Chapter 12

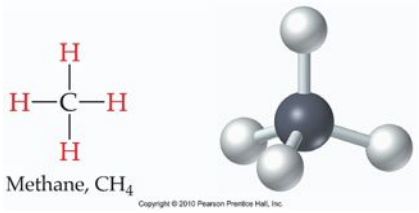
Goals:

- ✓ Know that organic chemistry is the study of carbon based compounds.
- ✓ Be able to name and draw straight chained hydrocarbons and branched hydrocarbons with up to 10 carbons in the parent chain.
- ✓ Know the difference in saturated and unsaturated hydrocarbons, and understand the general formulas for alkanes, alkenes and alkynes.
- ✓ Be able to recognize constitutional and cis-trans isomers.
- ✓ Know the definition of a functional group.
- ✓ Be able to recognize and name the functional groups listed in table 12.1 (excepts anhydride).
- ✓ Understand the molecular geometry of organic compounds (this is from chapter 5).

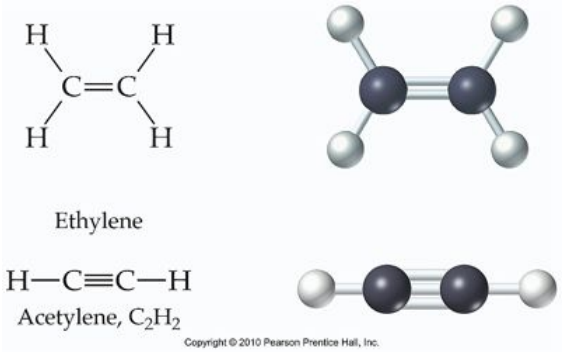
Organic Chemistry

- Organic chemistry is the branch of chemistry that deals with the study of carbon based compounds.

- Hydrocarbons are the simplest organic compounds and are made up of C and H only.
  - Saturated: contain the maximum number of H atoms possible per C atom. Saturated hydrocarbons are known as alkanes.



  - Unsaturated: contain less than the maximum number of H atoms possible per C atom. Unsaturated hydrocarbons are known as alkenes or alkynes.



Nomenclature of Straight Chained Hydrocarbons

Composed of a prefix that tells how many carbons are in the chain:

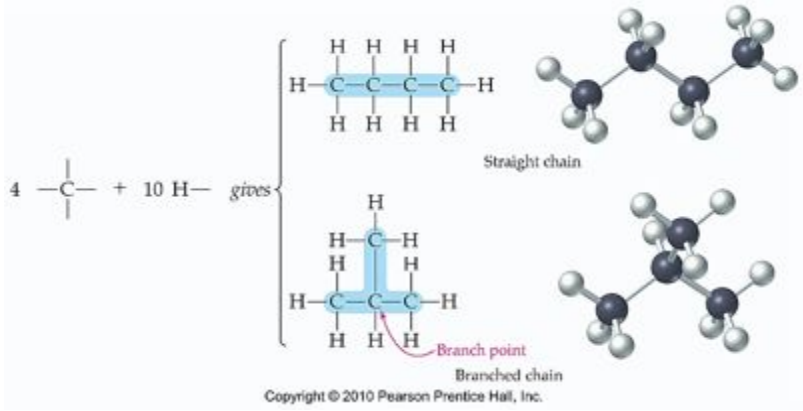
- Meth-
- Eth-
- Prop-
- But-
- Pent-
- Hex-
- Hept-
- Oct-
- Non-
- Dec-

Composed of a suffix that tells whether it is an alkane, alkene or alkyne:

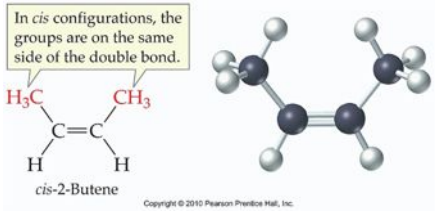
- -ane
- -ene
- -yne

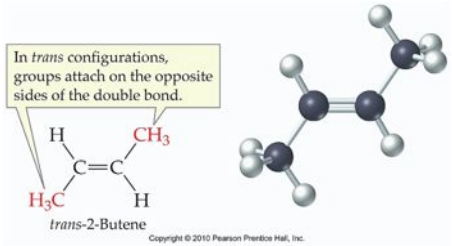
Isomers

- Iso- means same and –mers means parts.
- Isomers are compounds with the same molecular formula, but different chemical structures.
- Structural isomers (constitutional isomers) have the same molecular formula, but a different connectivity of atoms.



- Geometric isomers (cis-trans isomers) have the same molecular formula, same connectivity of atoms, but different 3-D arrangements about the double bond; only alkenes can have geometric isomers.





Nomenclature of Branched Alkanes

1. Name the longest chain
2. Number the main chain giving the lowest number priority to any branched groups
3. Name the branched groups and identify their position by the number in the chain
4. Write the full name as a single word
   - use hyphens to separate numbers from prefixes
   - use commas to separate numbers from numbers
   - use alphabetical order for branched groups
   - use di-, tri-, or tetra- prefixes if there are multiples of the same branch group

TABLE 12.4 Some Common Alkyl Groups*

CH_3- Methyl	CH_3CH_2- Ethyl	$CH_3CH_2CH_2-$ *n*-Propyl	$CH_3CH(CH_3)-$ Isopropyl
$CH_3CH_2CH_2CH_2-$ *n*-Butyl	$CH_3CH(-)CH_2CH_3$ *sec*-Butyl	$CH_3CH(CH_3)CH_2-$ Isobutyl	$CH_3C(CH_3)_2-$ *tert*-Butyl

*The red bond shows the connection to the rest of the molecule.

Copyright © 2010 Pearson Prentice Hall, Inc.

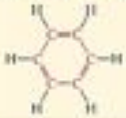
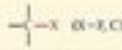
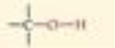
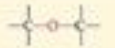
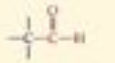
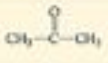
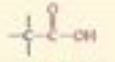
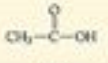
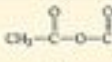
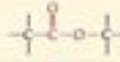
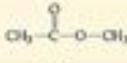
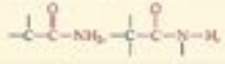
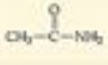
Nomenclature of Branched Alkenes and Alkynes

1. Name the parent chain, the longest chain containing the double or triple bond
2. Number the chain giving the lowest priority to the double or triple bond
3. Assign a name and number to the branched groups
4. Write the full name as one word
   - use hyphens to separate numbers from prefixes
   - use commas to separate numbers from numbers
   - use alphabetical order for branched groups
   - use di-, tri-, or tetra- prefixes if there are multiples of the same branch group
   - if it is an alkene, determine if cis-trans isomers apply

Functional Groups

When a small portion of a molecule is responsible for that molecule's reactivity we call that small portion a functional group.

TABLE 12.1 Some Important Families of Organic Molecules

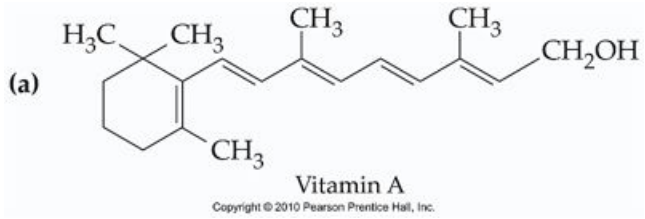
FAMILY NAME	FUNCTIONAL GROUP STRUCTURE*	SIMPLE EXAMPLE	NAME ENDING
Alkane	Contains only C—H and C—C single bonds	CH_3CH_3 Ethane	-ane
Alkene		$H_2C{=}CH_2$ Ethylene	-ene
Alkyne		$H{-}C{\equiv}C{-}H$ Acetylene (Ethyne)	-yne
Aromatic		 Benzene	None
Alkyl halide	 (X = F, Cl, Br, I)	$CH_3{-}Cl$ Methyl chloride	None
Alcohol		$CH_3{-}OH$ Methyl alcohol (Methanol)	-ol
Ether		$CH_3{-}O{-}CH_3$ Dimethyl ether	None
Amine		$CH_3{-}NH_2$ Methylamine	-amine
Aldehyde		 Acetaldehyde (Ethanal)	-al
Ketone		 Acetone	-one
Carboxylic acid		 Acetic acid	-ic acid
Anhydride		 Acetic anhydride	None
Ester		 Methyl acetate	-ate
Amide		 Acetamide	-amide
			

*The bonds to R or to hydrogen are not specified but assumed to be attached to carbon or hydrogen atoms in the rest of the molecule.

Copyright © 2010 Pearson Prentice Hall, Inc.

Problems for Ch 12

1. Circle and name the functional group(s):



2. Draw and name the saturated, unbranched alkane with 5 carbons.

3. Draw an isomer of pentane.

4. Draw 2-methyl-2-butene, and explain why there is no cis-trans isomer for this molecule.