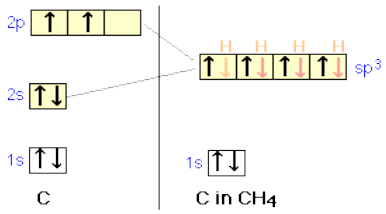
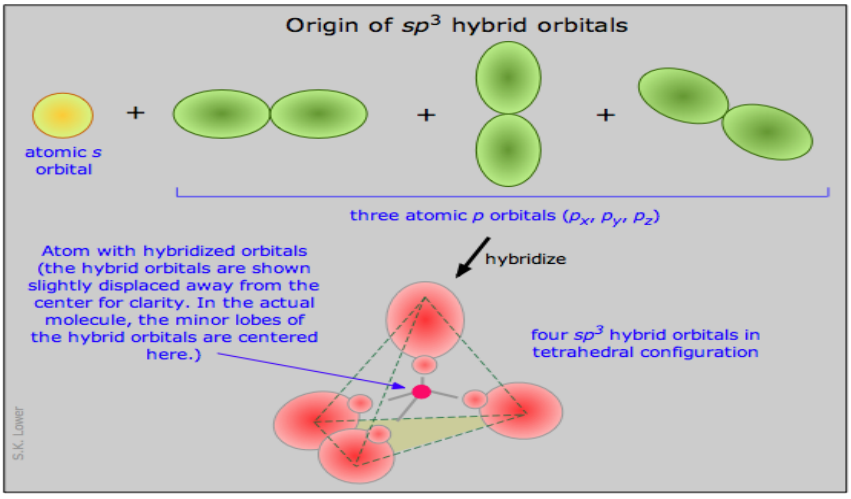
TETRAHEDRAL (SP^3) HYBRIDIZATION

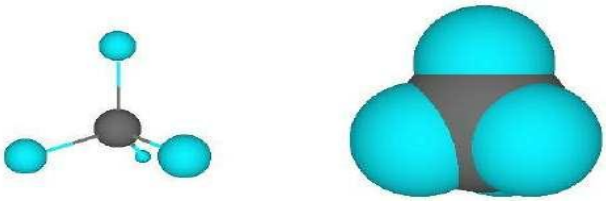
Let us now look at several tetravalent molecules, and see what kind of hybridization might be involved when four outer atoms are bonded to a central atom. Perhaps the commonest and most important example of this bond type is methane, CH4.



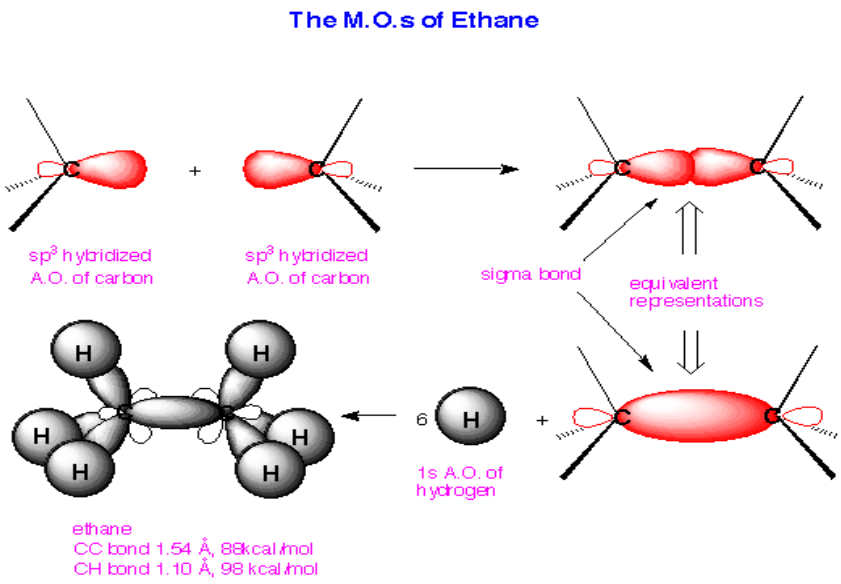
In the ground state of the free carbon atom, there are two unpaired electrons in separate 2porbitals. In order to form four bonds (tetravalence), need four unpaired electrons in four separate but equivalent orbitals. We assume that the single 2s and the three 2porbitals of carbon mix into four sp3 hybrid orbitals which are chemically and geometrically identical; the latter condition implies that the four hybrid orbitals extend toward the corners of a tetrahedron centered on the carbon atom.



Methane is the simplest hydrocarbon; the molecule is approximately spherical, as is shown in the space-filling model:



By replacing one or more of the hydrogen atoms in CH4 with another sp3 hybridized carbon fragments, hydrocarbon chains of any degree of complexity can be built up. The simplest of these is ethane:



This shows how an sp3 orbital on each of two carbon atoms join (overlap) to form a carbon-carbon bond, and then the remaining carbon sp3 orbital overlaps with six hydrogen 1s orbitals to form the ethane molecule.

Source: http://www.chem1.com/acad/webtext/chembond/cb06.html