**Bonding**Unit 5 Page 14  
**Learning Target:  
I** **can** represent the structure of a molecule by drawing bonds and unshared pairs.  
**Criteria for Success:  
I can** construct electron dot structures to illustrate covalent bonds.

**A.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**are formulas used to model what atoms look like in a compound that contains atoms that are **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**bonded together. Remember that in a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** bond, **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** atoms **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**electrons in order to obtain a full valence shell. For **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** , a full valence shell will have **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** electrons. For all other nonmetals, a full valence shell will have **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. The idea that nonmetals will **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** electrons to get **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** valence electrons and be **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is part of the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.

**1.** Element symbols represent the atom’s **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.   
**2.** **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**electrons are then represented using either dot-pairs or dashes.   
**a.** If the valence electrons are not involved in bonding they are represented using **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. These represent unshared pairs of electrons.   
**b.** If the valence electrons are involved in bonding they are represented using a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** between two atomic symbols. These represent shared electron pairs in covalent bonds.   
**i.** Remember that **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**are formed when **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**valence electrons in order to mutually achieve **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**valence shells (to be **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** like noble gases).  
**ii.** Only valence electrons that are already **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** will be shared from one atom to another

Notice that a pattern shows up for covalent bonds with certain atoms. Certain atoms are most **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**with a specific number of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**and a specific number of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**) **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**of electrons.

|  |  |  |
| --- | --- | --- |
| Element | # bonds | # lone pairs |
| H | 1 | 0 |
| C | 4 | 0 |
| N | 3 | 1 |
| O | 2 | 2 |
| All Halogens | 1 | 3 |
| All Noble Gases | 0 | 4 |

Atoms in the same groups as C, N, and O will *tend* to follow the same pattern, but they *may not always.*

**B.** Steps to writing a Lewis structure of a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**covalent compound  
**1.** Choose a central atom.  
 **a.** If **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**is in the molecule, it will be the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** atom.   
 **b.** Otherwise, the atom that is capable of having the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**will most likely be the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**atom.  
 **c.** It is possible for all atoms in a molecule to be bonded in a straight line, like Example 4 above. In this case, there is not one sole central atom. The formula for the molecule will generally be written by listing the elements in the order they are chained in the atom. Ex: HSCN, CH3COOH  
**2.** Write the symbol for the central atom. Then write the symbols for the other atoms around the central atom.   
**3.** Draw the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**for the individual atoms.  
**4.** Figure out how to “connect the dots.”   
**5.** Draw **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** between atoms to show **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** pairs of electrons. Be sure to show the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** around atoms that have them.  
**6.** Double check that each atom has a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** by counting both **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** and **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** as **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** electrons each belonging to the atom.

**C.** Multiple bonds, expanded octets, and other exceptions  
 **1.** Only certain atoms can form **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** and **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** bonds. Generally, they are the “**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**,” although others can exist.  
**2.** Some atoms in the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** and **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** energy levels can hold electrons in their otherwise empty **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. This allows them to form more than 4 bonds and have more than a full **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. This is most common with **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** , although any nonmetal that has access to **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**(so, nonmetals in the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** and **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** ) are capable of doing it. These can have **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** valence electrons in a molecule. If you are ever drawing a molecule that has lone pairs and unsure of where else to put them, the lone pairs should go on the expanded octet atom.  
**3.** Boron is stable with only **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** electrons, rather than a full **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. This means it can be stable with **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** bonds and **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** lone pairs.  
**4.** Some **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** , under extreme laboratory conditions, can be forced to **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. This has only been shown to occur with the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** noble gases (**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** and **\_\_\_\_\_\_\_\_\_\_\_\_\_\_**) and the most **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** atom (**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**). **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is able to so strongly attract electrons to itself that it can attract valence electrons in noble gases that have a lot of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.  
**5.** Lewis structures for **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_**can be drawn using generally the same process as covalent molecules. However, the final structure must have **\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**drawn around it and the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**must be written outside the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**as a superscript in the upper right corner.

**D.** How to tell if you’re dealing with an exception

**1.** If a molecule is forming ­­­­­\_\_\_\_\_\_\_\_\_\_\_bonds than what you would \_\_\_\_\_\_\_\_\_\_\_ it will then it is an exception.

Lewis Structures Practice: Draw the Lewis Structures for each compound or ion listed below.

|  |  |
| --- | --- |
| NH3 | CCl4 |
| SO3 | C2H6 |
| H2CO | N2 |
| CO2 | O2 |
| NH4+1 | PH3 |

Lewis Structures Practice: Draw the Lewis Structures for each compound or ion listed below.

|  |  |
| --- | --- |
| SO4 | SO2 |
| OF2 (O in the middle) | HOOH |
| AsF3 | HCN |
| COCl2 (everything attaches to C) | SiH4 |
| H2S | PO4 |