

CHEM 221 section 01

LECTURE #19

Tues., Nov.08, 2005

## ASSIGNED READINGS:

TODAY'S CLASS: **continue Ch.5**

NEXT LECTURE: **finish Ch.5**

<http://artsandscience.concordia.ca/facstaff/P-R/rogers>

(1)

Back to thinking about practical things, like isolating compounds in the lab.

**HOW CAN WE SEPARATE ENANTIOMERS?**

Bruice 5.14: Resolution of racemic mixtures

SEPARATING enantiomers in a racemic mixture requires SPECIAL TRICKS...

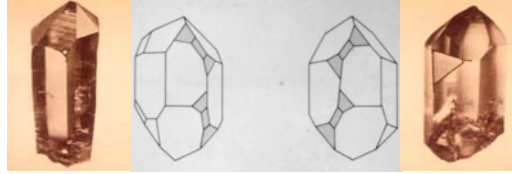
- *Techniques normally used to separate constitutional isomers and diastereomers work because compounds have DIFFERENT physical properties*  
→ use distillation, recrystallization, chromatography...

The separation of a mixture of enantiomers is called the "resolution" of a racemic mixture

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## "Special tricks?" USE CHIRALITY !

Pasteur resolved crystals of sodium ammonium tartrate (obtained via making wine) by manually separating left- and right-handed crystals using a microscope to distinguish them visually.



Biological resolution involves 'feeding' a racemic mixture to a biological system which only converts one enantiomer to another product leaving behind the other enantiomer unchanged.

OTHER WAYS IN LAB: CLEVER...

→ modify enantiomers so they stop being enantiomers...

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### A common way to separate enantiomers:

- chemically convert them into compounds that are diastereomers
- diastereomers HAVE different physical properties
- result: can now separate compounds
- Final step: convert purified compounds back into previous form ⇒ resolved enantiomers!

**E.g., reaction of a chiral acid with a racemic base**  
**Or reaction of a chiral base with a racemic acid**

These give a mixture of salts that are diastereomers...

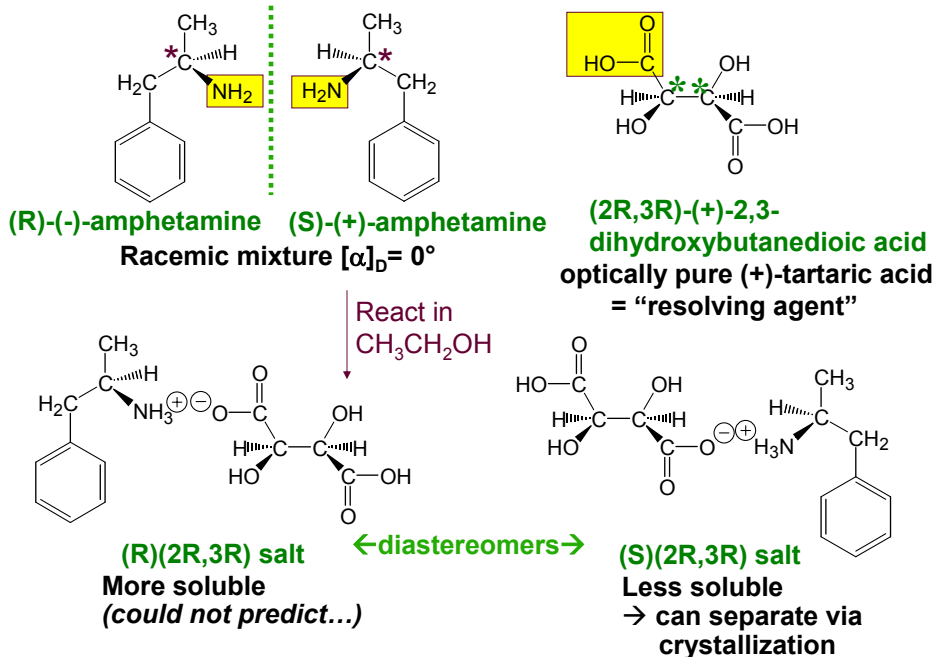
...THUS: different physical properties, *e.g.*, solubility

...THUS: can be separated by recrystallization

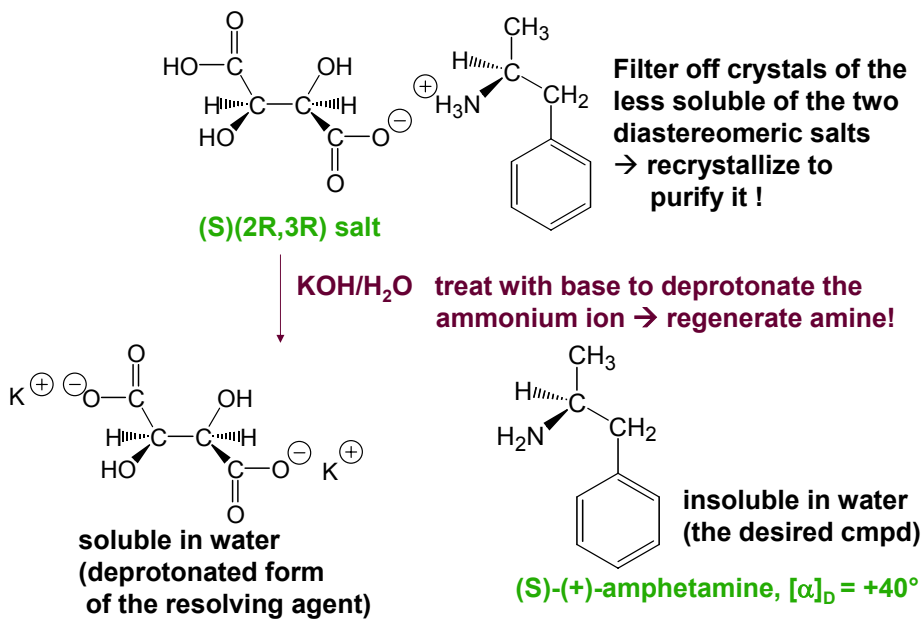
**AND, IMPORTANT FEATURE:**

**easily reversible chemistry!**

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## 5.15 Discrimination of enantiomers by biological molecules

Many naturally occurring compounds exist as one of two possible enantiomers

All natural amino acids have the same handedness  
→ they are levorotatory, (L) or (-)...

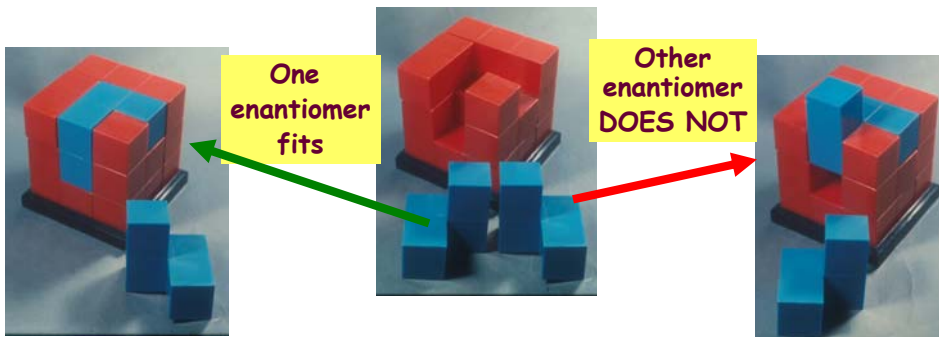
Biological systems can distinguish between one enantiomer and its mirror image. Mirror images can behave quite differently under biological conditions

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Why do the two enantiomers of chiral compounds interact differently with the body?

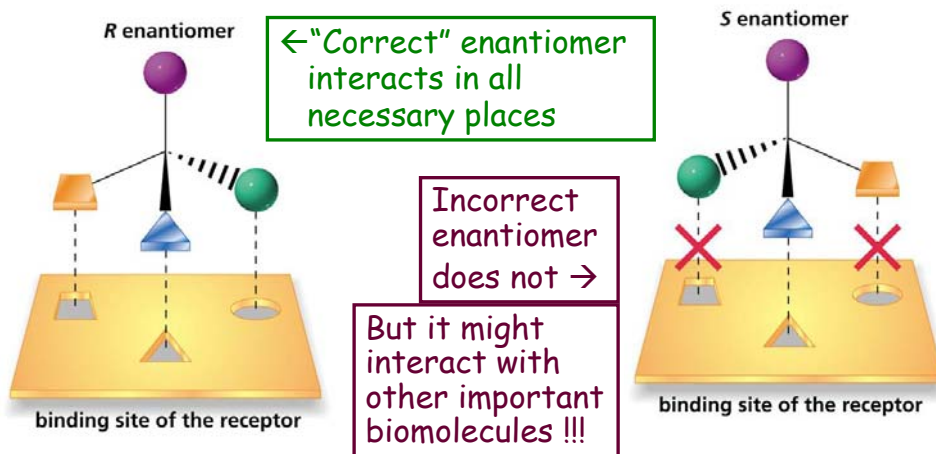
All amino acids (except one) are chiral, so the enzymes they make are chiral as well

The interaction between **SUBSTRATE & ENZYME**  
is superficially analogous to **HAND & GLOVE**



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Interactions between enzyme & substrate are "stereospecific": only one stereoisomer works!



See more in 5.20

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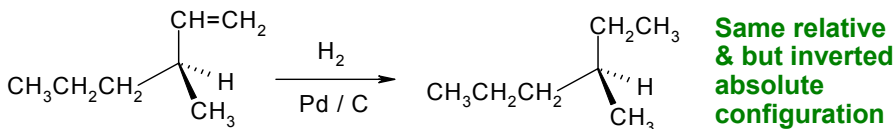
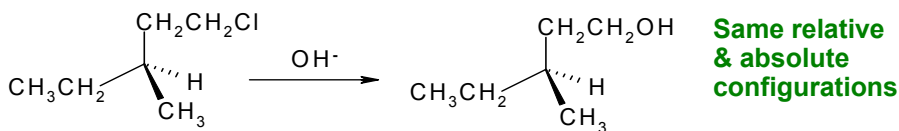
## 5.12: Rxns of cmpds with asymmetric carbons

Does the configuration at asymmetric centres change?

→ depends on whether or not bonds to asymmetric atom are broken during the reaction

1.) If no bonds to C\* broken: relative configuration same

- *i.e.*, no change in relative positions of groups
- BUT: might have changed one of the substituents enough that priority of group changes!  
*i.e.*, absolute configuration might change



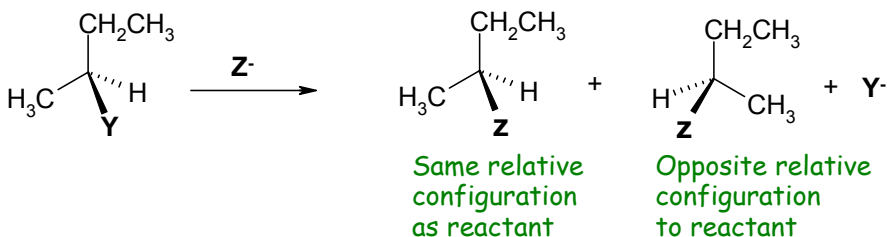
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**Does the configuration at asymmetric centres change?**

→ depends on whether or not bonds to asymmetric atom are broken during the reaction

1.) If no bonds to C\* broken: relative configuration unchanged

2.) If a bond to C\* is broken: configuration MAY change  
→ depends on mechanism of reaction!



Coming soon: mechanisms of this type of reaction!

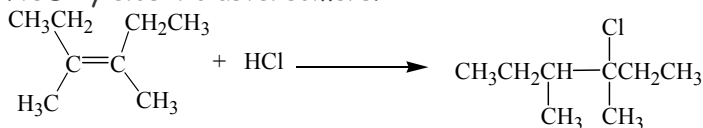
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## 5.19 Stereochemistry of hydrohalogenation

IF ALKENE IS ASYMMETRIC, RXN CAN YIELD 2 STEREOCENTRES:

- H<sup>+</sup> can bond to either side of alkene ⇒ 1<sup>st</sup> C is racemized
- nucleophile can attack planar carbocation from either side  
⇒ adjacent C also racemized!

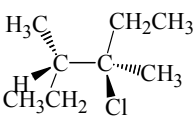
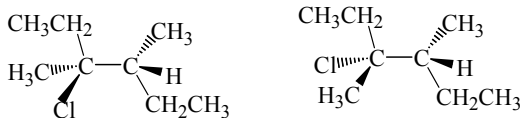
THUS: yields 4 diastereomers!



**Descriptive terms:**

If it looks like both groups added to the same side of C=C: "syn addition"

If...added to opposite sides of C=C: "anti addition"



syn addition

anti addition

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## ASSIGNED READINGS

### BEFORE NEXT LECTURE:

**Read:** rest of Ch.5

**Practice:** predicting stereochemistry of products of alkene reactions