SCH 102

Introduction to Organic Chemistry, Chemistry of Alkanes and Cycloalkanes

Dr. Solomon Derese; Chemistry Department
Room 118; sderese@uonbi.ac.ke

Teaching timetable

Monday 8-10 am, MH1, A
Wednesday 8-10 am, MH1, B

Course Evaluation

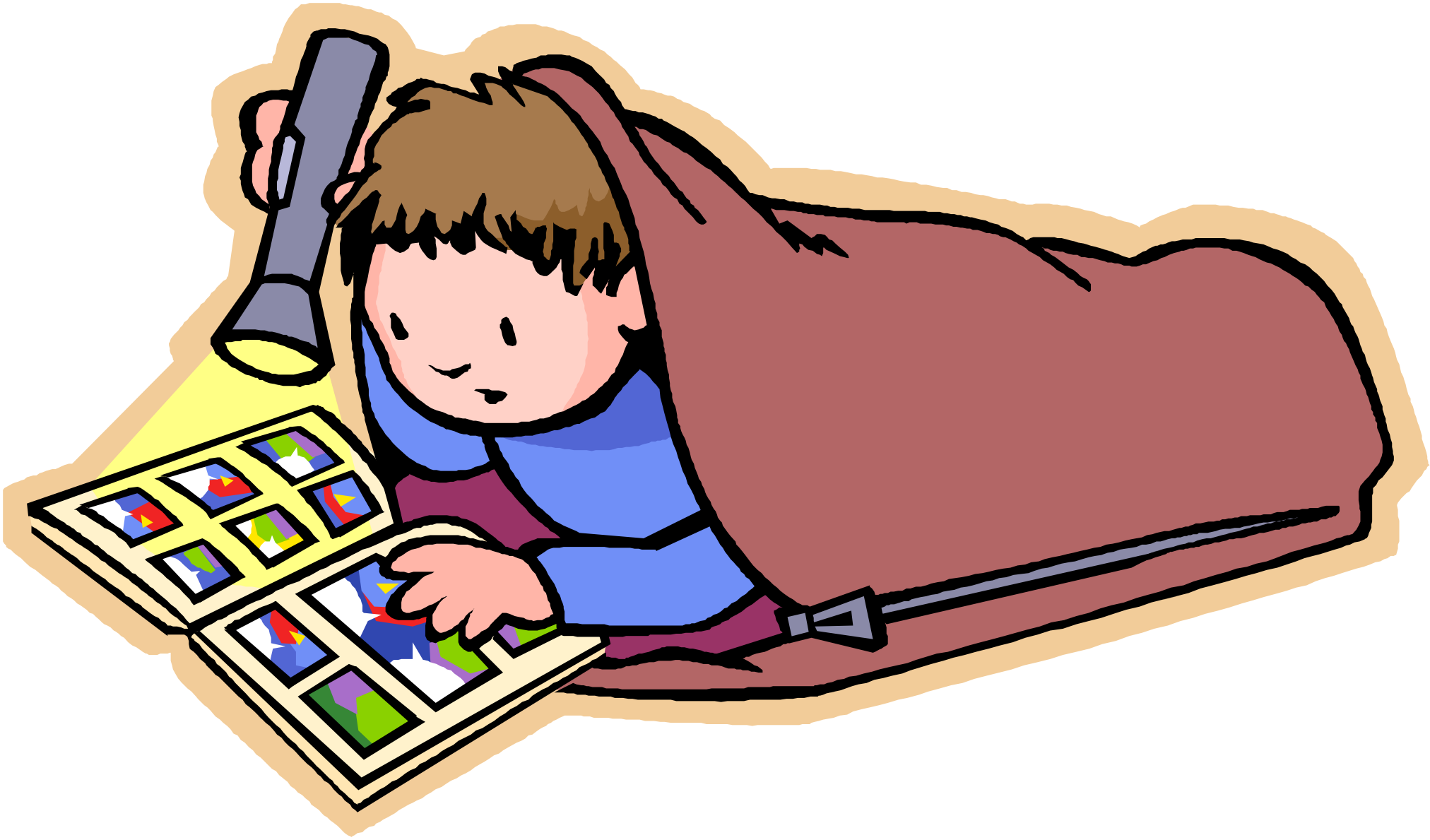
PRACTICALS (15 marks)
Two CATS (15 MARKS)
Final Exam (70 MARKS)

Recommended text books

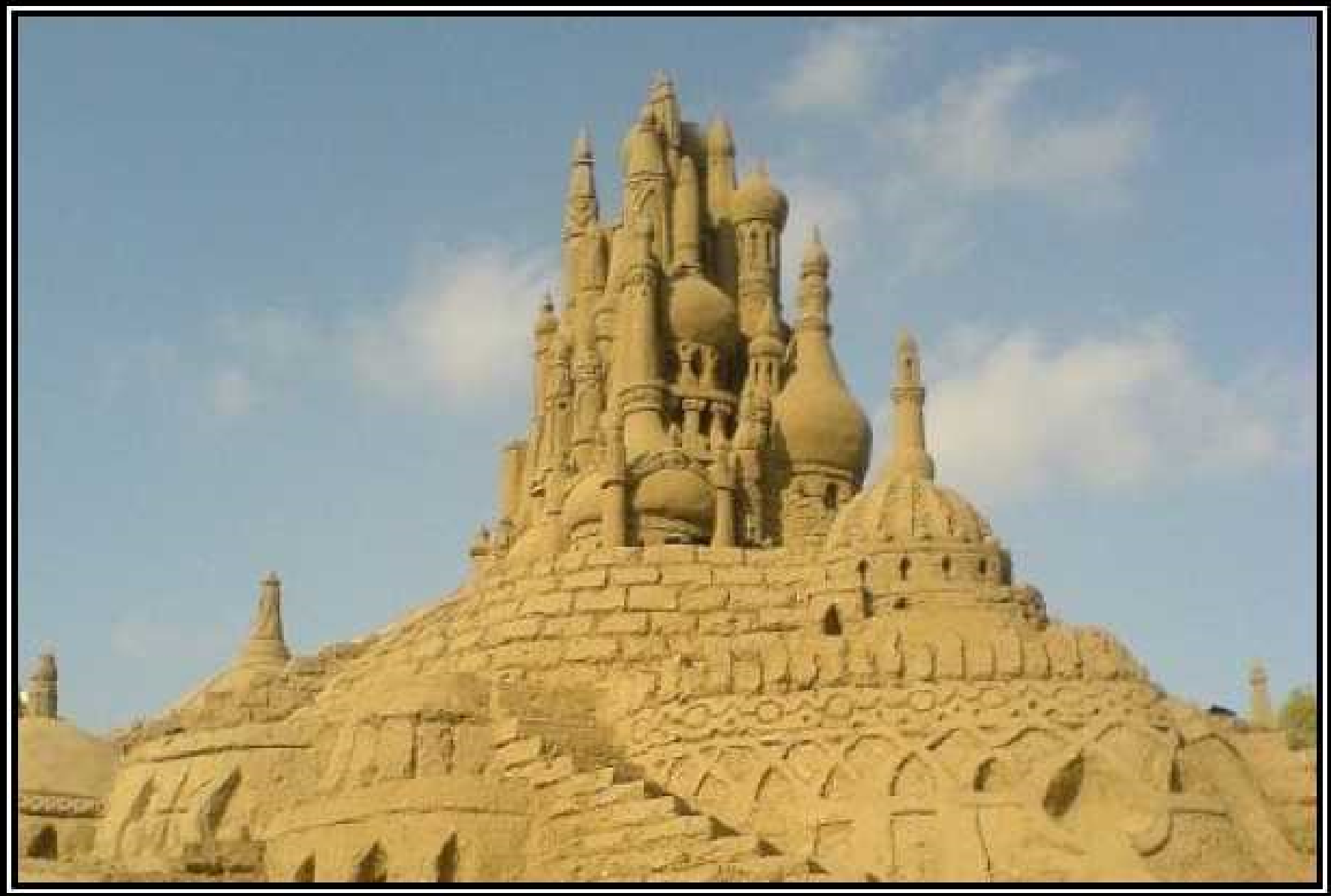
1. Organic Chemistry, John McMurry
2. Organic Chemistry, Francis Carry
3. Organic Chemistry, Solomons T.W.G.

Course Outline

1. Introduction to Organic Chemistry.
2. Atomic Structure, Chemical Bonding, Chemical Structure and in Organic Compounds: Lewis structure, resonance and hybridization.
3. Polar covalent bonds: electronegativity, dipole moment
4. Overview of the Intramolecular and Intermolecular Forces of attractions in Organic Molecules.
5. Overview of Types of Organic Reactions.
6. Basic Concepts of Organic Reaction Mechanisms.
7. Alkanes: Nomenclature, Structural Isomers, Conformational Isomers and Reactions.
8. Cycloalkanes: Nomenclature, Conformational Analysis and Reactions.
9. Overview of Stereochemistry.




READ MORE
Knowledge is power.



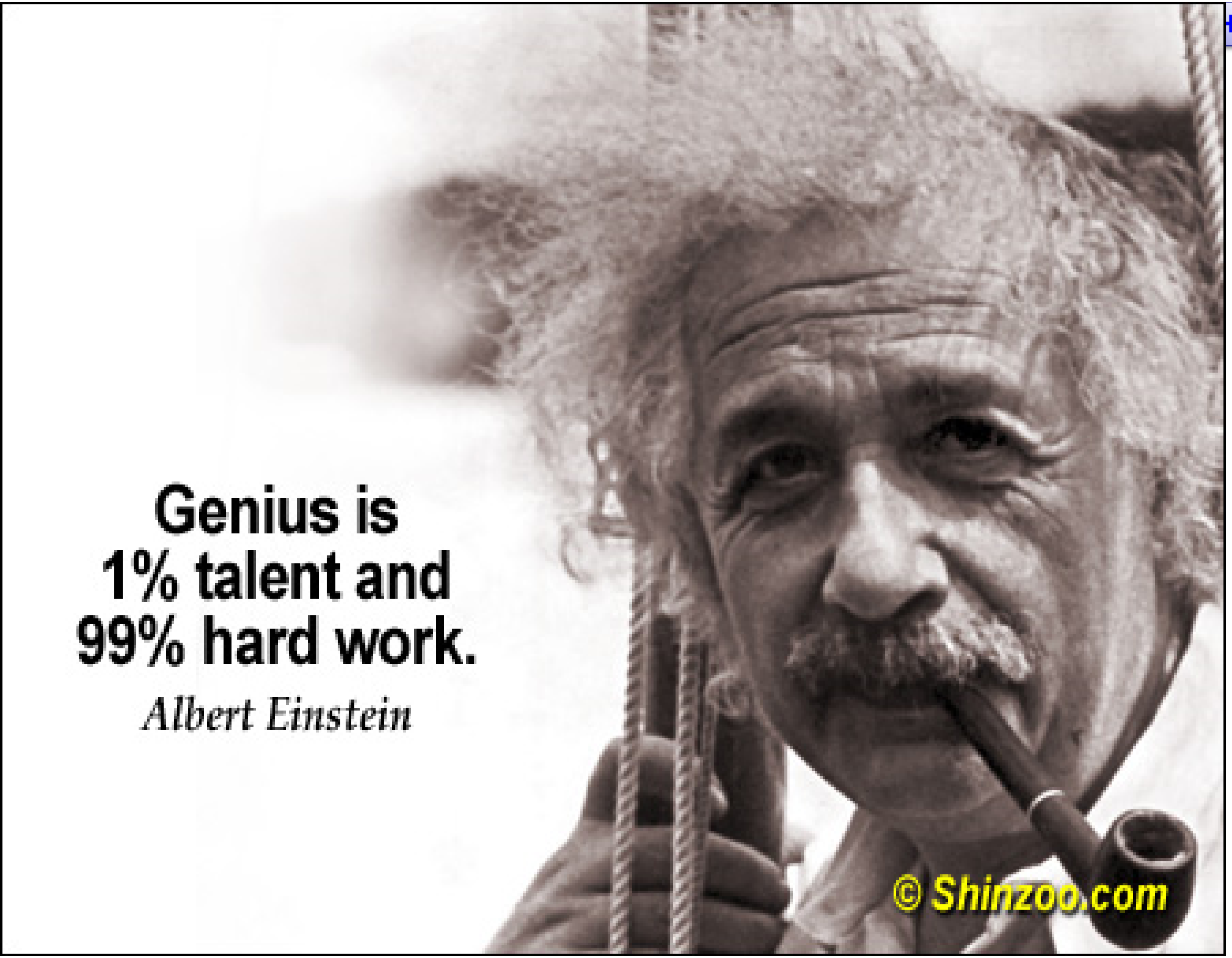
DO IT WELL

Whatever you do, do your best.

WORK HARD

Success is 1% inspiration, 99% perspiration.

Success Depends on the Second Letter


Genius is
1% talent and
99% hard work.
Albert Einstein
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Walking into class late and everyone stares at you..

like you murdered someone

Introduction to Organic Chemistry

What is organic chemistry?

Organic chemistry is the study of the chemistry of carbon compounds.

The compounds of carbon are the central substances of which all living things on this planet are made.

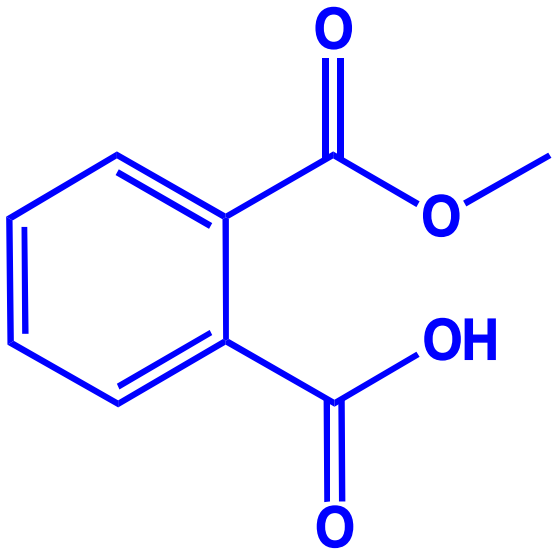
Every living organism is made of organic chemicals.

The proteins that make up your hair, skin, and muscles; the DNA that controls your genetic heritage; the foods that nourish you; and the medicines that heal you are all organic chemicals.

Examples of Organic Compounds

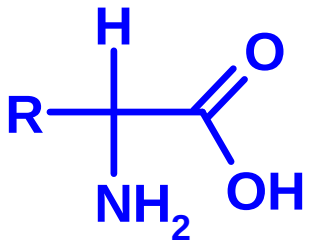
CH_4

Methane
(Chief constituent of natural gas)



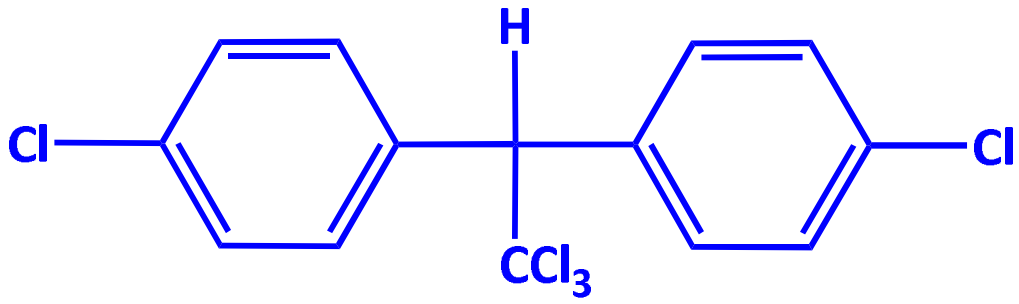
Acetylsalicylic acid
(Aspirin)

(Pain reliever)



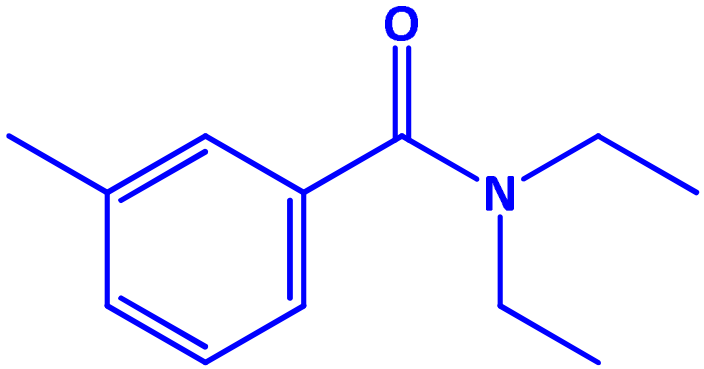
Aminoacids

(The building blocks of proteins)



1,1,1-Trichloro-bis(p-chlorophenyl) ethane (DDT)

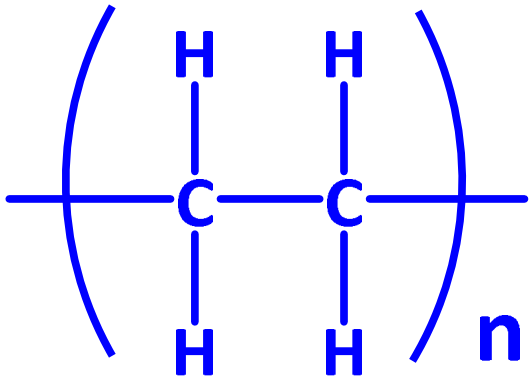
(Insecticide)



N,N-Diethyl-m-toluamide (DEET)

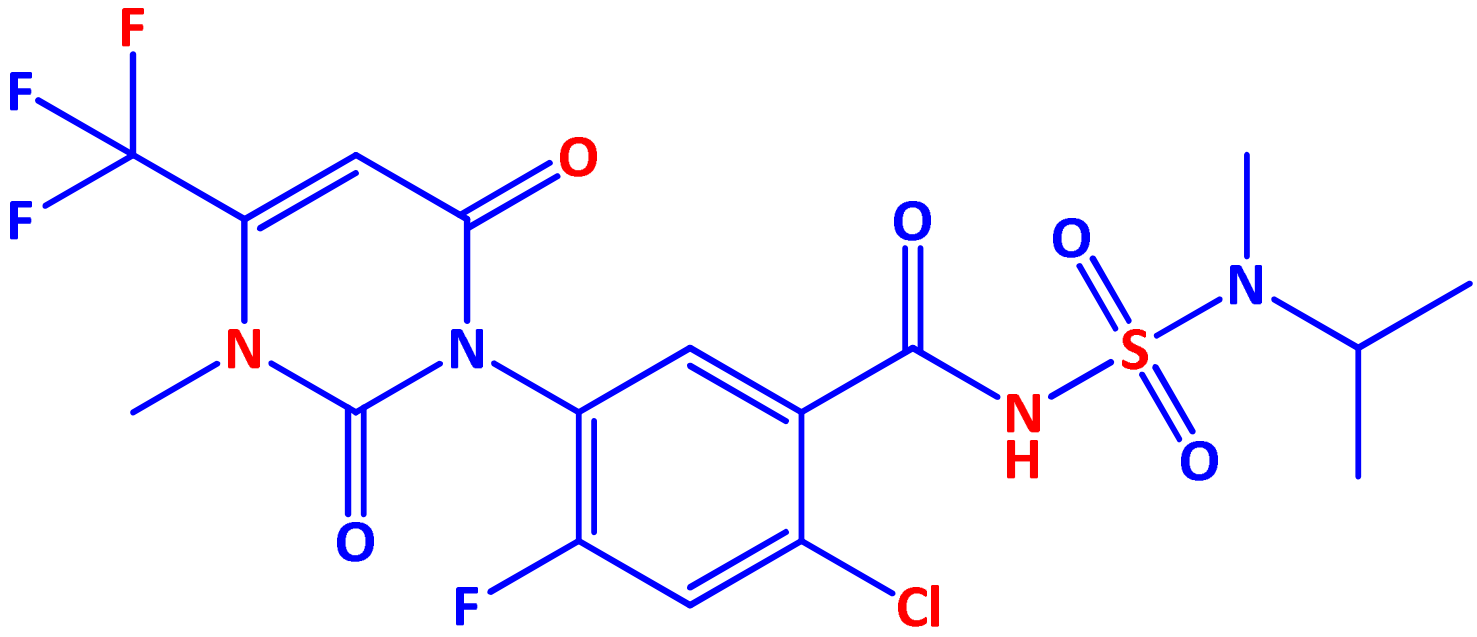
DEET, the active ingredient in the most widely used insect repellents, is effective against mosquitoes, fleas, and ticks.

Polyethylene



Although carbon is the principal element in organic compounds, most also contain hydrogen, and many contain nitrogen, oxygen, phosphorous, sulfur, halogens or other compounds.

Example



Saflufenacil (Herbicide)

Anyone with a curiosity about life and living things, and anyone who wants to be a part of the remarkable advances now occurring in medicine and the biological sciences, must first understand organic chemistry.

Although carbon is the principal element in organic compounds, most also contain hydrogen, and many contain nitrogen, oxygen, phosphorous, sulfur, halogens or other compounds.

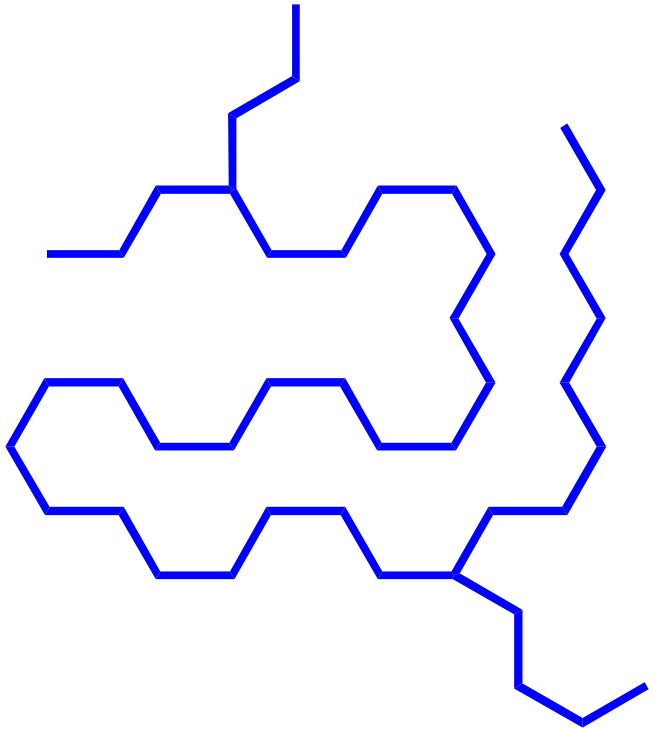
Currently there are close to 37 million known chemical compounds, of these 99% of them contain carbon.

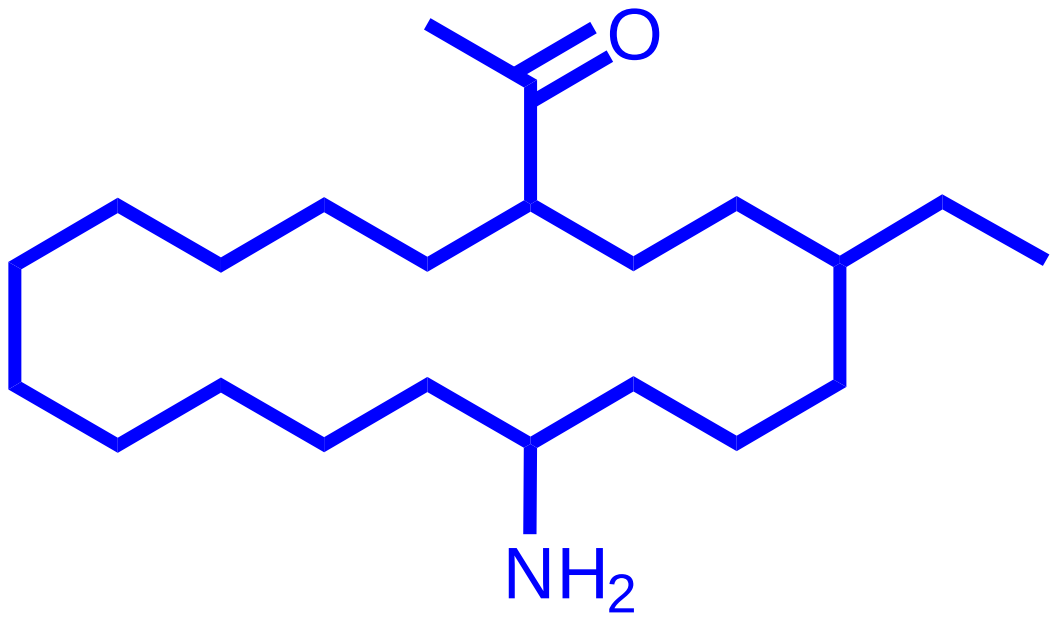
What makes carbon special?

The reason for this are:

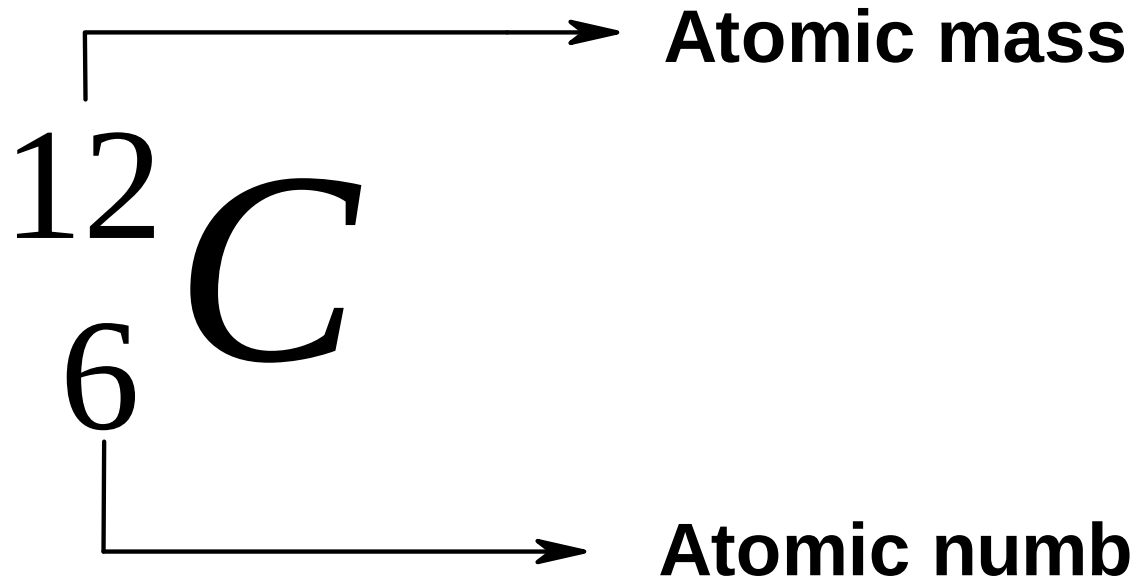
- As a group 4A element (at the centre of the periodic table), carbon can share four valence electrons and form four strong covalent bonds.
- Furthermore, carbon atoms can bond to one another, forming long chains and rings from the simplest methane with one carbon complex molecules such as DNA with more than 100 million carbons.

Carbon atoms can attach themselves to one another to an extent not possible for atoms of any other elements.

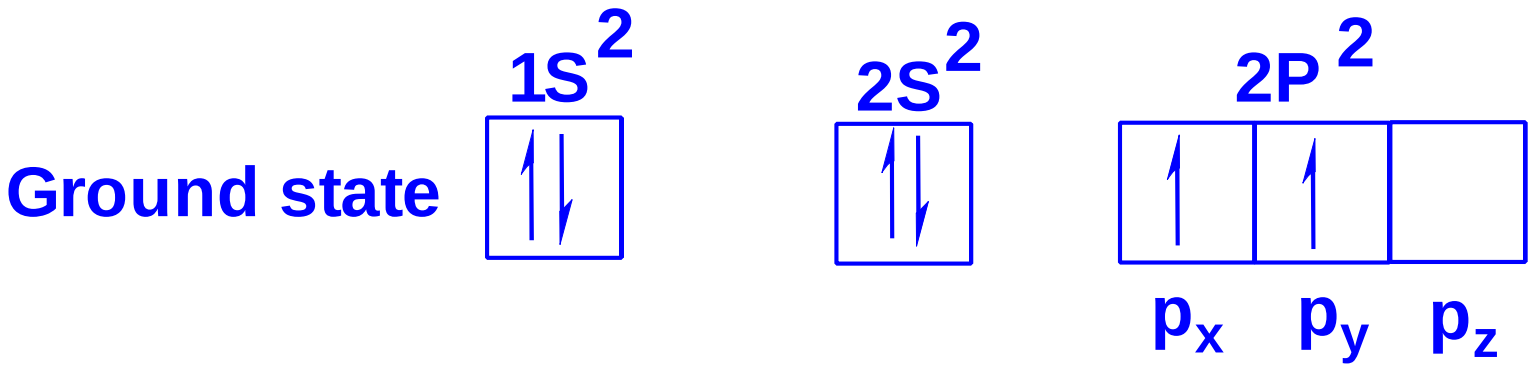




Each arrangement corresponds to a different compound, and has it own characteristic set of physical and chemical properties.



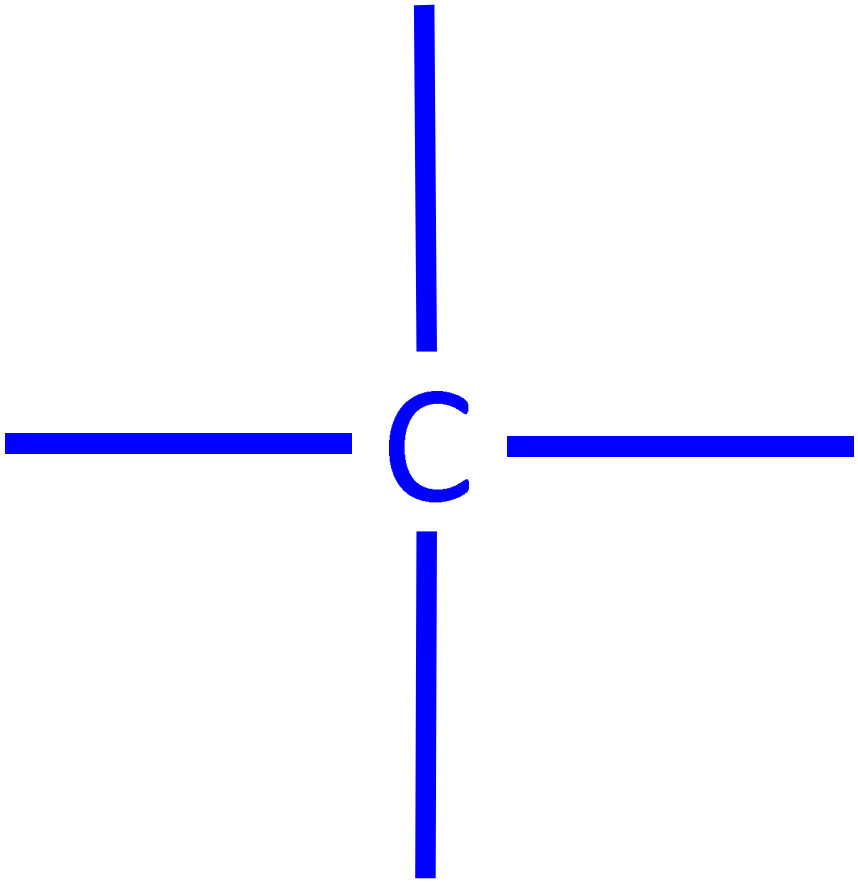
Electronic configuration: $1s^2 2s^2 2p^2$



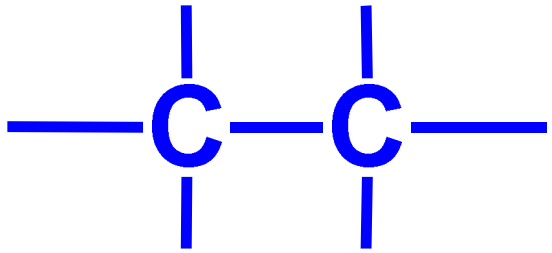
Carbon has four electrons in its outer most shell and requires four more electrons in a covalent bond to have a complete outer shell of electrons.

Bond formation in carbon

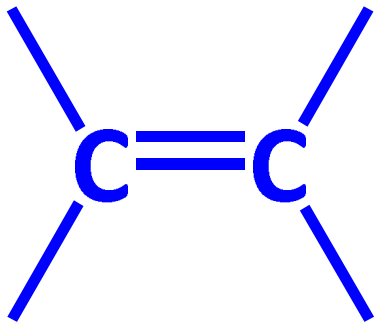
1. Carbon is tetravalent; that is it forms four bonds



2. A carbon atom can use one or more of its valence electrons to form bonds with other carbon atoms.



Single bond



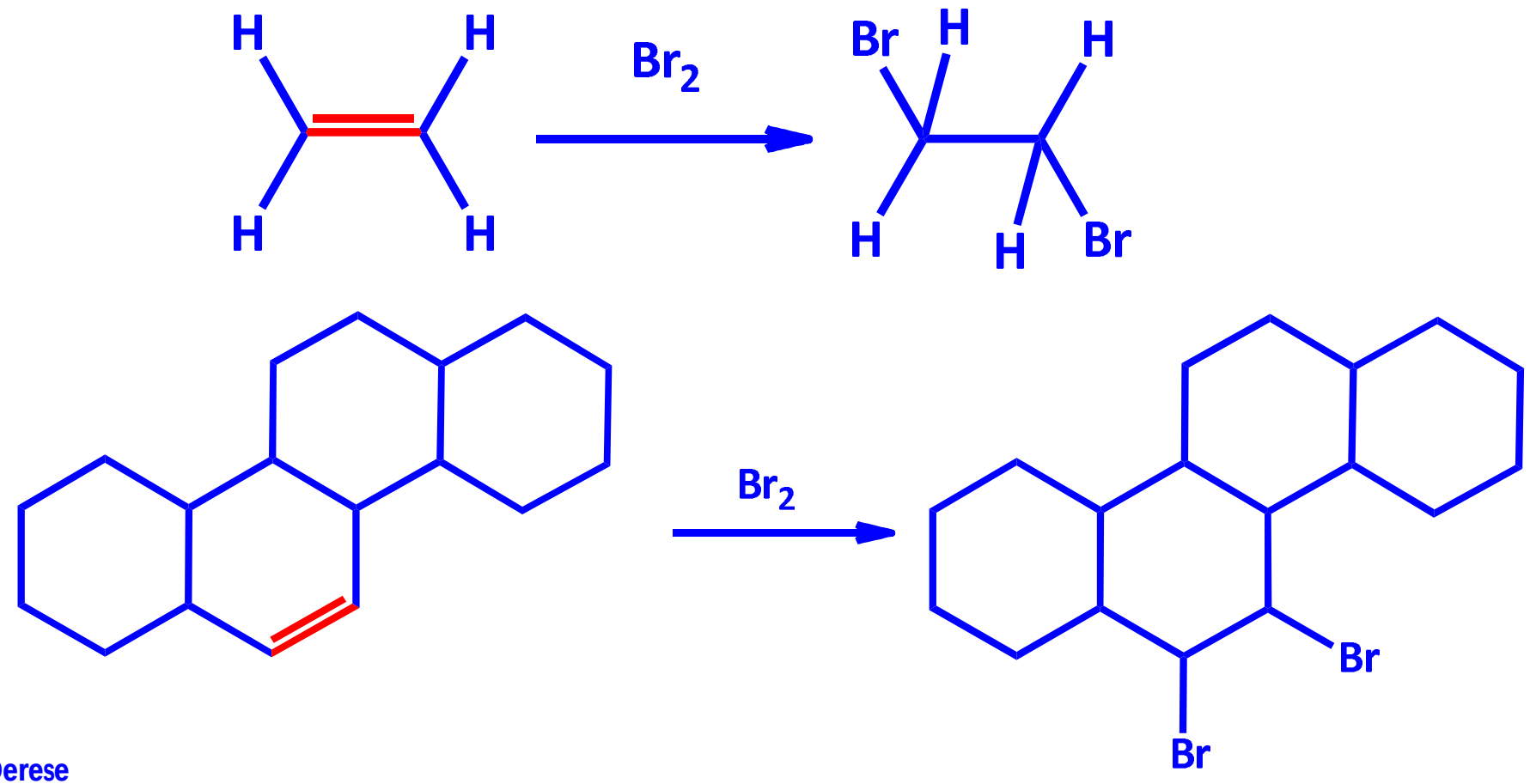
Double bond

Triple bond

Functional Groups

- Chemists have learned through many years of experience that organic compounds can be classified according to their structural features and that members of a given family often have similar physical and chemical behaviour.
- The structural features that make it possible for classify organic compounds by reactivity are called functional groups.

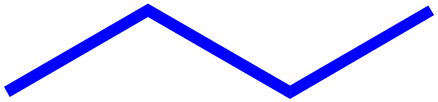
A functional group is part of a molecule where most of its chemical reactions occur. It is the part that effectively the compound's chemical properties (and most of its physical properties as well).



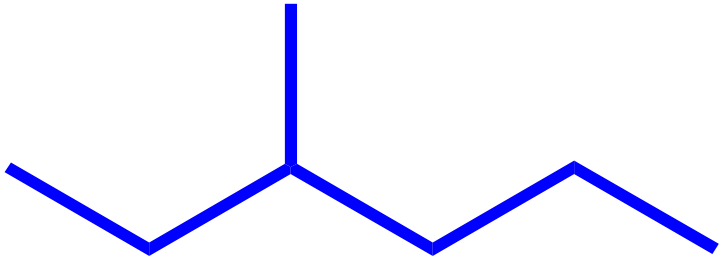
The chemistry of every molecule, regardless of size and complexity, is determined by the functional group it contains.

Alkanes

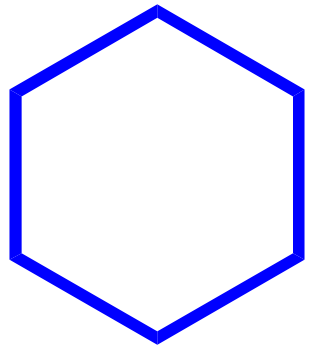
- They contain only C-C single bonds.
- The alkanes are the simplest class of organic molecules because they contain no functional groups. They are extremely unreactive.



Butane



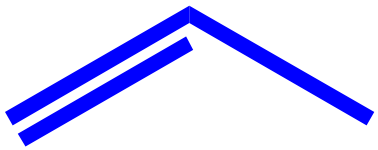
3-Methylhexane



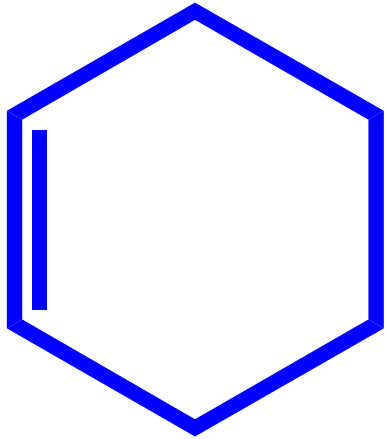
Cyclohexane

Alkenes

- Sometimes called olefins are hydrocarbons which contain C=C double bonds.



Prop-1-ene

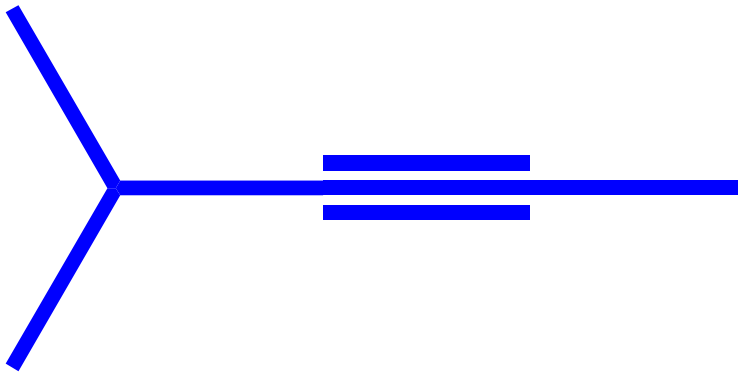


Cyclohexene

Alkynes

Alkynes are hydrocarbons that contain C≡C triple bond.

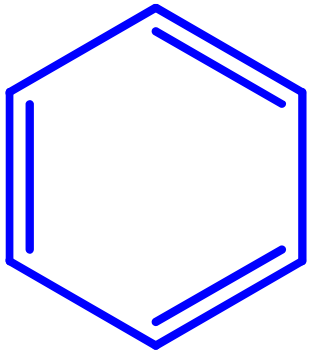
Ethyne (Acetylene)



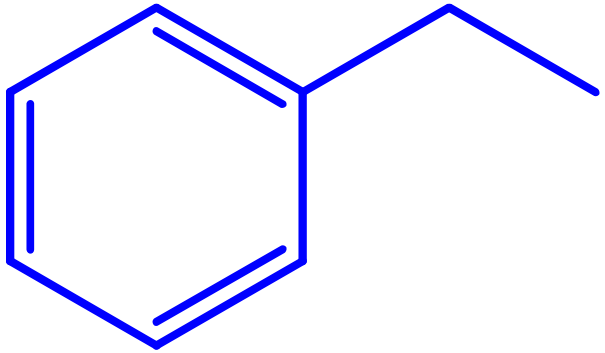
4-Methylpent-2-yne

Aromatic

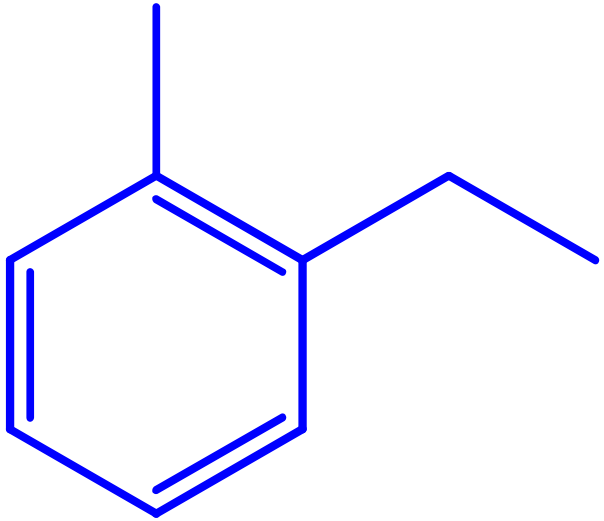
Compounds that contain benzene.



Benzene



Ethylbenzene

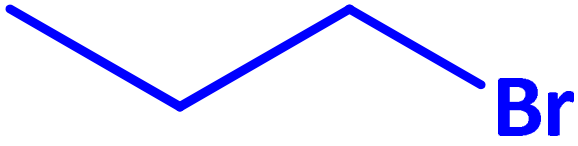


1-Ethyl-2-methylbenzene

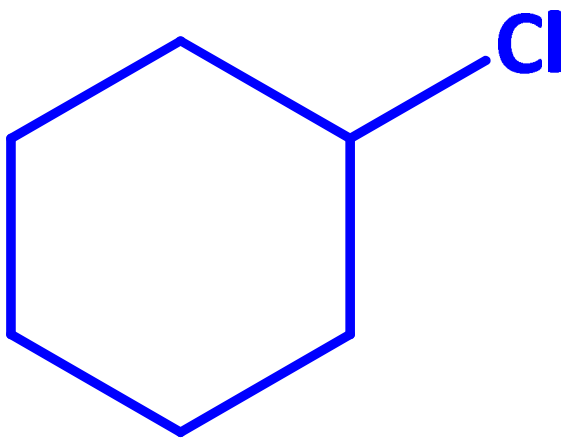
Alkyl Halides

Contain an alkyl group bonded to F, Cl, Br or I.

R——X where X is a halogen



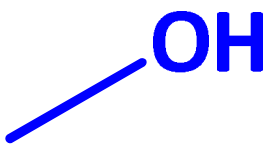
1-Bromopropane



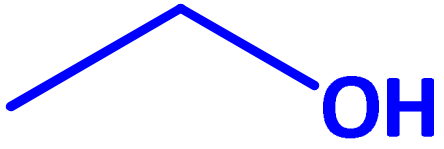
Chlorocyclohexane

Alcohols

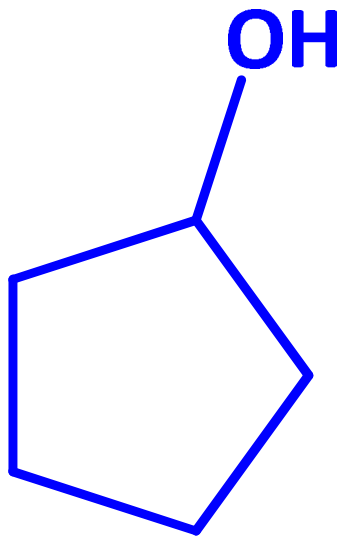
Alcohols contain a hydroxyl (OH) group.



Methanol



Ethanol

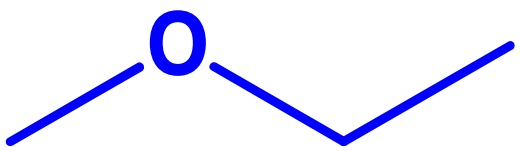


Cyclopentanol

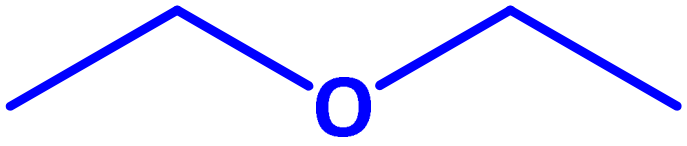
Ethers

Ethers contain R_1–O–R_2. It refers to any compound that has two alkyl groups linked through an oxygen atom.

R_1-O-R_2



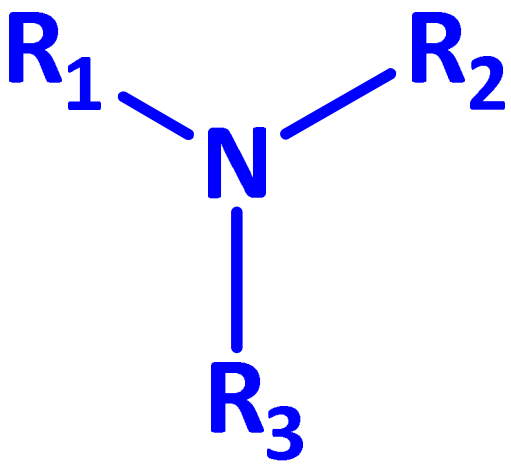
Ethyl methyl ether

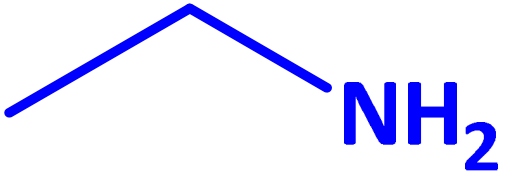


Diethyl ether

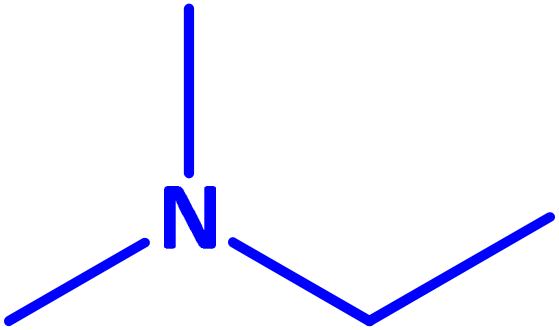
Amines

Amines contain the amino ($NR_1R_2R_3$) group, a nitrogen attached to an alkyl group.





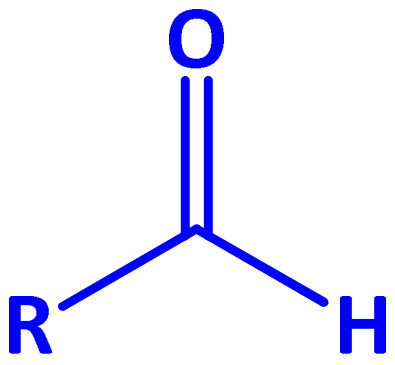
Ethanamine



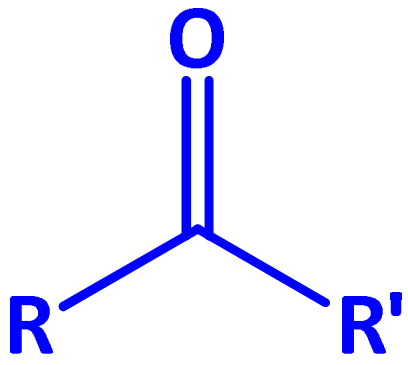
***N*,*N*-Dimethylethanamine**

Alhdeydes and Ketones

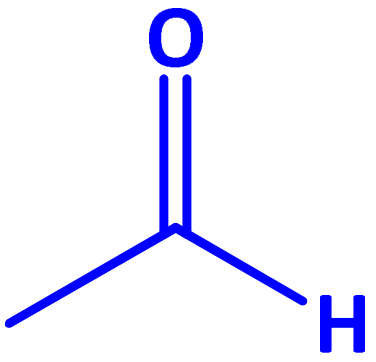
Aldehydes (R–CHO) and ketones (R_1–CO–R_2) contain the carbonyl group C=O.



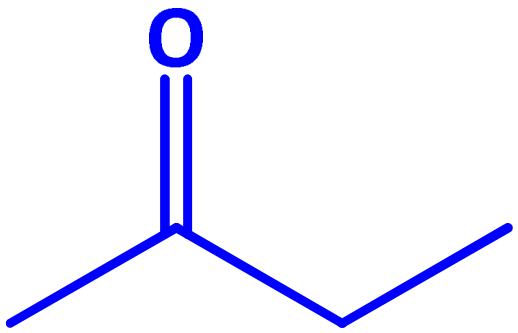
Aldehyde



Ketone



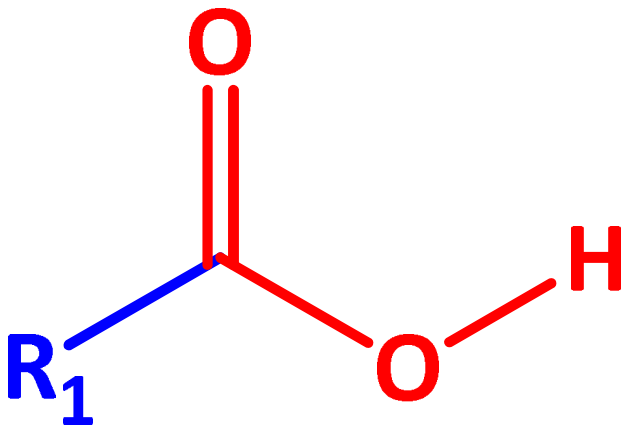
Acetaldehyde

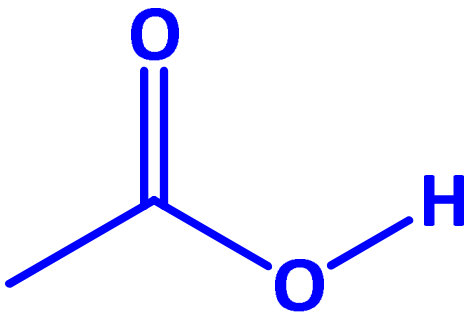


Butan-2-one

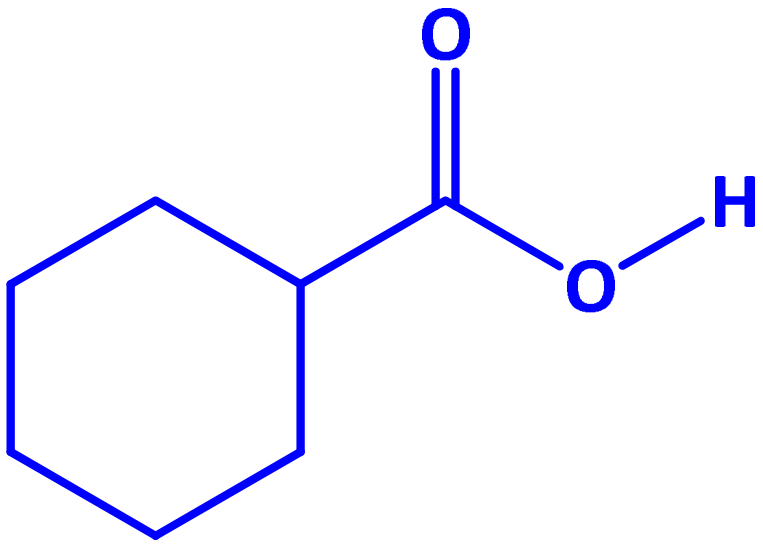
Carboxylic Acids

Carboxylic acids (R–CO_2H) contain the carboxyl group CO_2H.





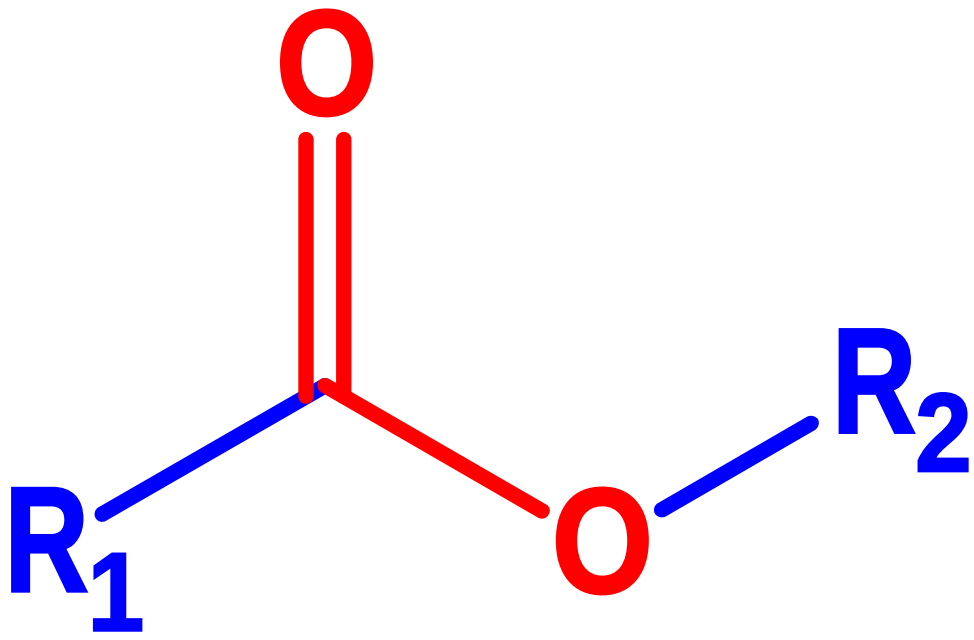
Acetic acid (Vinegar)



Cyclohexanecarboxylic acid

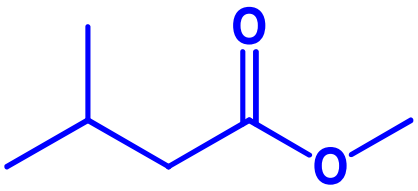
Esters

Esters (R_1–CO_2-R_2) contain a carboxyl group with an extra alkyl group (-CO_2R).

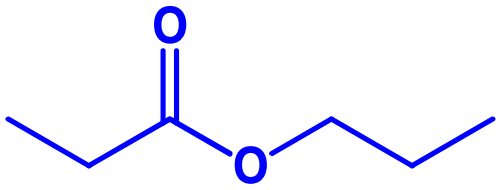


Commercial applications of esters

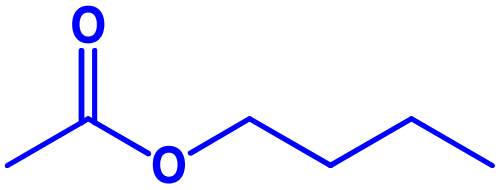
The characteristics fruity smell of esters lead to their use in artificial fruit essences.



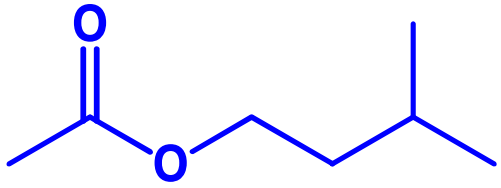
Methyl 3-methylbutanoate



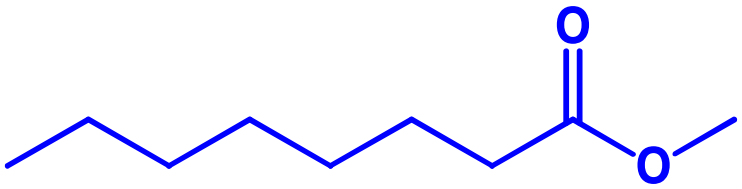
Propyl propionate



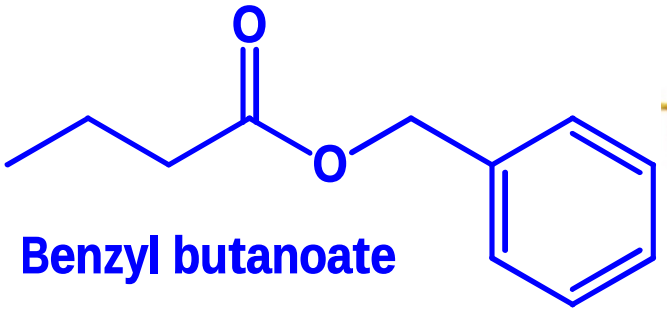
Butyl acetate



3-Methylbutyl acetate



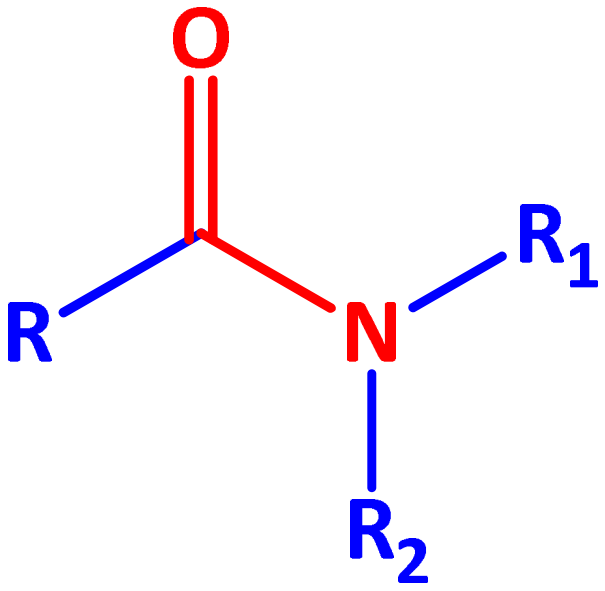
Methyl octanoate

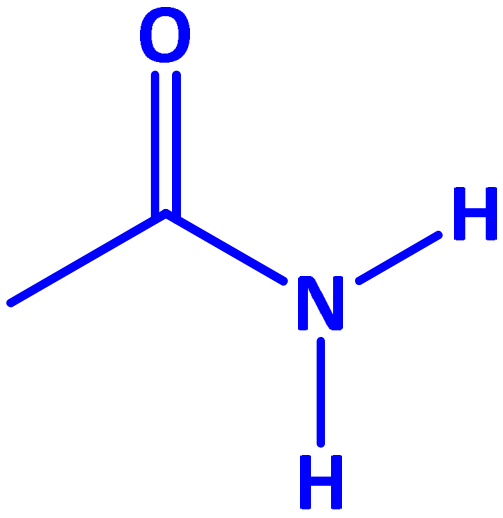


Benzyl butanoate

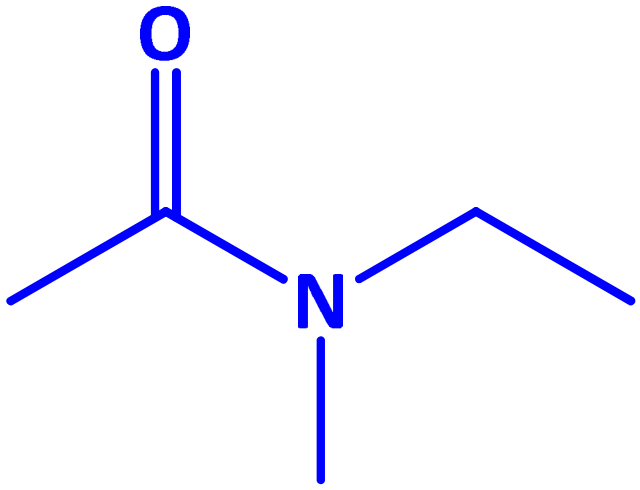
Amides

Amides ($RCONR_1R_2$)





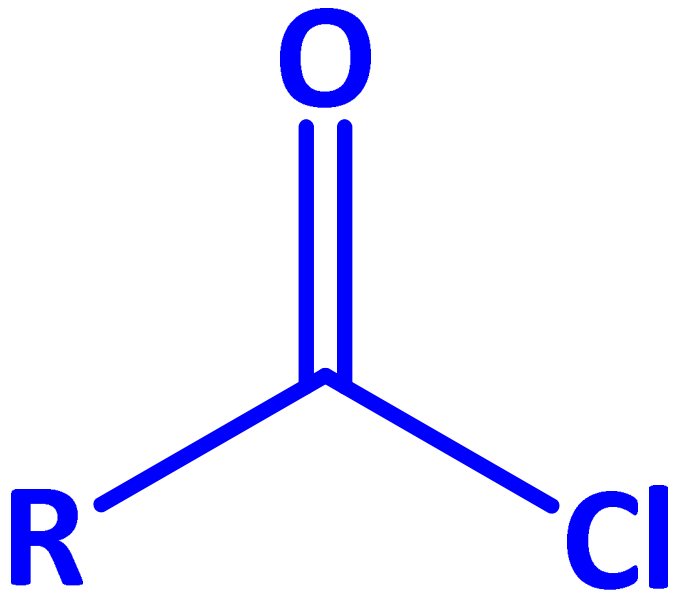
Acetamide

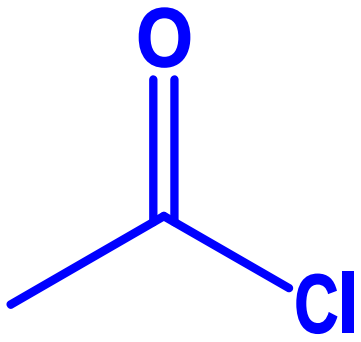


***N*-ethyl-*N*-methylacetamide**

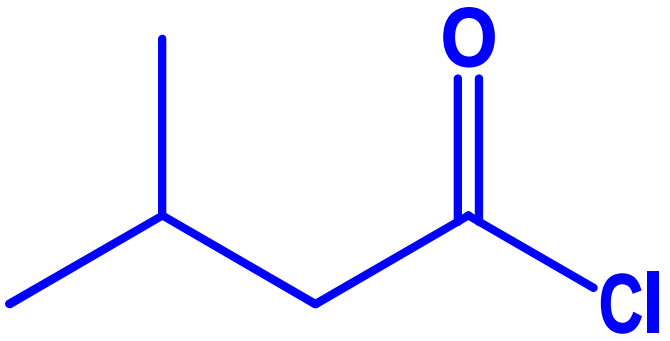
Acid Chlorides

Acid chlorides (R–COCl)



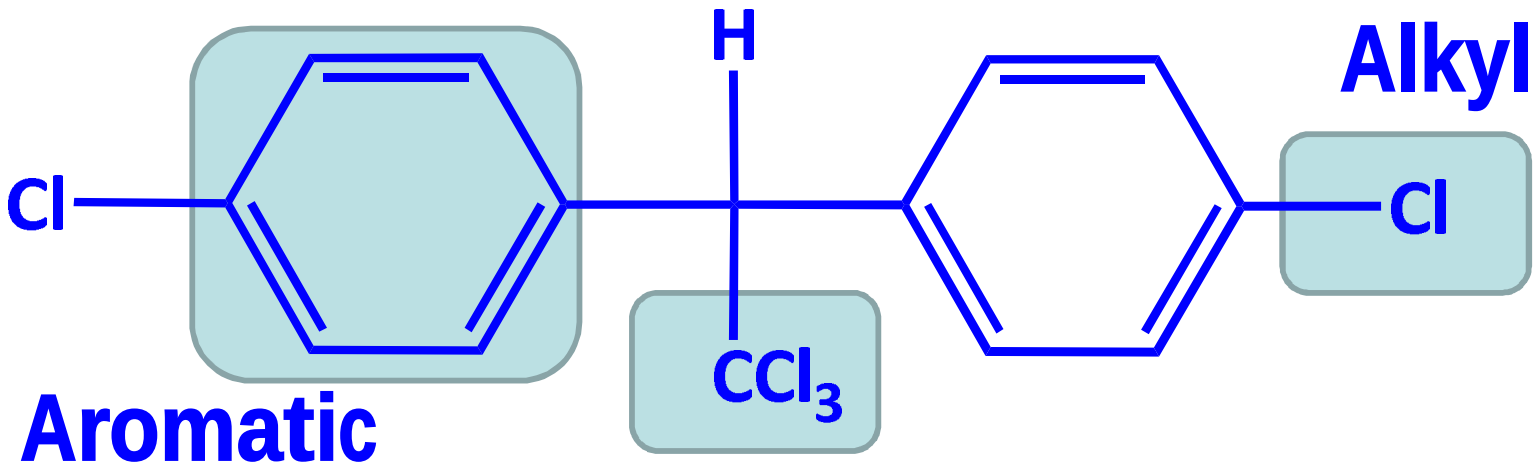


Acetyl chloride



3-Methylbutanoyl chloride

DDT

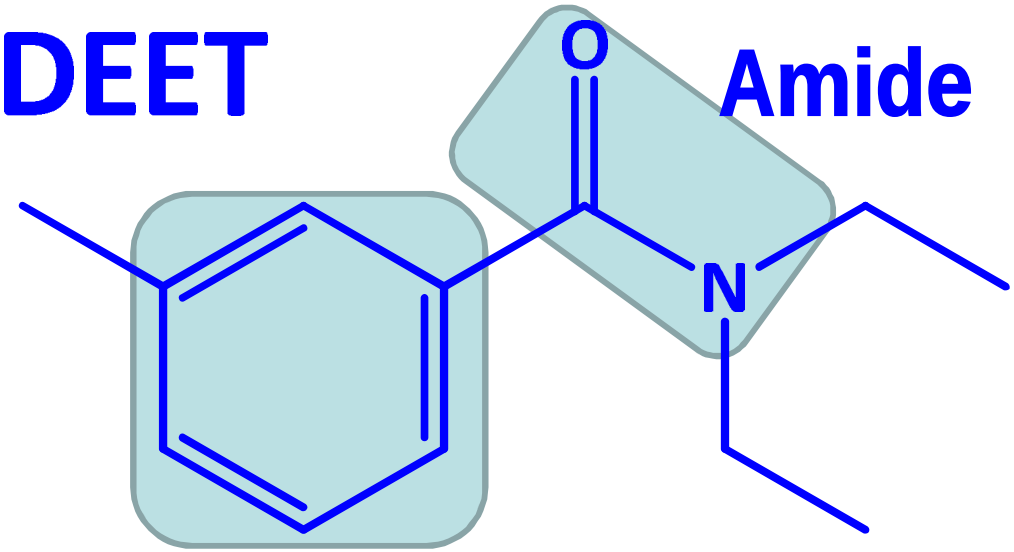


Alkyl halide

Aromatic

Alkyl halide

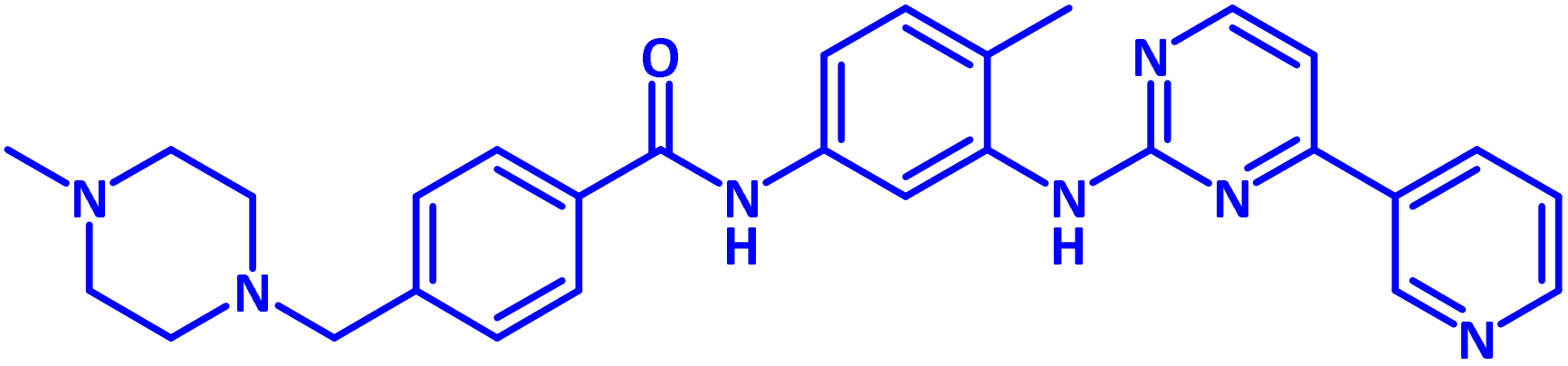
DEET



Amide

Aromatic

Application of Organic Chemistry in Drug Discovery – a Case of the Anticancer Drug Imatinib



Imatinib marketed as Gleevec/Glivec

IUPAC Name

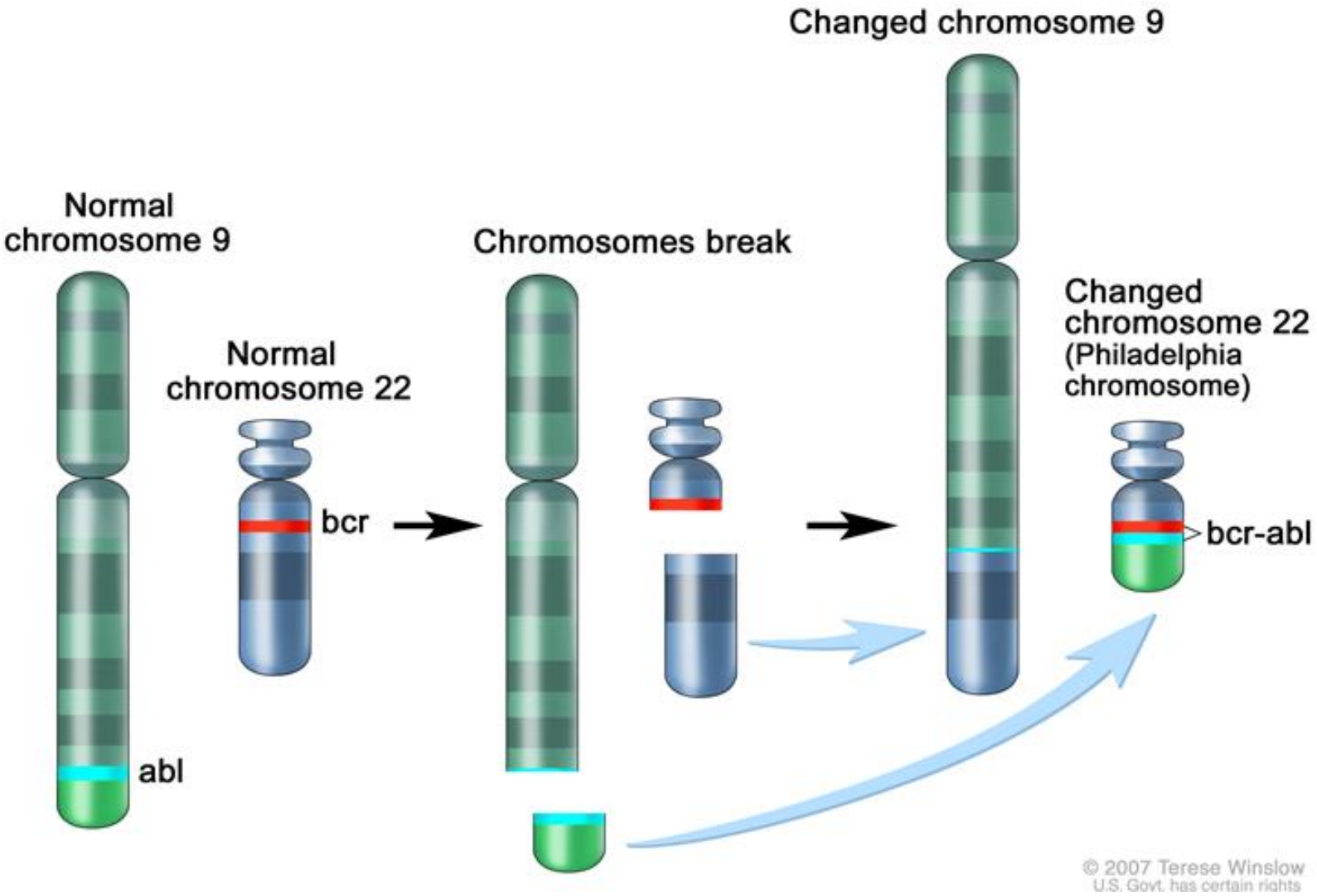
N-(4-Methyl-3-((4-(pyridin-3-yl)pyrimidin-2-yl)amino)phenyl)-4-((4-methylpiperazin-1-yl)methyl)benzamide

- Imatinib is used for the treatment of Chronic Myelogenous Leukemia (CML), before its discovery a diagnosis of a relatively uncommon cancer of the blood and bone marrow, was a death sentence.
- Imatinib was discovered through collaboration of, an oncologist, Brian Drucker, and a biochemist, Nicholas Lydon, using results on the genetic basis of CML.

Dr. Brian Druker

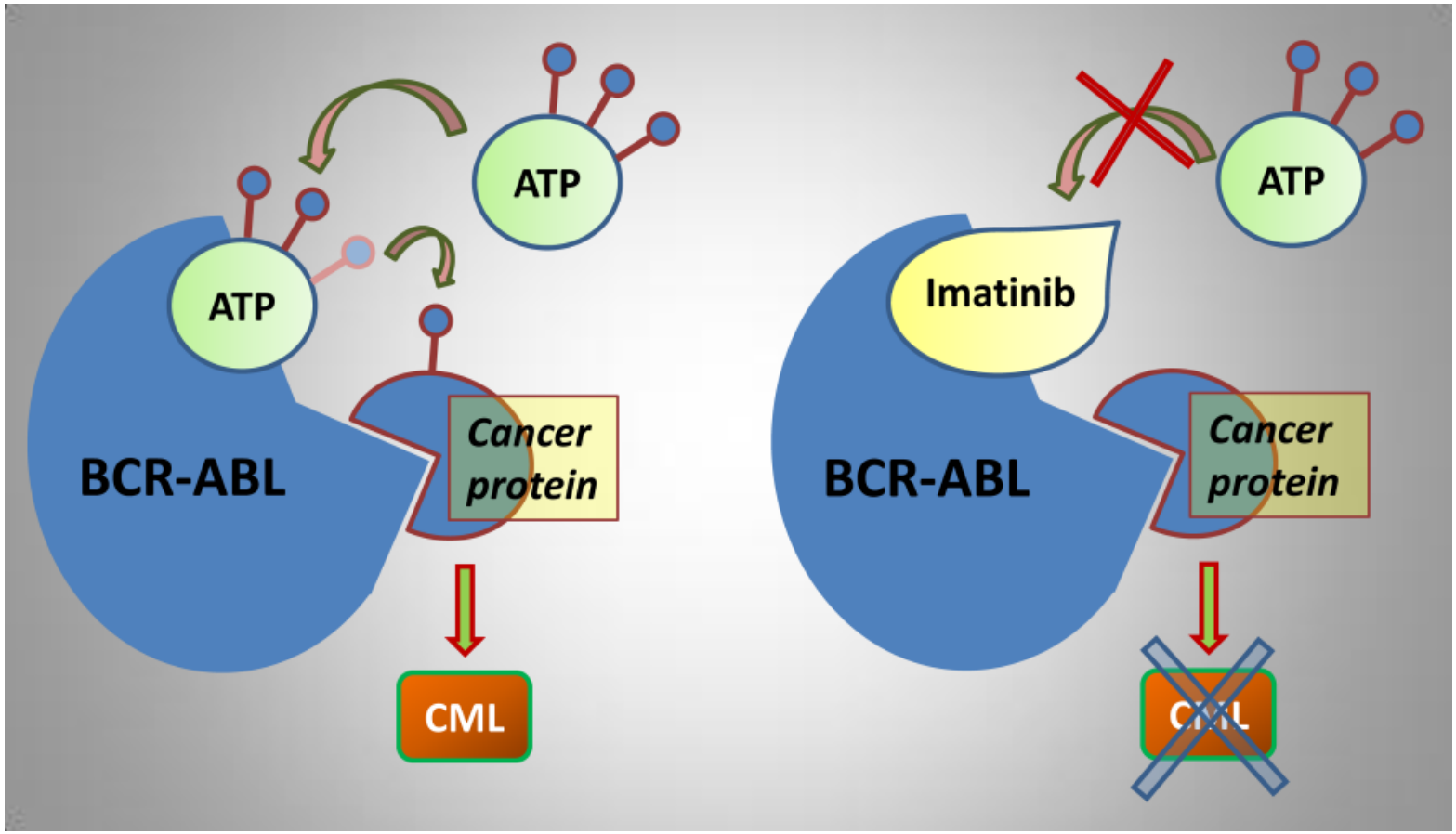
Dr. Nicholas Lydon

Genetic Basis of CML



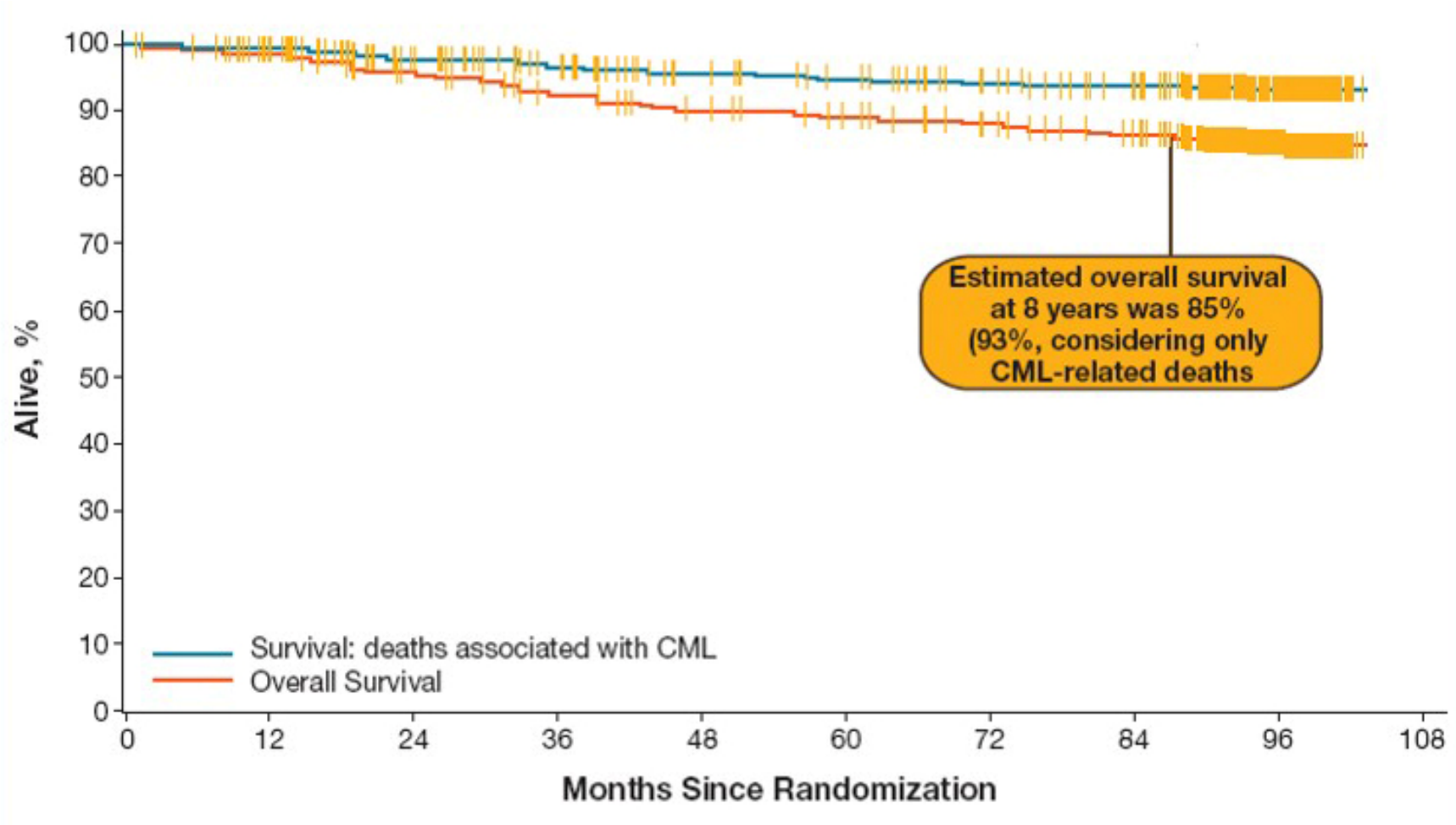
CML is caused by the mutated chromosome bcr-abl.

A number organic compounds were screened for their ability to inhibit *bcr–abl*, and this resulted in the discovery of imatinib as the drug of choice for treatment of CML.



Inhibition of bcr-abl by imatinib

Overall survival on First-Line Imatinib treatment of patients diagnosed with CML



Such was the need and success of Imitanib that this was featured on the cover of Time magazine in 2001

Generic imatinib is available in Canada for **$8,800**/year and Gleevec is available for $38,000/year. In the United States, Gleevec is priced today at **about $146,000**/year. Thus, the "generic price" in the United States was in fact not much lower than the branded drug price. May 25, 2016

In this unit and subsequent organic chemistry units you will learn about:

- Structure
- Nomenclature
- Properties
- Reactions
- Synthesis/Preparation

of such type of organic compounds.