

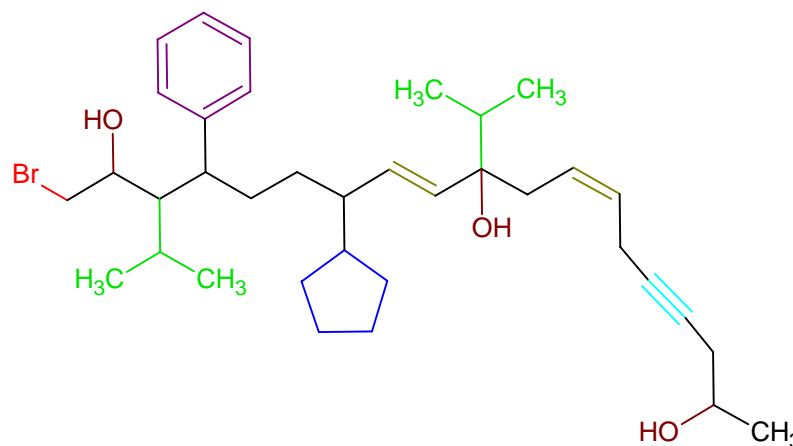
Nomenclature Study Guide

The following summary of nomenclature is useful for the compounds you will be asked to name in Chem 212. It is not a complete list of the official IUPAC rules, which take up several books! Many molecules which are too complicated for these rules are still important for reactions and biochemistry, and will appear in the text and in class.

- Find the parent chain or ring by finding the longest chain or largest ring containing the as many functional groups as possible.
 - If the chain is larger than the ring, the chain is the parent, otherwise the ring is the parent.
 - If the ring is aromatic, choose the parent from the list in order of priority (know these names; the order is the same as the priority of functional groups, except for the last two): benzoic acid > benzaldehyde > aniline > anisole > phenol > styrene > toluene > ethyl benzene
 - If there are two identical substituents on an aromatic ring, and both could be the parent group, choose the next highest priority group as the parent, or choose benzene.
 - If the molecule is a simple ether, the common name is made by naming the two groups attached to the oxygen and adding the word "ether" at the end. If the ether is more complicated, use "methoxy" etc. (see 4f below)
- Number the chain (or ring) from the end that gives the lower number to (in order of priority):
 - The highest priority functional group; also, alkene or alkyne must have sequentially numbered carbons, which is very important in numbering cycloalkenes.
 - If rule 2a does not determine which way to number the chain, number it so that the first substituent is lower numbered, or that the lowest number that would be depend on the direction of numbering is lowest.
 - If rule 2b does not determine which way to number the chain, number it so that the first alphabetically lower substituent is lower numbered. This rule only applies if rules 2a and 2b do not determine the direction of numbering.
- The size of the ring or chain determines the parent name. You are expected to know the parent names up to 20 carbons (eicosane). The parent name for a ring is simply "cyclo" + parent name for number of carbons.
- You are expected to know the names and structures of the following groups that could be substituents:
 - Small alkyl groups: methyl, ethyl, propyl, isopropyl, butyl, isobutyl, sec-butyl, tert-butyl (underlined portion of these names are not considered in alphabetizing)
 - Longer chain alkyl groups: pentyl, hexyl, heptyl, octyl, etc.
 - Cyclic alkyl groups: cyclopropyl, cyclobutyl, cyclopentyl, etc.
 - Halogens: fluoro, chloro, bromo, iodo
 - Benzene ring as side chain: phenyl (not to be confused with phenol!)*
 - Functional groups: hydroxy, methoxy-, ethoxy-, thio-
 - (more to be added later)*
- Know the following prefixes and infixes:
 - Number of same substituents attached, or number of functional groups named in suffix: di, tri, tetra, penta, hexa, hepta, octa
 - The following prefixes, in order of appearance in a suffix if there are several:
 - Presence of alkene: -ene-
 - Presence of alkyne: -yne-
 - Presence of alcohol, when it takes priority in rule 2a: -ol

- iv. Presence of thiol, when it takes priority in rule 2a: -thiol
 - v. (more to come)
6. If a double bond is present, it could be one of the following:
 - a. Neither cis nor trans, if it has two identical attachments on one end. No prefix should be added for any double bond that is neither cis nor trans.
 - b. cis, if the two attachments are on the same side of the double bond (or if the path of the longest chain does not cross over the double bond) – add “#-cis” for each double bond that requires it.
 - c. trans, if the two attachments are on opposite sides of the double bond (or if the path of the longest chain crosses over the double bond) – add “#-trans” for each double bond that requires it.
 7. If a cycloalkane has two and only two substituents, their relationship must be indicated in the name with the prefix:
 - a. cis, if the two substituents are on the same side of the ring (i.e. both represented with wedges or both represented with dashes)
 - b. trans, if the two substituents are on opposite sides of the ring (i.e. one is represented with a wedge, and one with a dash)
 - c. If a cycloalkane has more than two substituents, their relationship will be specified by the R,S system
 8. If an aromatic ring has two and only two substituents, their relationship can be indicated in the name with ONE of the following prefixes (do not use numbers AND letters together):
 - a. “o-” or “ortho-” or “1,2” if the substituents are adjacent
 - b. “m-” or “meta-” or “1,3” if the substituents are not adjacent and not
 - c. “p-” or “para-” or “1,4” if the substituents are opposite
 - d. If an aromatic ring has more than two substituents, the number system must be used.
 9. Assemble the name as follows:
 - a. The name is easiest to construct from the end to the beginning. The parent name is written first, suffixes are added at the end, then substituents are added in front of the parent, and finally modifiers such as cis and trans are placed at the beginning.
 - b. If only one type of functional group is named by a suffix, the position number of that functional group can be placed immediately before the parent name. (e.g. 1,4-pentadiene)
 - c. If there are several different types of functional groups named by suffixes, the position numbers for each of the functional groups is inserted into the name immediately before the multiplier and suffix for that group. (i.e. hexa-1,5-diene-3-yne)
 - d. The substituents are placed in the name in alphabetical order, connected by dashes, regardless of their position numbers. The prefixes di, tri, tetra, etc. and sec-, tert-, are not considered in the alphabetization.
 - e. Cis and trans appear at the beginning of the name, in position number order.

Consider this molecule as an example of a very complicated structure that can be named with the above rules:



7-*cis*-11-*trans*-19-bromo-13-cyclopentyl-10,17-diisopropyl-16-phenyl-nonadeca-7,11-diene-4-yne-2,10,18-triol

Step 1. The longest chain is much longer than the largest ring. It is 19 carbons long, giving the parent name nonadecane. Do not forget to count each of the carbons in the triple bond, which is drawn linearly to represent its VSEPR geometry!

Step 2. To determine the direction of numbering, we find the highest priority functional group, OH. It is positioned at 2,10 and 18 regardless of the direction of numbering! The next highest priority functional group is the triple bond, which is encountered at a lower number when counting from right to left in the diagram above, so that is the correct numbering. (Rule 2a)

If the triple bond had been the same number either way, we would look at the numbering for the double bonds, (still Rule 2a) and if those also were the same either way, only then would we look at the numbering of the substituents (Rule 2b). If after all of that, the substituents would have been the same numbering either way, only at that last resort do we look at the alphabetical order of the substituents (Rule 2c).

The functional groups are named as follows:

Positions 7 and 11 have double bonds, so the infixes "-di-" + "-ene-" are added

Position 4 has a triple bond, so the infix "-yne-" is added

Positions 2,11,19 have alcohols, which are the highest priority functional group, so the infix and suffix "tri" + "-ol" is added. If there had been a higher functional group than alcohol (i.e. a carboxylic acid), the alcohols would have been named as "2,11,19 trihydroxy-" and inserted into the name alphabetically under h.

The other side chains are:

Positions 10 and 17 both have isopropyl groups, so "10,17-diisopropyl" is one substituent name

Position 13 has a five carbon ring attached as a side chain. A five carbon chain is pentane, so attached as a side chain it would be pentyl. Likewise, a five carbon ring is called cyclopentane, and as a side chain it is called cyclopentyl.

Position 16 has a benzene ring attached as a side chain, which is called a phenyl group.

Position 19 has a bromine, so the term "bromo" is used.

The alphabetical order of the side chains is **b**romo, **c**yclopentyl, **i**sopropyl, **p**henyl, so this is the way they are ordered in the name.