Shape Lab Worksheet

VSEPR and the 3D shapes of molecules · Logical Home Schooling

Name: _____ **Date:** _____ **Period:** _____

In this lab you will use Shape Lab to spin 3D models of molecules, discover why electron groups spread out, see how lone pairs change shapes, predict shapes from Lewis structures, and connect shape to polarity.

Link: www.logicalhomeschooling.com/shape-lab.html

Objectives

By the end of this lab you will be able to:

- Explain VSEPR theory and name the five electron geometries and their bond angles.
- Explain how lone pairs change molecular shape and bond angles.
- Predict a molecule's shape from its Lewis structure.
- Use shape to decide whether a molecule is polar.

Materials: a computer or tablet with Shape Lab open, a pencil, this worksheet. Time: about 50 minutes.

VSEPR steps. (1) Count electron groups on the central atom: each bond (single, double, or triple = ONE group) plus each lone pair. (2) Groups spread as far apart as possible: that is the electron geometry. (3) Name the molecular shape by where the atoms are.

Part 1: Pre-lab

1. Why do you think electron groups around an atom push away from each other?

2. Draw the Lewis structure of water (H_2O). How many lone pairs are on the oxygen?

Part 2: Stage 1, The balloon model

Electron groups	Electron geometry name	Bond angle(s)	Sketch
2			
3			
4			
5			
6			

1. Four balloons make a tetrahedron (109.5°), not a flat square (90°). Why?

Part 3: Stage 2, Lone pairs

Molecule	Bonds	Lone pairs	Electron geometry	Molecular shape	Bond angle
CH_4					
NH_3					
H_2O					

1. All three molecules have the same electron geometry but different shapes. Explain the difference between electron geometry and molecular shape.

2. Why do the bond angles shrink from 109.5° to 107° to 104.5°?

3. **Challenge:** In XeF_4, where do the two lone pairs go, and what shape do the fluorines make?

Part 4: Stage 3, Build it

Molecule	Electron groups	Lone pairs	Electron geometry	Molecular shape	Bond angle
CO_2					
BF_3					
CH_4					
NH_3					
H_2O					
SO_2					
PCl_5					
SF_6					
XeF_4					
ClF_3					

1. CO_2 has two double bonds. Why does it count as only 2 electron groups?

Part 5: Stage 4, Shape and polarity

Molecule	Shape	Polar or nonpolar?	Why?
CO_2			
H_2O			
BF_3			
NH_3			
CCl_4			
CH_3Cl			

1. CCl_4 and CH_3Cl have the same shape. Why is one polar and the other not?

Part 6: Practice problems

Answer these **without** Shape Lab. Draw the Lewis structure first.

1. CF_4: shape, bond angle, polar or nonpolar?

2. PH_3: shape and polar or nonpolar?

3. H_2S: shape?

4. CS_2: shape and polar or nonpolar?

5. BCl_3: shape, bond angle, polar or nonpolar?

6. CO_2 and H_2O both have polar bonds. Explain why CO_2 is nonpolar but H_2O is polar.

Conclusion

Write 3 to 5 sentences explaining how VSEPR predicts the shape of a molecule and why shape matters. Use the words **electron group**, **lone pair**, **bond angle**, **molecular shape**, and **polar**.