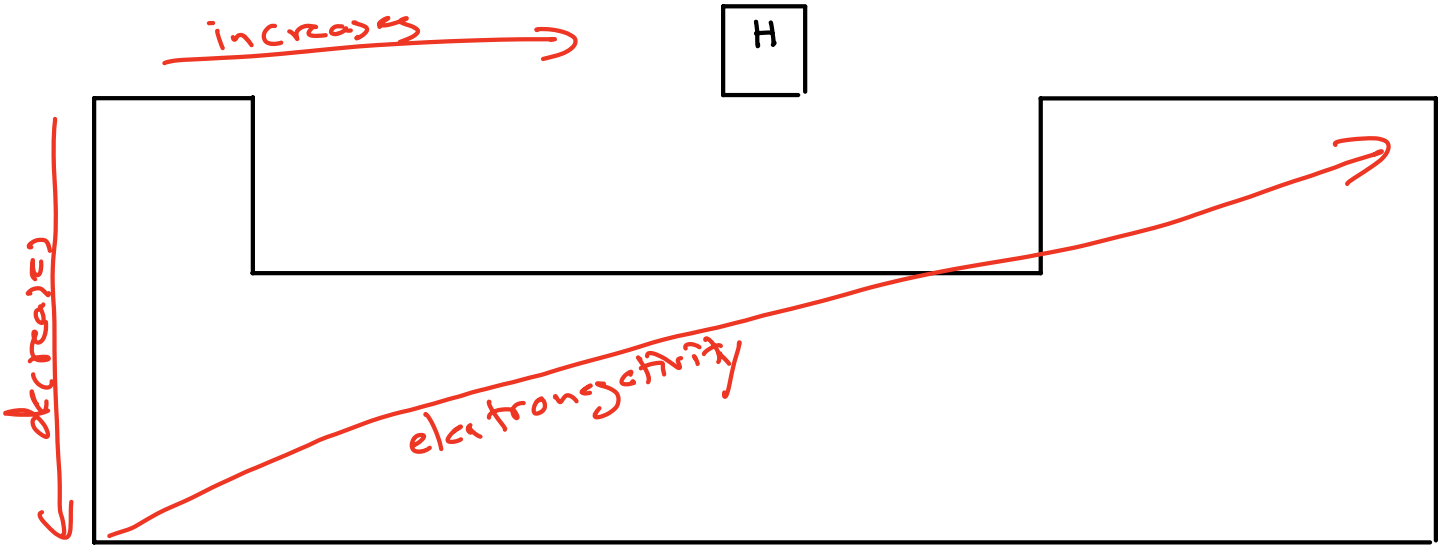
Formal Charge → not a theory → it just keeps track of electrons vs. protons in a molecule

Theory → tells us quantitatively where electrons are located

↳ Linus Pauling → more electron density is around the more electronegative atom

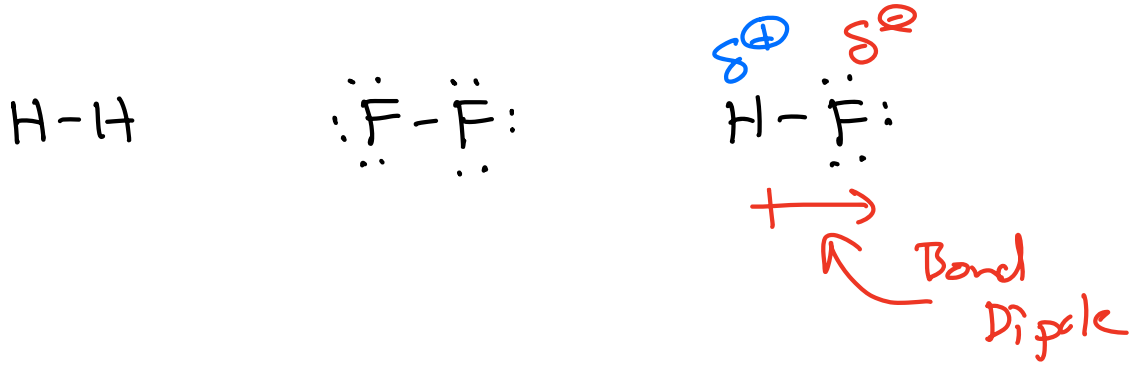


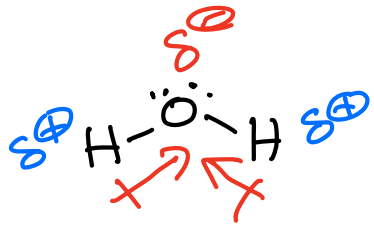
Periodic Table

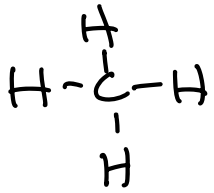
Electronegativity → increases with increasing nuclear charge

→ decreases with increasing number of electrons

⟹ "Based on electrostatic attraction between proton in the nucleus and electrons







b.p. 100°C

Because of partial charges, molecules attracted to each other

Stick together

b.p. −161°C

Minimal attraction between molecules

<u>Organic Chemistry</u> is the study of carbon-containing molecules.

This class has two points.

The first point of the class is to understand the organic chemistry of living systems. We will teach you how to think about and understand the most amazing things on the planet!!

Water is essential for life, you will learn why water has such special properties. 8/27/25

You will learn the secret structural reason proteins, the most important molecular machines in our bodies, can support the chemistry of life.

You will learn why when you take Advil for pain, exactly half of what you take works, and the other half does nothing.

You will learn how toothpaste works.

You will learn how a single chlorofluorocarbon refrigerant molecule released into the atmosphere can destroy many, many ozone molecules, leading to an enlargement of the ozone hole.

You will learn how medicines like Benadryl, Seldane, and Lipitor work.

You will learn how Naloxone is an antidote for an opioid overdose.

You will learn why Magic Johnson is still alive, decades after contracting HIV.

You will learn how MRI scans work.

The second point of organic chemistry is the synthesis of complex molecules from simpler ones by making and breaking specific bonds.

You will learn how to understand movies of reaction mechanisms like alkene hydration.

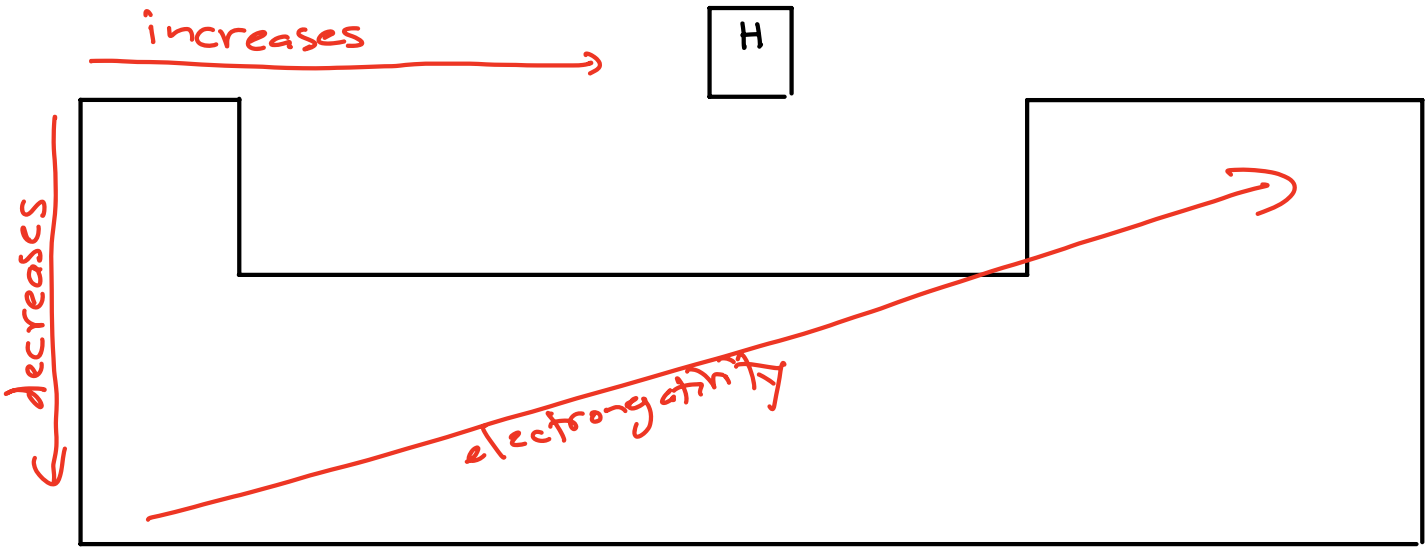
You will learn reactions that once begun, will continue reacting such that each product molecule created starts a new reaction until all the starting material is used up.

You will learn reactions that can make antifreeze from vodka.

You will learn a reaction that can make nail polish remover from rubbing alcohol.

You will learn how to look at a molecule and accurately predict which atoms will react to make new bonds, and which bonds will break during reactions.

You will learn how to analyze a complex molecule's structure so that you can predict ways to make it via multiple reactions starting with less complex starting molecules.



1A	2A											3A	4A	5A	6A	7A
							H 2.1									
Li 1.0	Be 1.5											B 2.0	C 2.5	N 3.0	O 3.5	F 4.0
Na 0.9	Mg 1.2	3B	4B	5B	6B	7B	8B			1B	2B	Al 1.5	Si 1.8	P 2.1	S 2.5	Cl 3.0
K 0.8	Ca 1.0	Sc 1.3	Ti 1.5	V 1.6	Cr 1.6	Mn 1.5	Fe 1.8	Co 1.8	Ni 1.8	Cu 1.9	Zn 1.6	Ga 1.6	Ge 1.8	As 2.0	Se 2.4	Br 2.8
Rb 0.8	Sr 1.0	Y 1.2	Zr 1.4	Nb 1.6	Mo 1.8	Tc 1.9	Ru 2.2	Rh 2.2	Pd 2.2	Ag 1.9	Cd 1.7	In 1.7	Sn 1.8	Sb 1.9	Te 2.1	I 2.5
Cs 0.7	Ba 0.9	La 1.1	Hf 1.3	Ta 1.5	W 1.7	Re 1.9	Os 2.2	Ir 2.2	Pt 2.2	Au 2.4	Hg 1.9	Tl 1.8	Pb 1.8	Bi 1.9	Po 2.0	At 2.2

<1.0 | 1.0 – 1.4 | 1.5 – 1.9 | 2.0 – 2.4 | 2.5 – 2.9 | 3.0 – 4.0

Formal Charge

↓

Method of counting # of protons vs. # of electrons

↓

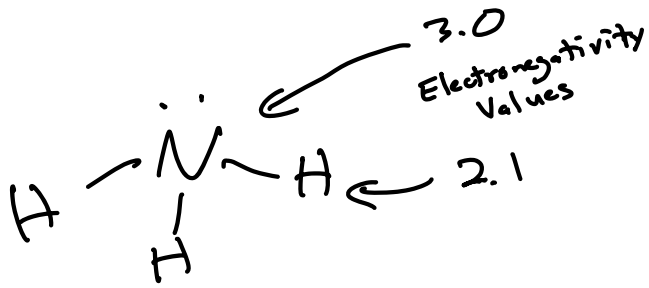
Identifies molecules and atoms with full charges

protons ≠ # electrons

↓

NOT a theory

does not REALLY always tell you where electrons are in molecules



Polar Covalent Bonds

↓

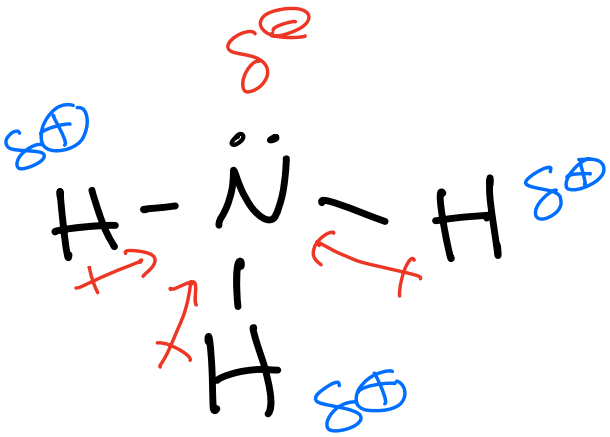
Understanding properties of molecules

↓

Identifies partial charges associated with bonds

↓

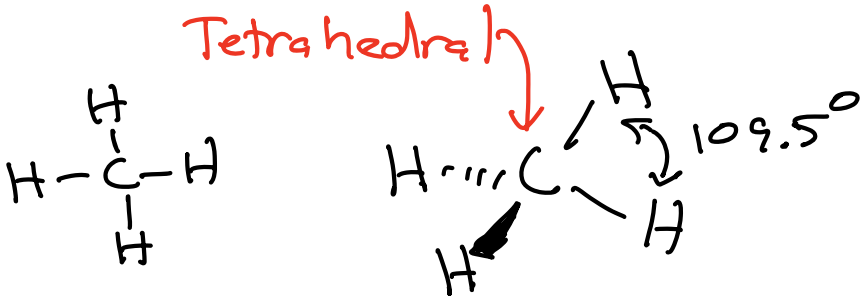
Based on a theory → very accurate

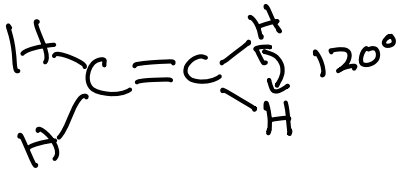


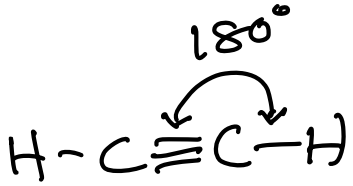
Shapes → VSEPR

↳ 1st approximation → areas of electron density

(bonds or lone pairs) repel each other and stay as far apart as possible around an atom



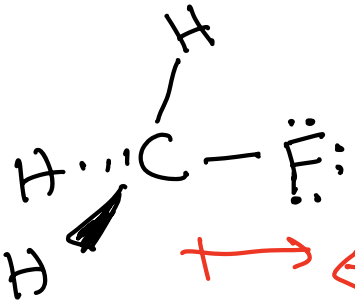




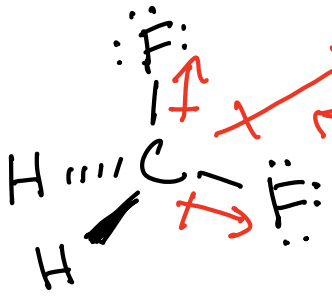
VSEPR → model → helpful

BUT ⇒ sometimes WRONG!

Putting it all together: Molecular Dipoles



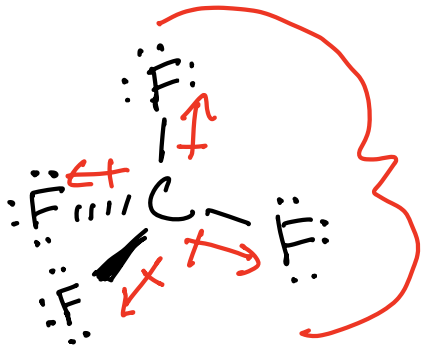
Overall Molecular Dipole Moment



Overall Molecular Dipole Moment

Vector sum of all bond dipole moments

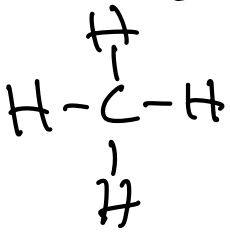
No Overall Molecular Dipole Moment ⇒

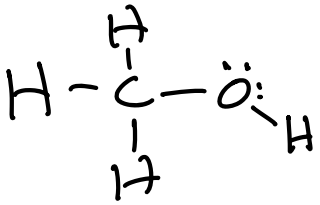


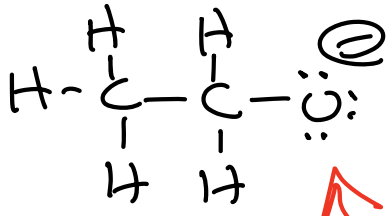
These bond dipoles cancel in 3d space

Molecular Dipole Moment

The good news: Lewis structures accurately describe molecules (most of the time)





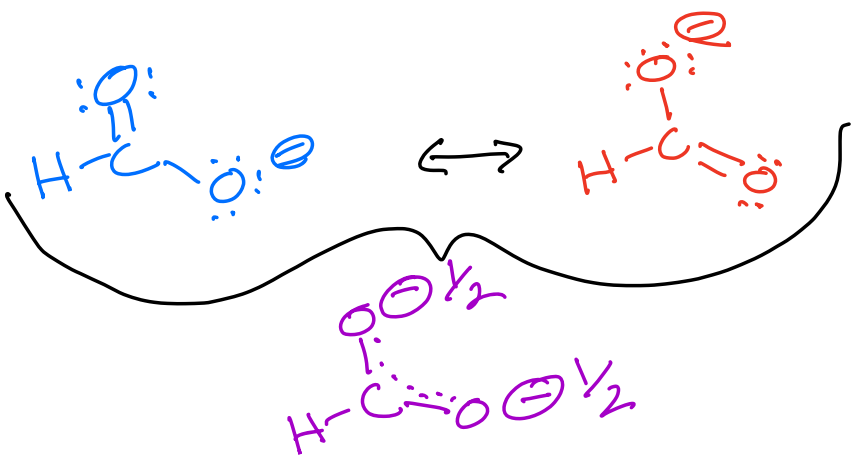


⊖ charge is indeed on O atom

However,

Contributing Structures ⇒ cases in which no single Lewis structure describes the true situation (bonding/charges)

Combined to make hybrid structure ⇒ NOT equilibrating back and forth ⇒ The hybrid describes a SINGLE structure.



Contributing Structures

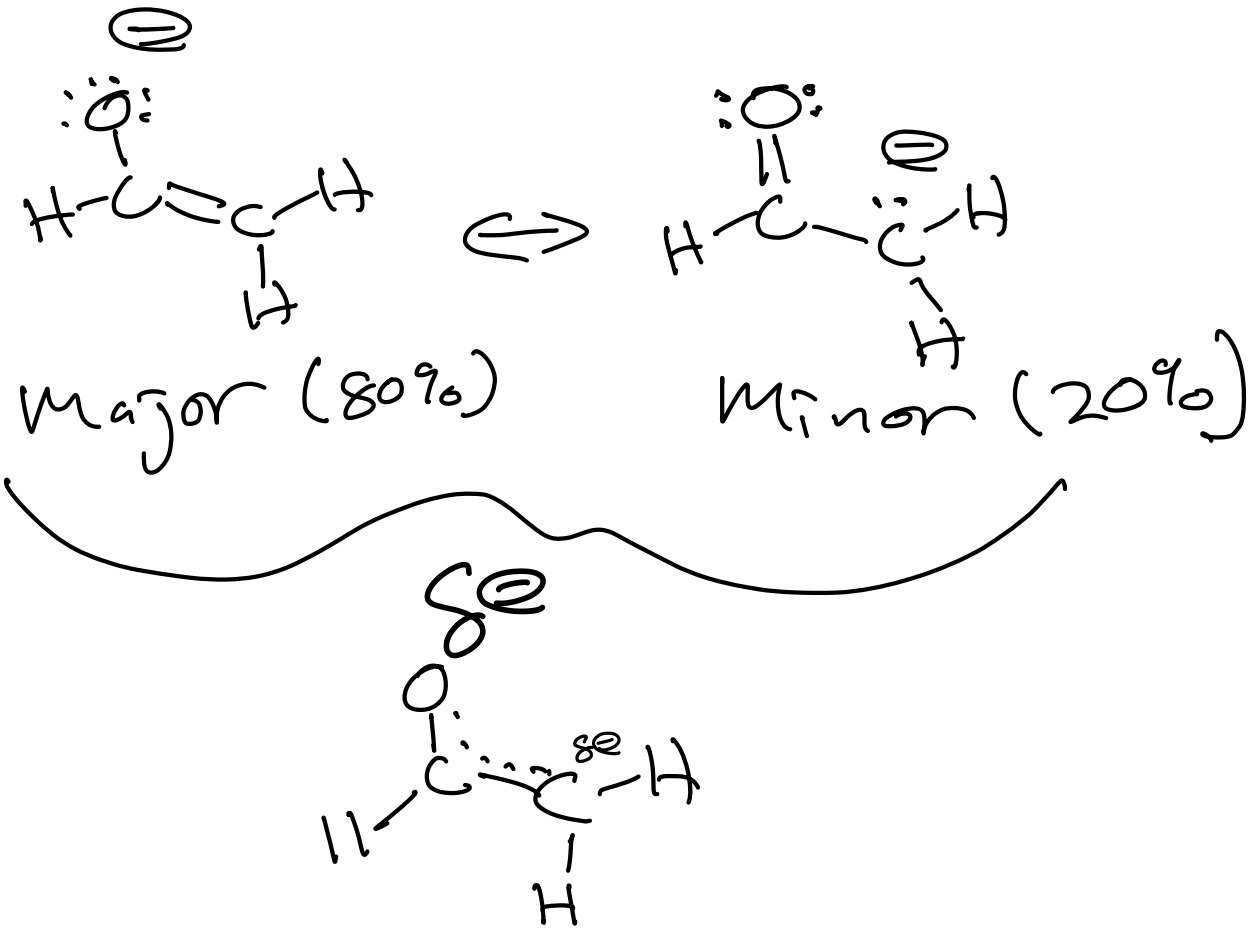
Contributing Structures ⇒ Generally interconvert double (π) bonds and lone pairs on adjacent atoms (sometimes ⊕ charges or unpaired electrons)

- Must be reasonable Lewis structures
  - NEVER move atoms → only electrons (lone pairs, bonds) are different
  - NEVER exceed filled valence shells
  - NEVER create unpaired electrons that did not previously exist
- When deciding which contributing structure makes the major contribution rank according to the following

Priority ↑

1) More atoms with filled valence shells
2) More total number of covalent bonds
3) Fewer overall formal charges
4) ⊖ on the more electronegative element and vice versa

Classic Example



Office Hours Today: 4-5 PM BUR 106

Review Session Tonight: 7-9 PM WEL 2.224
(Gen Chem Review)

Next Monday → No class! (Labor Day)

Next Wednesday → Flipped Class!
(September 3)

Watch a recording of my 3rd lecture from last year before class

Check out the ROTD for Sept. 3 or the Canvas Calendar for a link

→ Come to class at the normal time and place to work on your Homework 1 due that evening

T.A.'s will be there to help you!

Everyone can get 100% correct!!

The following Monday → Flipped Class!
(September 8)

Watch a recording of my 4th lecture from last year before class

Check out the ROTD for Sept. 3 or the Canvas Calendar for a link

→ Come to class at the normal time and place to work on your Homework 2 due later that week

T.A.'s will be there to help you!

Everyone can get 100% correct!!

I am back on Wednesday September 10