

10B – LEWIS STRUCTURES AND VSEPR

INQUIRY

Why do molecules have specific compositions and shapes?

MATERIALS

- Molecular Model Set
- Periodic table

PERIODIC TABLE OF ELEMENTS

atomic number, symbol, atomic mass, name

alkali metals, alkaline earth metals, transition metals, rare earth metals, non-metals, halogens, noble gases, metalloids

PASCO essential CHEMISTRY



BACKGROUND

Atoms combine to form molecules by sharing electrons and lowering their chemical potential energy. Since the atoms of each element have unique electronic structures, different elements form different numbers of bonds. Elements typically form chemical bonds to reach a stable configuration of eight valence electrons, with hydrogen and helium being exceptions to the rule, only needing two valence electrons for a stable configuration. The bonding and non-bonding electrons around a central atom in a molecule determine the molecular shape.

SAFETY

Follow regular lab safety procedures.

PROCEDURE

Part 1 – Lewis structures of atoms

1. Instructions for building molecules:

- Use long bonds for double bonds.
- If an atom is not listed in the color guide found in the Molecular Model Set or in the following table, use the color for an atom found in the same group/family.

Color Key for Molecular Model Set

Color	Element	Color	Element
Black	Carbon	Orange	Phosphorus
White	Hydrogen	Yellow	Sulfur
Red	Oxygen	Green	Chlorine
Blue	Nitrogen	Purple	Sodium

2. For each of the atoms in Table 1 on your answer sheet, identify the total number of electrons in the atom and the number of valence electrons in each. Record your answers in Table 1.
3. Draw dots around the element symbol in the first column of Table 1 to represent the valence electrons as a Lewis structure. Remember to place electron dots as singles on each of the 4 sides before pairing electron dots.
4. Count the number of lone pairs of electrons (pair of dots) on each atom, if any. Record your answers in Table 1.

PROCEDURE

- Count the number of un-paired electron (single dot) sides; that is how many bonds that atom can make to get to the closest noble gas configuration. Record your answers for each atom in Table 1.
- Use the model set to identify the color representing each element, then count the number of holes in the atoms. Record your answers in Table 1.

ANALYSIS

Complete the analysis for Part 1 on your answer sheet.

QUESTIONS

Answer the questions for Part 1 on your answer sheet.

PROCEDURE**Part 2 – Lewis structures of molecules**

- For each of the diagrams in Table 2 on your answer sheet, build a model using the modeling set.
 - Each pair of dots between two atoms represents a bond; two pairs of electrons between two atoms represents a double bond.
- Once you have built the model, draw the structural formula in Table 2. Arrange the bonds in the same angles and spacing that you see in the model you built. Include lone pairs where present.
- Write the chemical formula for each molecule in Table 2.

ANALYSIS

Complete the analysis for Part 2 on your answer sheet.

QUESTIONS

Answer the questions for Part 2 on your answer sheet.

PROCEDURE**Part 3 – VSEPR**

- Draw the Lewis structure for each chemical formula in Table 3 on your answer sheet.
- Use the model set to create a molecule model for each chemical formula in Table 3.
- Identify the bonding and non-bonding electron domains around the central atom(s).
 - Any bonding area counts as one electron domain. For example, a single bond counts as one electron domain, and a double bond also counts as only 1 electron domain.
 - Each lone pair on the central atom counts as a non-bonding electron domain.
- Record the number of electron domains in Table 3.
- Record the molecular shape of the central atom in Table 3. Choose from the following shapes: linear, bent, trigonal planar, trigonal pyramidal, or tetrahedral.

ANALYSIS

Complete the analysis for Part 3 on your answer sheet.

QUESTIONS

Answer the questions for Part 3 on your answer sheet.