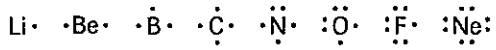
Drawing Lewis Symbols

To draw Lewis symbols for main group atoms:

- Write the element symbol to represent the nucleus and any filled energy levels of the atom.
- Add a dot to represent each valence electron.
- Start by placing valence electrons singly into each of four valence orbitals (represented by the four sides of the element symbol).
- If additional locations are required for electrons, once each orbital is half-filled, start filling each of the four orbitals with a second electron until up to eight positions for valence electrons have been occupied.

The Lewis symbols for atoms of the Period 2 elements show the dot arrangement for main group atoms.



Practise drawing Lewis symbols for the main group elements in Period 3.

Lewis Formulas and Structural Formulas for Molecules, Extra Exercises

1. Use Lewis formulas and structural formulas to represent molecules of the following compounds.
   (a) $PH_3(g)$ phosphine

   (b) $CS_2(l)$ carbon disulfide

   (c) $CH_3Cl(g)$, chloromethane

   (d) $CH_3SH(g)$ methanethiol

Predicting Molecular Shapes, Extra Exercises

For each of the following molecules, write the chemical formula (if not provided), draw the Lewis formula, and describe the shape around the central atom.

1. hydrogen iodide

2. silane, SiH_4

3. formaldehyde, H_2CO

4. hydrogen peroxide

5. hydrogen peroxide

6. hydrazine, N_2H_4

7. propane, C_3H_8

Investigation 1.A: Modelling Molecules

Name _____

Models are very important tools for chemists. You cannot see detailed features of molecules, even with a microscope. However, you can build models that fit some of the properties that chemists have determined through experimentation. In this investigation, you will use a molecular model kit to assemble models of a few molecules.

Question

What can you predict about the structure of molecules by building models?

Materials

- molecular model kit
- paper
- pen

Procedure

1. Obtain a model kit from your teacher.
2. In the table on the following page, draw Lewis structures of each molecule in the list below:
   - **(a)** hydrogen bonded to hydrogen: $H_2(g)$
   - **(b)** chlorine bonded to chlorine: $Cl_2(g)$
   - **(c)** oxygen bonded to two hydrogens: $H_2O(\ell)$
   - **(d)** carbon bonded to two oxygens: $CO_2(g)$
   - **(e)** nitrogen bonded to three hydrogens: $NH_3(g)$
   - **(f)** carbon bonded to four chlorines: $CCl_4(\ell)$
   - **(g)** nitrogen bonded to three fluorines: $NF_3(g)$
3. Look through the chapter and choose three other molecules that are not in the list above. Draw the Lewis structures of your selected molecules in your table.
4. Based on your Lewis structures, build models of all the molecules. Make a sketch of your model.

Analysis

1. Compare your models and sketches with those of your classmates. Discuss any differences.

2. What can you learn from models that you cannot learn from Lewis structures?

Lewis Structures and Molecular Shapes of Some Simple Molecules Built Using a Model Kit

Name	Formula	Lewis Structure of Compound	Three Dimensional Sketch of Model

Conclusion

3. Summarize the strengths and limitations of creating molecular models using kits. What can you deduce from the models? What features of molecules cannot be deduced from models?

Additional Mini Investigation: London Forces

London forces (sometimes called London dispersion forces) are the weakest of the three types of intermolecular forces. London forces are the only force of attraction between nonpolar molecules such as butane (the liquid in cigarette lighters). Butane boils at –1 °C, but it can be compressed into a liquid at room temperature. While under pressure, butane molecules come close enough to each other, for London forces to form. However, when you press on the lever of the lighter, the pressure is released and butane quickly evaporates. In this activity, you will combine starch and water into a gooey mixture that will demonstrate the weakness of London forces.

Materials

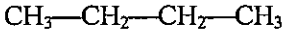
eye protection
lab apron
cornstarch
plastic cup
water
spoon or lab scoop

- Mix the cornstarch with enough water in the plastic cup to get a smooth, viscous paste.
- Pour some of the paste into the palm of your hand. Squeeze the paste. If it is of the correct consistency, you will feel it solidify under the pressure of your hand.
- Release the pressure and observe what happens to the paste.

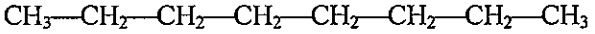
(a) Explain your observations by referring to intermolecular bonding.

(b) Butane and octane (a major component in gasoline) are both nonpolar molecules with similar structures:

butane



octane



Use your knowledge of London forces to explain why octane is a liquid at room temperature, while butane is a gas.