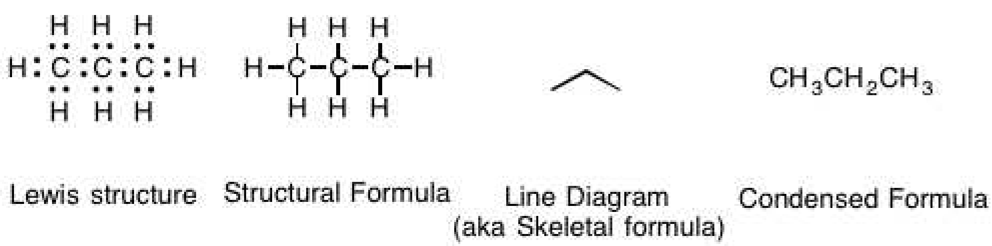
I Standard Methods

There are many ways to convey information about organic molecules. Each method has advantages and disadvantages to its use and many are situationally used. You should be familiar with all the methods used (especially Line Drawings). You should also be flexible in how you think about the molecules, and be able to shift from one form of drawing to another.

Below each section is a list of example molecules, they are the same for all sections, use them to see the similarities/differences and the advantages/disadvantages of each method.

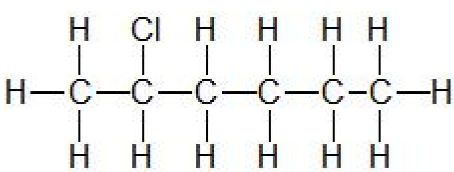
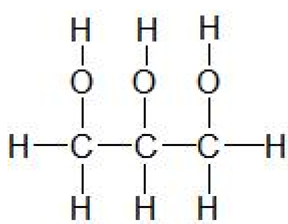
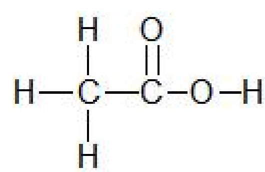
Lewis Structures :

Lewis structures show the full structure of the molecule and include the lone pair electrons. Depending on the book/web-site bonds may be either shown as lines (like in class) or as electrons between two atoms (indicating they are shared).



Full Structural Formula:

Essentially the Lewis Dot structure of the molecule (minus lone pair electrons, see Ch 11 for review). It conveys structural information in great detail and the class of the molecule is very apparent. It is also used often for chemical reactions because it conveys the complete structural information for the reaction mechanism. One disadvantages is size, it takes up multiple lines, thus only works well in figures (not normal text). The other disadvantage is it conveys a lot of information, that may not be needed, and can distract from the more important structural information. I rarely draw out full structural formula's, there are alternative ways to convey the same information in a simpler and more concise manner, and I'm to lazy/efficient to draw them.

Ex:  ,  , 

Molecular Formula:

Generally conveys the least amount of information as it contains no structural information, and does not even allow one to determine the class of the molecule. Generally used when the only information required is the number and type of atoms (for instance when calculating molecular weights) or to save space.

Ex: C_6H_{14}, $C_3H_6O_3$, $C_2H_3O_2$

Condensed Structural Formula:

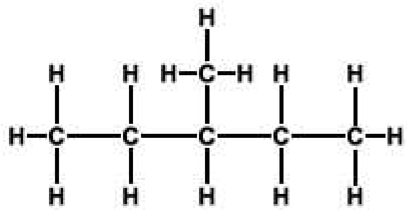
Contains some structural information, but no real details. It does allow the identification of the class of the molecule. Its main advantage is they information fits on one line of text (thus works well when using the formula in paragraphs). Disadvantages are they can be confusing for larger molecules.

Ex: $CH_3CHClCH_2CH_2CH_2CH_3$, CH_3COOH

To shorten the notation (and make it more readable) there are two conventions regarding the use of parenthesis. The first is to use parenthesis to indicate a group is repeated many times.

Ex: Condensed $CH_3CH_2CH_2CH_2CH_2CH_2CH_3$ vs With Parenthesis $CH_3(CH_2)_5CH_3$

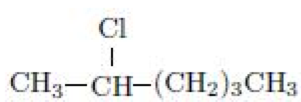
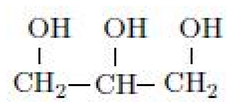
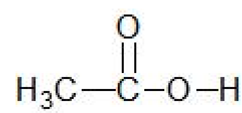
The second convention is to use parenthesis to indicate side chains or functional groups in a molecule. The parenthesis show the group attached to the carbon to the left.

Ex: $CH_3CH_2CH(CH_3)CH_2CH_3$ is drawn 

An excellent guide to condensed structures is linked at www.chemhaven.org/che102 from the web-site Mastering Organic Chemisry https://www.masterorganicchemistry.com/2011/06/20/deciphering-what-the-brackets-mean/

Hybrid Structures:

A compromise between condensed and full structural formula's. Generally shows the full structure for the region of interest on the molecule and uses a condensed structure for the rest of the molecule. We will often use these in class when showing reaction mechanisms.

Ex: $CH_3CHCl(CH_2)_3CH_3$ or , , 

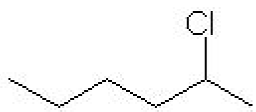
Naming Molecules:

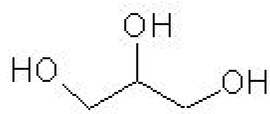
Chemical names are designed to be unique for every possible chemical compound (there are billions). The rules were determined by the Union of Pure and Applied Chemists (IUPAC). The advantage to using chemical names is that they are often simple to represent, the major disadvantage is that they don't make structural features obvious, and often it is harder to visualize how the reaction occurs.

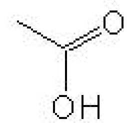
Ex: 2-chlorohexane, 1,2,3-propanetriol, ethanoic acid

Line Drawings:

This is he "lazy/efficient" chemists way to give structural information with less work. Line drawings assume that the reader (you) know some information about organic chemistry, and thus that information can be left out of the structure. Line drawings typically do not show the hydrogen atoms (unless they are important in the reaction), thus reducing the time/effort required to draw a structural model. Time is also saved by representing carbon atoms as either the endpoints of the line or the vertex of the lines, saving even more time/effort. They take a little getting used to, but the time/effort saved over drawing full structural models is well worth the effort to learn how to draw them. The main disadvantage of line drawings is that they do assume a knowledgeable reader, and imply a lot of information.

Ex: 

, 

, 

II Examples

A few examples might clarify matters, please refer to the table below for each example

Example 1

A simple example to show how line drawings compare to structural models. Each point/bend in the structure indicates a carbon atom. Note that we leave off the hydrogen atoms in line drawings. The number of hydrogen attached to each carbon is implied because we know that carbon has four bonds in hydrocarbons.

Example 2

Example 2 shows another simple alkane. The key part to note here is the condensed structure showing the use of $(CH_2)_3$ to indicate several CH_2 groups in a row.

Example 3

A double bond is shown.

Example 4

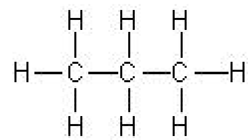
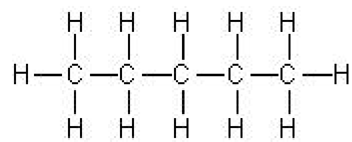
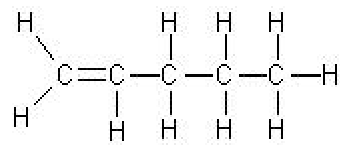
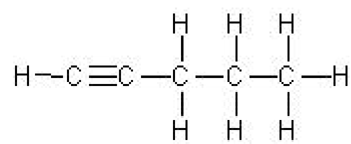
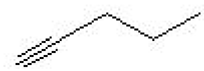
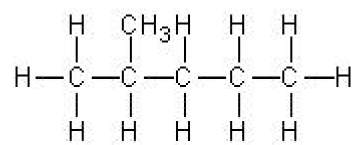
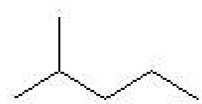
A triple bond is shown

Example 5

In the line drawing a methyl group is shown attached to carbon 2. Also note how a methyl group is shown in the condensed structure.

Example 6

Shows how a chlorine group/atom is shown.

Ex #	Molecular	Condensed	Structural	Line
1	C_3H_8	$CH_3CH_2CH_3$		
2	C_5H_{12}	$CH_3CH_2CH_2CH_2CH_3$ or $CH_3(CH_2)_3CH_3$		
3	C_5H_{10}	$CH_2CHCH_2CH_2CH_3$ or $CH_2{=}CHCH_2CH_2CH_3$		
4	C_5H_8	$CHCCH_2CH_2CH_3$ or $CH{\equiv}CCH_2CH_2CH_3$		
5	C_6H_{14}	$CH_3CH(CH_3)CH_2CH_2CH_3$ or $CH_3CH(CH_3)(CH_2)_2CH_3$		
6	$C_6H_{13}Cl$	$CH_3CHClCH_2CH_2CH_3$ or $CH_3CHCl(CH_2)_2CH_3$