Teacher Name: Dwight Lillie Student Name: _____

Class: ELL Chemistry

Period: Per 4

Assignment: Assignment week 3

Due: ***Friday, 5/8***

Lewis Dot Diagrams & Structures

General Instructions:
Please do the activities for each day as indicated. Any additional paper needed please attach.
Submitted Work:

1) Completed packet.

Questions:

Please send email to your instructor and/or attend published virtual office hours.

Schedule:

Date	Activity
Monday (5/4)	Read Sections 8.1 and 8.2 in your textbook.
Tuesday (5/5)	Read and work through problems in Model I
Wednesday (5/6)	Read and work through problems in Model II
Thursday (5/7)	Read and work through problems in Model III
Friday (5/8)	Read and work through problems in Model IV

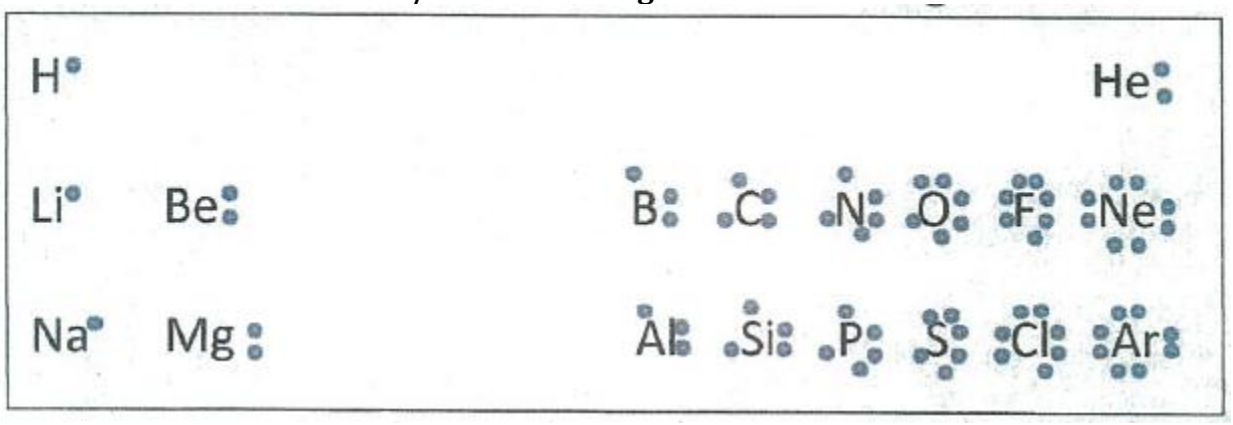
Lewis Dot Diagrams & Structures

How are electrons shared to create covalently bonded molecules?

Read This!

Why? Covalent bonds result from a sharing of electrons by two or more atoms (usually nonmetals). Lewis theory (Gilbert Newton Lewis, 1875-1946) focuses on the valence electrons, since the outermost electrons are the ones that are highest in energy and farthest from the nucleus, and are therefore the ones that are most exposed to other atoms when bonds form. Lewis dot diagrams for elements are a handy way of picturing valence electrons, and especially, what electrons are available to be shared in covalent bonds.

Model 1 – Valence Electrons / Lewis Dot Diagrams



Exploration I

1. How many valence electrons do the atoms H, Li, and Na each have?

2. How many valence electrons do the atoms B and Al each have?

3. How many valence electrons do the atoms F and Cl each have?

4. Create a rule about how many valence electrons an atom will have?

5. Why do you believe that the electron dot diagram for the He atoms violates this rule?

Read This!

Notice that the placement of the electron dots is very purposeful. The firs two (if applicable) are always placed together. Then, any remaining valence electrons are placed individually on each of the remaining three sides of the chemical symbol. After each side has one electron, then any remaining valence electrons are paired on the three sides.
NOTE: On the Internet, OGT, and some textbooks, the Lewis Dot Diagram are not drawn properly. For example, carbon is drawn:

Given the instructions for Lewis Dot structures of elements – how do you think it should be drawn?

6. What electrons are considered to be valence electrons? Explain how you came to this conclusion.

7. Why are only these electrons considered valence electrons?

8. Hypothesize: Why are the valence electrons placed around an atom in the manner described?

Application:

9. Draw Lewis dot diagram for the barium atom.

10. Draw the Lewis dot diagram for the silicon atom.

11. Draw the Lewis dot diagram for the iodine atom.

12. Draw the Lewis dot diagram for the xenon atom.

13. Hypothesize: Why are noble gases considered to be non-reactive?

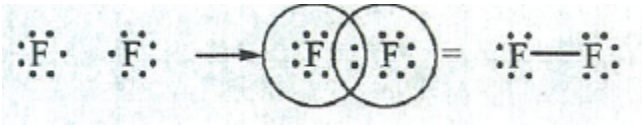
Model II: Lewis Dot Structures

Read This!

Covalent bonds generally form when a nonmetal combines with another nonmetal. Both elements in the bond are attracted to the unpaired valence electrons so strongly that neither can take the electron away from the other (unlike the case with ionic bonds), so the unpaired valence electrons are shared by the two atoms, forming a **covalent bond.** The shared electrons act like they belong to both atoms in the bond, and they bind the two atoms together into a **molecule**. The shared electrons are usually represented as two dots (**:**) or as a line (--) between the bonded atoms. These represent a **single bond** (In Lewis structures, a line represents two electrons). Atoms tend to form covalent bonds in such a way as to satisfy the **octet rule**, with every atom surrounded by eight electrons (Hydrogen is an exception).
NOTE: A line (--) is used only for bonding electrons; never use it to represent a lone pair.

Example 1:

Example 2:



14. Identify the number of valence electrons in each atom of example 1.

15. How many total valence electrons are available to build the Lewis dot structure for HF?

16. Identify the number of valence electrons in each atom of example 2.

17. How many total valence electrons are available to build the Lewis dot structure for F_2?

18. How many valence electrons does each H atom have?

19. Ho many total electrons are available to build the Lewis dot structure for H_2?

20. How many valence electrons does each bromine atom have?

21. How many total electrons are available to build the Lewis dot structure for Br_2?

Read This:

When building a Lewis dot structure for a molecule, it is important to first place one pair of electrons between the atoms to be bonded. Once the atoms have been bonded, then valence electrons are placed in pairs around one atom until it has an octet. Then any remaining valence electrons are placed around another atom until it also has an octet. NEVER: place individual electrons! In other words: they always are drawn in pairs. All unbounded pairs of electrons are called **lone pairs**.

Extension Questions:

22. Draw a Lewis dot structure for the H2 molecule.

23. Draw the Lewis dot structure for the Br2 molecule.

24. Draw the Lewis dot structure for the HI molecule.

Read This!

When building molecules with more than two atoms, the structure will begin with one central atom, placed in the middle, with up to four surrounding atoms, placed on the top, bottom, right, and left sides of the central atoms. Deciding which atom is the central atom? **Never** use hydrogen or a halogen. They typically only form on bond as they achieve an octet. The central atom should be the atom that is farthest from the fluorine atom on the periodic table.

Rules for building Lewis dot structures:

Rule 1: Count the total number of valence electrons in each atom and then add them together to get the total number for electrons in the molecule (for example, H_2O has 2 x 1 + 6 = 8 valence electrons; CCl_4 has 4 + 4 x 7 = 32 valence electrons).

Rule 2: Place the atoms relative to each other. Place the atom that is farthest from fluorine on the period, as the central atom. Place the remaining atoms on the top, bottom, left, and right sides. Remember: Hydrogen and Halogens are never central atoms.

Rule 3: Place a pair of electrons between each atom to form a bond. Each bond uses two valence electrons.

Rule 4: Complete an octet on one surrounding atom before proceeding to the next surrounding atom. Once all surrounding atoms have octets, any remaining electrons should be placed on the central atom to achieve an octet. The number of electrons in the final structure must equal the number of valence electrons from Step 1.

Read This!

Lewis Dot structure for CH_4.

Step 1: C has 4 valence electrons; each H has 1 valence electron. Total electrons = 8.

Step 2: Place C as the central atom

Step 3: Place electrons to form bonds

Step 4: There were 8 valence electrons in step 1 and 8 electrons in the Lewis dot structure

Application:

25. Complete the Lewis dot structure for CCl_4.
26. Complete the Lewis dot structure for NH_3.
27. Complete the Lewis dot structure for H_2O.

Model IV: Double and Triple Bonds

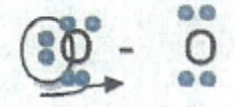
Read This!

When following the four rules for building a Lewis dot structure, it may appear as though there are not enough valence electrons to complete the structure. If this happens, you will move a **lone pair** from one of the surrounding atoms and place it in between that atom and the central atom. This will create a **double bond**. If this doesn't result in all atoms achieving an octet, move another **lone pair** from a surrounding atom and place it between atom atom and the central atom. This sharing of three pairs of electrons is called a **triple bond**. Atoms never share more than three pairs of electrons. **Warning:** do not create double or triple bonds unless it is needed. Hydrogens and Halogens **never** have double or triple bonds.

Building O2: Total valence electrons = 12

Following steps 1-4:

Move one lone pair:



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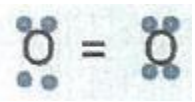

Total electrons = 12

28. Complete the Lewis dot structure for N2.
29. Complete the Lewis dot structure for CO2.
30. Complete the Lewis dot structure for CO.
31. Complete the Lewis dot structure for HCN.