Name: _____

Period: ----------

Due Date: _____

Lab: Models of Molecular Compounds - > VSEPR

Introduction:

Why should people care about the shapes of molecules? Consider that the properties of molecules, including their role in nature, depend not only on their molecular composition and structure, but their shape as well. Molecular shape determines a compound's boiling point, freezing point, viscosity, and the nature of its reactions.

The geometry of a small molecule can be predicted by examining the central atom and identifying the number of atoms bonded to it and the number of unshared electron pairs surrounding it. The shapes of molecules may be predicted using the VSEPR rule, which states that electron pairs around a central atom will position themselves to allow for the maximum amount of space between them.

Covalent bonds can be classified by comparing the difference in electronegativities of the two bonded atoms. If the difference in electronegativities is less than or equal to 0.3, the bond is called a nonpolar covalent bond. If the difference in electronegativities is between 0.3 and 1.7, a polar covalent bond exists. (If the difference in electronegativities is greater than 1.7, an ionic bond results.) In a polar covalent bond, the electrons are more attracted to the atom with the greater electronegativity, resulting in a partial negative charge on the atom. The atom with the smaller electronegativity value acquires a partial positive charge.

Molecules made up of covalently bonded atoms can be either polar or nonpolar. The geometry of the molecule determines whether it is polar or not. For example, if polar bonds are symmetrically arranged around a central atom, their charges may cancel each other out and the molecule would be nonpolar. If, on the other hand, the arrangement of the polar bonds is asymmetrical, the electrons will be attracted more to one end of the molecule and a polar molecule or dipole will result.

Ball-and-stick models can be used to demonstrate the shapes of molecules. In this experiment, you will construct models of covalent molecules and predict the geometry and polarity of each molecule.

Procedure:

1. Construct ball-and-stick models of the molecules in your data table.
2. For each of the compounds in the data table, be sure to also complete the structural formula, shape and polarity. As an example, the first line of the Data Table has been filled in for you.
3. When you have completed this investigation, take apart your models and return the model set to your teacher. Clean up your work area and wash your hands before leaving the laboratory.

Data Table: **Structure and Polarity of Molecules**

Formula	Electron Dot Structure (Lewis)	Shape of Molecule	Molecular Polarity	Bond Angle
H_2	H -- H	Linear	Nonpolar	180^o
a) HBr				
b) H_2O				
c) PH_3				
d) CH_4				
e) HClO				
f) N_2				
g) CH_3NH_2				
h) H_2CO				
i) C_2H_2				
j) CH_3Cl				
k) HCOOH				
l) HCN				
m) H_2O_2				

Post Lab Questions:

Critical Thinking: Analysis and Conclusions

1. List two advantages AND two disadvantages of using ball-and-stick models to construct molecules.

2. Can a molecule with nonpolar bonds ever be polar? Why or why not?

3. Can a molecule with polar bonds ever be nonpolar? Why or why not?

4. Using your data, does there appear to be a correlation between molecular geometry and polarity? Do you notice a pattern between symmetry of a molecule and polarity? Explain using examples from the lab.

Critical Thinking: Application

1. Based on your results, predict the type of bonding, molecular geometry, and molecular polarity of the following molecules:

Molecule	Type of Bond	Molecular Geometry	Molecular Polarity
HI			
H_2S			
NH_3			
CO_2			

2. Identify the intermolecular force that would form between the following combinations of molecules (letters!) from the data table:
   a. D and F _____
   b. B and F _____
   c. C and H _____
   d. B and G _____
   e. H and I _____

3. What type of intermolecular force is between water molecules? Draw a picture showing this intermolecular force between two water molecules. (You may NOT use pictures from online.)

4. Using water molecules as an example, tell what the difference is between a covalent bond and a hydrogen bond? Use pictures or diagrams to help explain your answer if needed. (You may NOT use pictures from online.)

5. Rank the four types of imfs from weakest to strongest. Explain the reason for each of your ranking by indicating/discussing the attractions between the molecules.

6. Would CH_4 and H_2O be soluble in each other? Why or why not?

7. What two factors determine whether a molecule is polar or not?