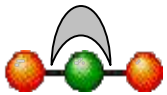
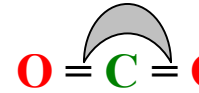
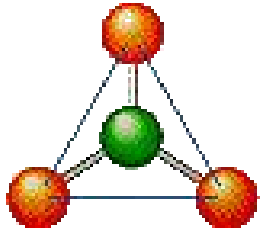
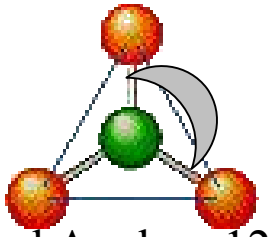
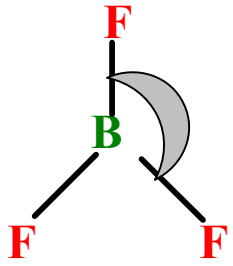
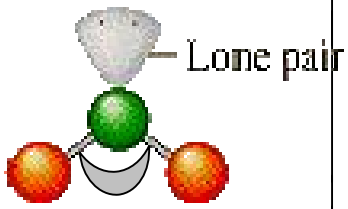
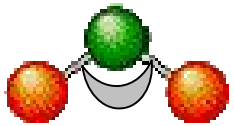
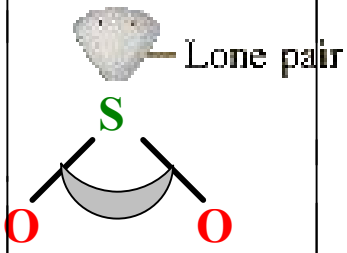
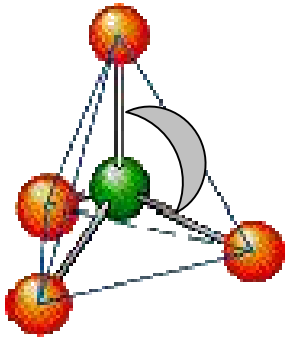
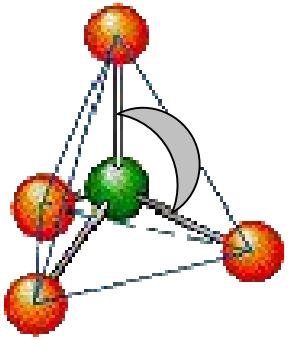
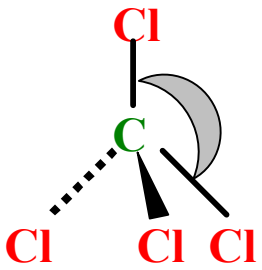
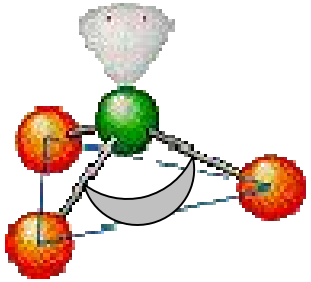
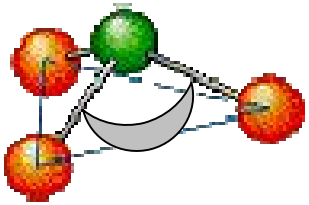
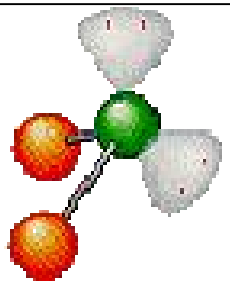
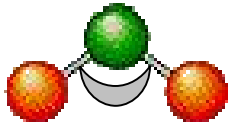
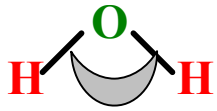
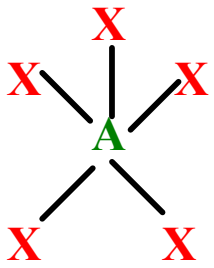
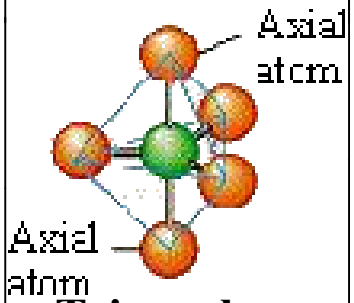
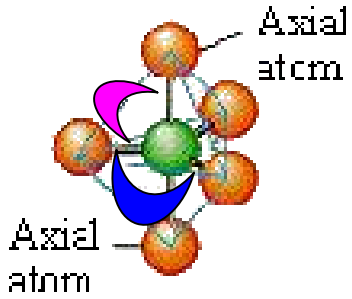
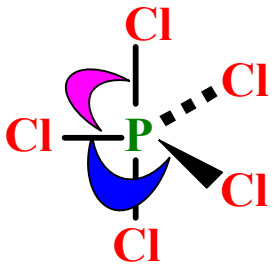
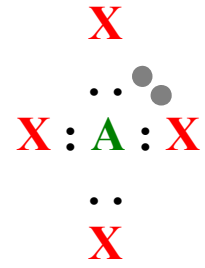
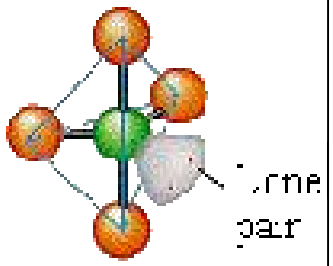
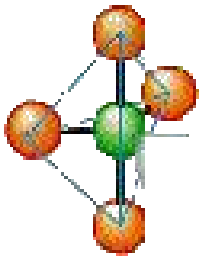
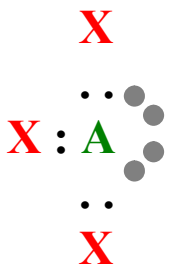
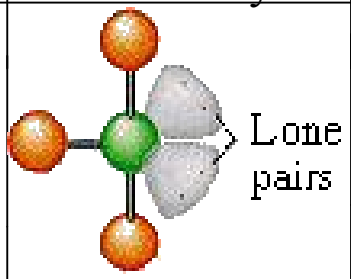
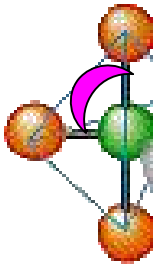
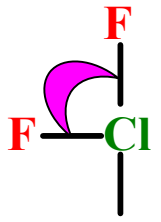
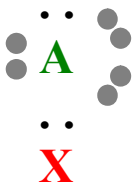
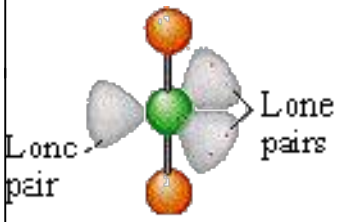
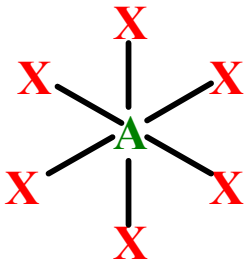
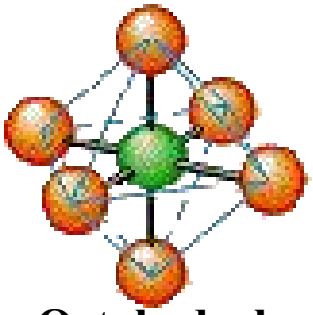
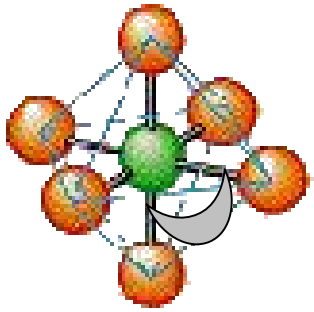
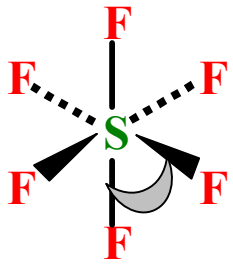
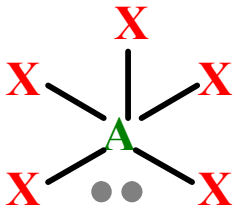
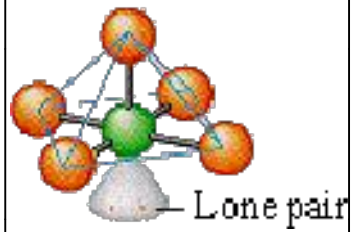
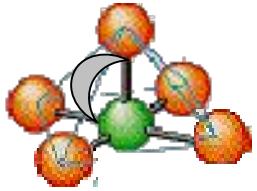
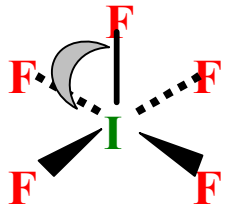
Lewis formula	Electron Pairs			Electron Pair Geometry	Molecular Geometry	Example
	Total	Bonding	Lone			
AX_2 X : A : X	**2**	**2**	**0**	 **Linear**	 **Linear** **Bond Angle = 180^0** **Nonpolar**	  Treat double bonds as single bonds
AX_3 X .. A : X .. X	**3**	**3**	**0**	 **Trigonal planar**	 Bond Angle = 120^0 **Nonpolar** **Trigonal Planar**	

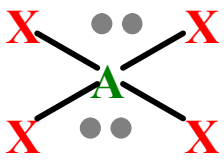
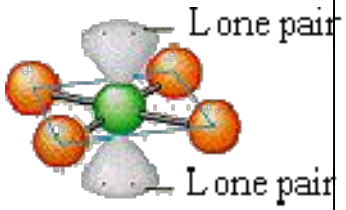
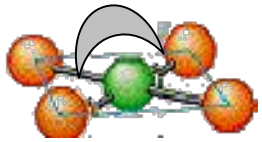
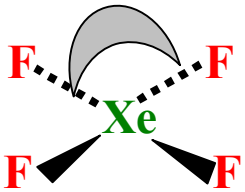
Lewis formula	Electron Pairs			Electron Pair Geometry	Molecular Geometry	Example
	Total	Bonding	Lone			
AX_2E E = lone pair . . X : A :: X **or** . . X :: A : X Treat double bonds as single bonds	**3**	**2**	**1**	 **Trigonal planar**	 **Bent (angular)** **Bond Angle ≈ 120^0** **Polar**	
AX_4 X . . X : A : X . . X	**4**	**4**	**0**	 **Tetrahedral**	 **Tetrahedral** Bond Angle ≈ 109.5^0 **Nonpolar**	

Lewis formula	Electron Pairs			Electron Pair Geometry	Molecular Geometry	Example
	Total	Bonding	Lone			
AX_3E E = lone pair : X : A : X : X	**4**	**3**	1	 **Tetrahedral**	 **Trigonal Pyramidal** Bond Angle ≈109.5^0 **Polar**	
AX_2E_2 : X : A : : X	**4**	**2**	2	 **Tetrahedral**	 **Bent (Angular)** Bond Angle ≈109.5^0 **Polar**	

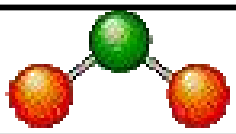
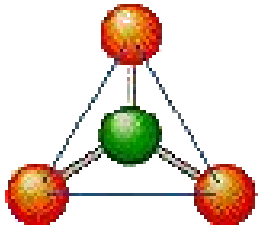
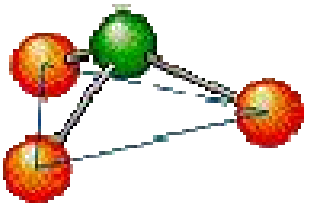
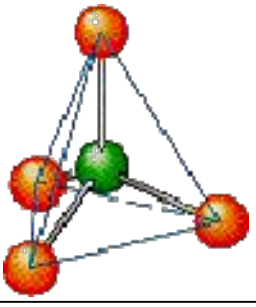
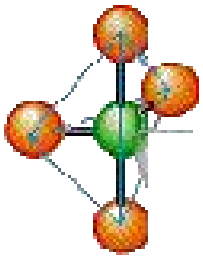
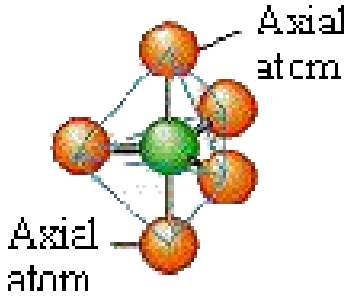
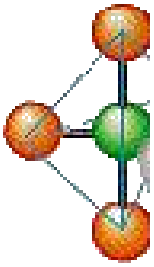
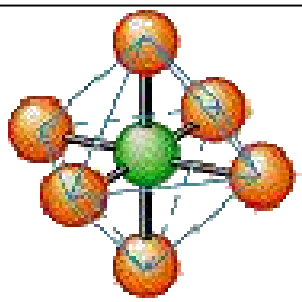
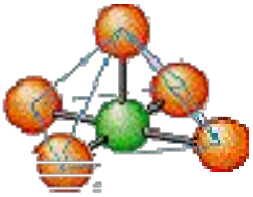
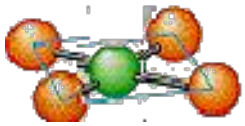
Lewis formula	Electron Pairs			Electron Pair Geometry	Molecular Geometry	Example
	Total	Bonding	Lone			
AX_5 	5	5	0	 **Trigonal bipyramidal**	 **Trigonal bipyramidal** Bond Angles: 120^0 (3) and 90^0 (6) **Nonpolar**	 PCl_5
AX_4E 	5	4	1	 **Trigonal bipyramidal**	 **Seesaw** Bond Angles: 120^0, 90^0, and 180^0 **Polar**	SF_4 

Lewis formula	Electron Pairs			Electron Pair Geometry	Molecular Geometry	Example
	Total	Bonding	Lone			
AX_3E_2 	5	3	2	 **Trigonal bipyramidal**	 **T-shaped** **Bond Angles: 90^0** **Polar**	ClF_3 
AX_2E_3 	5	2	3	 **Trigonal bipyramidal**	 **Linear** Bond Angle = 180^0 **Nonpolar**	XeF_2 

Lewis formula	Electron Pairs			Electron Pair Geometry	Molecular Geometry	Example
	Total	Bonding	Lone			
AX_6 	6	6	0	 **Octahedral**	 **Octahedral** Bond Angle = 90^0 **Nonpolar**	SF_6 
AX_5E 	6	5	1	 **Octahedral**	 **Square pyramidal** Bond Angle: 90^0 **Polar**	IF_5 

Lewis formula	Electron Pairs		Electron Pair Geometry	Molecular Geometry	Example
	Total Bonding	Lone			
AX_4E_2 	**6** **4**	**2**	 **Octahedral**	 **Square planar** Bond Angle: 90^0 **Nonpolar**	XeF_4 

SUMMARY

Symmetrical Arrangement Polar Bonds ⇨ Nonpolar Molecule		Asymmetrical Arrangement Polar Bonds ⇨ Polar Molecule	
Linear		Bent	
Trigonal Planar planar		Trigonal pyramidal	
Tetrahedral		Seesaw	
Trigonal bipyramidal		T-shaped	
Octahedral		Square pyramidal	
Square planar			

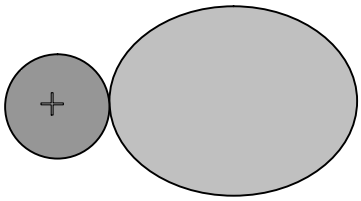
BOND ANGLES

- Bond angles between atoms can be approximately predicted from the VSEPR model.
- Some deviations from the predicted bond angles have been determined experimentally. These deviations are caused by 2 factors:

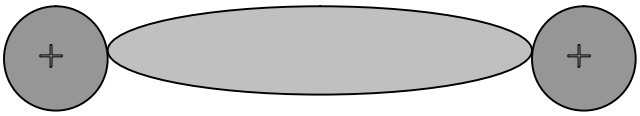
1. Effect of Lone Pairs

A lone pair tends to require more space than a bonding pair

Reason: A lone pair of electrons is attracted to only one atomic core, whereas a bonding pair is attracted to two.
The lone pair is larger, while the bonding pair is drawn more tightly to the nuclei.



Lone pair



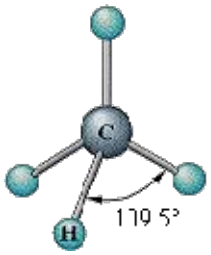
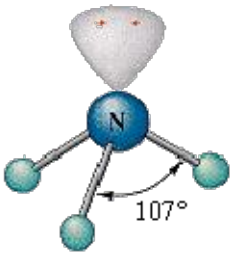
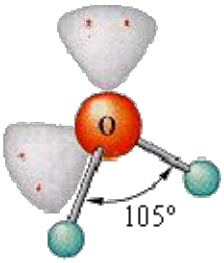
Bonding Pair

Lone pairs repel each other stronger than Bonding Pairs.

Result: The repulsions between electron pairs depend on the type of electron pairs involved.

REPULSION INCREASES

Bonding Pairs ⇨ ⇦ Bonding Pairs	Bonding Pairs ⇨ ⇦ Lone Pairs	Lone Pairs ⇨ ⇦ Lone Pairs
Weakest Repulsion		**Strongest Repulsion**

	CH_4	NH_3	H_2O
			
Electron Pair Geometry	Tetrahedral	Tetrahedral	Tetrahedral
Expected Bond Angle	109.5°	109.5°	109.5°
Bonding Pairs	4	3	2
Lone Pairs	0	**1**	**2**
Actual Bond Angle	109.5°	**107°**	**105°**

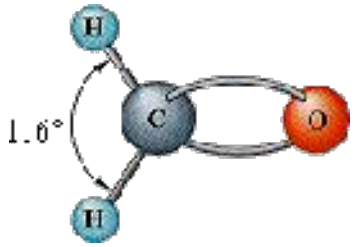
2. **Effect of Multiple Bonds**

Muiltiple bonds require more space than single bonds because of the greater number of electrons:

Electron Pair Geometry: Trigonal Planar

Expected Bond Angle: 120^0

Actual Bond Angle: 116^0



Reason: C = O ⇨ ⇦ C — H

Stronger Repulsion

C — H ⇨ ⇦ C — H

Weaker Repulsion