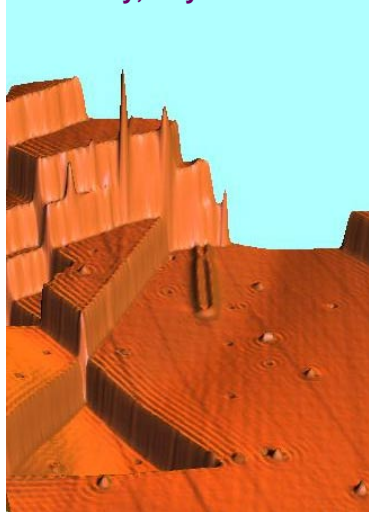


## GSCI 101: Chemistry, Physics and the Human Experience



February 21, 2001

- Bonding in Solids
  - Covalent Bonds

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## Covalent Bonding and Crystal Structure

Covalent bonding is **directional** and the closeness of the bonding is severely restricted by the directional and numerically limited number of bonds.

Co-valent means “valence electrons shared together”

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## Octet Rule...Again

Atoms want to get together to form this magical “octet” configuration.

When metals and non-metals combine together, they readily form ions (metals → cations, non-metals → anions), but the combination results in both the metal and the non-metal having this stable “noble gas” or **octet** configuration.

Q: What happens when two non-metals get together such as carbon atoms?

A: Rather than one atom “giving up” an electron and the other “accepting” and electron to form a cation and anion, respectively (this is what happens with an ionic solid)...the two atoms will equally share electrons. Their valence shell electrons will be “co-valent” or shared to form the magical octet.

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## Non-metals form covalent bonds

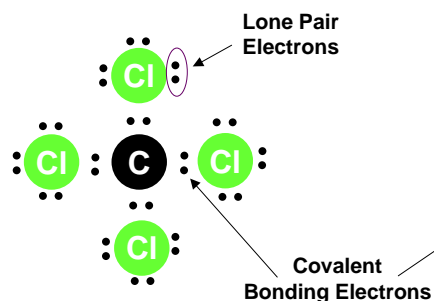
1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	104														

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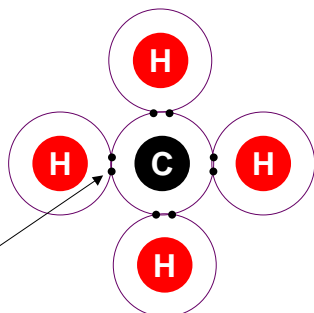
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## Lewis Structures...Single Covalent Bonds



32 total valence electrons  
(28 from Cl, 4 from C)

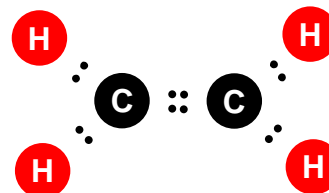


8 total valence electrons  
(4 from H, 4 from C)

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## More Lewis Structures...Double Bonds



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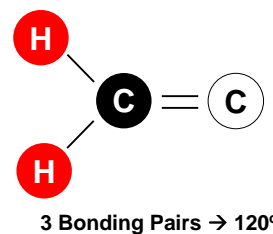
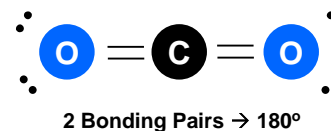
## Writing Lewis Structures

1. Write the "skeletal structure"
  - In general, the **least** electronegative atom occupies the central position, H and F occupy the terminal (end) position
2. Count the total number of valence electrons available
3. Draw a single covalent bond between the central atom and each of the surrounding atoms
4. If the octet rule is not satisfied for the central atom, add double/triple bonds by using lone pair electrons from the surrounding atoms.

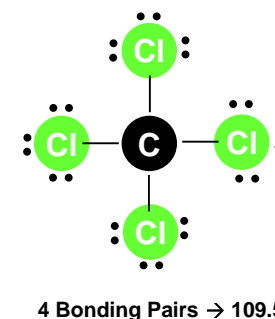
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## Predicting Geometry (of central C)

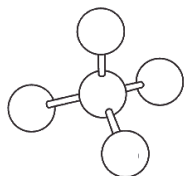


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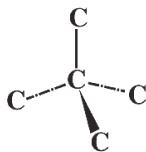


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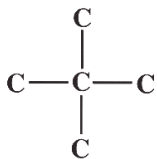
## 4 Different Tetrahedral Bonding Representations



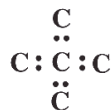
Ball and Stick Model



Perspective Model



Structural Formula

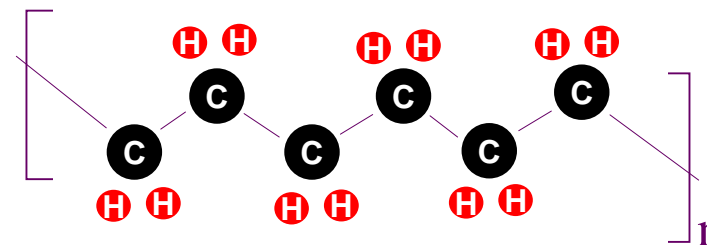


Electron-Dot, or Lewis Formula

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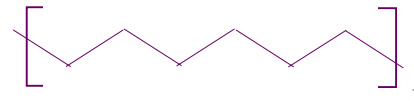
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## Covalent Bonding...Polymers



Polyethylene (HDPE, LDPE)

An Alternative Notation:



-CH<sub>2</sub>- is called a "mer"  
This is the repeat unit  
in a polymer



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