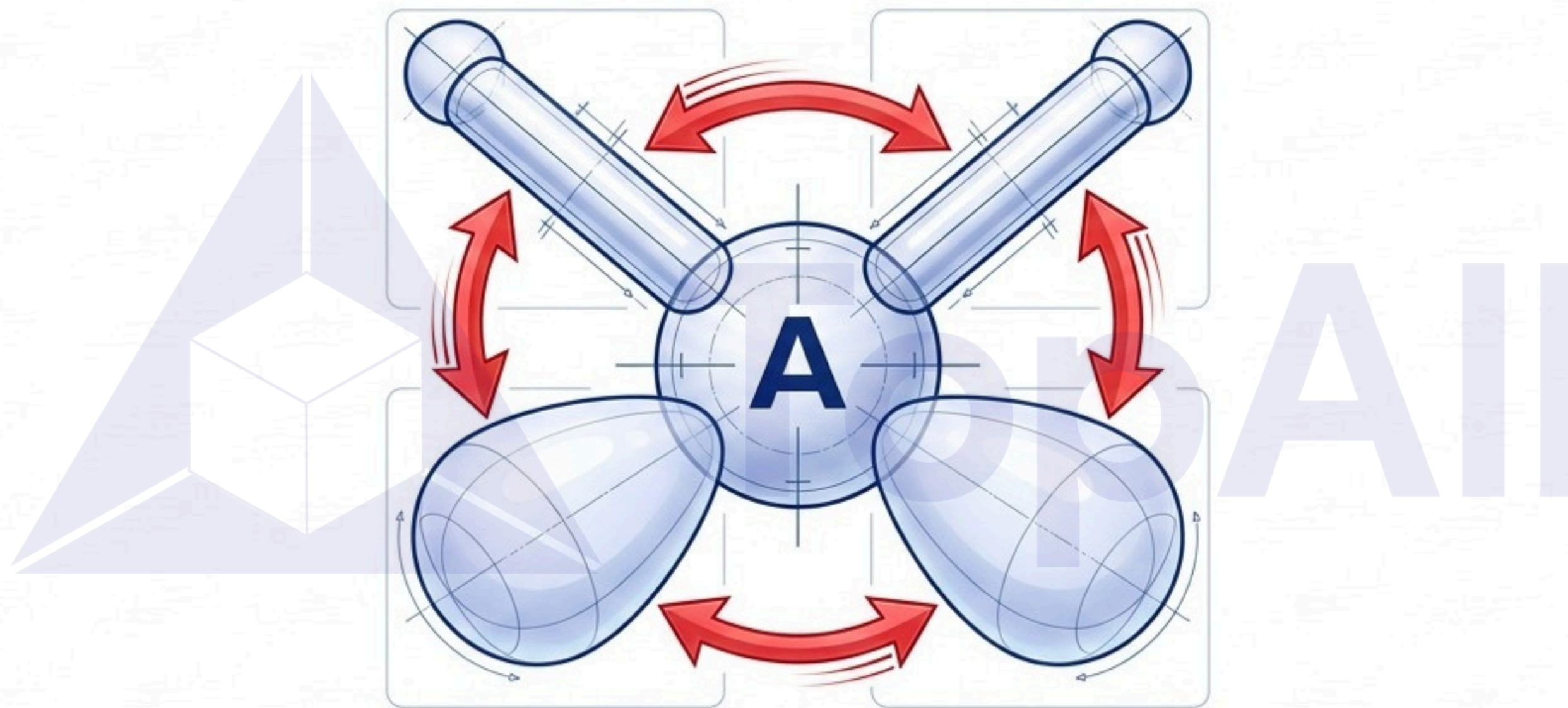


The Driving Force of Molecular Shape

Valence Shell Electron Pair Repulsion (VSEPR) Theory



Molecules automatically adopt 3D geometries that minimize electrostatic repulsion between valence electron pairs, maximizing the distance between them in space.

The Blueprint: Four Rules of VSEPR



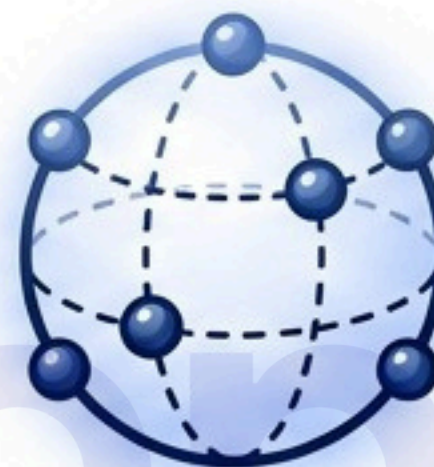
Count

Shape depends entirely on the total number of valence shell electron pairs (bonded + non-bonded) around the central atom.



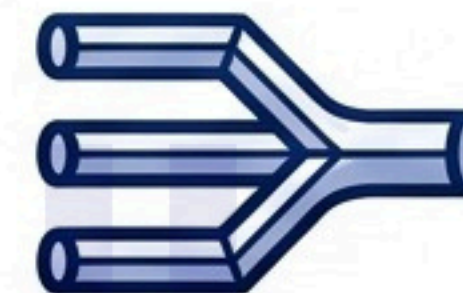
Repel

Electron clouds are negatively charged and inherently repel one another.



Space

Pairs localize on a spherical surface to maximize physical distance and minimize energy.

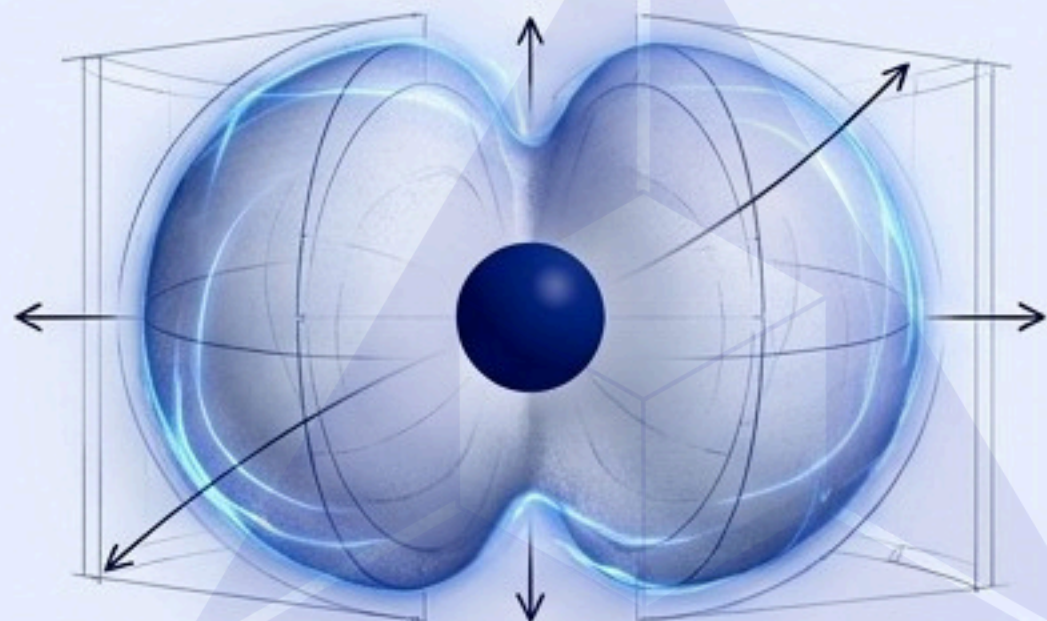


Super Pairs

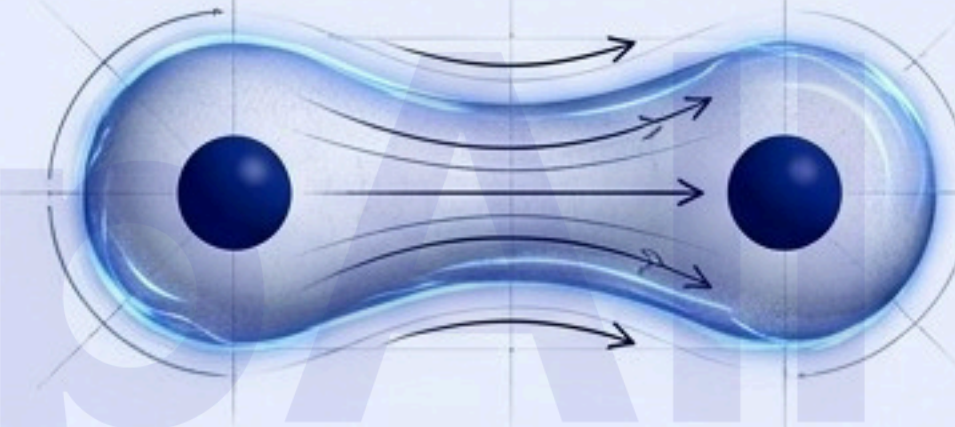
Multiple bonds (double/triple) are treated as a single super pair for the sake of geometry prediction.

The Hierarchy of Repulsion

$$\text{lp-lp} > \text{lp-bp} > \text{bp-bp}$$



Lone Pair (lp)
Localized & Fat
(Occupies more volume)



Bond Pair (bp)
Shared & Stretched
(Occupies less volume near the center)

The spatial difference means repulsions between two lone pairs (lp-lp) are the strongest, while repulsions between two bond pairs (bp-bp) are the weakest.



**You've Learned the Theory.
Let's Test Them Now.**

$$E=mc^2$$



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Ideal Geometries: Zero Lone Pairs

Steric No. 2

Linear
(AB₂)

180°

Example: BeCl₂

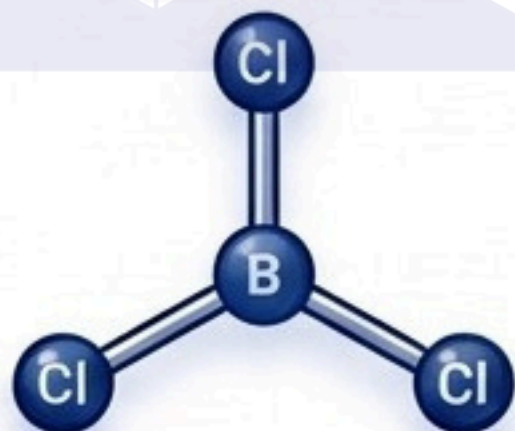


Steric No. 3

Trigonal
Planar (AB₃)

120°

Example: BCl₃

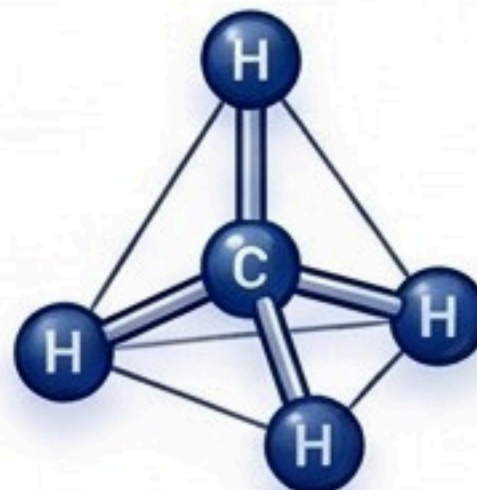


Steric No. 4

Tetrahedral
(AB₄)

109.5°

Example: CH₄

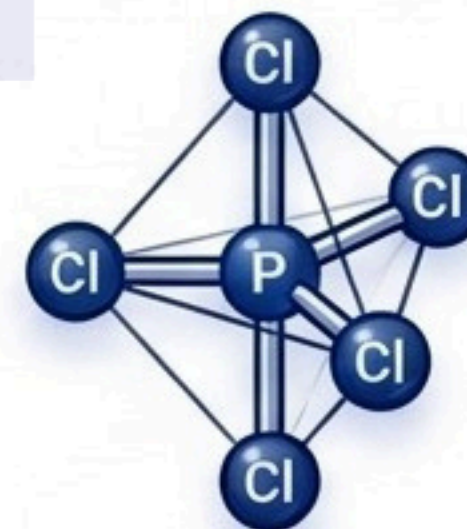


Steric No. 5

Trigonal
Bipyramidal
(AB₅)

90°, 120°

Example: PCl₅



Steric No. 6

Octahedral
(AB₆)

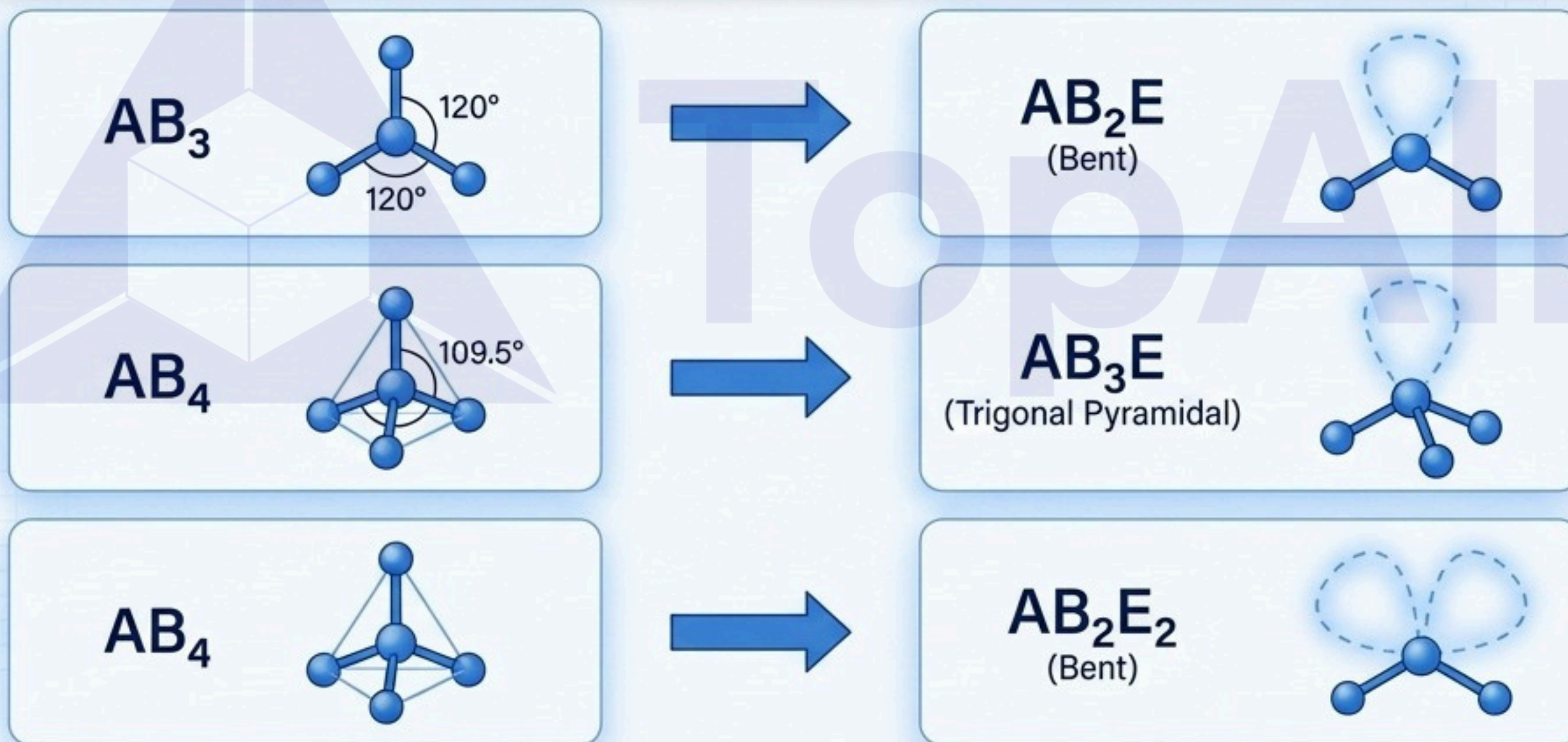
90°

Example: SF₆



Real Geometries: The Lone Pair Distortion

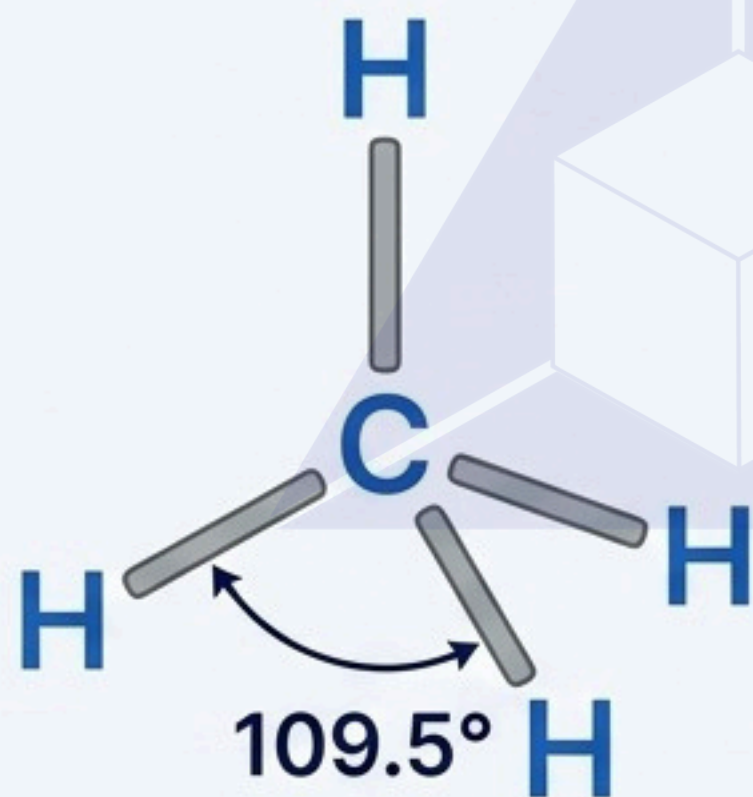
The invisible lone pair dictates the physical space, but we only name the geometry based on the visible atomic positions.



The Squeeze: Angle Reduction in Action

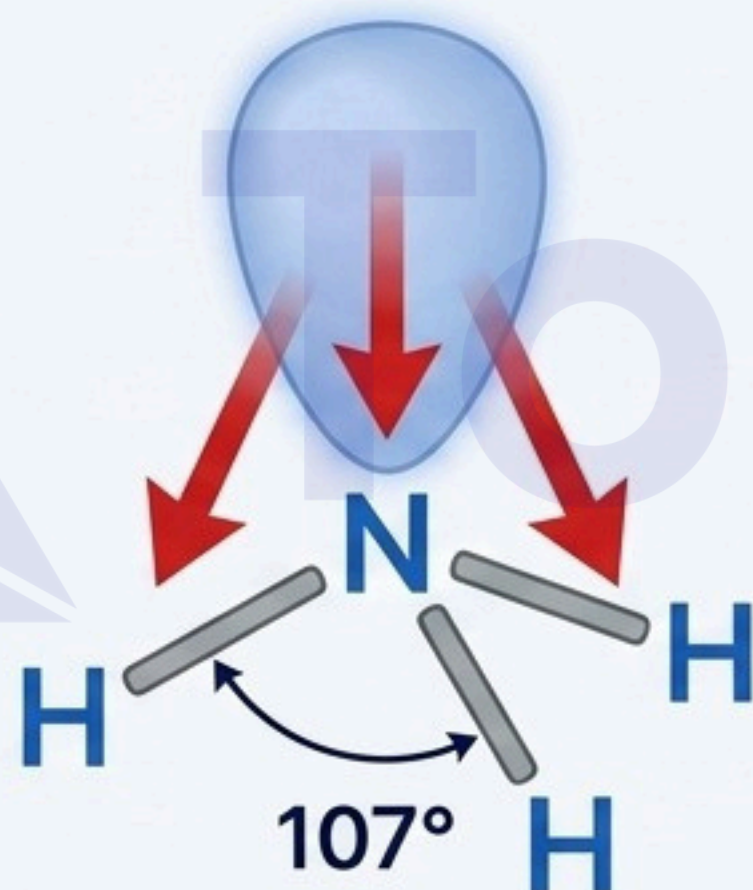
CH₄ - Methane

4 bp, 0 lp



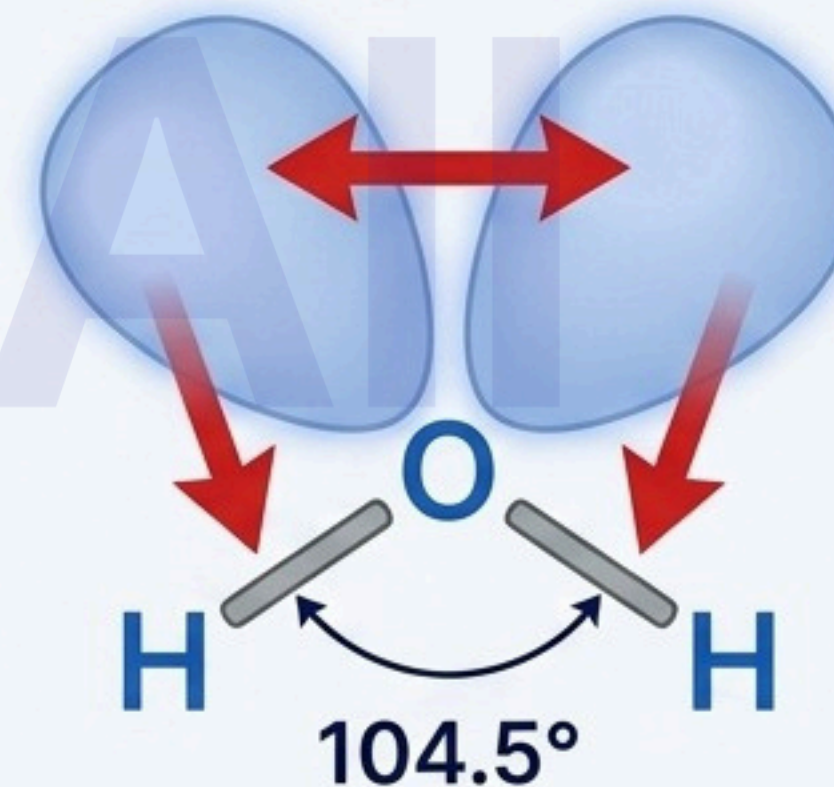
NH₃ - Ammonia

3 bp, 1 lp



H₂O - Water

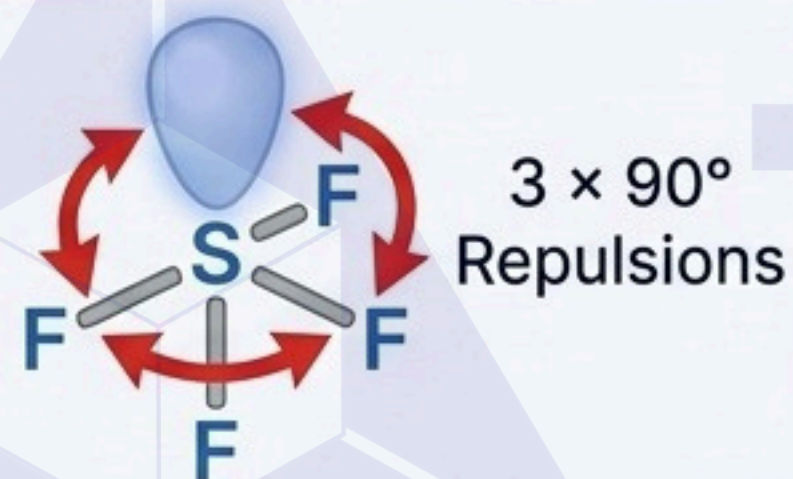
2 bp, 2 lp



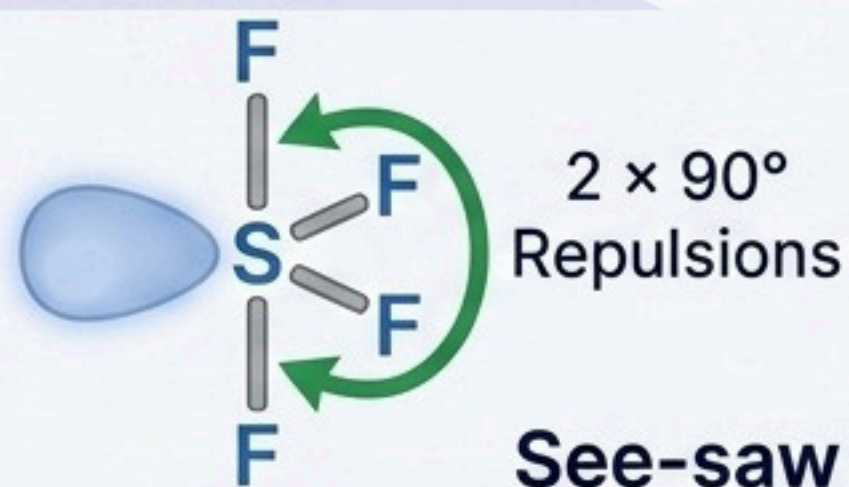
RULE: Lone pairs always occupy the **equatorial** positions in a **Trigonal Bipyramidal** base to minimize **90° lp–bp repulsions**.

Example 1: SF_4 (See-saw / AB_4E)

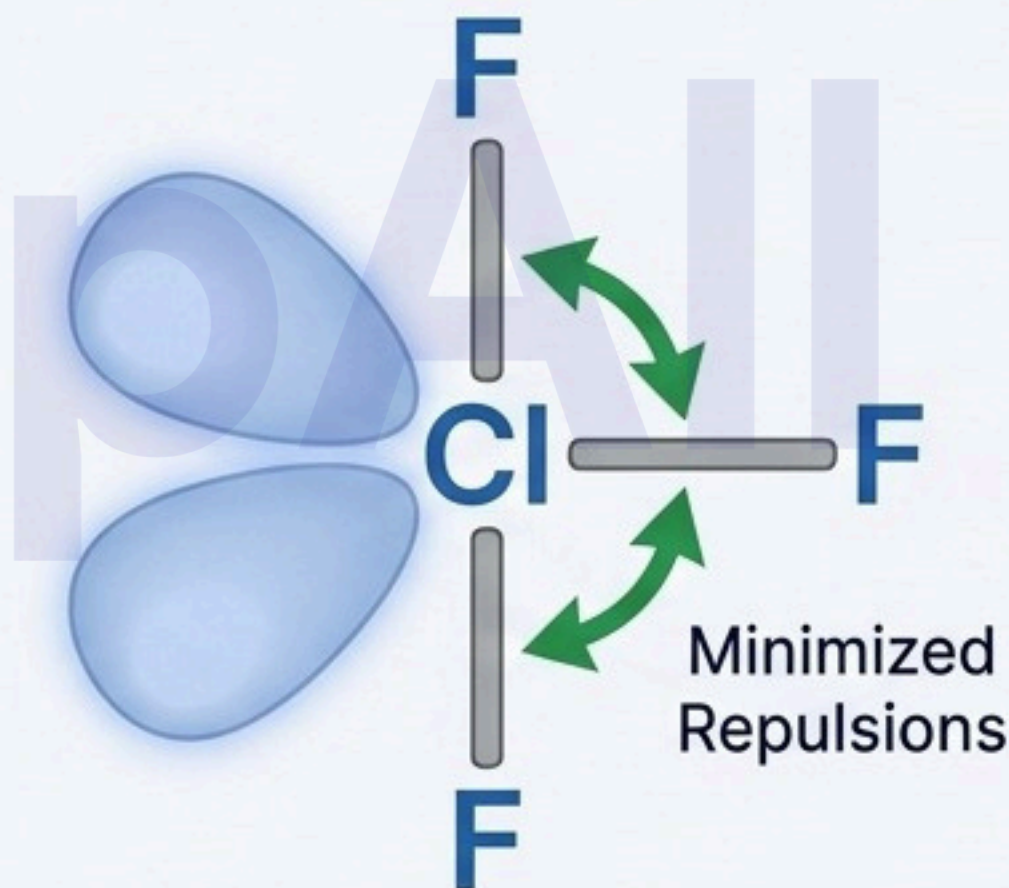
Incorrect
(Axial placement)



Correct
(Equatorial placement)



Example 2: ClF_3 (T-shape / AB_3E_2)



T-shape

VSEPR Theory Master Frame

Total Pairs	Bonding Pairs	Lone Pairs	Resulting Shape	Example
2	2	0	Linear	BeCl ₂
3	3	0	Trigonal Planar	BCl ₃
3	2	1	Bent	SO ₂
4	4	0	Tetrahedral	CH ₄
4	3	1	Trigonal Pyramidal	NH ₃
4	2	2	Bent	H ₂ O
5	5	0	Trigonal Bipyramidal	PCl ₅
5	4	1	See-saw	SF ₄
5	3	2	T-Shape	ClF ₃
6	6	0	Octahedral	SF ₆

Remember the Hierarchy: lp-lp > lp-bp > bp-bp drives all deviations.



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