(3) **Today**

Sections 1.1 – 1.3
Reviewing Periodic Trends

Section 1.4
Introduction to Chemical Bonding Theories
octet rule etc

Sections 1.5-1.10
Valence Bond Theory

Next Class (4)

Sections 1.5-1.10
Valence Bond Theory

(5) **Second Class from Today**

Sections 1.12
Drawing Chemical Structures

Third Class from Today (6)

Sections 2.1 - 2.4
Polar Covalent Bonds, Formal Charges,
Resonance/Electron Delocalization

Bring Modeling Kits to Class

Bring Modeling Kits to Lab this Week

Use the periodic table to identify metals and non-metals

Use the periodic table to remember trends in size

Use the periodic table to remember trends in electronegativity

Use trends in size, electron configuration, and nuclear charge to explain electronegativity trend

Use the periodic table to predict likely bond formation

Introduce Valence Bond Theory (hybridization)

The Periodic Table Is Your Friend

non-metals gain or share e^-

metals tend to lose e^-

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 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og

58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Na +11

-2 | +9 -8 | +1

$1s^2 | 2s^2\ 2p^6 | 3s^1$

This outer e^- doesn't experience the full +11 charge and is relatively easy to remove

F

$1s^2 | 2s^2\ 2p^5$

+9 -2 +7

nucleus

2 e^-'s in 1s shell cancel out some nuclear charge

e^-'s in 2nd shell experience a +7 charge strongly attracted to the nucleus

room for 1 more e^- that e^- also experiences a +7 nucleus; thus, F tends to gain e^-'s

Identify metals and non-metals

The Periodic Table Is Your Friend: Size

As we go down the table the size/volume increases
As we increase the n # the volume increases

Volume increases (slightly) from right to left
same shell … but nuclear charge increases (from left to right

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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
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This change is size is not very significant

bigger (Li)

smaller n = 2
smaller

significant differences

bigger n = 7

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Li^{3+} $1s^2$ (−2) | $2s^1$ (+1)

F^{9+} $1s^2$ (−2) | $2s^2 2p^5$ (+7)

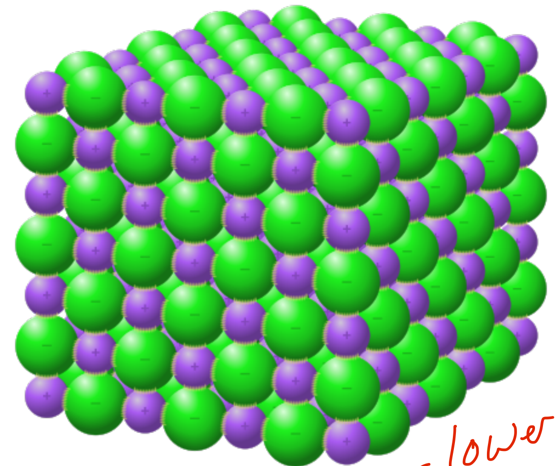
The higher effective nuclear charge pulls e^-'s in more strongly … closer

Remember periodic trends

Ionic Interactions, Polar Bonds, and Nonpolar Bonds

ionic interaction - the attraction of a cation for an anion

NaCl Na^{+} and Cl^{-}



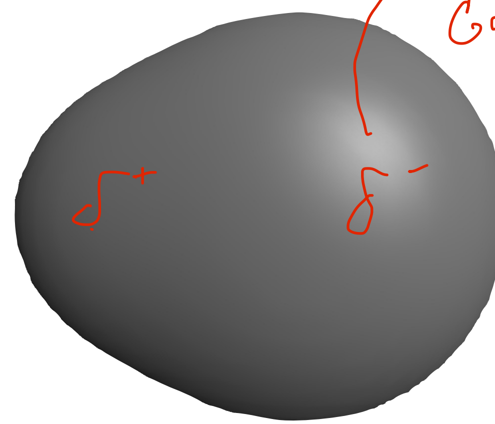
[1]

covalent bonds - the sharing of electrons between atoms

polar covalent bond

uneven sharing of e⁻'s

HF δ^{+} δ^{-} H—F

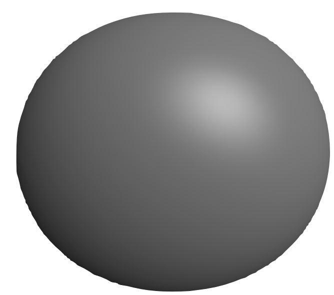


lower case Greek delta

If means partial ⊖

nonpolar covalent bond   even sharing

H_2 H—H



[1]https://en.wikipedia.org/wiki/Sodium_chloride#/media/File:NaCl_bonds.svg

H—H ⟶ H• H• ΔH_{BDE} = 436 kJ/mol[1]

:F—F: ⟶ :F• :F• ΔH_{BDE} = 155 kJ/mol[1]

H—F ⟶ H• :F•

assuming BDE is average of H_2 and F_2 BDE

predict ΔH_{BDE} = ~~296~~ kJ/mol ?   nope... actually 565 kJ/mol

Oh the "extra" energy is the attraction between the δ+ & δ-

δ+ δ- H—F

Pauling says attraction between these two opposite charges... accounts for the "extra" energy needed to break the H to F bond.

Pauling used BDE's to quantify just how good atoms were at attracting e⁻'s in a bond, thus, inventing the electronegativity scale

1. Atkins, Physical Chemistry, 3rd ed. p 882   565

The Periodic Table Is Your Friend: Electronegativity

Review

electronegativity increases from bottom to top

electronegativity increases from left to right

increases because distance is similar, number of core e^-'s is the same, and nuclear charge increases... so stronger attraction as we go accross the row

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F is #1 O is #2 Cl ~ N #3

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Remember periodic trends

pretend Li + F covalent

Li: +3 −2 F +9 −2 core e^-'s

+1 Li: e^- e^- +7 F

e^-'s in the pretend covalent bond between Li + F

9 e^- F −2 +7: $1s^2$ | $2s^2 2p^5$

+17 Cl −2 −8 +7: $1s^2$ | $2s^2 2p^6$ | $3s^2 3p^5$

valence e^-'s are farther away and less attracted to the nucleus

Why does electronegativity or the size of the atom matter?

High energy electrons are reactive

unstable e⁻

can be done by using eneg atoms

low energy electrons are less reactive

stable e⁻'s

get them close to ⊕ charge

or

make charge more diffuse

can be done by placing charge on large (volume) atoms

There are other ways to do both of these things room for 2 e⁻ (↓ O)

room for 1 e⁻ (↓ F)

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$[He]\ 2s^2 2p^5$ ← room for 1 e⁻

$F + e^- \rightarrow F^-$

$2s^2 2p^5 \rightarrow 2s^2 2p^6$

$O + 2e^- \rightarrow O^{2-}$

$2s^2 2p^4$ $\quad$ $2s^2 2p^6$

F will only make 1 bond

O will tend to make 2 bonds

can make 1 bond but will be ⊖

can make 3 bonds but will be ⊕

N will tend to make 3 bonds

can make 2 bonds but will be ⊖

can make 4 bonds but will be ⊕

C makes 4 bonds

$C \equiv N^{\ominus}$ $\quad$ $C \equiv O$

Predict the number of electrons or bonds needed for an element to form a stable compound

$^{\ominus}O - H$ $\quad$ $H - \overset{H}{\underset{\oplus}{O}} - H$