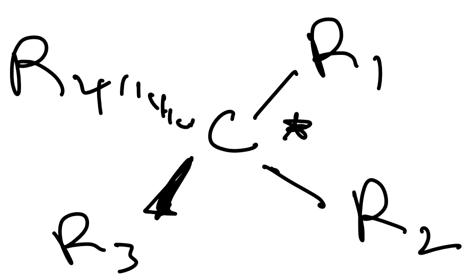
Stereoisomers → molecules with the same connectivity of atoms, but different orientations of groups in three-dimensional space

enantiomers ⇓ (stereoisomers that are mirror images of each other but not identical)

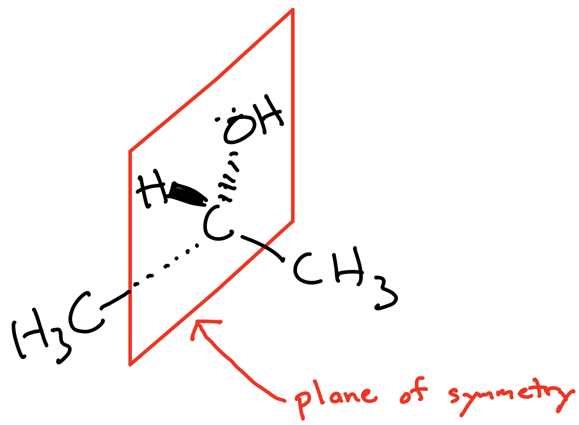
diastereomers ⇓ stereoisomers that are NOT enantiomers



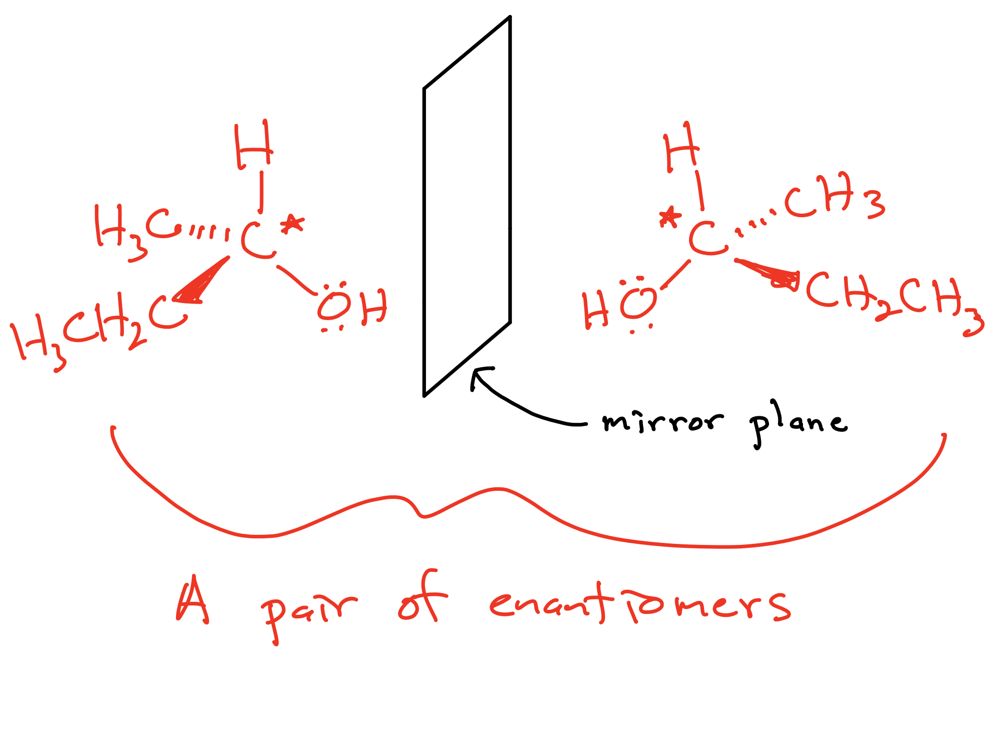
An sp^3 carbon atom that is tetrahedral with four different groups → it is chiral

⇒ Called a chiral center

Not superimposable on its mirror images



A carbon atom that is not chiral will have a plane of symmetry



A pair of enantiomers

Really hard part → naming the enantiomers

R,S convention →

Cahn, Ingold, Prelog (CIP) rules

For a carbon with four different groups:

1) Assign atomic number priorities for each group, ranking them 1 → 4

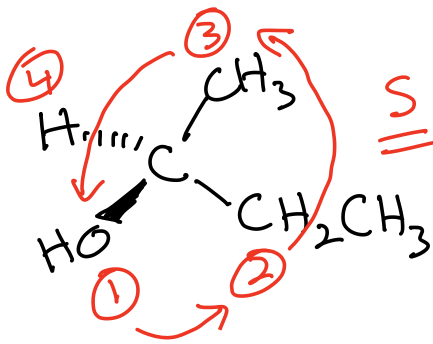
First point of difference wins

2) Position the molecule so you are looking down the C → 4 bond

Lowest priority group, often an H atom

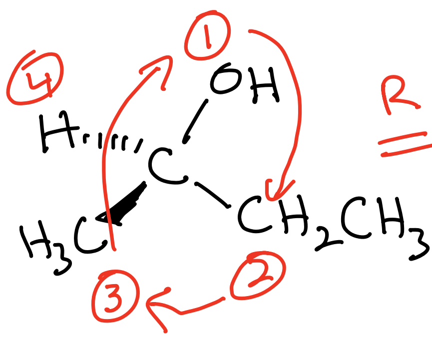
3) Count the remaining three groups in order → If 1 → 2 → 3 is clockwise → R

→ If 1 → 2 → 3 is counterclockwise → S

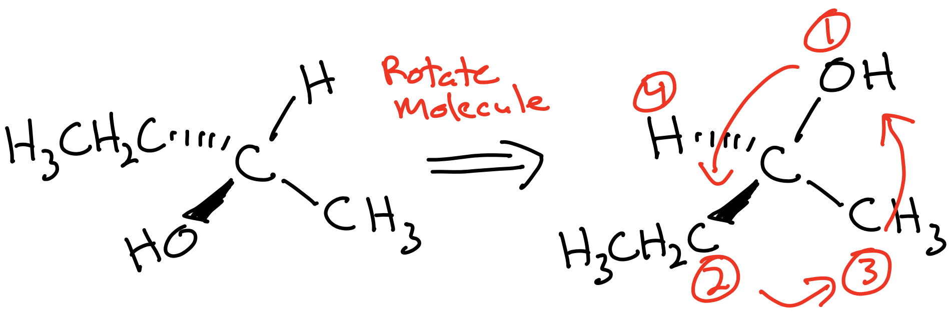


$\underline{\underline{S}}$ → Counterclockwise

S



$\underline{\underline{R}}$ → Clockwise



$\underline{\underline{S}}$

Diastereomer → stereoisomers that are not enantiomers

→ Applies to molecules with two or more chiral centers

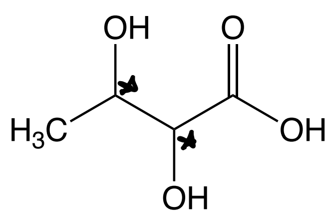
Molecules With 2 Chiral Centers

1) If a molecule contains n chiral centers there are 2^n possible stereoisomers → fewer if symmetry is present (see "meso")

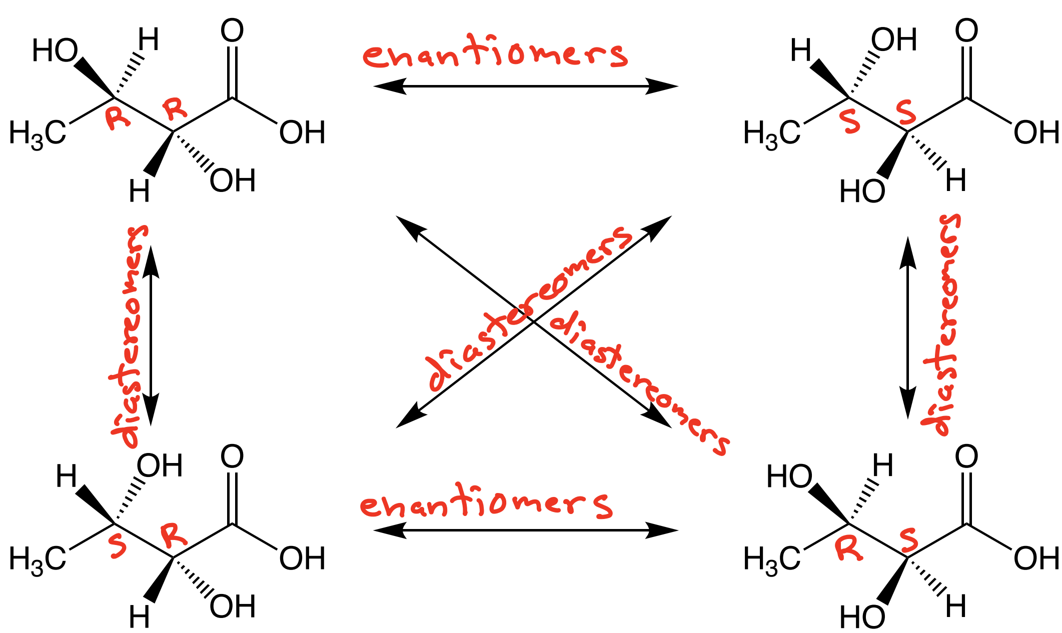
2) R,R and S,S are enantiomers
   R,S and S,R are enantiomers
   All other pairs are diastereomers (Ex. R,R and R,S)

3) To identify stereoisomer relationships → assign R and S to each chiral center and see Rule 2) above

$2^2 = 4$ stereoisomers



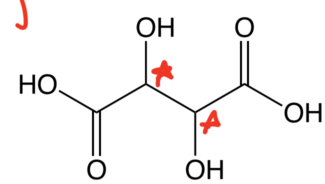
2 chiral centers → no overall symmetry

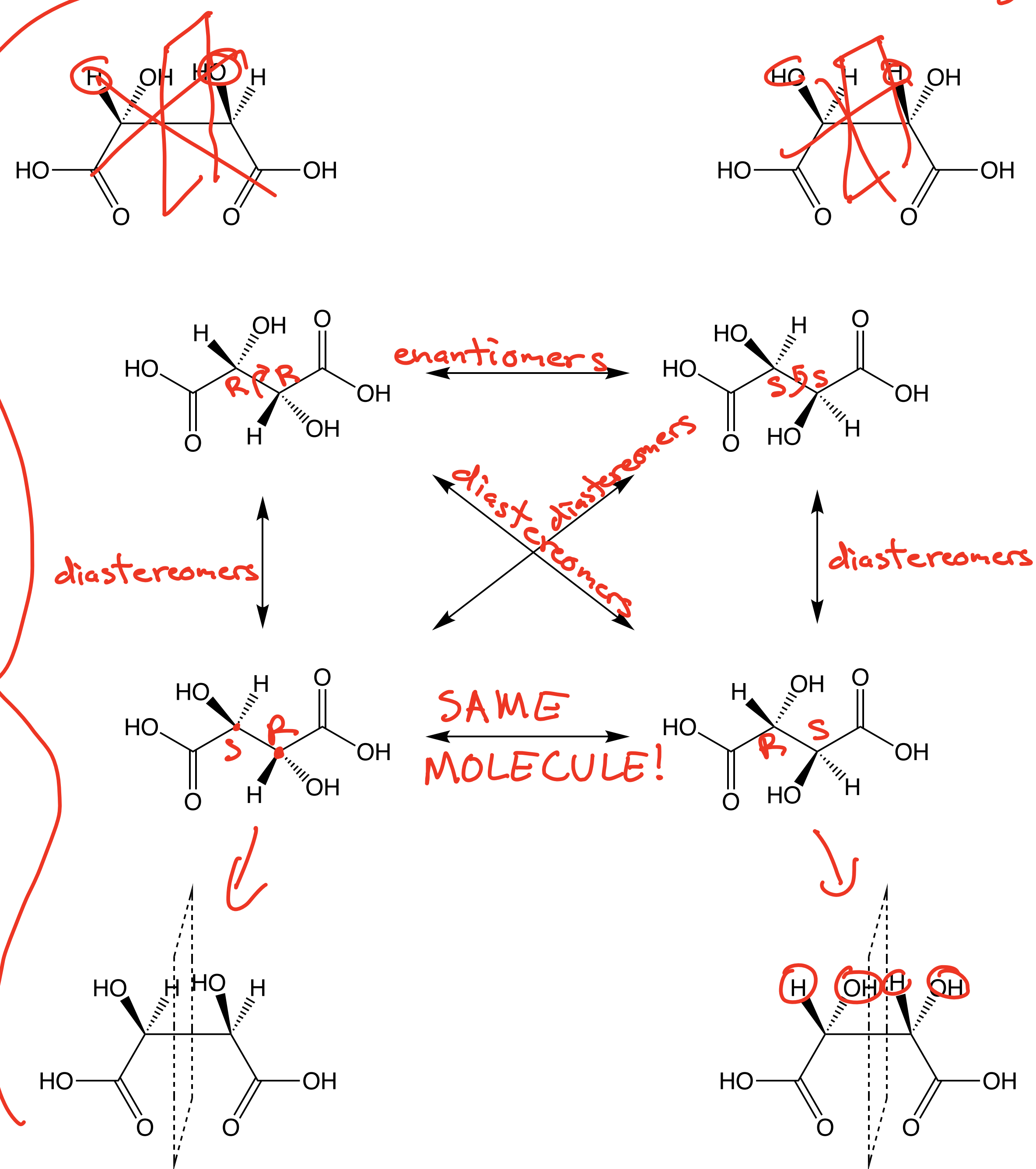


4) A meso compound has chiral centers but is not chiral due to symmetry (plane of symmetry)

You need to draw the molecule in the most symmetric possible conformation to look for symmetry → eclipsed is OK

2 chiral centers → symmetry → both chiral centers have the same four groups

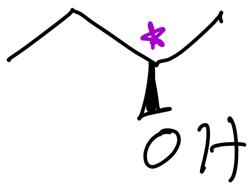


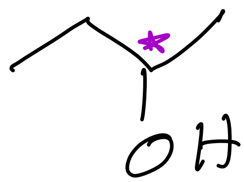


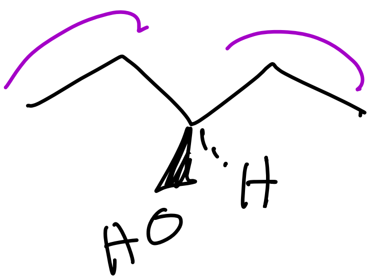
This molecule has only three stereoisomers!!

5) Meso compounds will always be the R,S = S,R stereoisomer if both chiral centers have the same four groups

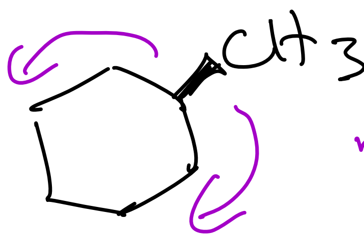
You need to be able to recognize chiral centers in molecules







not chiral



not chiral