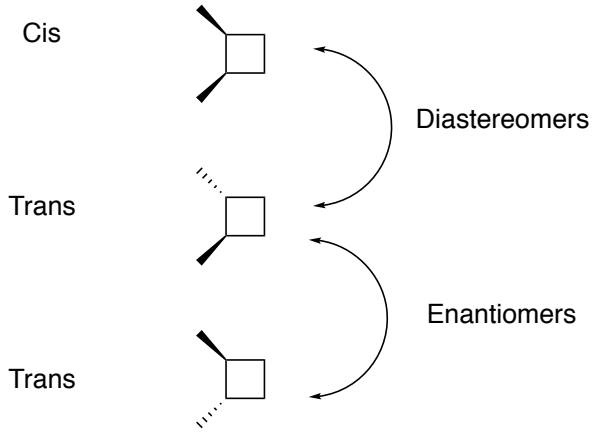
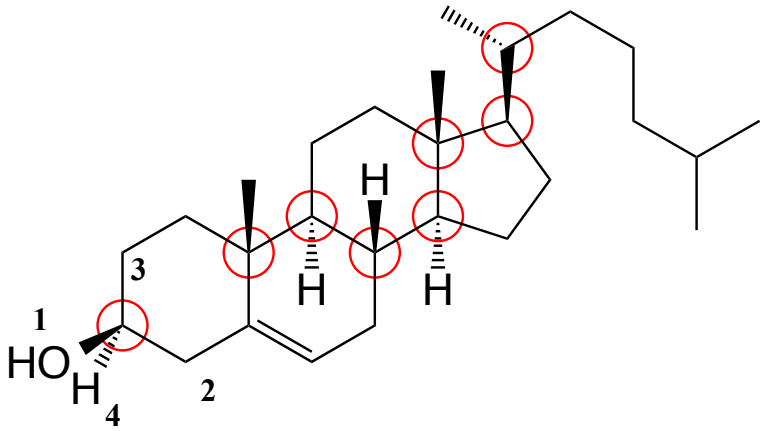
RECALL:



Enantiomers have opposite stereochemistry at **every** stereocenter (chiral center)

Diastereomers are all stereoisomers that are not enantiomers

Cholesterol - A steroid with 8 stereogenic centers (red circles)



Stereoisomer calculation:
If only some (not all) stereogenic centers are inverted, then a diastereomer of cholesterol is produced.

8 stereocenters identified in cholesterol:

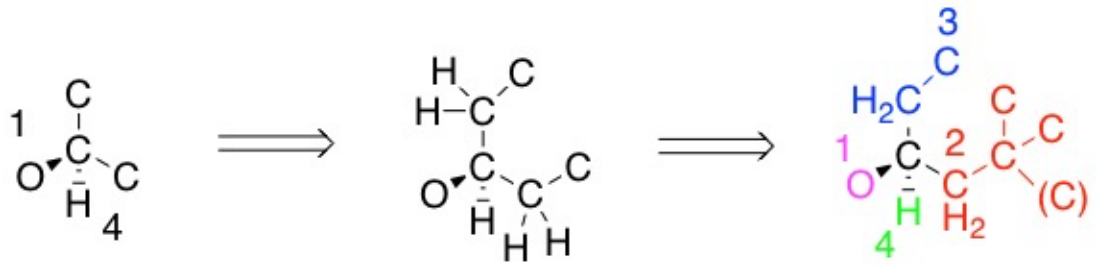
$2^n = 2^8 = 256$ stereoisomers, which are divided into three kinds below:

1 Cholesterol (the bioactive natural product)

1 enantiomer of cholesterol

254 are diastereomers of cholesterol

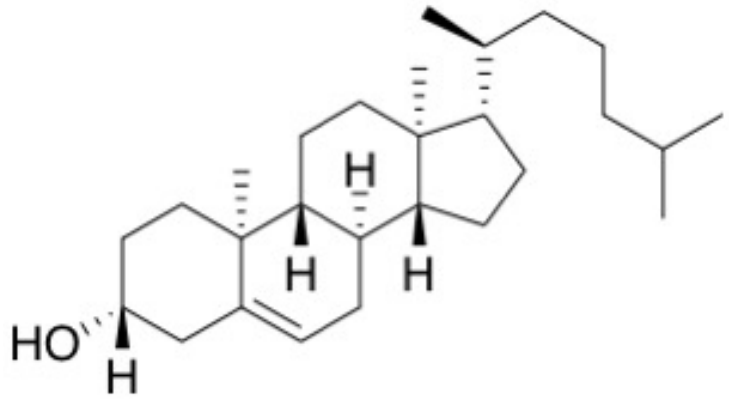
NB: Stereochemistry of carbon bearing the hydroxyl is **S**



Carbon in brackets represents the carbon-carbon double bond.

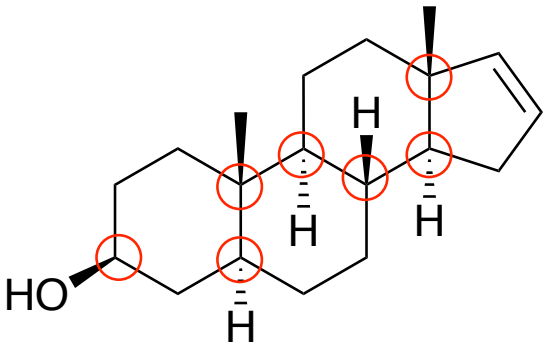
Enantiomer of cholesterol:

To make the enantiomer of cholesterol, invert every stereogenic center



Pheromones: from Greek "pherein horman" meaning to carry excitement. Discovered by Adolf Butenandt.

Male Pheromone:

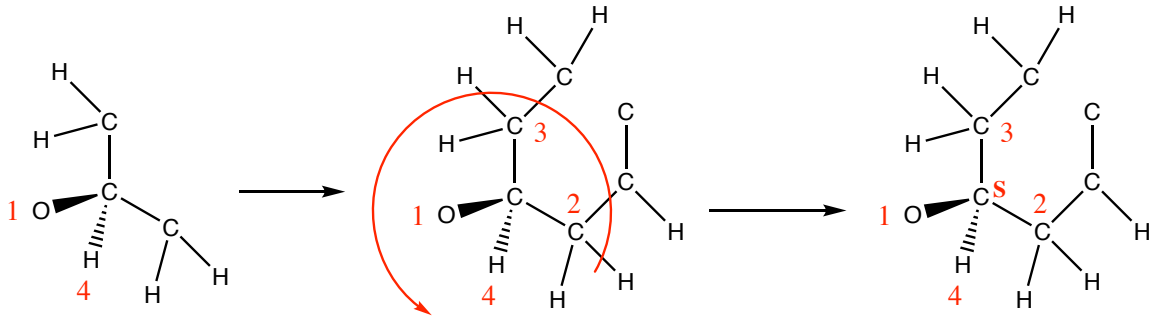


Only about 50 % of the population can smell this compound, which is genetically determined. About half find the smell disgusting while the other half find it tolerable or pleasant.

Some pheromones can be detected by insects at concentrations of 10^{-17} molar.

Contain 7 stereogenic centers, circled in red above.

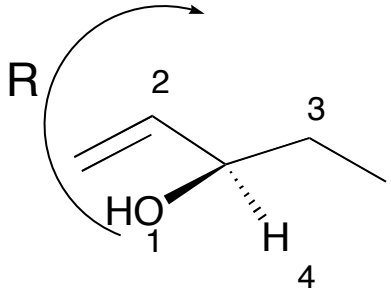
What is the R/S configuration of the carbon attached to OH?



S configuration of stereogenic center

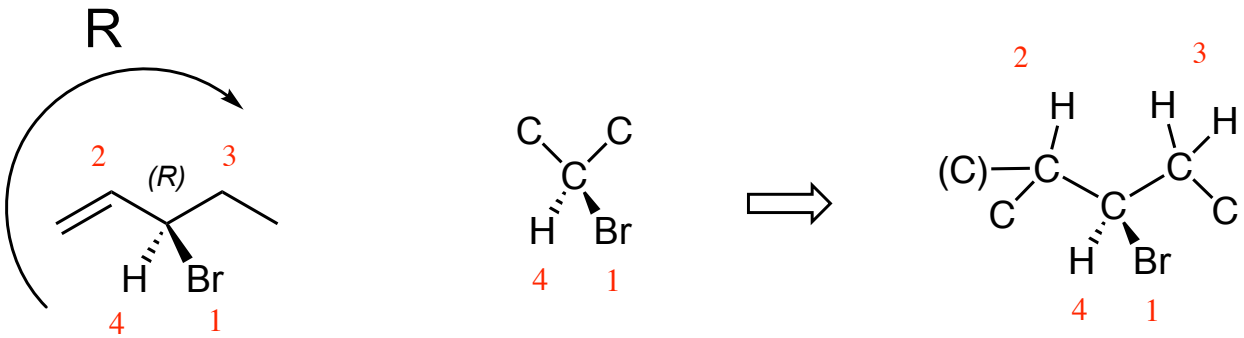
<u>Chiral Centers:</u>

Example: 3-hydroxy-pent-1-ene



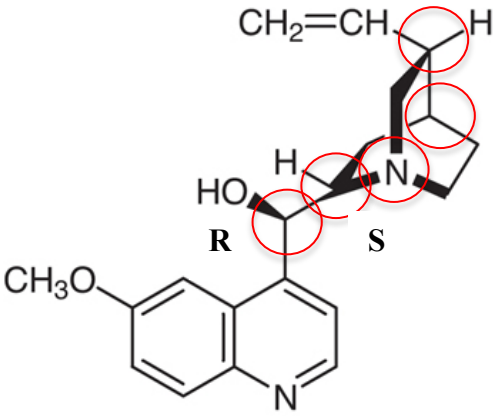
Carbon double bounded to another carbon is equivalent to a carbon bound to two carbons when considering priority

Example:

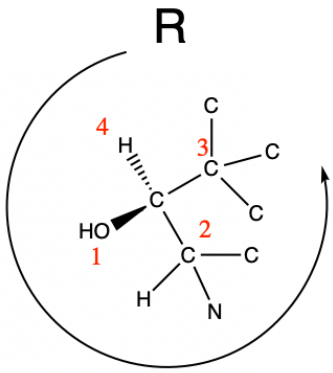


Quinine:

- An anti-malarial agent found in cinchona trees in South America
- Was brought to Spain by Jesuit missionaries in 1632 but was used by native populations long before
- Has 5 chiral centres (labeled in red)

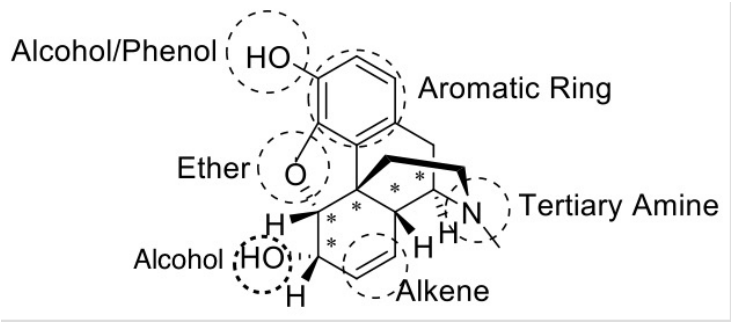


Ex)



Morphine:

- Is an alkaloid, meaning it contains nitrogen, can be isolated from a plant (or bacteria) and is considered a natural product.
- From Morpheus, Greek god of sleep
- Opium: Sap from the seed pod of opium poppy (*Papaver somniferum*)
    - (poppy sleep-carrying)
- ~10% of opium is morphine
- Morphine is used as an analgesic
- Heroin (diacetylmorphine) is even more potent (and more addictive)



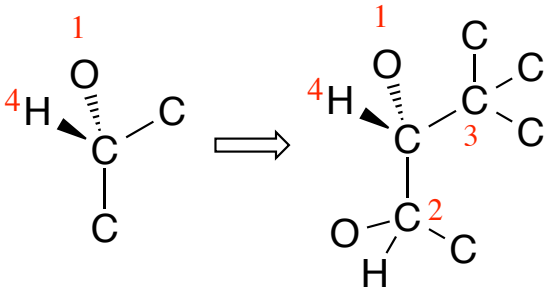
- 5 stereogenic centers in morphine (represented by *) – Nitrogen NOT a stereogenic centre because the methyl group can move up or down
    - $2^5 = 32$ stereoisomers possible, where:
    - 1 morphine (itself)
    - 1 enantiomer
    - 30 diastereoisomers

Mithridates VI (135-63 BC)

- Poisoned slaves and attempted to cure them using mixtures of different plants
- Favorite mixture was Theriac, which contained morphine

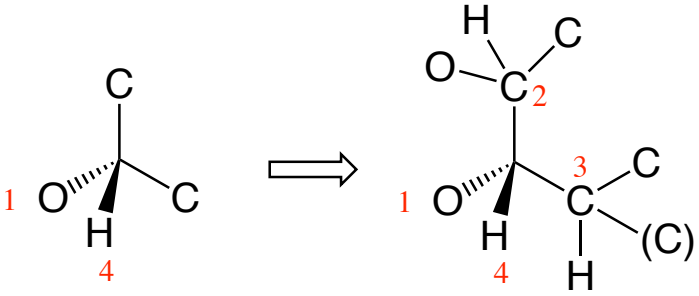
Examples of Configuration in Stereocenters of Morphine

Configuration at the **ether** stereocenter:

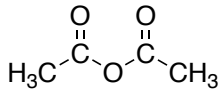


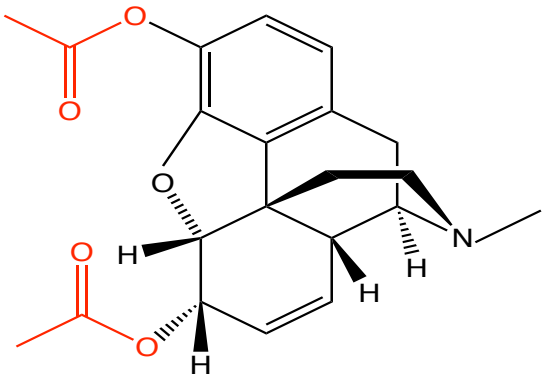
- Cannot assign 2, 3 at first try
- At the second atoms in the chain, there is a difference. The alcohol carbon is attached to one oxygen, one carbon, and one hydrogen. It has a higher priority than the other carbon which is attached to three carbons.
- Count 1, 2, 3: Counterclockwise
- This center is *R* and not *S* because the lowest priority group (the hydrogen) is pointing toward the front, not to the back.

Configuration at the **alcohol** stereocenter:



- Cannot assign 2, 3 at first try
- At the second atoms in the chain, the eth carbon is attached to one oxygen, one carl and one hydrogen. It has a higher priority the alkene carbon which is attached to tw carbons and one hydrogen
- Count 1, 2, 3: Clockwise
- This center is *S* and not *R* because the lo priority group (the hydrogen) is pointing toward the front, not the back

If you substitute CH_3COO for the two alcohol residues in morphine by reacting with acetic anhydride (), you then create **HEROIN.**

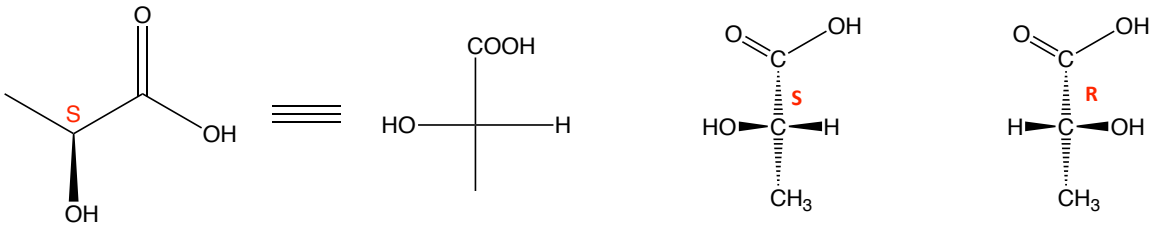


1000 times stronger and more addictive than morphine

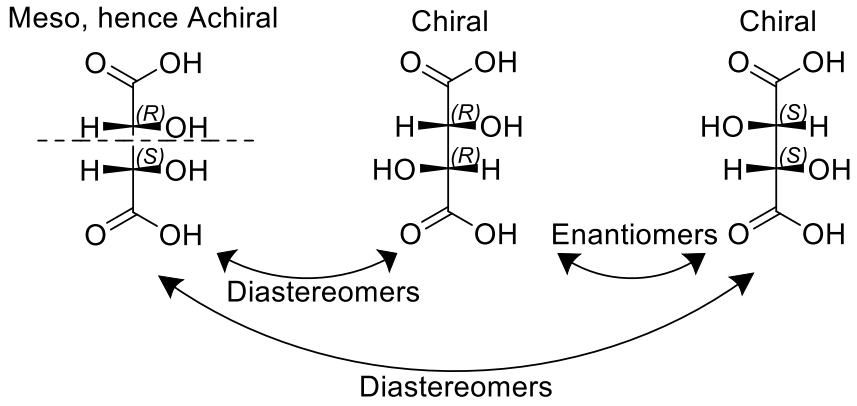
Fischer Projections

A method of drawing chemical structures, where the horizontal components are coming towards you and the vertical ones are going back.

Example #1: Lactic Acid



Example #2: Tartaric acid



Meso compounds have stereogenic centers but contain a plane of symmetry and are achiral

Racemic mixtures (or racemate) contain a 1:1 ratio of each enantiomer

Physical Properties of Enantiomers

- Same physical properties with achiral agents or procedures
    - Melting point, boiling point, solubility in achiral solvents
- Separation of enantiomers (resolution) require a chiral agent
- Diastereomers have different physical properties (m.p, b.p, density, solubility)

Resolution: defined as the separation of enantiomers