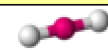
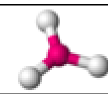
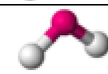
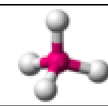
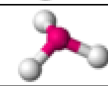
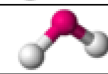
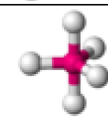
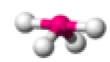
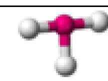
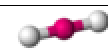
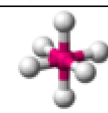
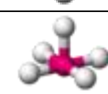
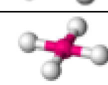
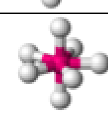
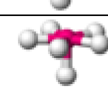
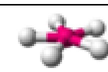
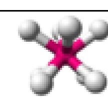
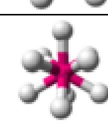
Visual Aid

Bonding electron pairs	Lone pairs	Electron domains (steric #)	Shape	Ideal bond angle (bond angle of example)	Example	Image
2	0	2	linear	180°	CO_2	
3	0	3	trigonal planar	120°	BF_3	
2	1	3	bent	120° (119°)	SO_2	
4	0	4	tetrahedral	109.5°	CH_4	
3	1	4	trigonal pyramidal	109.5 (107.8°)	NH_3	
2	2	4	bent	109.5° (104.48°)[10][11]	H_2O	
5	0	5	trigonal bipyramidal	90°, 120°, 180°	PCl_5	
4	1	5	seesaw	ax–ax 180° (173.1°), eq–eq 120° (101.6°), ax–eq 90°	SF_4	
3	2	5	T-shaped	90° (87.5°), 180° (175°)	ClF_3	
2	3	5	linear	180°	XeF_2	
6	0	6	octahedral	90°, 180°	SF_6	
5	1	6	square pyramidal	90° (84.8°)	BrF_5	
4	2	6	square planar	90°, 180°	XeF_4	
7	0	7	pentagonal bipyramidal	90°, 72°, 180°	IF_7	
6	1	7	pentagonal pyramidal	72°, 90°, 144°	$XeOF_5^-$	
5	2	7	planar pentagonal	72°, 144°	XeF_5^-	
8	0	8	square antiprismatic		XeF_8^{2-}	
9	0	9	tricapped trigonal prismatic		ReH_9^{2-}	

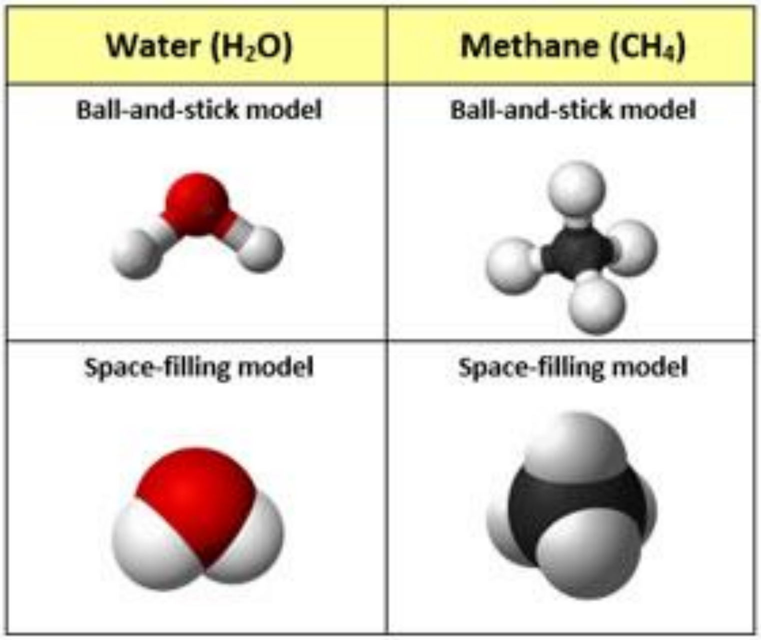


Figure 1. Ball-and-stick (top) versus space-filling models (bottom) for water and methane.

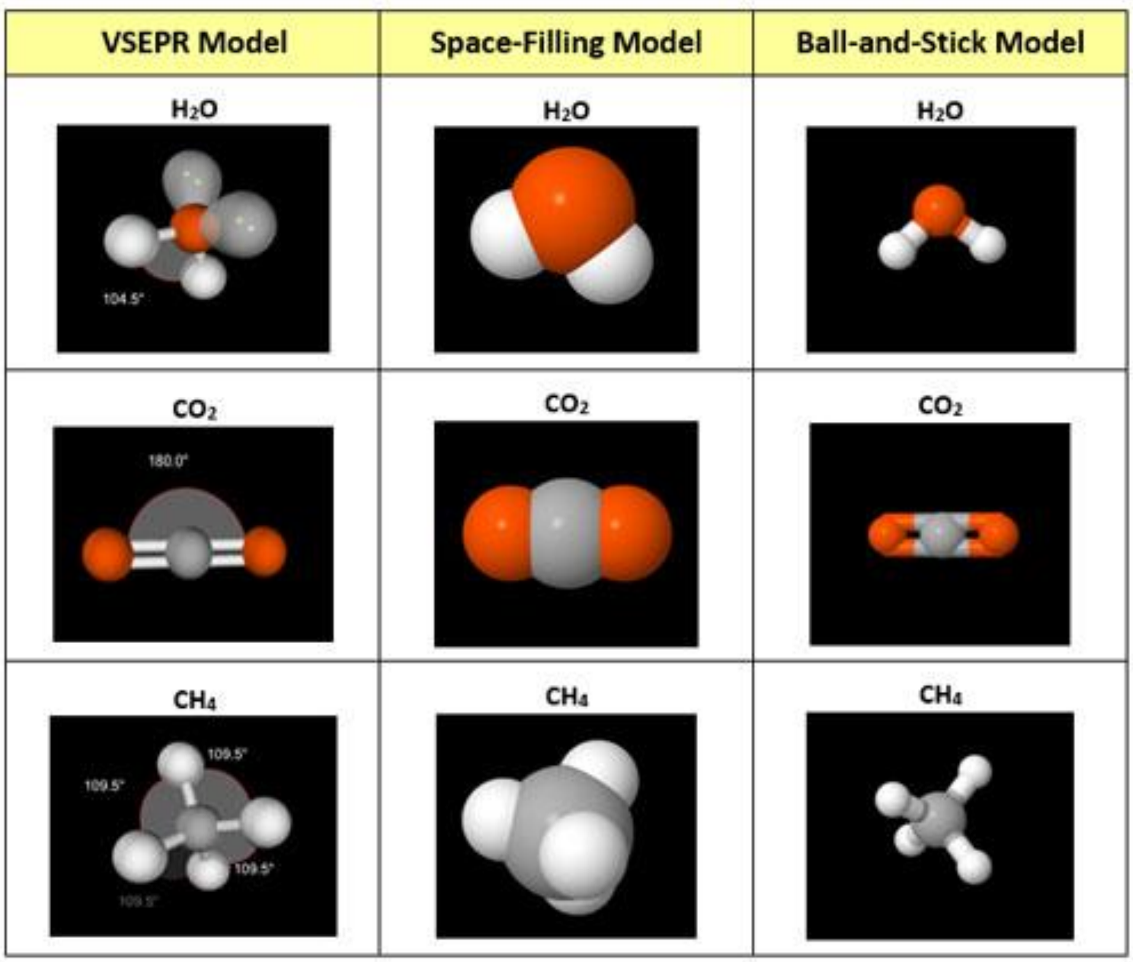
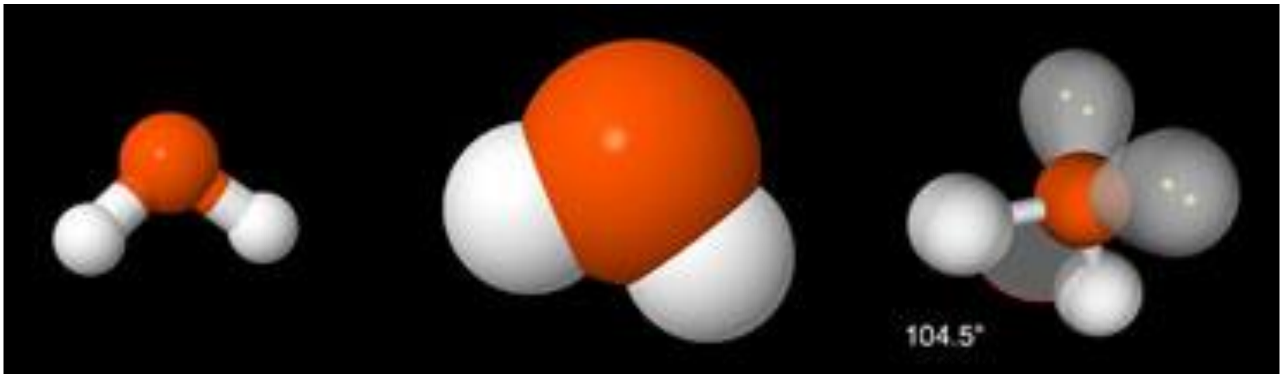


Figure 2. An example reference chart for the comparison of three types of molecular models.



Three ways to model the geometry of a molecule of water (H2O).

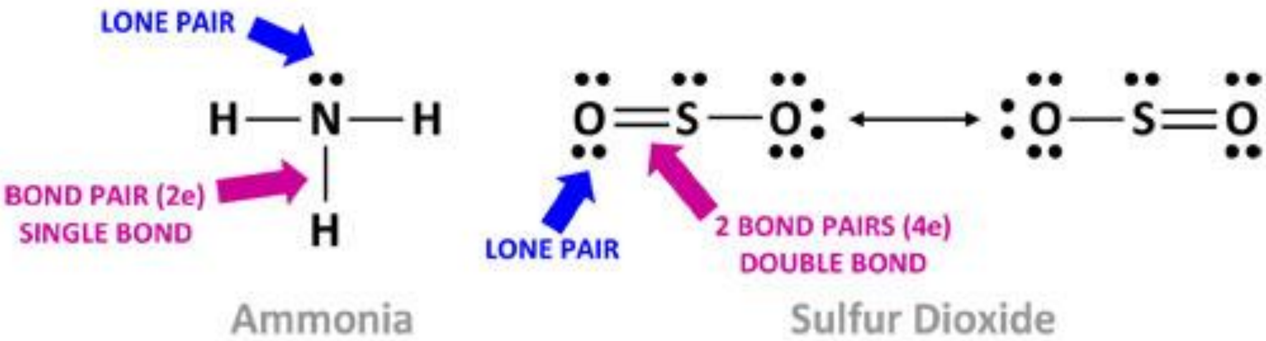


Figure 3. Chemical engineers know that the location(s) of lone pair electrons determines the overall molecular geometry.

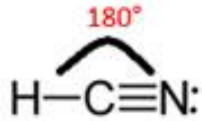
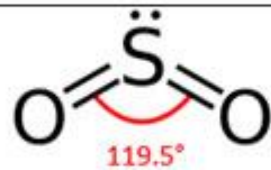
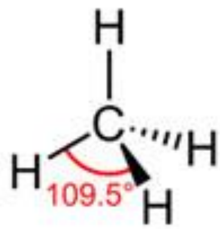
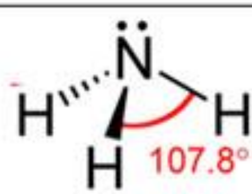
Geometric Type	Design	Description
Linear		Two atoms symmetrically distributed around the center atom. Results in a bond angle of **exactly 180°**.
Trigonal planar		Three atoms symmetrically distributed around the central atom without any lone pairs on the central. All of the atoms lie in the same plane. Results in a bond angle of **exactly 120°**.
Bent		Two atoms symmetrically distributed around the central atom with a lone pair on the central atom. Results in a bond angle **slightly less than 120°**.
Tetrahedral		Four outer atoms symmetrically distributed around the central atom. Forms a regular tetrahedron. Results in a bond angle **exactly 109.5°**.
Trigonal pyramidal		Three outer atoms symmetrically distributed around the central atom with one lone pair on the central atom. Results in a bond angle **slightly less than 109.5°**.
Bent		Two outer atoms symmetrically distributed around the central atom with two lone pairs on the central atom. Results in a bond angle **slightly less than 109.5°**.

Table 1. A reference for determining the molecular geometry.

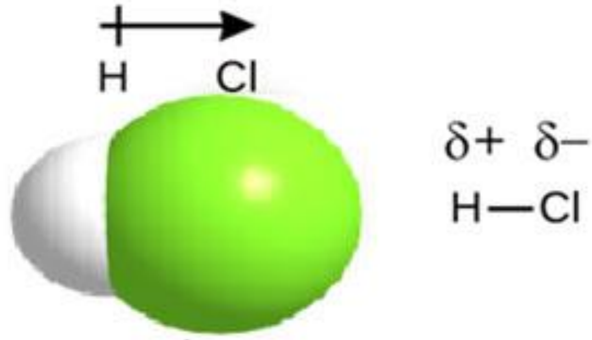


Figure 4. Because the bonded electrons are pulled closer to Cl due to its greater electronegativity, the HCl molecule contains a polar covalent bond.

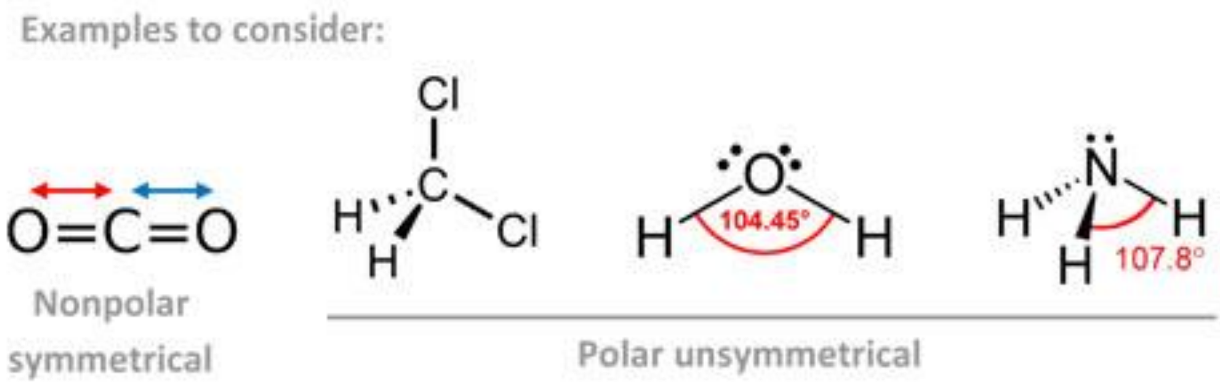


Figure 5. Chemical engineers use bond types and bond type symmetry to determine molecular polarity. If bond types symmetrically cancel each other out, then the molecular geometry is nonpolar. If the bond types do not cancel each other out, then the molecular geometry is polar.