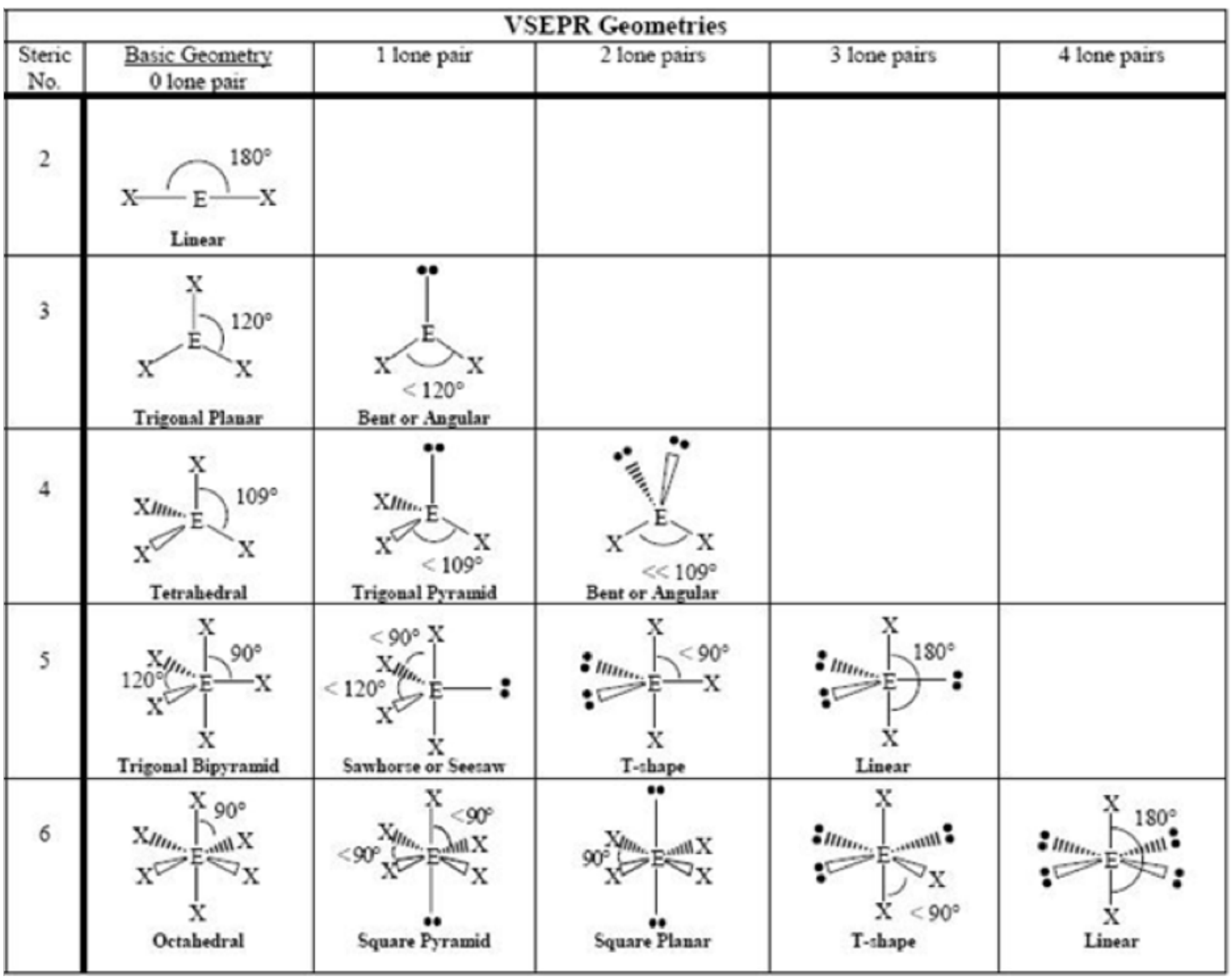
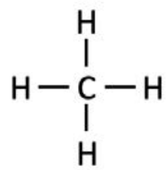
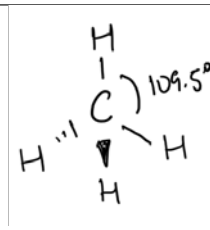
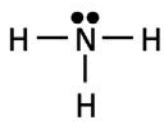
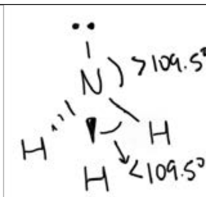
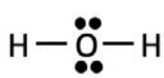
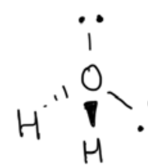
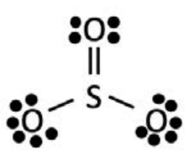
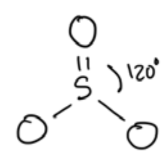
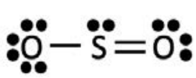
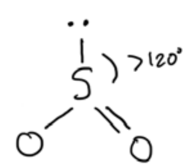
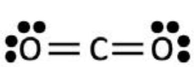
1 VSEPR

Lewis dot structures are a great tool to visualize how electrons can be arranged in molecules. Further, drawing resonance structures and determining the formal charge can help us determine which structures are most stable. However, neither of these tools provide much insight into the physical configuration of a molecule in 3D space. For this, we turn to **V**alence **S**hell **E**lectron **P**air **R**epulsion theory, or VSEPR.

Once we draw a viable Lewis structure, we can use the following chart to translate the 2D representation to a 3D geometry:



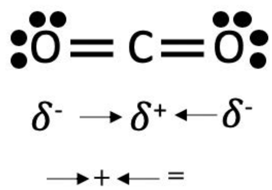
Example: Draw Lewis dot diagrams and determine the 3D VSEPR geometry of the following molecules: CH_4, NH_3, H_2O, SO_3, SO_2, CO_2

	Lewis dot diagram	Electrons around central atom	VSEPR description	Sketch of 3D model
CH_4		-4 groups of electrons in bonds -0 lone pairs	tetrahedral	
NH_3		-3 groups of electrons in bonds -1 lone pair	trigonal pyramidal	
H_2O		-4 groups of electrons in bonds -0 lone pairs	bent	
SO_3		-4 groups of electrons in bonds -0 lone pairs	trigonal planar	
SO_2		-4 groups of electrons in bonds -0 lone pairs	bent	
CO_2		-4 groups of electrons -0 lone pairs	linear	O=C=O

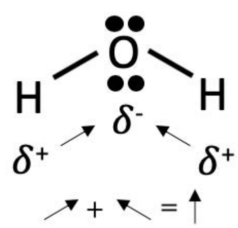
2 Polarity

The difference in electronegativity across a molecule can generate electric dipole moments. Dipole moments are vector quantities, and by convention point from a more positive region of charge to a more negative region. If individual dipoles within a molecule cancel, there is no net dipole.

Example: Determine whether CO_2 and H_2O have a net dipole moment.



In CO_2, the two electronic dipoles are exactly opposite and cancel each other, so there isn't a net dipole. Carbon dioxide is not a polar molecule.



In H_2O, the electronic dipoles don't fully cancel, so there is a net dipole moment. Water is a polar molecule!