MODEL MOLECULAR SHAPES

Covalent bonding occurs when atoms share valence electrons. In the Valence Shell Electron Pair Repulsion (VSEPR) theory, the way in which valence electrons of bonding atoms are positioned is the basis for predicting a molecule's shape. This method of visualizing shape is also based on the molecule's Lewis structure.

OBJECTIVES:
   Determine how Lewis structures and the positions of valence electrons affect the shapes of covalent compounds.

MATERIALS:
   molecular model kit

PROCEDURE:
   1. Create a table to record your data.
   2. Note and record the color used to represent each of the following atoms in the molecular model kit: hydrogen (H), oxygen (O), phosphorus (P), carbon (C), fluorine (F), sulfur (S), and nitrogen (N).
   3. Draw the Lewis structures of the H_2, O_2, and N_2 molecules.
   4. Obtain two hydrogen atoms and one connector from the molecular model kit, and assemble a hydrogen (H_2) molecule. Observe that your model represents a single-bonded diatomic hydrogen molecule.
   5. Obtain two oxygen atoms and two connectors from the molecular model kit, and assemble an oxygen (O_2) molecule. Observe that your model represents a double-bonded diatomic oxygen molecule.
   6. Obtain two nitrogen atoms and three connectors from the molecular model kit, and assemble one nitrogen (N_2) molecule. Observe that your model represents a triple-bonded diatomic nitrogen molecule.
   7. Recognize that diatomic molecules such as those formed in this lab are always linear. Diatomic molecules are made up of only two atoms and two points (atoms) can only be connected by a straight line.
   8. Draw the Lewis structure of water (H_2O), and construct its molecule.
   9. Classify the shape of the H_2O molecule using information in Table 8.6 in your textbook.
   10. Repeat Steps 8 and 9 for the PH_3, CF_4, CO_2, SO_3, HCN, and CO molecules.

Your tables will look like these:

Molecules Data		
Name	Lewis Structure	Shape
ammonia	••	trigonal pyramidal

Molecular Polarity	
Name	Electronegativity Difference
ammonia	3.04 – 2.20 = 0.84

over

ANALYZE AND CONCLUDE:

1. **Think Critically** Based on the molecular models you built and observed in this lab, rank single, double, and triple bonds in order of increasing flexibility and increasing strength.

2. **Observe and Infer** Explain why H_2O and CO_2 molecules have different shapes.

3. **Analyze and Conclude** One of the molecules from this lab undergoes resonance. Identify the molecule that has three resonance structures, draw the structures, and explain why resonance occurs.

4. **Recognize Cause and Effect** Use the electronegativity difference to determine the polarity of the molecules in Steps 8–10. Based on their calculated bond polarities and the models constructed in this lab, determine the molecular polarity of each structure. Create a calculations table and include the molecule its electronegativity difference.