

**Stereochemistry and Chirality:**

Chiral object (molecule):

- has a non-superimposable mirror image

Achiral object (not chiral)

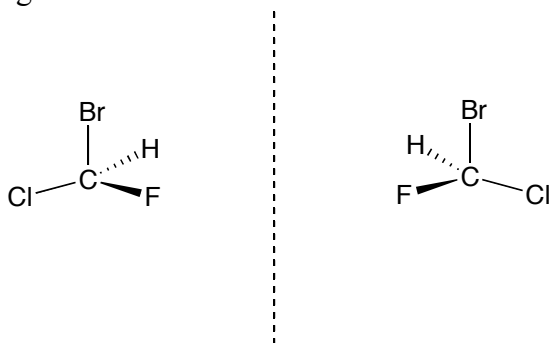
- Louis Pasteur 1848

Resolution: - Separation of right and left handed forms (enantiomers)

Enantiomers:

- molecules that are stereoisomers and are non-superimposable mirror images of each other

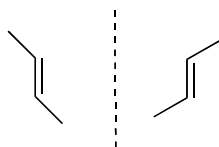
eg.



mirror plane

Mirror images are non-superposable : Stereoisomers  $\rightarrow$  Enantiomers

eg. Mirror images below are superposable

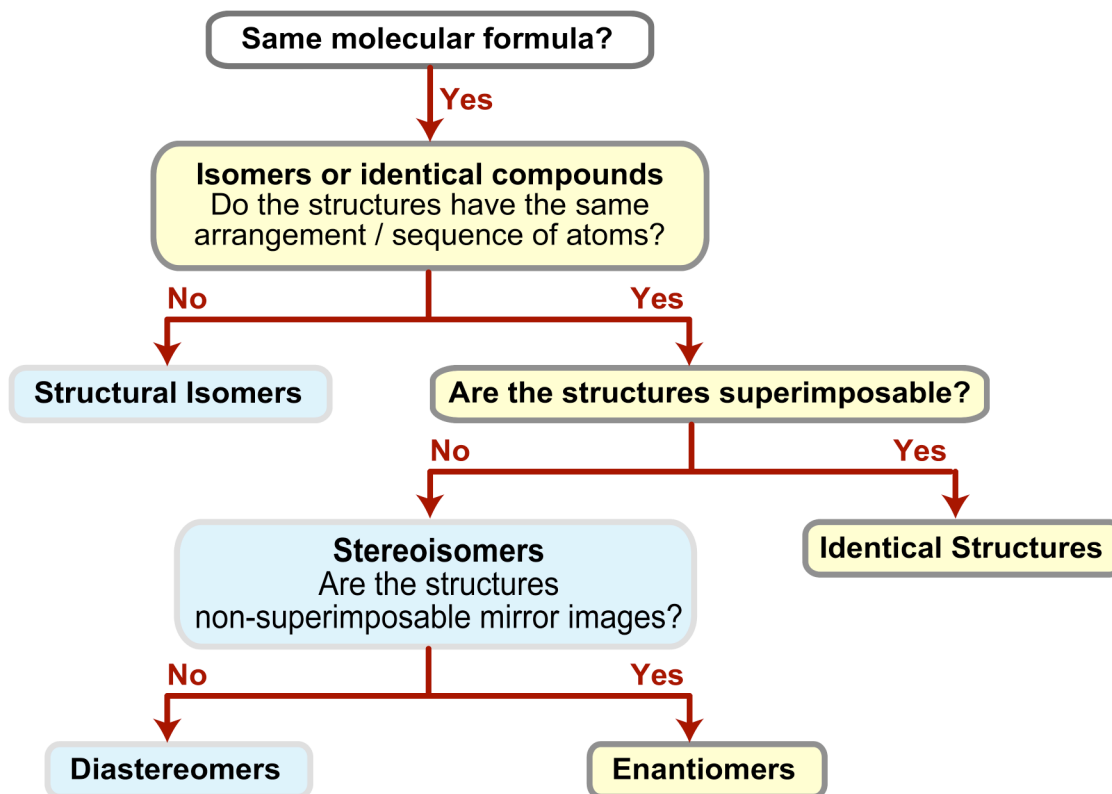


Mirror

Trans-2-butene is achiral.

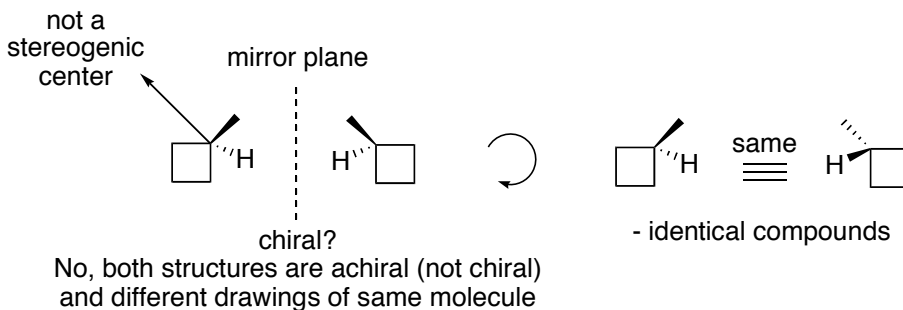
All stereoisomers which are not enantiomers are diastereoisomers

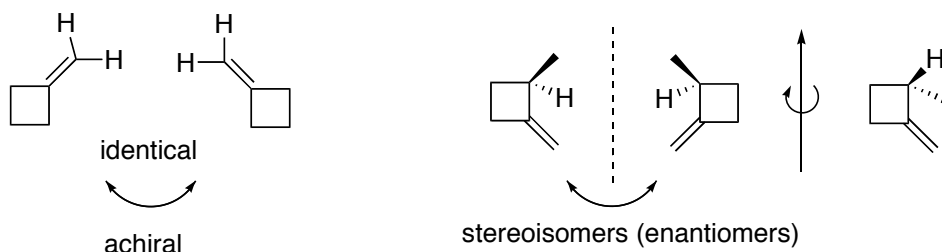
## Structure comparison



- If you have a mirror plane of symmetry within molecule → Achiral

Eg.





Stereogenic centre (chiral centers or asymmetric centers):

- often tetrahedral atom (carbon) with four different groups attached to it

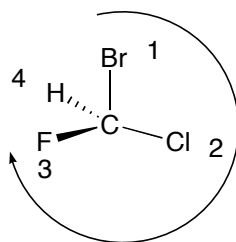
R and S designation of stereoisomers:

- R = Rectus
- S = Sinister

Each stereogenic center analyzed separately.

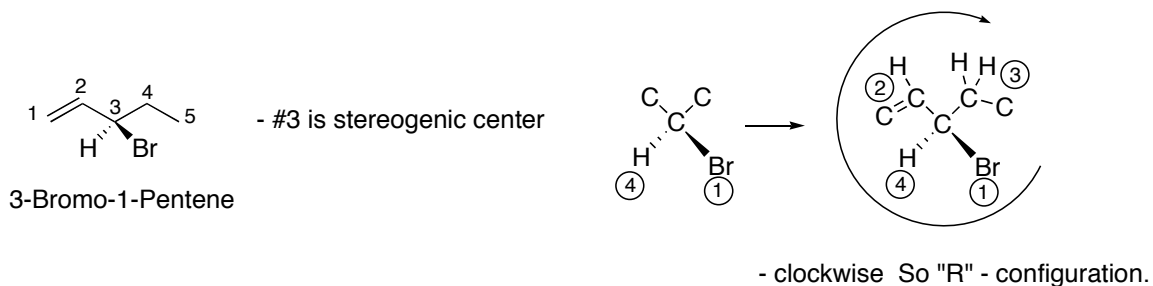
Labeling a stereogenic centre as R or S:

- assign priority based on atomic number (similar to *E* and *Z*)
- if cannot decide, go to next set of atoms
- lowest group pointing back, count 1, 2, 3:  
clockwise → R configuration, counterclockwise → S configuration

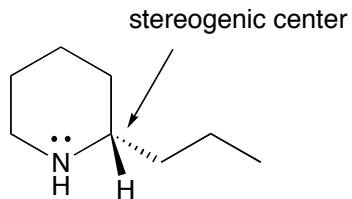


*R*-bromochlorofluoromethane

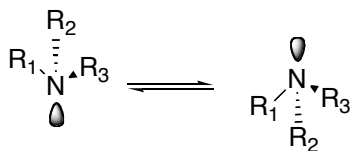
eg.



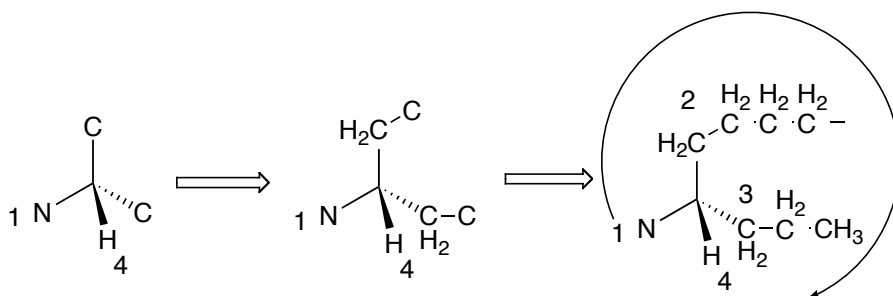
eg.



coniine: poison from Hemlock

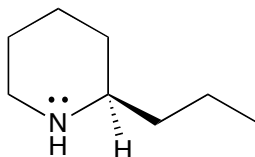


N can invert fast



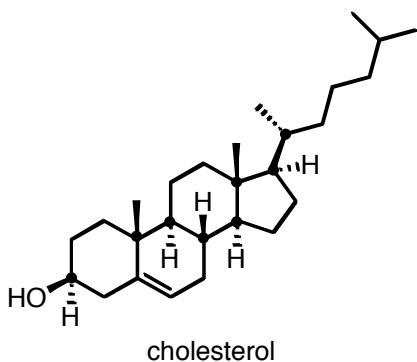
- 1,2,3 count is clockwise, BUT the smallest group is pointing forward, so the configuration is opposite of what you get if smallest group back
- in this case, the configuration of stereogenic centre is “S”

To draw an enantiomer invert every stereogenic centre



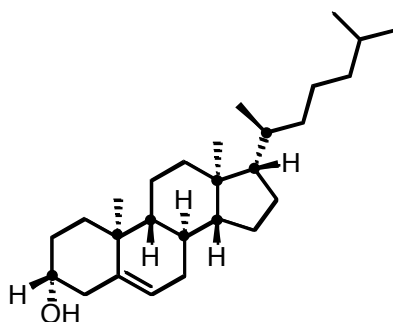
Enantiomer of coniine (non toxic)

## Cholesterol

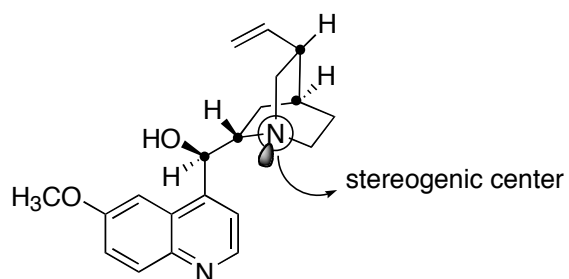


- stereogenic centres (8)
  - 256 stereoisomers possible or  $2^8$
  - 1 isomer is cholesterol
  - 1 is enantiomer of cholesterol
  - 254 are diastereomers.

- To draw enantiomer – invert every stereogenic center.



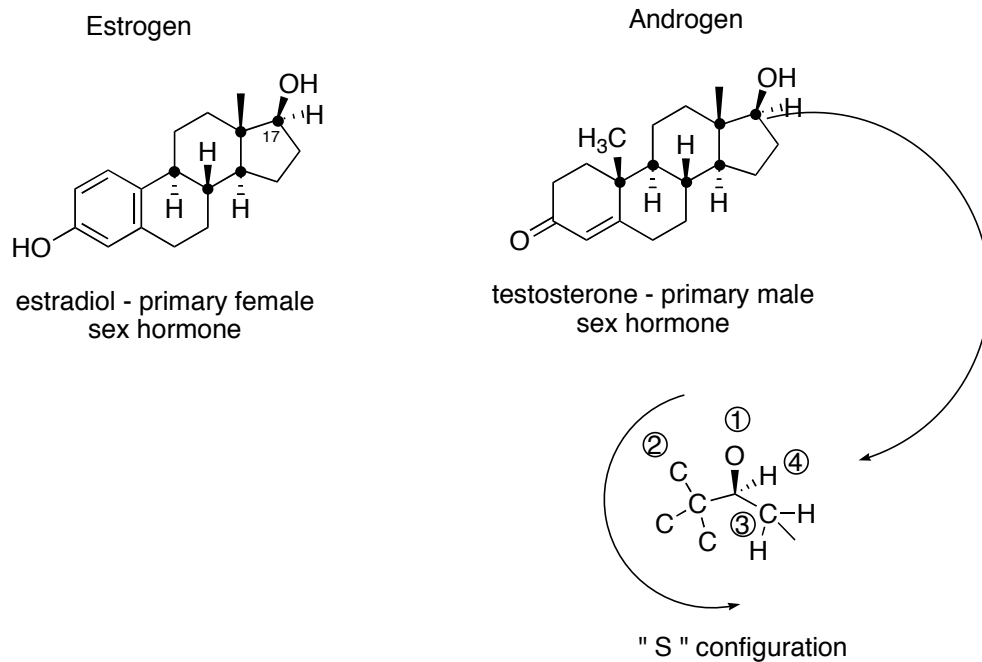
eg.



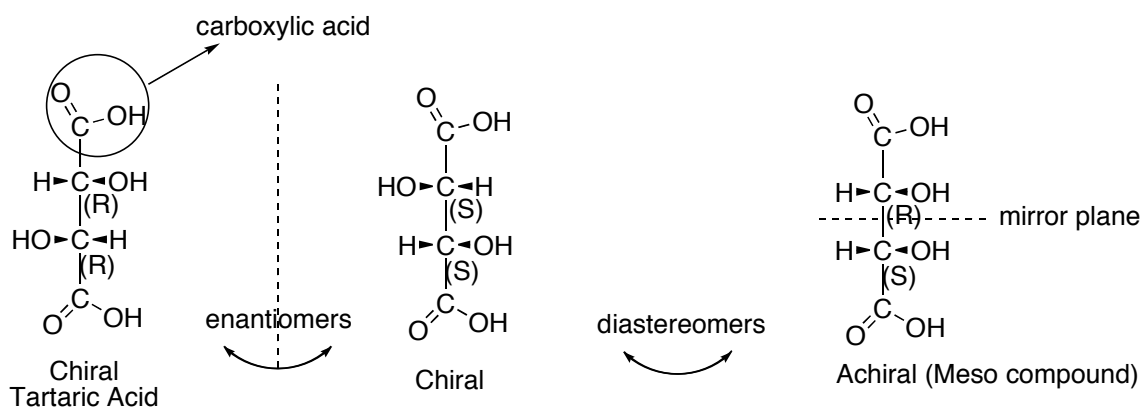
quinine - anti-malarial drug  
from the bark of the tree  
*Cinchona officinalis*

malaria is caused by *Plasmodium* species  
transmitted by *Anopheles* mosquito

eg.



eg.



- Meso compound has stereogenic centres but it is achiral (plane of symmetry within)