

VSEPR Theory

In order to explain the three-dimensional shape of molecules, scientists use Valence Shell Electron Pair Repulsion theory (VSEPR theory). **VSEPR theory** states that the repulsion between electron pairs causes molecular shapes to adjust so that the valence-electron pairs stay as far apart as possible.

Unshared pairs of electrons are also important in predicting the shapes of molecules. No bonding atom is vying for these unshared electrons. Thus they are held closer to the central atom than are the bonding pairs. The unshared pair strongly repels the bonding pairs, pushing them together.

When predicting molecular shape, you can use electron dot formulas to help you identify the bonding and nonbonding pairs of electrons around the central atom. In general, when four pairs of electrons must be accommodated, the pairs have maximum space when they are arranged tetrahedrally. When three pairs or groups must be accommodated, a trigonal planar arrangement provides the most space. Finally, when only two groups of electron pairs are present, they will adopt a linear arrangement. Remember that the presence of unshared electron pairs will affect the bond angles in the molecule and contribute to the final geometry.

The table below will help you identify the shape after you have done the NASL method.

# of lone pair electrons on 'central' atom	# of bonding groups (shared electrons) on 'central' atom	Molecular Geometry	Bond Angle
0	2	<u>linear</u>	180
0	3	<u>trigonal planar</u>	120
1	2	<u>bent</u>	less than 120
0	4	<u>tetrahedral</u>	109.5
1	3	<u>trigonal pyramidal</u>	less than 109.5
2	2	<u>bent</u>	less than 109.5

Page 260 in the textbook has an excellent table with pictures of the molecules.