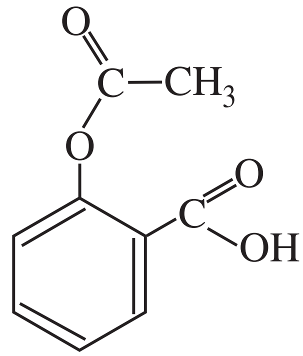
Super Models



Acetylsalicylic Acid (Aspirin)

Organic Chemistry Model Kit

Ryler Enterprises, Inc.

Recommended for ages 10 - adult.

Caution: Atom centers and vinyl tubing are a choking hazard. Do not eat or chew model parts.

Kit Contents:

16 black 4-peg carbon atom centers
7 black 3-peg carbon atom centers
6 red 2-peg oxygen atom centers
37 white 1-peg hydrogen atom centers
2 green 1-peg chlorine atom centers
2 dark green 1-peg bromine atom centers
2 light green 1-peg fluorine atom centers
50 clear, 1.25″ tubes (single bonds)
8 clear, 4 cm tubes (double/triple bonds)

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General Information

What are Organic Compounds?

The Chemical Abstracts Service (CAS) Registry of the American Chemical Society (ACS) has an extensive list of known chemicals. Currently the list includes 130 million different substances. CAS says that they add about 15,000 new chemicals daily.

So, while it is very difficult to say exactly how many organic compounds exist, we do know that they are the Kings of compounds, the Majesties of molecules. There are in fact about 80 times as many organic than inorganic substances.

Originally, organic was meant by chemists to mean made by a living thing, but that idea was upset by a German chemist in the 19^{th} century when he produced the organic waste material found in urine: urea. Friedrich Wöhler synthesized urea in a test tube. Here is an excerpt from a letter he sent to a fellow chemist with the exciting news.

"I can no longer, so to speak, hold my chemical water and must tell you that I can make urea without needing a kidney, whether of man or dog; the ammonium salt of cyanic acid is urea." Wöhler (1800-1882).

Today the term organic is applied to any of the compounds which contain carbon. There are some exceptions to this rule, namely CO_2, CO, H_2CO_3 and its salts, and HCN and its salts. They are classified as inorganic chemicals.

Categories of Organic Compounds

	Description
I. Hydrocarbons	**(Contain carbon and hydrogen only).**
A. Aliphatics	
1. Alkanes.	Straight chains, branched chains, cyclics. Single bonds only.
2. Alkenes.	Straight chains, branched chains, cyclics. At least one double bond.
3. Alkynes.	Straight chains, branched chains, cyclics. At least one triple bond.
B. Aromatics.	Rings, usually of six carbons, with alternating double bonds.

II. Carbon compounds with elements in addition to C and H.

A. Compounds with oxygen.
B. Compounds with halogens.
C. Compounds with nitrogen.
D. Compounds with other elements.
E. Compounds with combinations of different elements.

Nomenclature (naming) of organic compounds.

Of all the types of organic molecules listed above, alkanes are the only ones without reactive functional groups, so alkanes are relatively resistant to chemical change. Later, compounds with reactive functional groups will be added to the discussion of nomenclature.

One more topic should be covered before learning nomenclature, and that is how to represent molecular structures. There are four ways to draw an organic molecule: 1) Lewis structure, 2) condensed formula, 3) skeletal structure, and 4) 3-D drawing.

We assume you are already familiar with the method used for making Lewis structures, so we won't cover the procedure here. We will also not cover 3-D drawings. Fig. 1 shows the structure of pentane: the Lewis structure, a.; the condensed formula, b.; a second condensed formula, c.; and the skeletal structure, d.

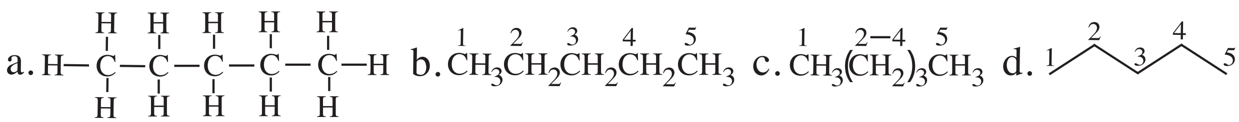


Fig. 1 Three methods of drawing the structure of pentane.

We will begin naming a compound starting with the structural diagram. In our example of pentane, structure a. is easily understood since all of the bonds and atoms are shown.

b. is a little more difficult because we don't see any bonds. To start analyzing the structure, read the formula from the left end, always keeping in mind that carbon atoms always form four bonds. The three hydrogens to the immediate right of carbon #1 belong to that carbon. Carbon #1's fourth bond, then, must be to carbon #2.

Carbon #2 has one bond to carbon #1 and two more bonds to the two hydrogens on the right. That leaves one more bond to account for. It must be to carbon #3. Use the same logic through the rest of the atoms in b..

In illustration c., carbon atoms 2 through 4 have been combined since they are alike.

Formula d. must look a bit mysterious, but it is quite logical. Where a line begins (or ends), and where two lines intersect, a carbon atom is assumed to be found. In example d., carbon #2 has one bond to carbon #1 and one bond to carbon #3. The two remaining bonds are to two hydrogen atoms that are assumed to be present. If a skeletal drawing is missing atoms, those atoms are hydrogens.

Acyclic alkanes (straight chains and branched chains).

There are three parts to the names of alkanes (See Fig. 2):

Prefix	+ Parent +	Suffix
Tells what is attached, how many are attached and where they are attached.	Tells the name of the longest chain.	Tells the name of the functional group.

Fig. 2 The three parts of a name for an organic molecule.

We know the suffix name of the alkanes -*ane*, so now let's work on the parent name. Parent names for the first 10 alkanes are in Fig. 3.

Straight Chain Alkanes

Number of Carbons	**Parent Name**
1	Methane
2	Ethane
3	Propane
4	Butane
5	Pentane
6	Hexane
7	Heptane
8	Octane
9	Nonane
10	Decane

Fig. 3 Parent names for the first 10 alkanes.

Try to name these alkanes. The hydrogens have been omitted since they don't affect the name.

a. C–C–C b. C–C–C–C–C–C–C c. C–C–C–C–C

d. C–C–C–C–C–C–C–C–C e. C

f. C–C–C–C–C–C–C–C–C–C

Substituents.

Substituents are the groups of atoms bonded to the main chain of carbons of an alkane. If the substituents are alkanes, name them by dropping the –*ane* and adding -*yl* to the parent name.

For instance, if ethane became a substituent of octane, the ethane would have to lose a hydrogen atom and become the ethyl group. See Fig. 4 and Fig. 5.

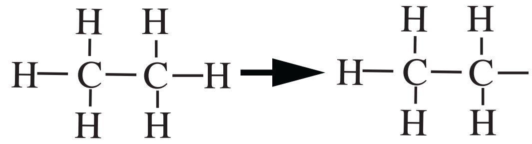


Fig. 4 As a substituent, ethane is named ethyl.

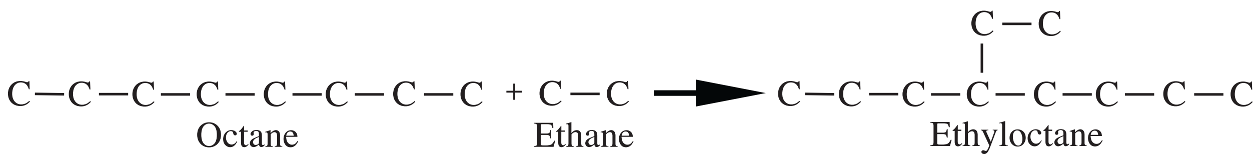


Fig. 5 Ethane as a substituent of octane.

Naming a substituted alkane.

1. Pick the longest chain of carbons, and use its name as the parent name.

   Examples in Fig. 6.

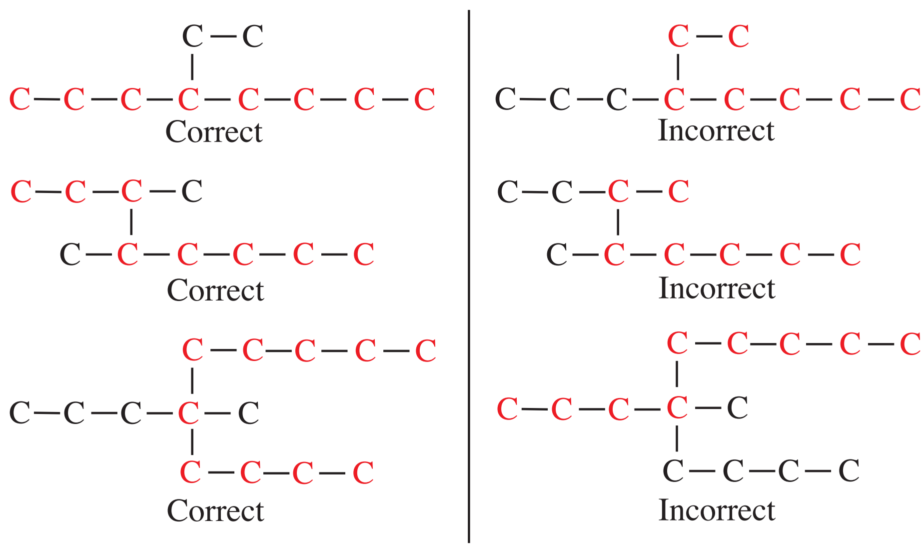


Fig. 6 Picking the chain of the longest length for the parent.

2. Number the carbons choosing the end closest to the first substituent as carbon #1 (C1). See Fig. 7.

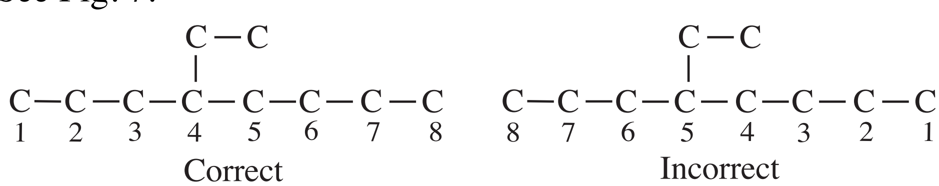


Fig. 7 Picking out a carbon to be C1.

a. If two of the same substituents are at equal distance from both ends, choose either end to be C1. See Fig 8.

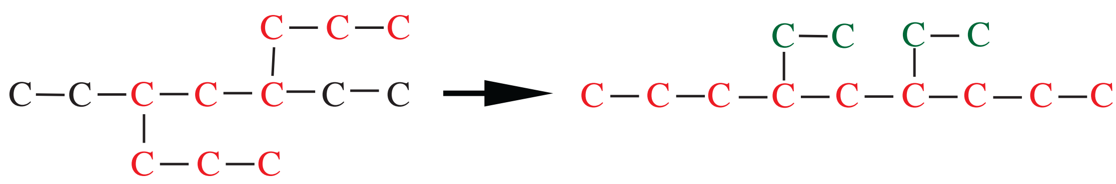


Fig 8 After rearranging the longest chain, both ethyl groups are four carbons away from the end. Use either end as carbon C1.

b. If the main chain has more than two substituents of the same type, choose C1 to give the lowest number to the third substituent. See Fig. 9.

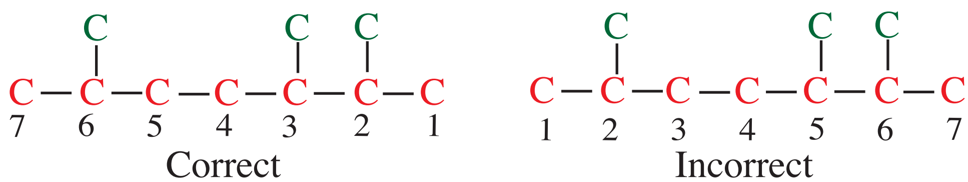


Fig. 9 On the left, the third substituent gets a lower number.

The methyl groups, on the correctly numbered molecule, are at C2, C3, and C6. The methyl groups, on the incorrectly numbered molecule, are at C2, C5, and C6. Lower numbers are preferred.

c. If there are two different substituents at equal distance from both ends, choose the end closest to the alphabetically lower substituent name to be C1. Ignore the Greek prefixes when alphabetizing. See Fig. 9.

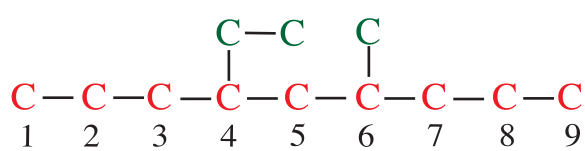


Fig. 9 The end carbon closest to the ethyl group (C-C) is picked as C1.

c. If there are two long chains of equal length, choose the one which has the most substituents. See Fig. 10.

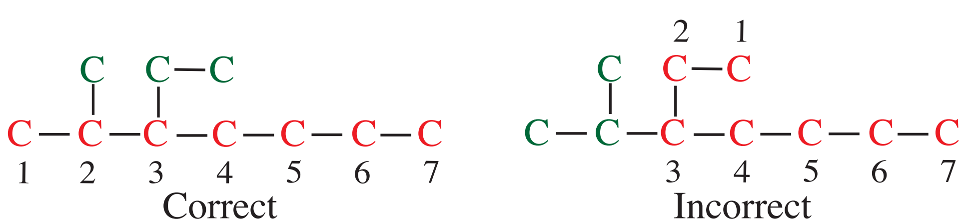


Fig. 10 The structure on the left has two substituents; the one on the right has one.

3. If a molecule has two or more of one type of substituent, use Greek-number prefixes in the name to indicate how many there are.

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

Three examples follow. See Fig. 11, Fig. 12 and Fig. 13. Digits are separated from digits by commas. Dashes separate names from digits.

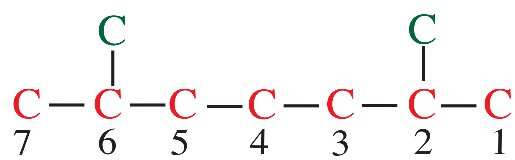


Fig. 11 2,6–dimethylheptane.

Prefix Two methyl groups, attached at the 2nd carbon and 6th carbon.

Parent –hept– means 7. The longest chain has 7 carbons.

Suffix –ane means the molecule is an alkane.

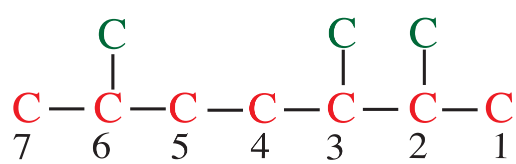


Fig. 12 2,3,6–trimethylheptane.

Prefix Three methyl groups, attached at the 2nd, 3rd, and 6th carbons.

Parent –hept– means 7. The longest chain has 7 carbons.

Suffix –ane means the molecule is an alkane.

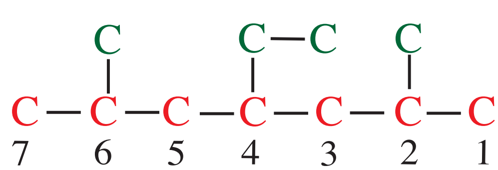


Fig. 13 4–ethyl–2,4–dimethylheptane.

Prefix Two methyl groups, attached at the 2nd and 6th carbons.
One ethyl group bonded to the 4th carbon.

Parent –hept– means 7. The longest chain has 7 carbons.

Suffix –ane means the molecule is an alkane.

Notice that the di– was not included in the alphabetizing of the names of the substituents.

Cyclic alkanes (rings of carbon atoms).

Put the prefix cyclo– in front of the parent name. The parent name tells the number of carbons in the ring. Remember to place enough hydrogens at the corners (where the carbons are) so that each carbon has four bonds. See Fig. 14.

Cyclobutane Cyclopentane Cyclohexane Cycloheptane

Fig. 14 Some examples of cyclic alkanes.

Alkenes (molecules with at least one double bond).

1. The naming of alkenes is much the same as it is for the alkanes, but for alkenes the position of the double bond must be specified, and the suffix –ene is used. Two examples follow in Fig. 15.

C=C–C–C–C–C
1 2 3 4 5 6
1-hexene

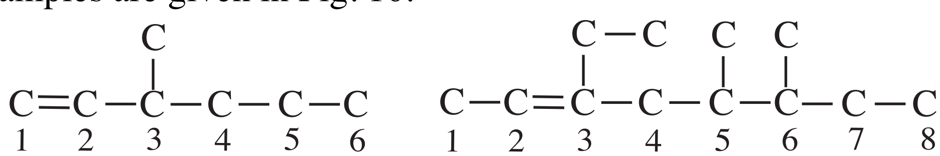
C–C=C–C–C–C
1 2 3 4 5 6
2-hexene

Fig. 15 1-hexene and 2-hexene.

2. To name alkenes with substituents, use the same rules as we used for alkanes.

a. Make sure that the longest chain contains the double bond. Number the chain so that the double bond starts at the lowest number as in Fig. 15 above.

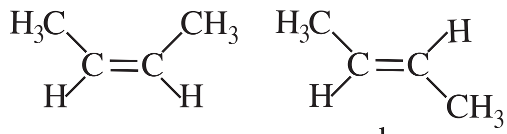
b. Two examples are given in Fig. 16.



3-methyl-1-hexene 3-ethyl-5,6-dimethyl-2-octene

Fig. 16 Applying naming rules to two alkenes.

c. An interesting problem arises in the naming of certain alkenes. When we add hydrogen atoms into the structural diagrams of some alkenes, we see that two different arrangements of atoms are possible. See Fig. 17 below.



a. b.

Fig. 17 Two versions of 2–butene.

Rotation around a double bond is not possible, so these are different compounds. But how can we differentiate between them with a name?

d. Introducing *cis*, *trans* designations. If the two –CH3 (methyl) groups are on the same side across the double bond, we call that *cis*. If they are on opposite sides then the term *trans* is applied. In Fig. 17, a. is called *cis*–2–butene, and b. is *trans*–2–butene.

Alkynes (molecules with at least one triple bond).

1. These molecules are named using a system very much like the one used for naming alkenes. The position of the triple bond must be specified, and the suffix –yne is used. Two examples follow in Fig. 18.

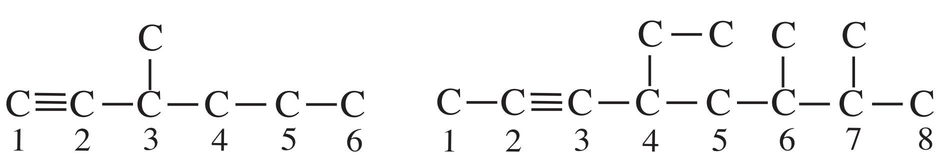
1-hexyne 2-hexyne

Fig. 18 1-hexyne and 2-hexyne.

2. To name alkynes with substituents, use the same rules as we used for alkanes.

a. Make sure that the longest chain contains the triple bond. Number the chain so that the triple bond starts at the lowest number as in Fig. 18 above.

b. Two examples are given in Fig. 19.



3-methyl-1-hexyne 4-ethyl-6,7-dimethyl-2-octyne

Fig. 19 Applying naming rules to two alkynes.

Aromatics (cyclic molecules with alternating double bonds).

1. The only compounds that we will deal with here are all based on the simplest aromatic hydrocarbon, benzene. Benzene is cyclic with alternating double bonds among its six carbon atoms. Fig. 20 shows the benzene skeleton with hydrogens on the left and on the right, the more common view of the molecule without the hydrogens.

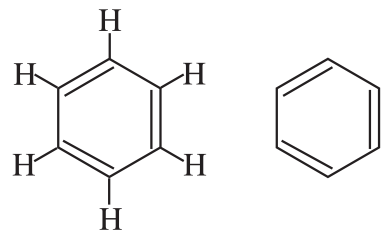
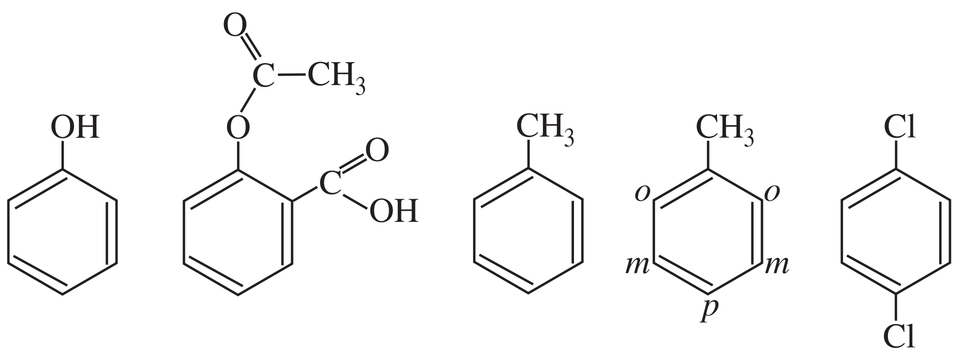


Fig. 20 Benzene with hydrogen atoms and alternating double bonds on the left. On the right, the skeletal structure without hydrogen.

2. The some derivatives of benzene have common names. See Fig. 21.



a. b. c. d. e.

Fig. 21 Benzene derivatives.

In Fig. 21, a. is phenol; b. is acetylsalicylic acid (aspirin); c. is toluene; d. shows the symbols for the names of the positions relative to the methyl group ($–CH_3$) at the top of the benzene ring. *o* is for *ortho*–, *m* is for *meta*–, and *p* is for *para*–. Therefore, the name of e. is *para*–dichlorobenzene.

Carbon compounds with elements in addition to C and H.

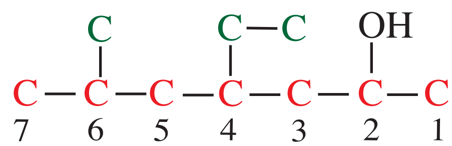
1. Organics compounds with oxygen.
a. **Alcohols** are carbon compounds with at least one –OH (hydroxyl) group bonded to a carbon atom.

To name alcohols, choose the longest chain which includes the hydroxyl group.
Step 1. Write down the parent name.
Step 2. If the compound is an alkane, write down –ane.
Step 3. List the substituents in alphabetical order along with the numbers of the carbon atoms they are bonded to.

Step 4. Write down –ol and the number of the carbon the hydroxyl group is bonded to. Drop the letter e, and replace it with ol.

Step 5. Combine the parts of the full name.

See Fig. 22 for an example.



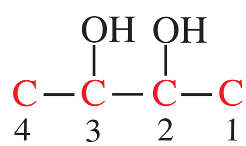
Step 1. Hex–
Step 2. –ane
Step 3. 4–ethyl, 6–methyl
Step 4. –ol
Step 5. 4–ethyl–6–methylhexanol

Fig. 22 Applying the rules for naming alcohols.

Alcohols with more than one –OH group.

Use the same procedure as you just learned, except in step 4 use –diol for an alcohol with two –OH, use –triol for an alcohol with three –OH, and so on.

See Fig. 23 for an example.



Step 1. But–
Step 2. –ane
Step 3. Not needed
Step 4. –diol
Step 5. 2,4–butanediol

Fig. 23 Applying the rules to name diols.

b. **Organic acids,** also called carboxylic acids, all have a –COOH group as their C1 carbons. There are two methods of naming the other carbons in the molecule. In addition to using numbers, in some cases the other carbons have Greek letter designations as you can see in Fig. 24. To derive the name of the acid, simply take the parent name, drop the –e, and then add –oic acid. If there are substituents, name them in the usual way, using either the numbers or the Greek letters for their locations. See Fig. 25 which shows the simplest amino acid with the common name glycine.

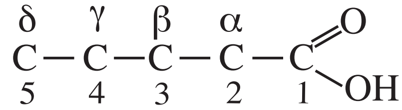


Fig. 24 Pentanoic acid.

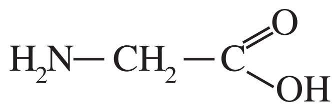


Fig. 25 Glycine (α–aminoethanoic acid, or 2–aminoethanoic acid).

c. An **ester** is made of a molecule of an acid (either organic or inorganic) bonded to an alcohol. To name the ester formed by reacting an acid with an alcohol, first write the name of the alcohol as the substituent using the parent name, dropping the –e and replacing it with –yl. Leave a space, and then name the acid by dropping the –ic and adding –ate. An example using butanoic acid and 1–propanol is in Fig. 26.

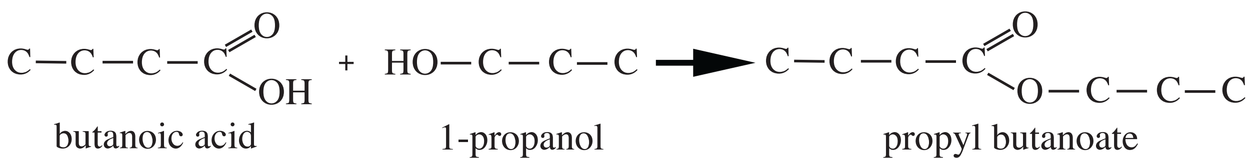


Fig. 26 Forming and naming an ester from butanoic acid and 1–propanol.

d. An **aldehyde** is an organic compound with a double bonded oxygen on an end carbon. All aldehydes have the kind of carbon as shown in Fig. 27.

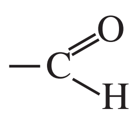


Fig. 27 An aldehyde carbon group.

Aldehydes are named by dropping the –e from the parent alkane name and replacing it with –al. As with acids, you don't have to number the position of the aldehyde carbon because it can only appear on an end of the molecule. See Fig. 28.

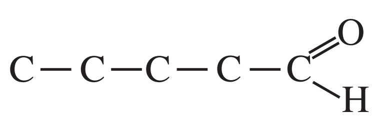


Fig. 28 Pentanal.

e. A **ketone** is a functional group related to an aldehyde. Ketones have their double bonded carbons and oxygens (C = O) that are not on an end of the longest chain. To name a ketone, write the number of the carbon that has the double bonded oxygen followed by a dash and then the parent name replacing the –e with –one. See Fig. 29.

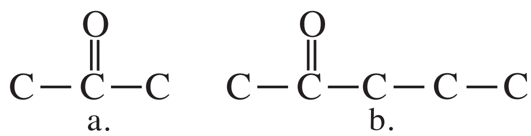


Fig. 29 a. propanone (commonly-acetone); b. 2–pentanone.

f. **Ethers** are organic compounds with an oxygen atom between two carbon atoms. In naming ethers, state the names of the alkyl groups in alphabetical order followed by the word ether. See Fig. 30.

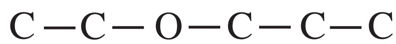
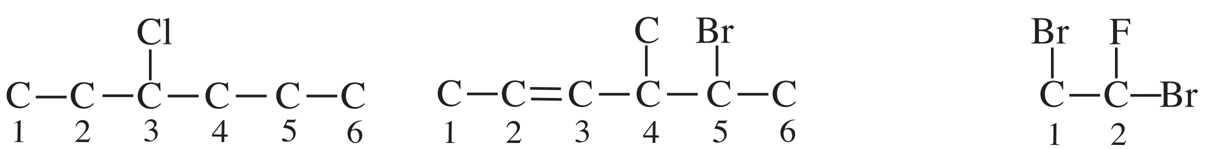


Fig. 30 Ethylmethyl ether.

g. **Halides** are halogen containing organic compounds that can be named using the basic rules you have already learned. The only additional thing we must learn is the prefix for the halogen in the compound. See Fig. 31 for examples. Also see Fig. 21 for a chlorinated benzene.

Halogen	Prefix
Bromine (Br)	bromo–
Chlorine (Cl)	chloro–
Fluorine (F)	fluoro–
Iodine (I)	iodo–



3-chlorohexane   5-bromo-4-methyl-2-hexene   1,2-dibromo-2-fluoroethane

Fig. 31 Examples of names of halides.

Hydrocarbon Lab Instructions

1. Obtain one Supermodels *Organic Chemistry Molecular Mode l* kit for your group.

2. Make one copy of the lab the "Master" copy and have the instructor stamp only that one sheet. Each student should fill out a sheet, but only the Master copy will be used for the final grade.

3. Use a pencil to fill in all blank boxes, except the "Model" row. This is where your instructor stamps or initials when your model is correct.

4. Build the models in sequence. Both lab partners show the instructor groups of models (Group A, Group B, Group C, Group D) for verification. Bring up the last three models (E, F, and G), one at a time.

5. Students should be prepared to answer questions about the models. Students may use scratch paper to draw Lewis structures to help determine structural formulas.

Functional Group Lab Instructions

1. Obtain one Supermodels *Organic Chemistry Molecular Model* kit for your group.

2. Make one copy of the lab the "Master" copy and have the instructor stamp only that one sheet. Each student should fill out a sheet, but only the Master copy will be used for the final grade.

3. Use a pencil to fill in all blank boxes, except the "Model" row. This is where your instructor stamps or initials when your model is correct.

4. Build the models in sequence. Both lab partners show the instructor groups of models (Group A, Group B, Group C, Group D) for verification. Bring up the last three models (E, F, and G), one at a time.

5. Students should be prepared to answer questions about the models. Students may use scratch paper to draw Lewis structures to help determine structural formulas.

Carboxylic Acid Ester Lab Instructions

Materials: 5 test tubes, rack, hot water bath, five 150 mL beakers, stirring rod, carboxylic acids, alcohols, sulfuric acid.

Objective: To synthesize esters from carboxylic acids and alcohols, and to study their structures using models.

1. Label five medium test tubes 1-5. Obtain safety goggles and an apron. Wear the goggles for the duration of the lab.

2. To test tube #1, add about 2 mL (40 drops) of ethanoic acid and about 2.5 mL (50 drops) of 1-pentanol.

3. To test tube #2, add about 2 mL of ethanoic acid and about 2.5 mL of ethanol.

4. To test tube #3, add about 2 mL of butanoic acid and about 2.5 mL of ethanol.

5. To #4 add about 2 mL of ethanoic acid and about 2.5 mL of 1-octanol.

6. To test tube #5, add about 1 g of salicylic acid and about 2.5 mL of methanol.

7. Add 10 drops of concentrated sulfuric acid to each test tube. (Caution! the acid may spatter out) Stir each test tube, cleaning the stirring rod between each use.

8. Heat the test tubes in a water bath for 15 minutes, stirring each mixture occasionally.

9. Remove the test tubes from the hot water, and add about 2 mL of R.O. water to each test tube and swirl.

10. Pour mixtures #1-#5 into separate 150 mL beakers and swirl.

11. Note the odor of each ester by wafting, and relate this smell to a common odor such as wintergreen, bananas, apples, grapes, pineapple. Record the odor in the data table.

Do not taste the esters!

12. Discard the contents of the test tubes into the sink and rinse.

Ester Lab Conclusion:

1. Demonstrate the structure of each carboxylic acid, alcohol, and ester produced by building a molecular model.

2. Fill in the spaces in the data sheet, except in the column headed “Model.” Show your model and data sheet to your instructor.

Hydrocarbons

Names_____________________________ Date__________ Period_____

	Name	Chemical Formula	Type of Compound	Structural formula (use dashes)	Electron dot formula (use dots)	Model Checked
A1	methane		Alkane			
A2	ethane					
A3	butane					
B1		C_5H_{12}			Omit	
B2		C_5H_{12}			Omit	
B3		C_5H_{12}			Omit	
C1	cyclohexane				Omit	
C2	benzene (4-peg)				Omit	
C3	benzene (3-peg)				Omit	
D1	ethene					
D2	trans-2-pentene				Omit	
D3	cis-2-pentene				Omit	
E	propyne					
F	3-ethyl-3,5,5-trimethyloctane				Omit	
G	2,3-dimethyl-1-butene				Omit	

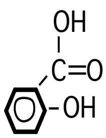
Functional Groups

Names________________________________ Date___________ Period_____

	Name	Chemical Formula	Type of Compound	Structural formula	Model Checked
A1	methanol		Alcohol		
A2	2-butanol				
A3	1,2-ethandiol				
B1	propanone (acetone)				
B2	3-hexanone				
B3	3-methylbutanal				
C1	phenol				
C2	methylbenzene (toluene)				
C3	paradichlorobenzene				
D1	propanoic acid				
D2	ethylpropyl ether				
D3	propylethanoate				
E	dichlorodifluoromethane				
F	2-bromopentanal				
G	2,2-dichloroethanal				

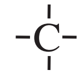
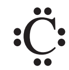
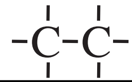
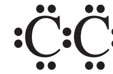
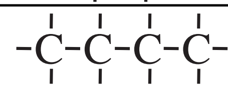
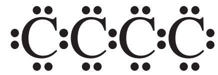
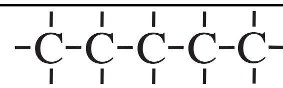
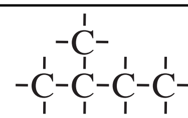
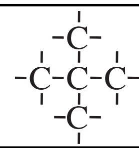
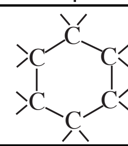
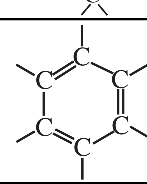
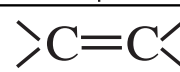
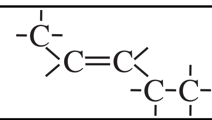
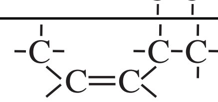
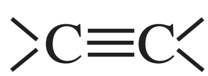
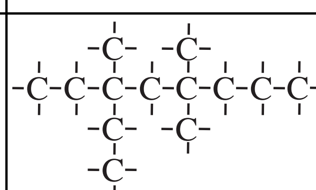
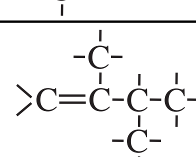
Ester Lab

Names___________________________________ Date__________ Period____

#	Carboxylic Acid	Chemical Formula	Model checked	Alcohol	Chemical Formula	Model checked
1	ethanoic acid			1-pentanol		
2	ethanoic acid			ethanol		
3	butanoic acid			ethanol		
4	ethanoic acid			1-octanol		
5	salicylic acid 	$C_7H_6O_3$		methanol		

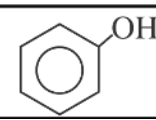
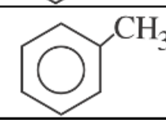
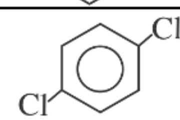
#	Name of Ester formed	Chemical Formula	Other Product	Structural Formula	Odor	Model Checked
1						
2						
3						
4						
5						

Names________________________________ Hydrocarbons Key Date__________ Period_____

	Name	Chemical Formula	Type of Compound	Structural formula (carbon skeleton)	Electron dot formula (use dots)	Model Checked
A1	methane	CH_4	Alkane			
A2	ethane	C_2H_6	Alkane			
A3	butane	C_4H_{10}	Alkane			
B1	pentane	C_5H_{12}	Alkane		Omit	
B2	2-methylbutane	C_5H_{12}	Alkane		Omit	
B3	2,2-dimethylpropane	C_5H_{12}	Alkane		Omit	
C1	cyclohexane	C_6H_{12}	Cyclic Alkane		Omit	
C2	benzene (4-peg carbon)	C_6H_6	Aromatic		Omit	
C3	benzene (3-peg carbon)	C_6H_6	Aromatic		Omit	
D1	ethene	C_2H_4	Alkene			
D2	trans-2-pentene	C_5H_{10}	Alkene		Omit	
D3	cis-2-pentene	C_5H_{10}	Alkene		Omit	
E	propyne	C_2H_2	Alkyne			
F	3-ethyl-3,5,5-trimethyloctane	$C_{13}H_{28}$	Alkane		Omit	
G	2,3-dimethyl-1-butene	C_6H_{12}	Alkene		Omit	

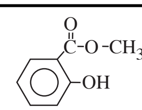
Functional Groups Key

Names________________________________ Date______ Period____

	Name	Chemical Formula	Type of Compound	Structural formula	Model Checked
A1	methanol	CH_3OH	Alcohol	H_3C-OH	
A2	2-butanol	C_4H_9OH	Alcohol	OH $H_3C-CH_2-CH-CH_3$	
A3	1,2-ethandiol (ethylene glycol)	$C_2H_6(OH)_2$	Alcohol	$HO-CH_2-CH_2-OH$	
B1	propanone (acetone)	C_3H_6O	Ketone	O $H_3C-C-CH_3$	
B2	3-hexanone	$C_6H_{12}O$	Ketone	O $CH_3CH_2-C-CH_2CH_2CH_3$	
B3	3-methylbutanal	$C_5H_{10}O$	Aldehyde	O CH3 $H-C-CH_2-CH-CH_3$	
C1	phenol	C_6H_6O	Aromatic Alcohol		
C2	methylbenzene (toluene)	C_7H_8	Aromatic Alkane		
C3	paradichlorobenzene	$C_6H_4Cl_2$	Aromatic Halocarbon		
D1	propanoic acid	$C_3H_6O_2$	Carboxylic acid	O $HO-C-CH_2-CH_3$	
D2	ethylpropyl ether	$C_5H_{12}O$	Ether	$CH_3CH_2-O-CH_2CH_2CH_3$	
D3	propyl ethanoate	$C_5H_{10}O_2$	Ester	O $H_3C-C-O-CH_2CH_2CH_3$	
E	dichlorodifluoromethane	CCl_2F_2	Halocarbon	F $Cl-C-Cl$ F	
F	2-bromopentanal	C_5H_9OBr	Aldehyde Halocarbon	O Br $H-C-CH-CH_2CH_2-CH_3$	
G	dichloroethanal	$C_2H_2OCl_2$	Aldehyde Halocarbon	O Cl $H-C-CH$ Cl	

Names____________________________________ Ester Lab Key Date______Period____

#	Carboxylic Acid	Chemical Formula	Model Checked	Alcohol	Chemical Formula	Model Checked
1	ethanoic acid	CH_3CO_2H		1-pentanol	$C_5H_{11}OH$	
2	ethanoic acid	CH_3CO_2H		ethanol	C_2H_5OH	
3	butanoic acid	$CH_3CH_2CH_2CO_2H$		ethanol	C_2H_5OH	
4	ethanoic acid	CH_3CO_2H		1-octanol	$C_8H_{17}OH$	
5	salicylic acid	$C_7H_6O_3$		methanol	CH_3OH	

#	Name of Ester formed	Chemical Formula	Other Product	Structural Formula	Odor	Model Checked
1	1-pentyl ethanoate	$H_3CCO_2CH_2(CH_2)_3CH_3$	H_2O	$H_3C-\overset{O}{\overset{\|}{C}}-O-CH_2-CH_2-CH_2-CH_3$	bananas	
2	ethyl ethanoate	$H_3CCO_2CH_2CH_3$	H_2O	$H_3C-\overset{O}{\overset{\|}{C}}-O-CH_2-CH_3$	ripe fruit	
3	ethyl butanoate	$CH_3(CH_2)_2CO_2CH_2CH_3$	H_2O	$CH_3-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-O-CH_2-CH_3$	pineapples	
4	1-octyl ethanoate	$H_3CCO_2CH_2(CH_2)_6CH_3$	H_2O	$H_3C-\overset{O}{\overset{\|}{C}}-O-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3$	oranges	
5	methyl salicylate	$HOC_6H_4CO_2CH_3$	H_2O		wintergreen	