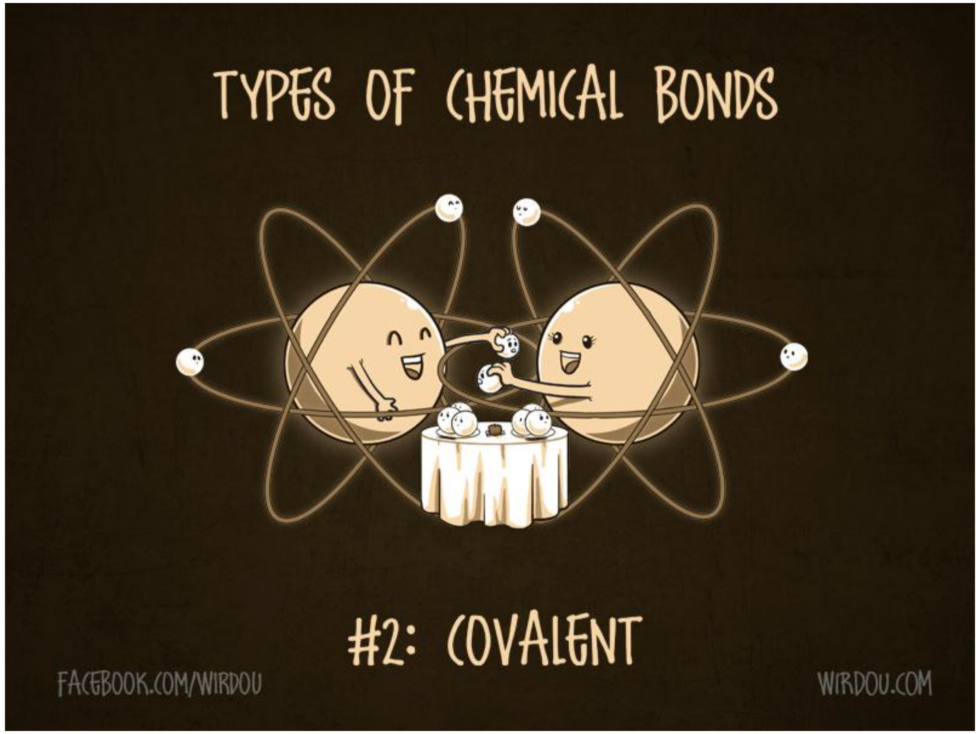
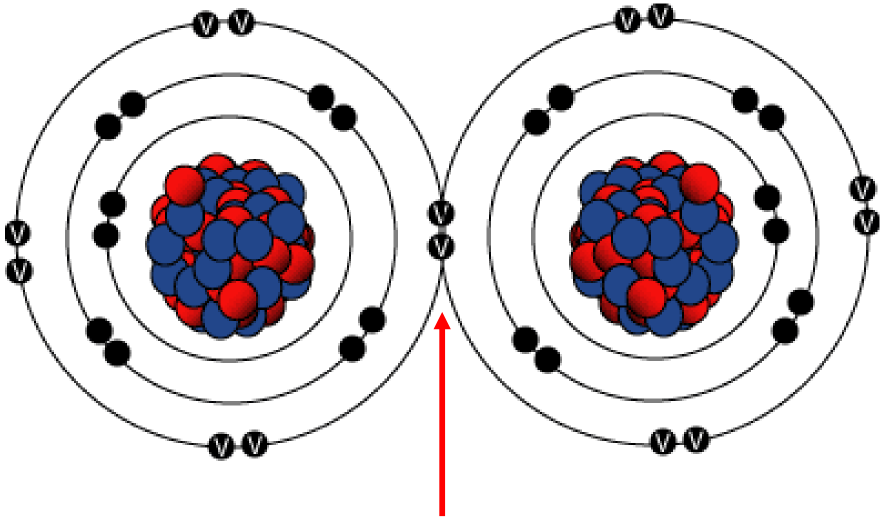
Molecular Compounds

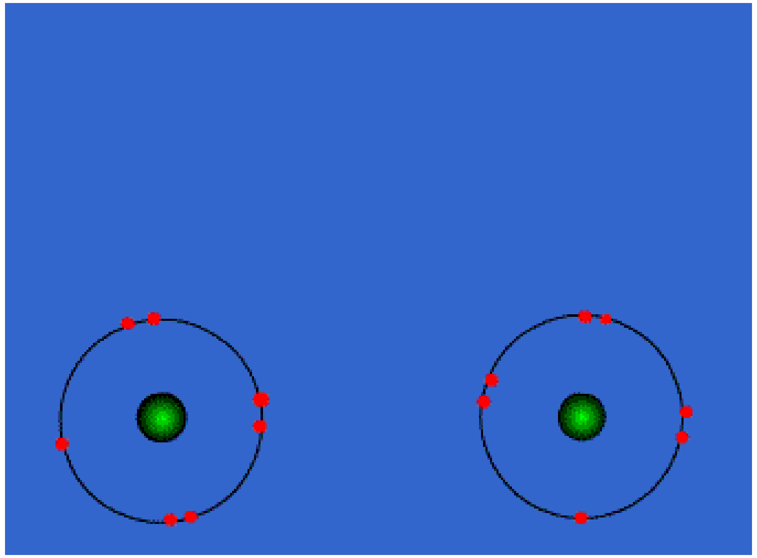
The majority of known compounds identified are known as molecular compounds. These molecular compounds consist of at least two non-metals bound to each other. In these types of compounds, the atoms are bonded to each other by the sharing of their electrons. This type of bond, with shared electrons is known as a **covalent bond**.



Atoms in molecular compounds are bound to each other by covalent bonds. In this type of bond atoms will share valence electrons with each other so that each atom can can have a full valence shell. For most elements covalent bonds will form so that they can form a stable octet, the exceptions are hydrogen and helium which only require 2 valence electrons to be stable. When electrons are shared in a covalent bond they are considered part of each atom’s valence shell.



Shared electrons form a covalent bond.



Lets start with the formation of a simple molecular compound, H_2. Hydrogen consists of 1 proton and 1 electron. When 2 hydrogen atoms interact, they will seek to share their valence electrons so that each atom has a full valence shell.

$$H\bullet + H\bullet \longrightarrow H\!:\!H$$

When a pair of electrons are shared in a covalent bond, it is called a single bond and can be represented in Lewis structure as a single line. Therefore the Lewis structure of H_2 would look like:

Click to See Lewis Structure of H_2

Lets start with the formation of a simple molecular compound, H_2. Hydrogen consists of 1 proton and 1 electron. When 2 hydrogen atoms interact, they will seek to share their valence electrons so that each atom has a full valence shell.

Shared electrons

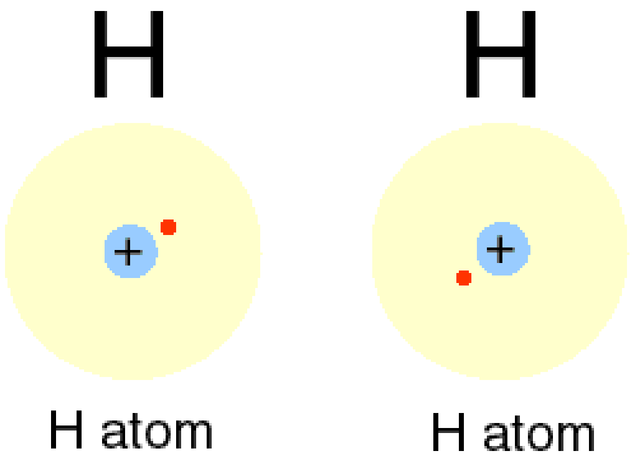
$$H\bullet \; + \; H\bullet \longrightarrow H{:}H$$

When a pair of electrons are shared in a covalent bond, it is called a single bond and can be represented in Lewis structure as a single line. Therefore the Lewis structure of H_2 would look like:

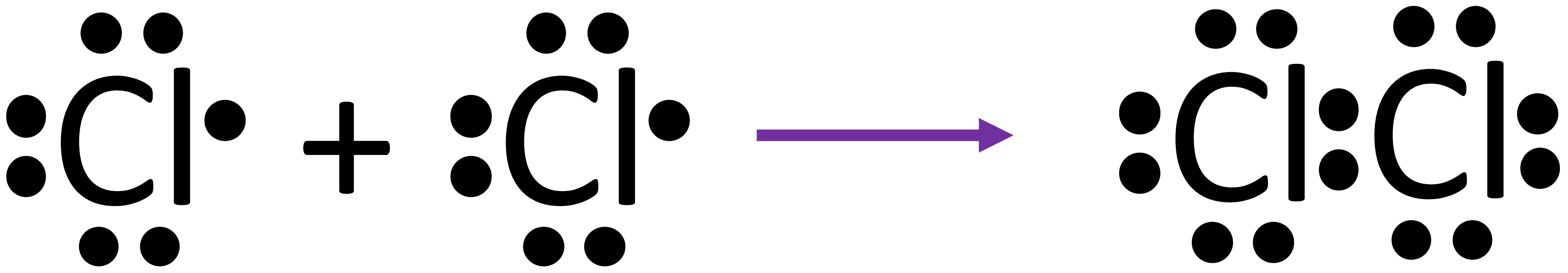
$$H\text{—}H$$

Click to See an Animation of H2 Covalent Bond Formation

When 2 Hydrogen atoms form a covalent bond, they share 1 valence electron with each other so that both atoms have a full valence shell.

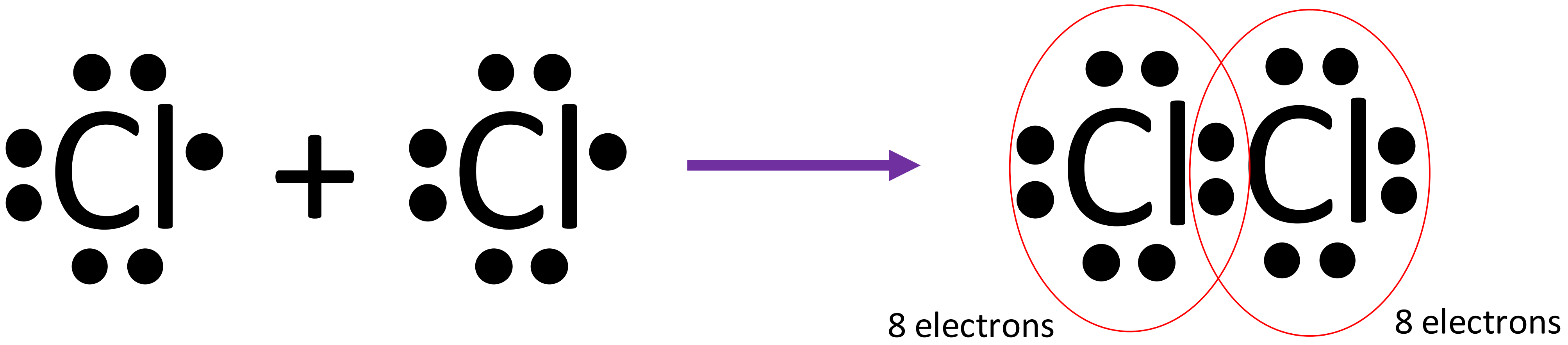


Lets look at another example, when 2 chlorine atoms bond to each other, they share 1 valence electron with each other to form a single bond so that each atom has a stable octet:

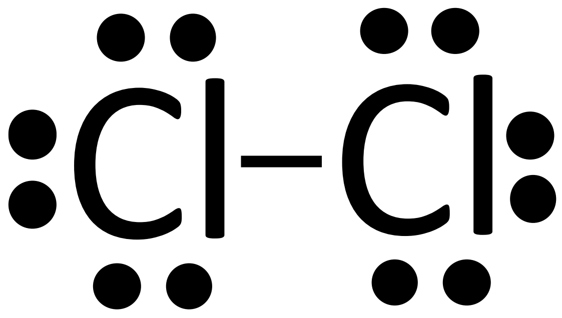


Click to See Lewis Structure of Cl_2

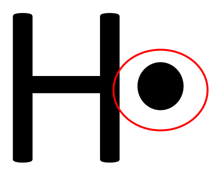
Lets look at another example, when 2 chlorine atoms bond to each other, they share 1 valence electron with each other to form a single bond so that each atom has a stable octet:

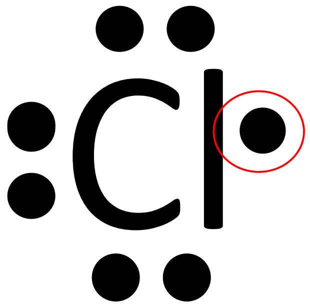


Lewis Structure of Cl_2:



Looking at hydrogen and chlorine, you can see that they each have 1 unpaired electron in its valence shell.





This unpaired electron is often called a bonding electron as it has the ability to form a covalent bond with another atom. The number of bonding electrons in an atom determines the number of covalent bonds that it is able to form and this number is known as its **bonding capacity** or **combining power.**

Unpaired electrons are called bonding electrons. The number of bonding electrons in an atom determines the number of covalent bonds that it is able to form and this number is known as its **bonding capacity** or **combining power.** Elements in the same group have the same bonding capacity. Complete the table below, to determine the bonding capacity of elements in each of the groups listed. Hint: Drawing Lewis structures will help you determine the unpaired electrons.

Group	1	14	15	16	17
Valence electrons					
Bonding Capacity					

Click for Completed Table

Group	1	14	15	16	17
Valence electrons	1	4	5	6	7
Bonding Capacity	1	4	3	2	1

Therefore, from this table you can see that elements in group 1 such as hydrogen and lithium can form 1 covalent bond with other atoms, while elements in group 14 such as carbon and silicon can form 4 covalent bonds with other atoms.

Atoms are able to share more than one pair of electrons between them. When two pairs of electrons are shared between atoms this is called a double bond and is represented by 2 lines:

$$X{=}X$$

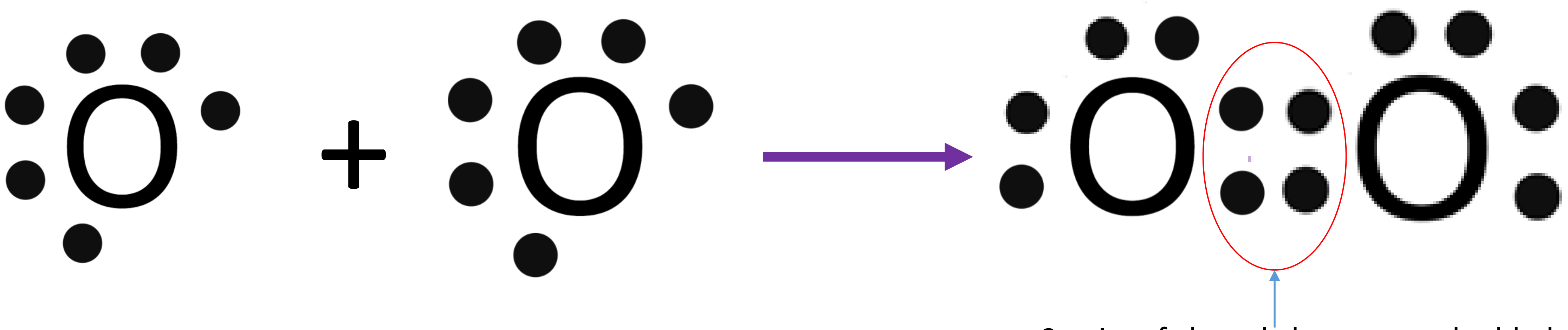
When 3 pairs of electrons are shared this is called a triple bond and is represented by 3 lines:

$$X{\equiv}X$$

From this information, can you predict the Lewis structure that will result when 2 oxygen atoms bond with each other? Look at the bonding capacity of elements in the group oxygen is in and try to draw the Lewis structure of $O_{2.}$

Click for the Solution

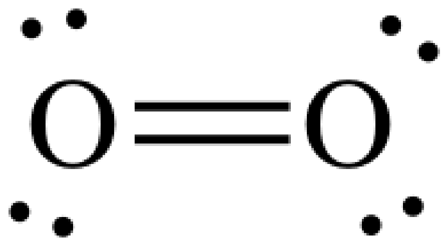
Oxygen has is in group 16 and therefore has 2 unpaired electrons and a bonding capacity of 2. This means that it can form 2 covalent bonds with other atoms. Therefore, when 2 oxygen atoms bond, they will share 2 valence electrons with each other, forming a double so that each atom will have a stable octet.



2 pairs of shared electrons = double bond

To See the Completed Lewis Structure Click Here

The completed Lewis structure of oxygen would look as follows. The unpaired electrons are positioned so that they are as far away from each other and the paired electrons as possible.

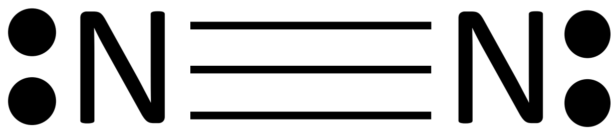


Test your understanding: Draw the Lewis structure for N_2

Click for the Solution

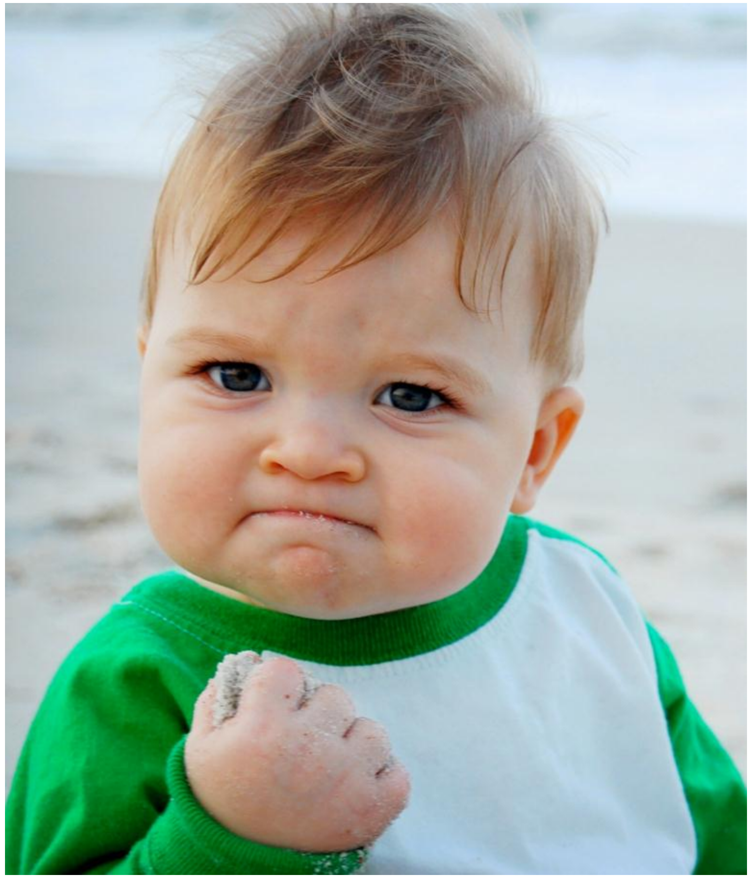
Lewis Structure for N_2

Nitrogen is in group 15 and therefore has a bonding capacity of 3. Therefore, it must form 3 bonds to have a stable octet. As a result, a molecule of N2 will have 2 nitrogen atoms triple bonded to each other.



Success!

You have reached the end of this activity. You will know that you have achieved the goals for this activity when you can describe a covalent bond and can predict and draw the structures of simple molecular compounds.



Back to Start