MOLECULAR MODELS

Purpose: You will study the three-dimensional structure of molecules and ions using model kits.

Background: A compound's chemical properties are determined not only by its formula but also its structure. The formula does not always indicate the arrangement of the atoms with respect to each other. In this lab we will get hands-on experience applying the basic rules for understanding structure. Please review the sections in our textbook on drawing Lewis diagrams and on molecular geometry prior to lab.

The **octet rule** is one of the most useful of these rules, although there are many molecules and ions that do not follow it. The first step of applying the octet rule is to determine the central atom(s). Then decide on the arrangement around it. The **electron domain geometry** refers to the arrangement in space of lone pairs and bonded nuclei. The **molecular geometry** of a molecule or ion refers to the arrangement in space of the nuclei, **NOT** lone pairs. Thus, when describing the molecular geometry, non-bonding electron pairs are neglected. Obviously the resulting molecular geometry is determined (in part) by these non-bonding electron pairs, but they are not included in the description.

It is important to use the correct descriptive terms for molecule shapes. For example, "flat" is not very useful in describing a molecule composed of four atoms, but "trigonal planar" is acceptable. The table of electron-domain geometries and molecular geometries in our textbook will be very helpful when identifying and labeling molecular shapes based on models. Whether the molecule or ion is polar can also be seen from the model. To be polar, the molecule must have a permanent dipole, meaning that the individual bond dipoles in the molecule do not cancel each other out. The model also helps determine if isomers exist: if two (or more) equally good structures can be built with different arrangements in space, they are geometric isomers. If two or more equally good structures have the same arrangement of atoms but differ only in the placement of multiple bonds, they are resonance structures, not isomers.

Procedure: Obtain a model set. For each of the assigned molecules or ions:

1. Determine the best 2-D Lewis diagram for each molecule.
2. Draw the 3-D VSEPR structure (use wedge-dash notation described in the **isomerism** section in our textbook). Count and record the number of electron domains. Use the sticks for single bonds. Use the springs for multiple bonds – two for a double bond and three for a triple bond.
3. Based on your model, describe the shape of the molecule (molecular geometry), and determine if there is a molecular dipole. Show example molecules to your instructor.

Molecules and ions to be studied can be found on the laboratory report form.