

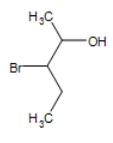
## 9.11: Nomenclature

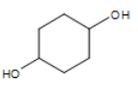
### Naming Alcohols

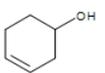
1. Find the longest chain containing the hydroxy group (OH). If there is a chain with more carbons than the one containing the OH group it will be named as a substituent.
2. Place the OH on the lowest possible number for the chain. With the exception of carbonyl groups such as ketones and aldehydes, the alcohol or hydroxy groups have first priority for naming.
3. When naming a cyclic structure, the -OH is assumed to be on the first carbon unless the carbonyl group is present, in which case the later will get priority at the first carbon.
4. When multiple -OH groups are on the cyclic structure, number the carbons on which the -OH groups reside.
5. Remove the final **e** from the parent alkane chain and add **-ol**. When multiple alcohols are present use **di**, **tri**, etc before the **ol**, after the parent name. ex. 2,3-hexan**diol**. If a carbonyl group is present, the -OH group is named with the prefix "hydroxy," with the carbonyl group attached to the parent chain name so that it ends with **-al** or **-one**.

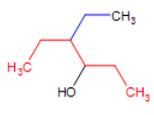
Ethane:  $\text{CH}_3\text{CH}_3$  -----> Ethanol:  (the alcohol found in beer, wine and other consumed sprits)

Secondary alcohol:  2-propanol

Other functional groups on an alcohol:  3-bromo-2-pentanol

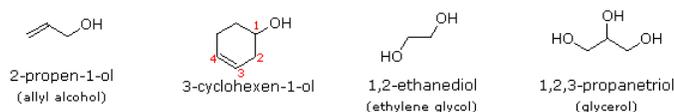
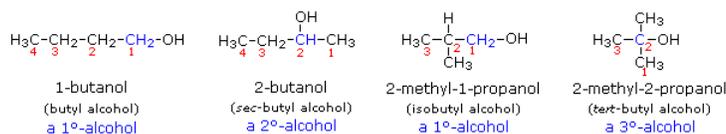
Cyclic alcohol (two -OH groups):  cyclohexan-1,4-diol

Other functional group on the cyclic structure:  3-hex**ene**ol (the alkene is in **bold** and indicated by numbering the carbon closest to the alcohol)

A complex alcohol:  4-ethyl-3-hexanol (the parent chain is in **red** and the substituent is in **blue**)

In the IUPAC system of nomenclature, functional groups are normally designated in one of two ways. The presence of the function may be indicated by a characteristic suffix and a location number. This is common for the carbon-carbon double and triple bonds which have the respective suffixes **-ene** and **-yne**. Halogens, on the other hand, do not have a suffix and are named as substituents, for example:  $(\text{CH}_3)_2\text{C}=\text{CHCHClCH}_3$  is 4-chloro-2-methyl-2-pentene.

Alcohols are usually named by the first procedure and are designated by an **-ol** suffix, as in ethanol,  $\text{CH}_3\text{CH}_2\text{OH}$  (note that a locator number is unnecessary on a two-carbon chain). On longer chains the location of the hydroxyl group determines chain numbering. For example:  $(\text{CH}_3)_2\text{C}=\text{CHCH}(\text{OH})\text{CH}_3$  is 4-methyl-3-penten-2-ol. Other examples of IUPAC nomenclature are shown below, together with the common names often used for some of the simpler compounds. For the mono-functional alcohols, this common system consists of naming the **alkyl group** followed by the word **alcohol**. Alcohols may also be classified as primary, **1°**, secondary, **2°**, and tertiary, **3°**, in the same manner as alkyl halides. This terminology refers to alkyl substitution of the carbon atom bearing the hydroxyl group (colored blue in the illustration).



Many functional groups have a characteristic suffix designator, and only one such suffix (other than "-ene" and "-yne") may be used in a name. When the hydroxyl functional group is present together with a function of higher nomenclature priority, it must be cited and located by the prefix **hydroxy** and an appropriate number. For example, lactic acid has the IUPAC name 2-hydroxypropanoic acid.

## Naming Ethers

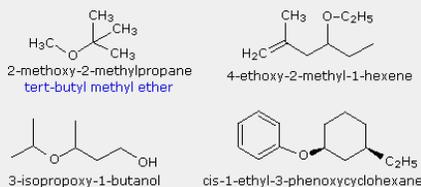
Ethers are compounds having two alkyl or aryl groups bonded to an oxygen atom, as in the formula  $\text{R}^1-\text{O}-\text{R}^2$ . The ether functional group does not have a characteristic IUPAC nomenclature suffix, so it is necessary to designate it as a substituent. To do so the common alkoxy substituents are given names derived from their alkyl component (below):

Alkyl Group	Name	Alkoxy Group	Name
$\text{CH}_3-$	Methyl	$\text{CH}_3\text{O}-$	Methoxy
$\text{CH}_3\text{CH}_2-$	Ethyl	$\text{CH}_3\text{CH}_2\text{O}-$	Ethoxy
$(\text{CH}_3)_2\text{CH}-$	Isopropyl	$(\text{CH}_3)_2\text{CHO}-$	Isopropoxy
$(\text{CH}_3)_3\text{C}-$	<i>tert</i> -Butyl	$(\text{CH}_3)_3\text{CO}-$	<i>tert</i> -Butoxy
$\text{C}_6\text{H}_5-$	Phenyl	$\text{C}_6\text{H}_5\text{O}-$	Phenoxy

The smaller, shorter alkyl group becomes the alkoxy substituent. The larger, longer alkyl group side becomes the alkane base name. Each alkyl group on each side of the oxygen is numbered separately. The numbering priority is given to the carbon closest to the oxygen. The alkoxy side (shorter side) has an "-oxy" ending with its corresponding alkyl group. For example,  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2-\text{O}-\text{CH}_2\text{CH}_2\text{CH}_3$  is 1-propoxypentane. If there is *cis* or *trans* stereochemistry, the same rule still applies.

### Example

Examples are:  $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$ , diethyl ether (sometimes referred to as ether), and  $\text{CH}_3\text{OCH}_2\text{CH}_2\text{OCH}_3$ , ethylene glycol dimethyl ether (glyme).



## Common names

Simple ethers are given common names in which the alkyl groups bonded to the oxygen are named in alphabetical order followed by the word "ether". The top left example shows the common name in blue under the IUPAC name. Many simple ethers are symmetrical, in that the two alkyl substituents are the same. These are named as "dialkyl ethers".

## Heterocycles

In cyclic ethers (heterocycles), one or more carbons are replaced with oxygen. Often, it's called heteroatoms, when carbon is replaced by an oxygen or any atom other than carbon or hydrogen. In this case, the stem is called the oxacycloalkane, where the prefix "oxa-" is an indicator of the replacement of the carbon by an oxygen in the ring. These compounds are numbered starting at the oxygen and continues around the ring. For example,

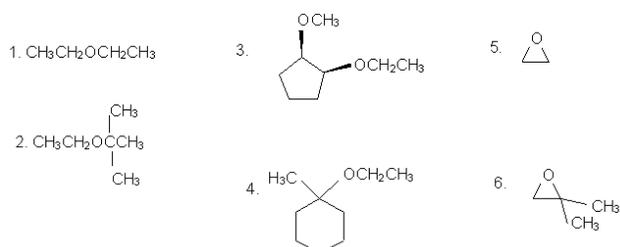


If a substituent is an alcohol, the alcohol has higher priority. However, if a substituent is a halide, ether has higher priority. If there is both an alcohol group and a halide, alcohol has higher priority. The numbering begins with the end that is closest to the higher priority substituent. There are ethers that contain multiple ether groups that are called cyclic polyethers or crown ethers. These are also named using the IUPAC system.

thyl sulphide. Sulphides are chemically more reactive than ethers, reflecting the greater nucleophilicity of sulfur relative to oxygen.

### Problems

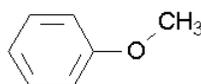
Name the following ethers:



(Answers to problems above: 1. diethyl ether; 2. 2-ethoxy-2-methyl-1-propane; 3. cis-1-ethoxy-2-methoxycyclopentane; 4. 1-ethoxy-1-methylcyclohexane; 5. oxacyclopropane; 6. 2,2-Dimethyloxacyclopropane)

### Common names of some ethers

**anisole** (try naming anisole by the other two conventions. J)



**oxirane**



1,2-epoxyethane, ethylene oxide, dimethylene oxide, oxacyclopropane,

**furan (this compound is aromatic)**



tetrahydrofuran



oxacyclopentane, 1,4-epoxybutane, tetramethylene oxide,

**dioxane**



1,4-dioxacyclohexane

### Contributors

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