



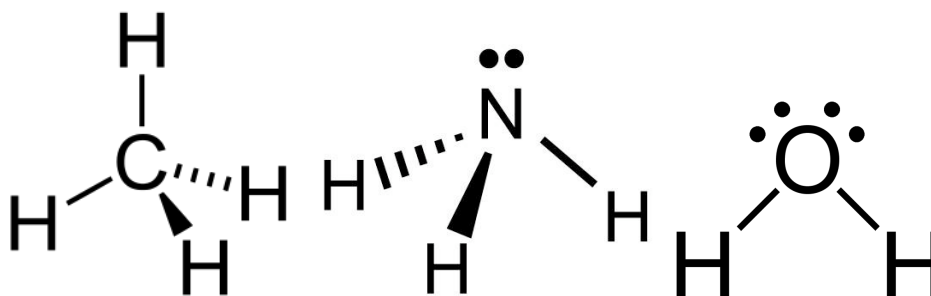
Molecular Formula	Lewis Structure	Bond Angle (calculated)	# of Bonding Regions (central atom)	# Nonbonding Regions (central atom)	# Total Electron Dense Regions	Approx. Bond Angles
CO ₂	$\begin{array}{c} \cdot\cdot \\ \text{O}=\text{C}=\text{O} \\ \cdot\cdot \end{array}$	$\angle\text{OCO}=180^\circ$	2	0	2	180°
HCCH	$\text{HC}\equiv\text{CH}$	$\angle\text{HCC}=180^\circ$	2	0	2	
H ₂ CCCH ₂	$\text{H}_2\text{C}=\text{C}=\text{CH}_2$	$\angle\text{CCC}=180^\circ$	2	0	2	
ClNCl	$\begin{array}{c} \cdot\cdot \\ \text{Cl}-\text{N}=\text{N}-\text{Cl} \\ \cdot\cdot \end{array}$	$\angle\text{ClNN}=117.4^\circ$	2	1	3	120°
(NO ₃) ⁻	$\begin{array}{c} \ominus \\ \cdot\cdot \\ \text{O}-\text{N}=\text{O} \\ \cdot\cdot \end{array}$	$\angle\text{ONO}=120^\circ$	3	0	3	
H ₂ CCH ₂	$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{HC}=\text{CH} \end{array}$	$\angle\text{HCH}=121.1^\circ$	3	0	3	
CH ₄	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{H} \\ \\ \text{H} \end{array}$	$\angle\text{HCH}=109.45^\circ$	4	0	4	109.5°
CH ₃ F	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{F} \\ \\ \text{H} \end{array}$	$\angle\text{HCF}=109.45^\circ$	4	0	4	
CH ₃ Cl	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{Cl} \\ \\ \text{H} \end{array}$	$\angle\text{HCF}=109.45^\circ$	4	0	4	
CCl ₄	$\begin{array}{c} \cdot\cdot \\ \text{Cl} \\ \cdot\cdot \\ \\ \cdot\cdot \\ \text{Cl}-\text{C}-\text{Cl} \\ \cdot\cdot \\ \\ \cdot\cdot \\ \text{Cl} \\ \cdot\cdot \end{array}$	$\angle\text{ClCCl}=109.45^\circ$	4	0	4	
NH ₃	$\begin{array}{c} \cdot\cdot \\ \text{H}-\text{N}-\text{H} \\ \\ \text{H} \end{array}$	$\angle\text{HNN}=107^\circ$	3	1	4	
NH ₂ F	$\begin{array}{c} \cdot\cdot \\ \text{H}-\text{N}-\text{H} \\ \\ \cdot\cdot \\ \text{F} \\ \cdot\cdot \end{array}$	$\angle\text{HNN}=106.95^\circ$ $\angle\text{HNF}=106.46^\circ$	3	1	4	
H ₂ O	$\begin{array}{c} \cdot\cdot \\ \text{H}-\text{O} \\ \\ \text{H} \end{array}$	$\angle\text{HOH}=104.5^\circ$	2	2	4	



IMF Unit – Understanding Shape

STUDY THE DATA TABLE ON BACK AND ANSWER THE FOLLOWING QUESTIONS:

1. How is the number of bonding regions around the central atom determined?
All types of bonds (single, double, triple) count as 1 bonding region.
2. How is the number of nonbonding regions around the central atom determined?
Each set of lone pairs (two electrons = 1 Lone Pair) count as 1 non-bonding region
3. The bond angles listed on the table can be grouped approximately around what three values?
 180° , 120° , 109.5°
4. What correlation can be made between the values in the last two columns of the table and the groupings identified in question 3?
(See edited table)
2 Regions of electron density TOTAL = 180°
3 Regions of electron density TOTAL = 120°
4 Regions of electron density TOTAL = 109.5°
5. Using information from the data table, sketch a 3 dimensional image of CH_4 , NH_3 and H_2O . Use a word or short phrase to describe the shape you drew.



Dashed line = going into the page away from you
Heavy triangle = coming out of the page toward you
Straight, normal line = in the plane of the page

6. Use the clay and toothpicks to make the molecules in 5.
(See class video for a replay)
7. A volunteer will make the electron domains with balloons. Compare the molecular models with the “electron region” model.
(See class video for a replay) In short, the electron regions truly fill a lot of space.



8. Compare the electron region geometries of the following molecules:
 CH_4 , NH_3 , H_2O , NO_3^{-1} , CO_2

