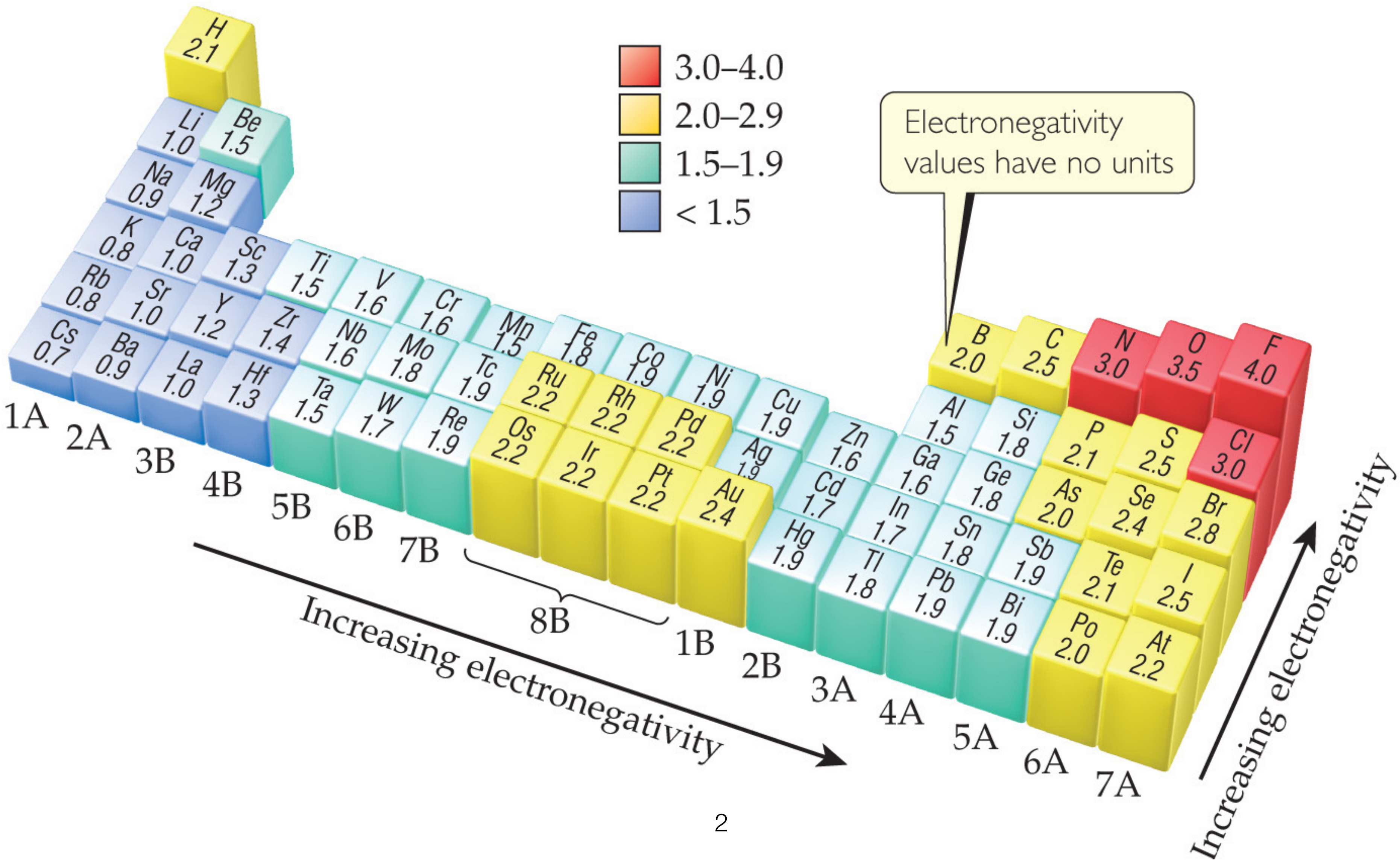
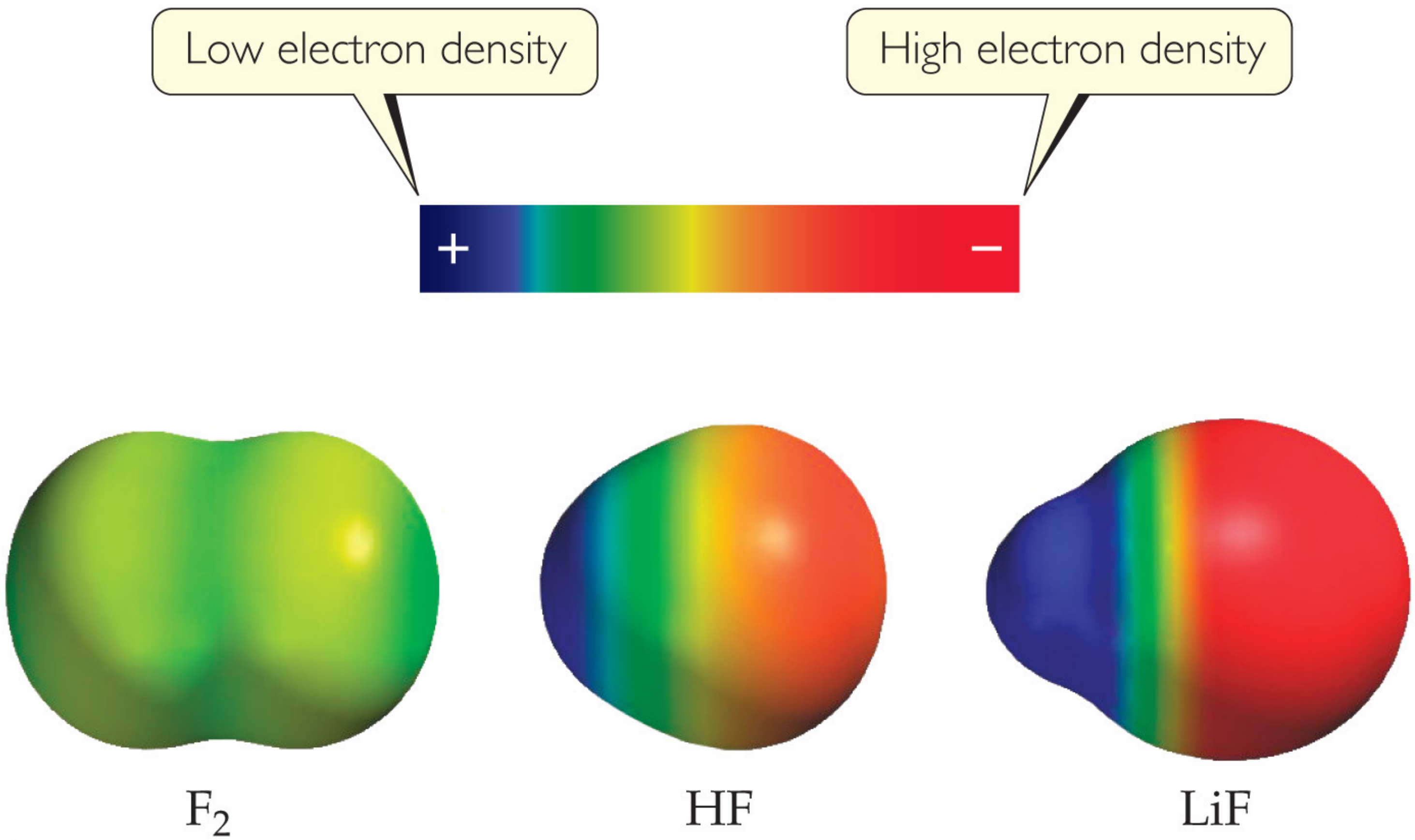
Outline for Today
Friday, Nov. 9

- Chapter 8: Chemical Bonding
  - Dipole Moments
  - Resonance Structures
  - Expanded Octet
  - Bond Enthalpies

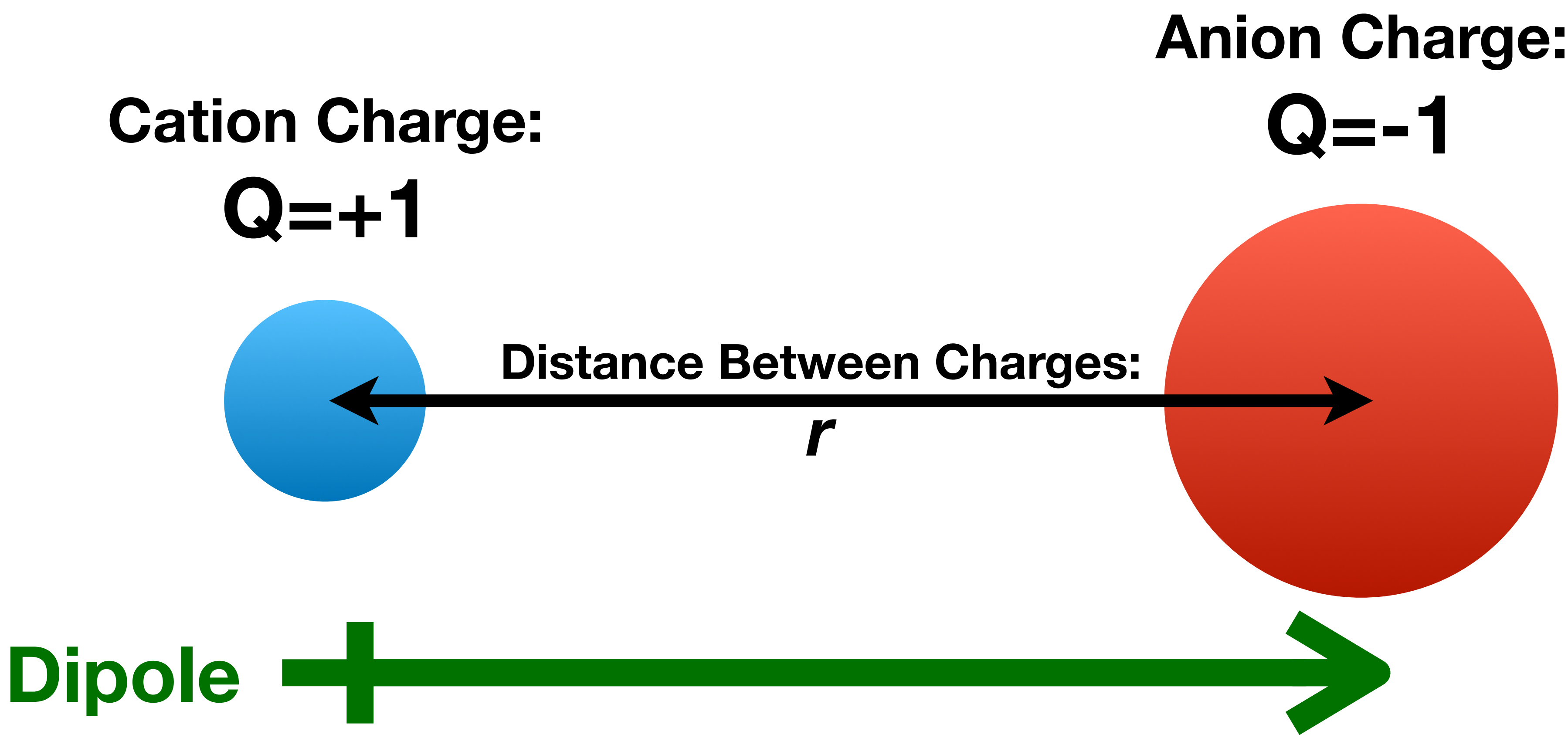
Review: Electronegativity Trends in the Periodic Table



Bond Polarity



Dipole Moment: Separation of Charge



Dipole Moment: $\mu = Qr$

Example: Bond Polarity

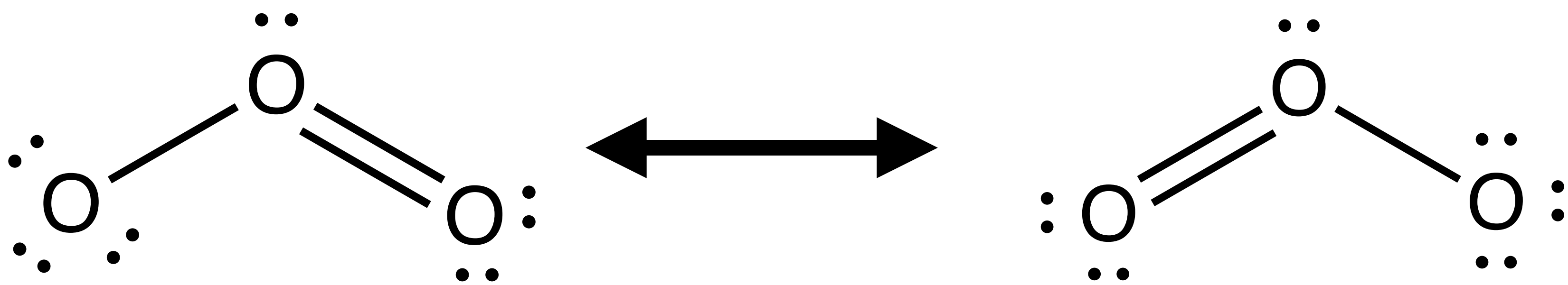
1. CO_2
2. F_2
3. HC_2F
4. OH^-
5. BrI
6. ClO_2

Examples: Multiple Bonds and Lone Pairs (Using Formal Charge)

1. SCN^-
2. HCN vs HNC
3. OCN^-
4. NO_2^- (is N in the middle or not?)
5. ClO_3^-

Examples: Resonance Structures

Resonance Structures: Equally valid Lewis structures that differ by only placement of electrons.



To accurately describe this ind of molecule, you need to consider all resonance structures!

Examples: Resonance Structures

1. NO_2^-
2. Benzene (C_6H_6)
3. SO_3
4. Acetate ion

Resonance examples that break the octet rule:

5. SO_4^{2-}
6. NO
7. PO_4^{3-}
8. Perchlorate ion

Exceptions to the Octet Rule

An atom can have **more** than 8 valence electrons in a molecule if it can use the unfilled d orbitals.

(Row 3 and below only!)

- SO_2
- SF_6
- XeF_4

Exceptions to the Octet Rule

Boron, Beryllium, Hydrogen and Helium can have fewer than 8 valence electrons:

1. BF_3

2. B_2H_4

3. BeF_2

Exceptions to the Octet Rule

Odd number of electrons? Use resonance structures and formal charge to guide your decisions.

NO

NO_2

Superoxide: O_2^-

Chapter 9 Spoiler Alert! Lewis Structures aren't great at describing radicals!! We'll learn about a better model next week called Molecular Orbital Theory!

Bond Strengths and Bond Enthalpies

- **Bond Enthalpy**: The energy it takes to BREAK a bond.
    - Related to bond strength and bond length.
- As the number of bonds between atoms increase, the bond becomes shorter and stronger.

Using Bond Enthalpies to Estimate Enthalpy of a Reaction

$$\Delta H_{rxn} = \Sigma \Delta H_{\text{bonds broken}} - \Sigma \Delta H_{\text{bonds formed}}$$

Selected Values from Table 8.4 in your text

Bond	Bond Enthalpy (kJ/mol)	Bond	Bond Enthalpy (kJ/mol)
C—H	413	C=C	614
C—C	348	O=O	495
C—O	358	C=O	799
O—O	146	N=N	418
O—H	463	C≡O	1072
N—H	391	C≡N	891
C—N	293	N≡N	941

Example Problem: Bond Enthalpies

Use bond enthalpies to estimate the ΔH for the combustion reaction of CH_4 (methane).

1. Balance the Reaction

2. Draw out Lewis Structures for all molecules

3. Look up Bond Enthalpies

4. Use $\Delta H_{rxn} = \sum \Delta H_{bonds\ broken} - \sum \Delta H_{bonds\ formed}$

On your note card…

1. Your Name

2. On one side, draw a **picture** or **diagram** that is important to your understanding of drawing Lewis structures.

3. On the other side, write a **2-3 sentence summary** of how to draw lewis structures.