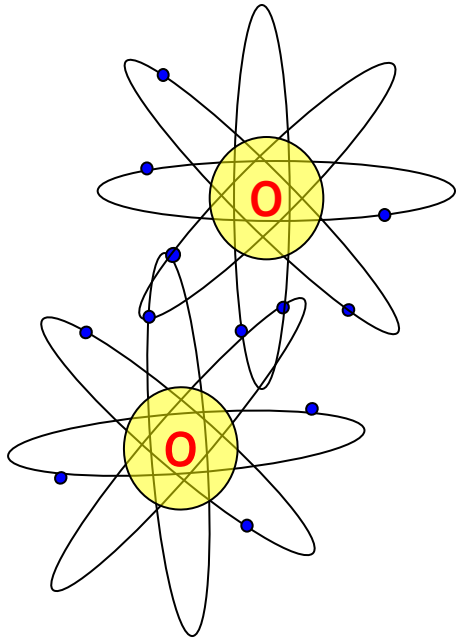
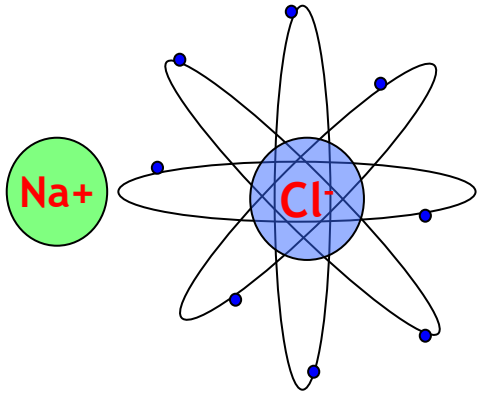


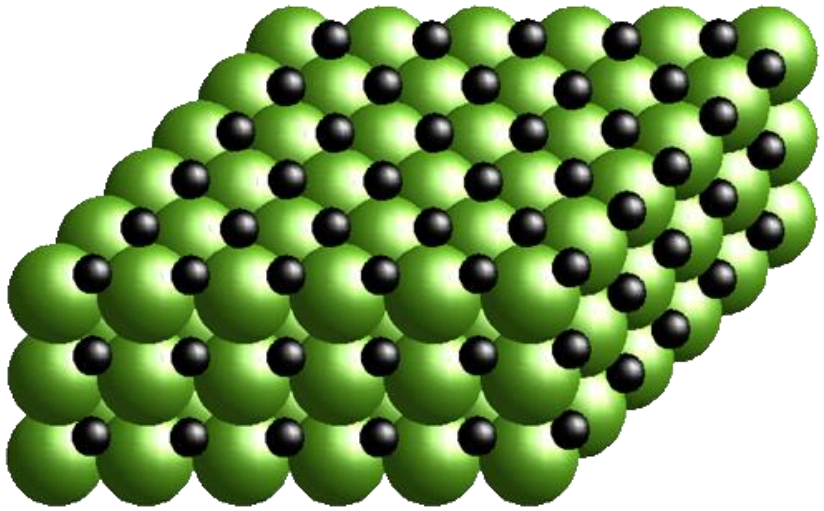


Writing and Naming Chemicals

Auburn Mountainview

Karl Steffin, 2001

8/30/2024



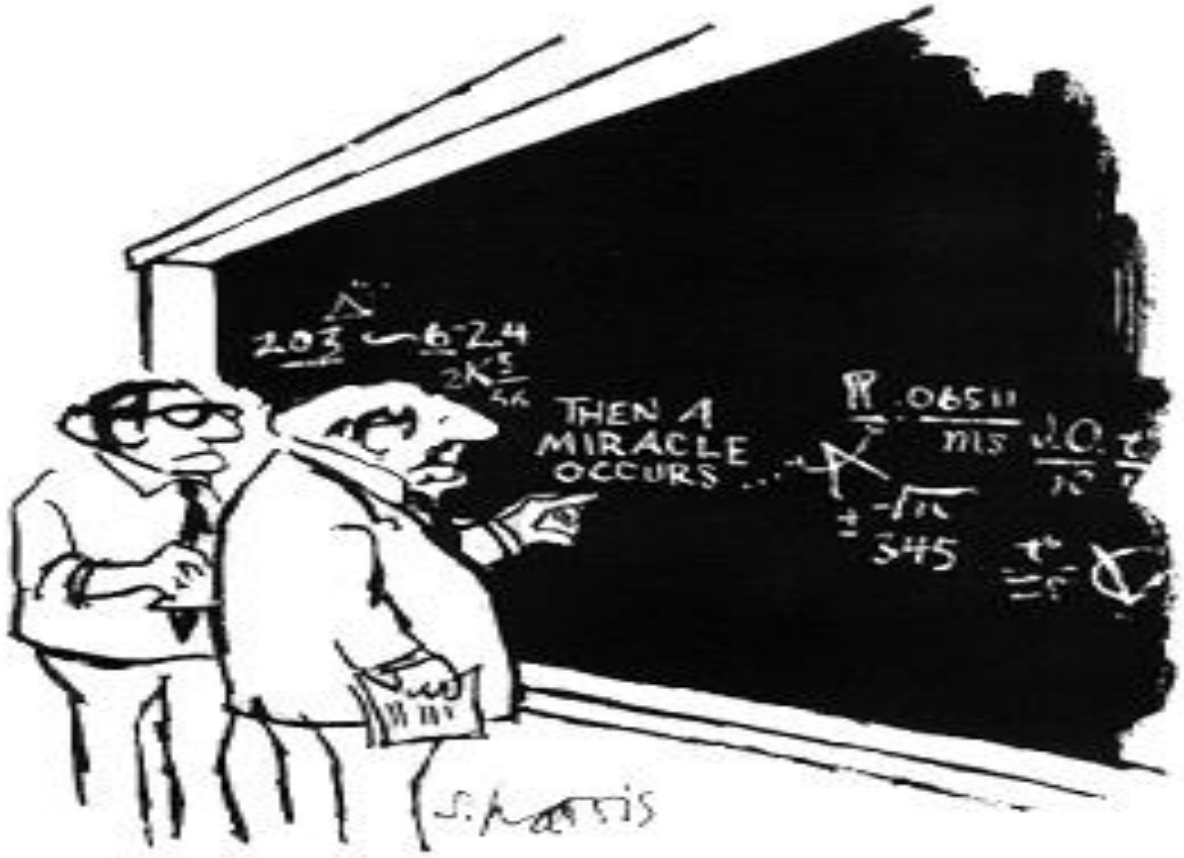
By end of this unit I can…

CB1: identify the properties of ionic compounds, covalent molecules, and metallic matrices/alloys.

CB2: write formulas for ionic compounds, covalent molecules, and metallic matrices/alloys.

CB3: name ionic compounds, covalent molecules, and metallic matrices/alloys.

Writing and Naming



"I think you should be more explicit here in step two."

The best way to show is through examples and practice.

Covalent Molecules

Subscript	Prefix
1	mono
2	di
3	tri
4	tetra
5	penta
6	hexa
7	septa
8	octa
9	nona
10	deca

Covalent Example 1

1. What is Carbon Dioxide?
   - Carbon is C, Oxygen is O. Di = two O.

CO_2

2. What is Dibromine Pentaoxide?

Br_2O_5

Covalent Example 2

1. What is CO?
   - Carbon is C, Oxygen is O.

     Carbon Monoxide

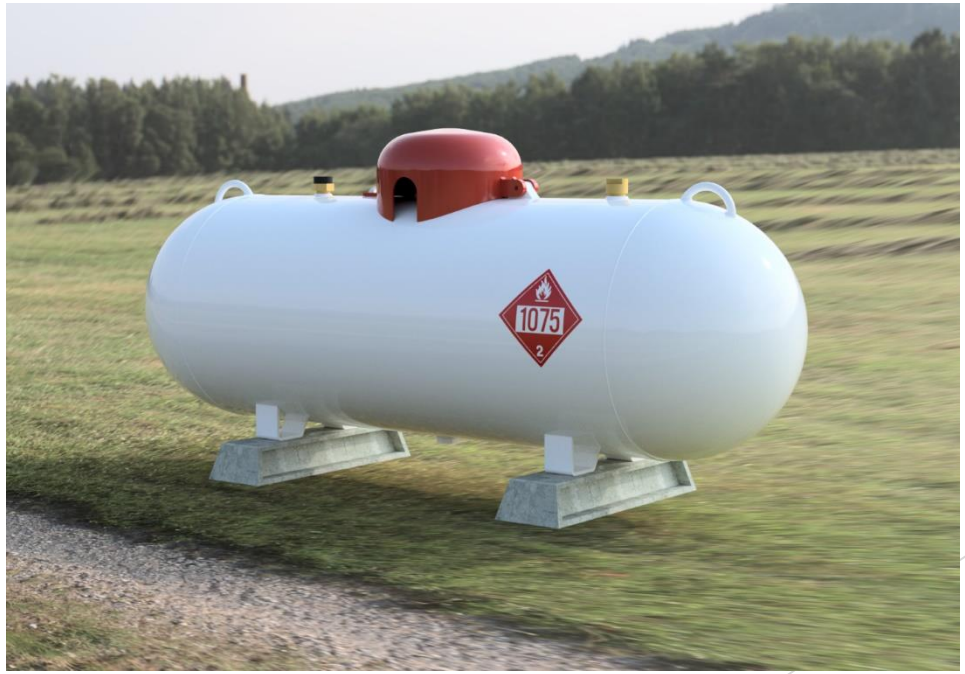
   - First element written normal if there is only one of them.
   - The last element always gets both a suffix (ide) and a prefix; even if there is only one.
   - Elements are not capitalized when led by a prefix.

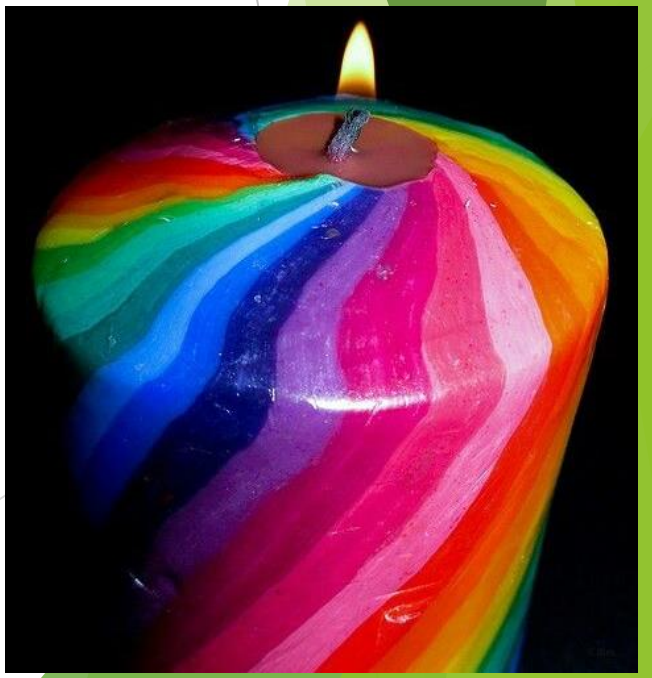
     Carbon MonOxide.

2. What is H_2O?
   - Dihydrogen Monoxide… but its trivial name is Water.

Special Covalent: Hydrocarbons

- Hydrocarbon: A chemical made of a Carbon backbone and Hydrogen pieces.
- Common Hydrocarbons include Polyethylene (plastic wrap), gasoline and candles.



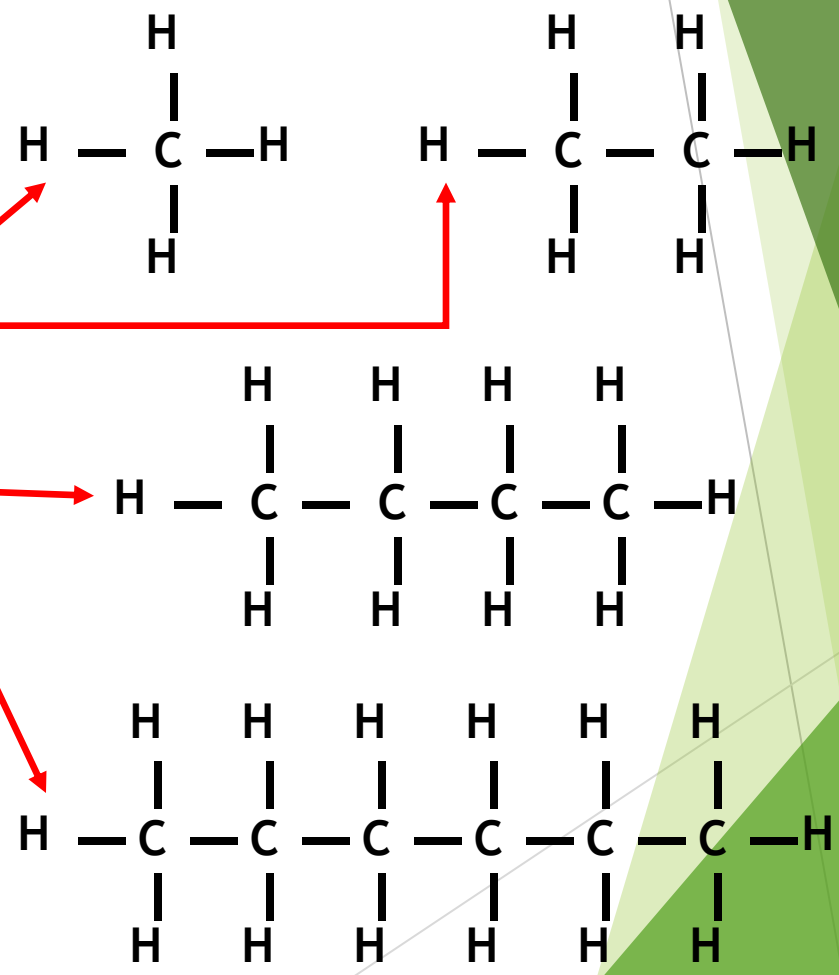


Naming Polymers

- Polymer (Greek: poly-many + mer-parts)
- Many polymers contain Carbon backbone and Hydrogen ends.
- Review:
  - Carbon has 4 e^- in its outer shell.
  - Carbon will single bond with four atoms, or double with two atoms, or …
- The number of Carbon, the type of bonds and what is bonded to the Carbon determines the name of the ‘mer’.

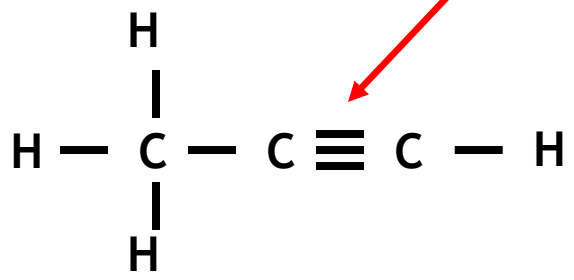
Polymer Prefixes (# of C)

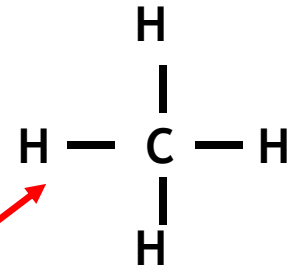
Single Bonded Hydrocarbons			
# of C	Prefix	Example	Name
1	Meth	CH_4	Methane
2	Eth	C_2H_6	Ethane
3	Prop	C_3H_8	Propane
4	But	C_4H_{10}	Butane
5	Pent	C_5H_{12}	Pentane
6	Hex	C_6H_{14}	Hexane
7	Hept	C_7H_{16}	Heptane
8	Oct	C_8H_{18}	Octane
9	Non	C_9H_{20}	Nonane
10	Dec	$C_{10}H_{22}$	Decane

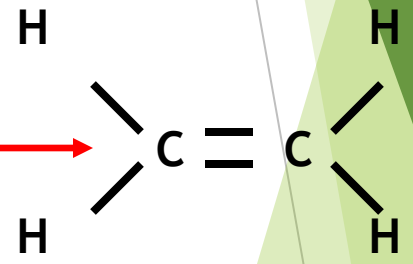


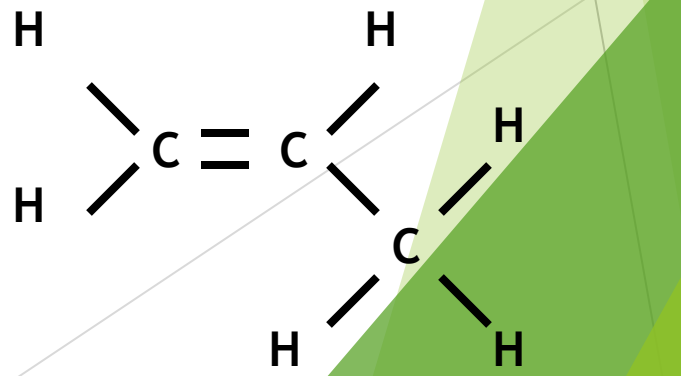
Polymer Suffix (Biggest Bond)

Bonded Hydrocarbons			
# of Bonds	Suffix	Ex.	Name
1 (Alkanes)	ane	CH_4	Methane
2 (Alkenes)	ene	C_2H_4	Ethene
2 (Alkenes)	ene	C_3H_6	Propylene
3 (Alkynes)	yne	C_3H_4	Propyne





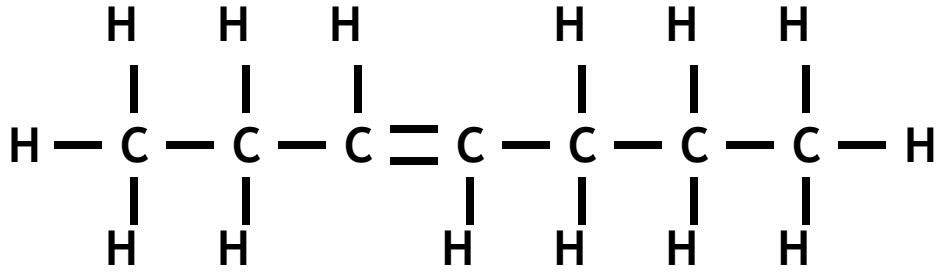




Complex Polymer Bonds

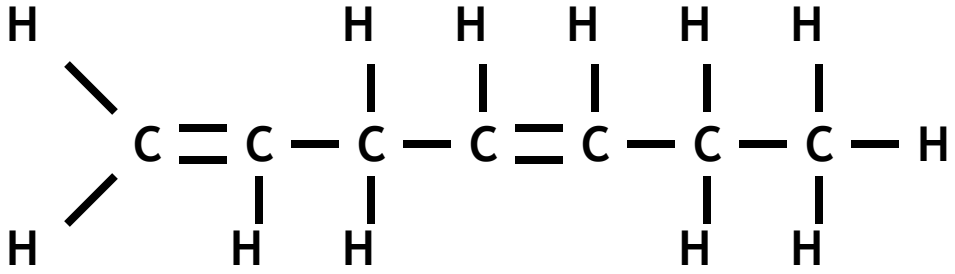
- If a polymer contains a double or triple bond, chances are it also contains single bonds.
- To name double or triple bonds:
  - Start from the shortest chain of single bonds.
  - Count the number of C before the double or triple bond.

Complex Linear Bond Examples



There are 7 C (Hept) and a double bond (ene). Double bond after the 3rd C.

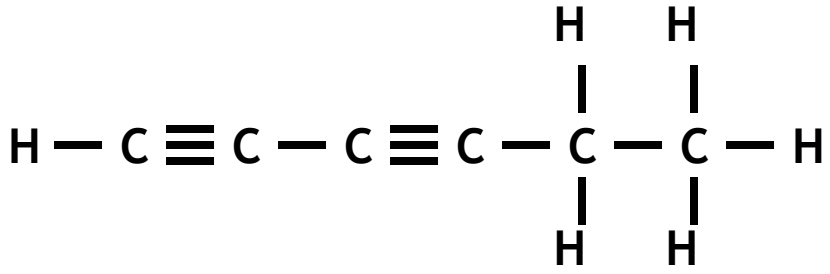
Name: 3 Heptene.



There are 7 C (Hept) and two double bonds (diene). Double bond after the 1st + 4th C.

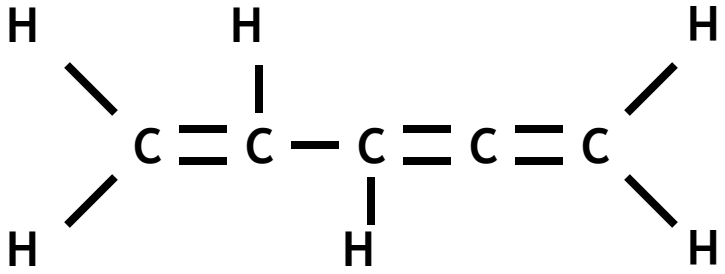
Name: 1,4 Heptadiene.

Complex Linear Bond Examples



There are 6 C (Hex) and two triple bonds (diyne). Triple bond after the 1st + 3rd C.

Name: 1,3 Hexadiyne.



There are 5 C (Pent) and three double bonds (triene). Double bond after the 1st, 2nd + 4th C.

Name: 1,2,4 Pentatriene.

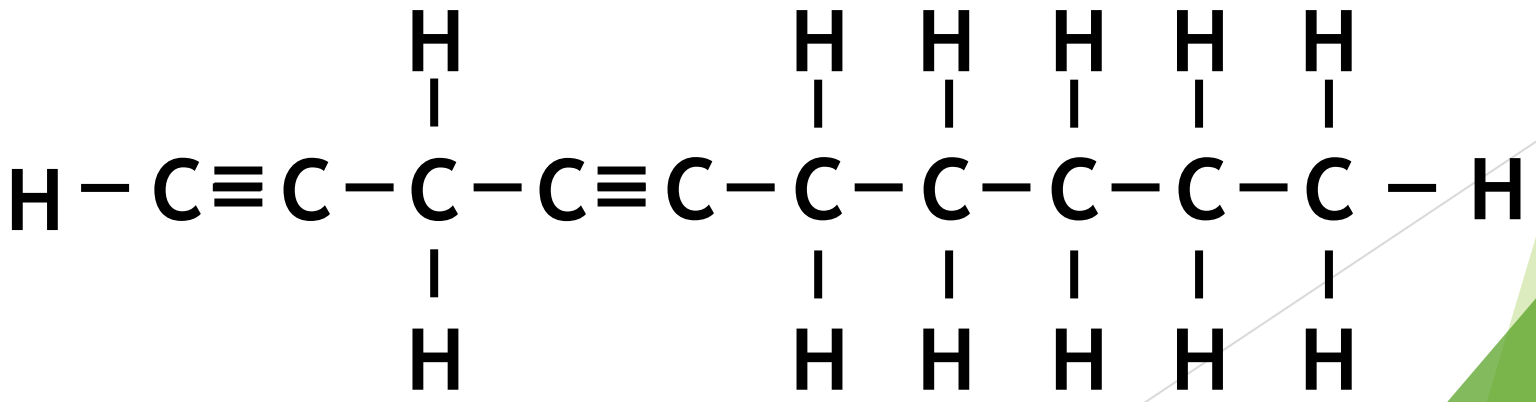
(read backwards)

1,3,4 Pentatriene

Complex Linear Bond Examples

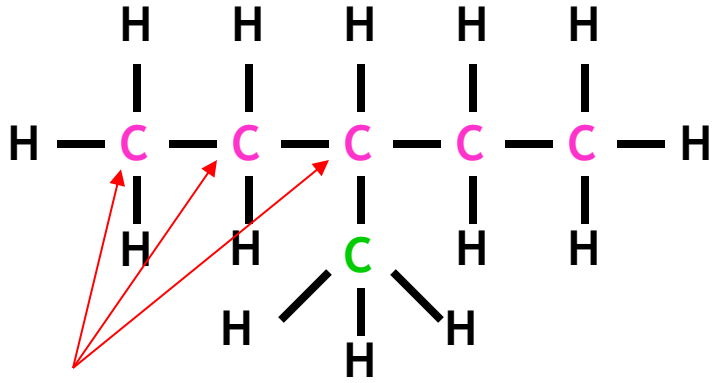
- Draw 1,4 Decadiyne

1) Deca – 10 Carbons
2) diyne- two triple bonds after first and fourth carbon.
3) Add Hydrogen to make every Carbon have 4 bonds.
   - If only one H on the top or bottom: your choice.

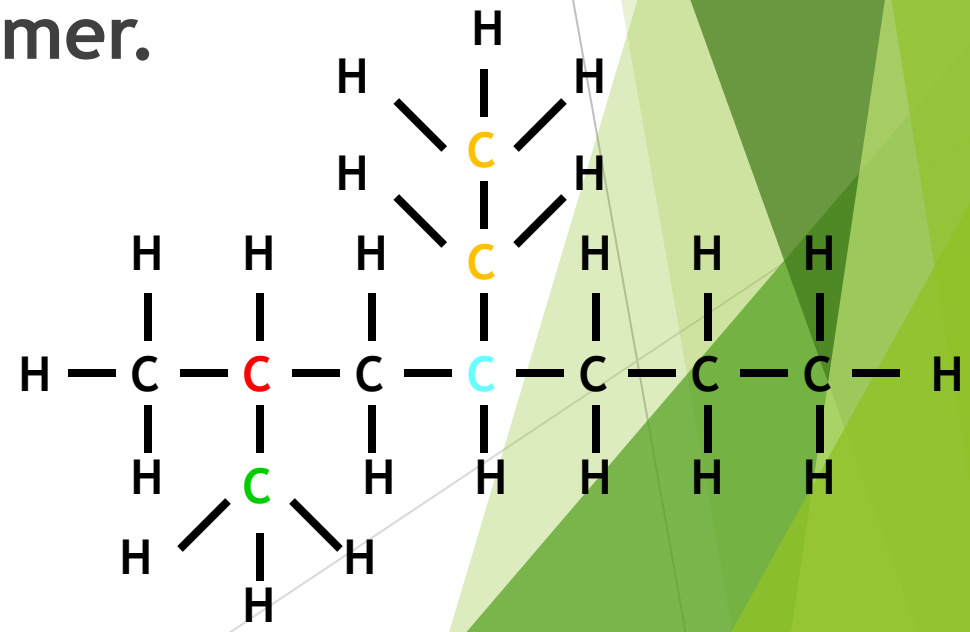


Branching Bonds

- Not all bonds are linear.
- Branching: The process of forming a fairly long chain or extension off the backbone of a polymer.



3 methyl pentane (yl:smallest)



2 methyl - 4 ethal heptane

Naming/Writing Ions

- Cations (positive charged)
  - Monatomic: Consist of only one element.
    - Have the same name as the root element.
    - Some have multiple positive charges: place charge after the name in roman numerals.
      - Cu^{+} is Copper (I) while Cu^{2+} Copper (II).
  - Polyatomic: Consisting of two elements.
    - While there are four Ammonium: NH_4^{+} is the one used in this class.
    - You may never modify any polyatomic ion
      - Ex: Need two Ammonium: $N_2H_8^{2+}$, NH_{42}^{+}, $(NH_4^{+})_2$

Ions Continued

- Anions (negative charged)
  - Monatomic: Suffix is replaced with ide.
    - Chlorine (Cl)→ Chloride (Cl^-)
  - Polyatomic: Common (covalent bond).
    - Binary: Two elements, the second being O, end in either ite or ate. Chlorite (ClO_2) or Chlorate (ClO_3). May have a prefix too.
    - Ternary: Three or more, last normally O, end in ate. Acetate ($C_2H_3O_2$).

Polyatomic Ions 'ate' versus 'ite'

# of O	Ion Modifier	Ion Example 'N'
$XO_{(x+1)}$	per 'X' ate	NO_4→Pernitrate
XO_x	'X' ate	NO_3→Nitrate
$XO_{(x-1)}$	'X' ite	NO_2→Nitrite
$XO_{(x-2)}$	Hypo 'X' ite	NO→Hyponitrite

- **Red** the most common will be on the ion chart.
- Ex: $NaClO_3$: Sodium **Chlorate** (ClO_3 is most Common)

  $NaClO_2$: Sodium **Chlorite** (One less 'O' move ↓ one)
- Ex: $Li_2B_4O_6$: Lithium **Borite** (B_4O_7 is most Common)

  $Li_2B_4O_8$: Lithium **Perborate** (Two more 'O' move ↑ two)
- Name: $NaNO_3$, $Ca(NO_2)_2$ and $LiNO_4$

Ionic Bonds: Compounds/Salts

- Review: An ionic bond is the joining of a positive to a negative ion(s).
- To write find the charge of the ions.
  - The positive Cation is written first.
- Do not write charges in final answer.
  - $Cu_2^{+}O^{2-}$ must be written Cu_2O
- When balancing reduce if needed:
  - Cu_4O_2 must be written Cu_2O.

Ionic Example 1

1. What is the formula for Mercury (I) Borate?
   - Mercury (I) is Hg^{+}, Borate is $B_4O_7^{2-}$.
   - The Least Common Multiple of 1 & 2 is 2.
     - Need two Hg at 1+ and one B_4O_7 at 2-.
     - Math 2 x (+1) + 1 x (-2) = 0

       $Hg_2B_4O_7$.
   - Remember in a final answer:
     - Never write the charges $Hg^{+}{}_2B_4O_7^{2-}$
     - Never write a 1: $Hg_2(B_4O_7)_1$

Ionic Example 2

2. **What is the formula for Lead (IV) Citrate?**
   - Lead (IV) is Pb^{4+}, Citrate is $C_6H_5O_7^{3-}$.
   - LCM of 4 and 3 is 12.
     - Three 4+, and four 3- are needed.

$$Pb_3(C_6H_5O_7)_4$$

   - Remember if more than one polyatomic ion is needed use a parentheses: $C_6H_5O_{74}$.

Naming: Ionic Example 3+4

3. What is NH_4CN?
   - NH_4 is Ammonium, CN is Cyanide.

     Ammonium Cyanide

4. What is PbS_2?
   - Pb is Lead (II or IV), S is Sulfide.
   - Sulfide has a -2 charge so S_2 is -4 total.
   - The one Lead must be a +4 cation. (? x 1 = +4)

     Lead (IV) Sulfide

     [Lead (II) Sulfide would be PbS]

PbS_2 Broken Down

$$Pb_{1} \quad S^{2-}_{2}$$

$$-4$$

As this is showing work, write all numbers.

Solve the negative side (multiply only)

Ionic bonds are neutral (Positive must balance negative) so the Cation must be equal and opposite to the Anion.

Solve for the missing positive charge on the right.

Reminder: This is only needed is the metal has multiple positive charge states: Metal (#)

Special Ions

- An Ionic Bond with Hydrogen cation(s) is considered an acid when mixed with water.
- Naming is based on the anion:
- If no Oxygen present: Hydro____ic Acid
  - HCl→ Hydrochloric Acid
  - HCN→Hydrocyanic Acid
- If paired with a polyatomic anion (ate/ite) the Polyatomic chart is used…

Naming Polyatomic Acids

# of O	Ion Modifier	Acid Modifier	Ion Example 'N'	Acid Example 'N'
$XO_{(x+1)}$	per 'X' ate	per 'X' ic	NO_4→Pernitrate	HNO_4 →Pernitric Acid
XO_x	'X' ate	'X' ic	NO_3→Nitrate	HNO_3 →Nitric Acid
$XO_{(x-1)}$	'X' ite	'X' ous	NO_2→Nitrite	HNO_2 →Nitrous Acid
$XO_{(x-2)}$	Hypo 'X' ite	Hypo 'X' ous	NO→Hyponitrite	HNO →Hyponitrous Acid

- A Cation ending in 'ate' turns to 'ic'
- A Cation ending in 'ite' turns to 'ous'
  - Prefixes follow the normal rules.
- Drop the Hydrogen from the name but add the word acid to the end.
- ONLY when mixed to make a solution (Chapter 9).

Metallic Bonds

- Metals form matrices (think MGM Grand).
- Elements introduced into the matrix form useful alloys.

- How long would it take you to sleep in every hotel room the MGM has???

Alloys

- Alnico (Al, Ni, Co) - Used for permanent magnets.
- Electum (Au, Ag) Rose Gold (Au, Cu) White Gold (Au, Ni, Pd)

  Used for Drinking vessels, jewelry and coinage.
- Brass (Cu, Zn) – Twenty-five different types: used for door fixtures and machines.
- Bronze (Cu, Sn) - Used for maritime and in sculptures.

Alloys

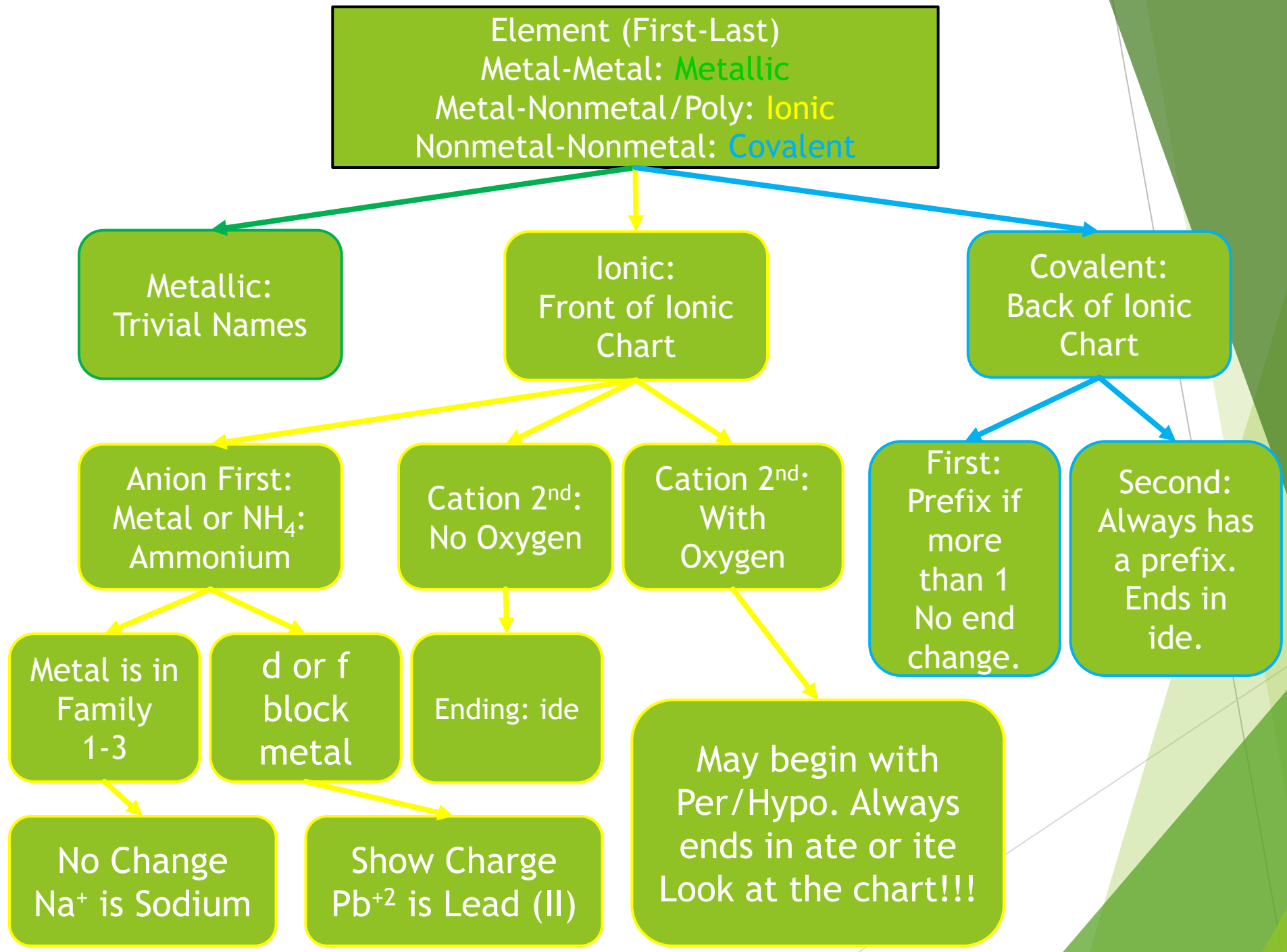
Wrought Iron

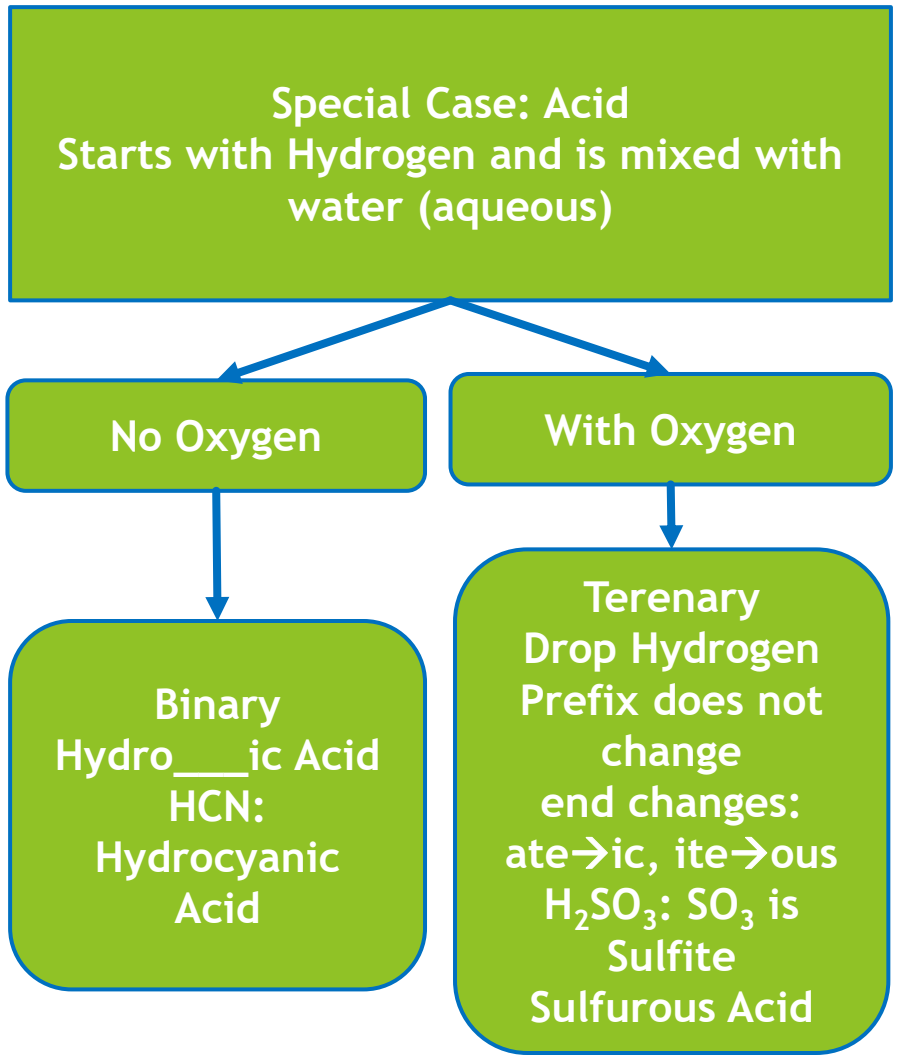
Cast Iron

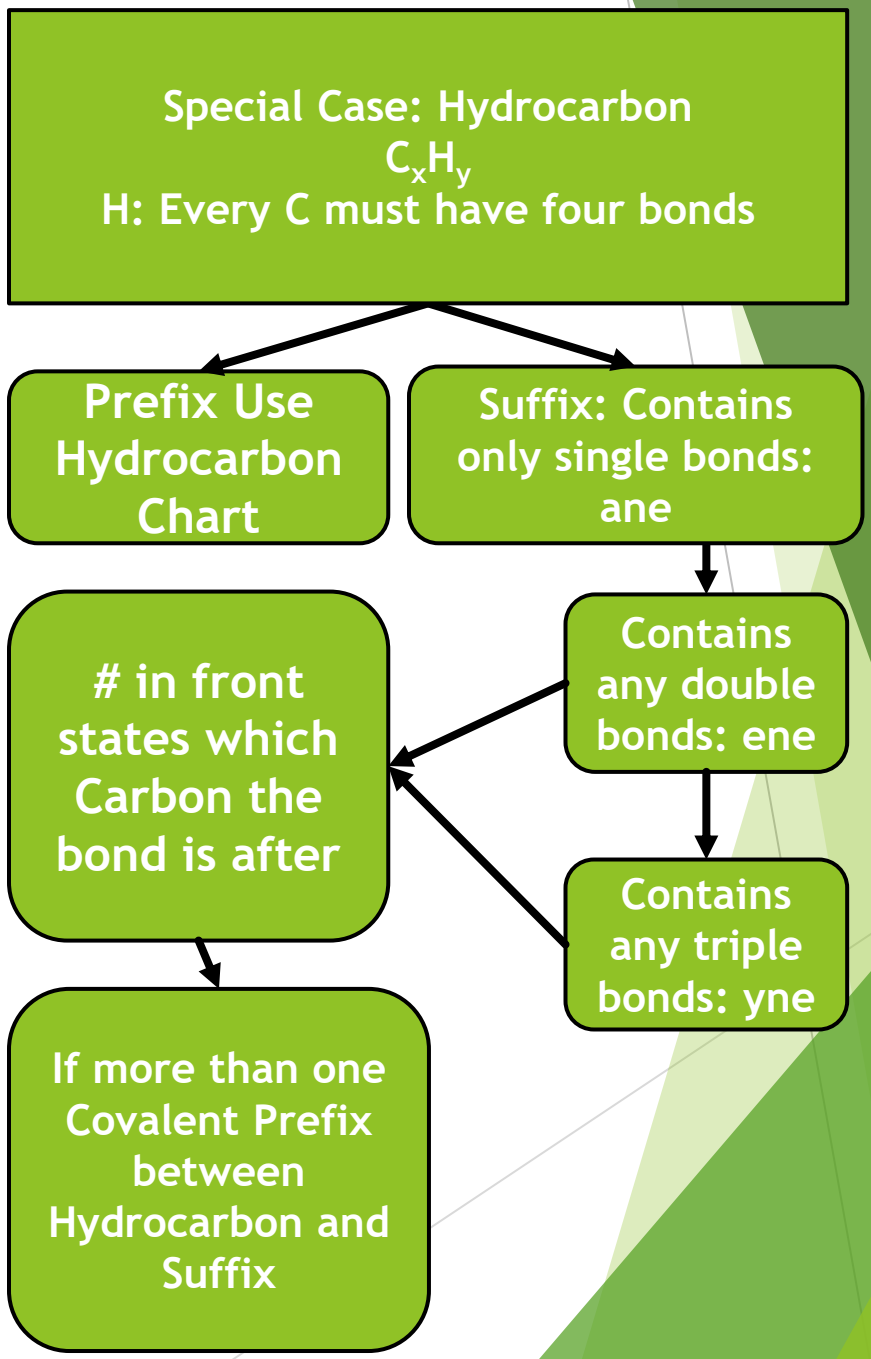
Mild Steel

High Carbon Steel

- Steel (Fe, C, +) - Various structural and tool uses.
- Solder (Pb, Sn) - Electrical connections.
- + Amalgam (Hg, +) - Ag: Dental work. Hg will alloy with almost any metal (Iron is one exception).
- Nichrome (Ni, Cr) - Heating elements.
- Nitinol (Ni, Ti) - Memory wire, glasses.
- Sterling Silver (Ag, Cu, +) - Jewelry.
- Pewter (Sn, Pb, Cu) - Cooking/Serving, ornamental.


Element (First-Last)
Metal-Metal: Metallic
Metal-Nonmetal/Poly: Ionic
Nonmetal-Nonmetal: Covalent
Metallic: Trivial Names
Ionic: Front of Ionic Chart
Covalent: Back of Ionic Chart
Anion First: Metal or NH_4: Ammonium
Cation 2nd: No Oxygen
Cation 2nd: With Oxygen
First: Prefix if more than 1 No end change.
Second: Always has a prefix. Ends in ide.
Metal is in Family 1-3
d or f block metal
Ending: ide
May begin with Per/Hypo. Always ends in ate or ite Look at the chart!!!
No Change Na^{+} is Sodium
Show Charge Pb^{+2} is Lead (II)


Special Case: Acid
Starts with Hydrogen and is mixed with water (aqueous)
No Oxygen
With Oxygen
Binary
Hydro___ic Acid
HCN:
Hydrocyanic
Acid
Terenary
Drop Hydrogen
Prefix does not change
end changes:
ate→ic, ite→ous
H_2SO_3: SO_3 is
Sulfite
Sulfurous Acid


Special Case: Hydrocarbon
C_xH_y
H: Every C must have four bonds
Prefix Use Hydrocarbon Chart
Suffix: Contains only single bonds: ane
Contains any double bonds: ene
Contains any triple bonds: yne
in front states which Carbon the bond is after
If more than one Covalent Prefix between Hydrocarbon and Suffix