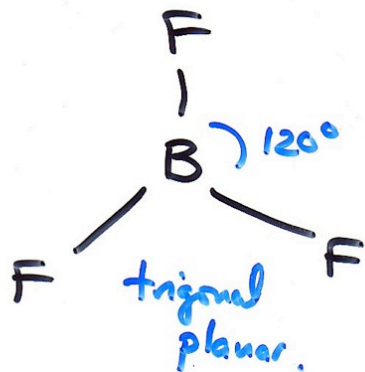
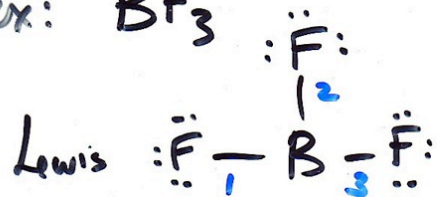


sp^3 : mix s, 3x p : 4 hybrids

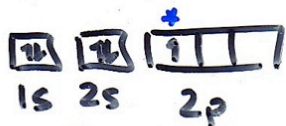
sp : mix s, 1x p : 2 hybrids
@ 180°

sp^2 hybridization

ex: BF_3



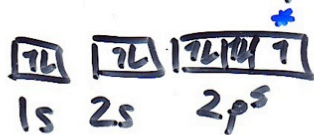
ex: B : $1s^2 2s^2 2p^1$



sp^2 hybridization



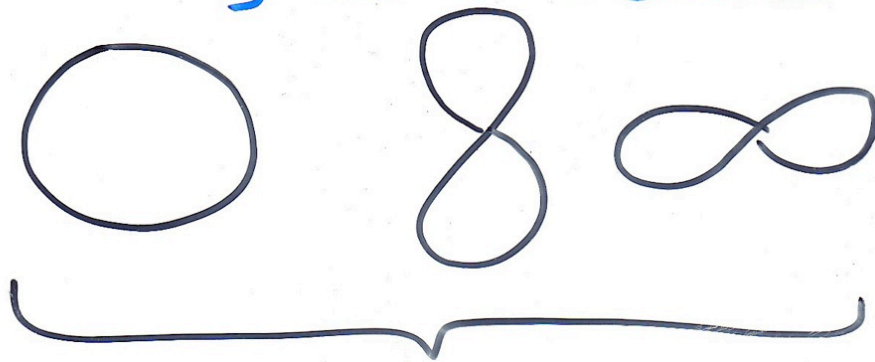
F: $1s^2 2s^2 2p^5$



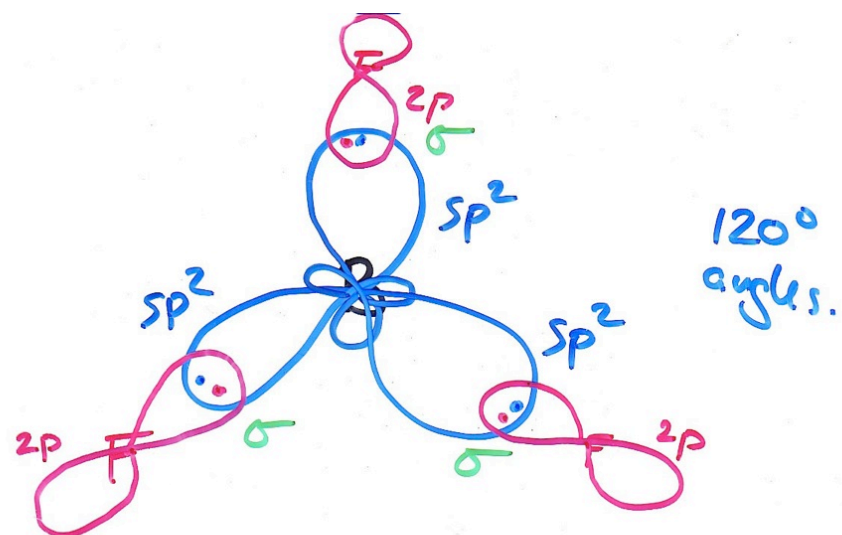
sp^2 hybrids

s, p, p

3 ATOMIC ORBITALS



3 HYBRID ORBITALS

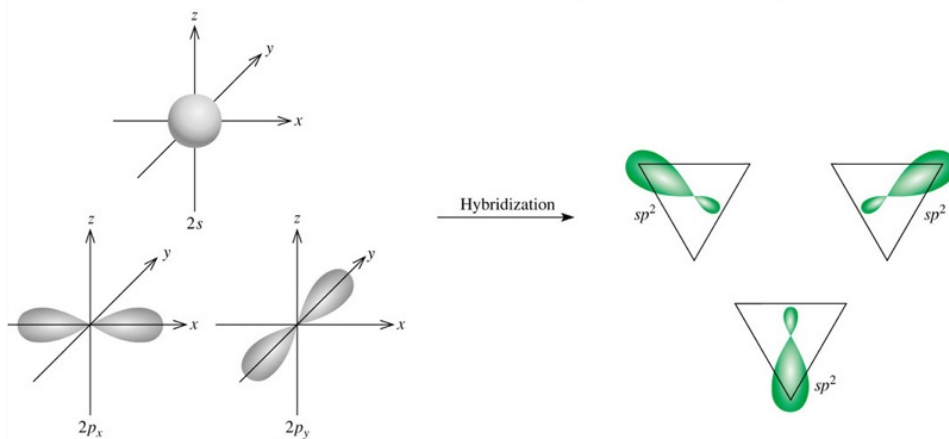


3 σ -bonds.

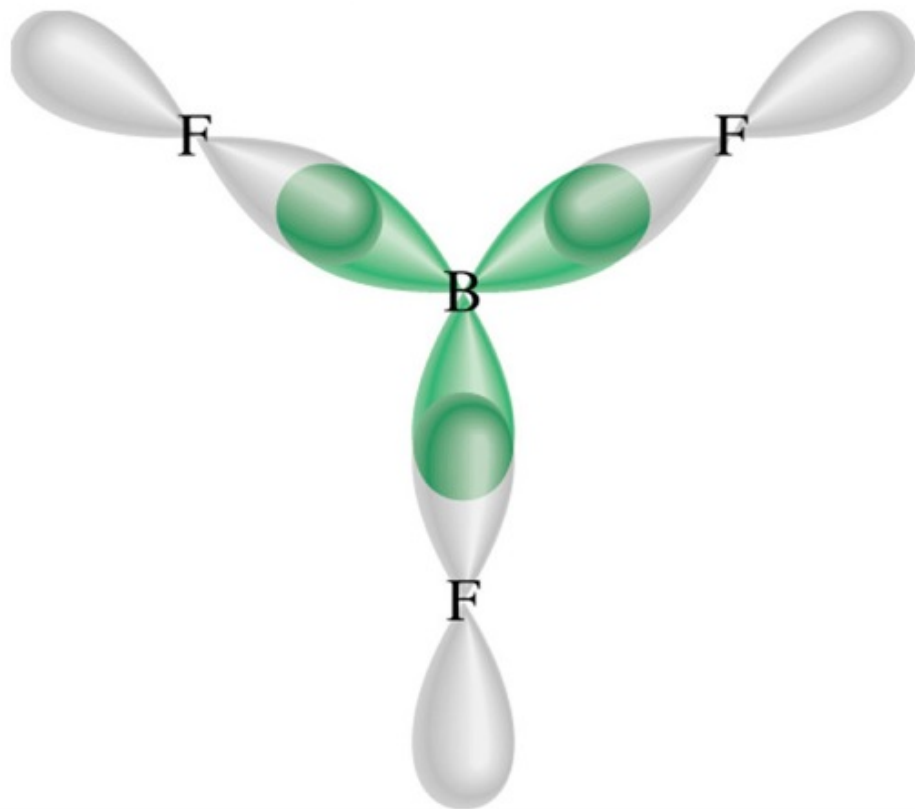
How do you know which type of hybrid orbital you need?

Lewis \rightarrow VSEPR \rightarrow geom + angles.

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display



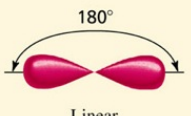
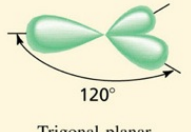
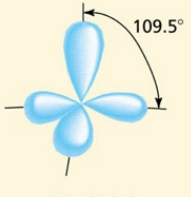
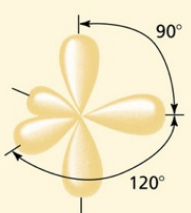
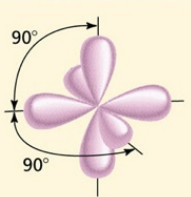
Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display



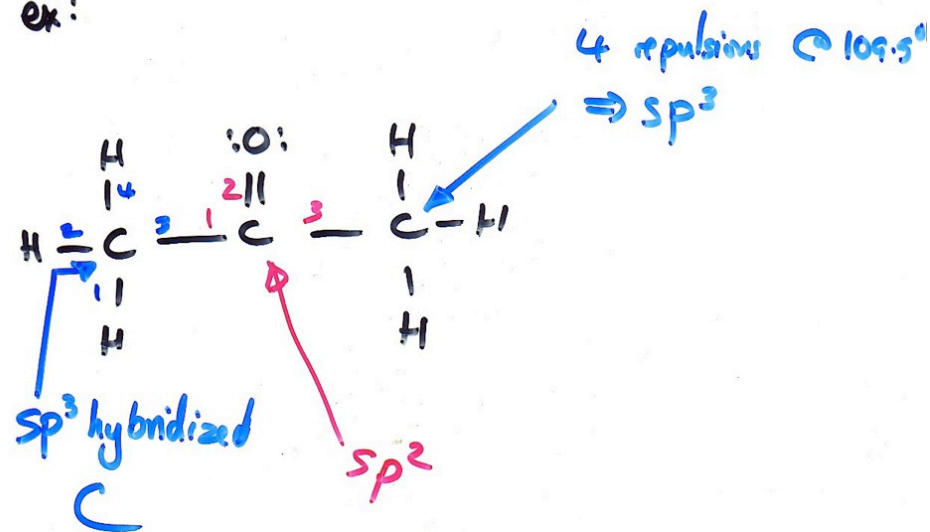
# repulsions	2	3
shape	linear, 180°	trigonal planar 120°
hybrids	sp	sp^2

# repulsions	4	5	6
shape	tetrahedral 109.5°	trig. bi. Pyr.	octa.
hybrids	sp^3	sp^3d	sp^3d^2

Table 10.4 Important Hybrid Orbitals and Their Shapes

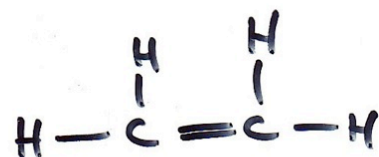
Pure Atomic Orbitals of the Central Atom	Hybridization of the Central Atom	Number of Hybrid Orbitals	Shape of Hybrid Orbitals	Examples
s, p	sp	2	 <p>180° Linear</p>	BeCl_2
s, p, p	sp^2	3	 <p>120° Trigonal planar</p>	BF_3
s, p, p, p	sp^3	4	 <p>109.5° Tetrahedral</p>	$\text{CH}_4, \text{NH}_4^+$
s, p, p, p, d	sp^3d	5	 <p>90° 120° Trigonal bipyramidal</p>	PCl_5
s, p, p, p, d, d	sp^3d^2	6	 <p>90° 90° Octahedral</p>	SF_6

ex:

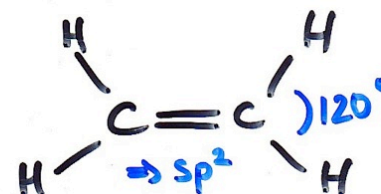


Molecules w/ double + triple-bonds

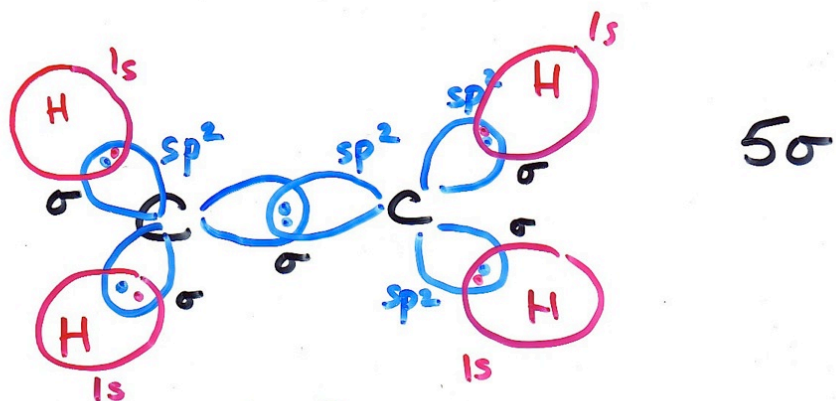
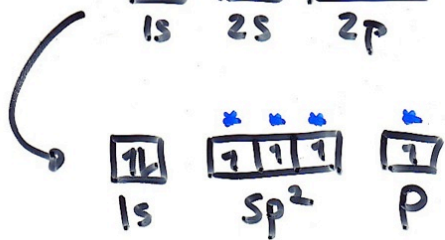
ex: C_2H_4 ethylene



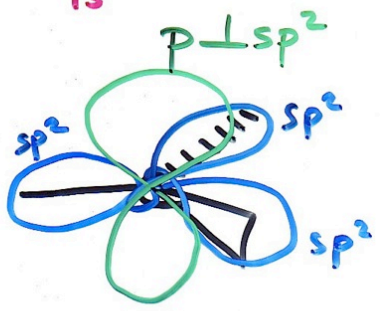
Lewis



VSEPR



5σ



Unhybridized p-orbitals are always \perp to the hybrid orbs.

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display

Ground state



2s



2p

Promotion of electron



2s



2p

sp^2 -Hybridized state

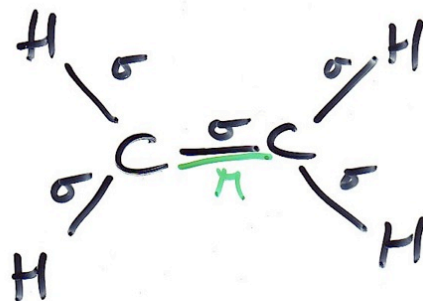
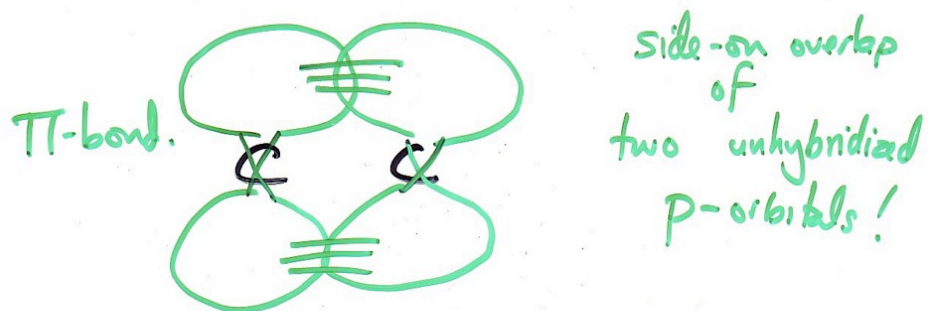
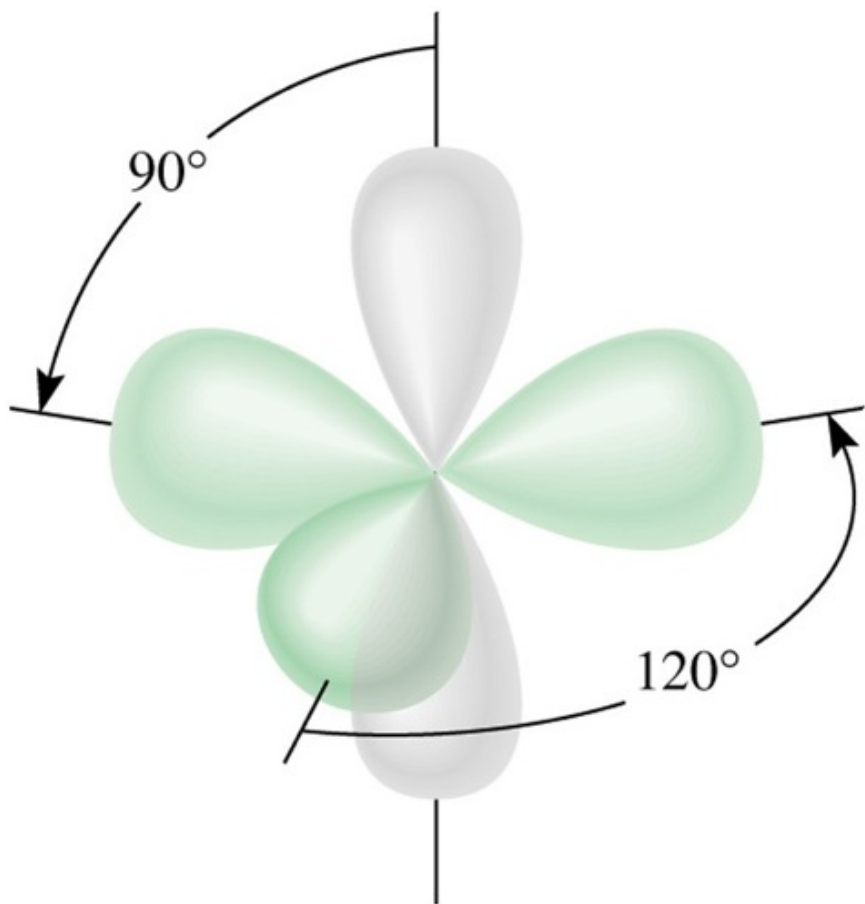


sp^2 orbitals



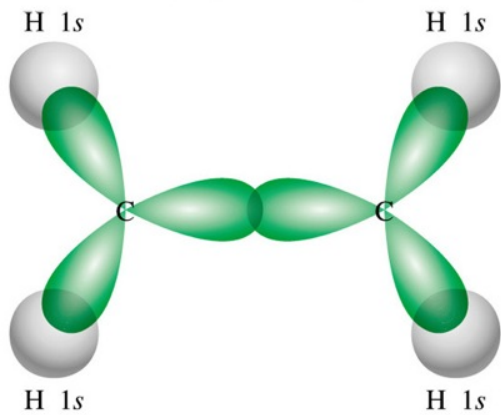
$2p_z$

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display

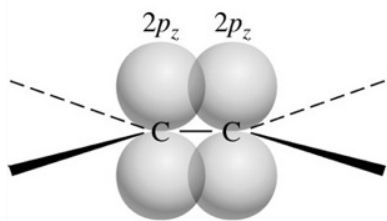


5 σ -bonds: head-on overlap!
1 π -bond: side-on overlap of
unhybridized p-orbitals!

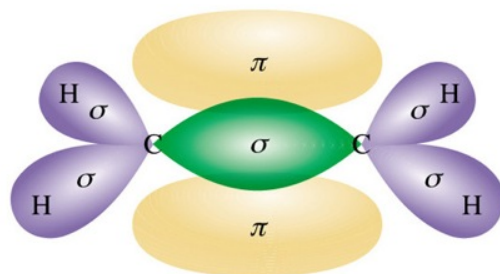
Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display



(a)

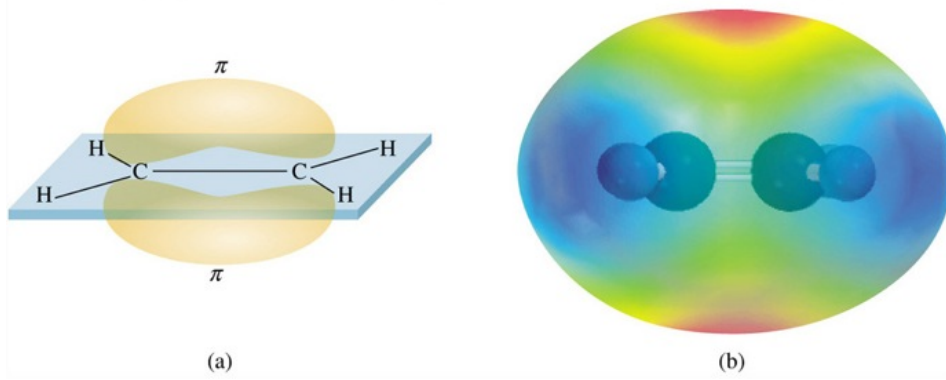


(b)

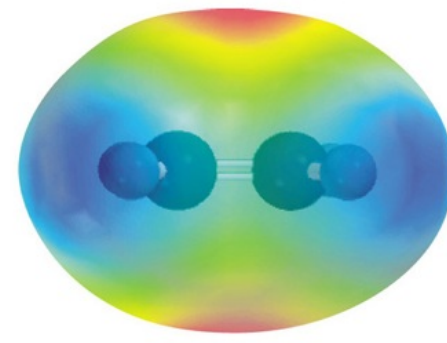


(c)

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display

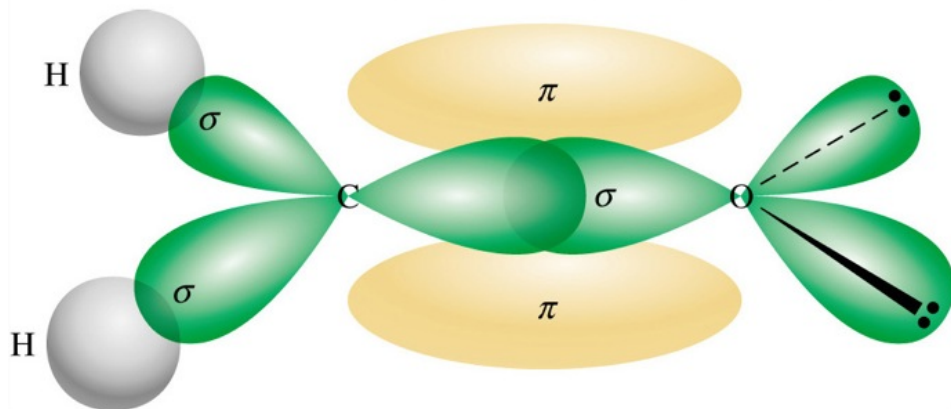


(a)



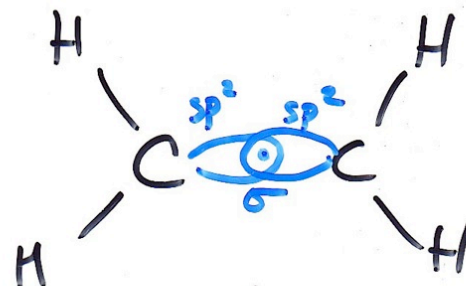
(b)

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display

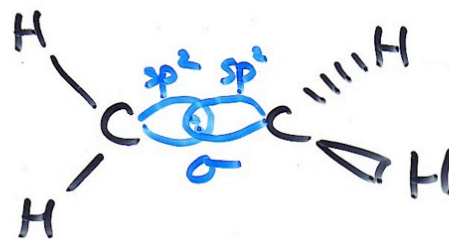


σ -bonds

C-C bond.

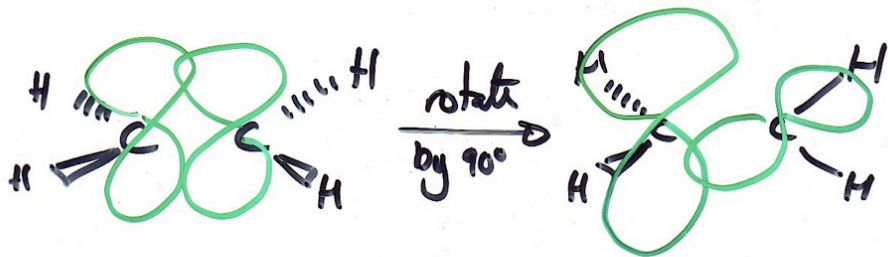


90° rotation about C-C bond



All σ -bonds can undergo free-rotation! They remain bonded/overlapped @ any angle!

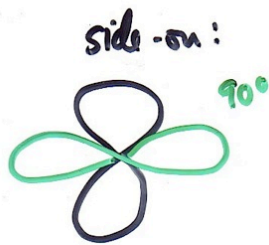
π -bond



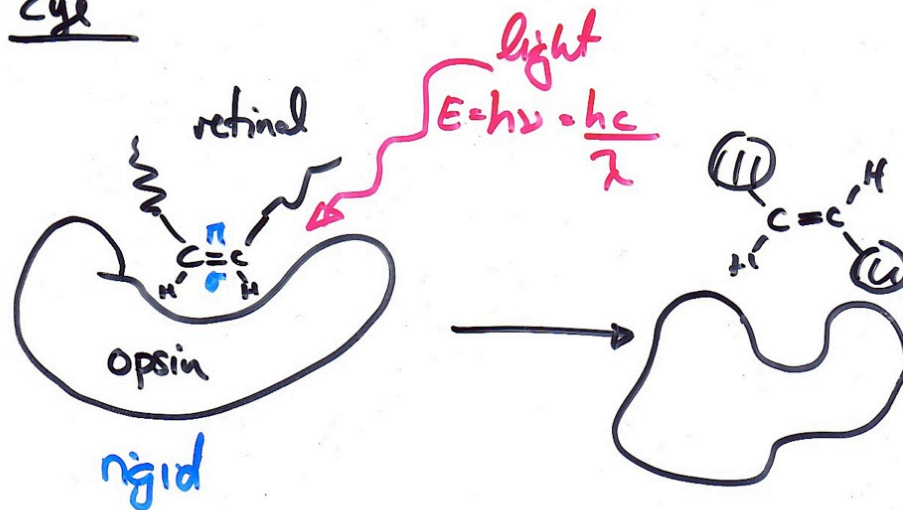
this breaks the π -bond!

\Rightarrow COSTS Energy!

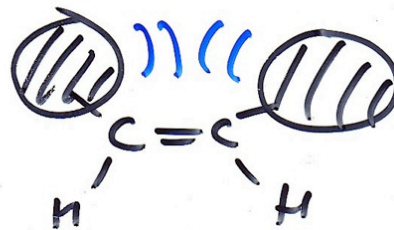
π -bonds are RIGID!



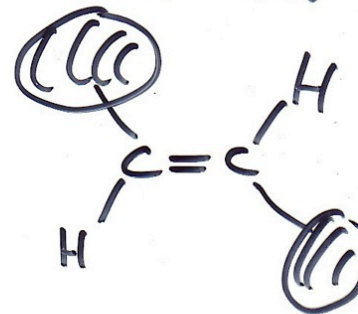
Eye



cis-retinal



trans-retinal



Acetylene C_2H_2



VSEPR:

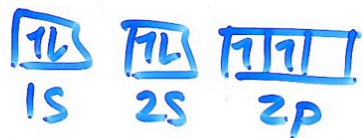
linear, 180°

linear, 180°

\Rightarrow sp hybrids!

$C: 1s^2 2s^2 2p^2$

$H: 1s^1$



$\perp sp.$

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display

Ground state



$2s$



$2p$

Promotion of electron

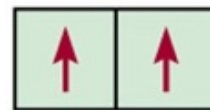


$2s$

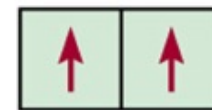


$2p$

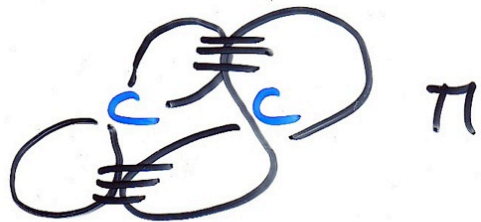
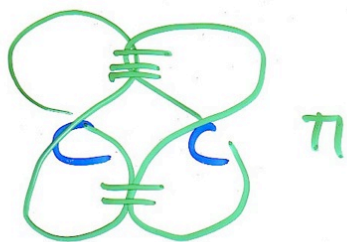
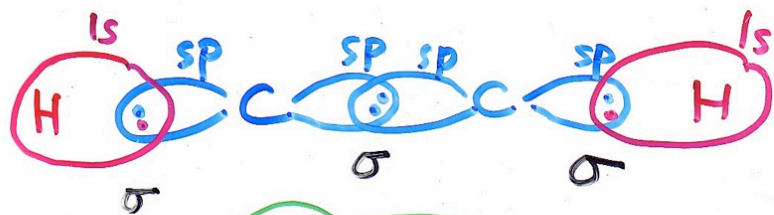
sp -Hybridized state



sp orbitals



$2p_y$ $2p_z$



$3 \times \sigma, 2 \times \pi$

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display

