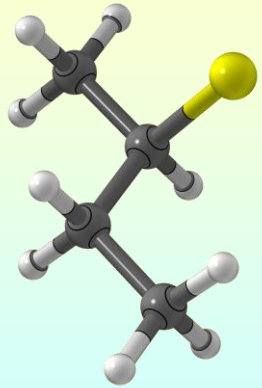
Quiz 5-1. Choose the answer that has selected structures identical to *A*.



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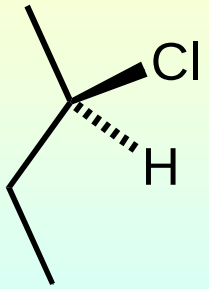
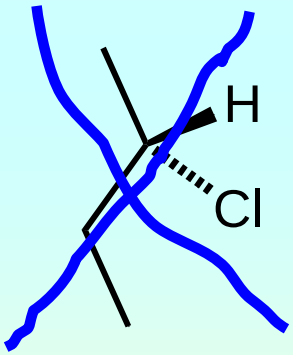
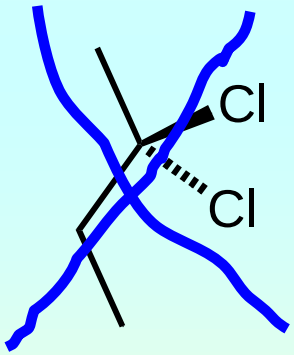
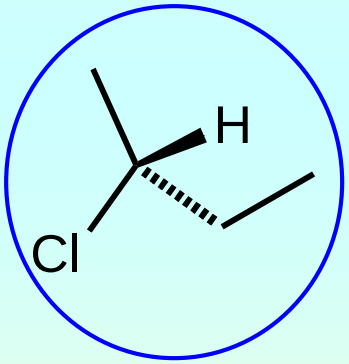
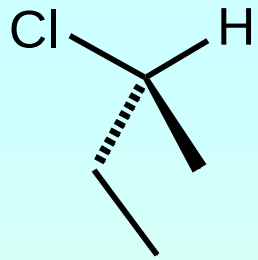


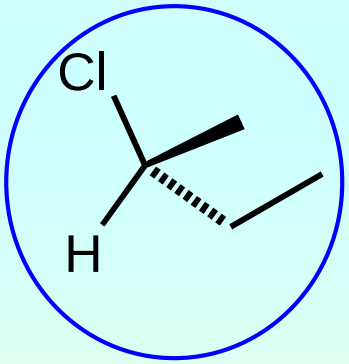
A











1 2 3 4 5

(a) ~~1 + 2~~

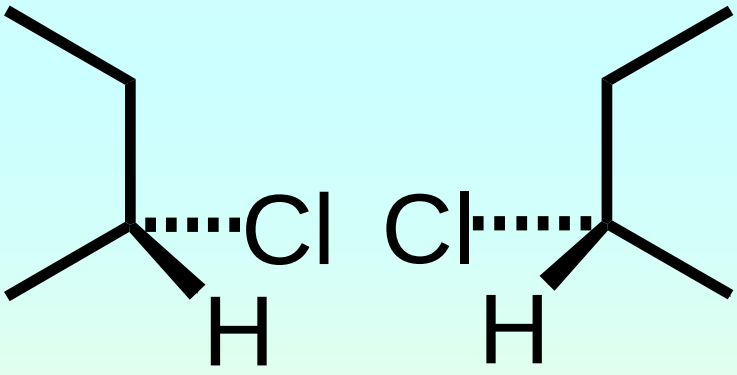
(b) ~~1 + 3~~

(c) 3 + 5

(d) 3 + 4

(e) 5 only

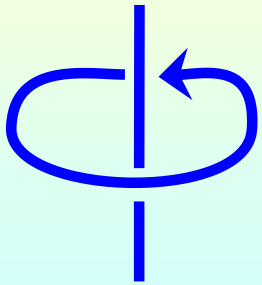
Stereoisomers

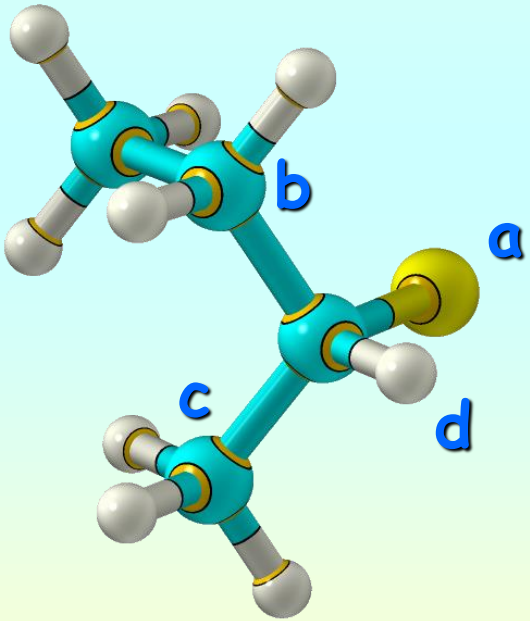


enantiomers

if enantiomers are different compounds they must have *different* properties and *different* names.

Stereoisomers





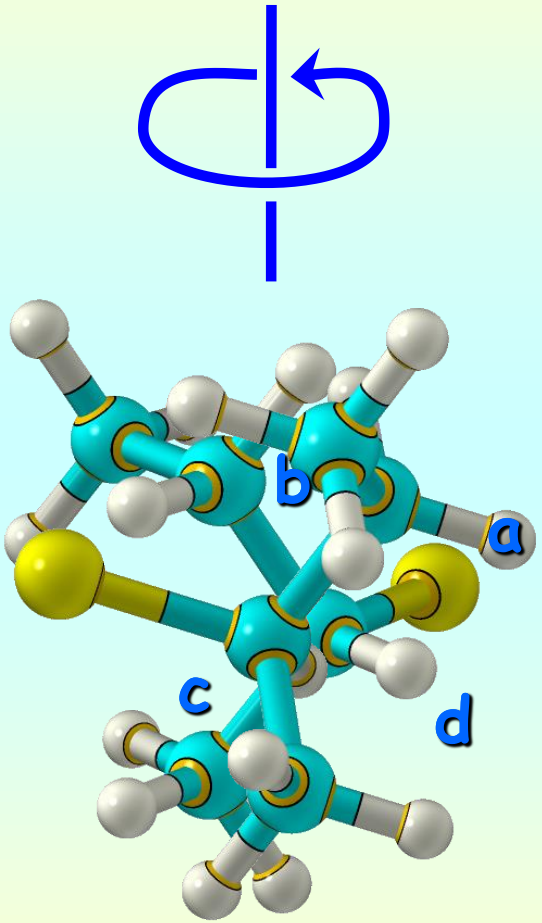
enantiomers

nomenclature

1. rank the substituents.
   (~ atomic number)

2. orient molecule with lowest priority away from the viewer.

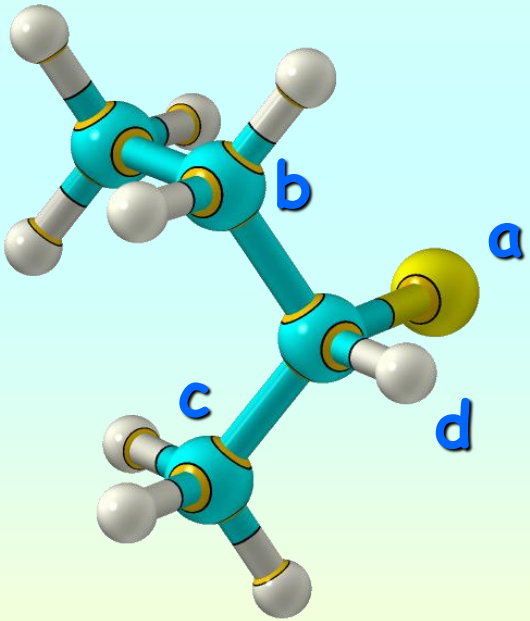
Stereoisomers

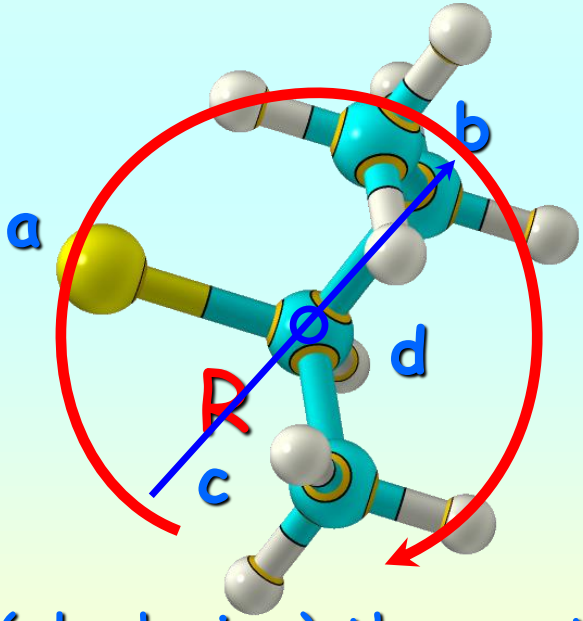


2. orient molecule with lowest priority away from the viewer.

Stereoisomers

3. draw a curved arrow from the highest to the next highest priority.

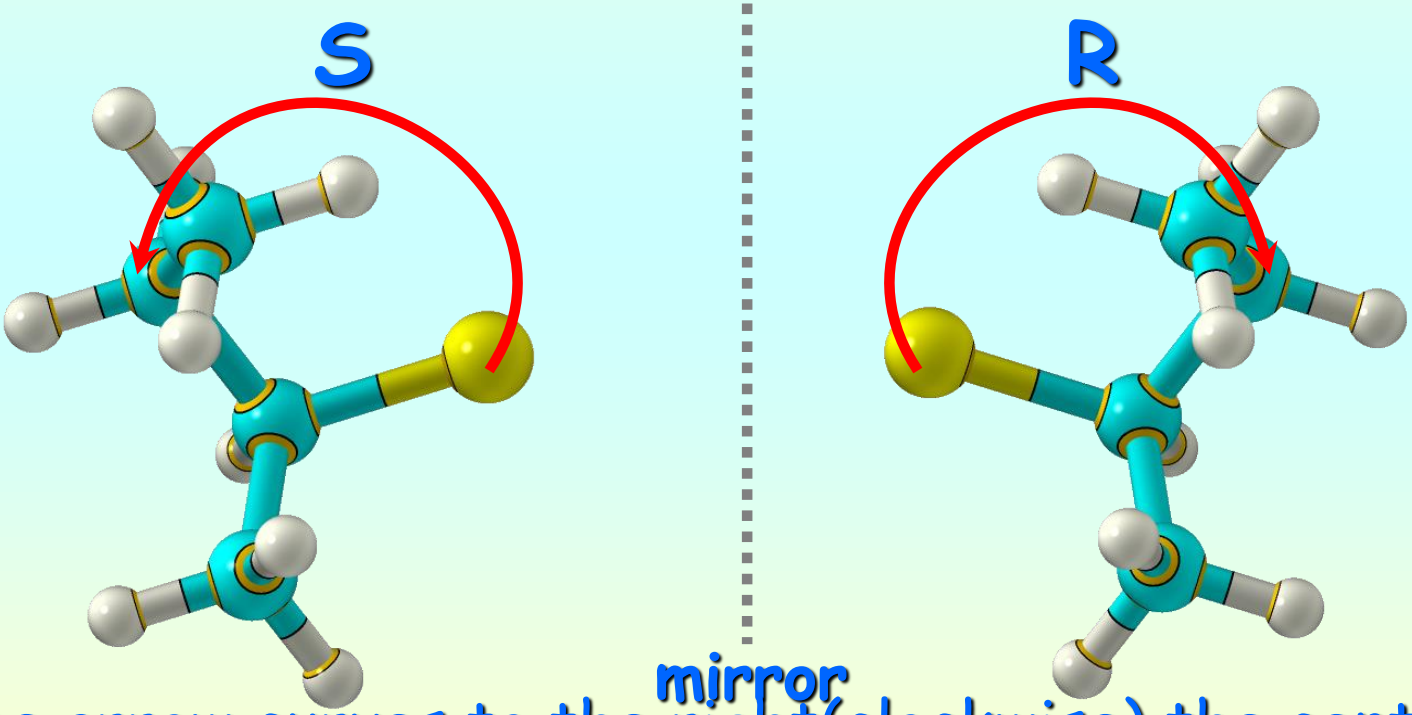




If the arrow curves to the right(clockwise) the center of chirality is *R*. If the arrow curves to the left (counterclockwise) the center of chirality is *S*.

Stereoisomers

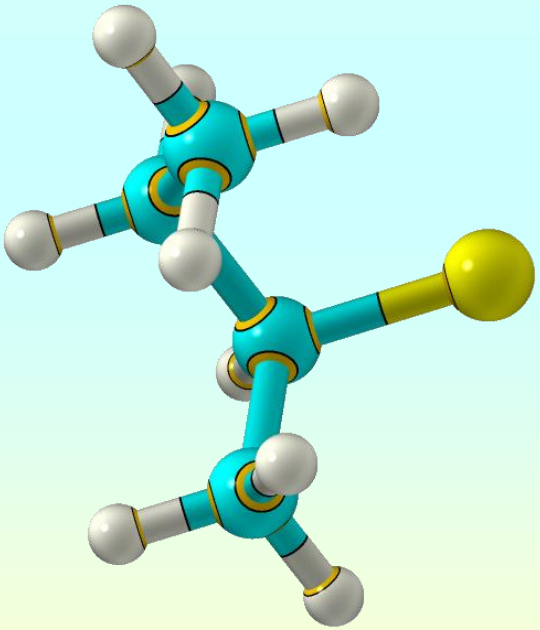
The enantiomer will have the *S* designation.



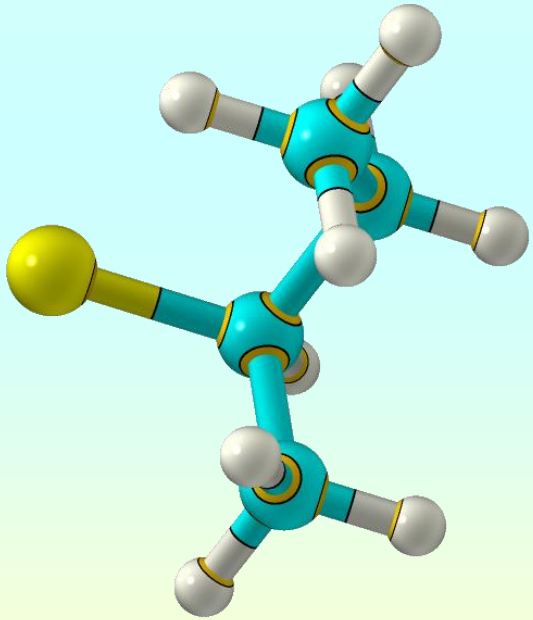
If the arrow curves to the right(clockwise) the center of chirality is *R*. If the arrow curves to the left (counterclockwise) the center of chirality is *S*.

Stereoisomers

if these compounds are different
they must have different names

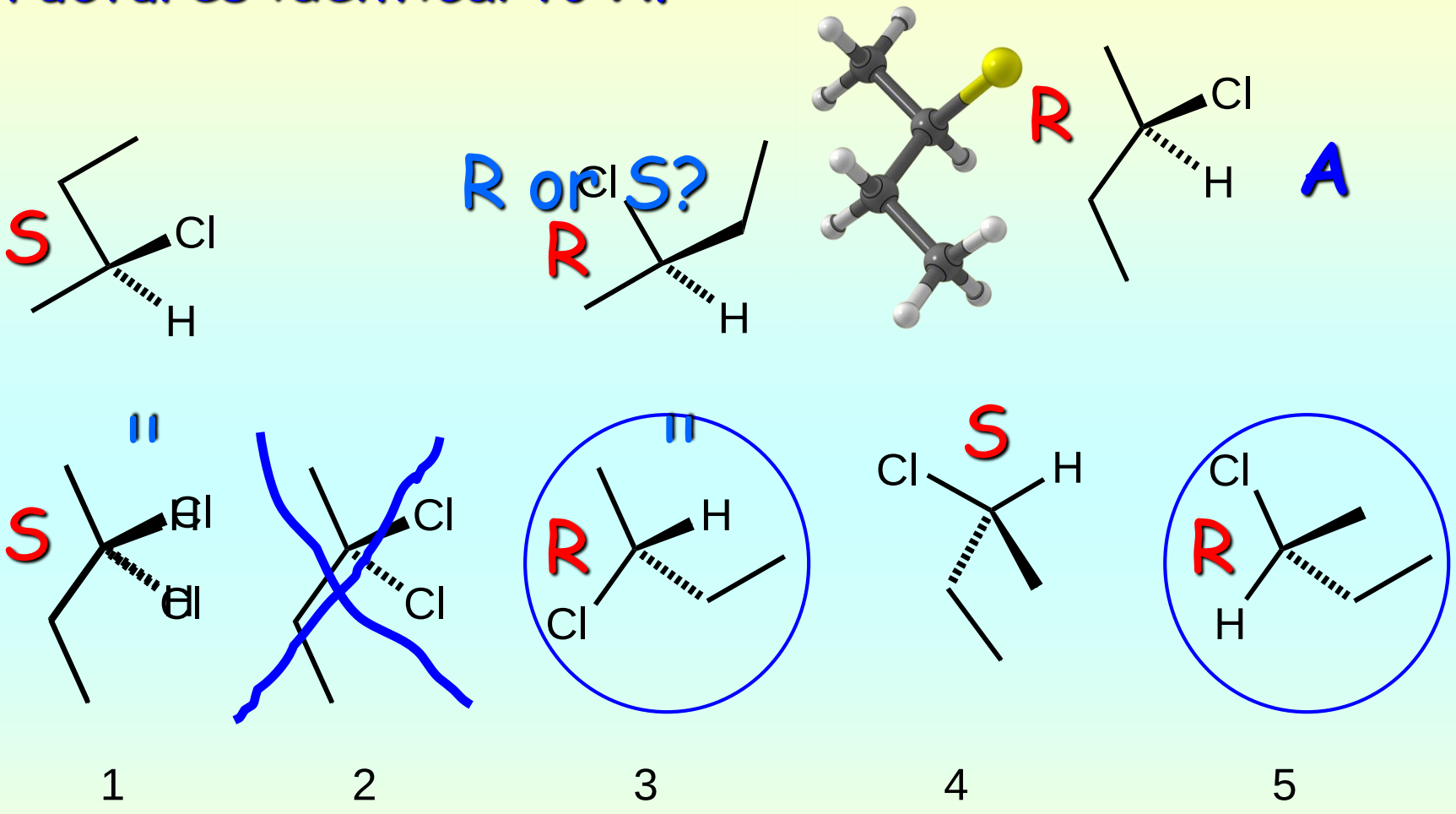


(*S*)-2-chlorobutane



(*R*)-2-chlorobutane

Quiz 5-1. Choose the answer that has selected structures identical to *A*.

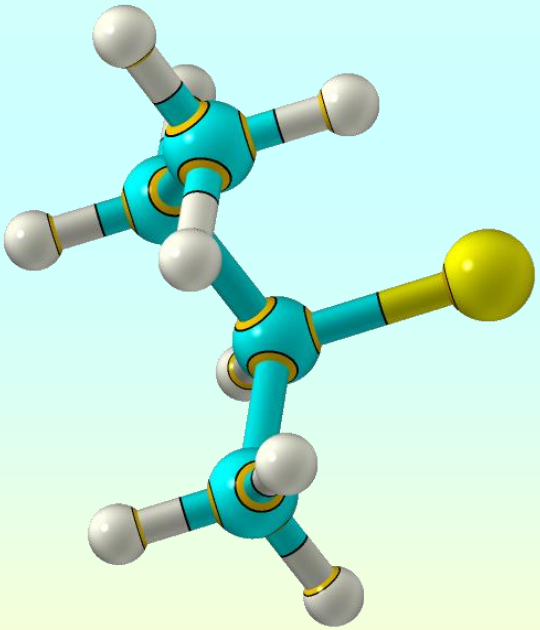


1. One interchange of groups = R(S) <—> S(R)

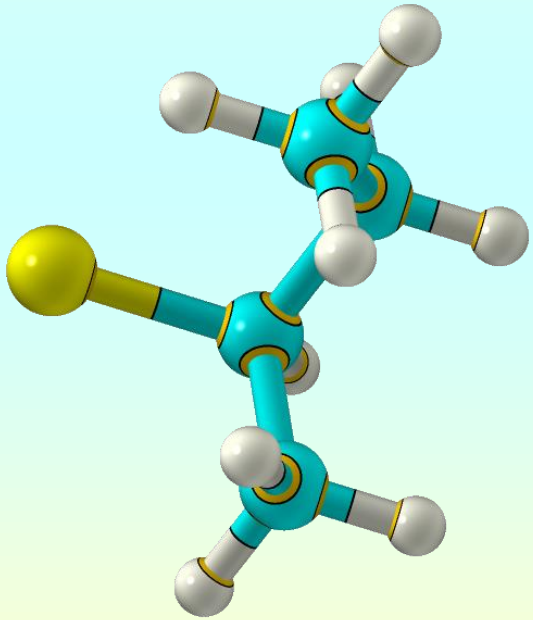
2. Two interchanges of groups = R(S) <—> R(S)

Stereoisomers

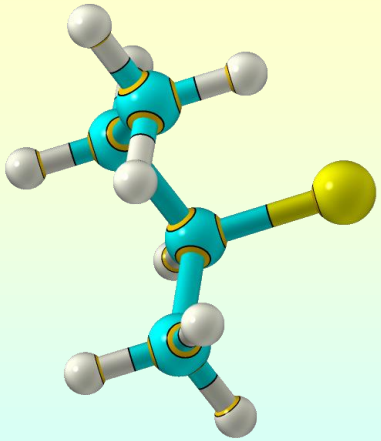
if these compounds are different
they must have different names



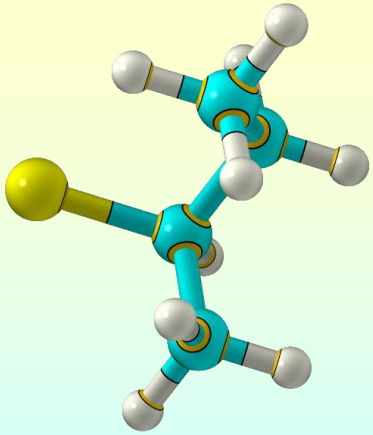
(*S*)-2-chlorobutane



(*R*)-2-chlorobutane

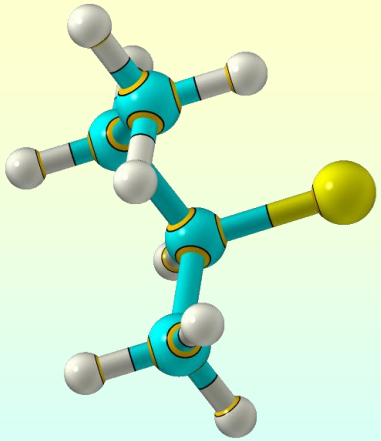


(*S*)-2-chlorobutane

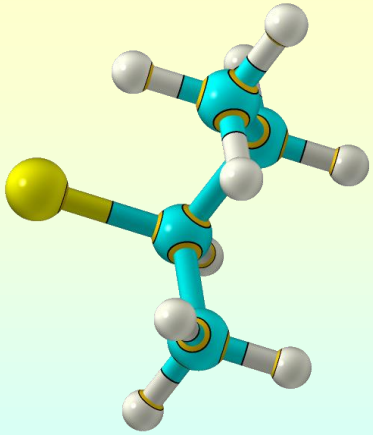


(*R*)-2-chlorobutane

If enantiomers are different compounds with different names they must have different properties.



(*S*)-2-chlorobutane



(*R*)-2-chlorobutane

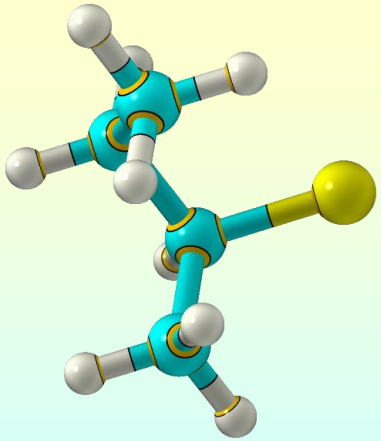
Enantiomers have many of the same properties:

melting points

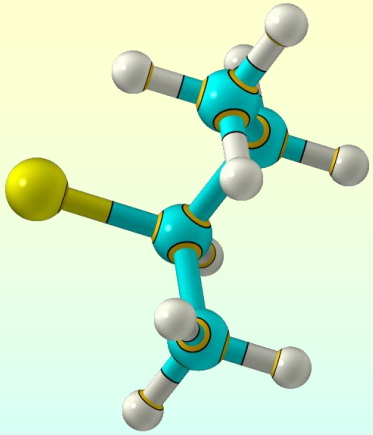
boiling points

solubility in common solvents (achiral)

reactivity with achiral reagents



(*S*)-2-chlorobutane

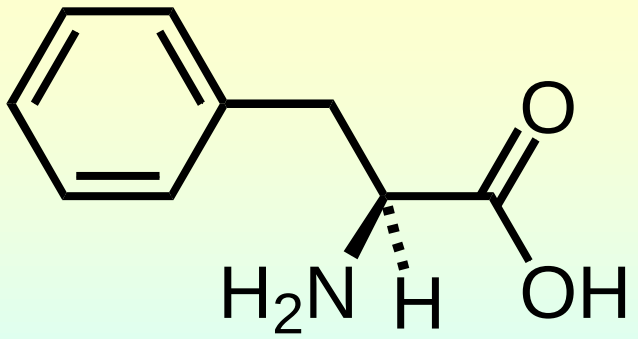


(*R*)-2-chlorobutane

Enantiomers have different properties when a second element of chirality is involved.

For example, the melting points of the two enantiomers are the same but different than the racemic mixture.

	MP
(*R*, *S*)-2-phenylalanine	266° C
(*S*)-phenylalanine	273° C
(*R*)-phenylalanine	273° C



(*S*)-phenylalanine

Enantiomers have different properties when a second element of chirality is involved.

For example, the melting points of the two enantiomers are the same but different than the racemic mixture.

	MP
(*R, S*)-2-phenylalanine	266° C
(*S*)-phenylalanine	273° C
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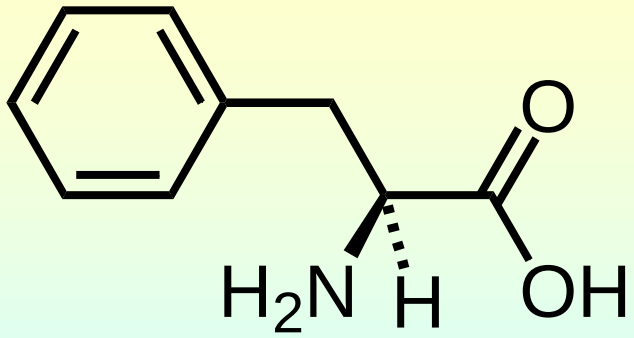


(*S*)-phenylalanine

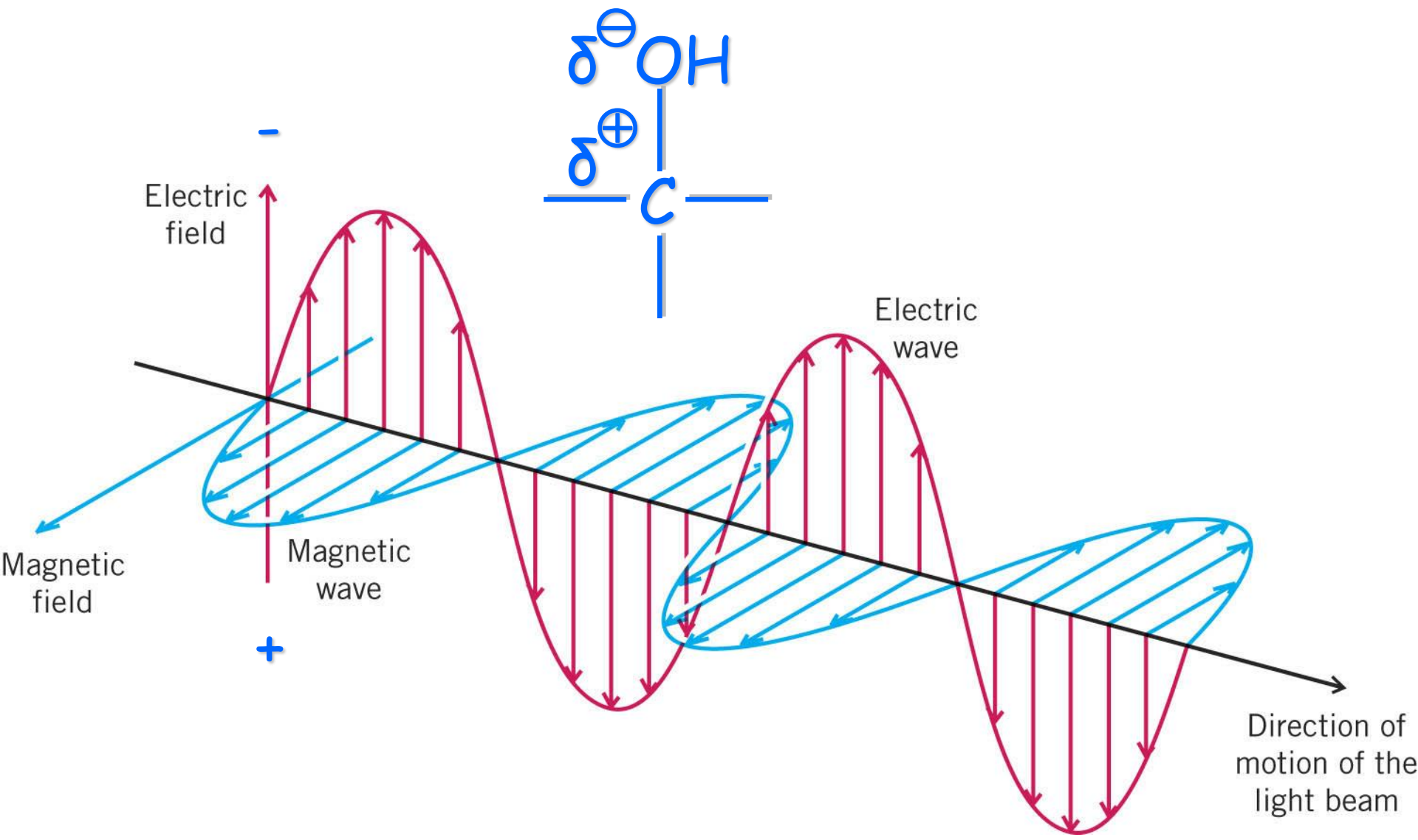
Enantiomers have different properties when a second element of chirality is involved.

The optical rotation of (*S*)-phenylalanine is the opposite of (*R*)-phenylalanine .

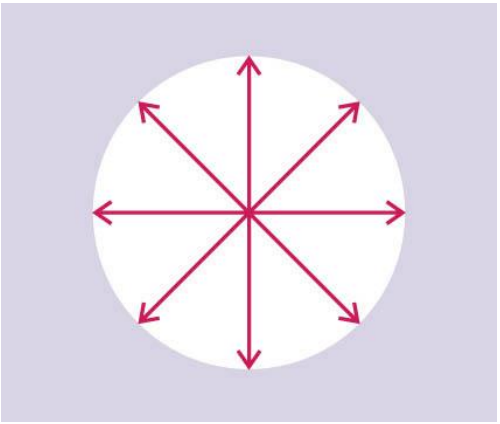
(*S*)-phenylalanine = -32.7°

(*R*)-phenylalanine = +32.7°

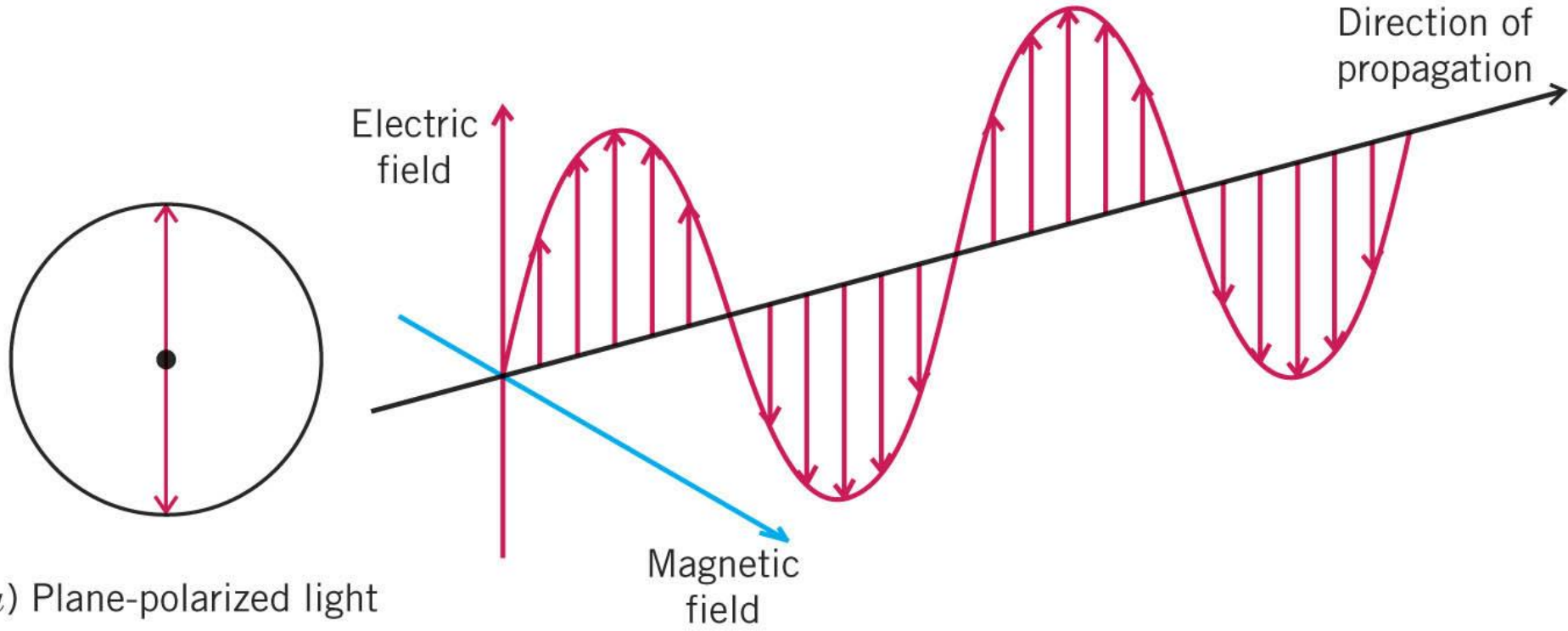
A model for electromagnetic radiation (light).



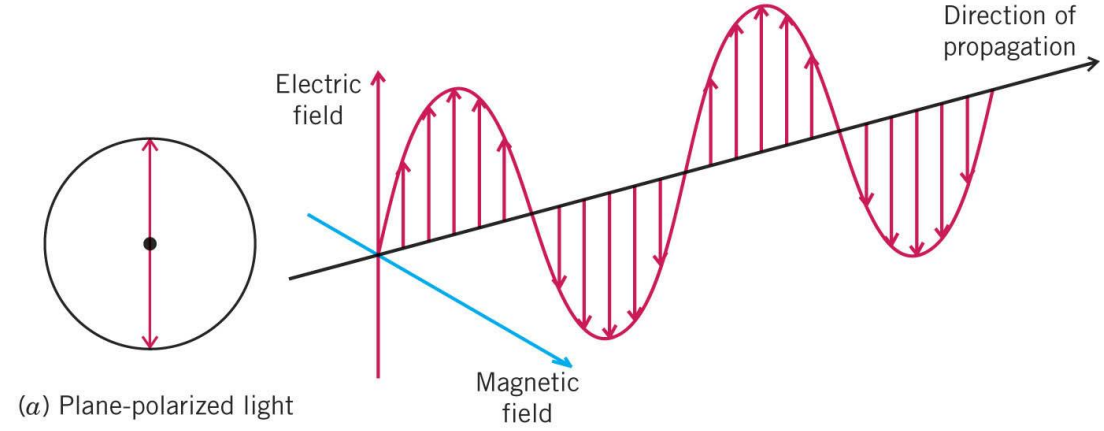
A model for plane polarized light.



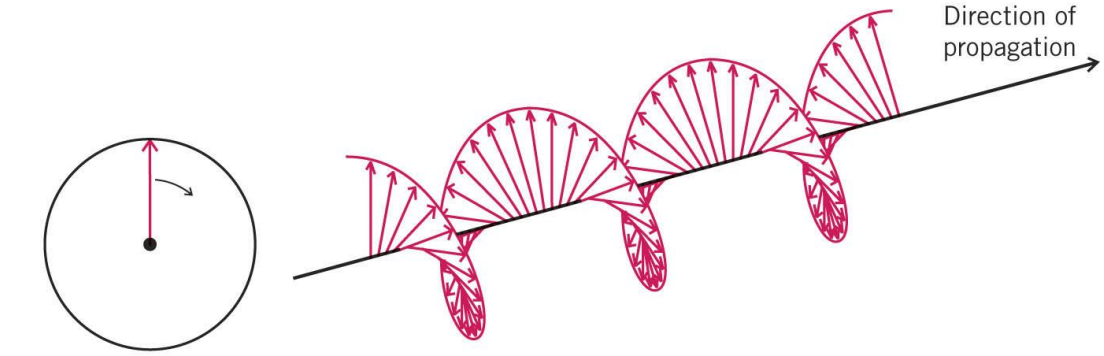
unpolarized light



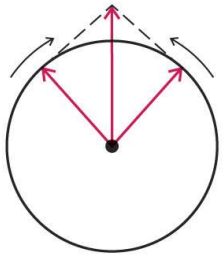
A model for plane polarized light



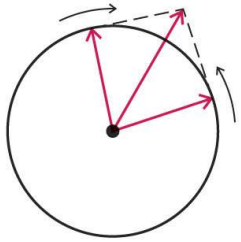
(*a*) Plane-polarized light



(*b*) Circularly-polarized light

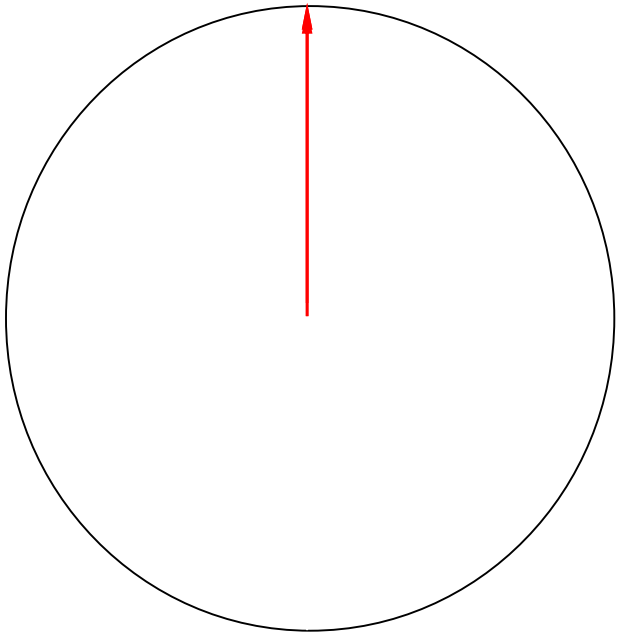


(*c*) Two circularly-polarized beams counter-rotating at the same velocity (in phase), and their vector sum. The net result is like (*a*) above.



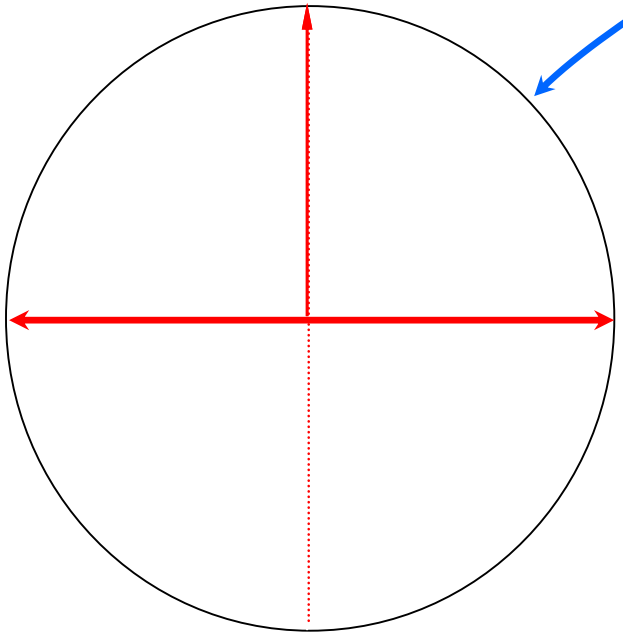
(*d*) Two circularly-polarized beams counter-rotating at the different velocities, such as after interaction with a chiral molecule, and their vector sum. The net result is like (*b*) above.

A model for polarized light

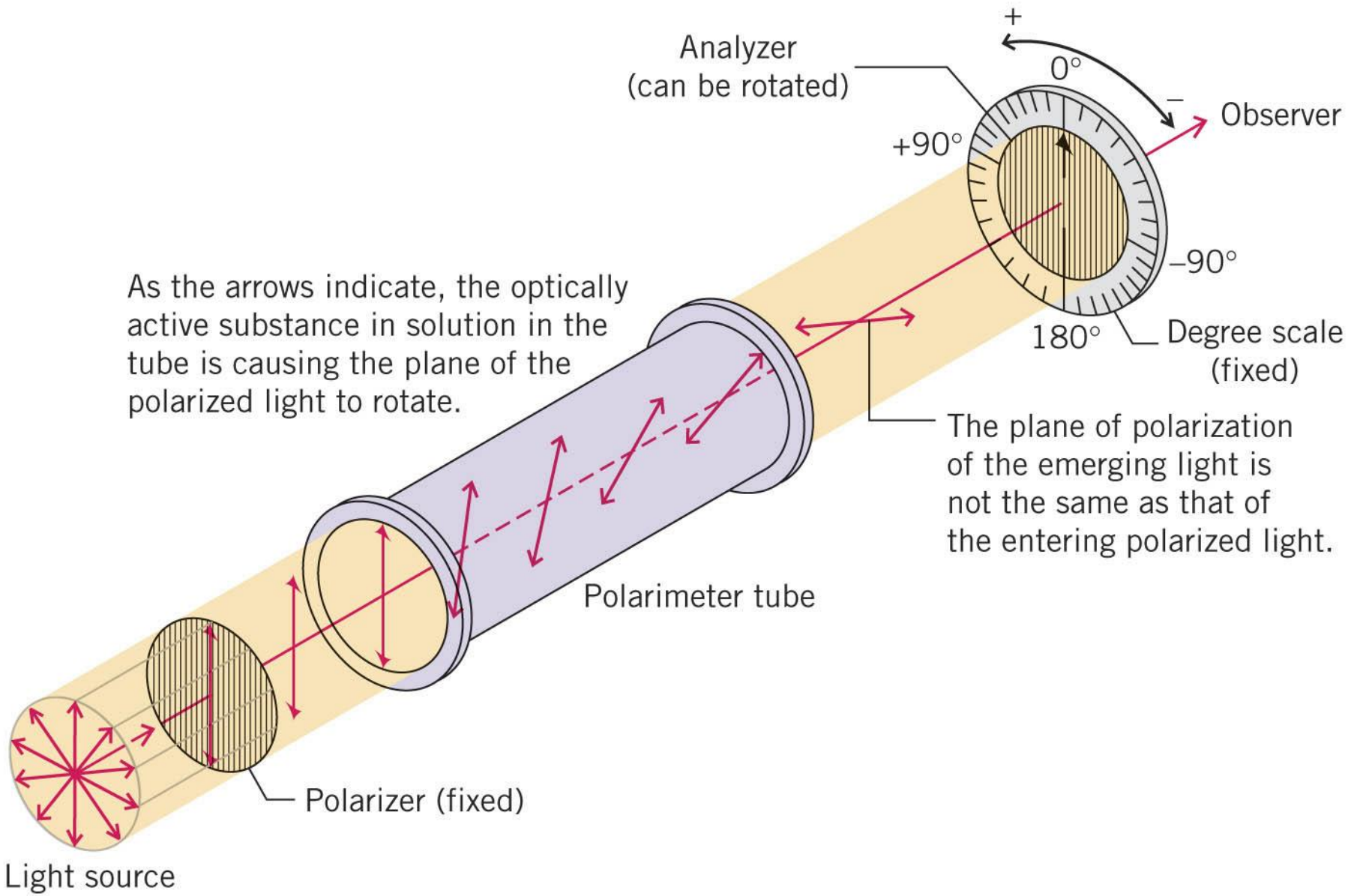


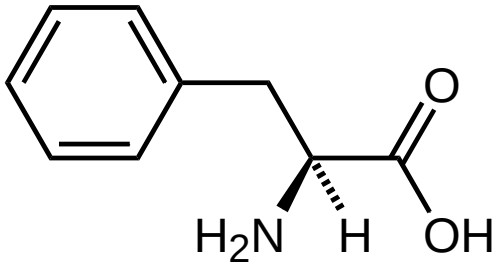
A model for polarized light

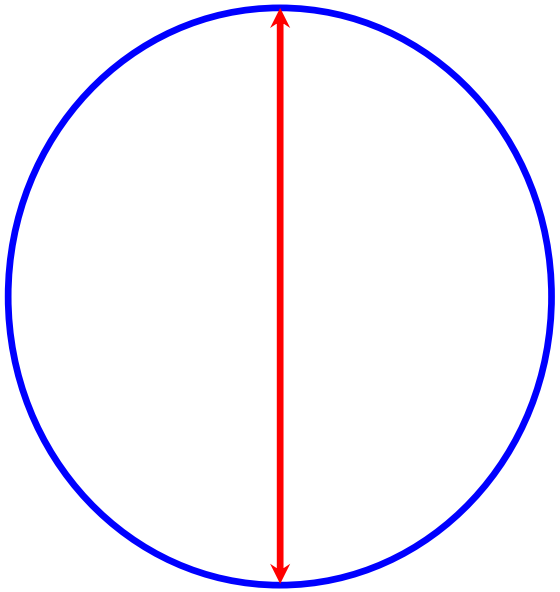
rotation = 90°

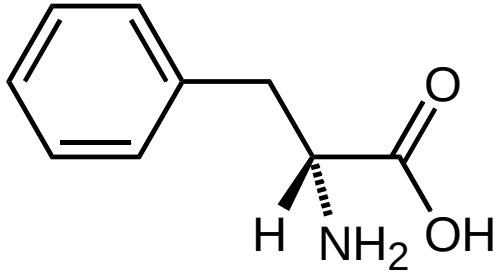


An instrument for measuring the rotation of the plane of polarized light.



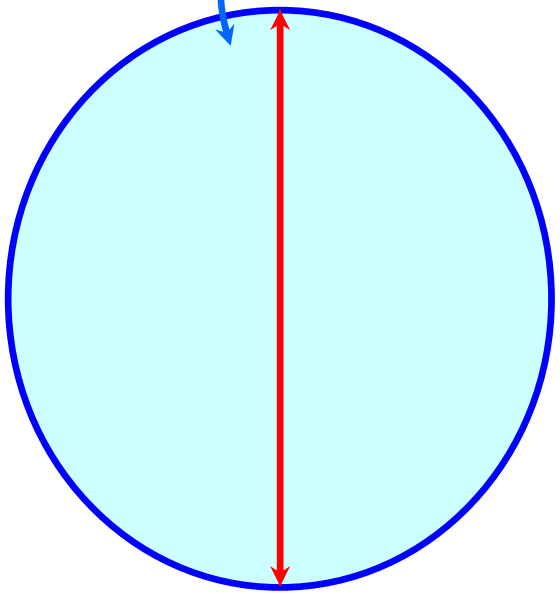


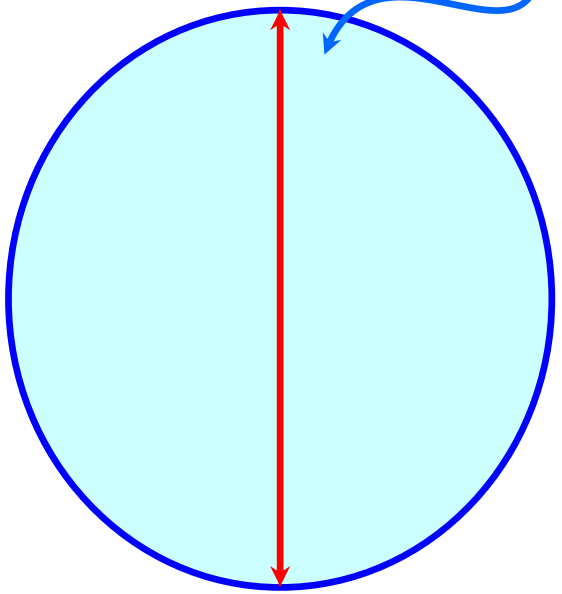




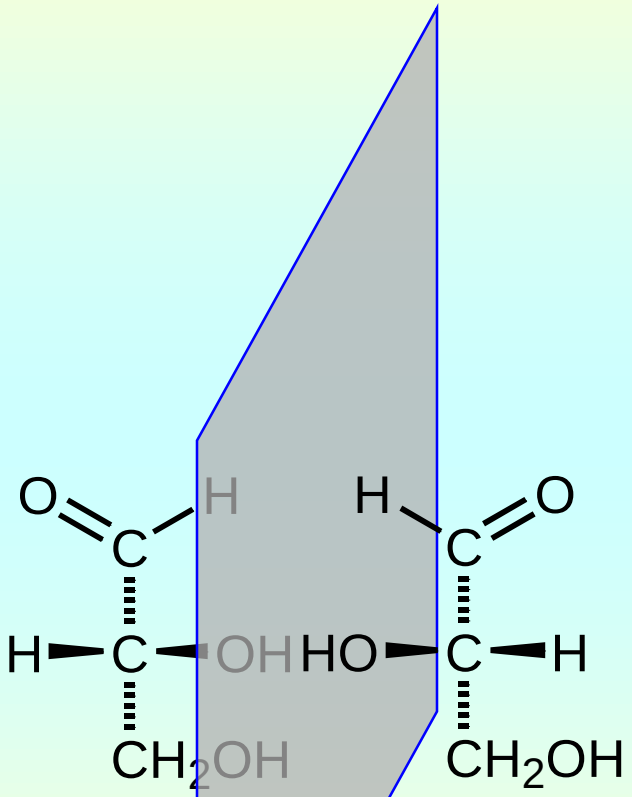
(*S*)-phenylalanine = -32.7°

(*R*)-phenylalanine = +32.7°





Since enantiomers are different structures they must have different names and different properties



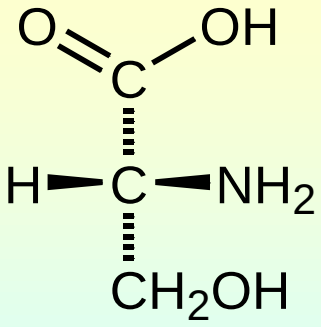
(*R*)-glyceraldehyde
D-glyceraldehyde

+ rotation of plane polarized light

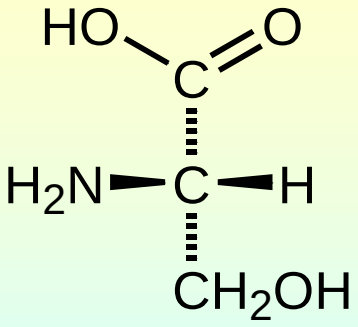
(*S*)-glyceraldehyde
L-glyceraldehyde

- rotation of plane polarized light

amino acids

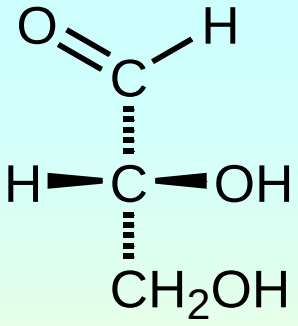


D-serine



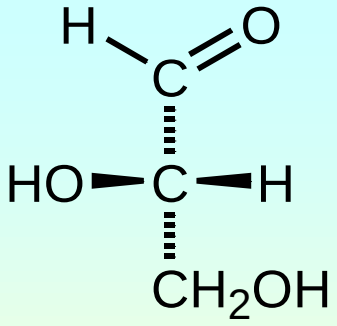
L-serine

carbohydrates



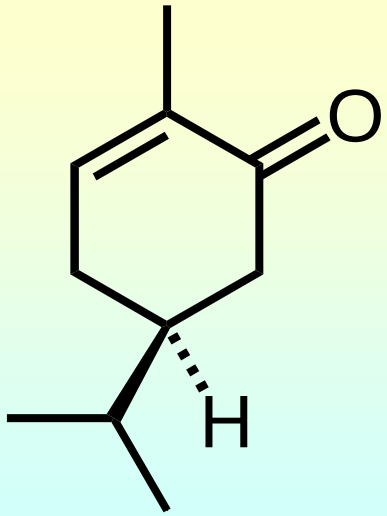
(*R*)-glyceraldehyde
D-glyceraldehyde

+ rotation of plane polarized light

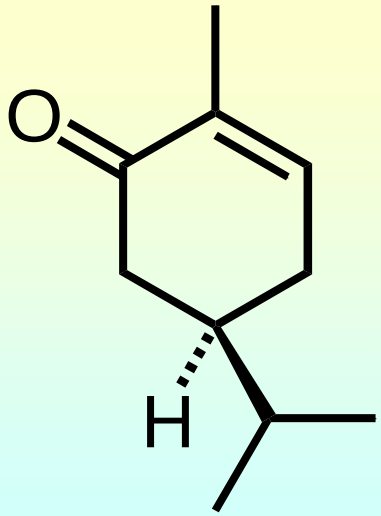


(*S*)-glyceraldehyde
L-glyceraldehyde

- rotation of plane polarized light



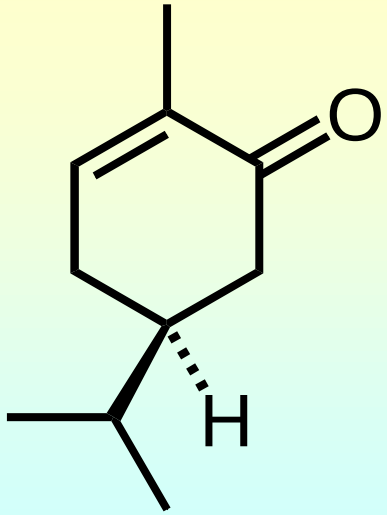
(+)-carvone
oil of caraway

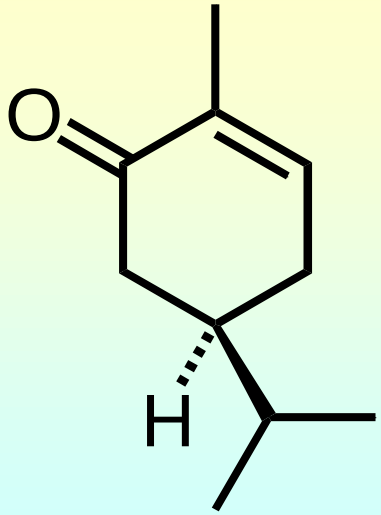


(-)-carvone
oil of spearmint

Enantiomers have different properties when a second element of chirality is involved.

Enantiomers have different ***biological activity.***





(+)-carvone
oil of caraway

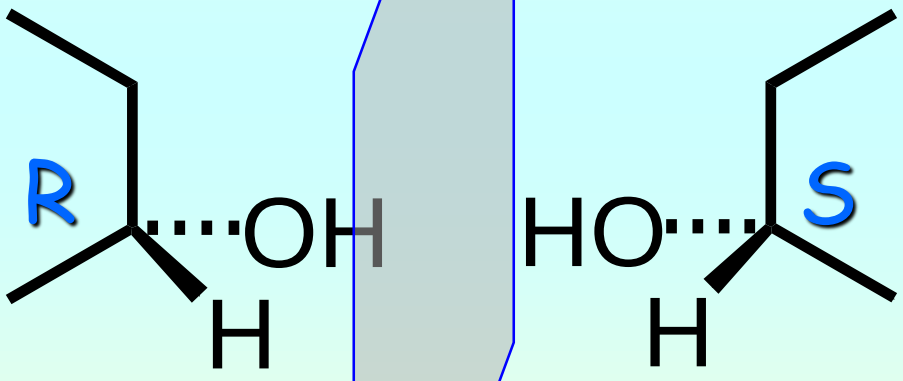
(-)-carvone
oil of spearmint

Enantiomers are different compounds.

They have different names (R or S).

They have different properties.

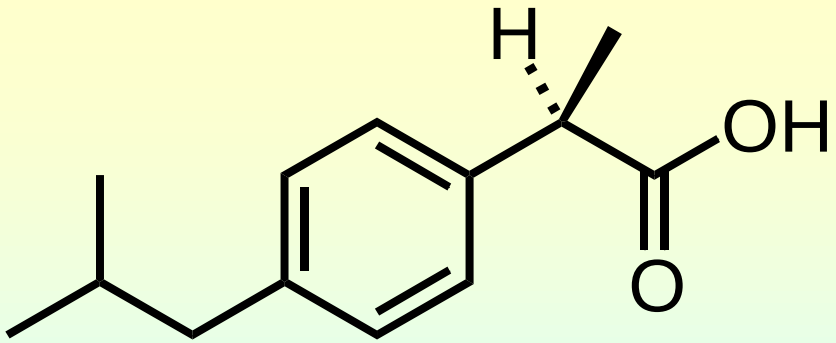
$[\alpha]_D^{25} = -13°$

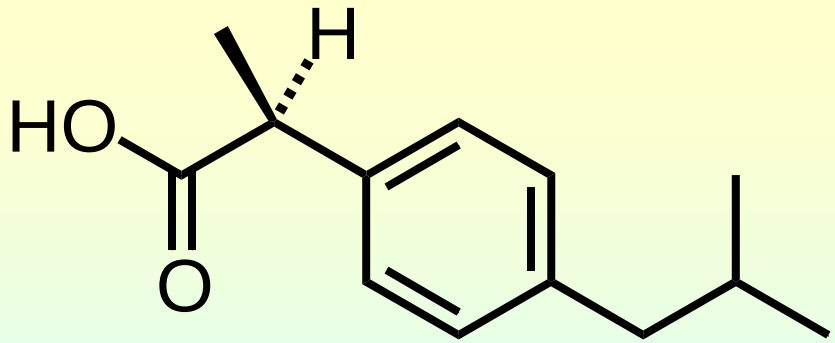


(*R*)-2-butanol

$[\alpha]_D^{25} = +13°$

(*S*)-2-butanol

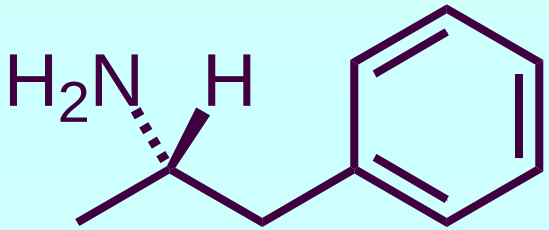




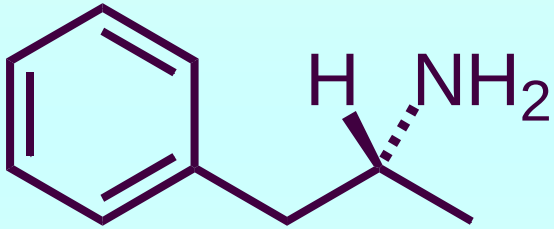
Ibuprofen

The fairest isomer of them all

Different enantiomers of a drug can have different effects.



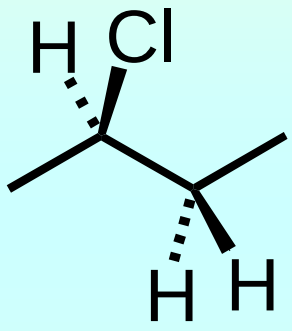
amphetamine



stimulant

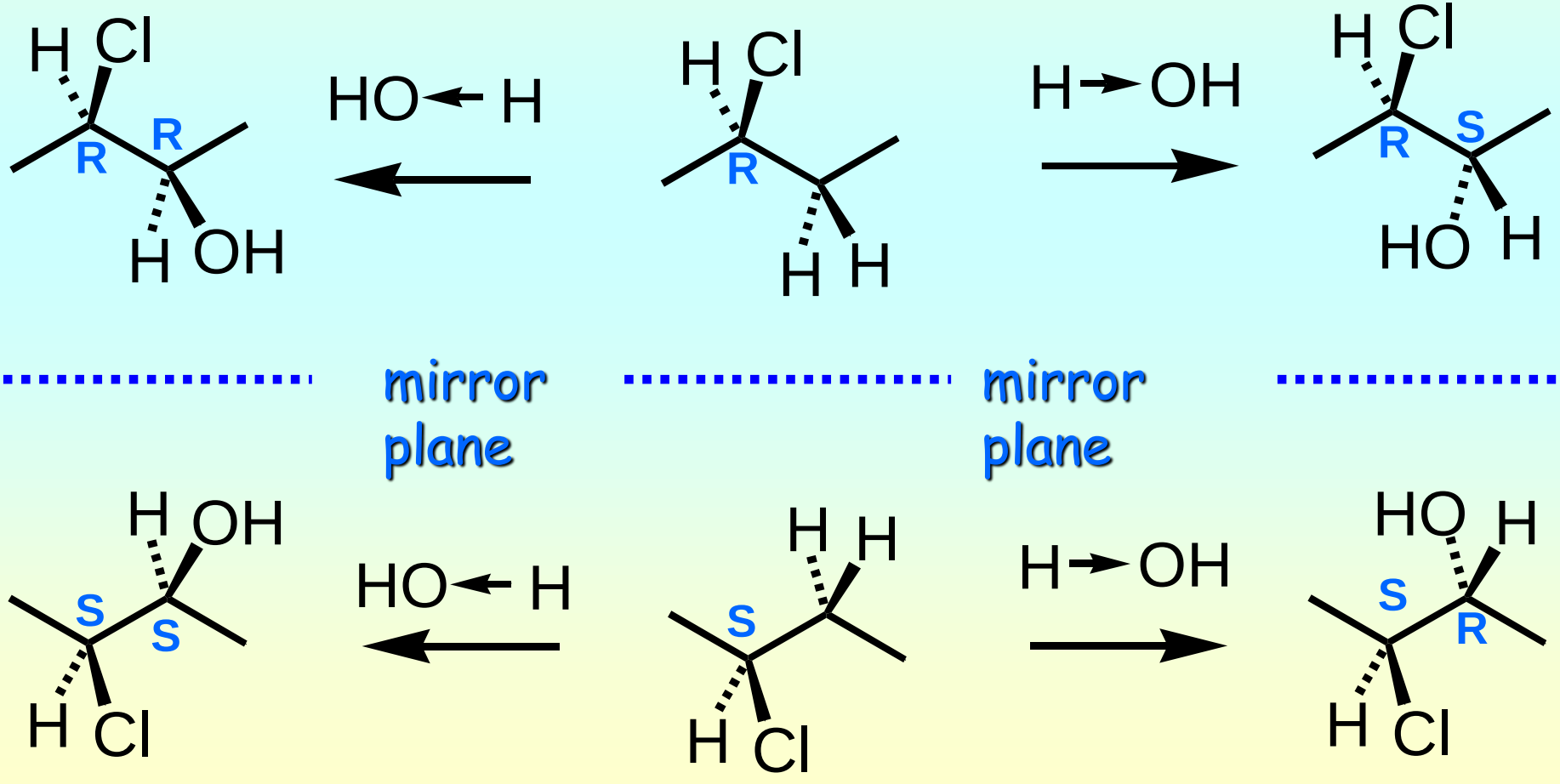
adverse cardiovascular effects

Molecules with more than one stereocenter.

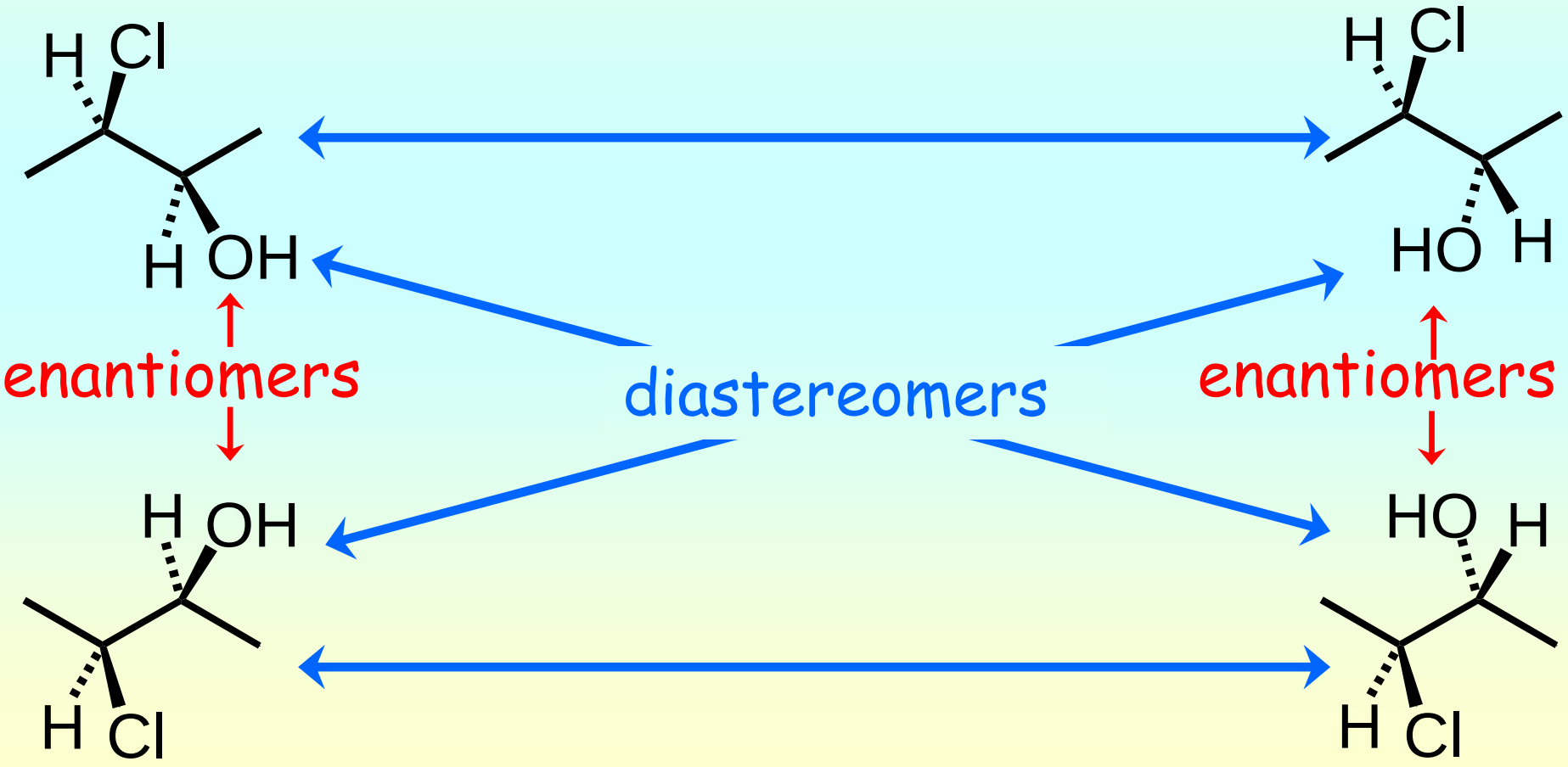


Each of these hydrogens are ***prochiral***. Substituting any of these hydrogens will produce different stereoisomers.

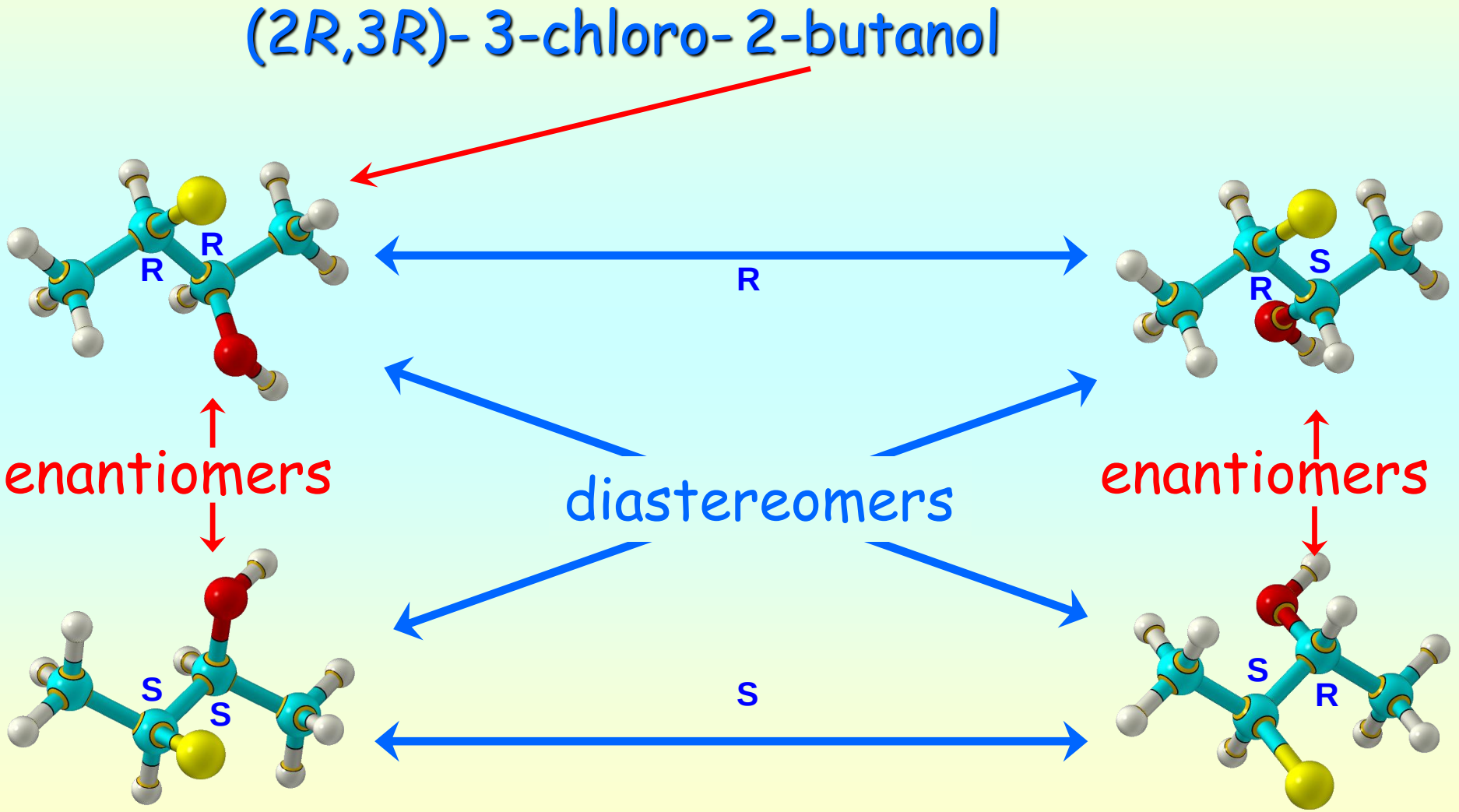
Molecules with more than one stereocenter.



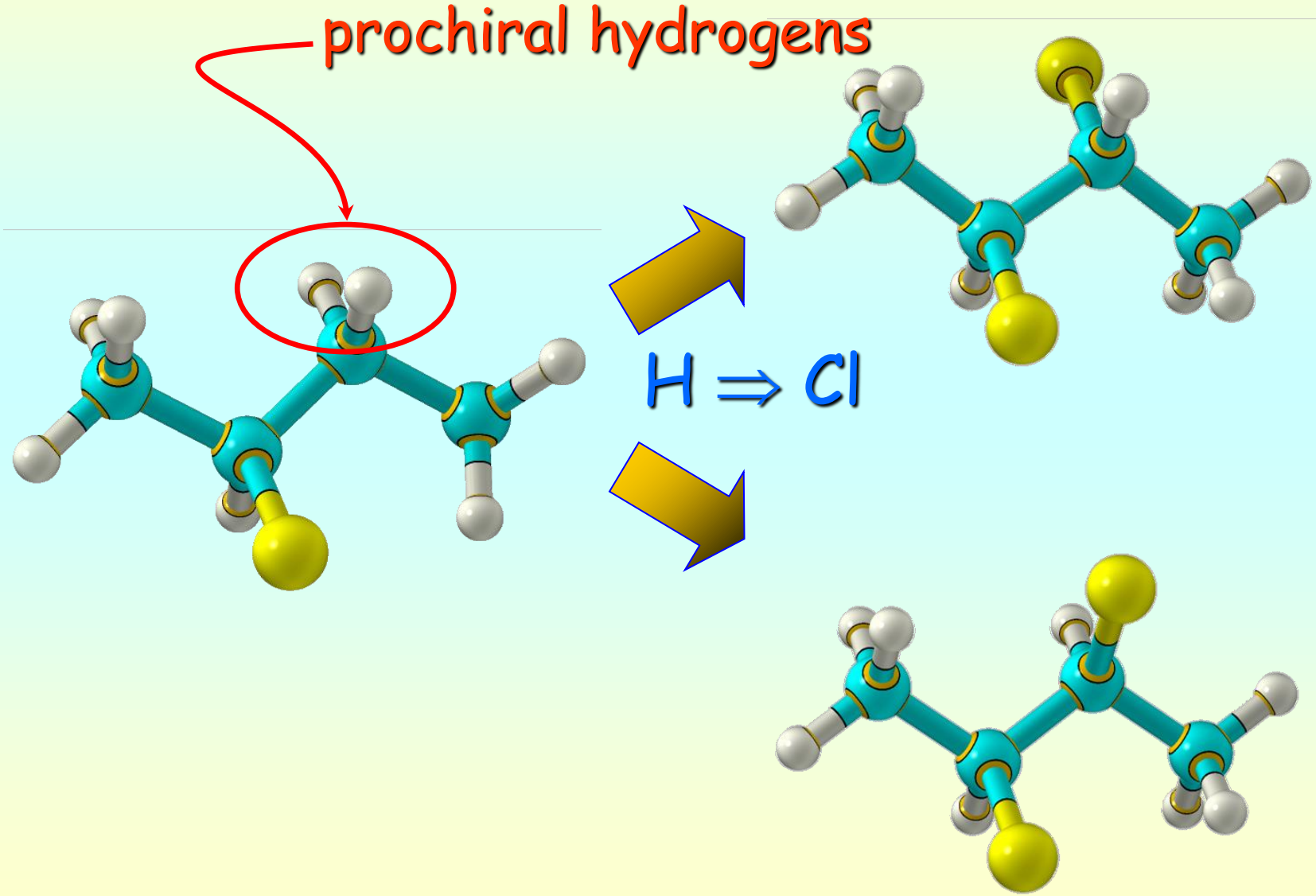
Molecules with more than one stereocenter.



Molecules with more than one stereocenter. Nomenclature:

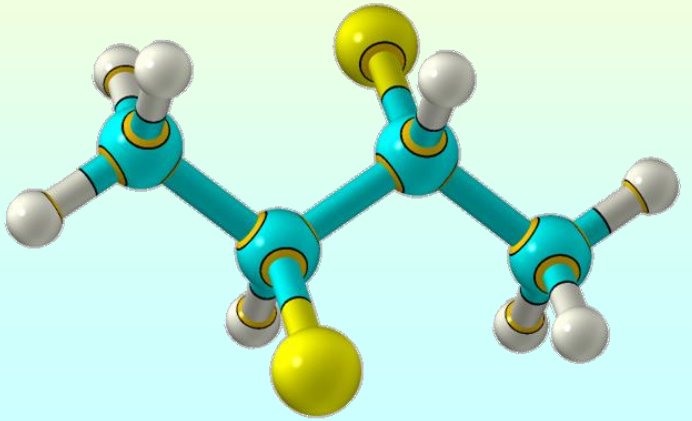


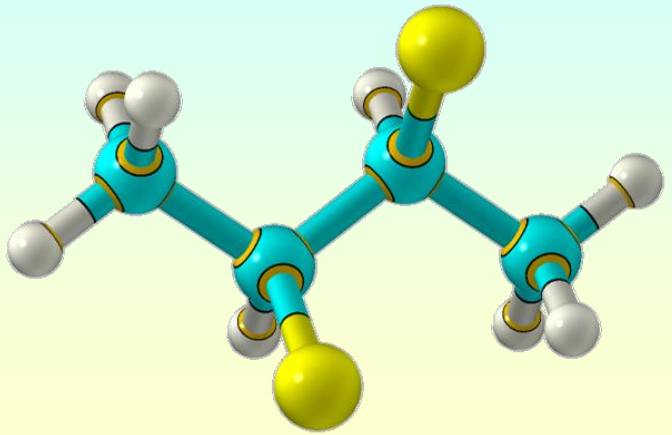
Molecules with more than one stereocenter.



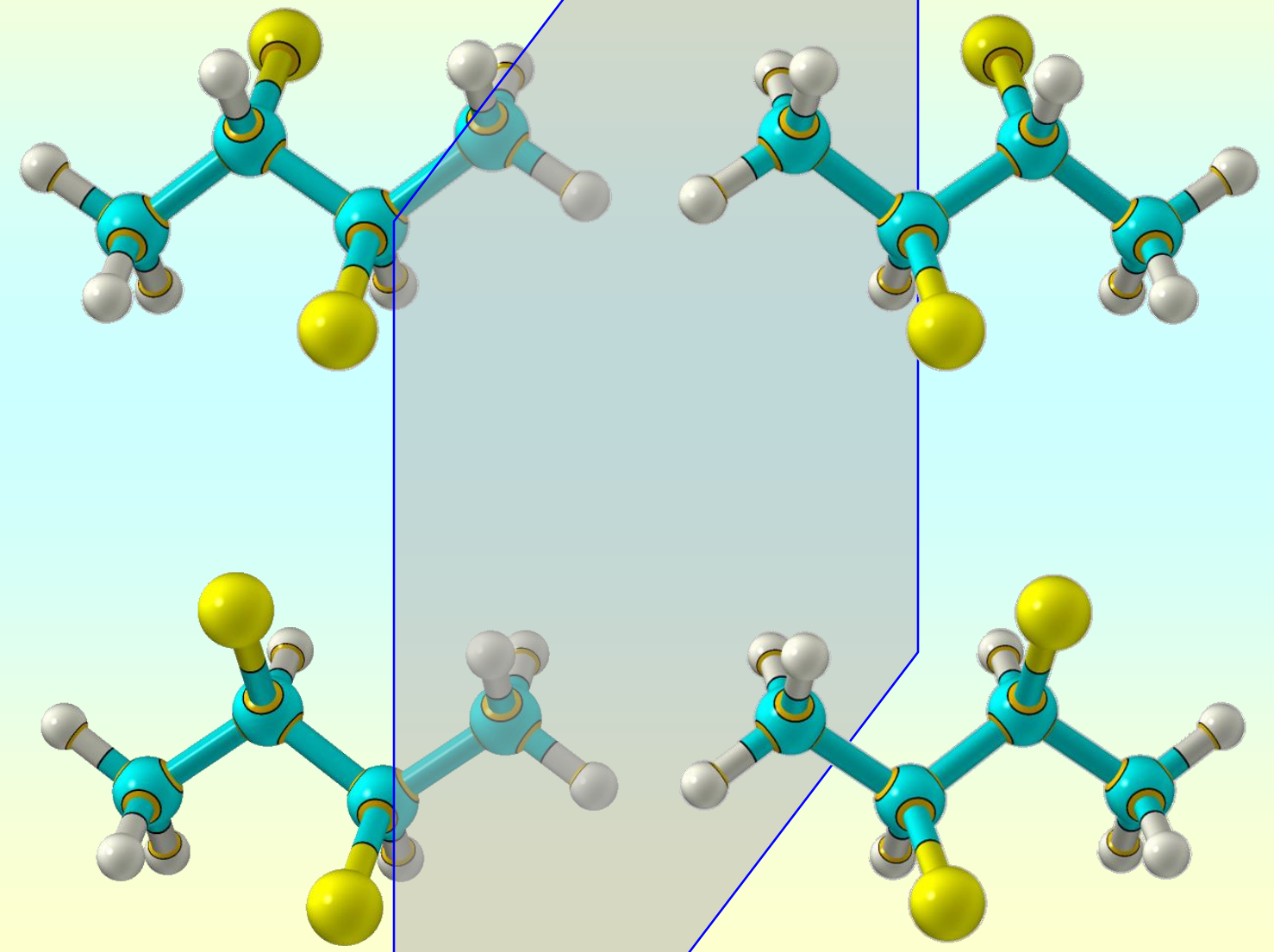
Molecules with more than one stereocenter.

Stereoisomers that are not mirror images are called diastereomers.



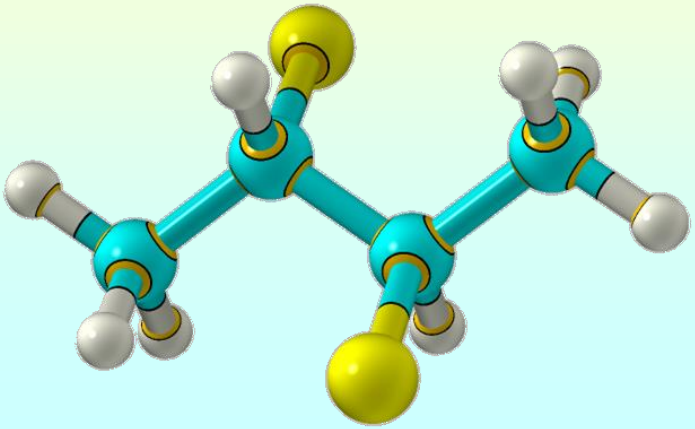


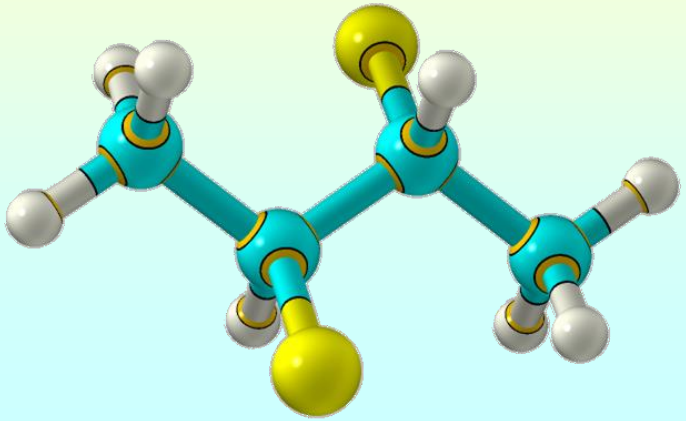
Molecules with more than one stereocenter

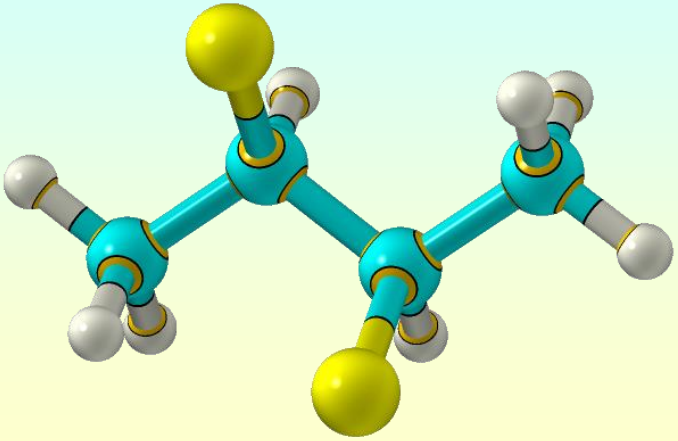


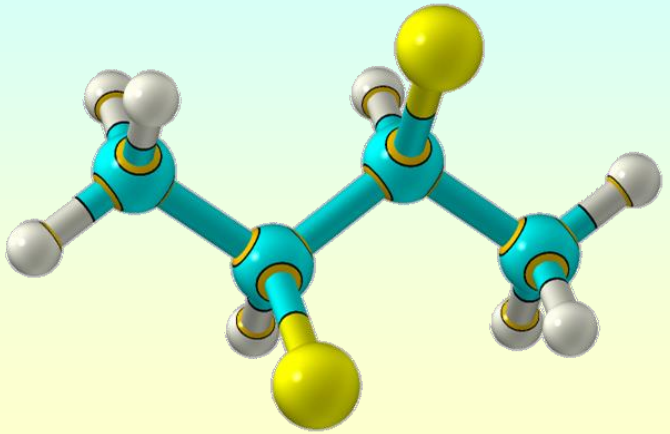
Molecules with more than one stereocenter

Are all of these molecules stereoisomers?



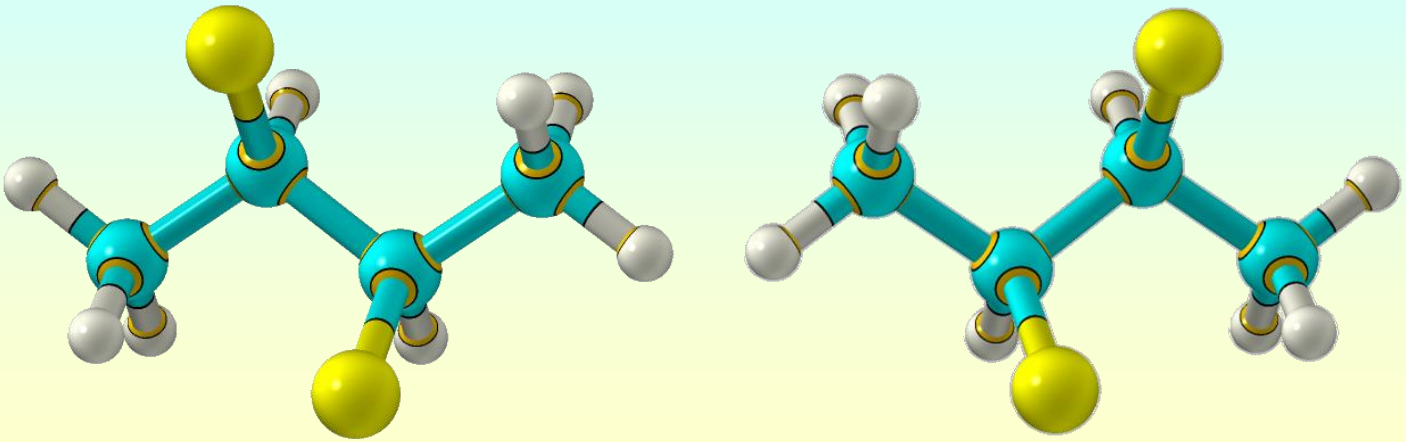






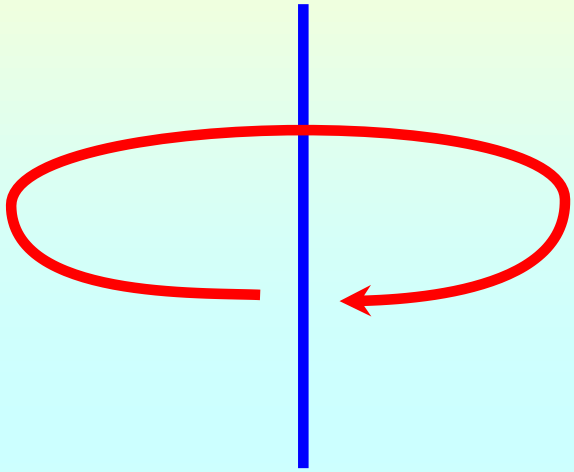
Molecules with more than one stereocenter

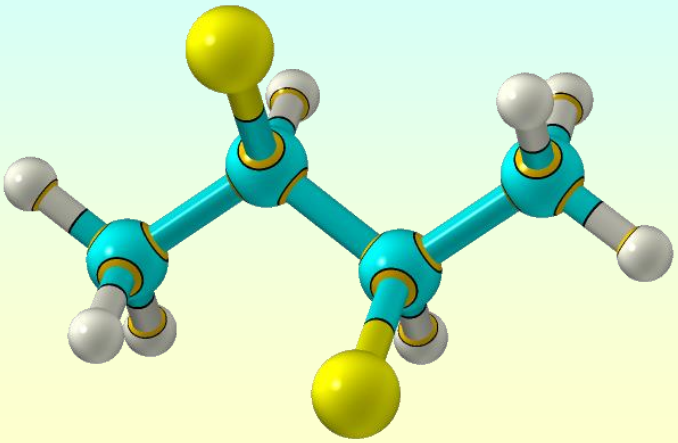
Do any of these images represent the same structure?

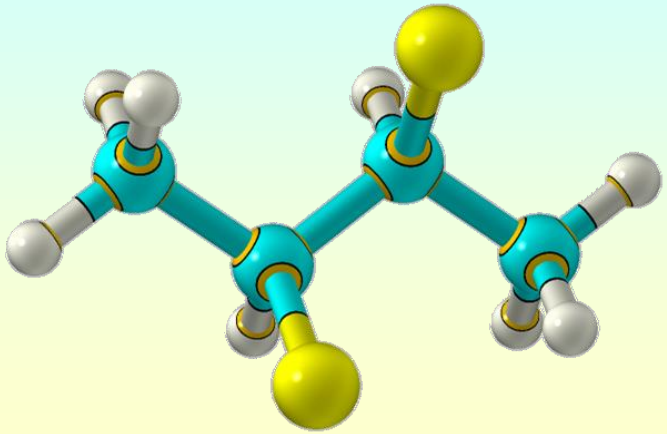


Molecules with more than one stereocenter

Do any of these images represent the same structure?

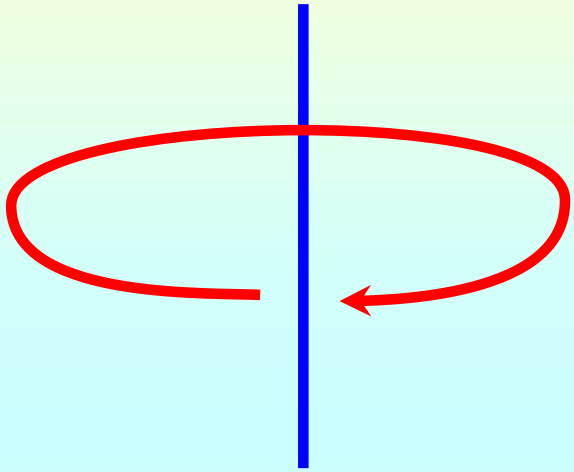


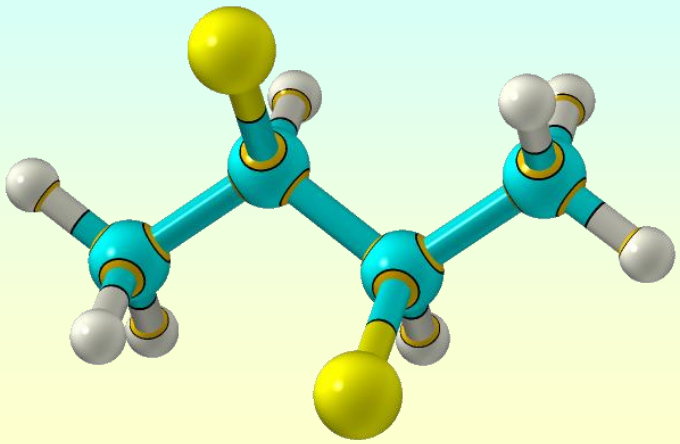


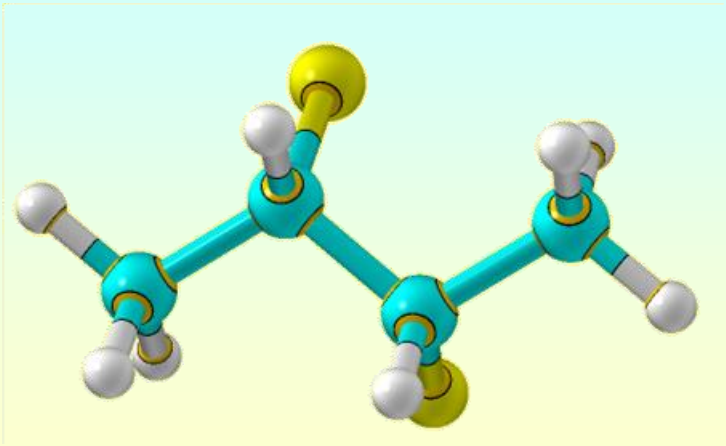


Molecules with more than one stereocenter

Do any of these images represent the same structure?

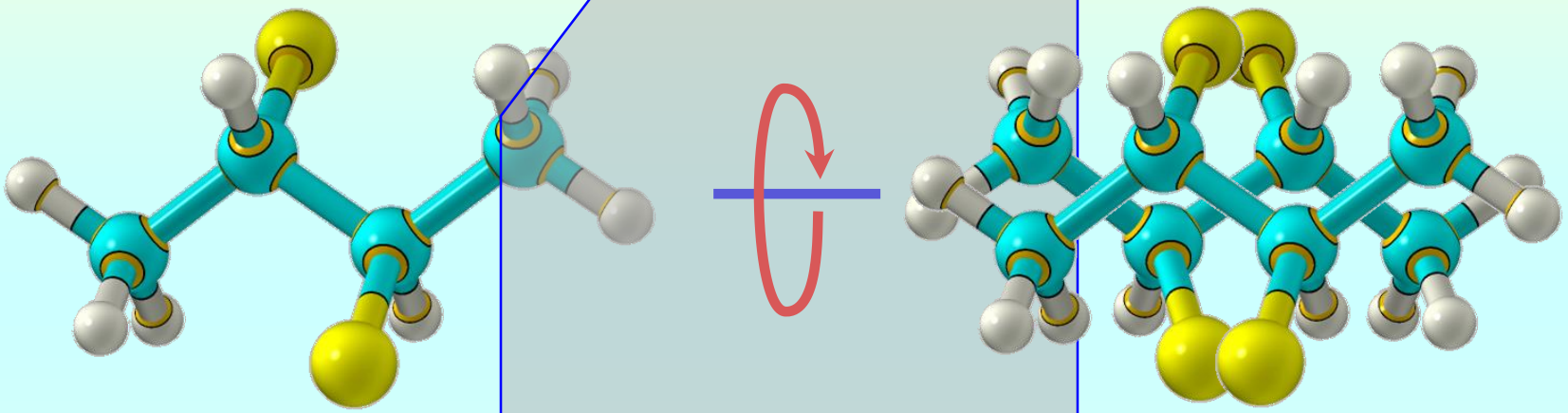






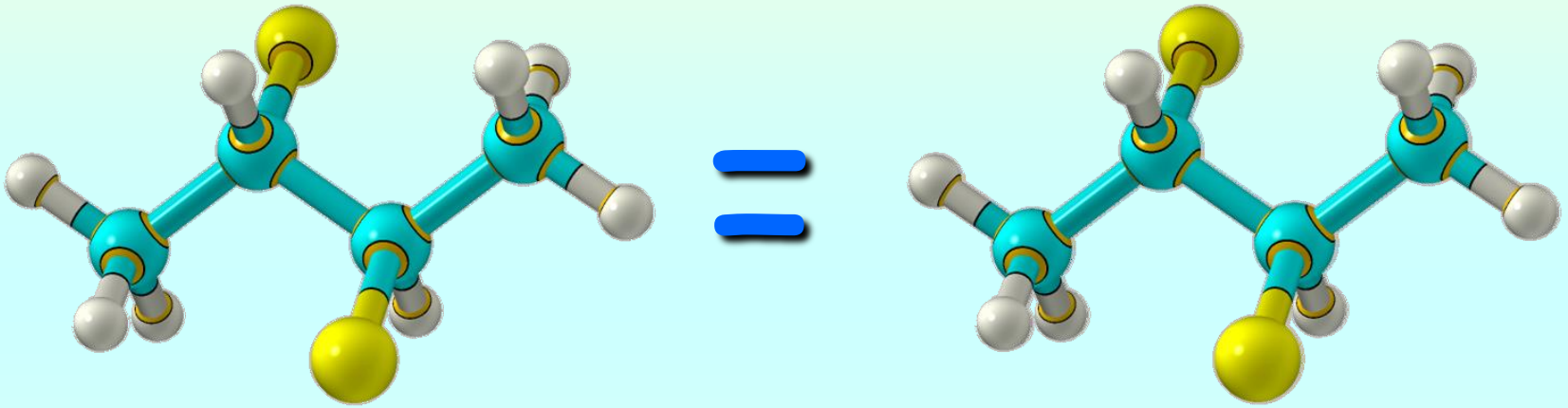
Molecules with more than one stereocenter

Do any of these images represent the same structure?



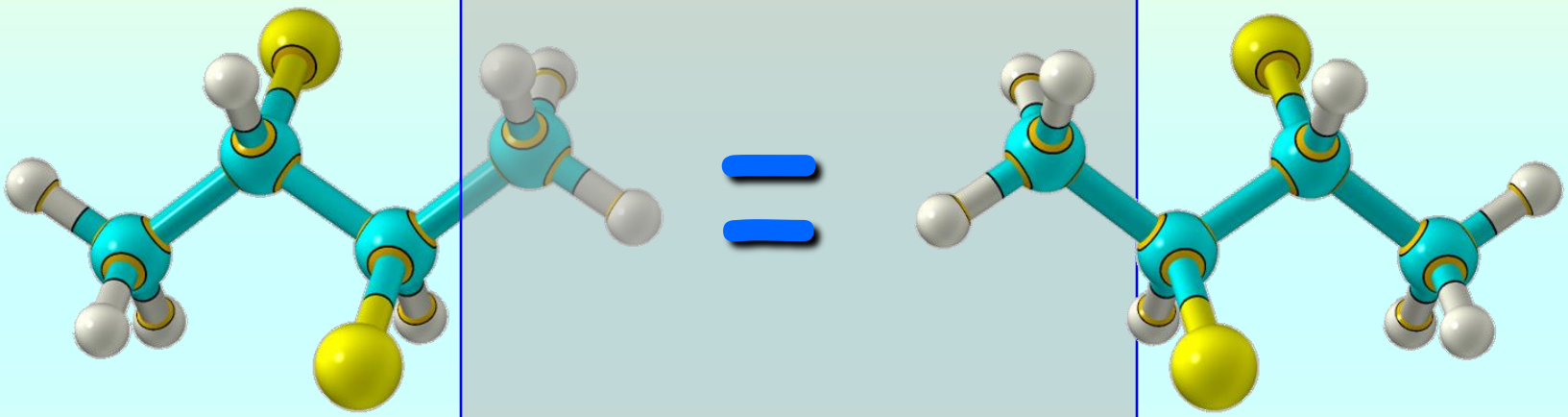
Molecules with more than one stereocenter

These mirror images are the same structure!



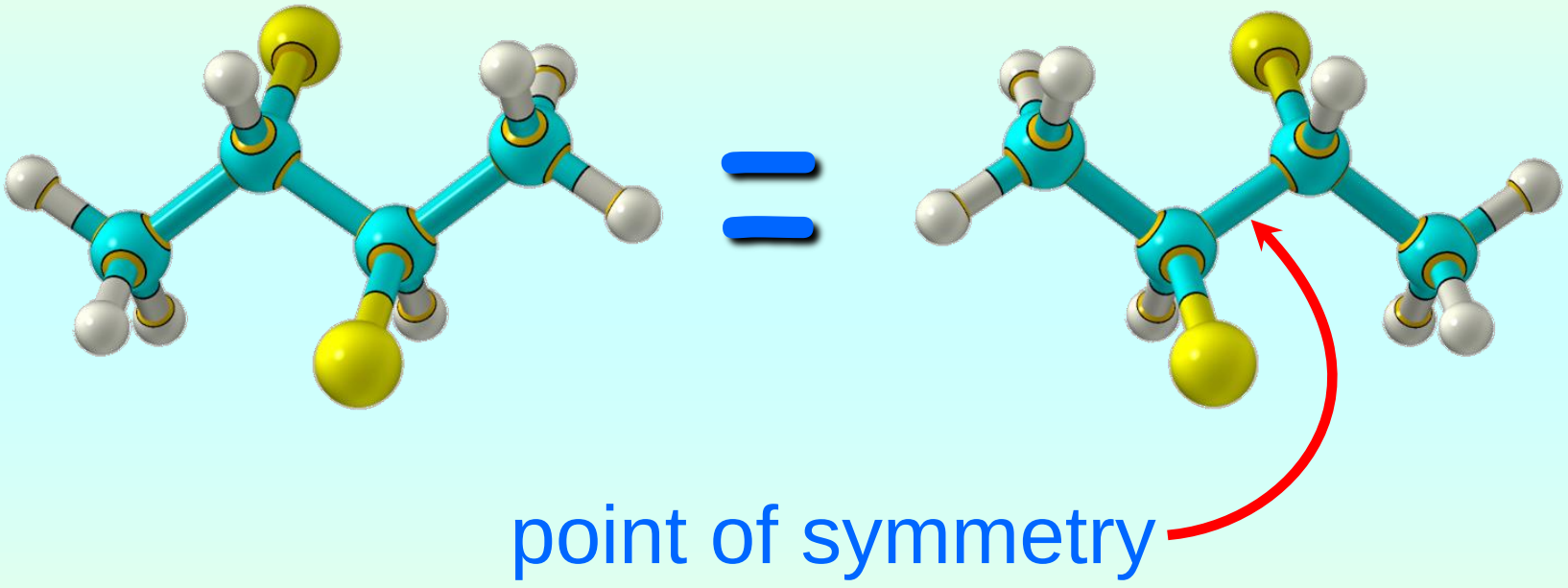
Molecules with more than one stereocenter

These structures are the same.



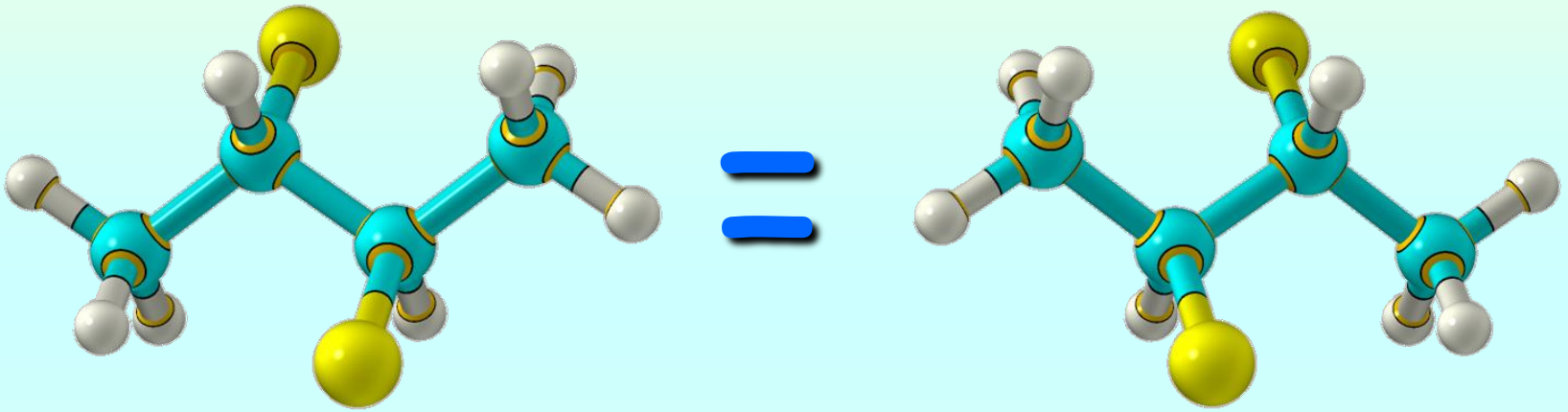
Molecules with more than one stereocenter

These structures are the same.



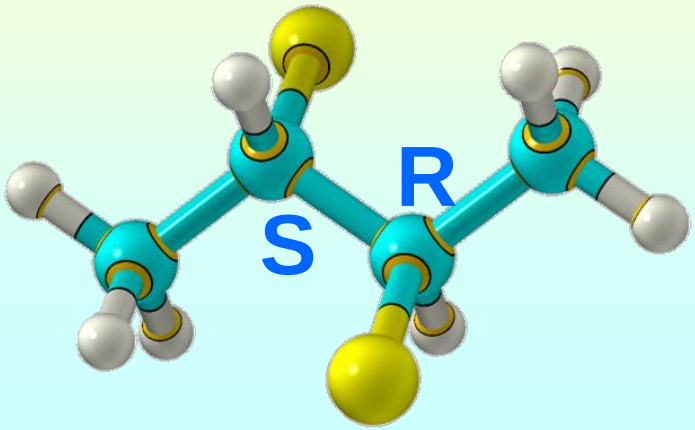
Any molecule that possesses a plane or point of symmetry will have an *identical* mirror image.

Molecules with more than one stereocenter



Any molecule that has stereoisomers but is not chiral is called a **meso** structure.

The 2,3-dichlorobutanes.



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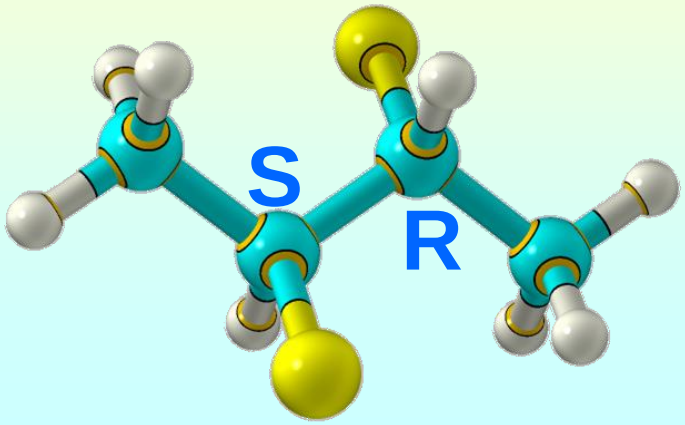
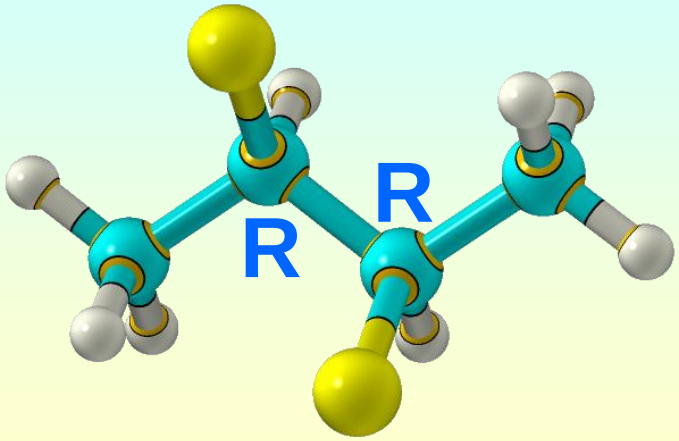
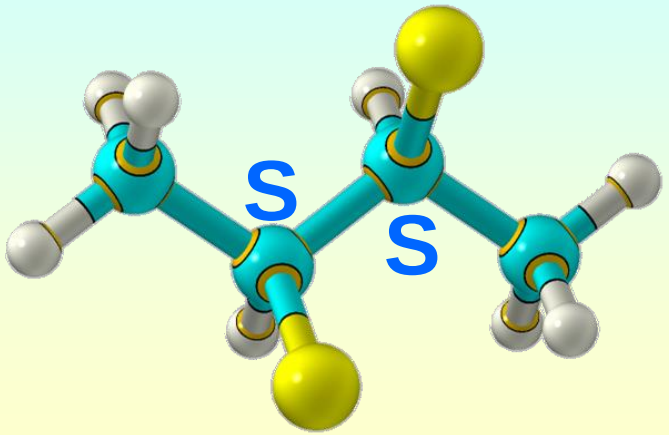
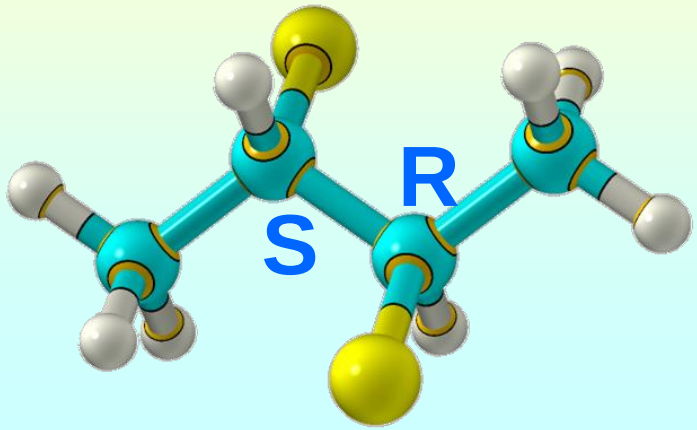


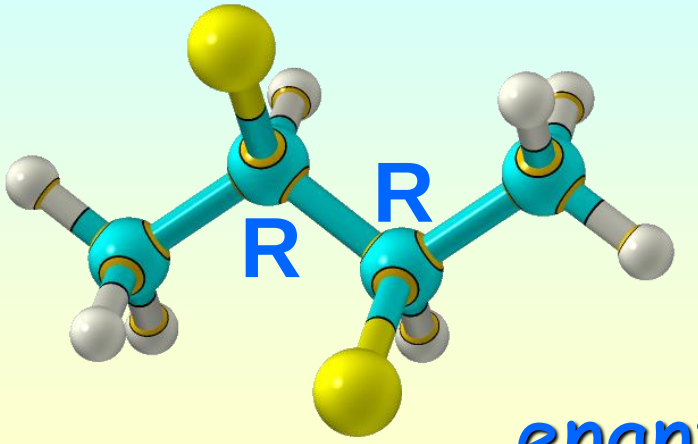


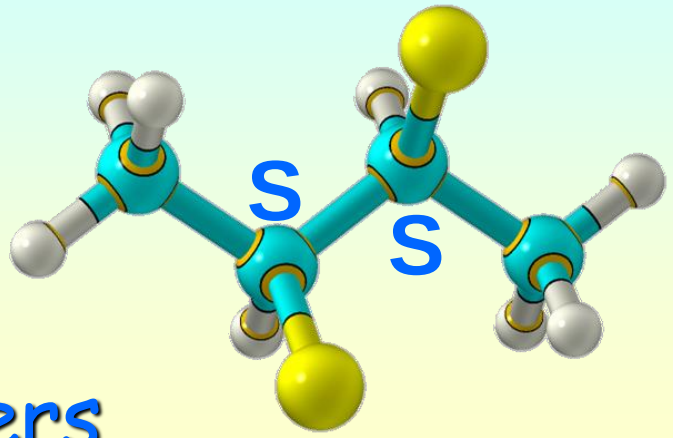


Although 2,3-dichlorobutane contains two stereocenters there are only three stereoisomers.



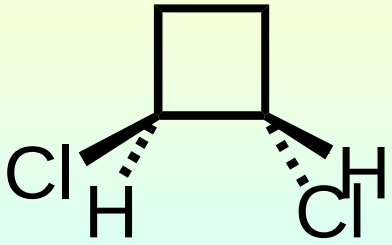
meso

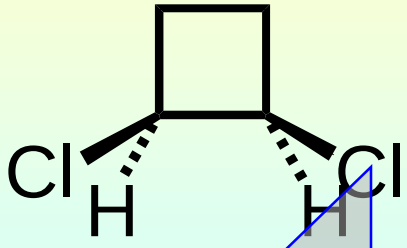




enantiomers

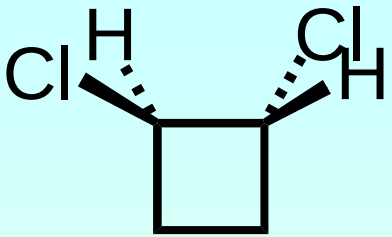
Molecules with more than one stereocenter

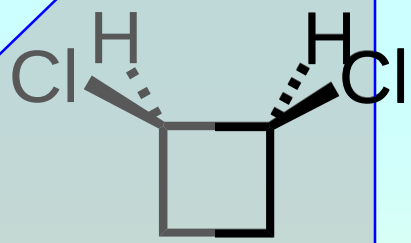




enantiomers

identical

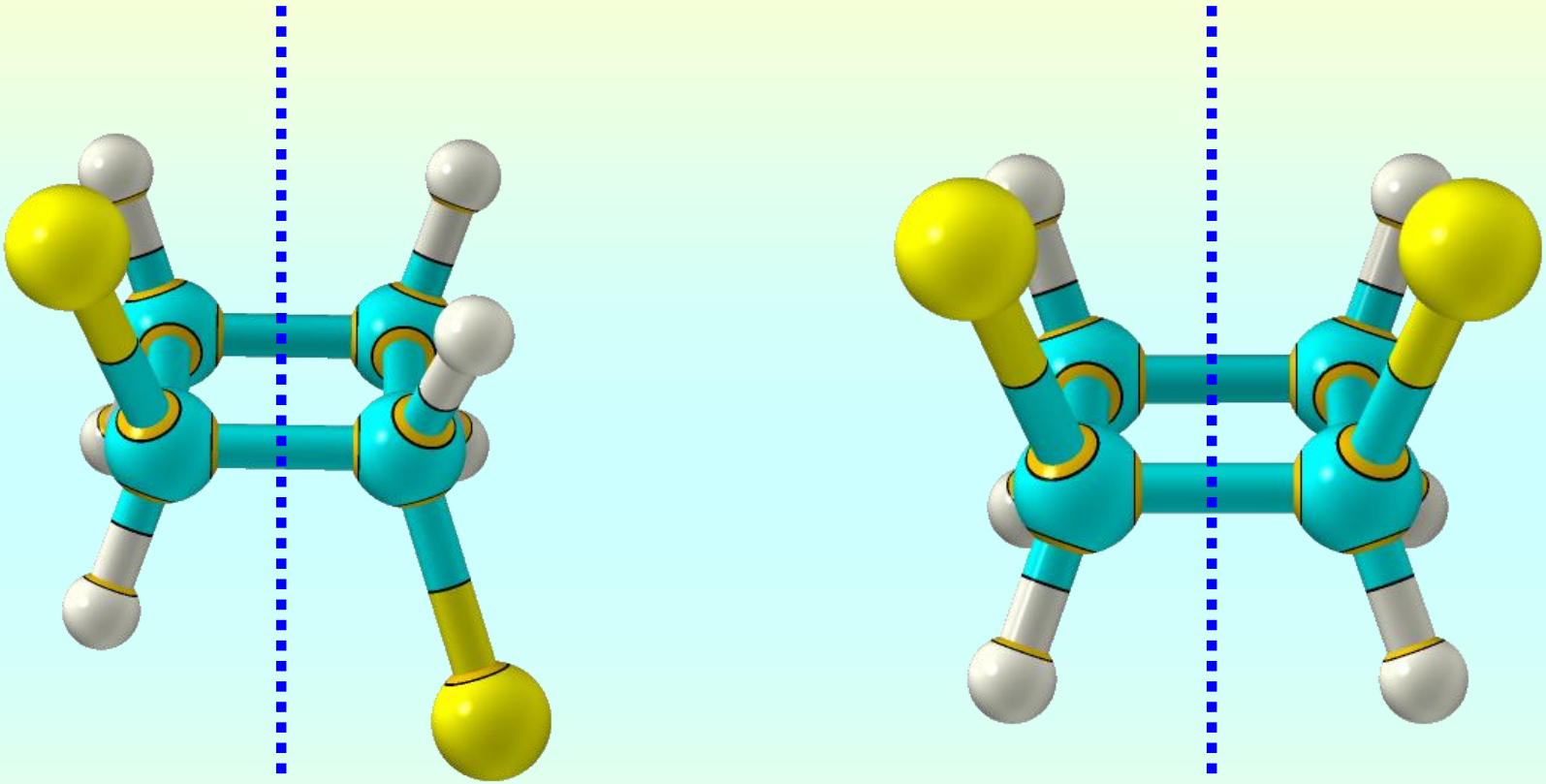




plane of symmetry

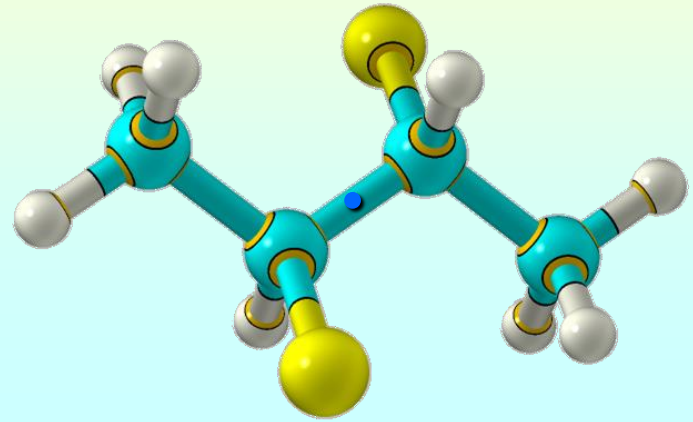
Any molecule that possesses a plane or point of symmetry will have an ***identical*** mirror image.

Molecules with more than one stereocenter

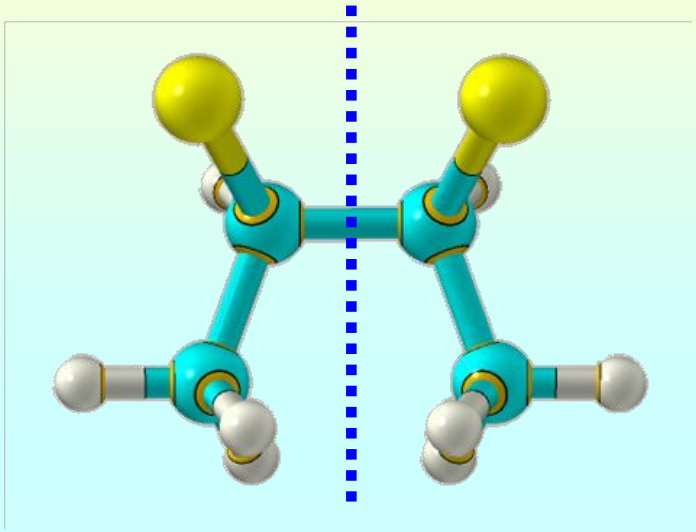


Any molecule that possesses a plane or point of symmetry will have an ***identical*** mirror image.

Molecules with more than one stereocenter



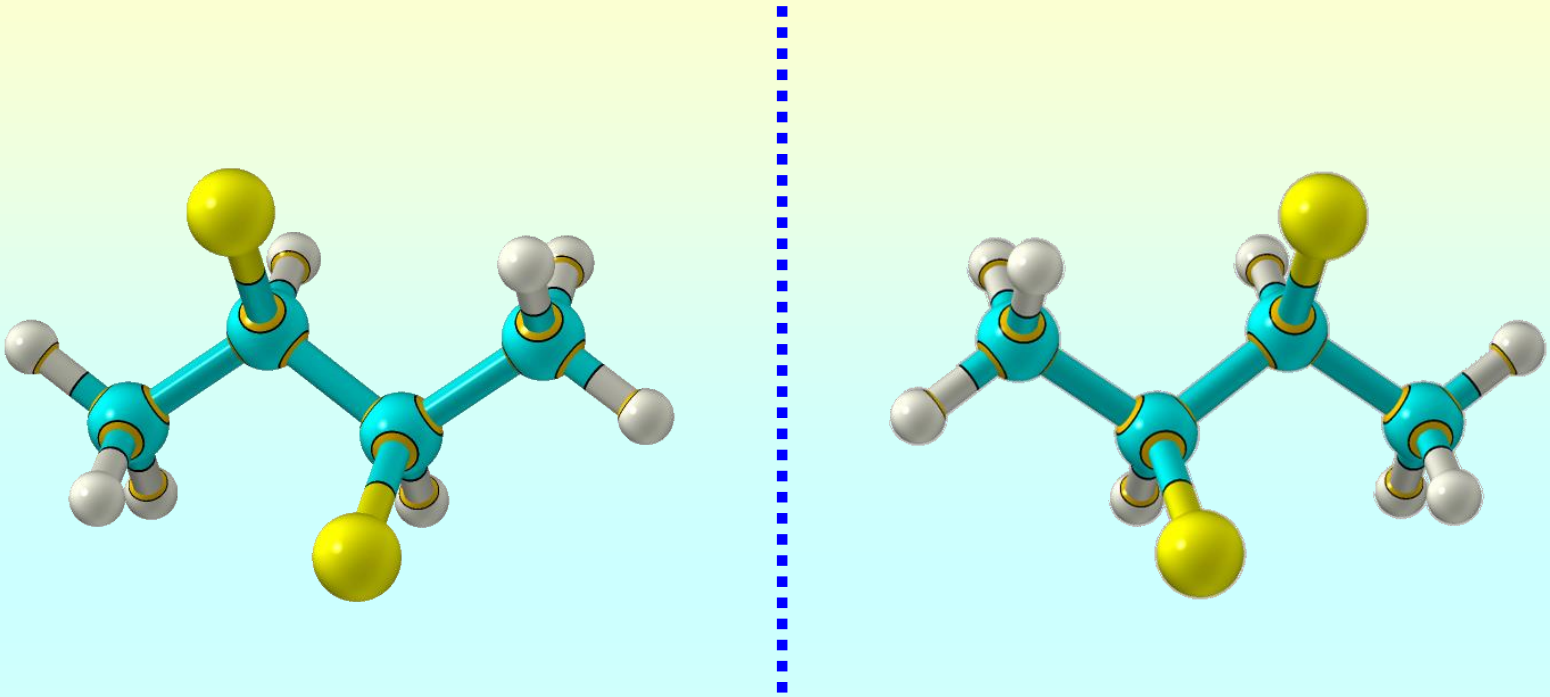
point of symmetry



plane of symmetry

Any molecule that possesses a plane or point of symmetry will have an ***identical*** mirror image.

Molecules with more than one stereocenter

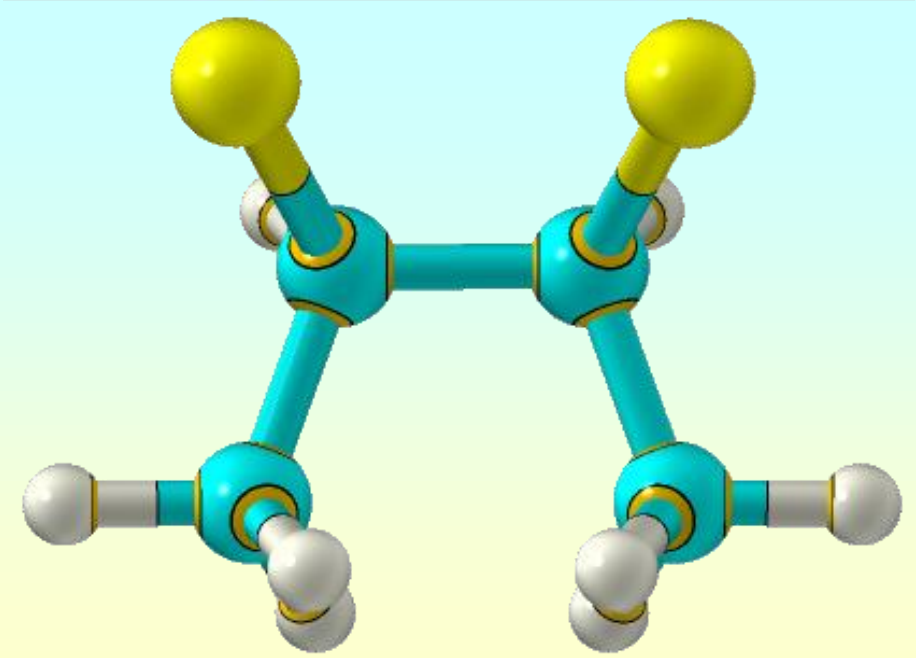


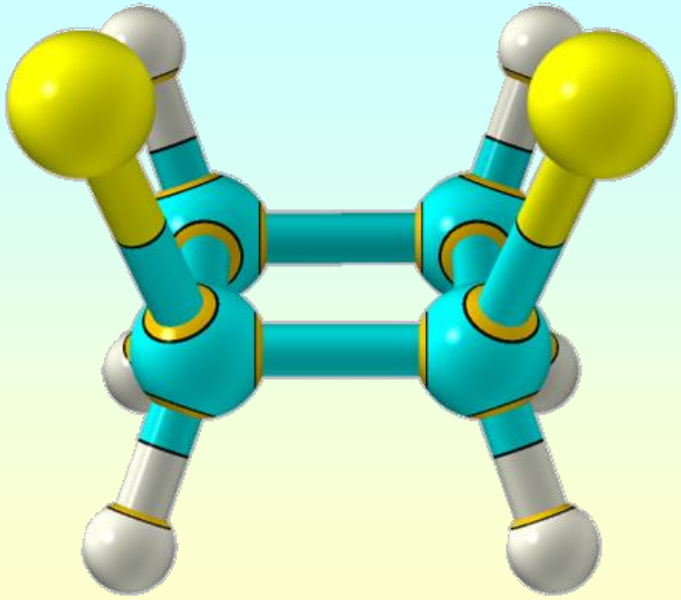
no point or plane of symmetry and the mirror image is non identical. These are chiral molecules.

Any molecule that possesses a plane or point of symmetry will have an ***identical*** mirror image.

Molecules with more than one stereocenter

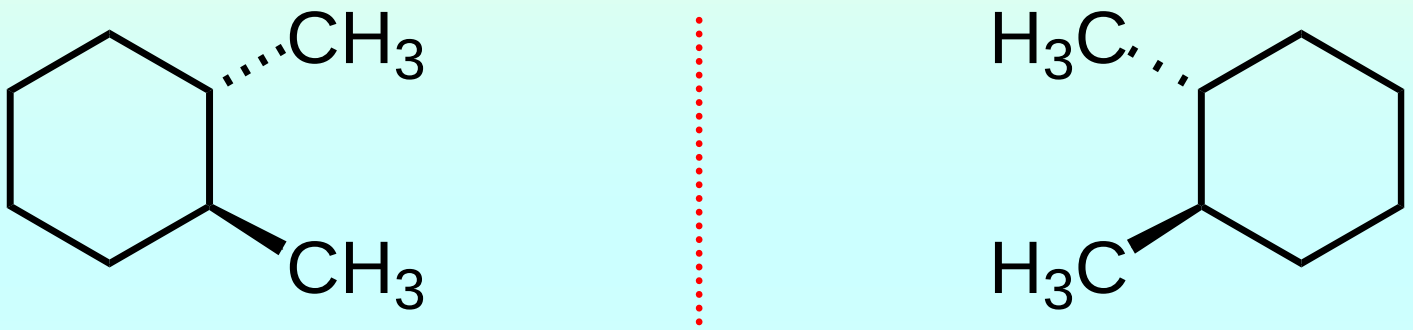
Stereoisomers with identical mirror images are called **meso** structures.



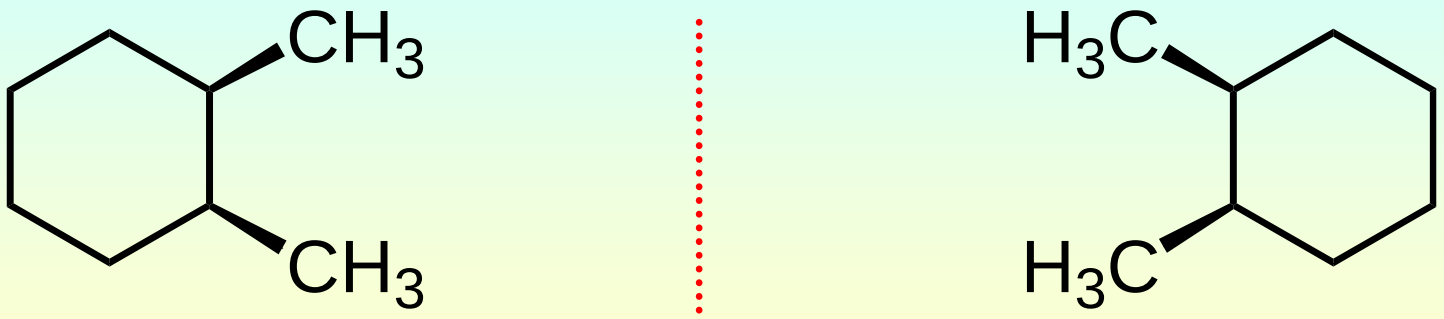


1, 2-Disubstituted Cyclohexanes.

enantiomers, diastereomers or identical?

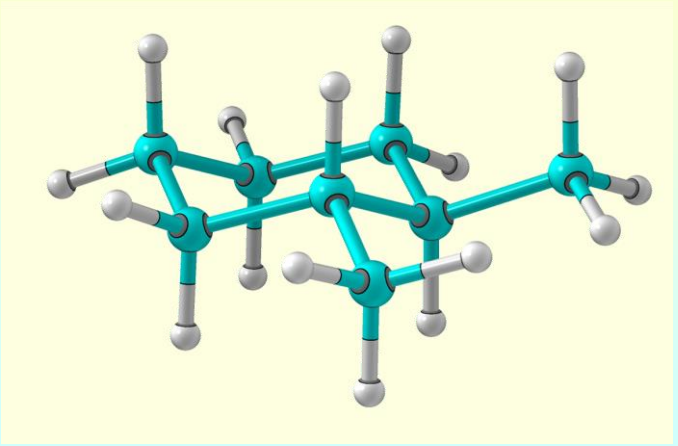


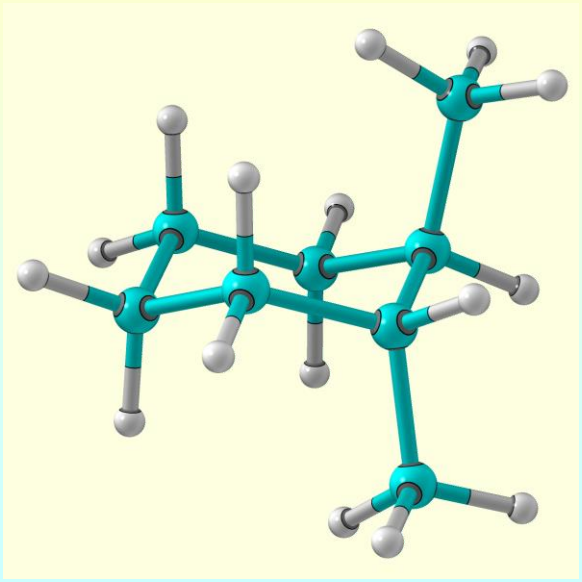
trans-1,2-dimethylcyclohexane



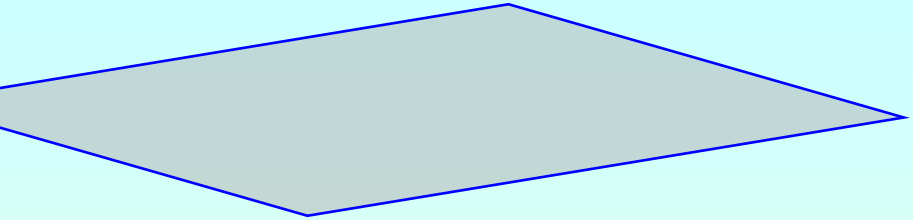
cis-1,2-dimethylcyclohexane

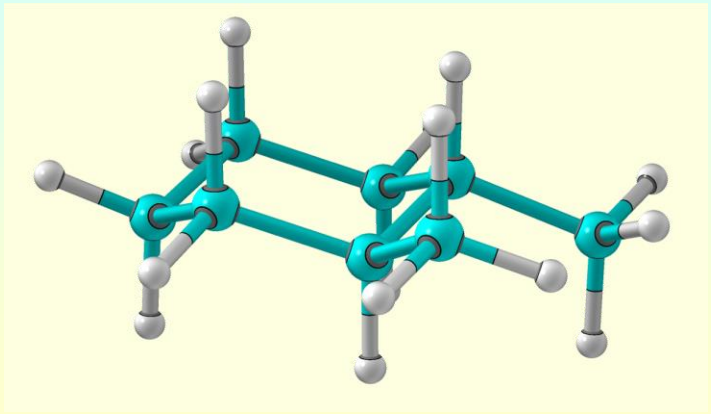
1, 2-Disubstituted Cyclohexanes.

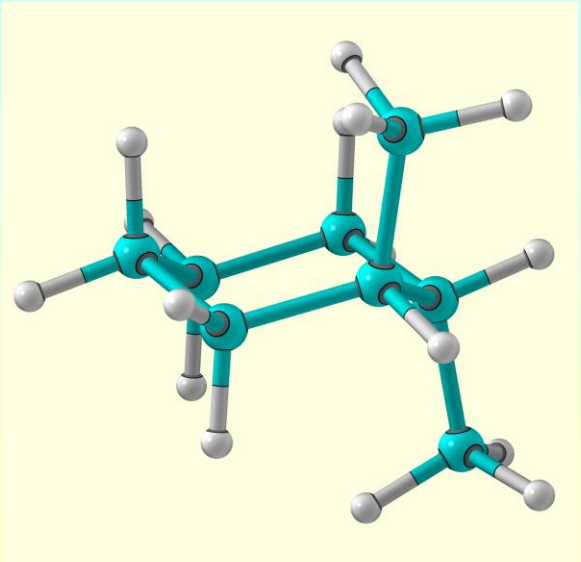




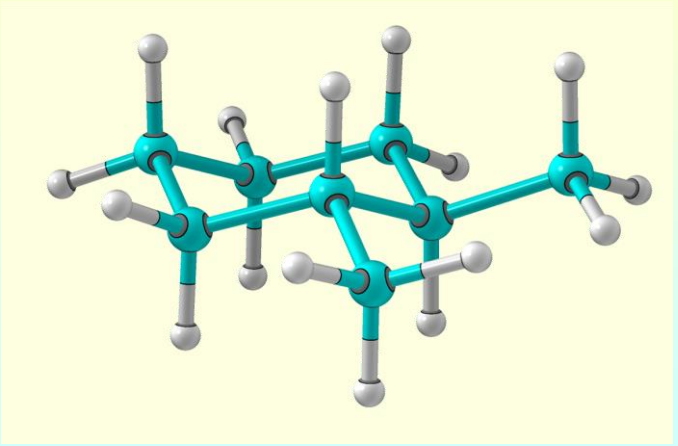
trans-1,2-dimethylcyclohexane

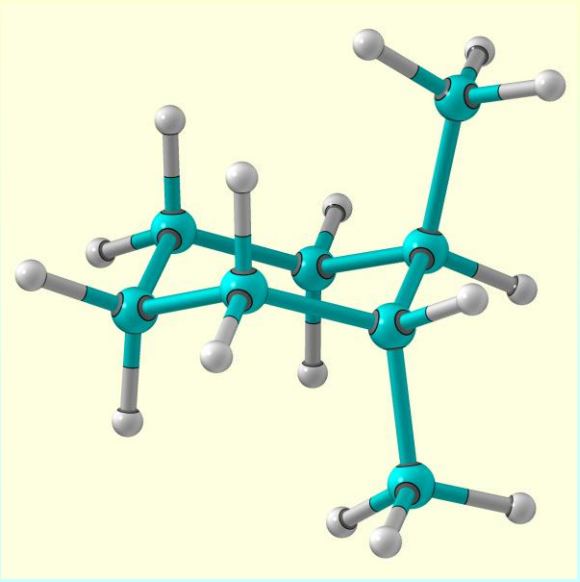




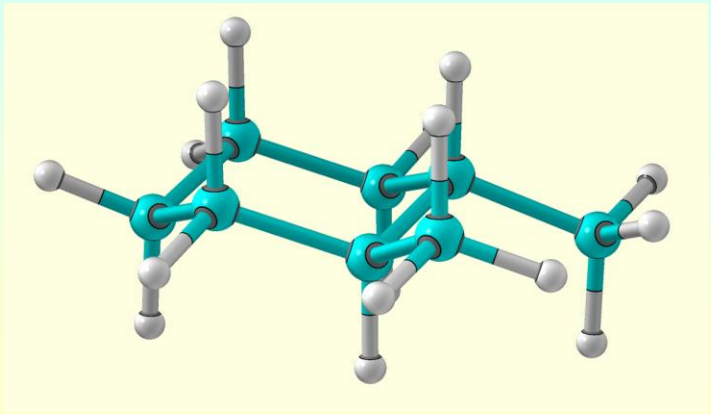


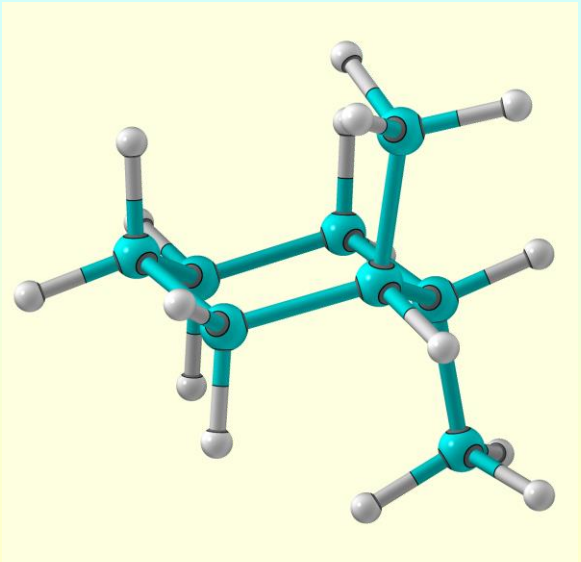
1, 2-Disubstituted Cyclohexanes.



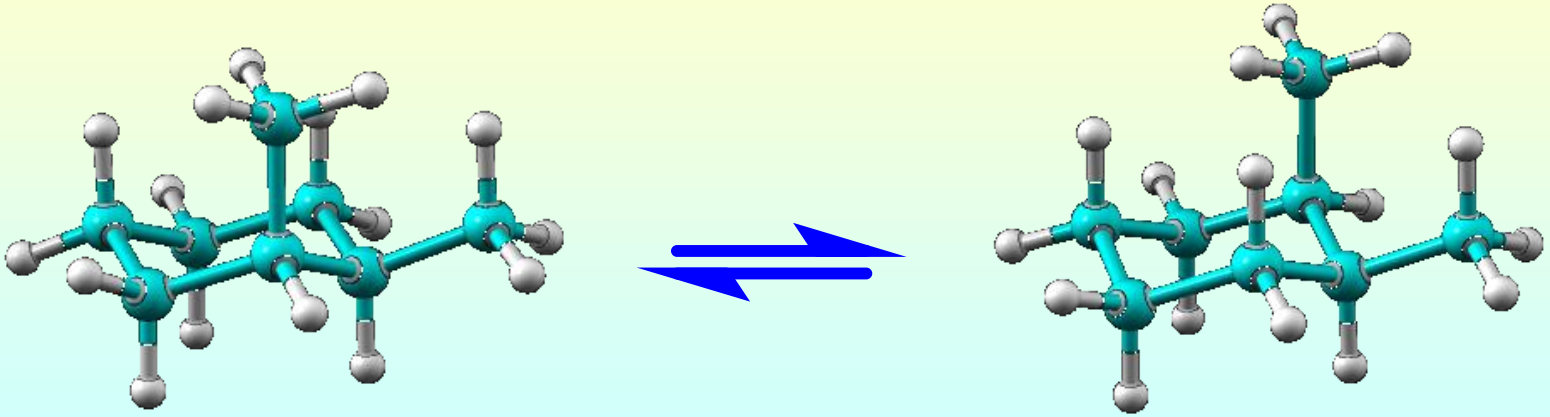


The mirror images of *trans* 1,2-dimethylcyclohexane are not identical. These are enantiomers.



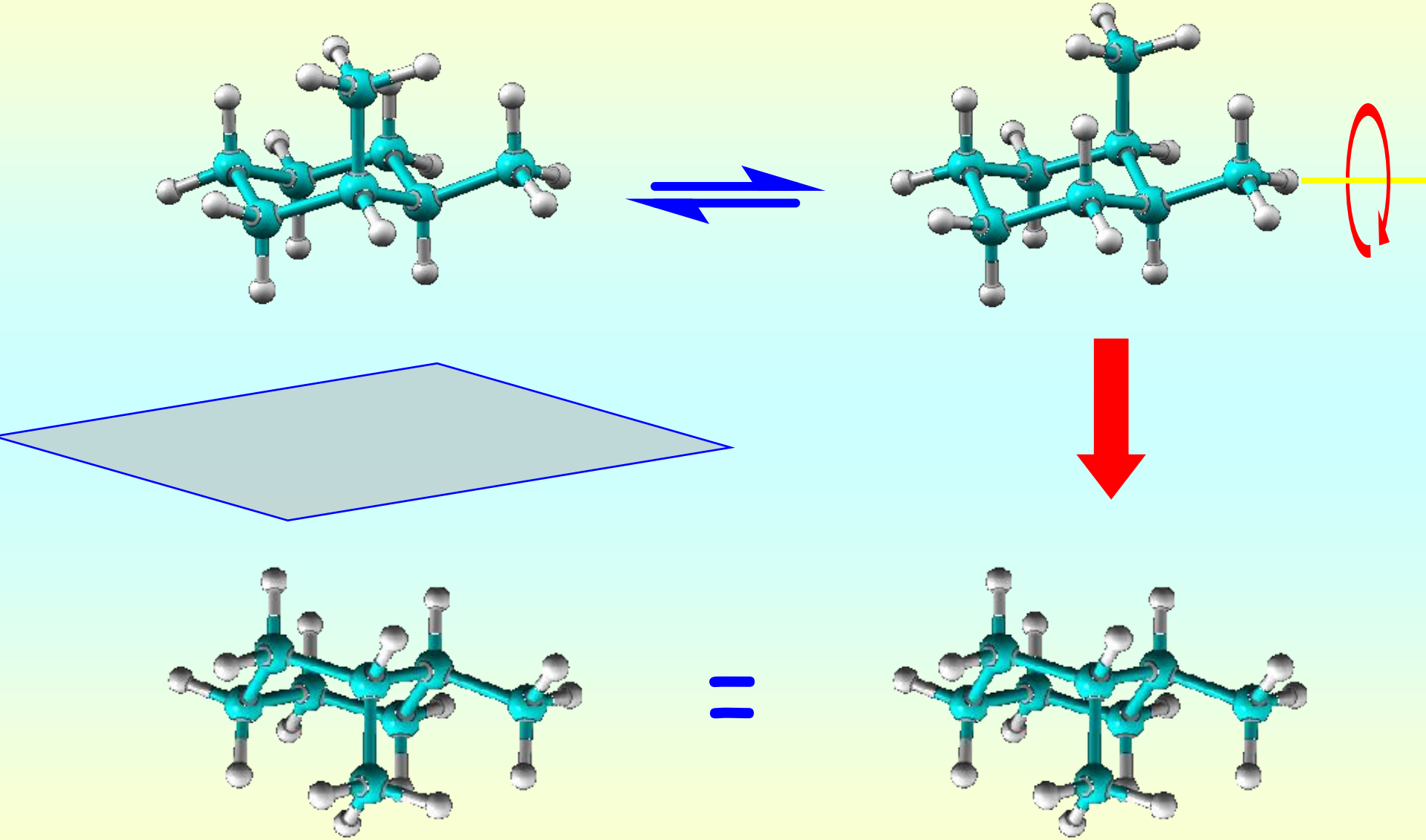


1, 2-Disubstituted Cyclohexanes.

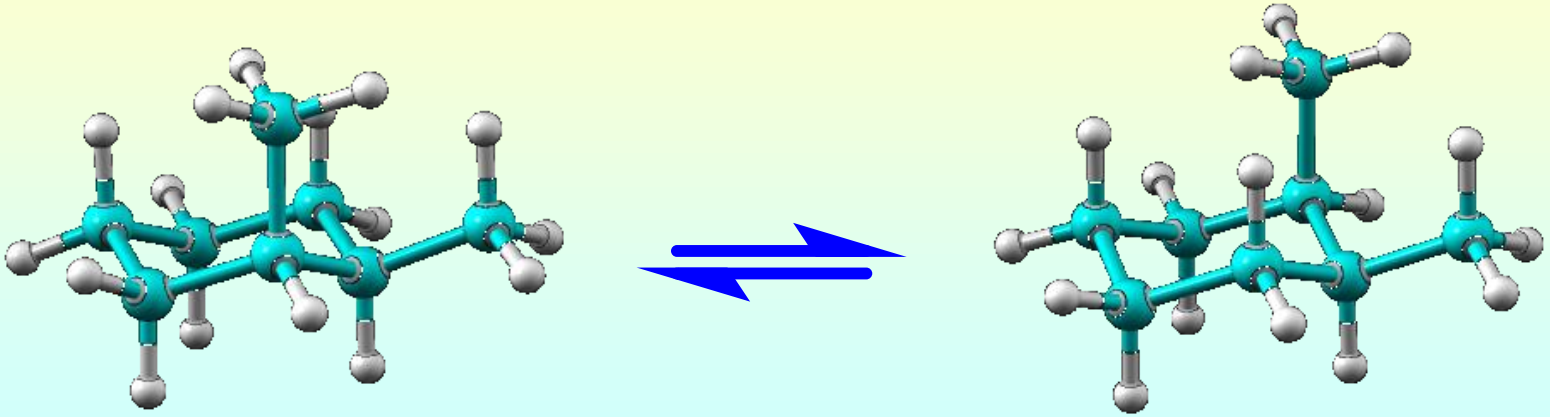


cis-1,2-dimethylcyclohexane

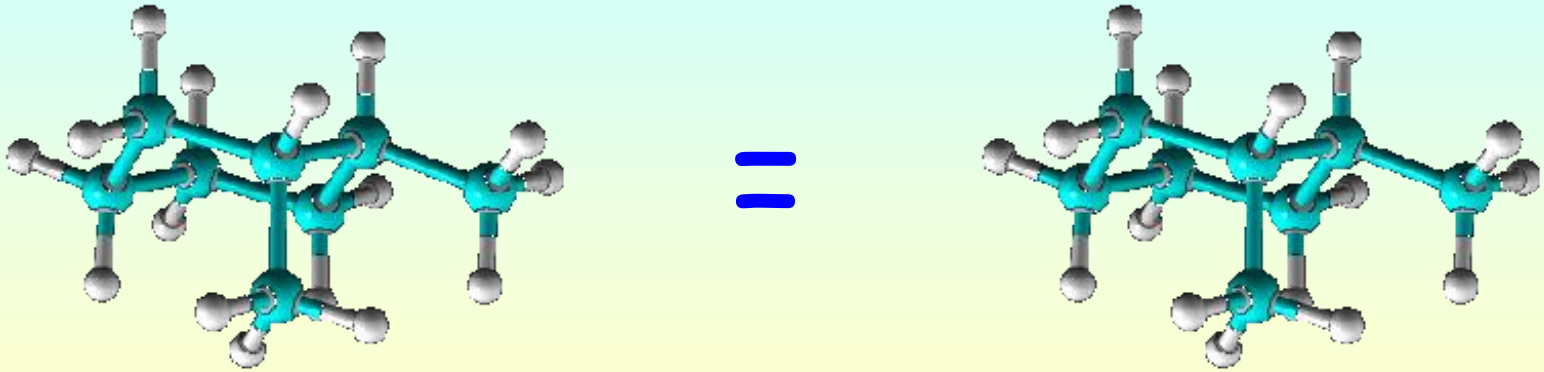
1, 2-Disubstituted Cyclohexanes.



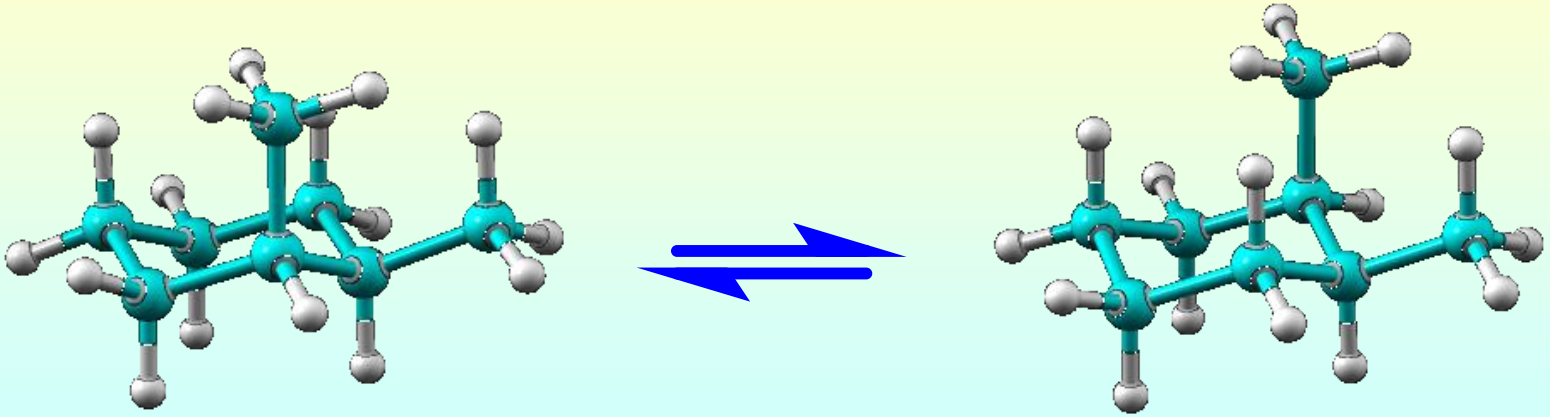
1, 2-Disubstituted Cyclohexanes.



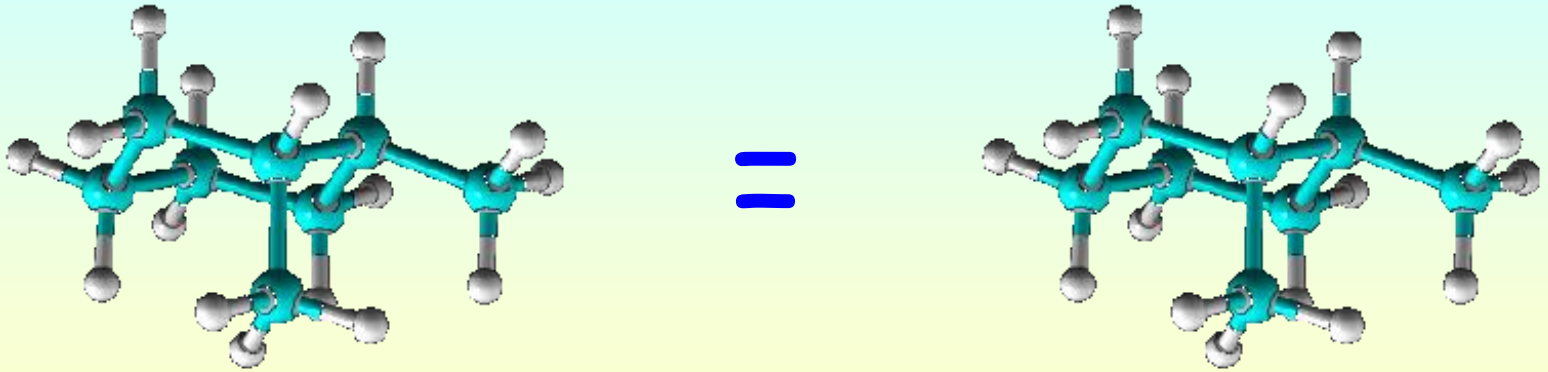
the two conformations of *cis*-1,2-dimethylcyclohexane are mirror images.



1, 2-Disubstituted Cyclohexanes.

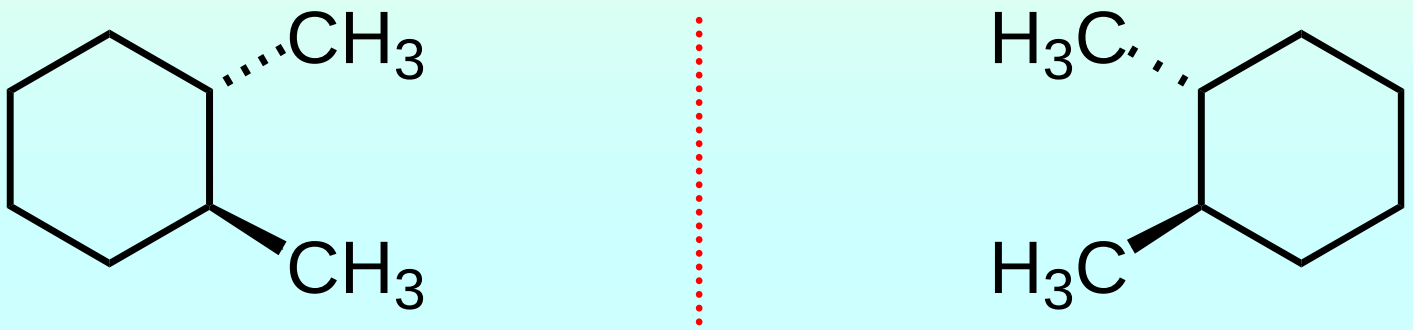


under normal conditions *cis*-1, 2-dimethylcyclohexane does not display properties of a chiral molecule.

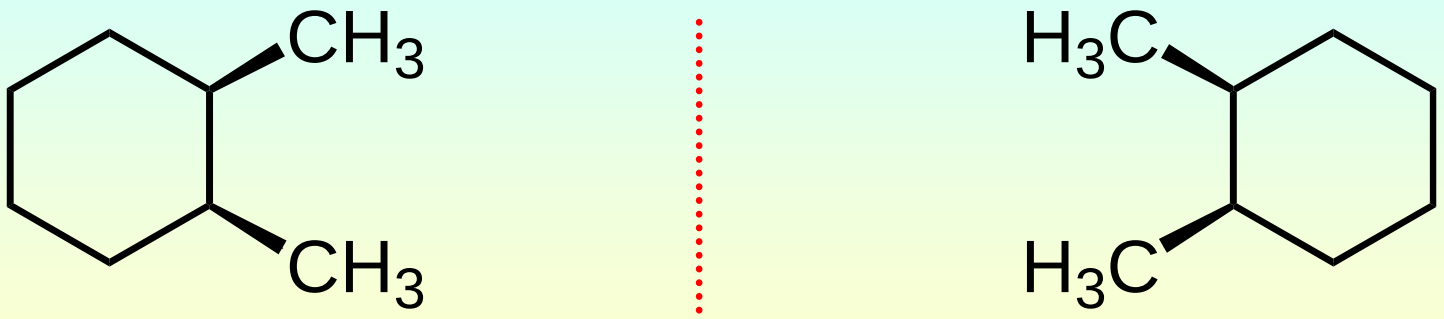


1, 2-Disubstituted Cyclohexanes.

enantiomers, diastereomers or identical?

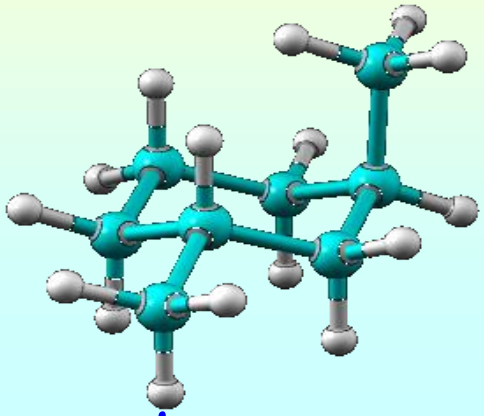


trans-1,2-dimethylcyclohexane

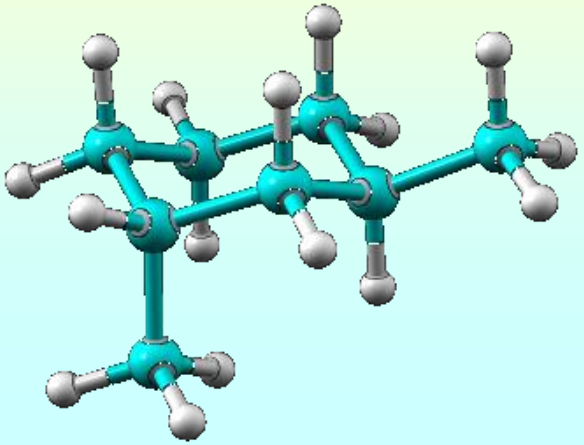


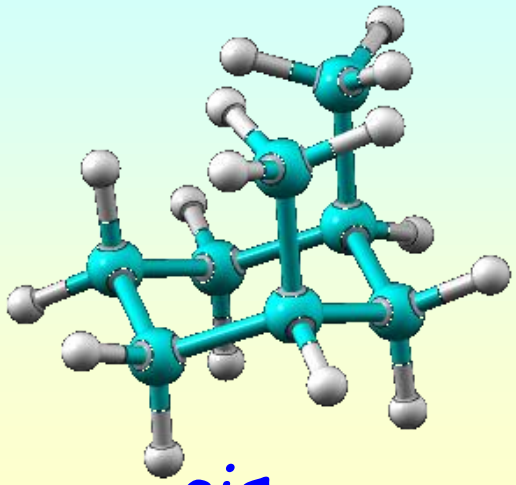
cis-1,2-dimethylcyclohexane

1,3- dimethylcyclohexane

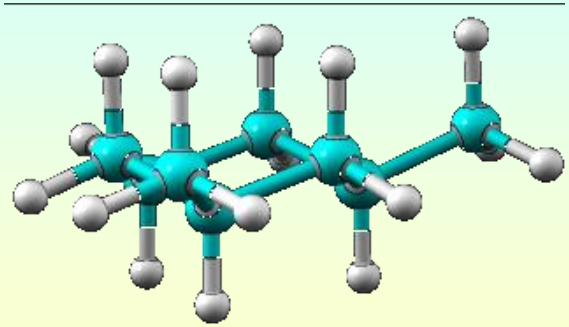


trans



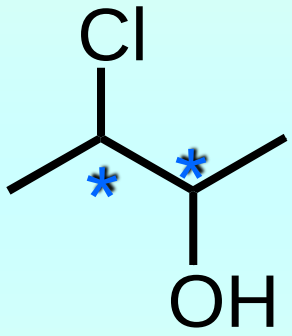


cis



Molecules with more than one stereocenter.

The maximum number of stereoisomers is equal to 2^n where n = the number of stereocenters.

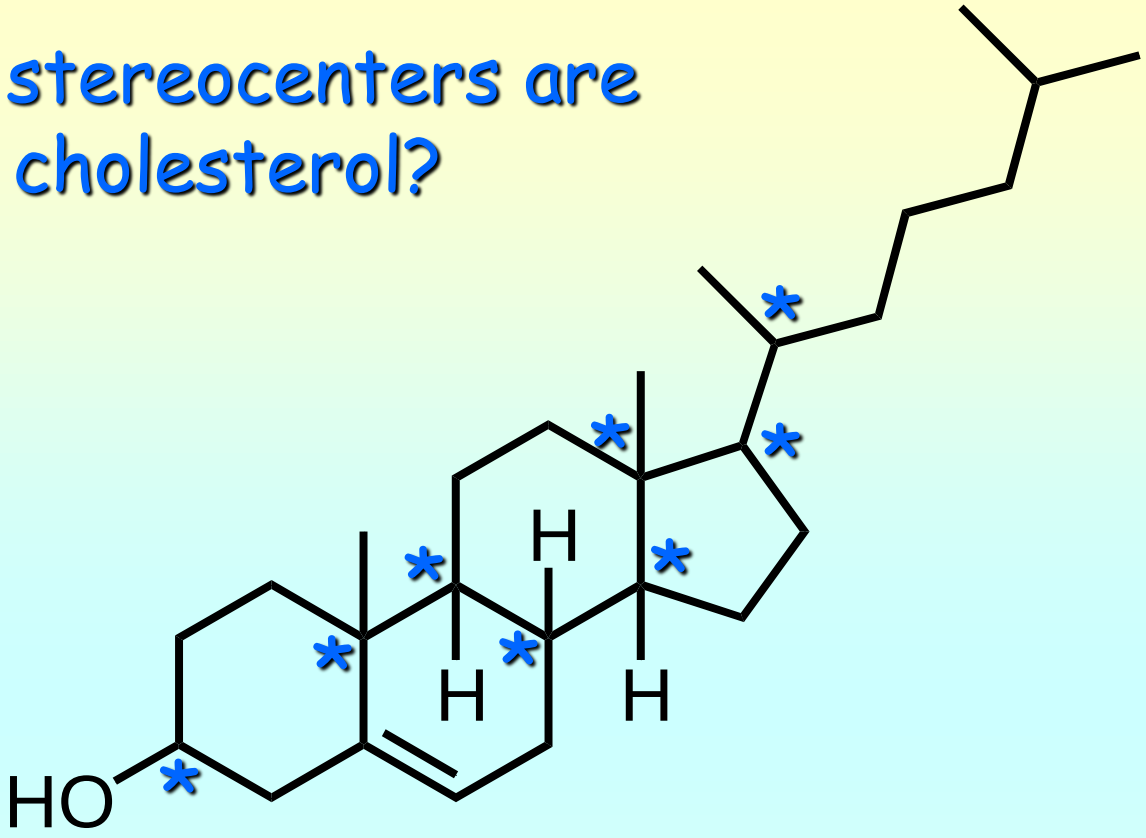


2^n = maximum number of stereoisomers

if n = 2 then

2^2 or 4 = maximum number of stereoisomers

How many stereocenters are present in cholesterol?

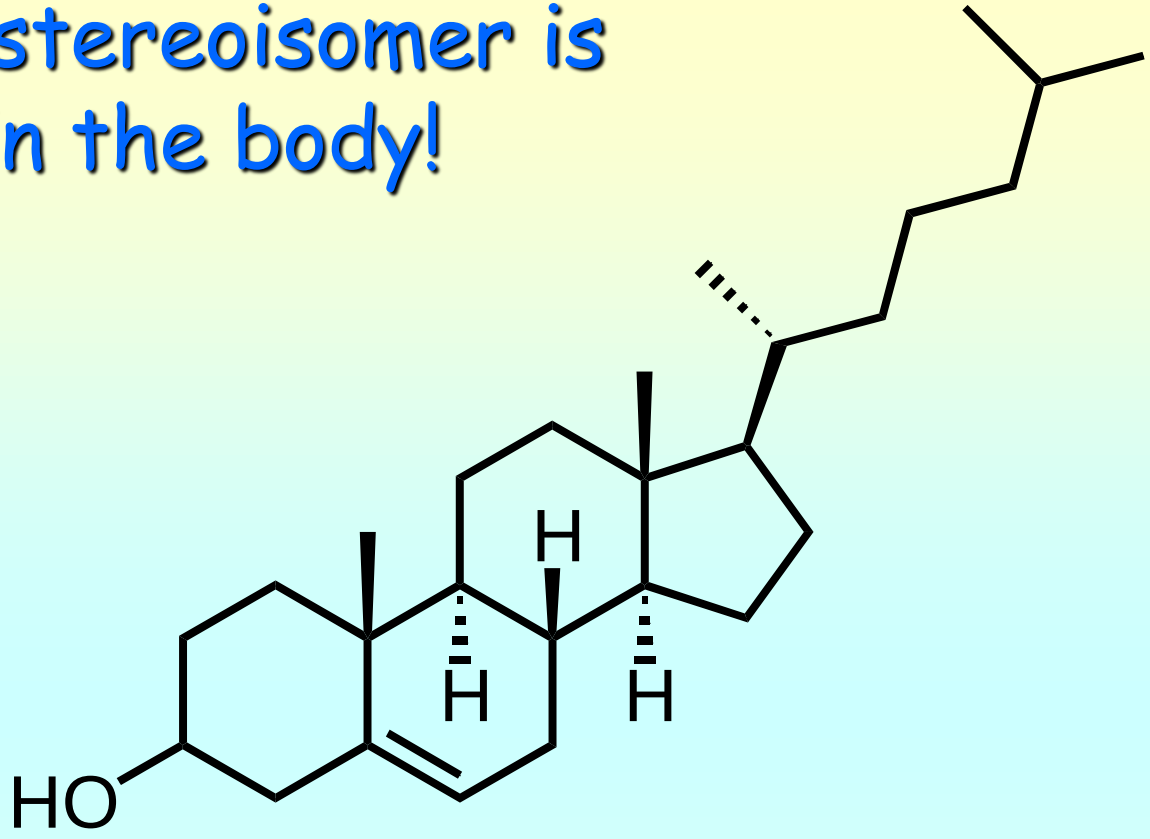


cholesterol

How many stereoisomers are represented by this structure?

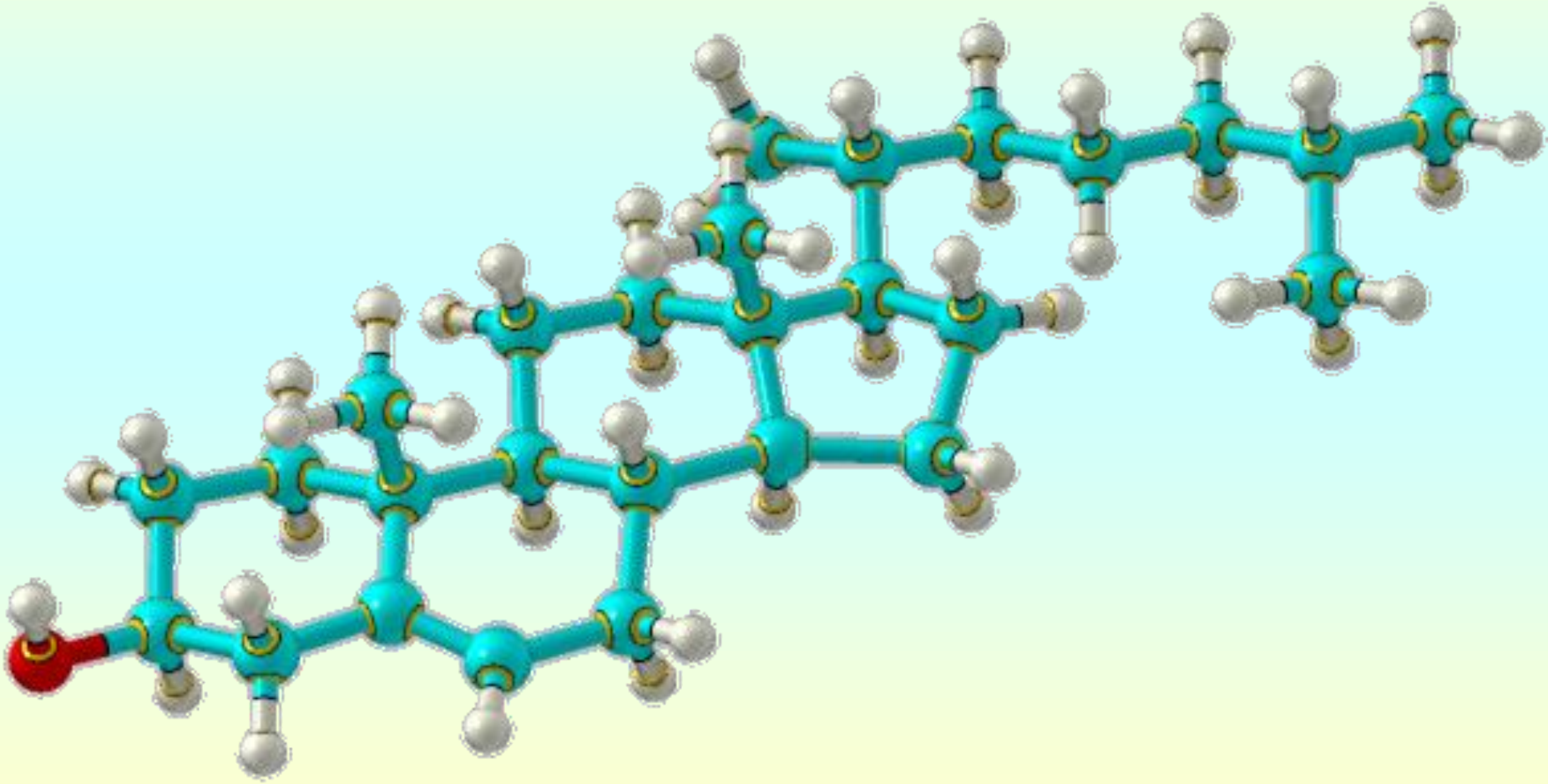
If n = 8, then $2^8 = 256$ stereoisomers!

only one stereoisomer is present in the body!



cholesterol

only one stereoisomer is present in the body!



chiral - a structure whose mirror image is not identical

enantiomers - two structures that are mirror images but are not identical

diastereomers - structures that are stereoisomers but are not enantiomers

meso - a structure that has diastereomers but is not chiral