

Activity 13: Molecular Shape

Learning Objectives

Predict the molecular shapes tetrahedral, trigonal planar, linear, bent, and pyramidal for molecules containing C, O, and N.

Estimated Completion Time 75 Minutes

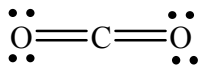
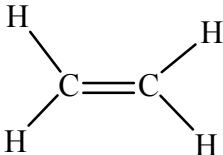
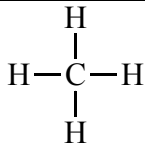
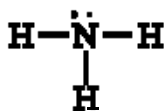
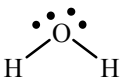
Instructor Information

Molecular models are not recommended for this activity as it does not allow students to explore all possible shapes. Keep reminding students that the electrons in the bonds must be as far away from each other as possible and that molecules are three dimensional. Most students will work in two dimensions until prompted when they build methane (the first attempt is often a plus symbol vs. a tetrahedral). It is possible to build all the shapes in a 45-minute class period; however, it will take longer to complete the entire activity.

ANSWERS TO QUESTIONS

1. a. Linear b. Trigonal planar
 c. Tetrahedral d. Trigonal pyramidal
 e. Bent

2.

Molecular Formula	Lewis Structure	Molecular Shape (geometry) [from question 1]	Number of Atoms Bonded to Carbon or Central Atom	Number of Lone Pairs on Carbon or Central Atom
CO ₂		Linear	2	0
H ₂ CCH ₂		Trigonal planar	3	0
CH ₄		Tetrahedral	4	0
NH ₃		Trigonal pyramidal	3	1
H ₂ O		Bent	2	2

3. Complete the following table:

Molecular Formula	Lewis Structure	Molecular Shape (geometry)	Number of Atoms Bonded to Carbon or Central Atom	Number of Lone Pairs on Carbon or Central Atom
CH ₃ F	$ \begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{H} \\ \\ \text{F} \end{array} $	Tetrahedral	4	0
HCCH	$ \text{H}-\text{C}\equiv\text{C}-\text{H} $	Linear	2	0
CH ₂ CHCl	$ \begin{array}{c} \text{H} \qquad \text{H} \\ \diagdown \quad \diagup \\ \text{C}=\text{C} \\ \diagup \quad \diagdown \\ \text{H} \qquad \text{Cl} \end{array} $	Trigonal planar	3	0
NH ₄ ⁺	$ \begin{array}{c} \text{H} \\ \\ \text{H}-\text{N}^+-\text{H} \\ \\ \text{H} \end{array} $	Tetrahedral	4	0
CH ₃ CH ₃	$ \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array} $	Tetrahedral	4	0

4. Carbon bonded to 4 atoms: Tetrahedral
 Carbon bonded to 3 atoms: Trigonal planar
 Carbon bonded to 2 atoms: Linear

Activity 12: Skill Development

1. a. Nitrogen: trigonal pyramidal; oxygen: bent
 b. The bond angle NOH will be smaller than HNH because there are two lone pairs on the oxygen.

2.

