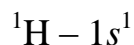
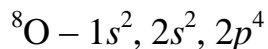
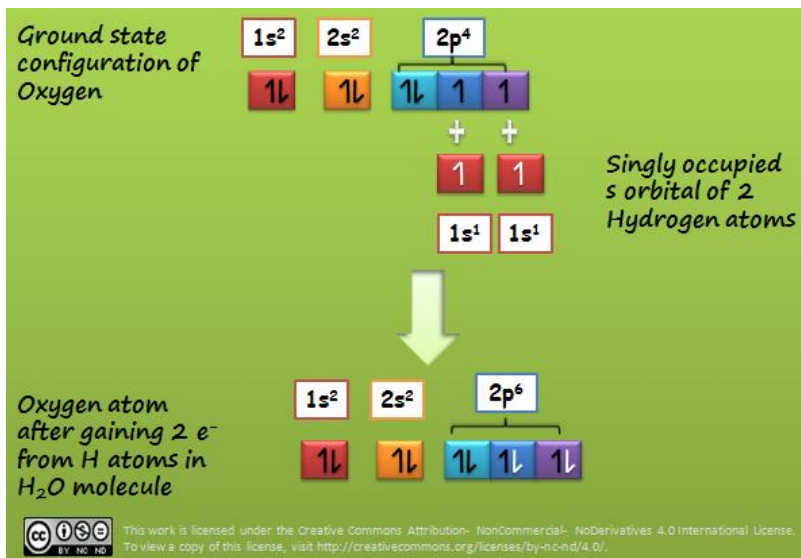


VALENCE BOND THEORY (VBT)

Linus Pauling proposed the Valence Bond Theory (VBT) to explain how valence electrons of different atoms combine to form a molecule. He said that unpaired electrons (valence electrons) of one atom combines with unpaired electrons of other atoms and thus forms a molecule. I am not going to puzzle you with rules; we will learn the rules by examples.

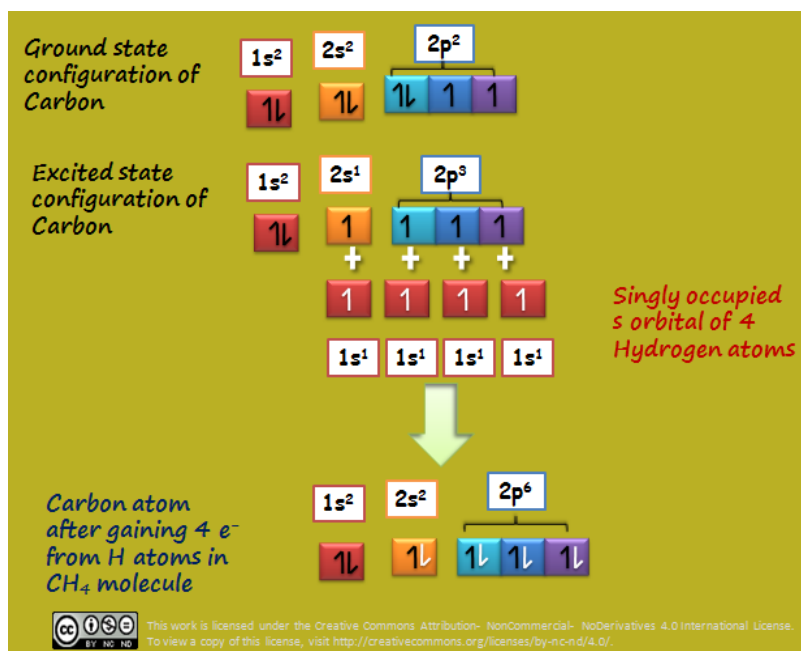
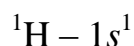
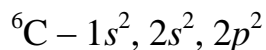
Let's take an example of H_2O molecule and see how it is formed by O and H. To understand it we have to look at the electronic configurations of O and H.



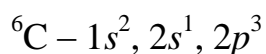
Now place these electrons to their corresponding orbitals. You can see here that O is the central atom and it has 6 valence electrons, out of which 2 are unpaired. Each of the

unpaired electron gets paired with 1 electron of H. Thus O and H share electrons and form H₂O molecule. In this pairing they also follow the ‘Pauli Exclusion Principle’ which means the spin of both paired electrons must be opposite.

Now take another example of CH₄. Write the electronic configurations of C and H.

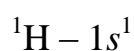
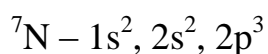


After placing these electrons to their corresponding orbitals you will find that C has 4 valence electrons, out of which only 2 are unpaired. But to complete its octet it needs 4 unpaired electrons to get paired with 4 atoms of H. To accomplish this C supplies some energy to its paired electrons and promotes one of them to the empty p orbital so that C has 4 unpaired electrons. Now its electronic configuration becomes:

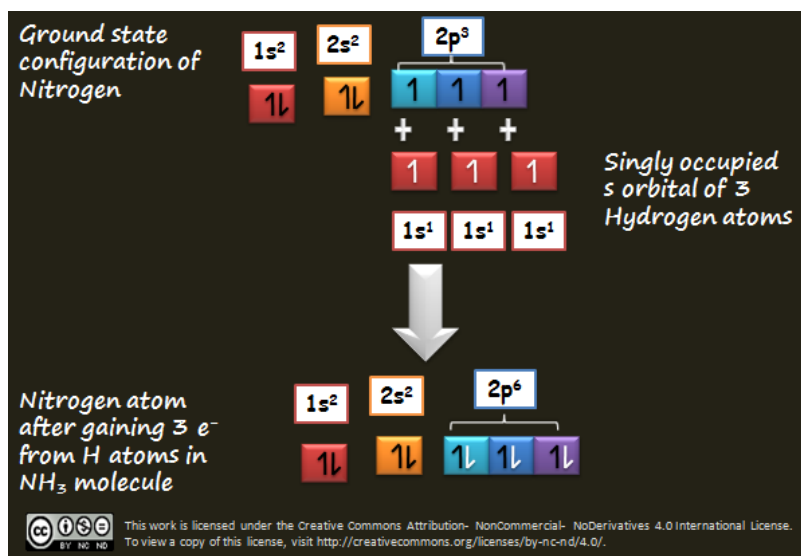


This new configuration is called the excited state configuration and the previous configuration is known as the ground state configuration.

Let's practice it with one more example of NH_3 . Write the electronic configurations of N and H.



In NH_3 molecule N is the central atom. N has 3 unpaired electrons to combine with unpaired electrons of 3 atoms of H. Now it can get paired with unpaired electrons of H atoms.



At this stage when VBT explained the formation of molecule a new question arose. The bonding electrons or paired electrons are placed in the orbitals of the central atom, which means the orbitals of the central atom decide the shape of the molecule. In H_2O

molecule bonding electrons are placed in two p orbitals of O. These two p orbitals are at right angle to each other but the shape of H_2O molecule is bent and angle is $104^\circ 27'$. Similarly in CH_4 molecule the question arises that how one spherical orbital and three dumbbell shaped p orbitals which are at right angle to each other can give tetrahedral shape to the CH_4 molecule?

In answer to these questions scientists proposed the phenomenon of Hybridization. it is similar to the process of Hybridization some of you have used or listened in gardening.

Source : <http://chemistrynotmystery.blogspot.in/2014/08/valence-bond-theory-vbt.html>