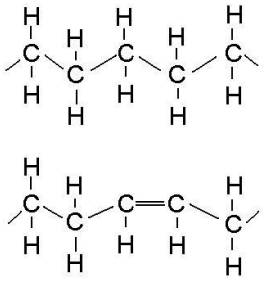
D. Molecular Formula vs. Structural Formulas vs. Condensed Structural Formula

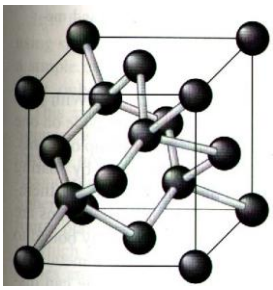
1.) **Molecular Formula** – shows the type and the # of atoms involved

Examples: C_4H_{10} C_2H_4 C_8H_{18}

2.) **Structural Formula** – shows the arrangement of atoms and bonds in a molecule

2-dimensional vs. 3-dimensional





3.) **Condensed Structural Formula** – shows the arrangement of atoms in a molecule, without including all the bonds between atoms

Examples: $CH_3CH_2CH{=}CHCH_3$ $CH_3\text{-}(CH_2)_4\text{-}CH_3$

II. HYDROCARBONS

A. Definition: Organic compounds that contain only atoms of _____ and _____.

B. Homologous series of compounds

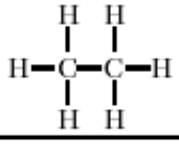
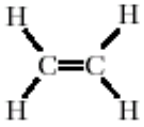
↳ _____

1.) Alkanes

2.) Alkenes

3.) Alkynes

Table Q
Homologous Series of Hydrocarbons

Name	General Formula	Examples	
		Name	Structural Formula
alkanes	C_nH_{2n+2}	ethane	
alkenes	C_nH_{2n}	ethene	
alkynes	C_nH_{2n-2}	ethyne	

n = number of carbon atoms

1.) Alkanes
- Single bonds only between carbon atoms
- Homologous series of _____ hydrocarbon

2.) Alkenes
- Chain of carbon atoms with one _____ bond between C atoms
- Homologous series of _____ hydrocarbons
- The double bond can be anywhere within the carbon chain
- Alkenes are named by changing the – ane name to -ene

3.) Alkyne
- Chain of carbon atoms with one _____ bond between C atoms
- Homologous series of _____ hydrocarbons
- The triple bond can be anywhere within the carbon chain
- Alkynes are named by changing the – ane name to –yne

C. Naming Simple Hydrocarbons – **Use Reference Table P & Q**

1.) Determine the number of carbons in the chain
2.) Choose the appropriate prefix from Table P
3.) Determine the type of bonding found in the chain from Table Q (single, double or triple)
4.) Choose the suffix –ane, -ene or –yne for single, double or triple bonding respectively

Table P
Organic Prefixes

Prefix	Number of Carbon Atoms
meth-	1
eth-	2
prop-	3
but-	4
pent-	5
hex-	6
hept-	7
oct-	8
non-	9

Practice:

1.) Tell if the following are saturated hydrocarbons or unsaturated hydrocarbons (Hint: saturated = alkane; unsaturated = alkene or alkyne, use general formulas)

a) C_2H_2 _____

b) C_5H_{12} _____

c) C_3H_8 _____

d) C_4H_6 _____

e) C_2H_2 _____

f) C_7H_{14} _____

g) C_7H_{16} _____

h) C_6H_{10} _____

2.) Name the following by determining what "General Formula" the formula given fits into from Table Q and choosing the proper prefix from Table P

a) C_2H_2 _____

b) C_5H_{12} _____

c) C_3H_8 _____

d) C_4H_6 _____

e) C_2H_2 _____

f) C_7H_{14} _____

g) C_7H_{16} _____

h) C_6H_{10} _____

D. Drawing structural formulas when the <u>Molecular Formula</u> is given

- 1st determine what "General Formula" the formula fits into (C_nH_{2n+2}, C_nH_{2n}, or C_nH_{2n-2})
- 2nd draw the carbon chain
- 3rd insert the single bonds between carbon
  - → include one double bond in the chain if it's an alkene
  - → include one triple bond in the chain if it's an alkyne
- 4th add the hydrogen atoms to each carbon ensuring that each carbon has 4 bonds

a) C_3H_6

b) C_5H_8

c) C_4H_{10}

d) C_2H_6

e) C_2H_2

f) C_4H_8

E. Drawing structural formulas when the <u>Name of the Organic Compound</u> is given

- 1st determine how many carbons are in the chain based on the prefix and Table P
- 2nd draw the carbon chain
- 3rd look at the ending of the name to see if it ends in –ane, -ene or –yne
- 4th insert the single bonds between carbon atoms if it ends in –ane

- if there is a number in front of the name (ex. 2-butene) that number tells you **after** which carbon to place the double (-ene ending) or triple bond (-yne ending)

-5th add hydrogen atoms to each carbon ensuring that each carbon has 4 bonds

Example 1:

a) 2-butene =

- prefix but- means 4 carbon chain
- suffix -ene means there is a double bond
- the #2 means after the 2nd carbon insert the double bond; all remaining bonds between carbons get single bonds
- insert hydrogen atoms to give each carbon four bonds

Example 2:

b) 2-hexyne =

- prefix hex- means 6 carbon chain
- suffix -yne means there is a triple bond
- the #3 means after the 3rd carbon insert the triple bond; all remaining bonds between carbons get single bonds
- insert hydrogen atoms to give each carbon four bonds

Example 3:

c) nonane =

- prefix non- means 9 carbon chain
- suffix -ane means there is all single bonds
- insert hydrogen atoms to give each carbon four bonds

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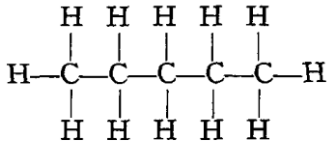
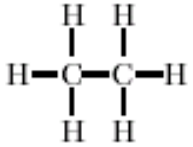
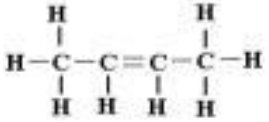
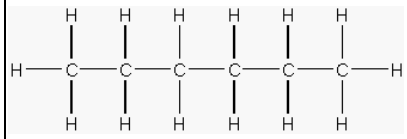
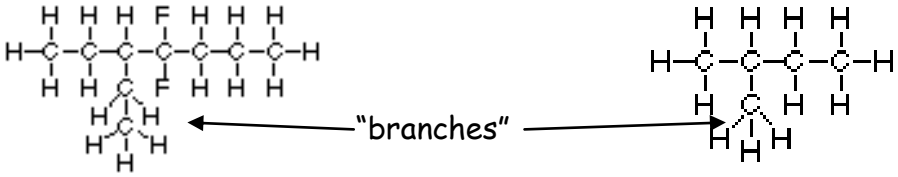
Molecular Formula	**General Formula**	**Series**	**Structural Formula**	**Condensed Structural Formula**	**Name of Compound**
C_5H_{12}	C_nH_{2n+2}	Alkane		**C**H_3**C**H_2**C**H_2**C**H_2**C**H_3	Pentane
					
					3- Heptyne
				$CH_3CH_2CH_3$	
				$CH_3CH{=}CHCH_2CH_3$	
C_9H_{20}					
					

Molecular Formula	General Formula	Series	Structural Formula	Condensed Structural Formula	Name of Compound
					
					1-Octene
				$CH_2=CH-CH_3$	
C_8H_{18}					
C_9H_{18}					
				$CH_3-(CH_2)_4-CH_3$	

F. Naming Branched-Chain Hydrocarbons

- There are also hydrocarbons chains which have smaller carbon chains **branching off** the main chain of carbon atoms



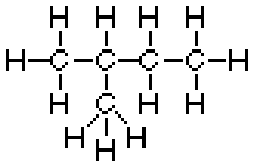
- These organic compounds are named like we learned before, except we must now add in the part to tell us the location and the type of branch that forms off the main chain

1) When straight-chain hydrocarbons have attached groups these also must be named. These groups are called _____groups. The group names end in **–yl**, and we use the prefix from Table P to tell us how many carbons there are.

* The CH_3- group off the main chain is called a **methyl group**.
* The CH_3-CH_2 group off the main chain is called an **ethyl group**.
* The CH_3-CH_2-CH_2 group off the main chain is called an **propyl group**

2) We also need to show the location of the "branch" off the main chain, so we give the _____ of the carbon atom it falls on. To do this, we number the carbons in the chain, making sure that the branch falls on the lowest possible number.

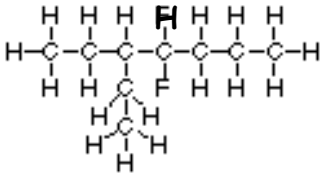
Example 1:



2–methyl–butane

- main chain of carbons = 4 carbons (but-)
- on the 2nd carbon is a CH_3 group = methyl
- we first list the number the group is on, then the name the "branched" group, then end with the main chain name

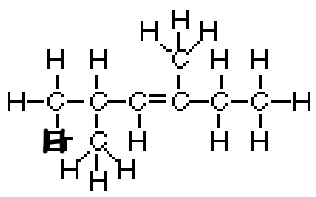
Example 2:



3–ethyl–heptane

- main chain of carbons = 7 carbons (hept-)
- on the 3rd carbon is a CH_3CH_2 group = ethyl
- we first list the number the group is on, then the name the "branched" group, then end with the main chain name

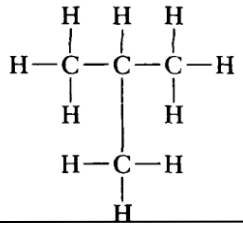
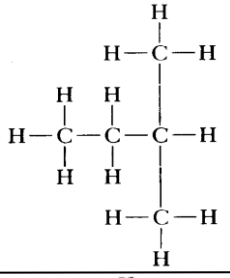
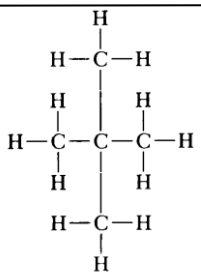
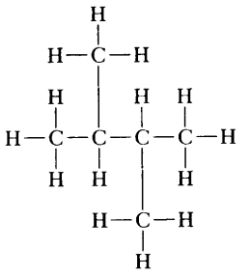
Example 3:



2,4-dimethyl–hexene

- main chain of carbons = 6 carbons (hex-)
- on the 2nd & 4thcarbon is a CH_3- group = methyl
- we first list the number the groups are on, then the name the "branched" group, then end with the main chain name

Practice Drawing and Naming Branched – Chain Hydrocarbons:

STRUCTURAL FORMULA	NAME
	
	
	
	
	3-ethyl-3-methyl-hexane
	2-methyl-3-ethyl heptane
	1,3-diethylpentane