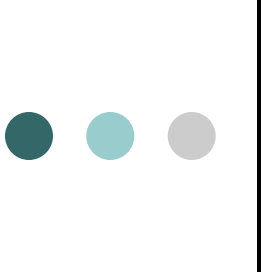


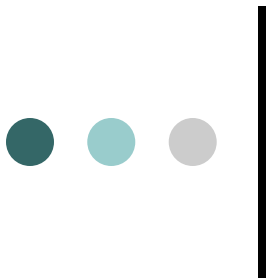
Trigonal Bipyramidal Electronic Geometry: AB_5 , AB_4U , AB_3U_2 , and AB_2U_3

- If lone pairs are incorporated into the trigonal bipyramidal structure, there are three possible new shapes.
 1. *One lone pair - Seesaw shape*
 2. *Two lone pairs - T-shape*
 3. *Three lone pairs – linear*
- The lone pairs occupy equatorial positions because they are 120° from two bonding pairs and 90° from the other two bonding pairs.
 - Results in decreased repulsions compared to lone pair in axial position.

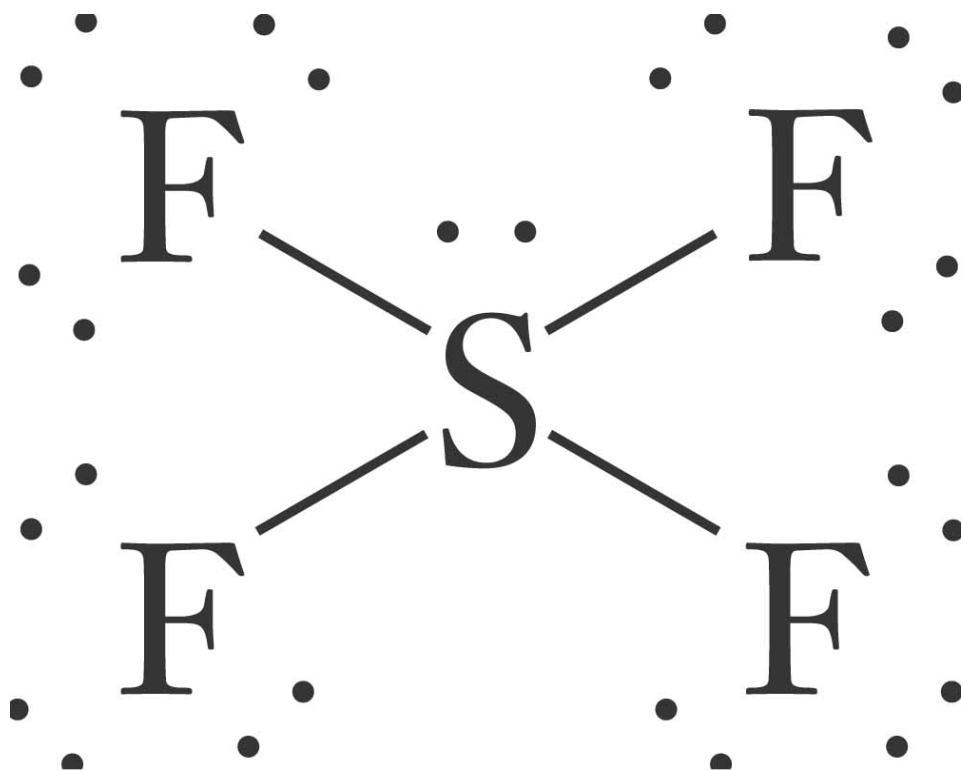


Trigonal Bipyramidal Electronic
Geometry: AB_5 , AB_4U , AB_3U_2 , and
 AB_2U_3

- AB_4U molecules have:
 1. *Trigonal bipyramid electronic geometry*
 2. *Seesaw shaped molecular geometry*
 3. *and are polar*
- One example of an AB_4U molecule is SF_4
- Hybridization of S atom is sp^3d .

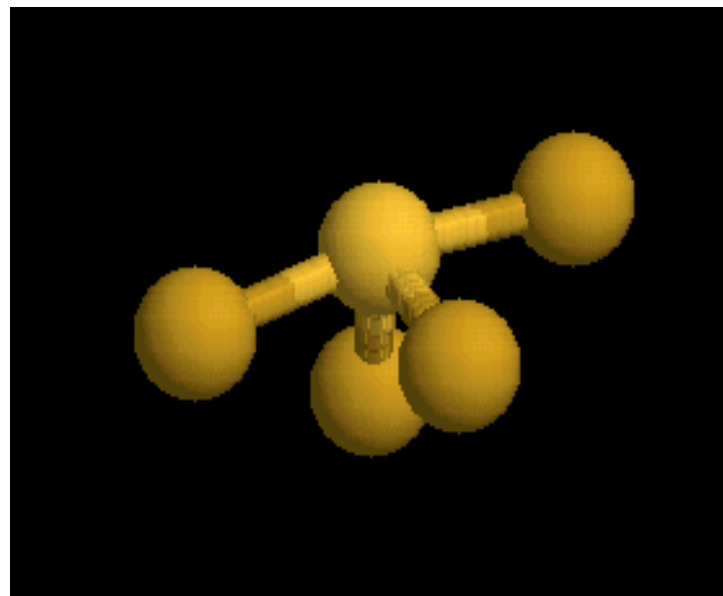


Lewis Dot

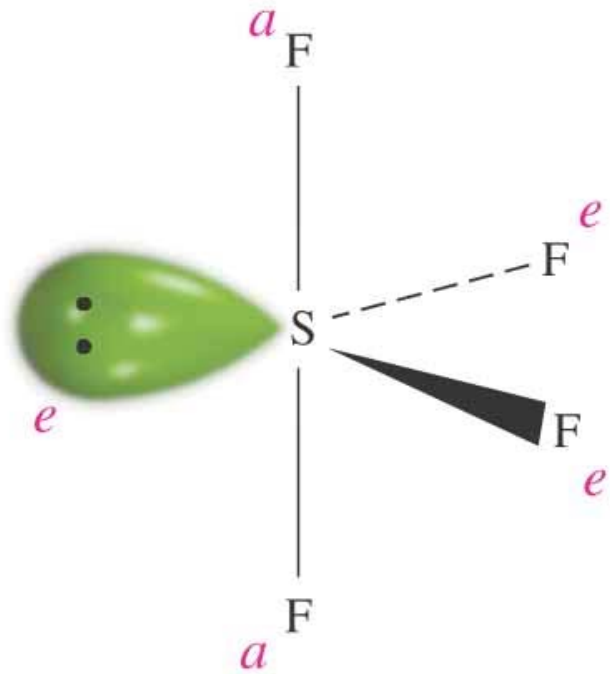


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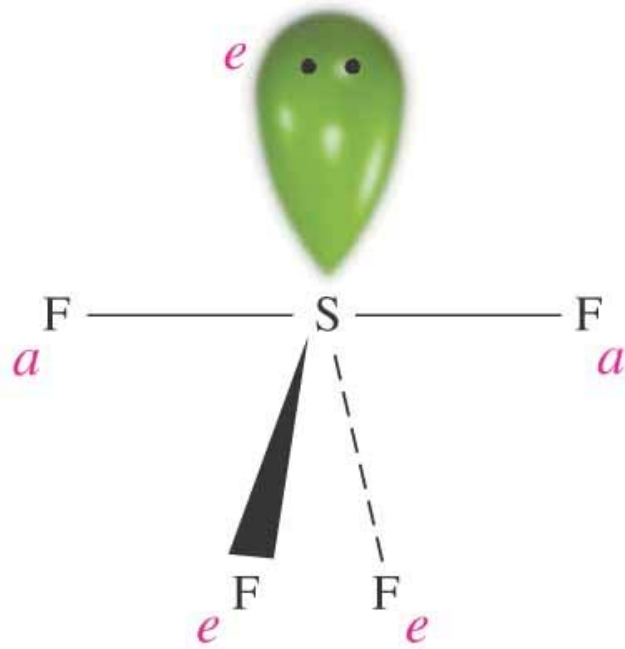
Molecular Geometry



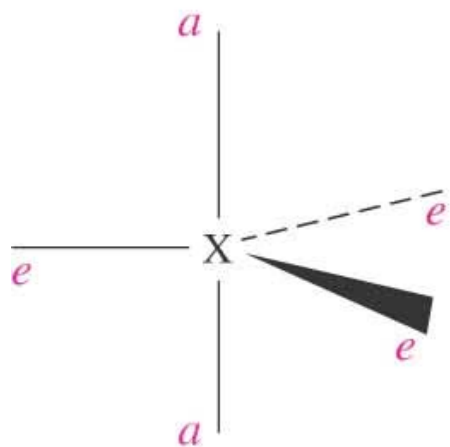
Seesaw



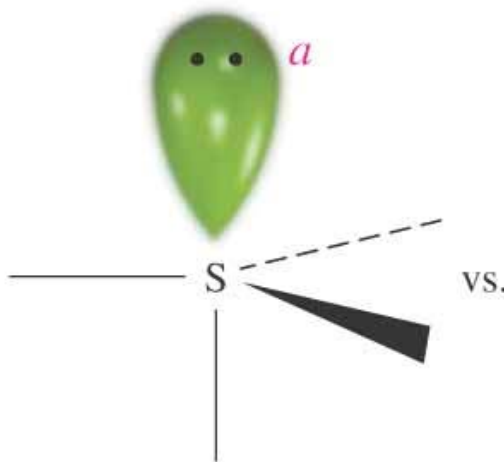
or



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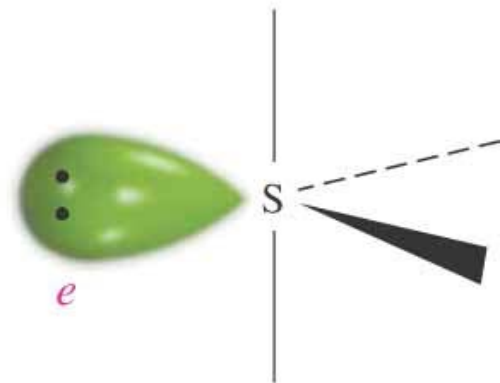


Trigonal bipyramidal
electronic geometry



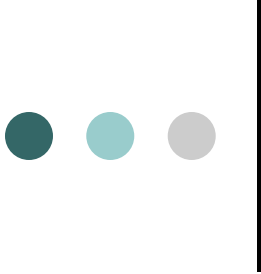
Lone pair in
axial position

vs.



Lone pair in
equatorial position
(preferred arrangement)

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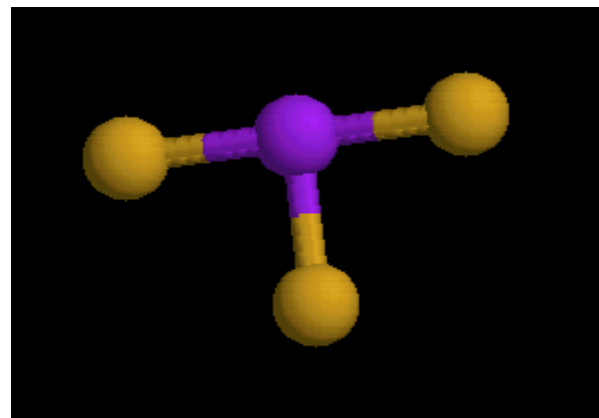
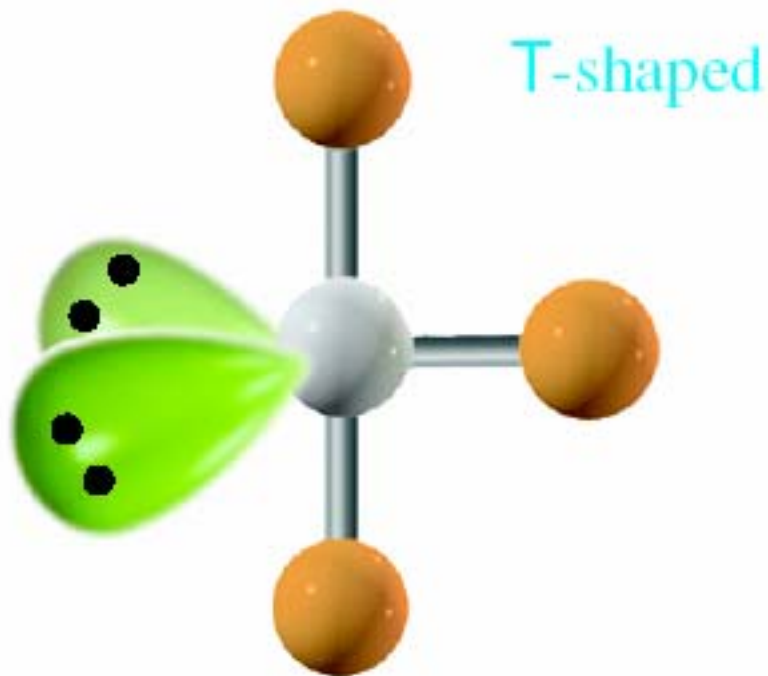


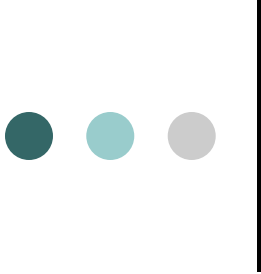
Trigonal Bipyramidal Electronic
Geometry: AB_5 , AB_4U , AB_3U_2 , and
 AB_2U_3

- AB_3U_2 molecules have:
 1. *Trigonal bipyramid electronic geometry*
 2. *T-shaped molecular geometry*
 3. *and are polar*
- One example of an AB_3U_2 molecule is
 IF_3
- Hybridization of I atom is sp^3d .

● ● ● | Trigonal Bipyramidal Electronic
Geometry: AB_5 , AB_4U , AB_3U_2 , and
 AB_2U_3

Molecular Geometry



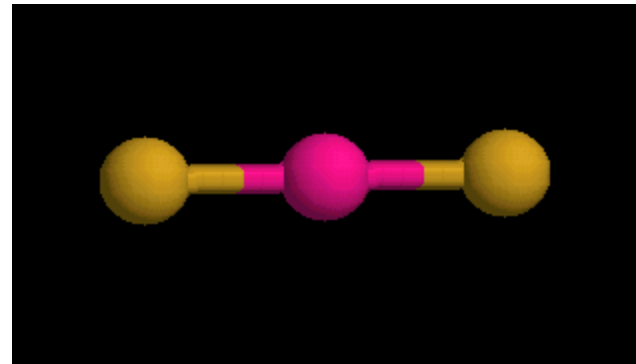
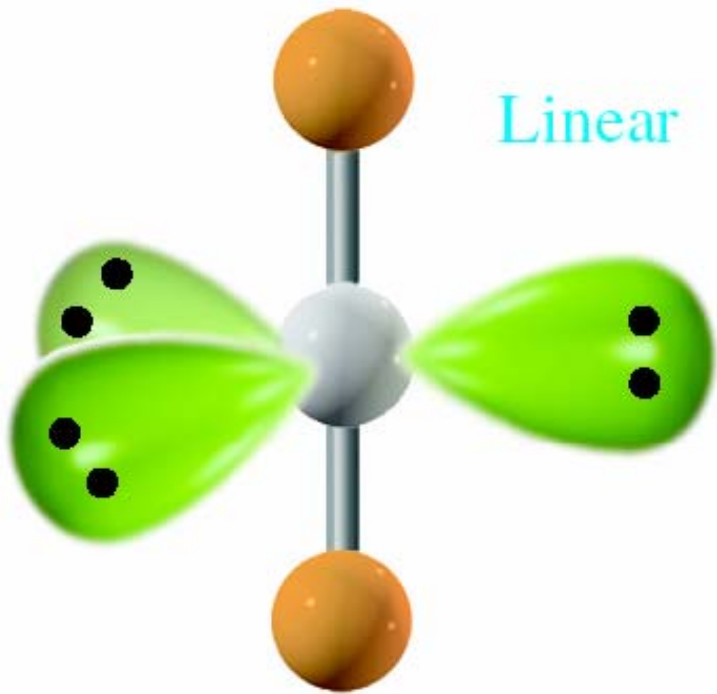


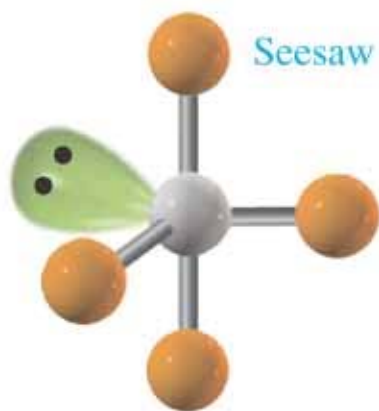
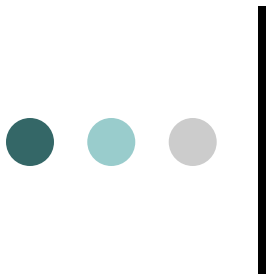
Trigonal Bipyramidal Electronic
Geometry: AB_5 , AB_4U , AB_3U_2 , and
 AB_2U_3

- AB_2U_3 molecules have:
 1. *Trigonal bipyramid electronic geometry*
 2. *Linear molecular geometry*
 3. *and are nonpolar*
- One example of an AB_3U_2 molecule is XeF_2
- Hybridization of Xe atom is sp^3d .

● ● ● | Trigonal Bipyramidal Electronic
Geometry: AB_5 , AB_4U , AB_3U_2 , and
 AB_2U_3

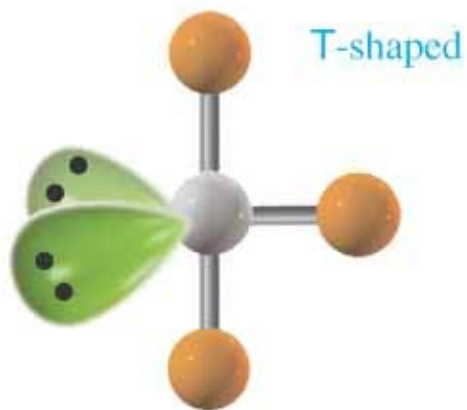
Molecular Geometry





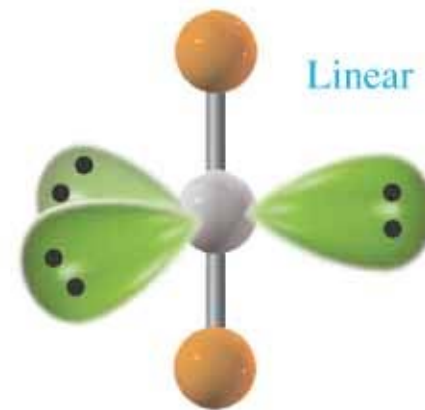
AB_4U 4 bonded atoms (B)
1 lone pair (U) in
equatorial position

Seesaw molecular geometry
Example: SF_4



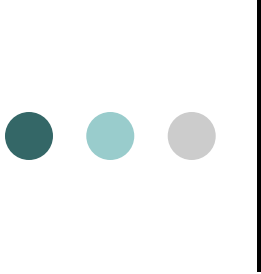
AB_3U_2 3 bonded atoms (B)
2 lone pairs (U) in
equatorial positions

T-shaped molecular geometry
Examples: ClF_3 , BrF_3



AB_2U_3 2 bonded atoms (B)
3 lone pairs (U) in
equatorial positions

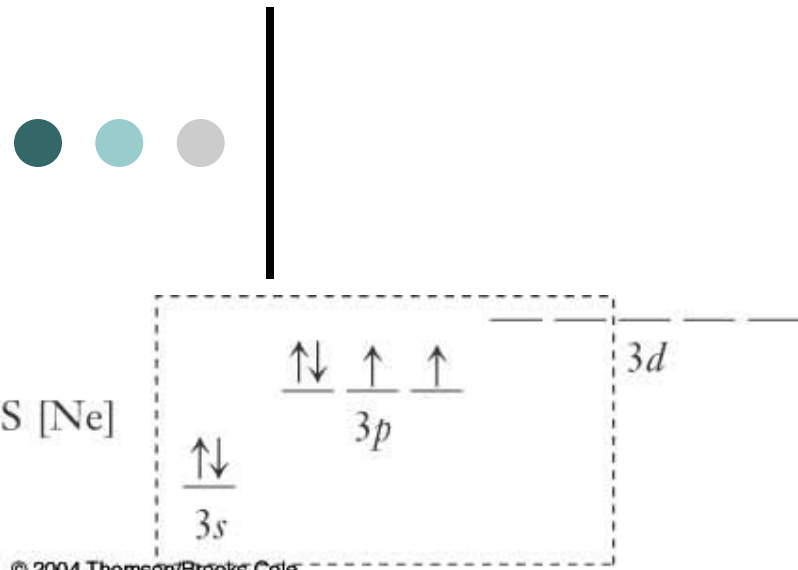
Linear molecular geometry
Examples: XeF_2 , I_3^-



Octahedral Electronic Geometry: AB_6 , AB_5U , and AB_4U_2

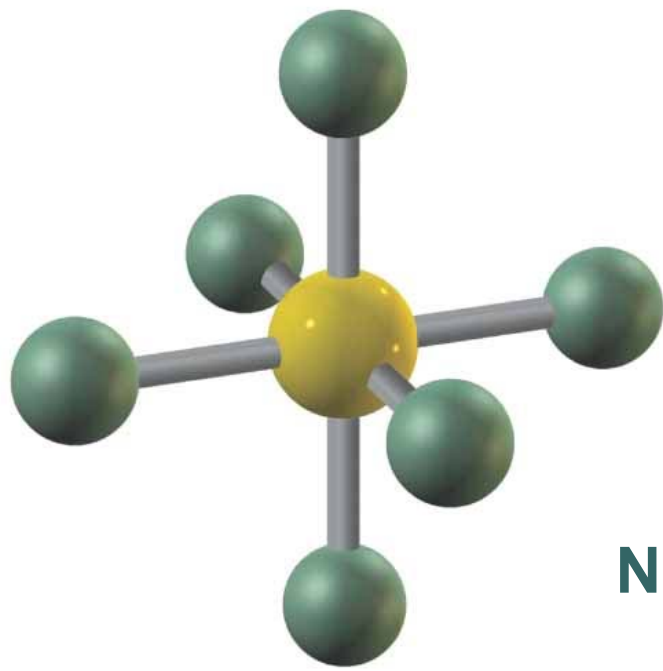
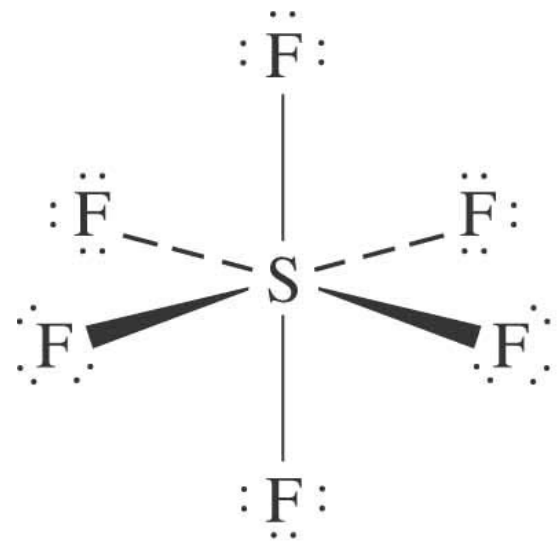
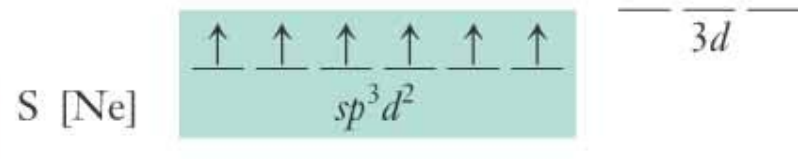
- Some examples of molecules with this geometry are: **SF_6 , SeF_6 , SCl_6 , etc.**
- These molecules are examples of central atoms with six bonding pairs of electrons.
- Molecules are **octahedral** and **nonpolar** when all six substituents are the same.

If the six substituents are not the same **polar** molecules can result, SF_5Cl is an example.

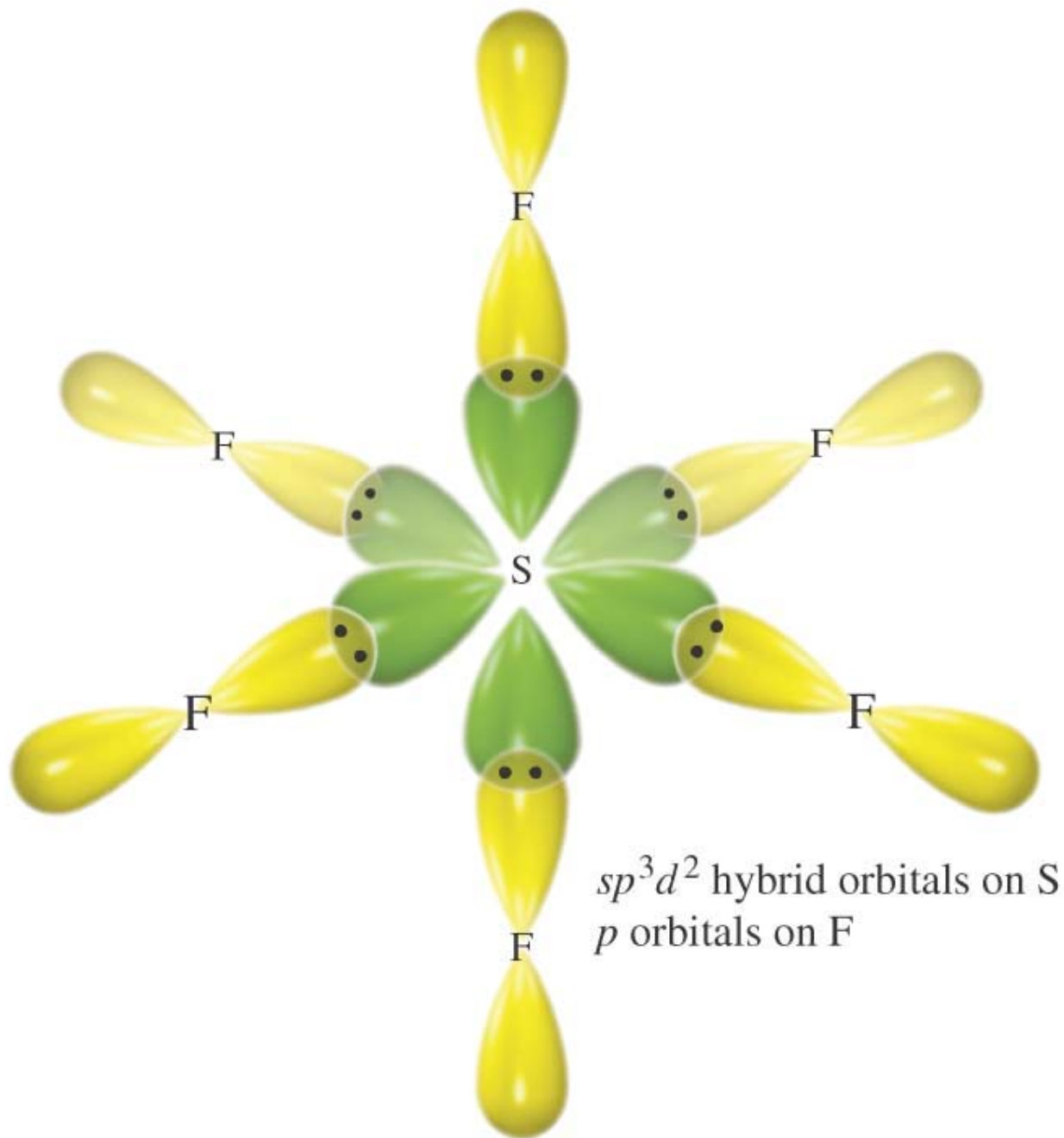


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hybridize →



Nonpolar



Regions
of high
electron
density

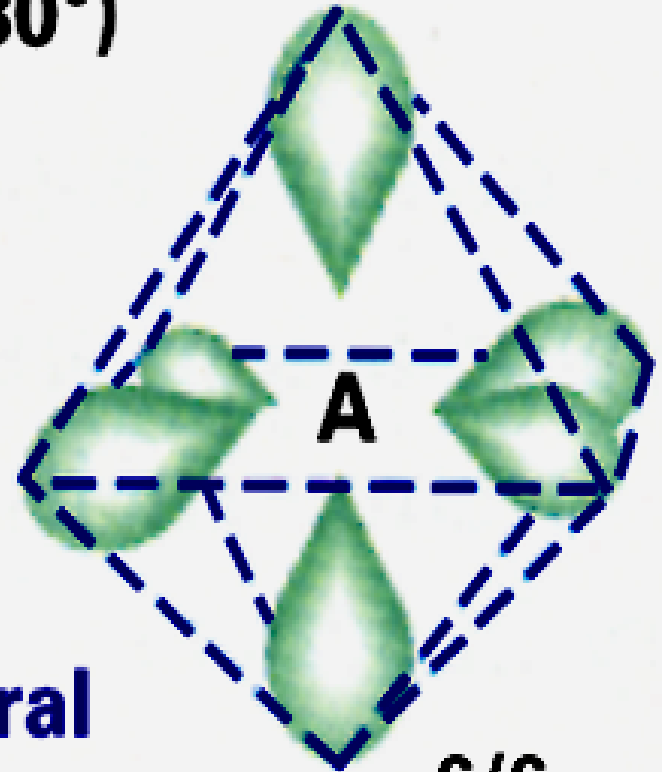
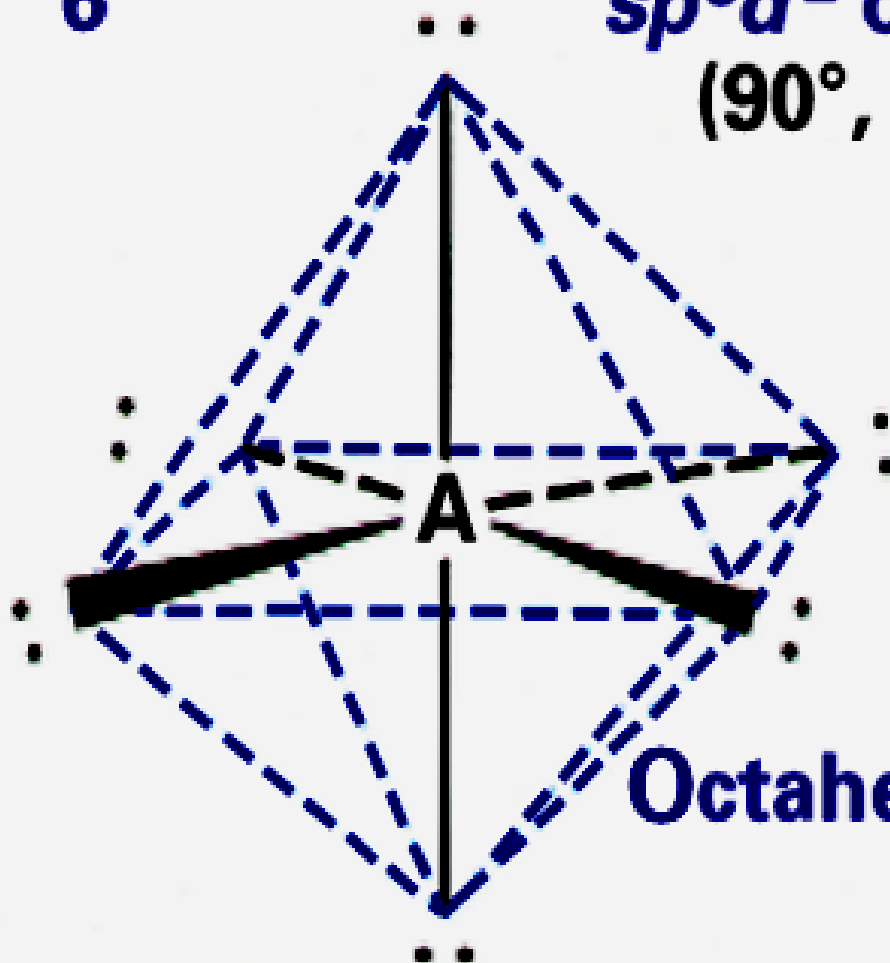
Electronic
geometry

Hybridization
at central
atom
(angle)

Hybridized
orbital
orientation

6

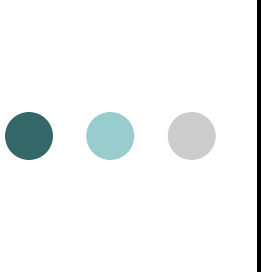
sp^3d^2 or d^2sp^3
(90° , 180°)





Octahedral Electronic Geometry: AB_6 , AB_5U , and AB_4U_2

- If lone pairs are incorporated into the octahedral structure, there are two possible new shapes.
 1. *One lone pair - square pyramidal*
 2. *Two lone pairs - square planar*
- The lone pairs occupy axial positions because they are 90° from four bonding pairs.
 - Results in decreased repulsions compared to lone pairs in equatorial positions.



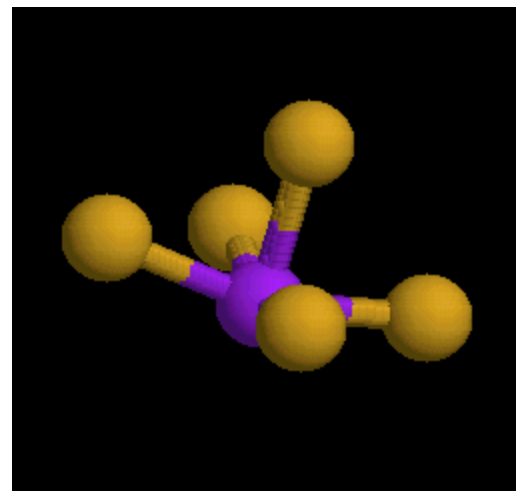
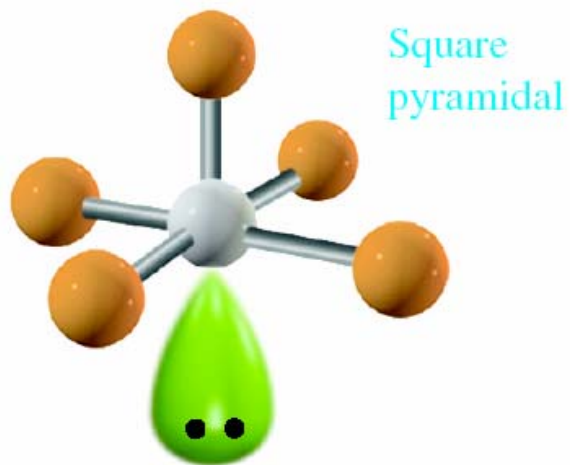
Octahedral Electronic Geometry: AB_6 , AB_5U , and AB_4U_2

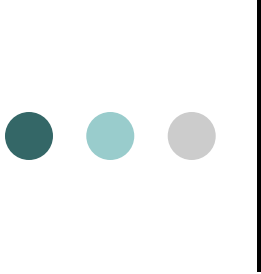
- AB_5U molecules have:
 1. *Octahedral electronic geometry*
 2. *Square pyramidal molecular geometry*
 3. *and are polar.*
- One example of an AB_4U molecule is IF_5
- Hybridization of the iodide atom is sp^3d^2 .

● ● ● |

Octahedral Electronic Geometry: AB_6 , AB_5U , and AB_4U_2

Molecular Geometry





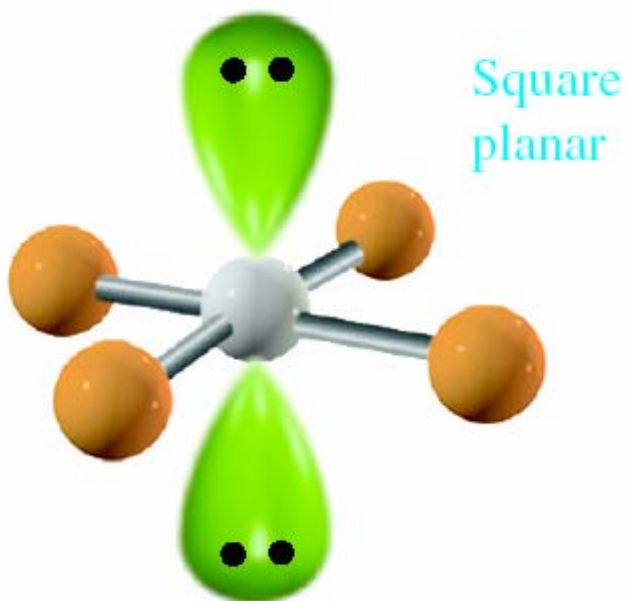
Octahedral Electronic Geometry: AB_6 , AB_5U , and AB_4U_2

- AB_4U_2 molecules have:
 - 1. octahedral electronic geometry**
 - 2. square planar molecular geometry**
 - 3. and are nonpolar.**
- One example of an AB_4U_2 molecule is **XeF₄**
- Hybridization of Xe atom is sp^3d^2 .

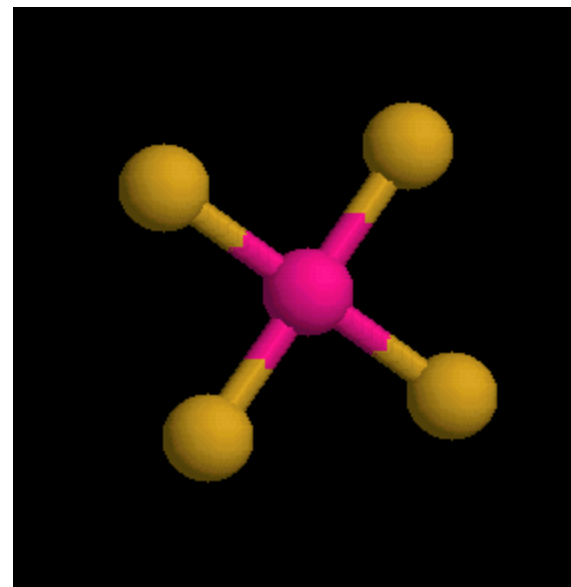
● ● ● |

Octahedral Electronic Geometry: AB_6 , AB_5U , and AB_4U_2

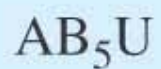
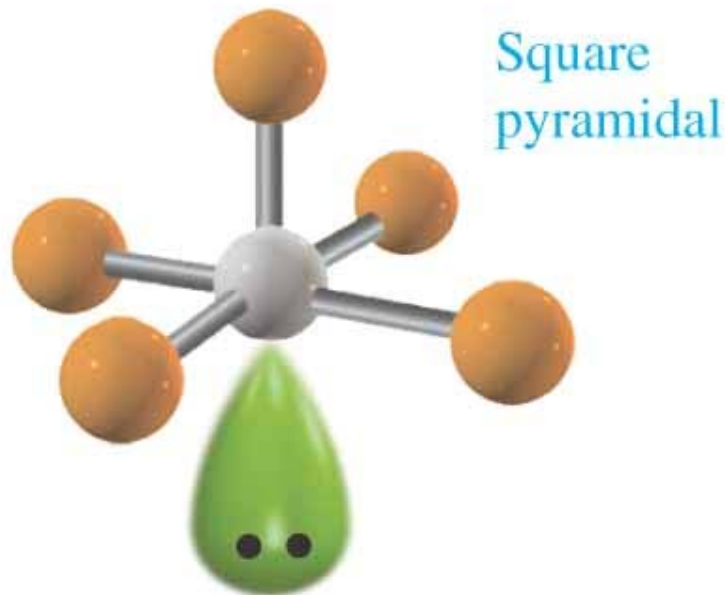
Molecular Geometry



Polarity

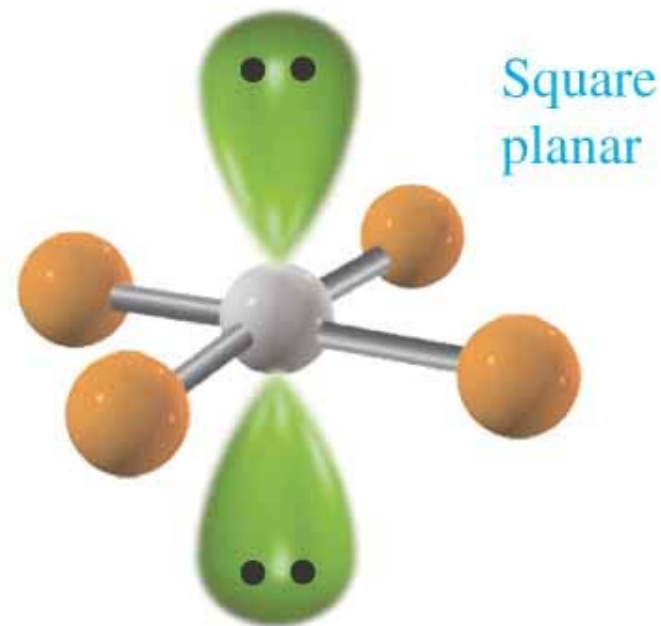


Nonpolar



5 bonded atoms (B)
1 lone pair (U)

Square pyramidal molecular geometry
Examples: IF_5 , BrF_5



4 bonded atoms (B)
2 lone pairs (U)

Square planar molecular geometry
Examples: XeF_4 , IF_4^-

TABLE 8-3*Molecular Geometry of Species with Lone Pairs (U) on the Central Atom*


General Formula	Regions of High Electron Density	Electronic Geometry	Hybridization at Central Atom	Lone Pairs	Molecular Geometry	Examples
AB_2U	3	trigonal planar	sp^2	1	 Angular	O_3 , NO_2^- , SO_2

TABLE 8-3

Molecular Geometry of Species with Lone Pairs (U) on the Central Atom


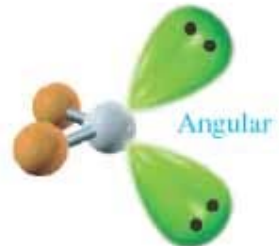

General Formula	Regions of High Electron Density	Electronic Geometry	Hybridization at Central Atom	Lone Pairs	Molecular Geometry	Examples
AB_3U	4	tetrahedral	sp^3	1		NH_3, SO_3^{2-}
AB_2U_2	4	tetrahedral	sp^3	2		H_2O, NH_2^-



TABLE 8-3 *Molecular Geometry of Species with Lone Pairs (U) on the Central Atom*

General Formula	Regions of High Electron Density	Electronic Geometry	Hybridization at Central Atom	Lone Pairs	Molecular Geometry	Examples
AB_4U	5	trigonal bipyramidal	sp^3d	1	 Seesaw	SF_4

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TABLE 8-3

Molecular Geometry of Species with Lone Pairs (U) on the Central Atom

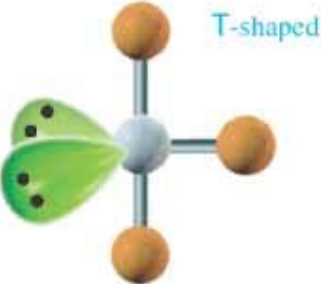
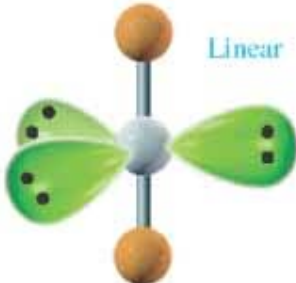
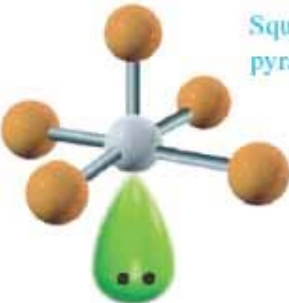
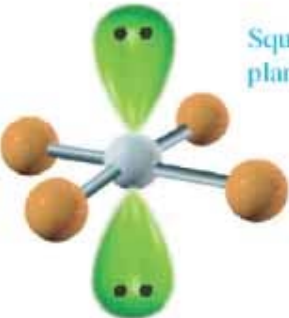
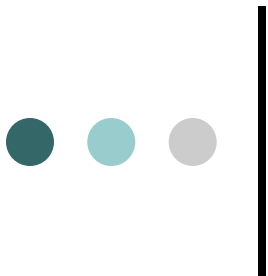
General Formula	Regions of High Electron Density	Electronic Geometry	Hybridization at Central Atom	Lone Pairs	Molecular Geometry	Examples
AB_3U_2	5	trigonal bipyramidal	sp^3d	2		ICl_3, ClF_3
AB_2U_3	5	trigonal bipyramidal	sp^3d	3		XeF_2, I_3^-

TABLE 8-3
Molecular Geometry of Species with Lone Pairs (U) on the Central Atom

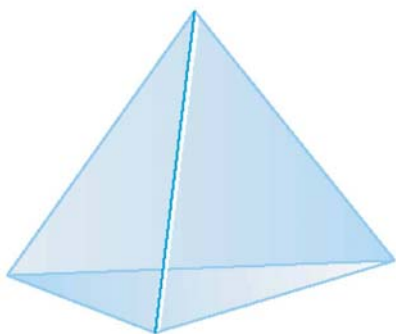
General Formula	Regions of High Electron Density	Electronic Geometry	Hybridization at Central Atom	Lone Pairs	Molecular Geometry	Examples
AB_5U	6	octahedral	sp^3d^2	1	 <p>Square pyramidal</p>	IF_5, BrF_5
AB_4U_2	6	octahedral	sp^3d^2	2	 <p>Square planar</p>	XeF_4, IF_4^-

**TABLE 8-2***Relation Between Electronic Geometries and Hybridization*

Regions of High Electron Density	Electronic Geometry	Atomic Orbitals Mixed from Valence Shell of Central Atom	Hybridization
2	linear	one <i>s</i> , one <i>p</i>	<i>sp</i>
3	trigonal planar	one <i>s</i> , two <i>p</i> 's	<i>sp</i> ²
4	tetrahedral	one <i>s</i> , three <i>p</i> 's	<i>sp</i> ³
5	trigonal bipyramidal	one <i>s</i> , three <i>p</i> 's, one <i>d</i>	<i>sp</i> ³ <i>d</i>
6	octahedral	one <i>s</i> , three <i>p</i> 's, two <i>d</i> 's	<i>sp</i> ³ <i>d</i> ²



Tetrahedral



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**Regions of
high electron
density = 4**

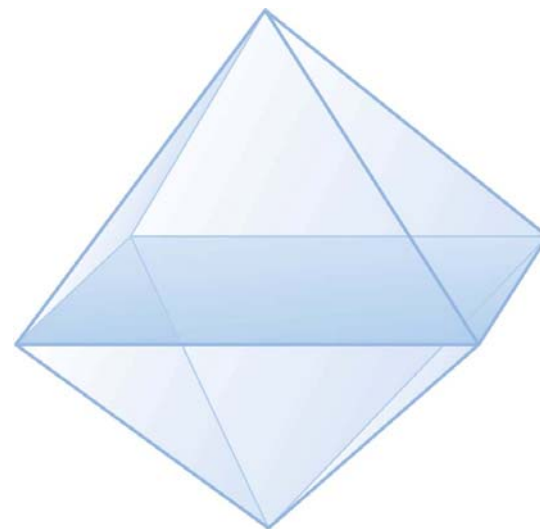
Trigonal Bipyramidal



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**Regions of
high electron
density = 5**

Octahedral



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**Regions of
high electron
density = 6**

TABLE 8-4 *A Summary of Electronic and Molecular Geometries of Polyatomic Molecules and Ions*



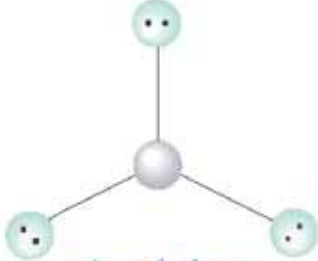

Regions of High Electron		Hybridization at Central Atom	Hybridized Orbital		
2	 <p>linear</p>	sp (180°)		BeCl_2 HgBr_2 CdI_2 CO_2^b C_2H_2^c	linear linear linear linear linear
3	 <p>trigonal planar</p>	sp^2 (120°)		BF_3 BCl_3 NO_3^{-e} $\text{SO}_2^{d,e}$ $\text{NO}_2^{-d,e}$ C_2H_4^f	trigonal planar trigonal planar trigonal planar angular (AB_2U) angular (AB_2U) planar (trig. planar at each C)

TABLE 8-4
A Summary of Electronic and Molecular Geometries of Polyatomic Molecules and Ions

 Regions
of High
Electron
Density^a

Electronic Geometry

 Hybridization at
Central Atom
(Angles)

 Hybridized Orbital
Orientation

Examples

Molecular Geometry

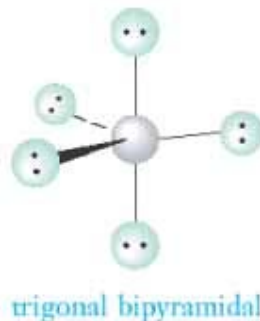
4


 sp^3
(109.5°)

 CH₄
 CCl₄
 NH₄⁺
 SO₄²⁻
 CHCl₃
 NH₃^d
 SO₃^{2-d}
 H₃O⁺^d
 H₂O^d

 tetrahedral
 tetrahedral
 tetrahedral
 tetrahedral
 distorted tet.
 pyramidal (AB₃U)
 pyramidal (AB₃U)
 pyramidal (AB₃U)
 angular (AB₂U₂)

5

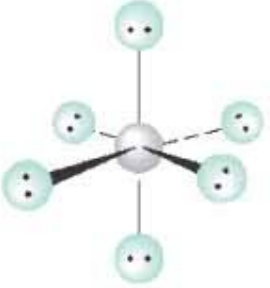


 sp^3d
(90°, 120°, 180°)

 PF₅
 SbCl₅
 SF₄^d
 ClF₃^d
 XeF₂^d
 I₃^{-d}

 trigonal bipyramidal
 trigonal bipyramidal
 seesaw (AB₄U)
 T-shaped (AB₃U₂)
 linear (AB₂U₃)
 linear (AB₂U₃)



TABLE 8-4 *A Summary of Electronic and Molecular Geometries of Polyatomic Molecules and Ions*

Regions of High Electron Density ^d	Electronic Geometry	Hybridization at Central Atom (Angles)	Hybridized Orbital Orientation	Examples	Molecular Geometry
6	 <p>octahedral</p>	sp^3d^2 (90°, 180°)		SF_6 SeF_6 PF_6^- BrF_5^d XeF_4^d	octahedral octahedral octahedral square pyramidal (AB ₅ U) square planar (AB ₄ U ₂)

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Chemistry is fun!