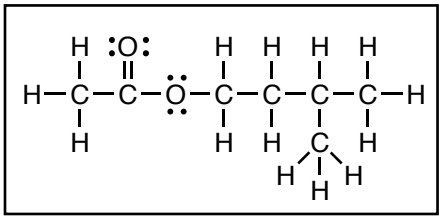
# Learning Guide for Chapter 2 - Introduction to Organic molecules

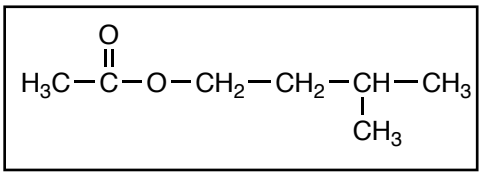


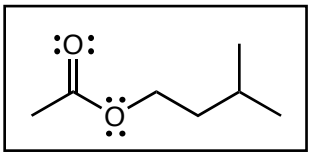
## I. Ways to represent organic molecules

The molecule which causes the odor of ripe bananas is shown in several different ways below. Identify each and explain it characteristics.

$C_7H_{14}O_2$





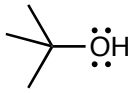


isopentyl acetate

Here is the line structure for tert-butyl alcohol. What is its molecular formula, condensed structure, and line structure?

name: tert-butyl alcohol

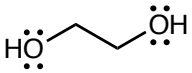
condensed structure:

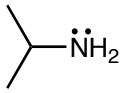
line structure: 

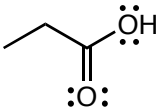
Lewis structure:

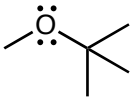
molecular formula:

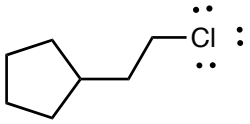
Give a molecular formula and condensed structure for the following line structures.



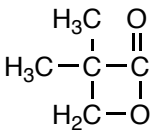


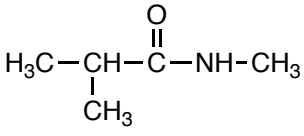


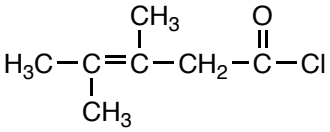


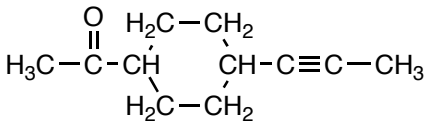


Give a line structure for the following condensed structures.









## II. Classification of Organic Molecules

Why is it important to put organic compounds into categories?

How do chemists decide what categories to create?

General terms:

compounds with only C, H:

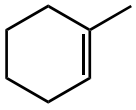
compounds containing a benzene ring:

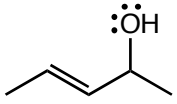
compounds which don't have a benzene ring:

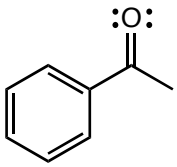
compounds containing carbon-carbon
double or triple bonds (not in a benzene ring):

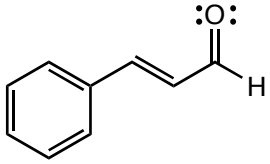
compounds which don't have a carbon-carbon
double or triple bond (or a benzene ring):

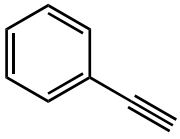
Label the following compounds with all terms that apply to them.

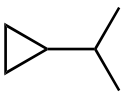


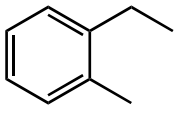


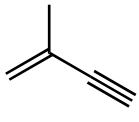



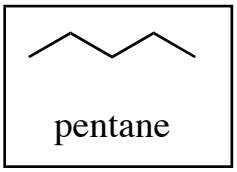
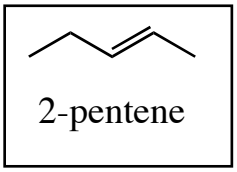
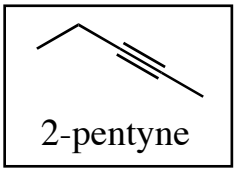




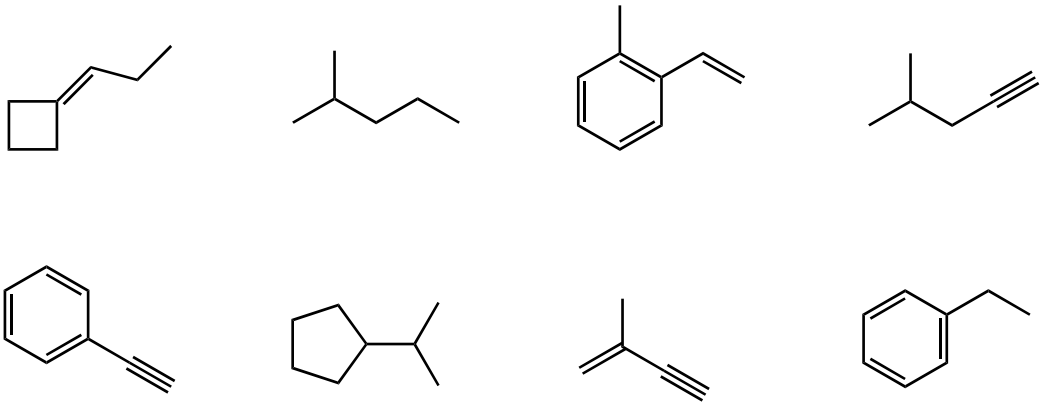


What is a functional group?

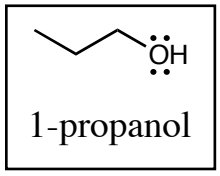
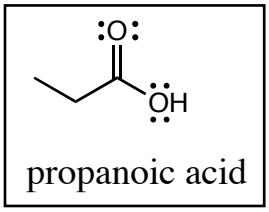
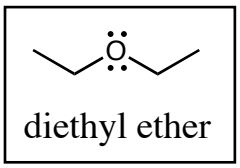
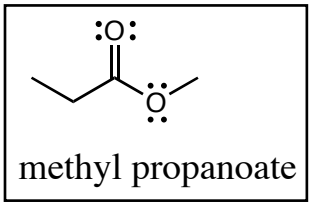
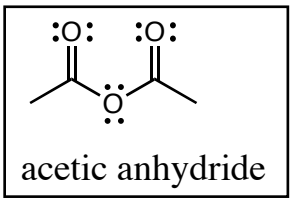
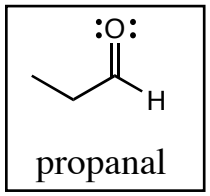
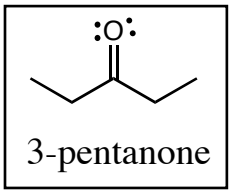
<u>Hydrocarbon functional groups</u>

| | functional group | description | name |
|---|---|---|---|
|  pentane | | | |
|  2-pentene | | | |
|  2-pentyne | | | |

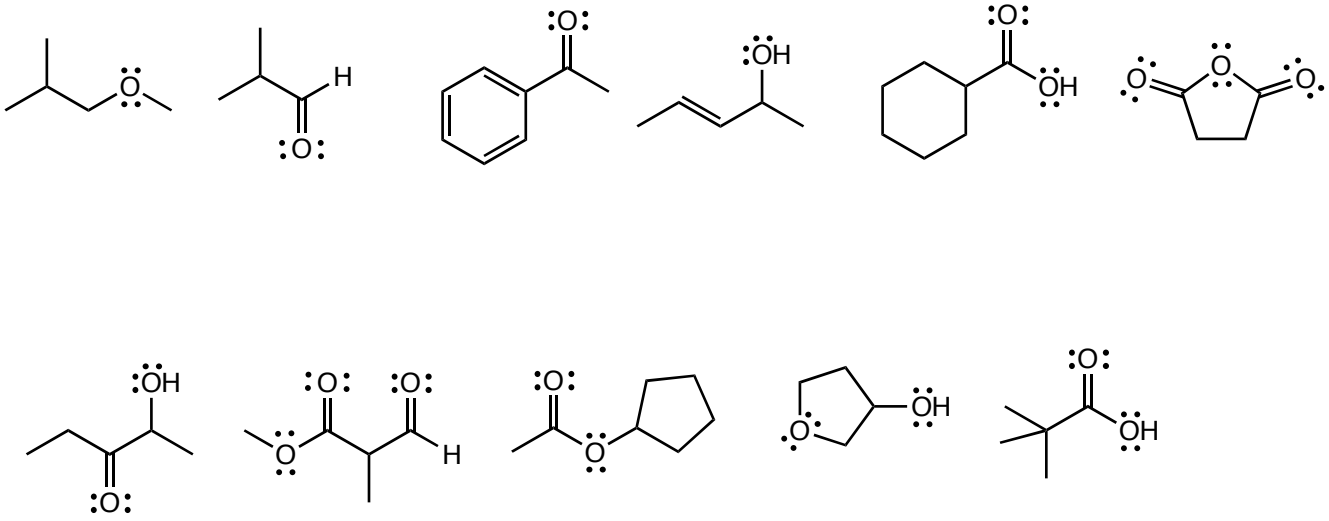
Label the alkanes, alkenes, and alkynes below.



Functional groups containing only oxygen:

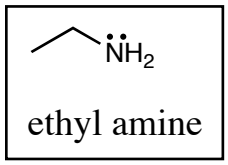
| | functional group | description | name |
|---|---|---|---|
|  | | | |
|  | | | |
|  | | | |
|  | | | |
|  | | | |
|  | | | |
|  | | | |

Label the following compounds with the functional group they contain.

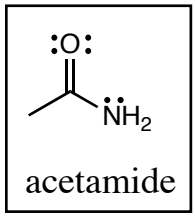


Functional groups containing nitrogen:

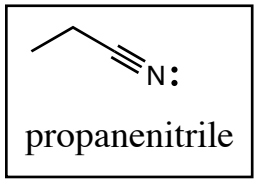
| functional group | description | name |
|---|---|---|



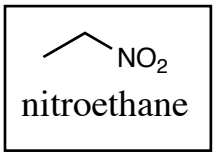
ethyl amine



acetamide

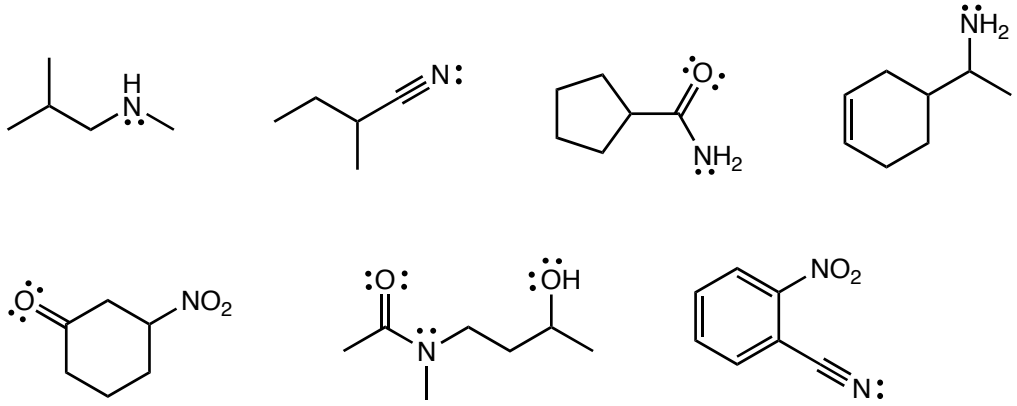


propanenitrile

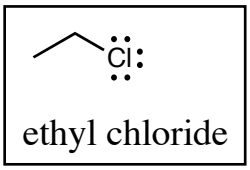
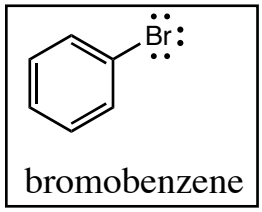
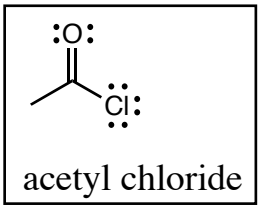


nitroethane

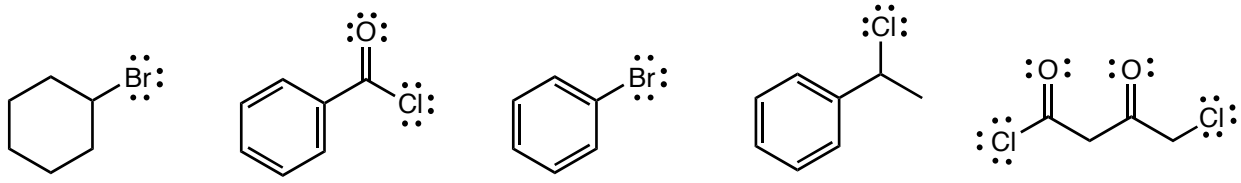
Label the compounds below.



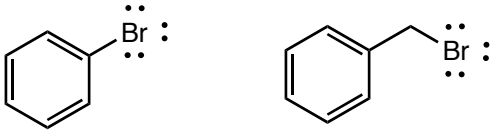
Functional groups containing halogens:

| functional group | description | name |
|---|---|---|
|  | | |
|  | | |
|  | | |

Label the compounds below.

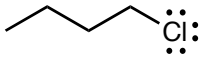


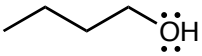
How are these two compounds different?

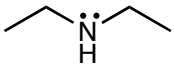


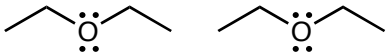
What would each of the following compounds become if a C=O was added next to the existing functional group?

alkane 

alkyl chloride 


alcohol 


amine 


ether 


What can you tell about the following compounds from their names?

N-ethylpropanamine

3-methoxy-1-propanol

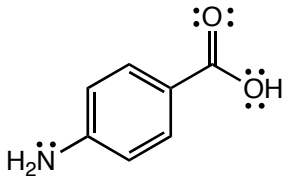
3-bromobenzamide

3-oxo-pentanoic acid

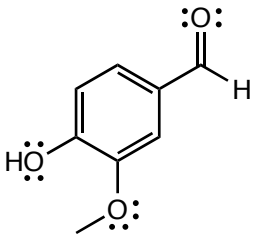
4-nitro-2-pentene

methyl 3-cyanobenzoate

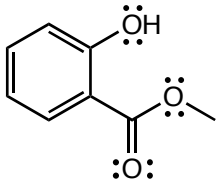
Identify the functional groups present in the following compounds. Which are aromatic? Which are unsaturated?



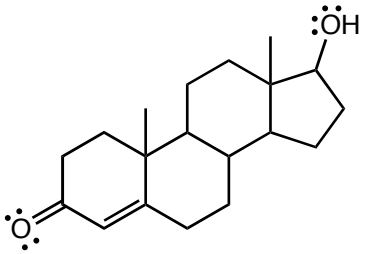
p-aminobenzoic acid - PABA
(used in sunblocks)



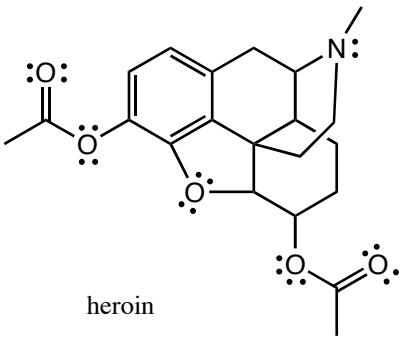
vanillin



methyl salicylate
(oil of wintergreen)



testosterone



heroin

## III. Physical Properties of Organic Molecules

List some physical properties of organic compounds.

What determines the physical properties of a compound?

What can we predict by looking at the structure of molecules?

Intermolecular forces

What is an intermolecular force?

What are the three intermolecular forces? How do they compare in strength?

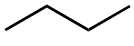
How are these different from covalent and ionic bonds?

Which is stronger, a covalent bond or a hydrogen bond?

What causes Van der Waals forces?

What kinds of molecules experience Van der Waals forces?

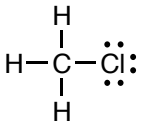
In what kinds of molecules will van der Waals forces be significant?

Example: butane 

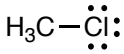
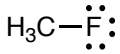
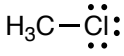
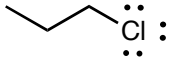
What factors affect the strength of Van der Waals forces?

What are dipole forces?

What kinds of molecules experience dipole forces?

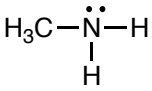
Example: chloromethane 

What factors affect the strength of dipole forces?

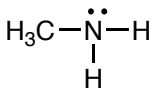
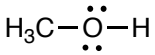
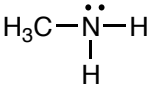
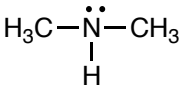





What is hydrogen bonding?

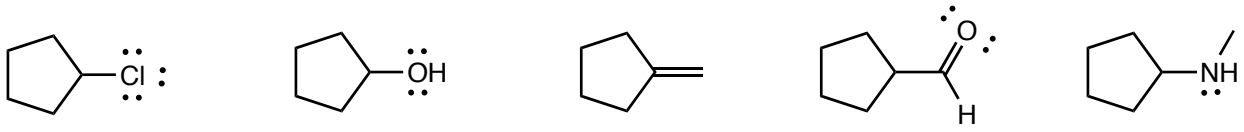
What kinds of molecules experience hydrogen bonding?

Example: methyl amine 

What factors affect the strength of hydrogen bonding?

What will be the most important intermolecular force for each of the following molecules?




<u>States of matter and transitions between them</u>

What are the three states of matter that an organic compound can be in?

Consider a container of fireflies, a container of apples, and a container of snakes.

Which is most like a gas? Why?

Which is most like a solid? Why?

Which is most like a liquid? Why?

What happens when a solid changes to a liquid?

What is a melting point?

How does the size of the molecule affect the melting point? Why is this so?

How does the strength of the intermolecular forces affect the melting point and why?

Does atmospheric pressure affect the melting point?

What happens when a liquid changes to a gas?

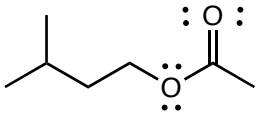
What is a boiling point?

How does the size of the molecule affect the boiling point? Why is this so?

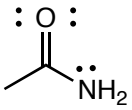
How does the strength of the intermolecular forces affect the boiling point and why?

Does atmospheric pressure affect the boiling point? Why?

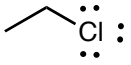
What state of matter will the following compounds be in at room temperature?




mp -78ºC; bp 142 ºC

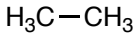



mp 80ºC; bp 221 ºC



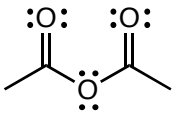
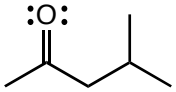

mp -139ºC; bp 12.3 ºC

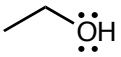
Which of the two molecules below would you expect to have a higher melting and boiling point? Why?

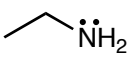
1)  ethane  butane

2)  pentane  2,2-dimethylpropane

3)  dimethyl ether  propane

4)  acetic anhydride  4-methyl-2-pentanone

5)  dimethyl ether  ethanol

6)  dimethyl amine  ethyl amine

Solubility

What does it mean to say that two substances are soluble in each other?

Give an example of:

a solid dissolving in a liquid

a gas dissolving in a liquid

a liquid dissolving in another liquid

What does it look like when one substance dissolves in another?

Why does salt dissolve in water?

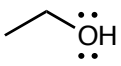
Why do ethanol and water dissolve in each other?

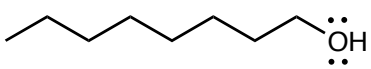
Why doesn't hexane dissolve in water?

Why are all gases soluble in each other?

Would the following compounds be more likely to dissolve in water or hexane?

propylene 

ethanol 


1-octanol 


acetone 


sodium butanoate