







VALENCE SHELL ELECTRON PAIR REPULSION (VSEPR) THEORY

In 1957 Gillespie and Nyholm (see Further Reading) improved the Sidgwick–Powell theory to predict and explain molecular shapes and bond angles more exactly. The theory was developed extensively by Gillespie as the Valence Shell Electron Pair Repulsion (VSEPR) theory. This may be summarized:

1. The shape of the molecule is determined by repulsions between all of the electron pairs present in the valence shell. (This is the same as the Sidgwick–Powell theory.)

Number of electron pairs in outer shell	Shape of molecule	Bond angles
2	linear 	180°
3	plane triangle 	120°
4	tetrahedron 	109°28'
5	trigonal bipyramid 	120° and 90°
6	octahedron 	90°
7	pentagonal bipyramid 	72° and 90°

- A lone pair of electrons takes up more space round the central atom than a bond pair, since the lone pair is attracted to one nucleus whilst the bond pair is shared by two nuclei. It follows that repulsion between two lone pairs is greater than repulsion between a lone pair and a bond pair, which in turn is greater than the repulsion between two bond pairs. Thus the presence of lone pairs on the central atom causes slight distortion of the bond angles from the ideal shape. If the angle between a lone pair, the central atom and a bond pair is increased, it follows that the actual bond angles between the atoms must be decreased.
- The magnitude of repulsions between bonding pairs of electrons depends on the electronegativity difference between the central atom and the other atoms.
- Double bonds cause more repulsion than single bonds, and triple bonds cause more repulsion than a double bond.