molymod®

molecular models

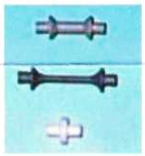
Art. ref: MMS-008

Contents: 53 Atoms & 64 Links

Qty	Element	Colour	Holes / Type	Dia mm
14	Carbon **C**	Black	4 tetrahedral.	23
20	Hydrogen **H**	White	1	17
6	Oxygen **O**	Red	2 angular(bent)	23
2	Nitrogen **N**	Blue	3 pyramidal	23
2	Nitrogen **N**	Blue	4 tetrahedral	23
1	Sulphur **S**	Yellow	4 tetrahedral	23
1	Phosphorus **P**	Purple	4 tetrahedral	23
1			5 trigonalbipyr.	23
1	Sulphur **S**	Yellow	6 octahedral	23
4	Halogen **Cl**	Green	1	17
1	Metal **Na**	Grey	1	17
26	Link	Grey	medium	19 / 31 *
12	Link	Grey	long flexible	32 / 43 *
26	Link	White	short	2 / 10 *
1	Tool			* Total

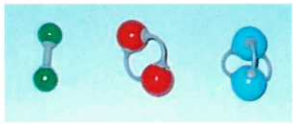
WARNING! This set is NOT a toy! It is designed for educational use only and is only suitable for people over 12 years of age. This set contains small parts which may present a choking hazard and should be kept away from small children.
Please keep this leaflet for future reference.

Links, Bond Types and Use:

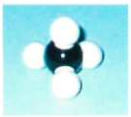


Medium grey links are used for single covalent bonds.
Long grey links are used for double or triple covalent bonds.
Short white links can be used instead of the standard medium link to make compact models.

Open models are made using medium or long links. Examples of single, double and triple bonds are shown in the image across.

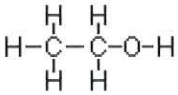


Compact models are made using short white links, e.g. Methane, which is made from four Hydrogen atoms (white), connected to a central Carbon atom using short links.



Molecular, and Structural Formulae:
The **molecular formula** shows the exact number of atoms of each element which are present in one molecule, e.g. **Ethanol** C_2H_6O = 2 Carbons, 6 Hydrogen and 1 Oxygen.

The **Displayed Formula** is a plan view of the arrangement of the atoms in a molecule, showing symbols for atoms, and lines for the bonds between atoms.



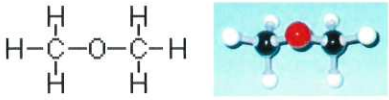
Ethanol

A Molecular Model of Ethanol:
The structural formula is only a 2-dimensional representation of the molecule and does not show the true bond angles. The bond angles in a Carbon atom are arranged in a tetrahedral formation and are at 109.5° to each other. A molecular model gives a more accurate idea of the bond angles, and orientation of the atoms.

The **Structural Formula** is an abbreviated version of a molecule and shows groups of atoms. For example, $CH_3.CH_2.OH$ is an abbreviated version for the formula of Ethanol.

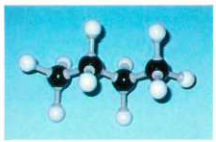
Isomerism
It is possible to make a different structure using the same number of atoms, as in C_2H_6O

Arrange the atoms as shown across.

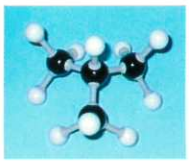


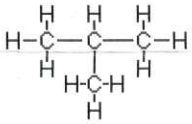
See how the Oxygen atom is between the two Carbon atoms. This structure is a completely different substance known as an **Ether**. When two or more substances have the same number and kind of atoms, but different structures, they are called Isomers.
Ether is an Isomer of **Ethanol**

Another Example of Isomerism:
Butane has the molecular formula C_4H_{10} Its structural formula is: $CH_3.CH_2.CH_2.CH_3$

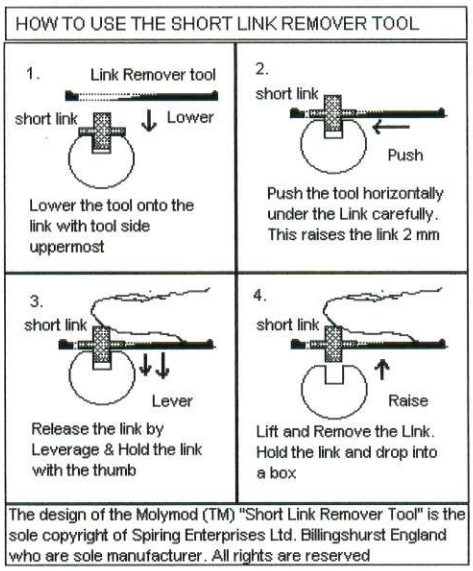


As shown in the image across, the same atoms can be rearranged to make a different structure named 2-methyl propane. The displayed formula is:





Disassembly of Compact Models:
Please read the following instructions for the recommended use of the link remover tool.



molymod® Molecular Models

Art. Nr. MMS-008

Organic (Student) Set

Organic Compounds

Alkanes General formula C_nH_{2n+2}

Note: If, for example, n = 6 then
2n+2 = (2 x 6) + 2 = 14
The formula will, therefore, be C_6H_{14}

Methane CH_4 Ethane C_2H_6

Propane C_3H_8 Butane C_4H_{10}

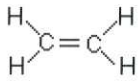
Pentane C_5H_{12} Hexane C_6H_{14}

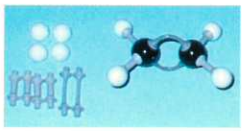
Heptane C_7H_{16} Octane C_8H_{18}

Alkyl radicals An alkyl radical is an alkane molecule, less one Hydrogen. e.g. Methane CH_4 gives CH_3- *methyl,* ethane gives *ethyl*, Propane gives *propyl*, Butane gives *butyl*, etc.

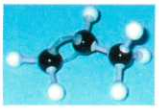
Alkenes General formula C_nH_{2n}

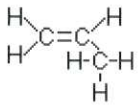
Ethene C_2H_4





Propene C_3H_6





Alkynes General formula C_nH_{2n-2}

Ethyne $H-C\equiv C-H$

Alcohols

General formula $C_nH_{2n+1}.OH$

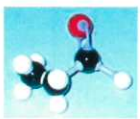
Propanol $CH_3-CH_2-CH_2-OH$

propan-2-ol (an isomer) $CH_3-\underset{\underset{OH}{|}}{CH}-CH_3$

Aldehydes General formula $C_nH_{2n+1}.CHO$

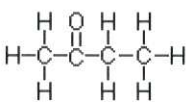
e.g. Propanal

$CH_3-CH_2-\underset{\underset{O}{\|}}{C}-H$



Ketones General formula $C_nH_{2n+1}.O.\ C_nH_{2n+1}$

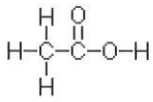
e.g. Butanone



Carboxylic acids

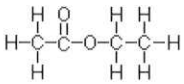
General formula $C_nH_{2n+1}.COOH$

e.g. Ethanoic acid



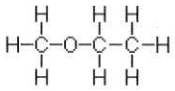
Esters General formula $C_nH_{2n+1}.COO.\ C_nH_{2n+1}$

e.g. Ethyl ethanoate



Ethers General Formula $C_nH_{2n+1}.O.\ C_nH_{2n+1}$

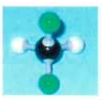
e.g. Methyl ethyl ether



Halogen Compounds

Monochloromethane CH_3Cl

Dichloromethane CH_2Cl_2



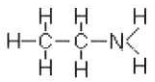
Trichloromethane $CHCl_3$
Tetrachloromethane CCl_4

Dichloroethane $C_2H_4Cl_2$ two isomers are possible. Check by making two models.

Amines

General formula $C_nH_{2n+1}.NH_2$

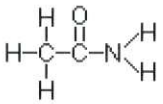
e.g. Ethylamine



Amides

General formula $C_nH_{2n+1}.CO.NH_2$

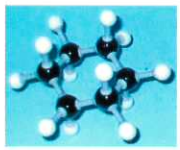
e.g. Acetamide



Cycloalkanes

These are ring compounds

e.g. Cyclohexane C_6H_{12}

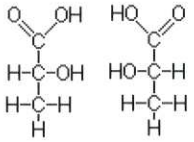


This molecule is capable of existing in one of two arrangements, known as either the "boat" or "chair".

The photo shows the "chair". See if you can change it to the "boat".

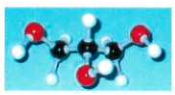
Biochemistry Compounds

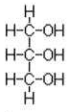
Lactic acid



Contains an asymmetric Carbon atom and can form structures that are mirror images of each other. They are known as optical isomers.

Glycerol

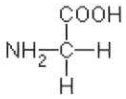




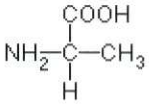
This compound can be made from animal fat (Glyceryl tristearate) which is a very large molecule.

Amino-acids

e.g. Glycine

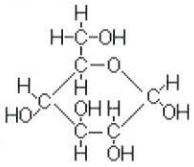


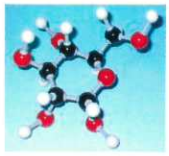
Alanine



Amino-acids combine to form proteins.

Glucose $C_6H_{12}O_6$



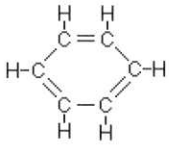


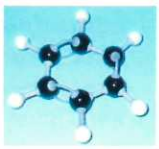
Glucose is the simplest of the monosaccharides.

Aromatic Compounds

Benzene is the first of the Aromatic family of compounds containing the same type of ring structure.

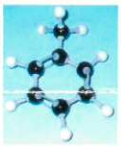
Benzene C_6H_6





Toluene $C_6H_5.CH_3$

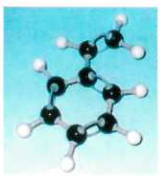
The structure consists of a methyl group joined to a benzene ring in piace of a Hydrogen.



Styrene

$C_6H_5.CH=CH_2$

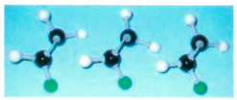
Many molecules of styrene can combine to form a polymer called polystyrene.



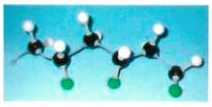
A Polymer

e.g. Polyvinyl chloride PVC

The photo shows 3 models of vinyl chloride, each with a double bond.



These can polymerise to form a chain known as Polyvinyl chloride (PVC).



Polymerisation involves the opening of the alkene bond to create the connections for a chain to form.