

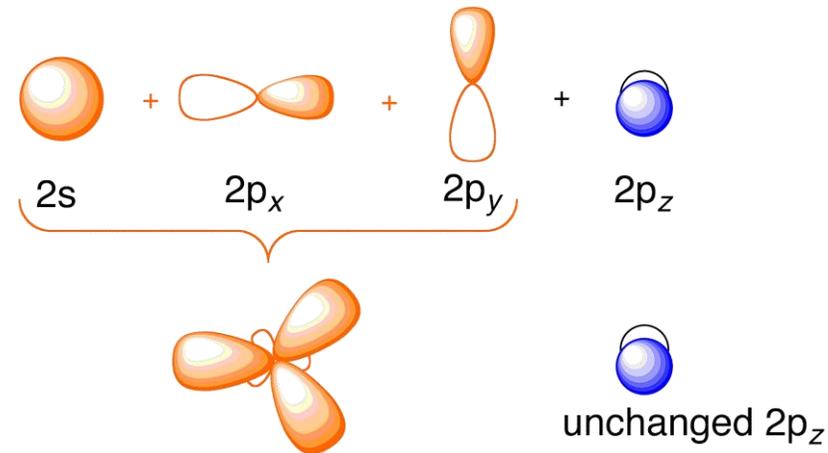
Hybridization

Definition – model that describes the changes in the **atomic orbitals** of an atom when it **forms a covalent compound**.

The new set of orbitals are called “hybrid orbitals”.

The valence shell electron pair repulsion (VSEPR) theory - is a model used to envisage **3D molecular geometry** based on the number of valence/outermost shell electron bond pairs among the atoms in a molecule or ion of an element.

Types of hybridization – based on the types of Orbitals **(s,p,d,f)** involved in the mixing, the hybridization can be classified as **sp³, sp², sp, sp³d, sp³d², sp³d³**.



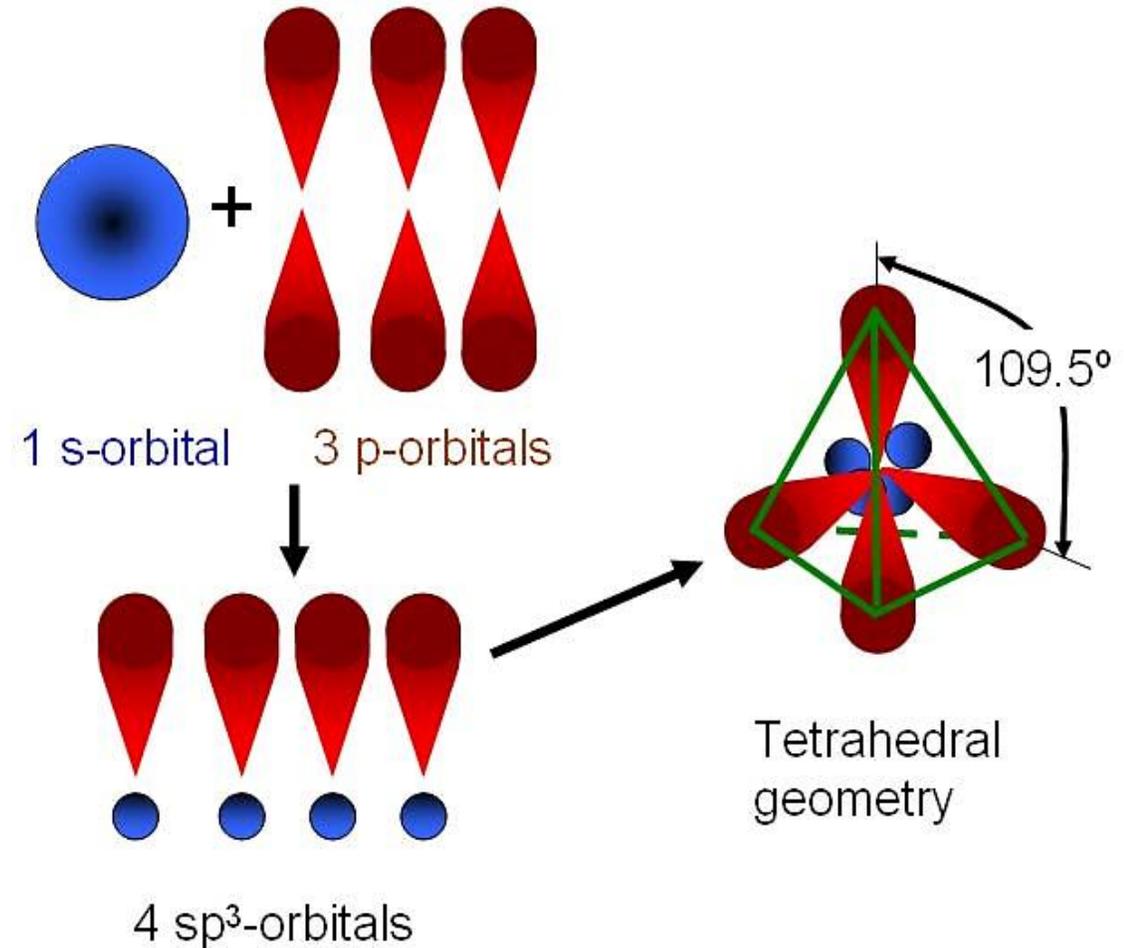
Sigma Bond	Pi Bond
It is formed by the end to end overlap of two orbitals.	It is formed by the lateral overlap of orbitals.
The orbitals involved in the overlapping are s-s , s-p, p-p .	These bonds are formed by the p-p orbitals overlap only.
It is a strong bond.	It is a weak bond.
The number of sigma bond's presence determines the molecule's shape.	It has no effect on shape.
Free rotation is possible.	Free rotation is restricted in case of pi bond.

Sp³ Hybridization

- The previous example which explained the bonding in methane, CH₄, is a classic example of sp³ hybridization.
- This type of hybridization occurs when the three “p” orbitals and one “s” orbital hybridize to form four identical sigma bonds.
- The shape is tetrahedral and has bond angles of 109.5 degree.

sp³

C	↑↓	↑↓	↑	↑		C atom ground state
	1s	2s	2p	2p	2p	
C*	↑↓	↑	↑	↑	↑	C atom excited state
	1s	2s	2p	2p	2p	
C*	↑↓	↑	↑	↑	↑	C atom sp ³ hybridized
	1s	sp ³	sp ³	sp ³	sp ³	



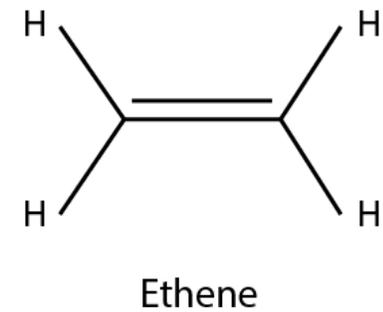
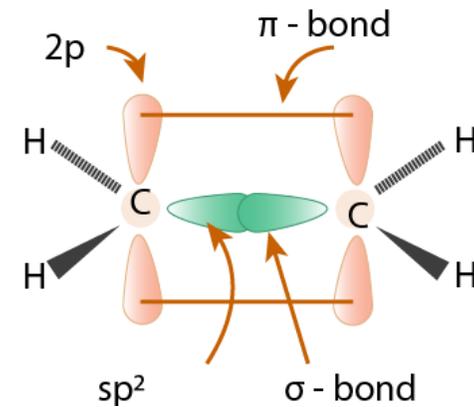
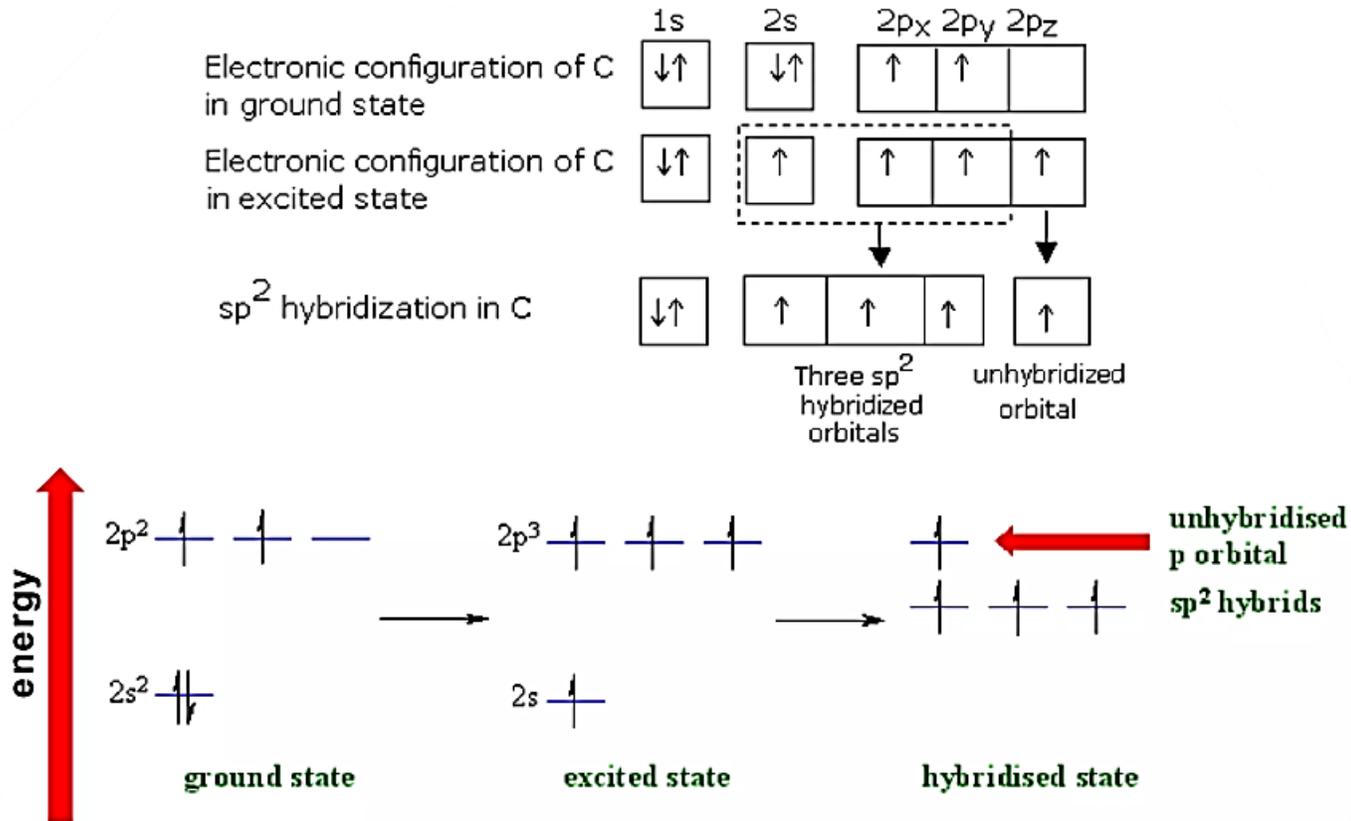
Sp² Hybridization

When carbon forms a double bond as in ethene, it undergoes **sp² hybridization**.

This type of hybridization occurs when the **three "p" orbitals** and **one "s" orbital** hybridize to form three hybrid orbitals and leaves one unhybridized "p" orbital.

The shape is **trigonal planar** with bond angles of **120 degrees**.

The unhybridized "p" orbitals overlap sideways forming a **pi bond**.



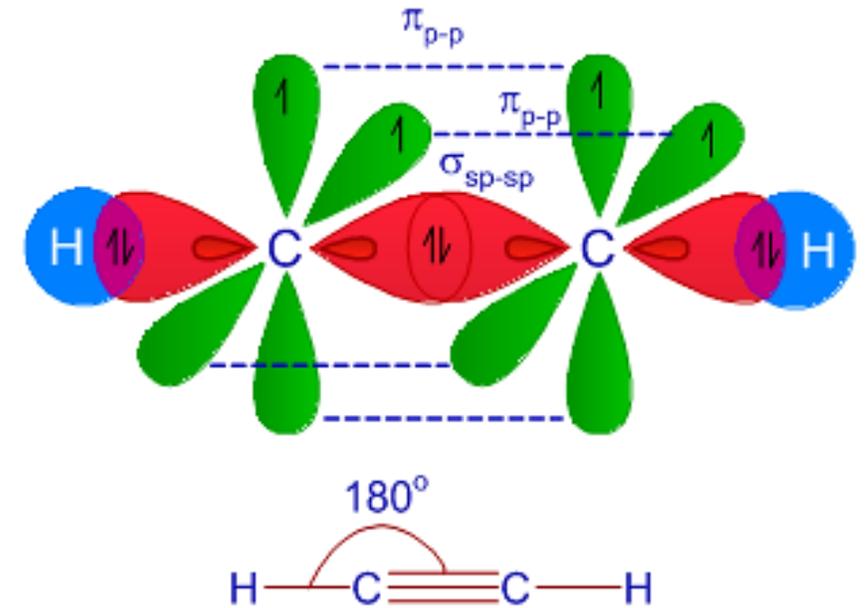
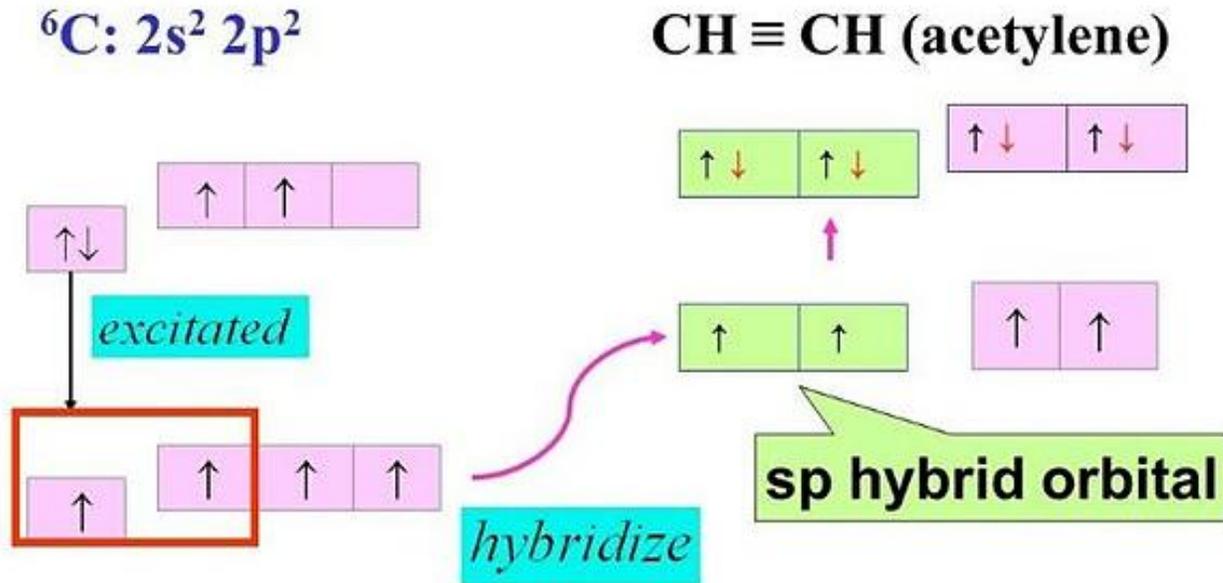
Sp Hybridization

When carbon forms a triple bond as in ethyne, it undergoes **sp hybridization**.

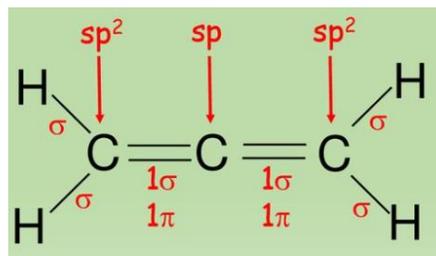
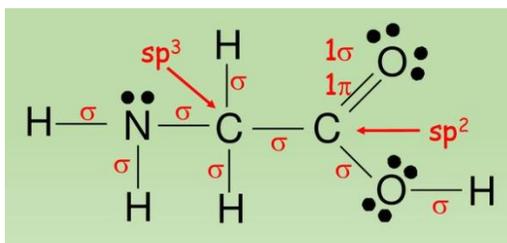
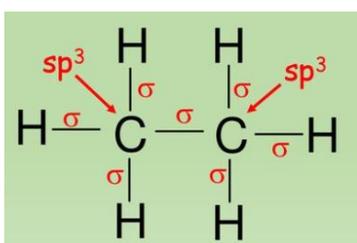
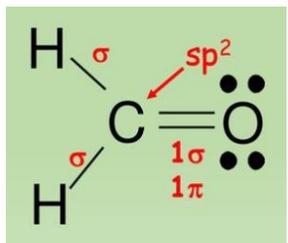
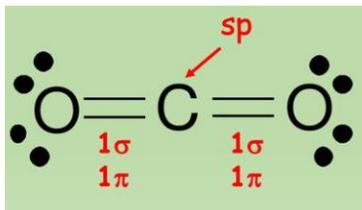
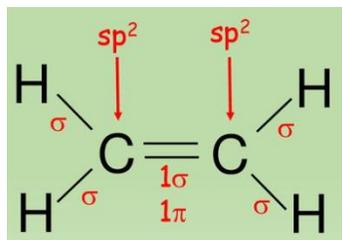
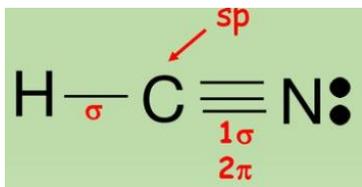
This type of hybridization occurs when the **three "p" orbitals and one "s" orbital** hybridize to form two hybrid orbitals and leaves two unhybridized "p" orbitals.

The shape is linear with bond angles of **180 degrees**.

The unhybridized "p" orbitals overlap sideways forming two pi bonds.



Examples for practice



Arrangement		Hybridization	
	linear	sp	
	trigonal planar	sp^2	
	tetrahedral	sp^3	