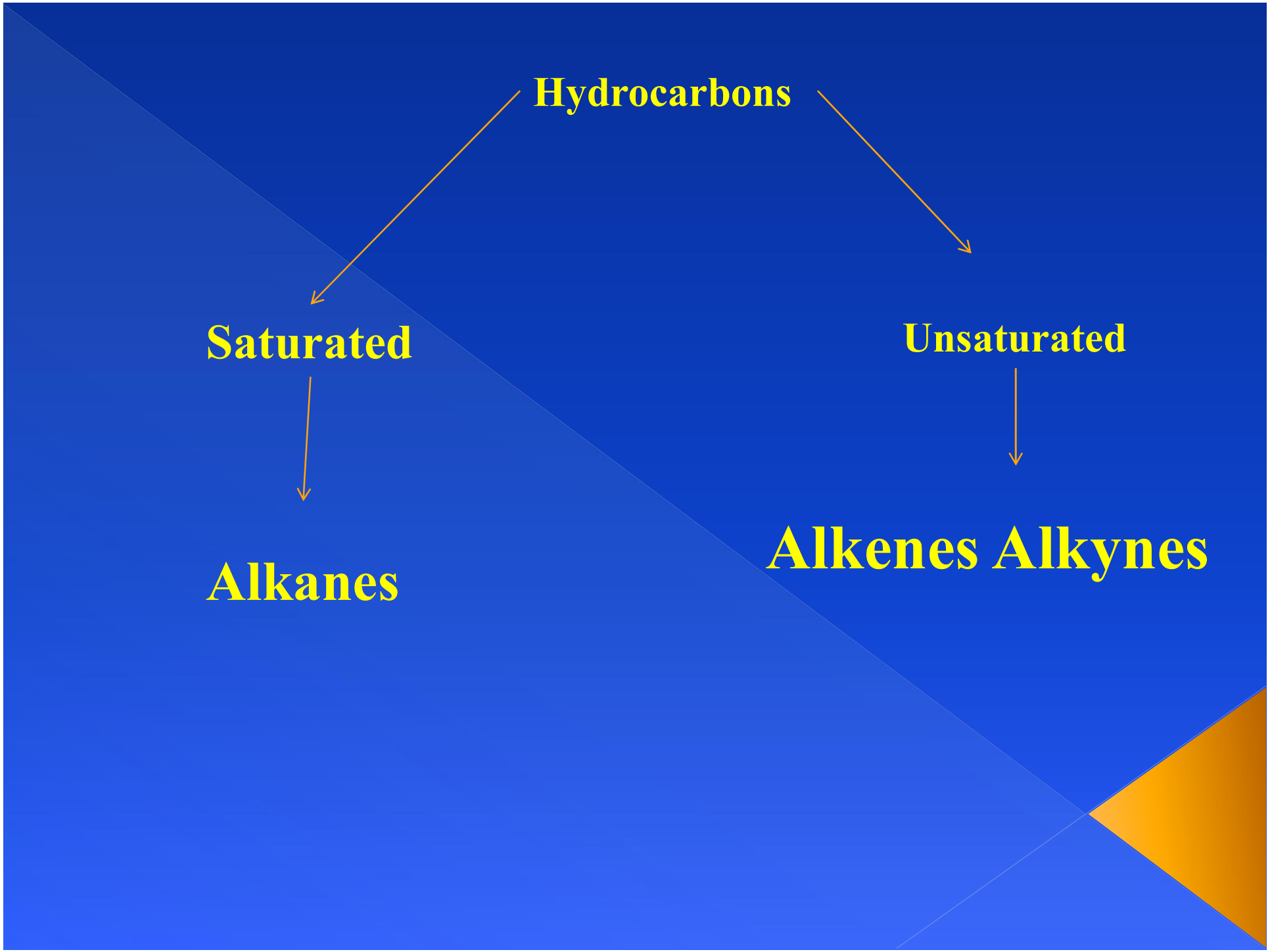
Organic chemistry

Organic chemistry is that branch of chemistry that deals with the structure, properties, and reactions of compounds that contain carbon.

Organic compounds are the compound which contains mainly **carbon** and **hydrogen**.


Hydrocarbons
Saturated
Unsaturated
Alkanes
Alkenes Alkynes

IUPAC Nomenclature The Three Basic Parts Basic Part – Suffixes

The name for any organic molecule consists of three basic

parts: Prefixes-Parent-Suffix Basic Part – Suffixes on the end of the name of an organic molecule tell you what major family the molecule belongs to

The suffix for an alkane is "-ane"

The suffix for an alkene is "-ene"

The suffix for an alkyne is "-yne"

Counting to Ten in Organic Basic Part – the Parent

The “parent” part of the name tells you how many carbons are in the longest chain “main chain” of the molecule.

Counting to Ten in Organic

01 = meth
02 = eth
03 = prop
04 = but
05 = pent
06 = hex
07 = hept
08 = oct
09 = non
10 = dec

Parent and suffix… The parent is named based on the number of carbons

1 carbon = “meth”
So a one-carbon alkane is called
methane CH4
2 carbons = “eth”
So a two carbon alkane is called
ethane.
CH3CH3
3 carbons = “prop”
So a three carbon alkane is called
propane.
CH3CH2CH3
4 carbons = “but”
So a four carbon alkane is called
butane.
CH3CH2CH2CH3

Prefixes Prefixes – the Halides

So name the following alkane (shown as both condensed formula and a skeletal structure) Prefixes

Prefixes are any substituent attached to the main chain (parent) of the molecule.

Prefixes – the Halides

Chlorine is called "**chloro**"

Fluorine is called " **Fluoro**"

Bromine is called "**bromo**"

Iodine is called "**iodo**

nine carbons + alkane family = ?

Follow the rules… Name the following…

4-Bromoheptane

3,4-Dibromoheptane

3-Bromo-1-chloro-4-methylhexane

1,1-Dibromo-3-methyloctane

3-ethylhexane

Alkyl Groups Alkyl groups are named similarly to alkanes.

If you remove a hydrogen atom from one of these you get an **alkyl** group.

A fragment of methane, CH_4, would be CH_3- called "methyl"

A fragment of ethane, CH_3CH_3, would be CH_3CH_2-, called "ethyl".

Example: 3-ethylhexane ?

IUPAC Systematic Nomenclature - Alkanes

If compound has two or more chains of the same length, parent hydrocarbon is chain with greatest number of substituents.

Quiz Draw Some Simple Alkanes:2-methylpentane3-ethylhexane

Example 1: Write the structural formula for 2-methylpentane

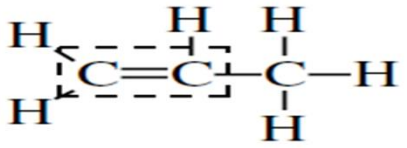
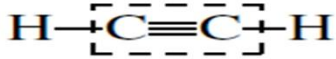
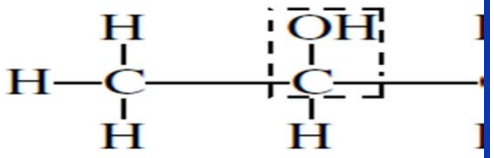
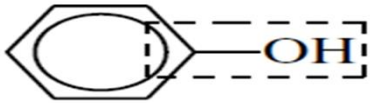
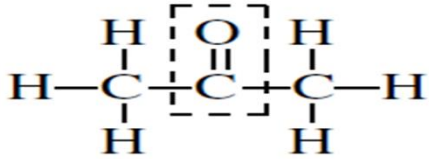
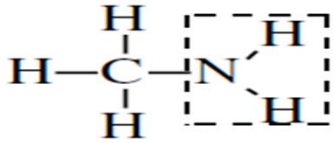
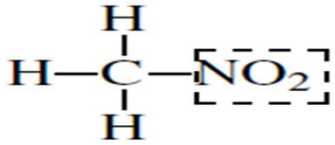
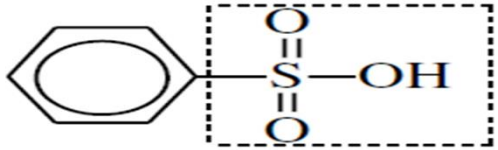
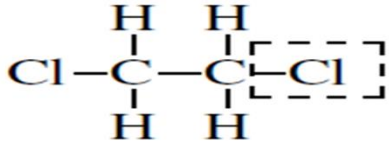
Start from counting the number of carbon atoms in the longest chain - pent counts 5 carbons.
Are there any carbon-carbon double bonds?No – an tells you there aren't any.
Now draw this carbon skeleton:Put a methyl group on the number 2 carbon atom:

Write the structural formula: 2,3-dimethylbutane. 2,2-dimethylbutane. 3-ethyl-2-methylhexane. 4-bromo-3-methylhexene.

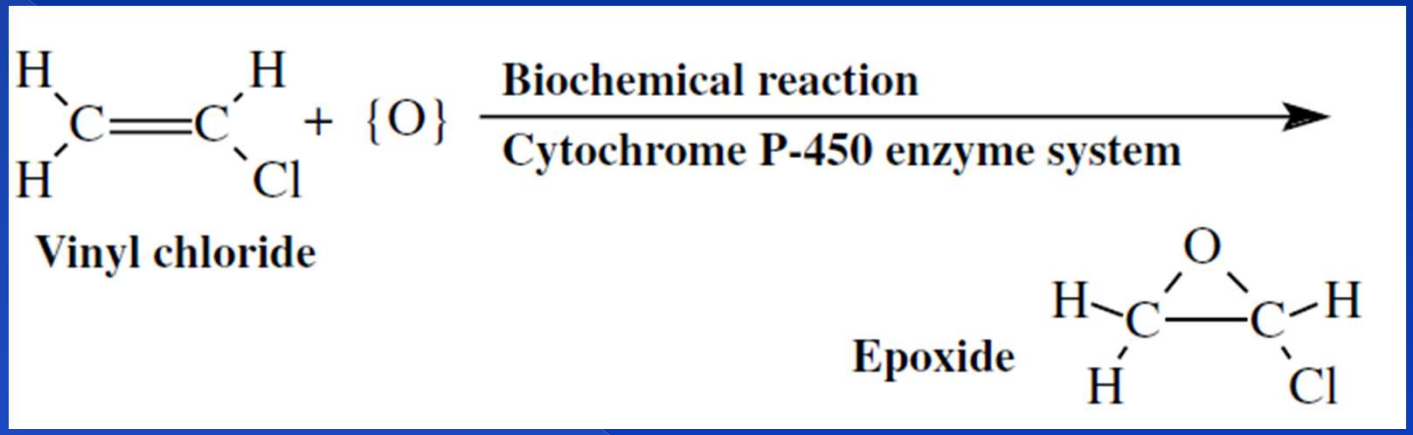
Nomenclature of Substituents

The name of the alkyl group followed by the name of the class of compound constitutes the common name for alcohols amines, and alkyl halides:

Suffix	General Formula	Function Class
OH	Alcohols	ol
CHO	Aldehydes	al
C=O	Ketones	one
-O-	Ethers	ether
-COO-	Esters	oate
-COOH	Carboxylic acids	oic acid
Amine	NH_2	

Type of Functional Group	Example Compound	Structural Formula of
Alkene (olefin)	Propene (propylene)	
Alkyne	Acetylene	
Alcohol (-OH attached to alkyl group)	2-Propanol	
Phenol (-OH attached to aryl group)	Phenol	
Ketone (When  group is on end carbon, compound is an aldehyde)	Acetone	
Amine	Methylamine	
Nitro compounds	Nitromethane	
Sulfonic acids	Benzenesulfonic acid	
Organohalides	1,1–Dichloro-ethane	

Addition Reactions alkenes alkynes



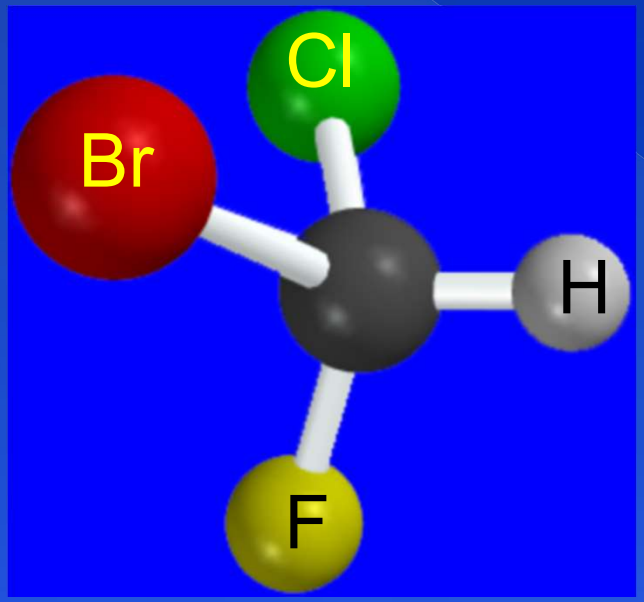
to produce a reactive epoxide that can bind to biomolecules in the body to produce liver cancer.

Chirality

A molecule is ***chiral*** if its two mirror image forms **are not** superposable upon one another. ASYMMETRIC!

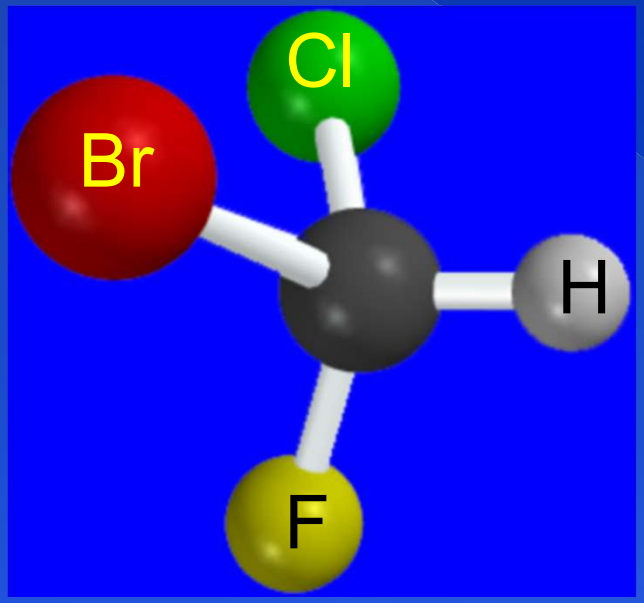
A molecule is **achiral** if its two mirror image forms **are** superposable. SYMMETRIC!

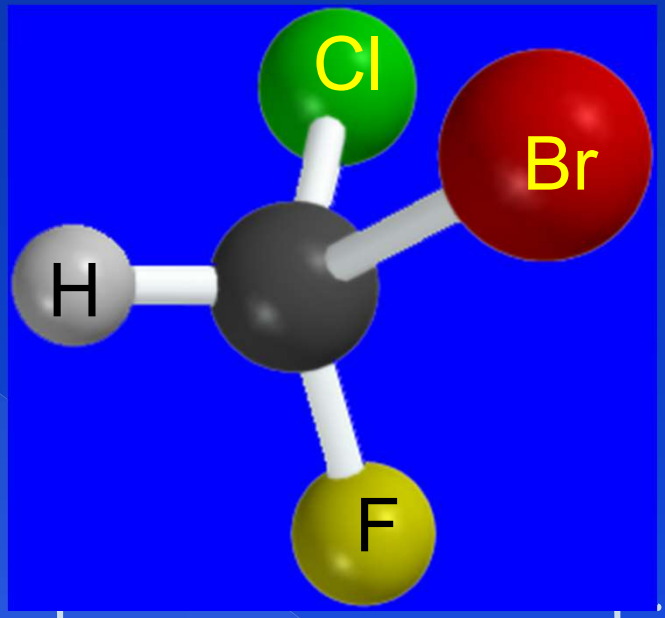
Bromochlorofluoromethane is chiral



It cannot be superposed point for point on its mirror image.

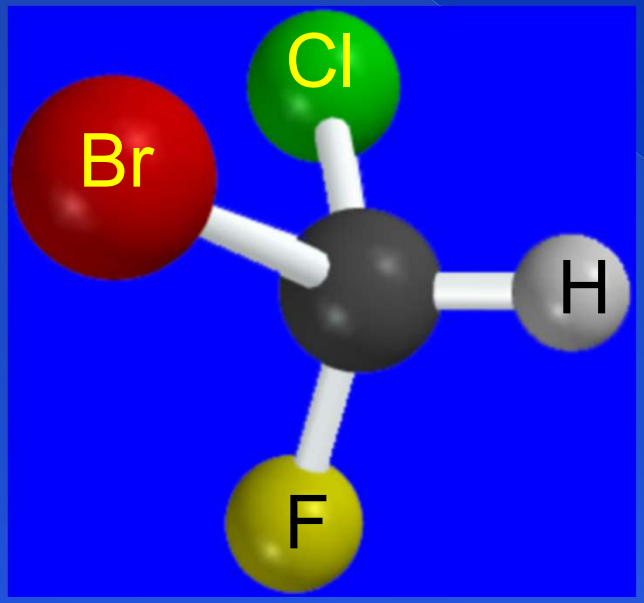
Bromochlorofluoromethane is chiral

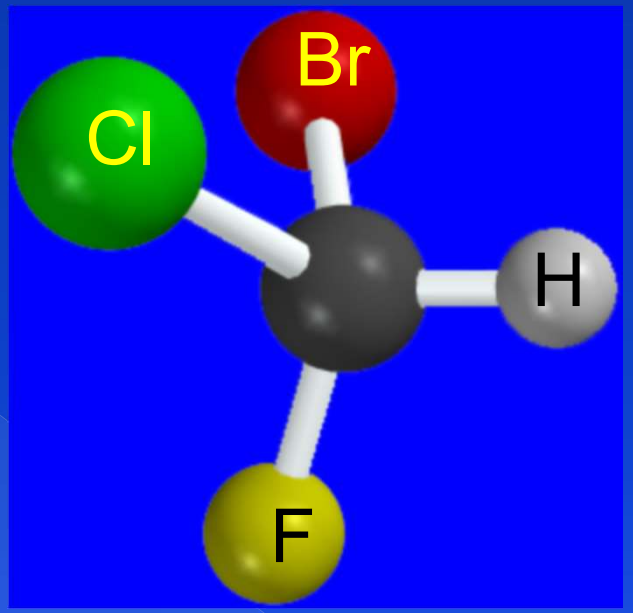


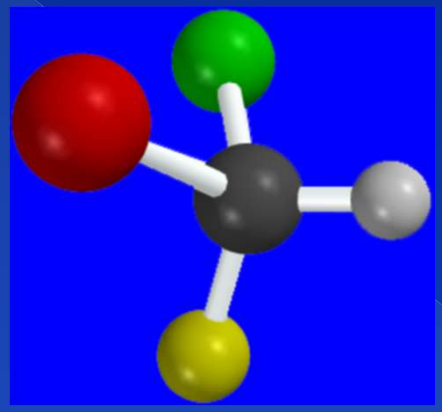


To show nonsuperposability, rotate this model 180° arou nd a vertical axis.

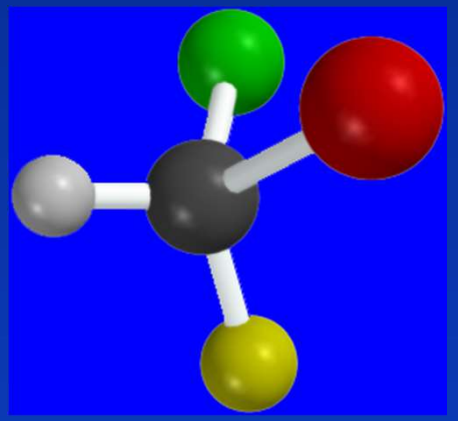
Bromochlorofluoromethane is chiral

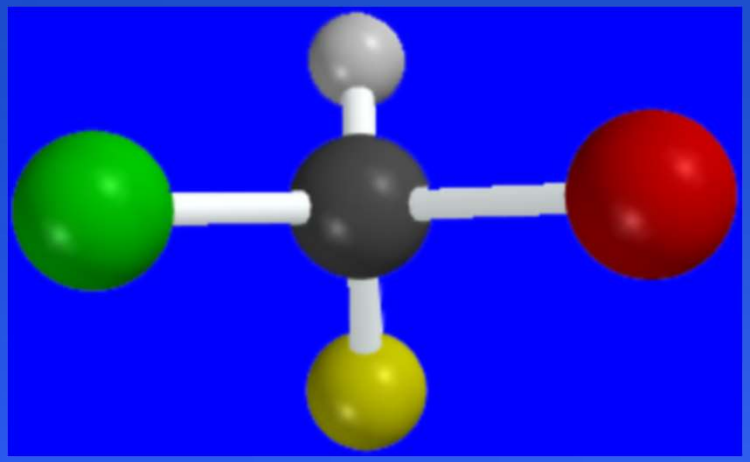


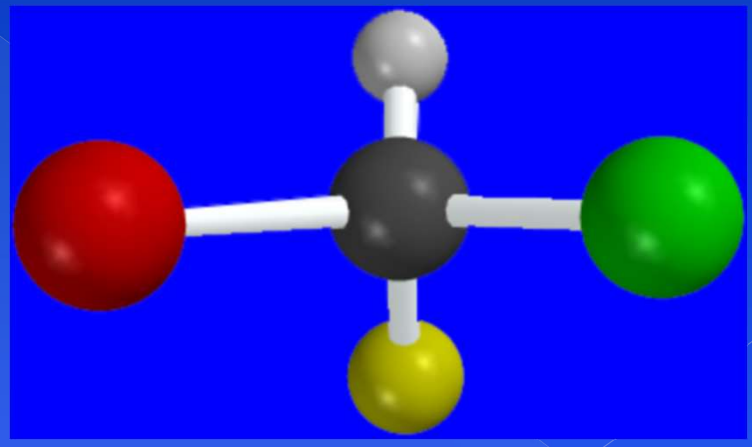




Another look

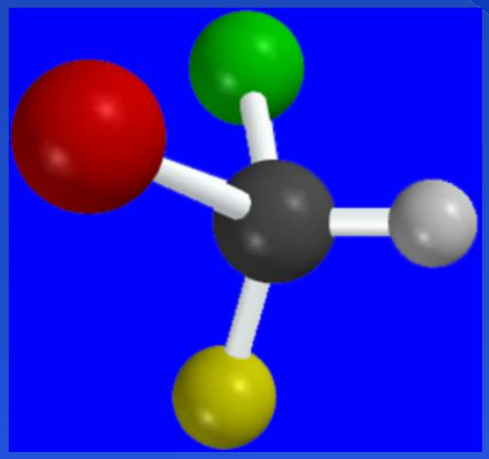




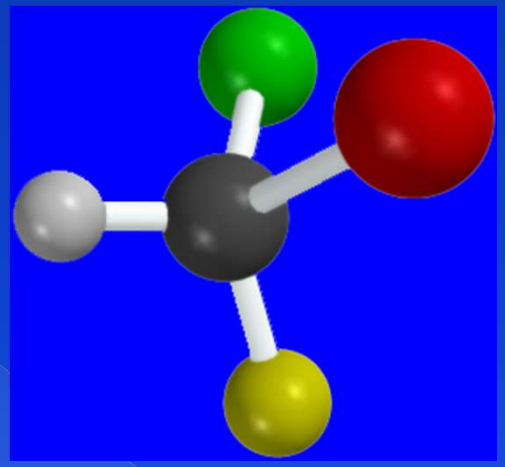


Enantiomers

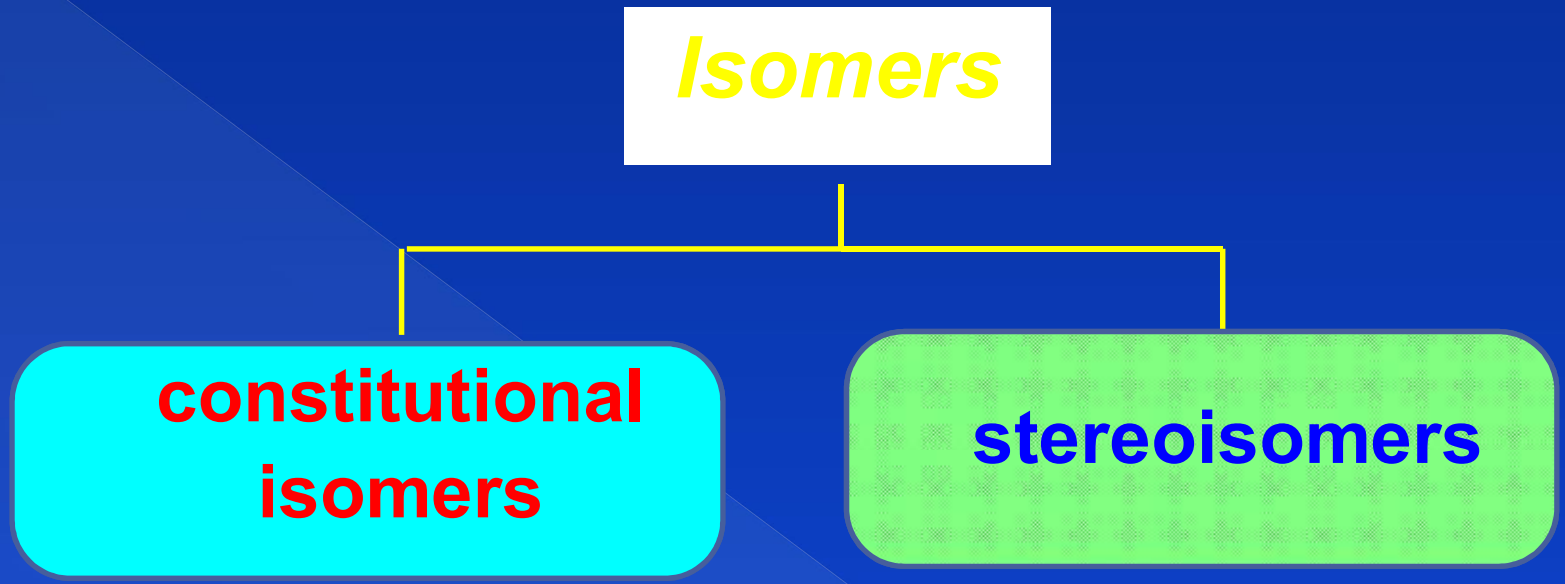
nonsuperposable mirror images are called enantiomers

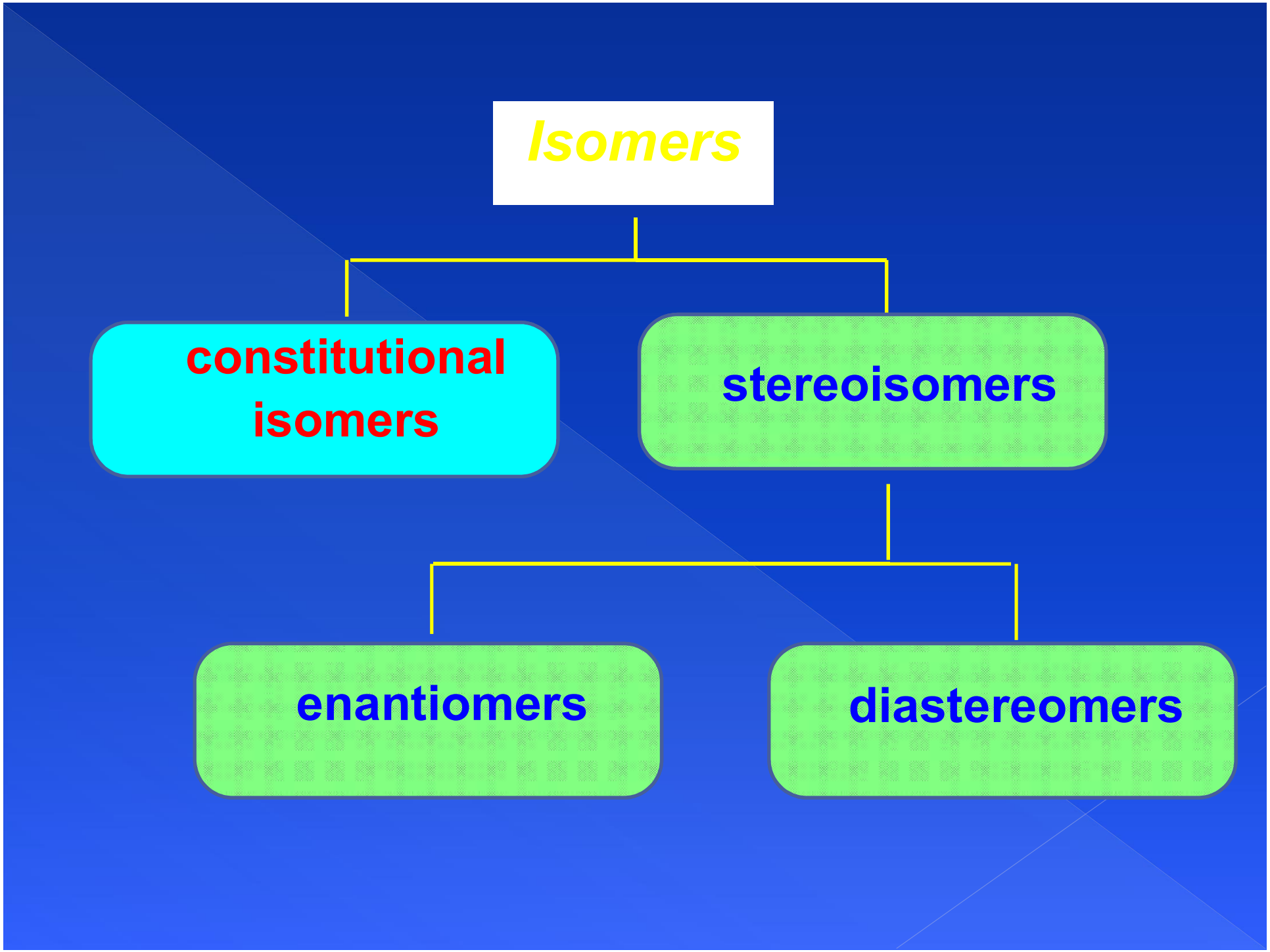


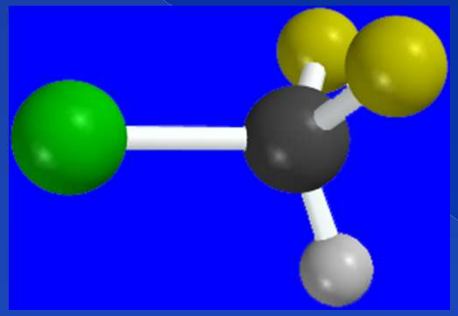
and



are enantiomers with respect to each other

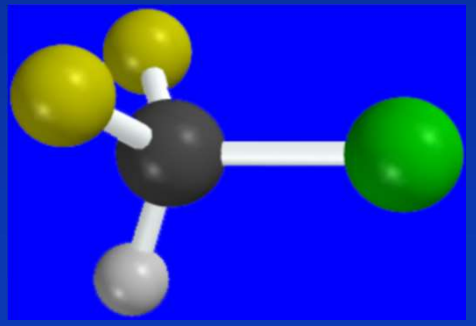

Isomers
constitutional isomers
stereoisomers

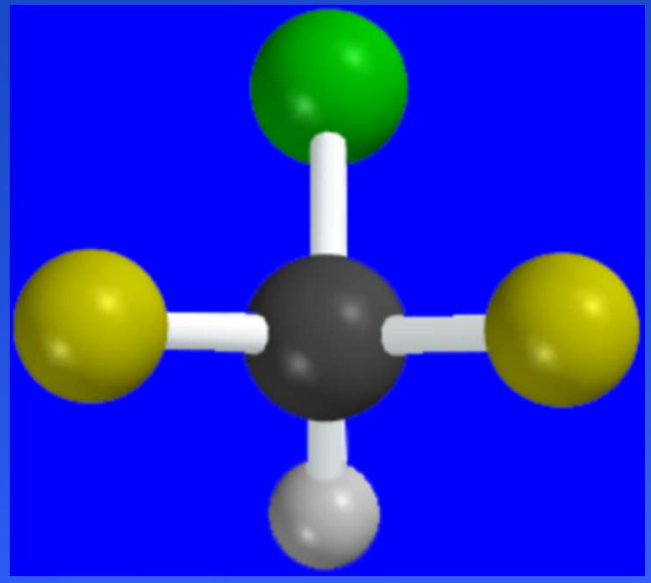

Isomers
constitutional isomers
stereoisomers
enantiomers
diastereomers

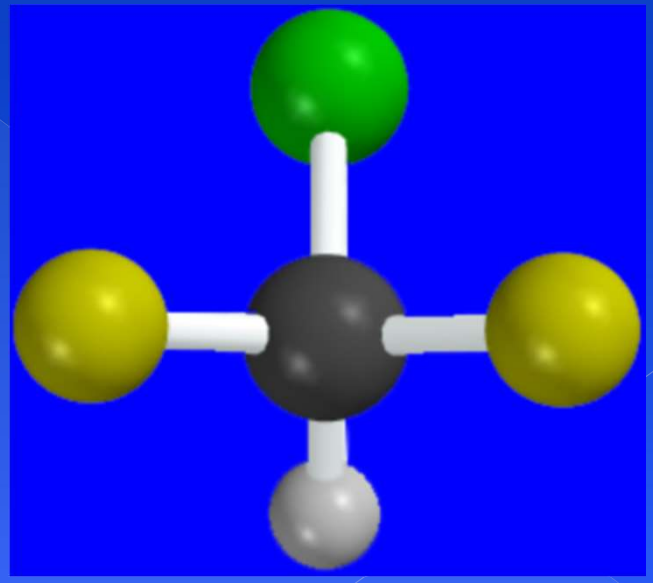


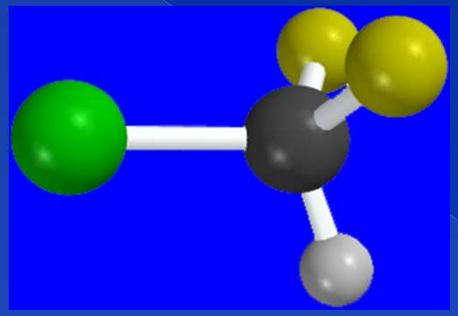
Chlorodifluoromethane

is achiral

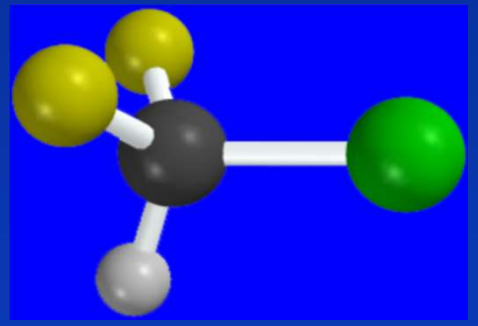


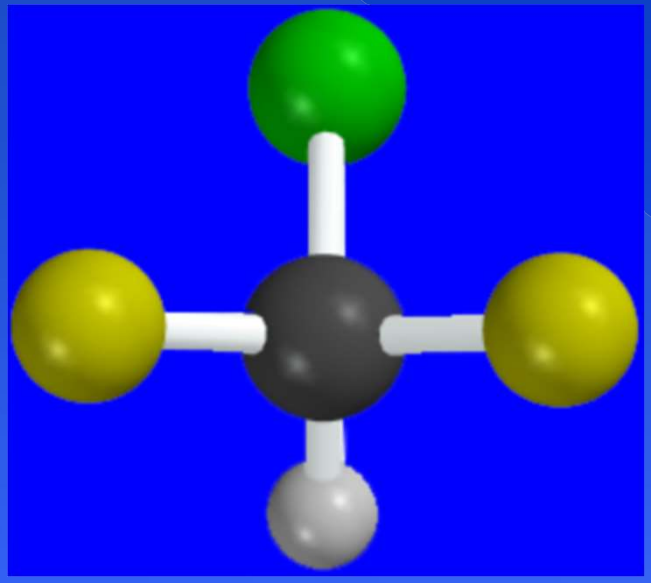






Chlorodifluoromethane is achiral

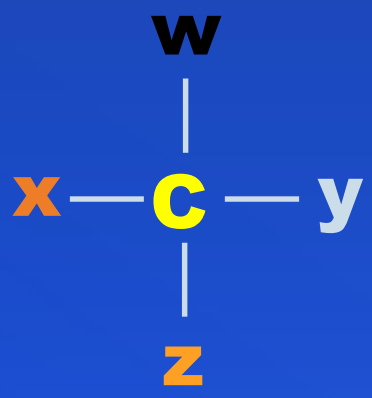




The two structures are mirror images, but are not enantiomers, because they can be superposed on each other.

The Chirality Center

The Chirality Center



a carbon atom with four different groups attached to it

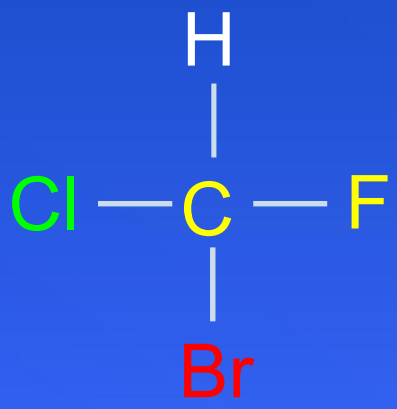
also called:

- chiral center
- asymmetric center
- stereocenter
- stereogenic center

Chirality and chirality centers

A molecule with a single chirality center is chiral.

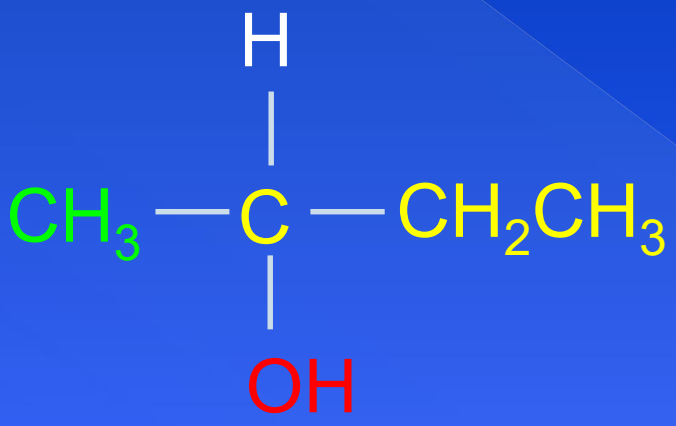
Bromochlorofluoromethane is an example.



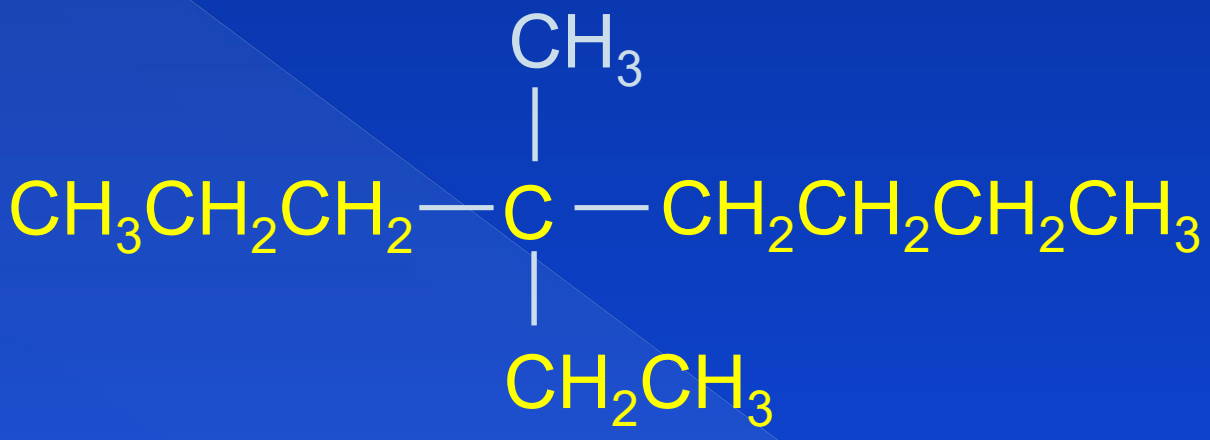
Chirality and chirality centers

A molecule with a single chirality center is chiral.

2-Butanol is another example.



Examples of molecules with 1 chirality center

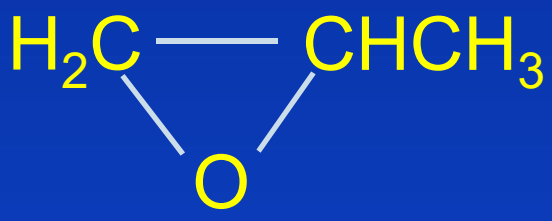


a chiral alkane

Examples of molecules with 1 chirality center

Linalool, a naturally occurring chiral alcohol

Examples of molecules with 1 chirality center



1,2-Epoxypropane: a chirality center can be part of a ring

attached to the chirality center are:

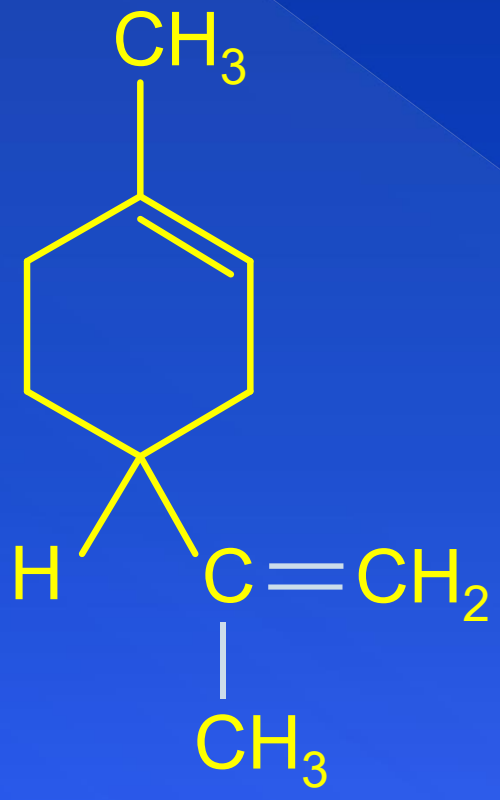
—H

—CH_3

—OCH_2

—CH_2O

Examples of molecules with 1 chirality center



Limonene: a chirality center can be part of a ring

attached to the chirality center are:

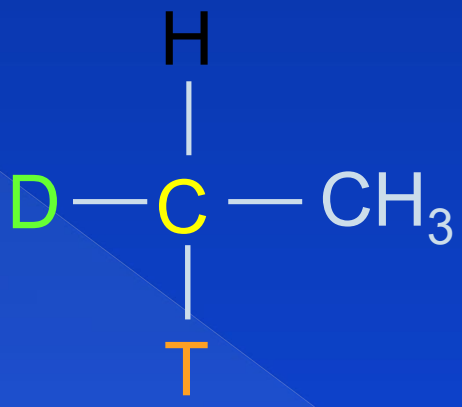
—H

—CH_2CH_2

—$CH_2CH{=}C$

—C=C

Examples of molecules with 1 chirality center



Chiral as a result of isotopic substitution

A molecule with a single chirality center must be chiral.

But, a molecule with two or more chirality centers may be chiral or it may not