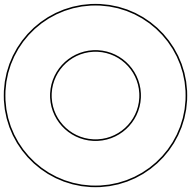
CHEM 8A, Lecture 1 – Structure & Bonding

- Orbitals & Electron Configuration
- Lewis Structures
- Valence Bond Theory & Hybrid Orbitals
- Condensed & Skeletal Structures

Review of Atomic Structure: Chloroform, $CHCl_3$

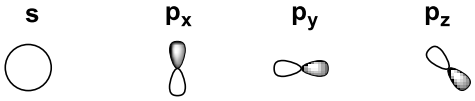


	Hydrogen, H	Carbon, C	Chlorine, Cl
proton, p^+			
neutron, n^o			
electron, e^-			

*** Where are the electrons and what are they doing?*

Bond →

Orbitals →



Use periodic table to assign **electron configuration (e- config)**

1																	18
1 H 1.008	2											13	14	15	16	17	2 He 4.0026
3 Li 6.94	4 Be 9.0122											5 B 10.81	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
11 Na 22.990	12 Mg 24.305	3	4	5	6	7	8	9	10	11	12	13 Al 26.982	14 Si 28.085	15 P 30.974	16 S 32.06	17 Cl 35.45	18 Ar 39.948
19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.867	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.693	29 Cu 63.546	30 Zn 65.38	31 Ga 69.723	32 Ge 72.630	33 As 74.922	34 Se 78.97	35 Br 79.904	36 Kr 83.798
37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.95	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57-71 *	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89-103 #	104 Rf (265)	105 Db (268)	106 Sg (271)	107 Bh (270)	108 Hs (277)	109 Mt (276)	110 Ds (281)	111 Rg (280)	112 Cn (285)	113 Nh (286)	114 Fl (289)	115 Mc (289)	116 Lv (293)	117 Ts (294)	118 Og (294)

* Lanthanide series	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.05	71 Lu 174.97
# Actinide series	89 Ac (227)	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

Electron Configuration (e-config)

Column Rep*	H	B	C	N	O	F
Total #e-						
Full e-config						
# of Valence e-						
Valence e-config						
Orbital Diagram						
Lewis dot (atom)						
Lewis dot (molecules)						

* Representative atom for a column on the periodic table.

Valence Bond Theory

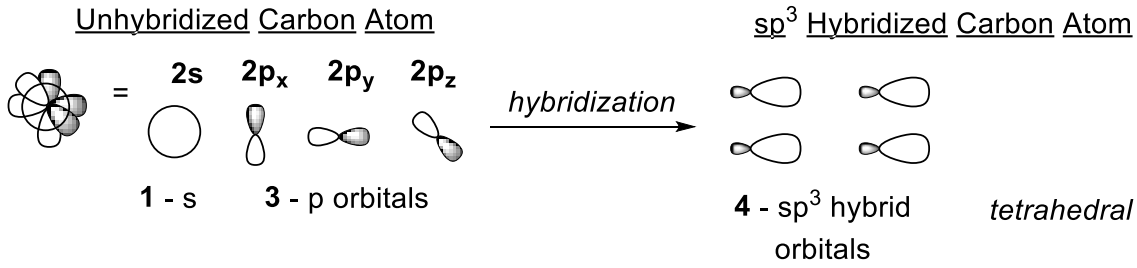
- Covalent bonds formed by sharing of e- through interactions of (hybrid) orbitals

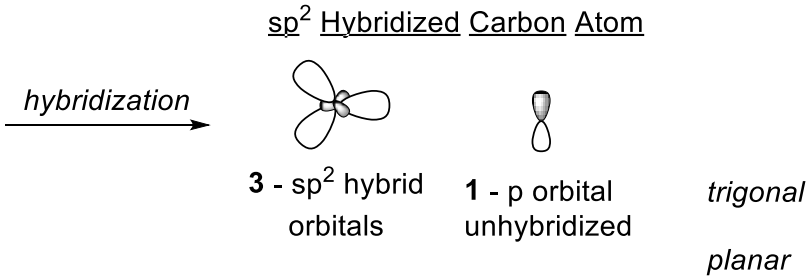
Ex. Hydrogen, H_2

Sigma (σ) bond
Direct orbital overlap
Localized e- sharing
AKA Single bond

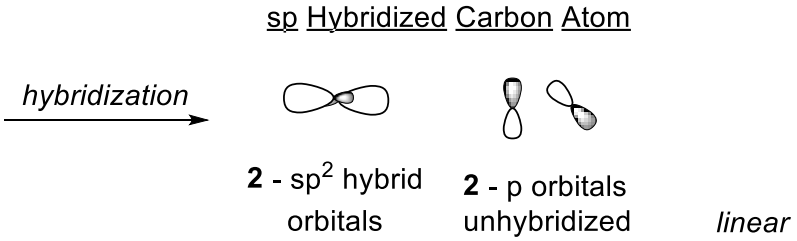
Ex. Chloroform

Hybridization = combining s & p orbitals to allow an atom to make the desired numbers and type of bonds

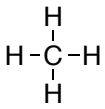
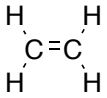
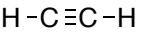
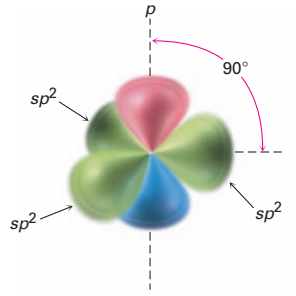
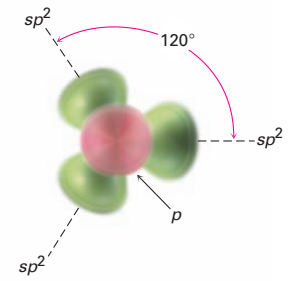
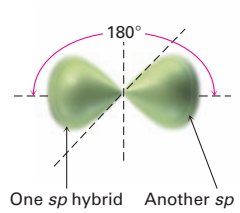
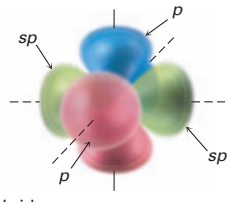
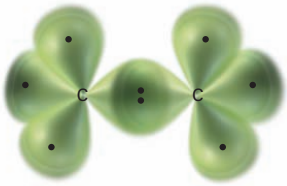
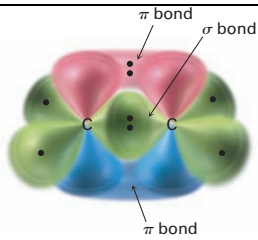
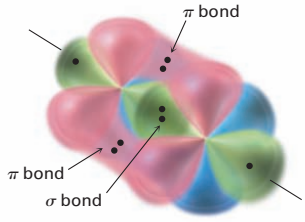




Pi (π) Bond
Delocalized e- sharing between p orbitals

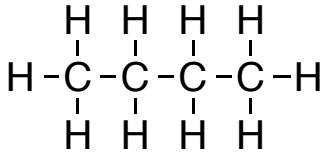
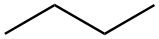
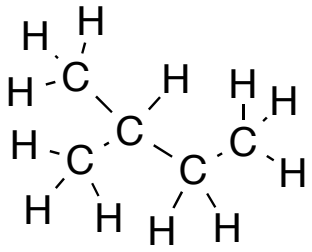
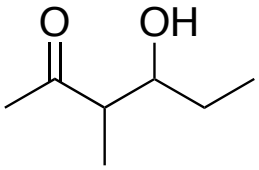


Valence Bond Theory

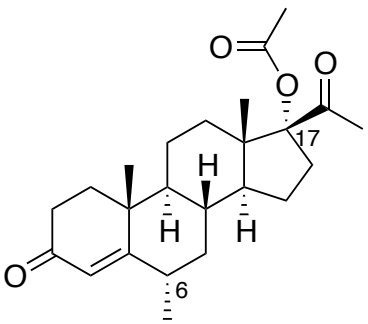
Hybridization	sp^3	sp^2	sp
Example			
# charge clouds*	4	3	2
Orbitals	 sp^3 carbon	 Side view  Top view	 
e-config			
Orbital Diagram	 sp^3–sp^3 σ bond	 Carbon–carbon double bond	 Carbon–carbon triple bond
Shape	Tetrahedral	Trigonal Planar	Linear
Bond Angles	109.5	120	180
More examples!			

* **Charge cloud** = atom or lone pair around central atom; NOT the number of bonds!

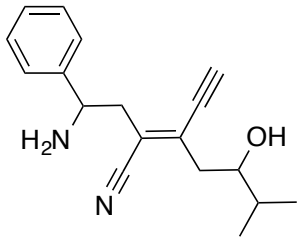
Representations of Organic Molecules

Line-Bond (Lewis)	Condensed	Skeletal (zig-zag)
	$CH_3CH_2CH_2CH_3$	
		
	$CH_2CHC(CH_3)_3$	
		

Indicate the **hybridization** (sp^3, sp^2, or sp) of every C, O, and N atom…



Depro-Provera
(depot-injected contraceptive)



"Fictitious molecule"
(for training purposes only!)

Next time…Polarity, Formal Charge, Resonance
** Take ~30 min to skim Chapter 2.1-2.6 before lecture, use Reading Questions!