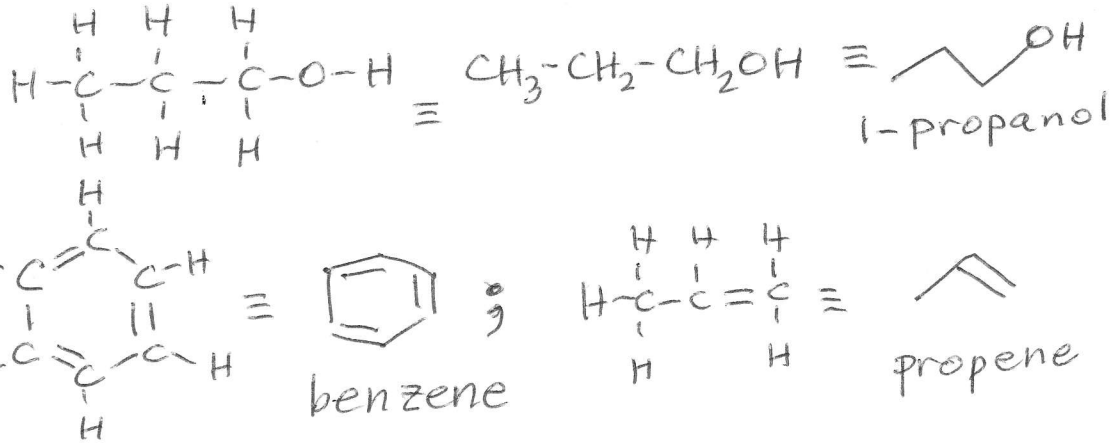
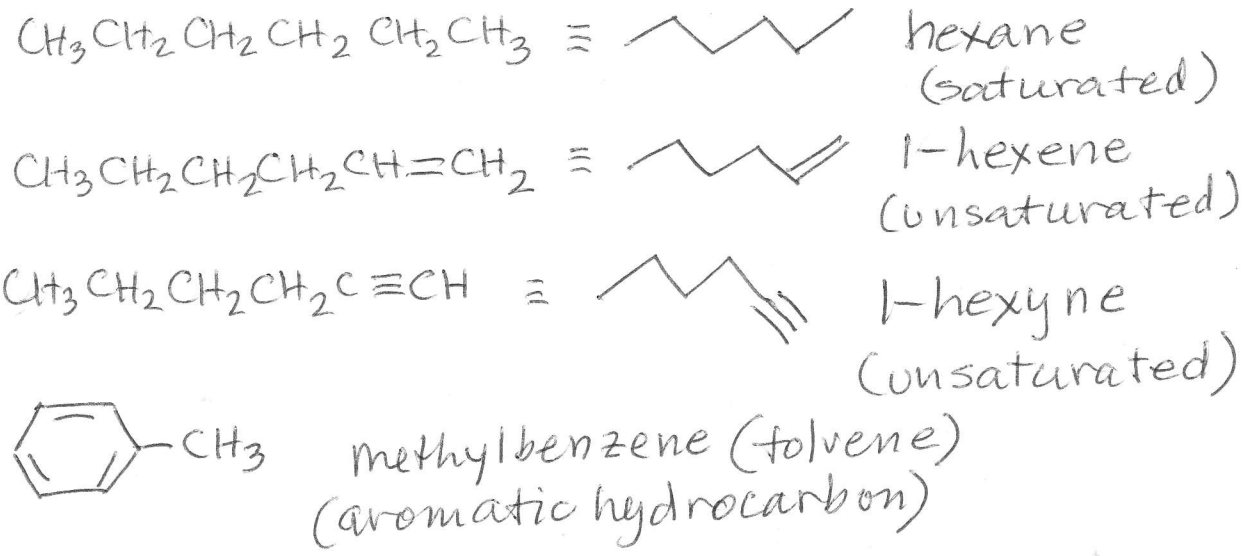
Organic chemistry is the chemistry of carbon-containing compounds. Carbon is the only element (except for silicon) that has the ability to bond to itself to make chains and rings. Polymers like polyethylene consist of chains of carbon atoms that extend for hundreds of atoms.

Carbon always forms four covalent bonds. The only possibilities are: 4 single bonds; 2 single bonds and 1 double bond; 1 single bond and 1 triple bond; 2 double bonds.

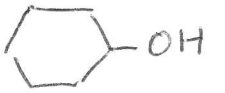
Drawing structures. Because carbon always forms 4 covalent bonds and hydrogen always forms one covalent bond, it is convenient to omit the C's and the H's when drawing the structures of organic compounds containing more than two carbon atoms. Here are some examples:

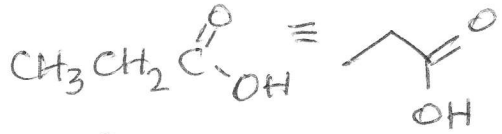


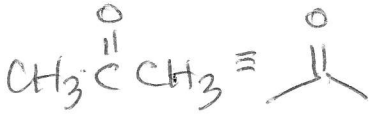
Hydrocarbons are compounds that contain only carbon and hydrogen. They are organized according to their unsaturation. An unsaturated hydrocarbon contains one or more carbon-carbon double or triple bonds. The simple types are named as follows: alkane (saturated), no double or triple bonds. Alkene (unsaturated), one double bond. Alkyne, one triple bond. There are also aromatic hydrocarbons containing a six-membered ring with alternating single and double bonds (not really but that is how they are drawn).



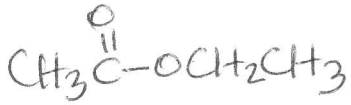
Functional groups. Most of the chemical reactions of organic compounds actually involve atoms other than carbon. So the study of organic chemistry is conveniently organized in terms of its common functional groups like alcohol, carboxylic acid, aldehyde, ketone, amine, ester, amide, etc. In the examples shown, capital R stands for the hydrocarbon part of the molecule.


cyclohexanol (alcohol) [R-OH]

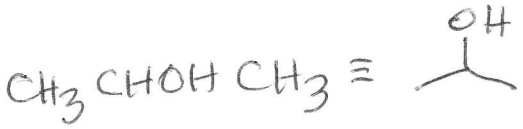

propanoic acid (carboxylic acid) [RCOOH]


2-propanone or acetone (ketone) [$R\overset{O}{\overset{\|}{C}}R'$]

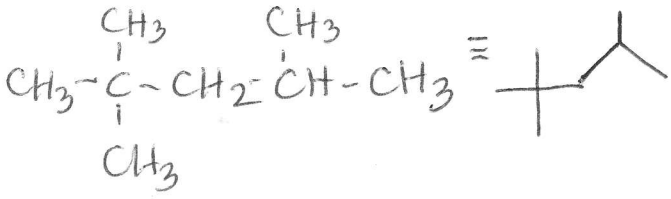
$(CH_3)_3N$ trimethylamine [R_3N]


ethyl acetate [$R\overset{O}{\overset{\|}{C}}-OR'$]

Nomenclature. Unfortunately, any given organic compound is likely to go by a number of different names or acronyms. Each has an official name, according to the IUPAC rules, but the official name is often rarely used except in scientific publications. Here are some examples of common organic chemicals together with their structures and common and official names.


isopropyl alcohol (common)
2-propanol (IUPAC)

CH_3COOH acetic acid (common)
ethanoic acid (IUPAC)

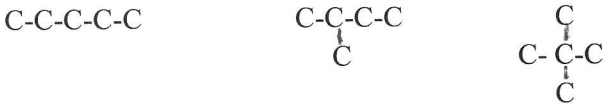

isooctane (common)
2,2,4-trimethylpentane (IUPAC)

Naming hydrocarbons. A hydrocarbon is a compound containing only C and H atoms. Hydrocarbons are classified as saturated, unsaturated or aromatic.

Type	Definition	IUPAC name	Common name
Saturated	No double or triple bonds	Alk**ane**	Alkyl hydrocarbon
Unsaturated	Contains one or more double or triple bonds		
	Contains a double bond	Alk**ene**	Alkylene; ethylene derivative
	Contains a triple bond	Alk**yne**	Acetylene derivative
Aromatic	Contains a benzene ring (C_6H_6)	Benzene	Benzene

Straight-chain vs, branched chain hydrocarbons.

Carbon can bond to itself in all possible ways including rings. For example, five carbon atoms can bond in three different ways (not counting rings):

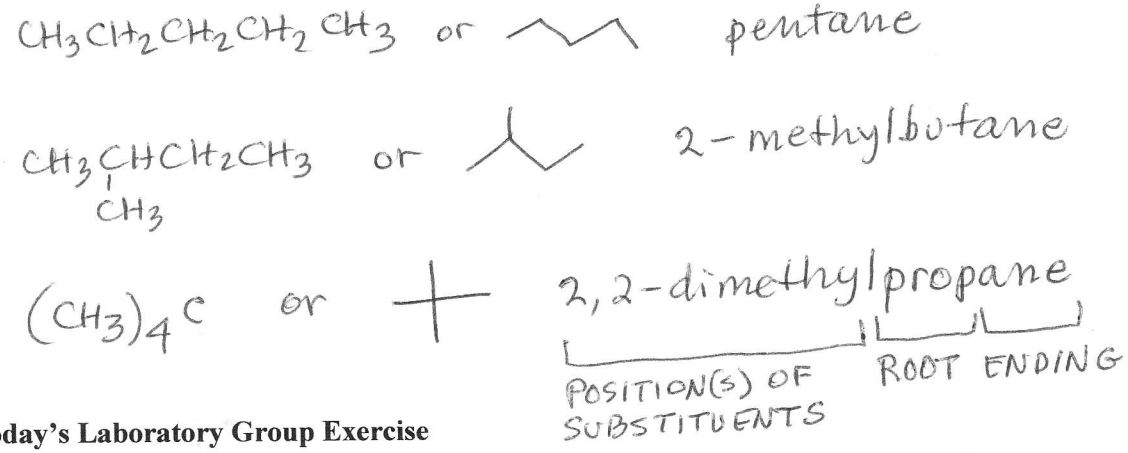


Compounds that have the same empirical formula but different structures are called ISOMERS.

IUPAC naming is based on the ROOT (longest continuous chain) and the ENDING (-ane, -ene, -yne, etc). The roots for the first six hydrocarbons are

Meth- Eth- Prop- But- Pent- Hex-

The chain is numbered from the end carbon nearest the branching. The three examples of C_5H_{12} isomers shown here are named (IUPAC) pentane, 2-methylbutane and 2,2-dimethylpropane.



Today's Laboratory Group Exercise

Your challenge is to construct – using the molecular models suppled – as many isomers of the empirical formulas (1) $C_2H_4Cl_2$ and (2) $C_2H_2Cl_2$ (no rings, please) as possible. And then give a name to each isomer. A pair of isomers must have different names. The numbers to shoot for are (1) 4 and (2) 3.

Names_____

I. Using the molecular models provided, construct as many isomers as possible having the empirical formula $C_4H_8Cl_2$ (saturated). Then draw the structures here and provide each structure with a proper IUPAC name.

II. Do the same for $C_2H_2Cl_2$ (unsaturated).