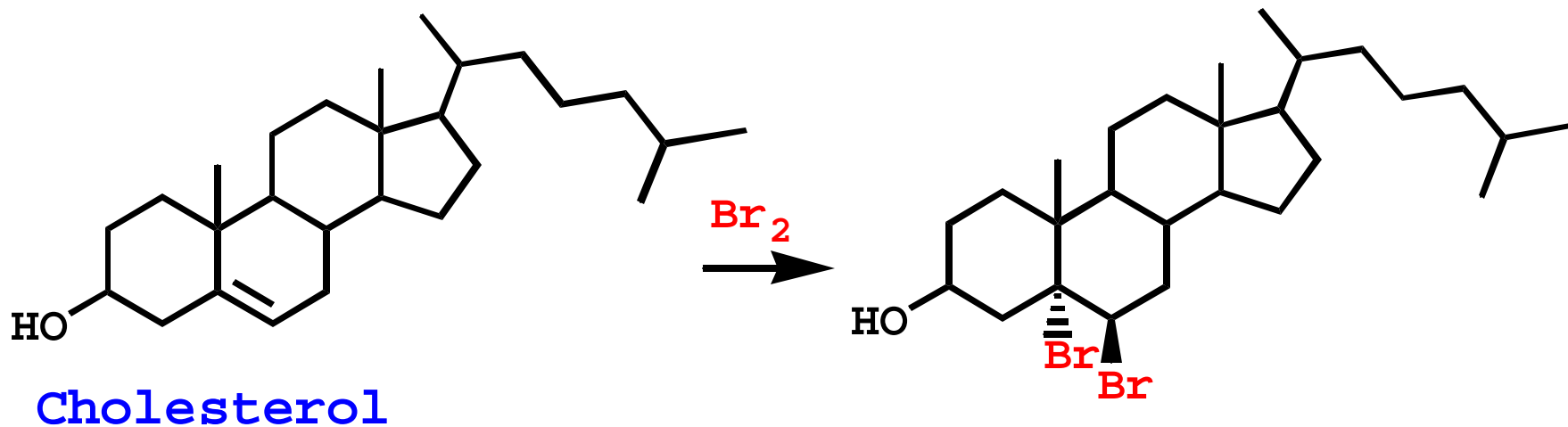
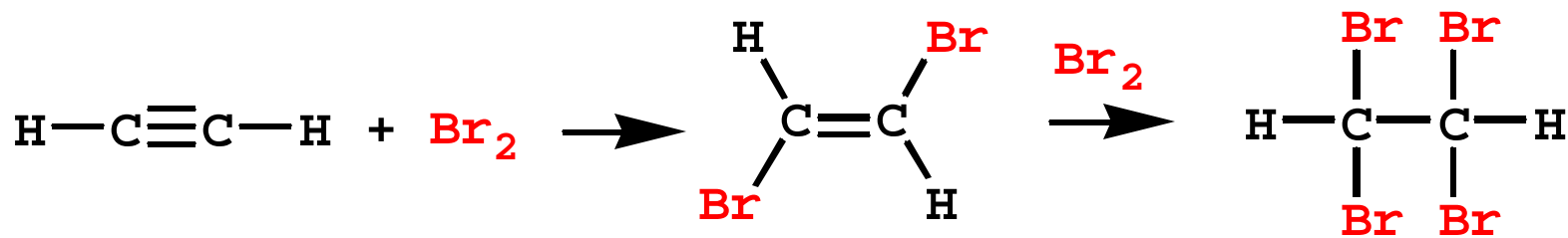
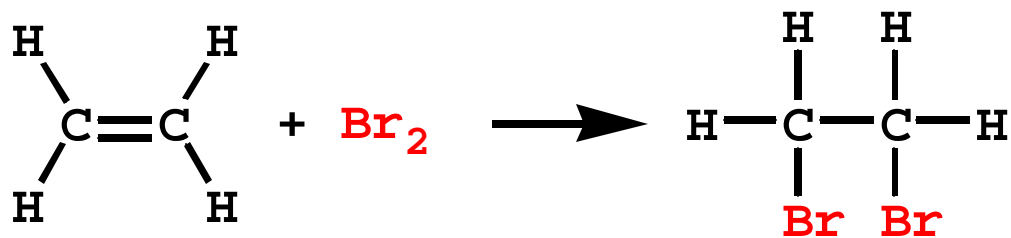


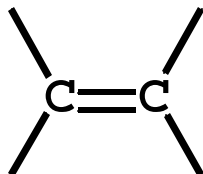

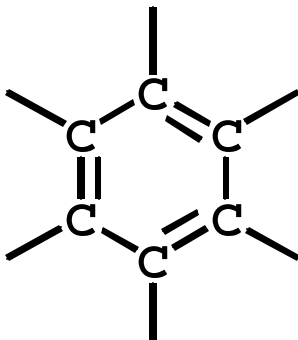
Chapter 3 - Nature of Organic Compounds: Alkanes and Cycloalkanes*

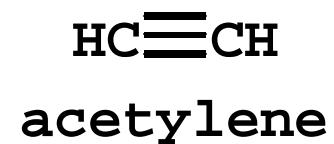
Functional group = a small structural fragment that has characteristic properties/reactivity

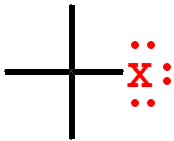
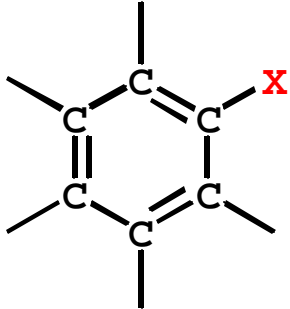
Chemistry of a molecule -> **determined** by the functional groups it contains

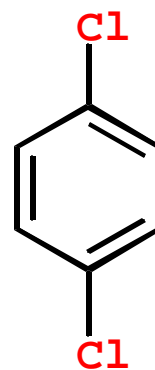


*Common **functional** groups (Table 3.1)...

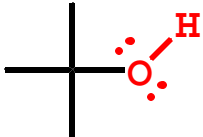
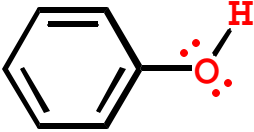
alkene	
alkyne	
arene (aromatic ring)	

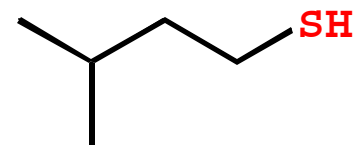
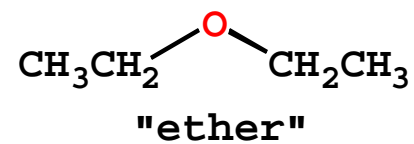
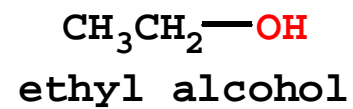


<p>alkyl halide</p>	 <p>X = F, Cl, Br, I</p>
<p>aryl halide</p>	

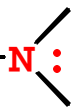
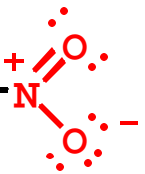


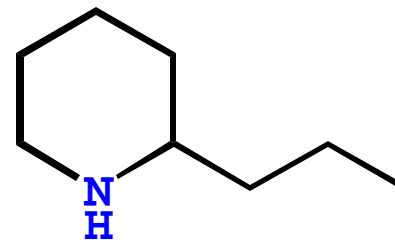
mothballs

alcohol	
phenol	
ether	$\text{Ar}_1, \text{R}_1 \text{---} \ddot{\text{O}} \text{---} \text{R}_2, \text{Ar}_2$
thiol	$\text{Ar}, \text{R} \text{---} \ddot{\text{S}} \text{---} \text{H}$
sulfide	$\text{Ar}_1, \text{R}_1 \text{---} \ddot{\text{S}} \text{---} \text{R}_2, \text{Ar}_2$



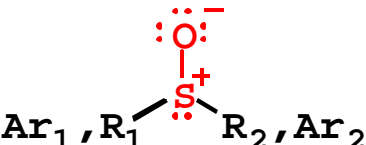
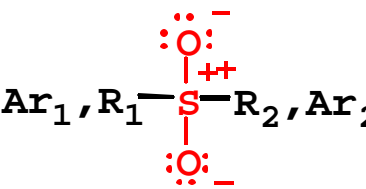
skunk perfume

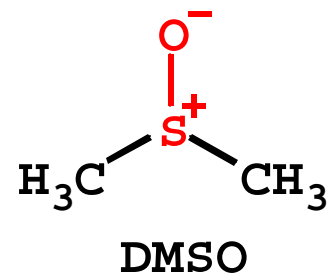
amine	$\text{Ar, R}-\text{N}:$ 
nitrile	$\text{Ar, R}-\text{C}\equiv\text{N}:$
nitro	$\text{Ar, R}-\text{N}^+\begin{matrix} \text{O}^- \\ \text{O}^- \end{matrix}$ 



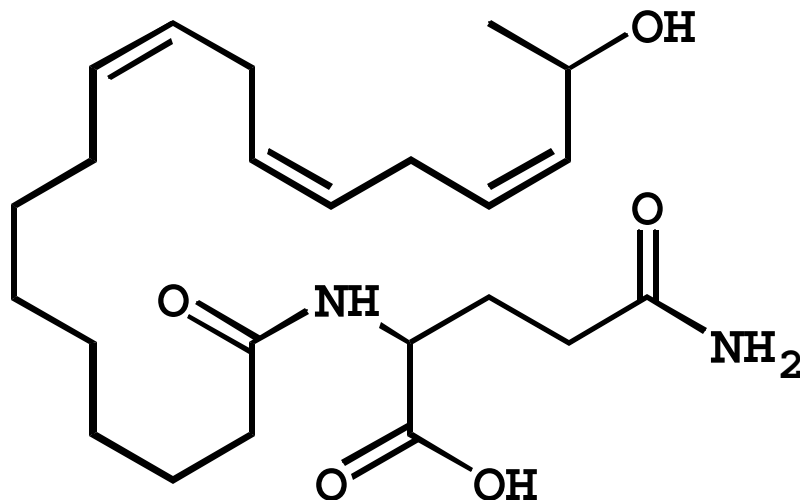
coniine -> poison

aldehyde	$\begin{array}{c} \text{:O:} \\ \parallel \\ \text{H, Ar, R} \text{---} \text{C} \text{---} \text{H} \end{array}$
ketone	$\begin{array}{c} \text{:O:} \\ \parallel \\ \text{Ar}_1, \text{R}_1 \text{---} \text{C} \text{---} \text{R}_2, \text{Ar}_2 \end{array}$
carboxylic acid	$\begin{array}{c} \text{:O:} \\ \parallel \\ \text{H, Ar, R} \text{---} \text{C} \text{---} \text{O} \text{H} \\ \text{:} \end{array}$
ester	$\begin{array}{c} \text{:O:} \\ \parallel \\ \text{H, Ar}_1, \text{R}_1 \text{---} \text{C} \text{---} \text{O} \text{---} \text{R}_2, \text{Ar}_2 \\ \text{:} \end{array}$
acid chloride	$\begin{array}{c} \text{:O:} \\ \parallel \\ \text{Ar, R} \text{---} \text{C} \text{---} \text{Cl} \\ \text{:} \end{array}$
acid anhydride	$\begin{array}{c} \text{:O:} \quad \text{:O:} \\ \parallel \quad \parallel \\ \text{Ar}_1, \text{R}_1 \text{---} \text{C} \text{---} \text{O} \text{---} \text{C} \text{---} \text{R}_2, \text{Ar}_2 \\ \text{:} \end{array}$
amide	$\begin{array}{c} \text{:O:} \\ \parallel \\ \text{H, Ar}_1, \text{R}_1 \text{---} \text{C} \text{---} \text{N} \text{---} \text{R}_2, \text{Ar}_2, \text{H} \\ \text{:} \\ \text{R}_3, \text{Ar}_3, \text{H} \end{array}$

<p>sulfoxide</p>	
<p>sulfone</p>	



Question: Identify the functional groups...



volicitin

Some plants respond to attack from chewing caterpillars by producing volatile terpenoids. Volicitin attracts parasitic wasps which come to the defense of the plants by parasitizing the caterpillars.

Consider the **pKa's** of the **OH's** in alcohols, phenols and carboxylic acids. Why are they so different?

***Saturated hydrocarbons = alkanes =**
aliphatic hydrocarbons

Aliphatic (from Greek meaning "fat") ->
contains no p-bonds or rings

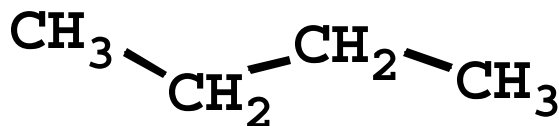
Learn names of C_1 to C_{10} alkanes (Table 3.3)...



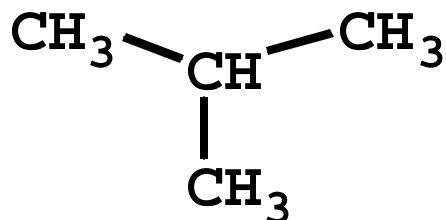
CH_4	methane
CH_3-CH_3	ethane
$CH_3-CH_2-CH_3$	propane
$CH_3-CH_2-CH_2-CH_3$	butane
C_5H_{12}	pentane
etc...	
$C_{10}H_{22}$	decane

*Alkane and alkyl group nomenclature

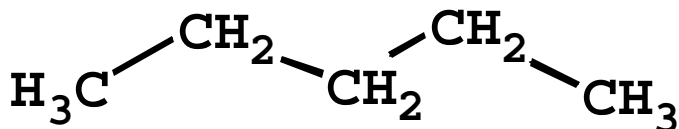
Common names of some butane and pentane isomers...



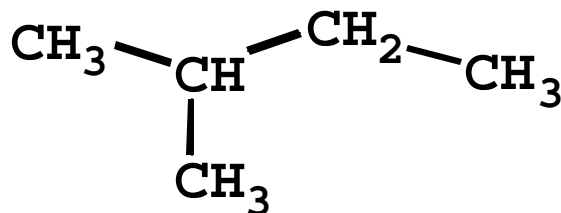
n-butane



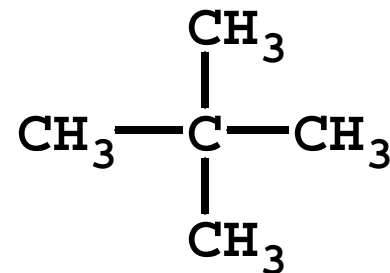
isobutane



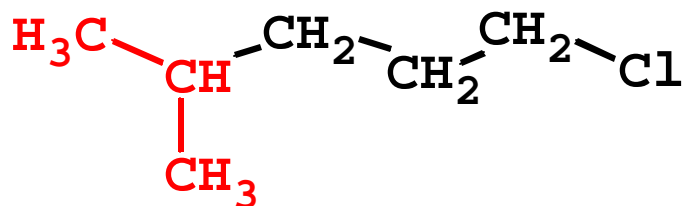
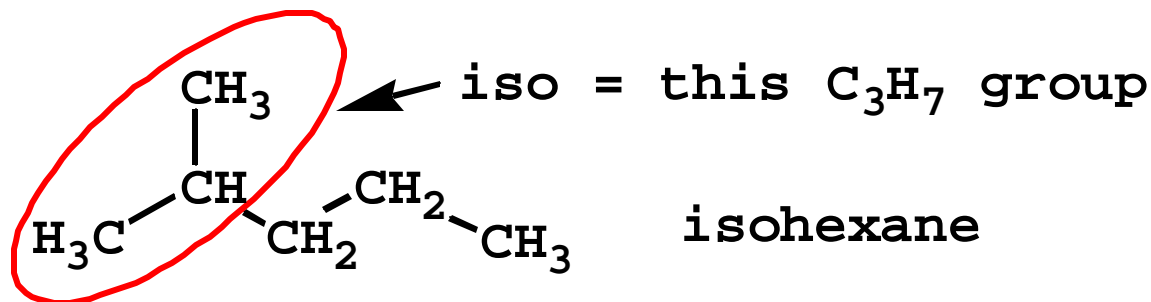
pentane



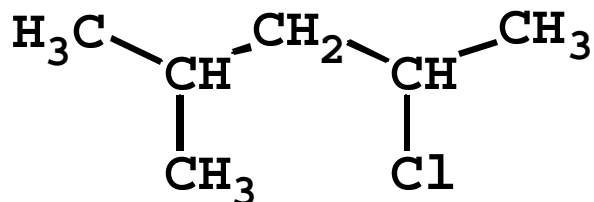
isopentane



neopentane



isohexyl chloride



not isohexyl chloride

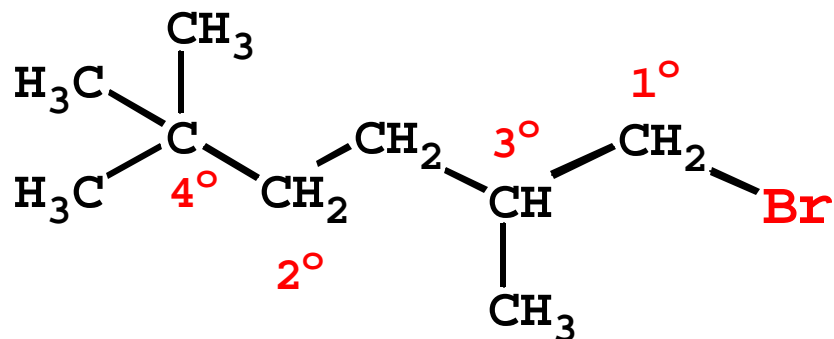
IUPAC name = 2-chloro-4-methylpentane

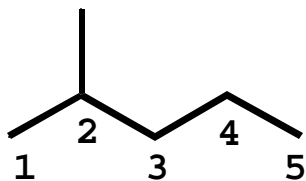
Common and IUPAC alkyl group names...

alkyl group	common name	IUPAC name
$\text{CH}_3-\text{CH}_2-\text{CH}_2-$	propyl	propyl
$\begin{array}{c} \text{CH}_3 \\ \diagdown \\ \text{CH}- \\ \diagup \\ \text{CH}_3 \end{array}$	isopropyl	1-methylethyl
$\begin{array}{c} \text{CH}_3 \\ \diagdown \\ \text{CH}-\text{CH}_2- \\ \diagup \\ \text{CH}_3 \end{array}$	isobutyl	2-methylpropyl
$\begin{array}{c} \text{CH}_3-\text{CH}_2-\text{CH}- \\ \\ \text{CH}_3 \end{array}$	sec-butyl (s-butyl)	1-methylpropyl
$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3-\text{C}- \\ \\ \text{CH}_3 \end{array}$	tert-butyl (t-butyl)	1,1-dimethylethyl

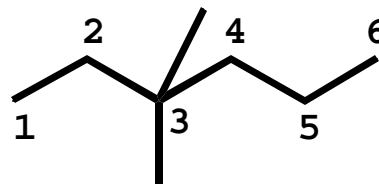
Comments about 1°, 2°, 3°...

Primary (1°) C is bonded to one other C atom.
Secondary (2°) C is bonded to two other C's, etc.

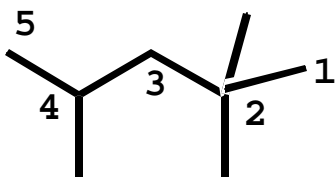




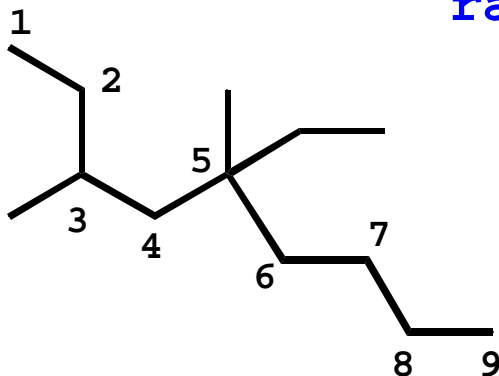
2-methylpentane



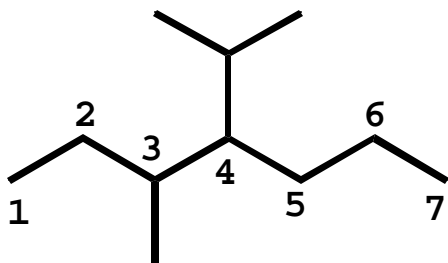
3,3-dimethylhexane



2,2,4-trimethylpentane
(isooctane; 100 octane
rating)



5-ethyl-3,5-dimethylnonane

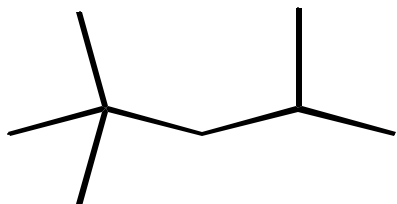


4-isopropyl-3-methylheptane

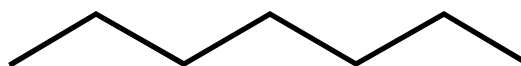
***Properties of alkanes:** Read and study section 3.5

An aside on gasoline, octane, petroleum..

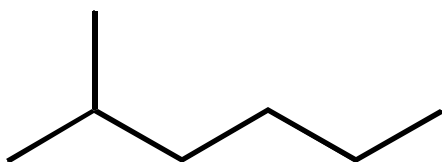
1929, procedure developed for establishing anti-knock quality of gasoline



isooctane
octane # 100

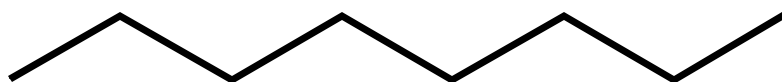


heptane
octane # 0



2-methylhexane
octane # 42

{ has same knocking
properties as mixture
of...
42% isooctane &
58% heptane



octane # -20

1930, anti-knock properties of tetraethyl lead discovered by Thomas Midgley.

3 g Et₄Pb per gal increases octane # 15-20.

2.4-3.2 g/gal in regular; 4.2 g/gal in premium.

Et₄Pb usage peaked in 1970's; used in ~99% of all U. S. gasoline

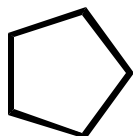
Components of petroleum..

Bp (°C)	# C's	Fraction/Use
< 30	2-4	petroleum gas, heating, propane, butane
30-180	4-9	gasoline
160-230	8-16	kerosene, heating, jet fuel
200-320	10-18	diesel, fuel
300-450	16-30	heavy oil, heating, lubrication
> 300	> 25	petroleum jelly, parafin wax
(vacuum)	> 35	asphalt

***Cycloalkanes...**

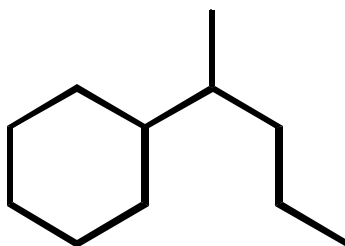


Cyclopropane

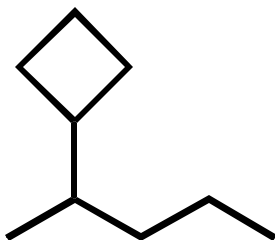


Cyclopentane

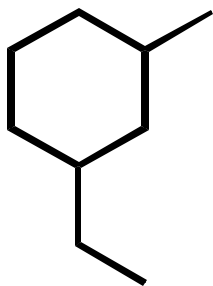
If the # ring C's =
the C's in largest
substituent, name as a
cycloalkane.



1-methylbutylcyclohexane
(is sec-pentylcyclohexane OK?)



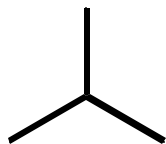
2-cyclobutylpentane



1-ethyl-3-methylcyclohexane

*Stereoisomers and cycloalkanes...

Constitutional isomers (**different** connections)...

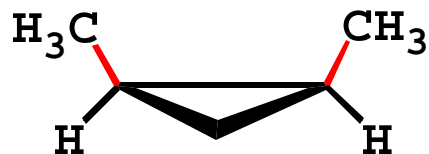


and

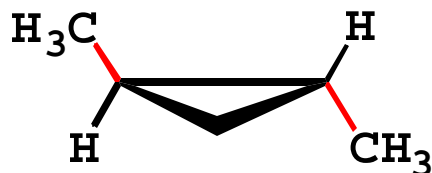


Hmmm..what is an isomer?

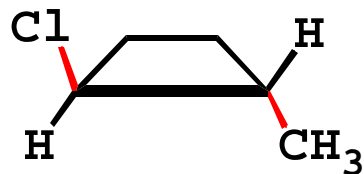
Stereoisomers (**same** connections, different 3D structures)...



cis-1,2-dimethylcyclopropane



trans-1,2-dimethylcyclopropane



trans-1-chloro-3-methylcyclobutane