single bonds (one bonding pair) to determine the shape of molecules with multiple bonds
- Example:  $\text{CO}_2$

Lewis structure:



3D diagram:



# VSEPR

## Homework

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