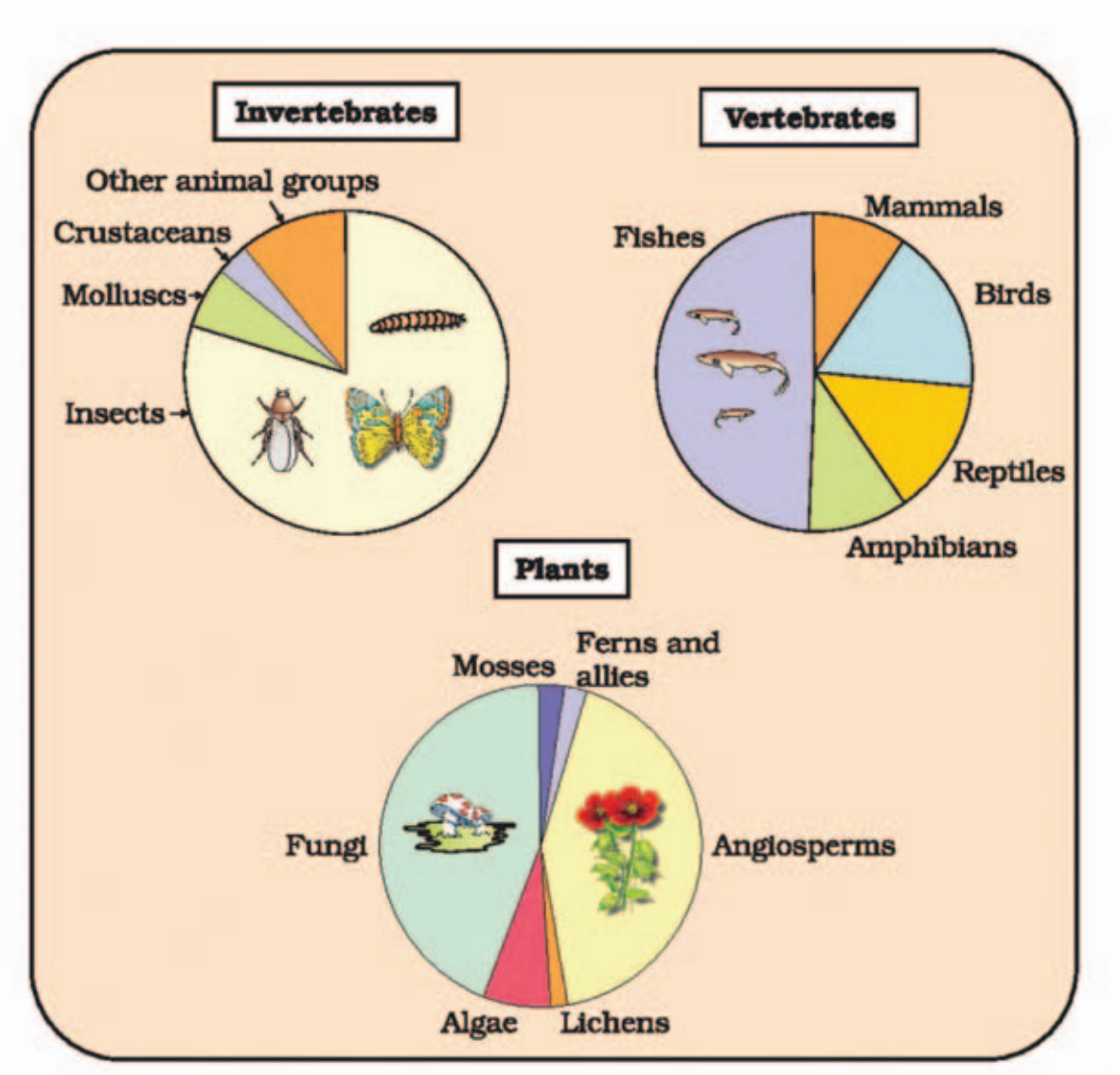
Zoology - I

Appendix

1. In the Page No. 16 after the first paragraph of 1.10 Biodiversity just before "Levels of Biodiversity" the following figure is added.



Representing global biodiversity: Proportionate number of species of major taxa of plants, invertebrate and vertebrates.

2. In the page No. 21 below the side heading of "Threats of Biodiversity" the following paragraphs are added

Loss of Biodiversity

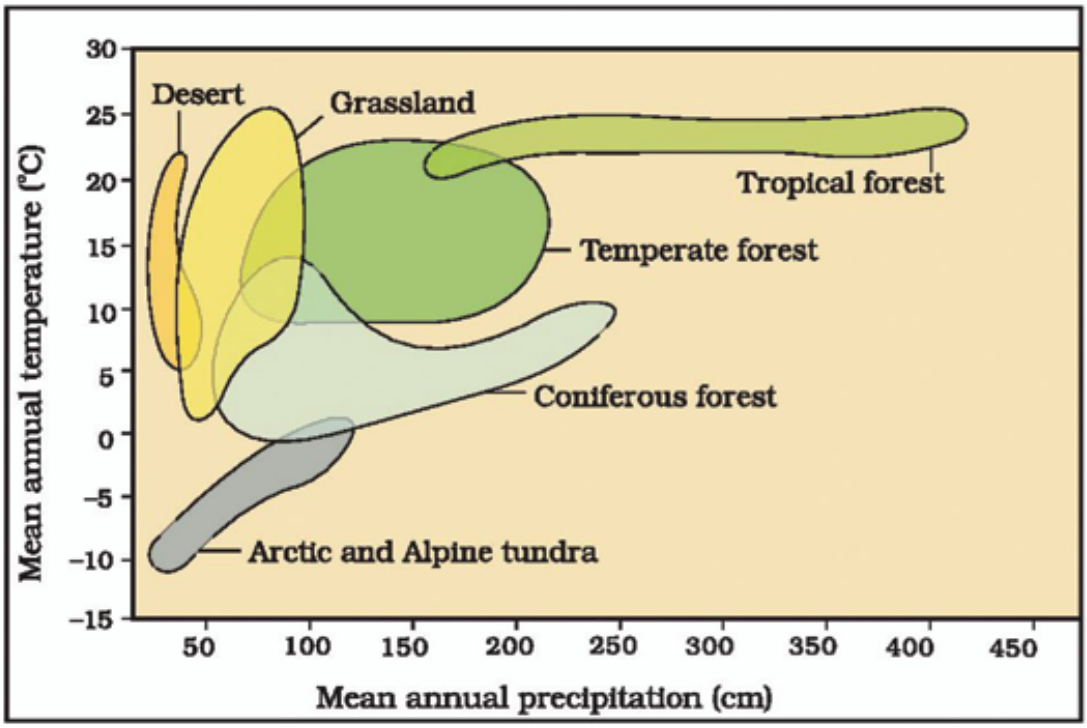
While it is doubtful if any new species are being added (through speciation) into the earth's treasury of species, there is no doubt about their continuing losses. The biological wealth of our planet has been deelining rapidly and the accusing finger is clearly pointing to human activities. The colonisation of tropical Pacific Islands by humans is said to have led to the extinction of more than 2,000 species of native birds. The UICN Red List (2004) documents the extinction of 784 species (including 338 vertebrates, 359 invertebrates and 87 plants) in the last 500 years. Some examples of recent extinctions include the dodo (Mauritius), quagga (Africa), thylacine (Australia), Steller's Sea Cow (Russia) and three subspecies (Bali, Javan, Caspian) of tiger. The last twenty years alone have witnessed the disappearance of 27 species. Careful analysis of records shows that extinctions across taxa are not random: some groups like amphibians appear to be more vulnerable to extinction. Adding to the grim scenario of extinctions is the fact that more than 15,500 species world-wide are facing the threat of extinction. Presently, 12 per cent of all bird species, 23 per cent of all mammal species, 32 per cent of all amphibian species and 31 per cent of all gymnosperm species in the world face the threat of extinction.

From a study of the history of life on earth through fossil records, we learn that large-scale loss of species like the one we are currently witnessing have also happened earlier, even before humans appeared on the scene. During the long period (>3 billion years) since the origin and diversification of life on earth there were five episodes of mass extinction of species. How is the 'Sixth Extinction' presently in progress different from the previous episodes? The difference is in the rates; the current species extinction rates are estimated to be 100 to 1,000 times faster than in the pre-human times and our activities are responsible for the faster rates. Ecologists warn that if the present trends continue, nearly half of all the species on earth might be wiped out within the next 100 years.

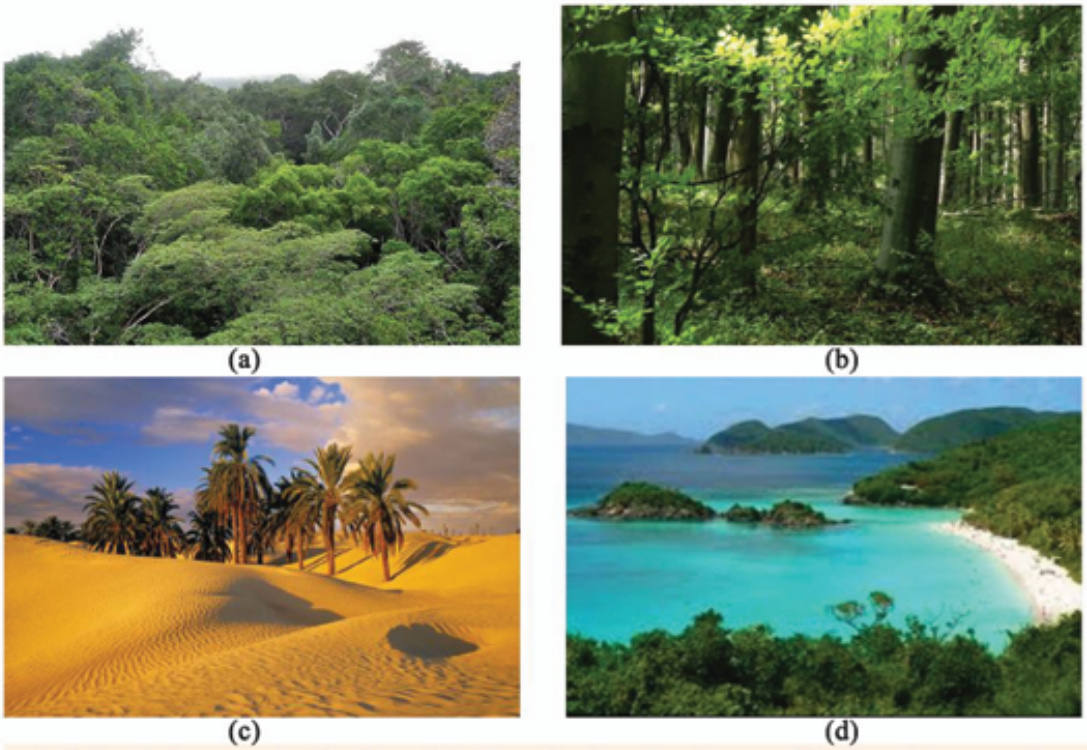
In general, loss of biodiversity in a region may lead to (a) decline in plant production, (b) lowered resistance to environmental perturbations such as drought and (c) increased variability in certain ecosystem processes such as plant productivity, water use, and pest and disease cycles.

3. In the Page No. 191 in 7.8 the following lines are added, if the head of cockroach is cut off, it will still live as long as 1 week as most part of the nervous system is present in the thorax and abdomen of the body ventrally (Belly).

4. In the Page No. 208 the following figures are added after Biomes.



Biome distribution with respect to annual temperature and precipitation

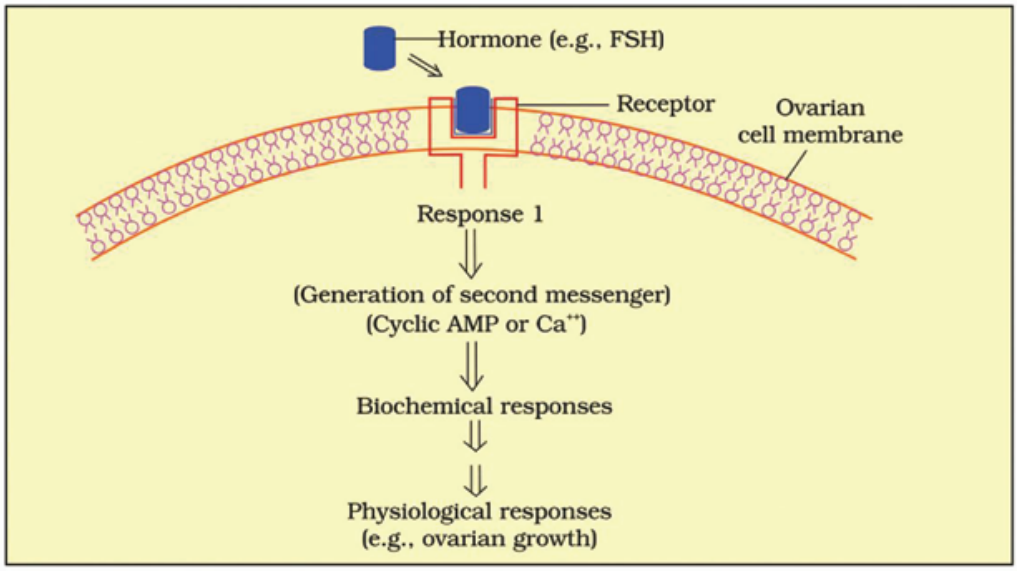


Major Biomes in India- (a) Tropical rain forest (b) Deciduous forest (c) Desert (D) Sea coast

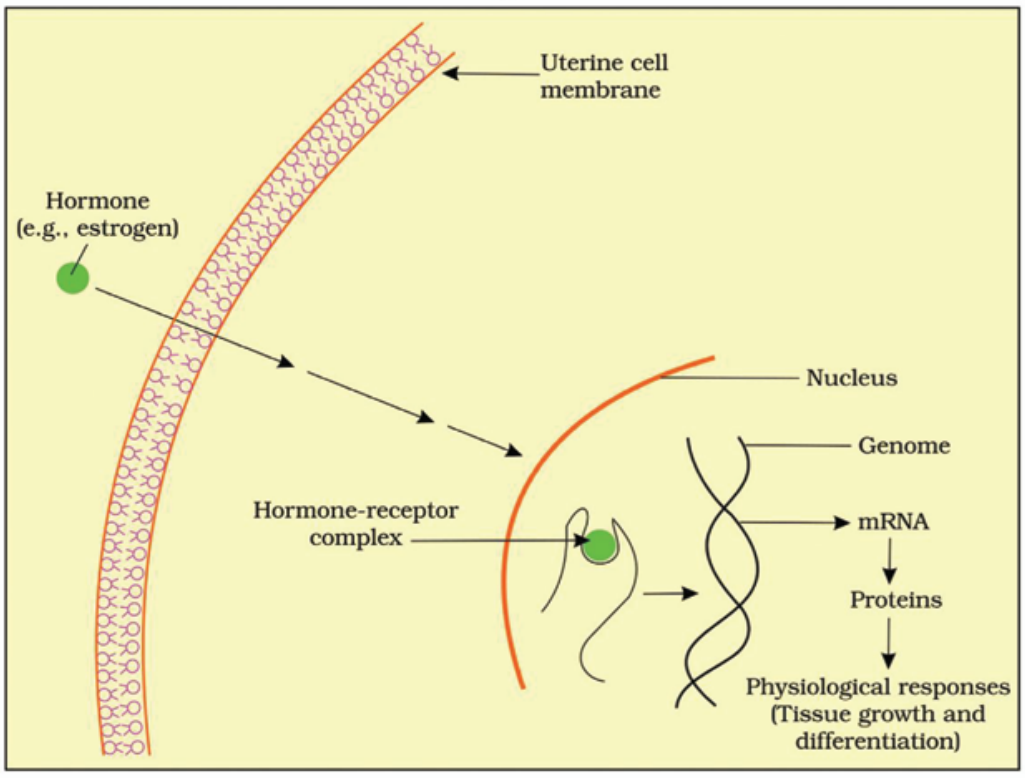
Zoology - II

Appendix

1. In the Page NO. 135 Fig 4.8 is replace by the following figure.



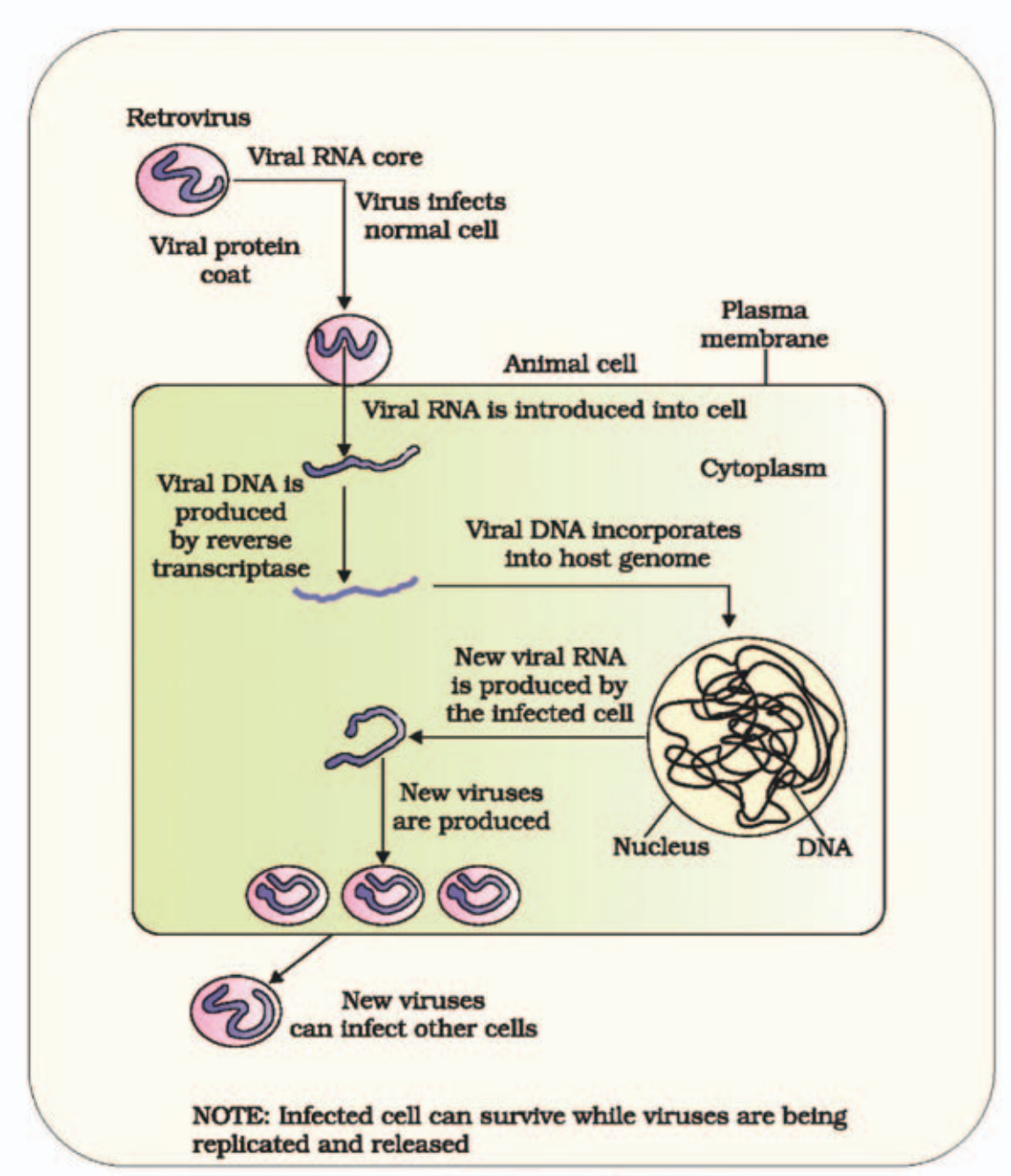
(a)



(b)

Diagramatic representation of the mechanism of hormone action :
(a) Protein hormone (b) Steroid hormone

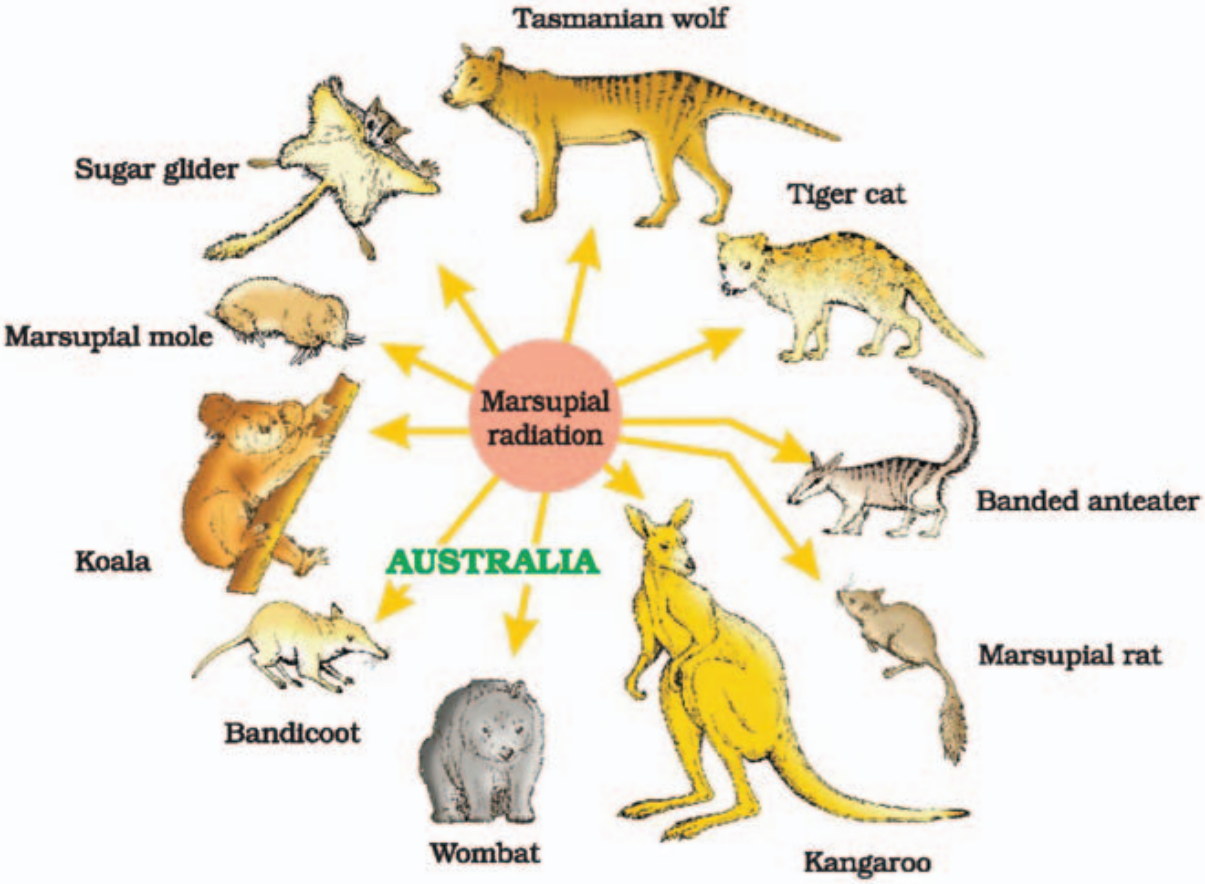
2. In the page No. 136 the term Grave's disease is added besides Exopthalmic Goitre within brackets.
3. In the Page No. 153 the following figure is added after last paragraph



Replication of retrovirus

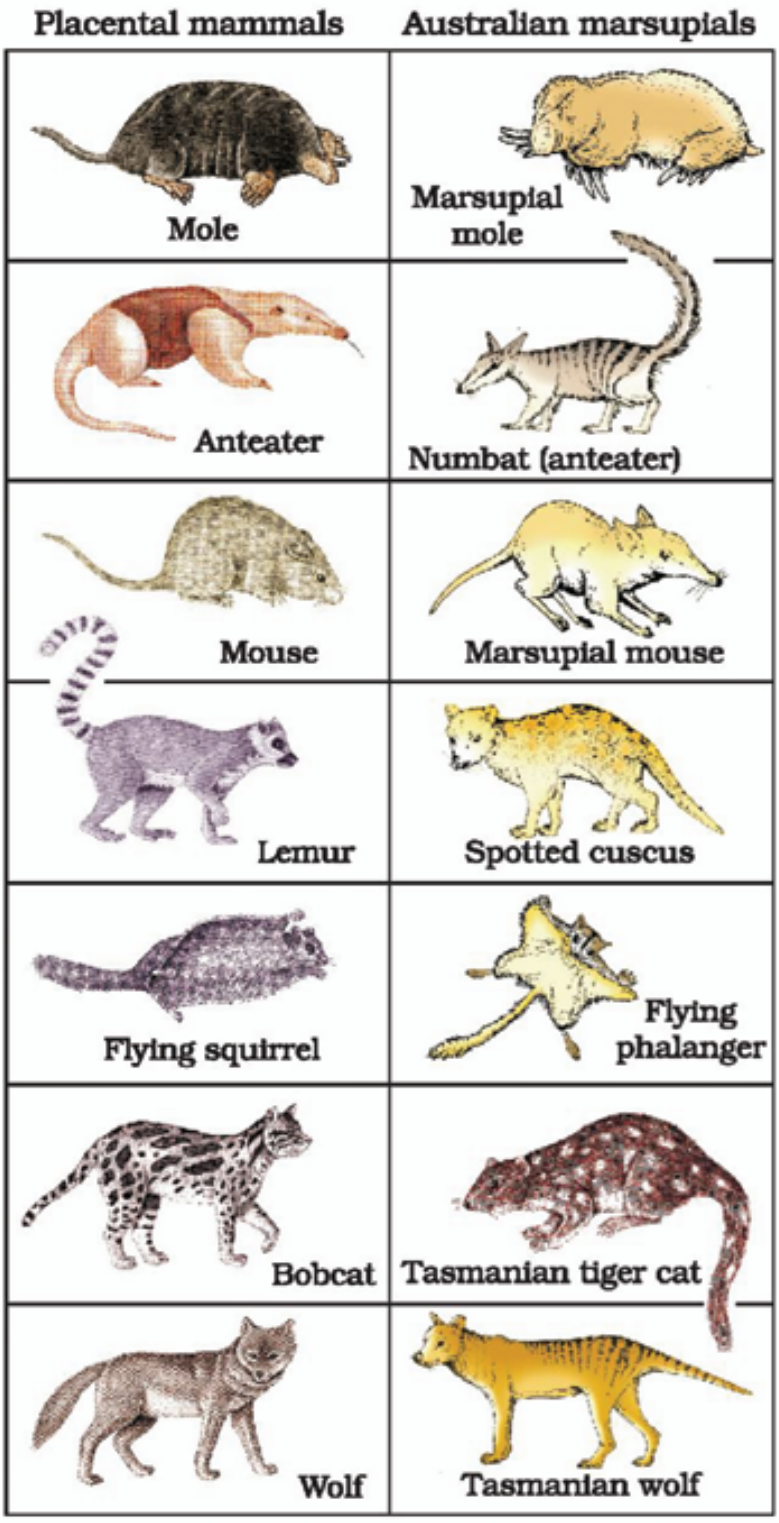
4. In the Page No. 244 the following figures are added after the first box.

Variety of beaks of finches that Darwin found in Galapagos Island



Adaptive radiation of marsupials of Australia

5. In the Page No. 244 the following figure is added after the Second box (after line number 18).



Picture showing convergent evolution of Australian Marsupials and placental mammals

6. In the Page No. 249 the following paragraph is added after v. Natural selection

Man has bred selected plants and animals for agriculture, horticulture, sport or security. Man has domestricated many wild animals and crops. This intensive breeding programme has created breeds that differe from other breeds (e.g., dogs) but still are of the same group. It is argued that if within hundreds of years, man could create new breeds, could not nature have done the same over millions of years.

7. In the Page No. 250 the following paragraph is added after the last paragraph

Similarly, excess use of herbicides, pesticides, etc., has only resulted in selection of resistant varicties in a much lesser time scale. This is also true for microbes against which we employ antibiotics or drugs aganist eukaryotic organisms/ cell. Hence, resistant organisms/ cells are appearing in a time scale of moths or years and not centureis. These are examples of evolution by anthropogenic action. This also tells us that evolution is not a directed process in the sense of determinism. It is a stochastic process based on chance events in nature in nature and chance mutation in the organisms.

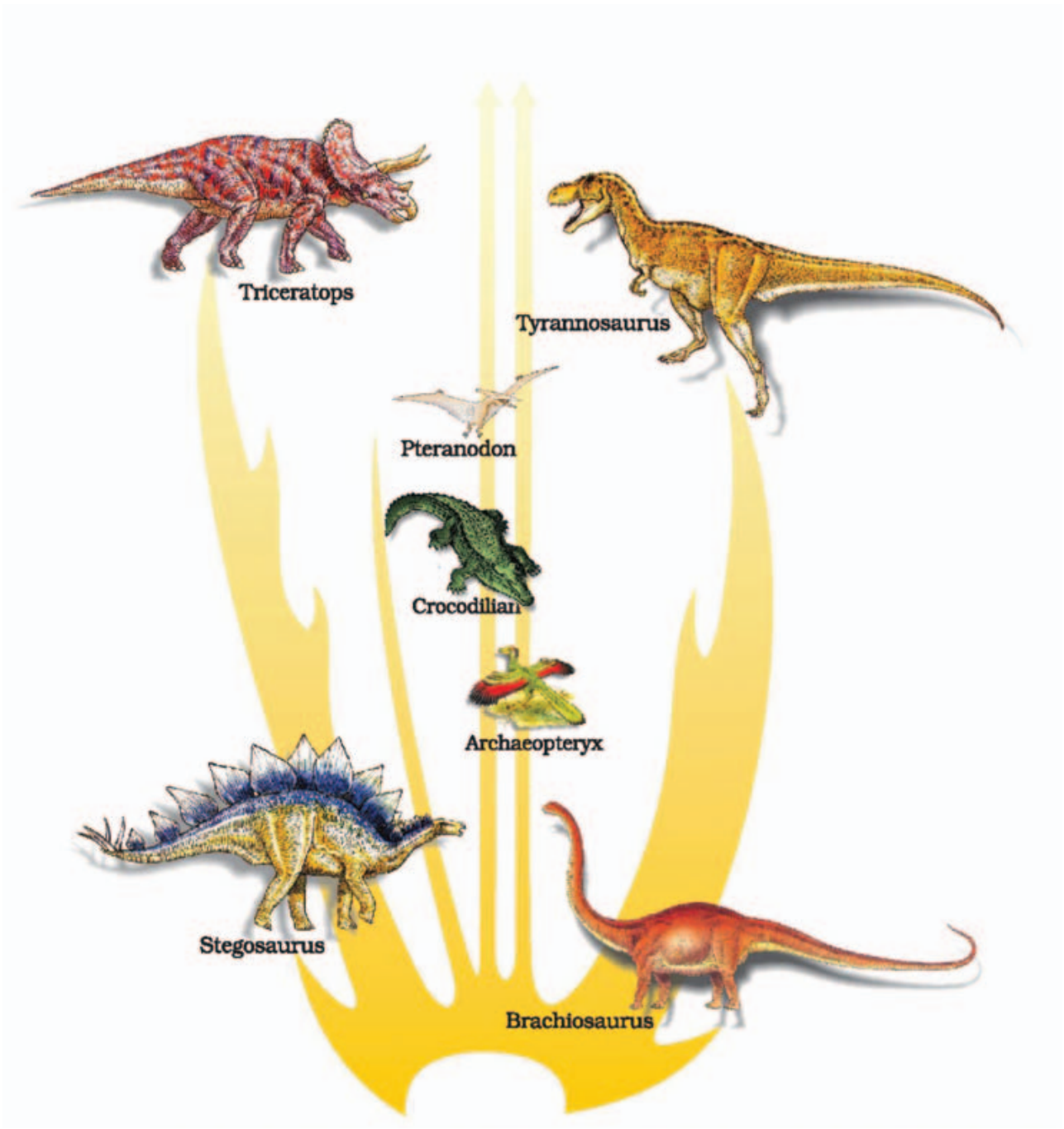
8. In the Page No. 252 the following paragraph is added

Biological Evolution

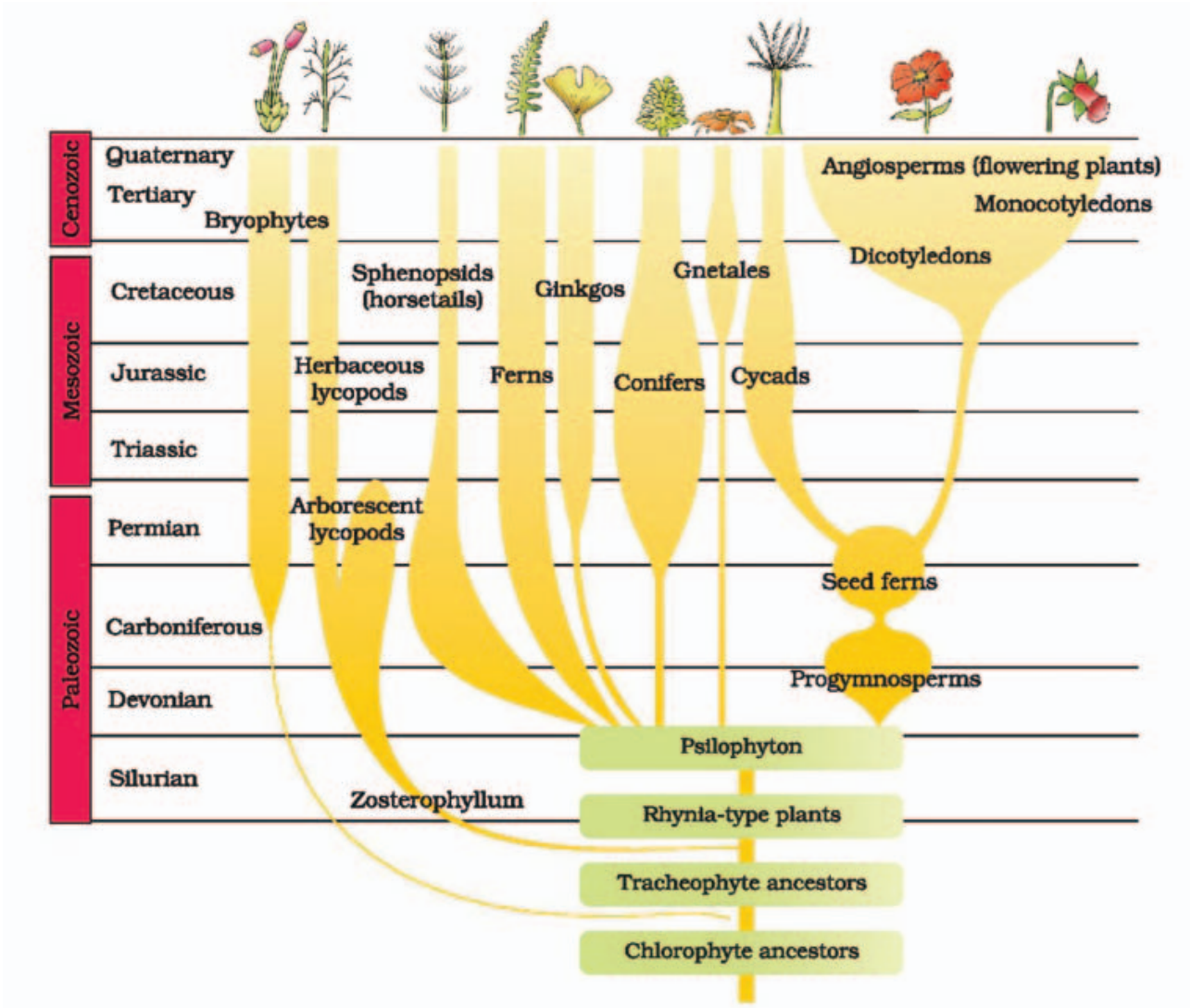
Evolution by natural selection, in a true sense would have started when cellular forms of life with differences in metabolic capability originated on earth.

The essence of Darwinian theory about evolution is natural selection. The rate of appearance of new forms is linked to the life cycle or the life span. Microbes that divide fast have the ability to multiply and become millions of individuals within hours. A colony of bacteria (say A) growing of a given medium has built in variation in terms of ability to utilise a feed component. A change in the medium composition would bring out only that part of the population (say B) that can survive under the new conditions. In due course of time this vartant population outgrows the others and appears as new species. This would happen within days. For the same thing to happen in a fish or fowl would take million of years as life spans of these animals are in years. Here we say that fitness of B is better than that of A under the new conditions. Nature selects for fitness. One must remember that the so called fitness is based on characteristics which are inherited. Hence, there must be a genetic basis for getting selected and to evolve. Another way of saying the same thing is that some organisms are better adapted to survive in an otherwise hostile environment. Adaptive ability is inherited. It has a genetic basis. Fitness is the end result of the ability to adapt and get selected by nature.

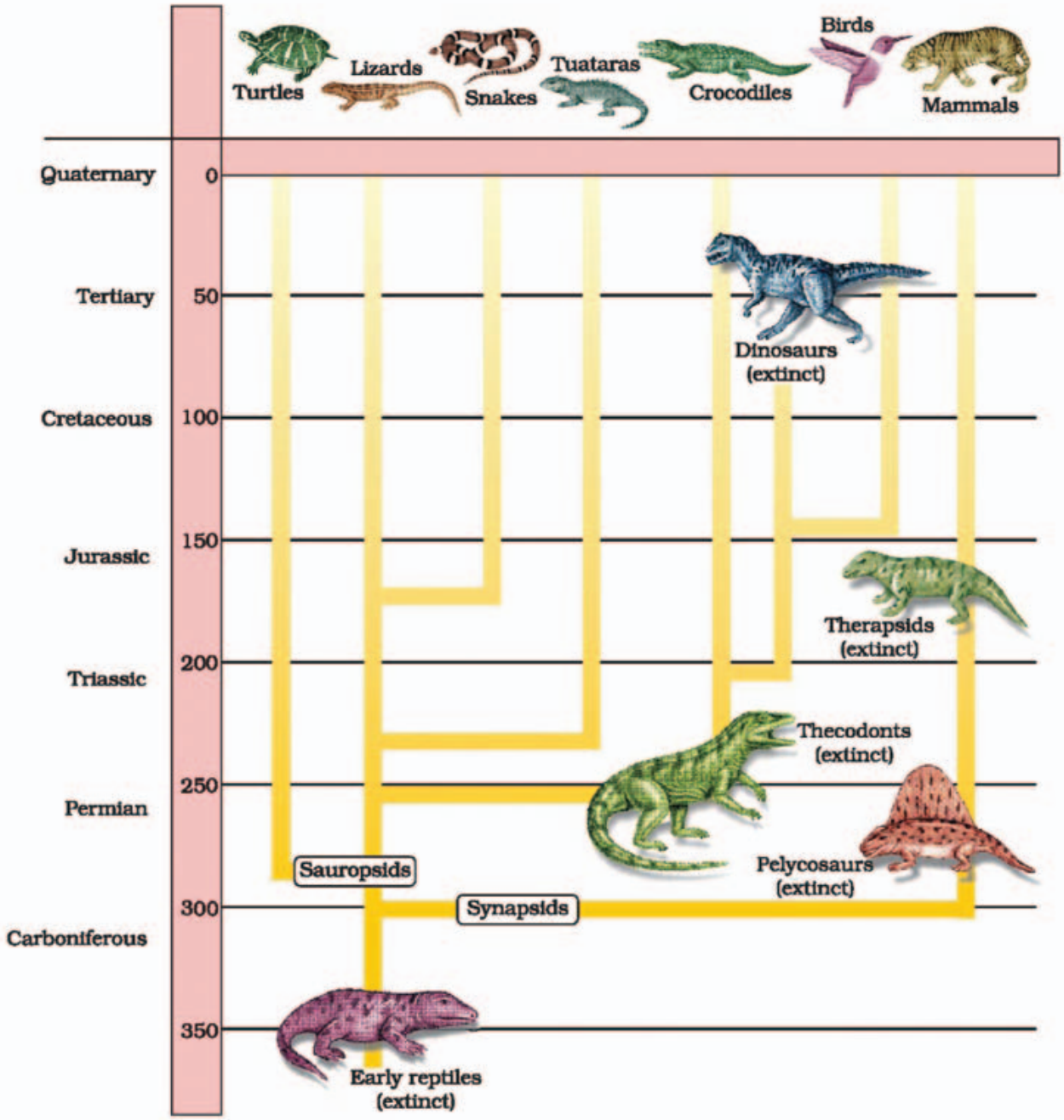
9. In the Page No. 258 after 7.7, the first paragraph the following figures are added along with the following paragraph is also added.



A family tree of dinosaurs and their living modern day counterpart organisms like crocodiles and birds.



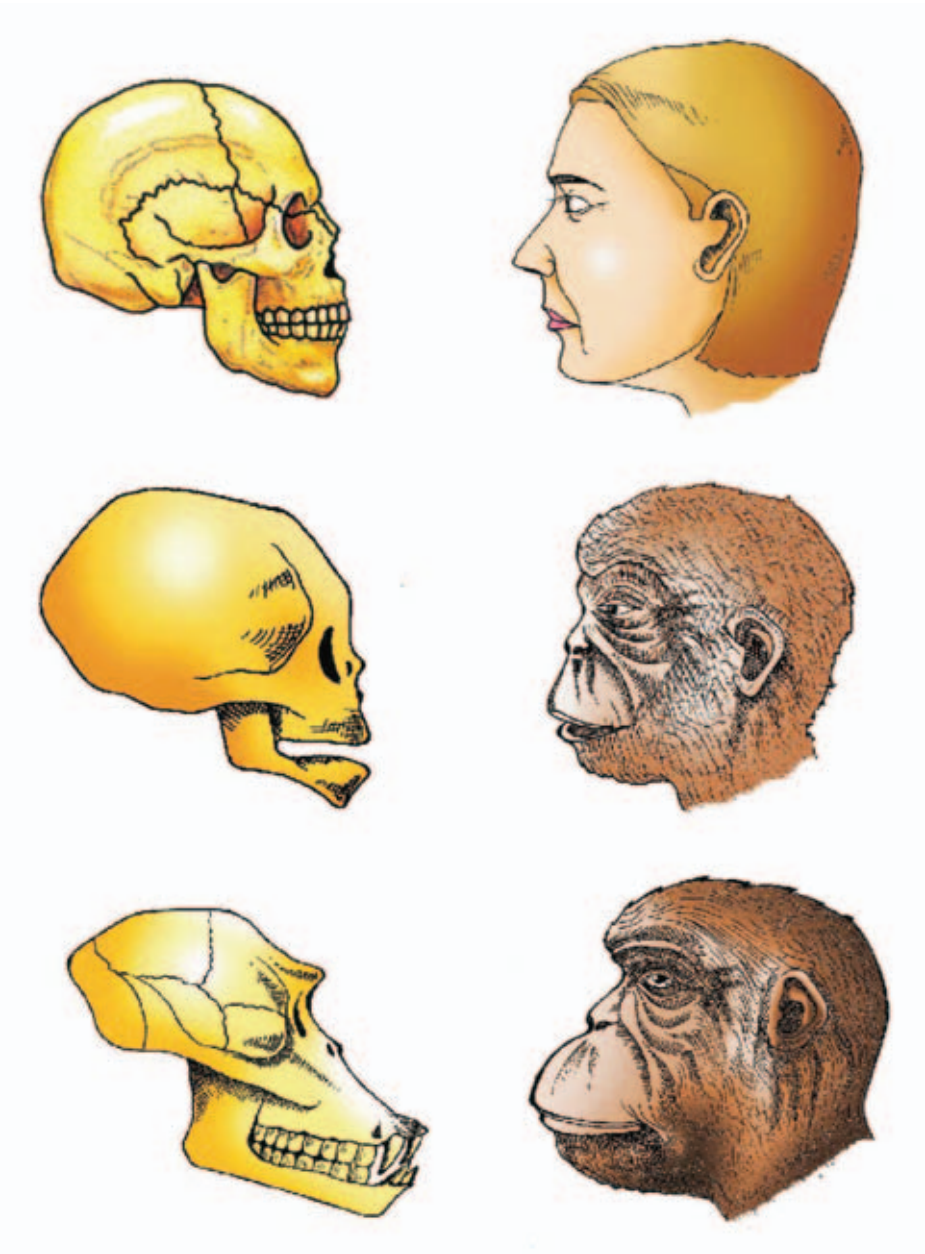
A sketch of the evolution of plant forms through geological periods



Representative evolutionary history of vertebrates through geological periods

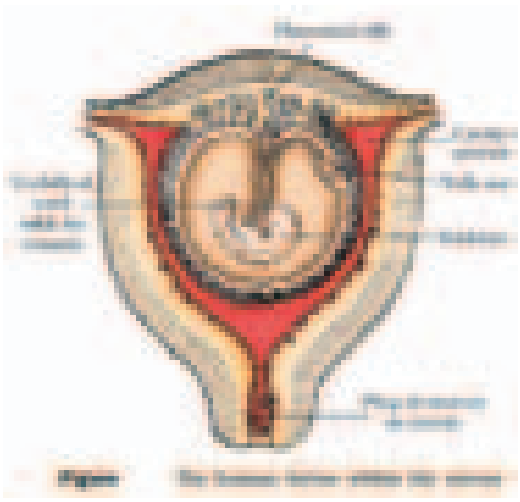
The first mammals were like shrews. Their fossils are small sized. Mammals were viviparous and protected their unborn young inside the mother's body. Mammals were more inteliggent in sensing and avoiding danger at least. When reptiles came down mammals took over this earth. There were in South America mammals resembling horse, hippopotamus, bear, rabbit etc. Due to continential driff, when South America joined North America, these animals were overridden by North American fanna. Due to the same continental drift pouched mammals of Australia survived because of lack of competition from any other mammal.

10. In the Page No. 259 the following figure is added after the last paragraph



A comparison of the skulls of adult modern human being chimpanzee and adult chimpanzee. The skull of baby chimpanzee is more like adult human skull than adult chimpanzee skull.

3.6 Pregnancy and Embryonic Development



After implantation, finger-like projections appear on the trophoblast called chorionic villi which are surrounded by the uterine tissue and maternal blood. The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between developing embryo (foetus) and maternal body called placenta (Figure 3.12).

The placenta facilitate the supply of oxygen and nutrients to the embryo and also removal of carbon dioxide and excretory/waste materials produced by the embryo. The placenta is connected to the embryo through an umbilical cord which helps in the transport of substances to and from the embryo. Placenta also acts as an endocrine tissue and produces several hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogens, progestogens, etc. In the later phase of pregnancy, a hormone called relaxin is also secreted by the ovary. Let us remember that hCG, hPL and relaxin are produced in women only during pregnancy. In addition, during pregnancythe levels of other hormones like estrogens, progestogens, cortisol, prolactin, thyroxine, etc., are increased severalfolds in the maternal blood. Increased production of these hormones is essential for supporting the fetal growth, metabolic changes in the mother and maintenance of pregnancy.

Immediately after implantation, the inner cell mass (embryo) differentiates into an outer layer called ectoderm and an inner layer called endoderm. A mesoderm soon appears between the ectoderm and the endoderm. These three layers give rise to all tissues (organs) in adults. It needs to be mentioned here that the inner cell mass contains certain cells called stem cells which have the potency to give rise to all the tissues and organs. What are the major features of embryonic development at various months of pregnancy? The human pregnancy lasts 9 months. Do you know many months pregnancy last in dogs, elephants, cats? Find out. In human beings, after one month of pregnancy, the embryo's heart is formed. The first sign of growing foetus may be noticed by listening to the heart sound carefully through the stethoscope. By the end of the second month of pregnancy, the foetus develops limbs and digits. By the end of 12 weeks (first trimester), most of the major organ systems are formed, for example, the limbs and external genital organs are well-developed. The first movements of the foetus and appearance of hair on the head are usually observed during the fifth month. By the end of 24 weeks (second trimester), the body is covered with fine hair, eye-lids separate, and eyelashes are formed. By the end of nine months of pregnancy, the foetus is fully developed and is ready for delivery.

3.7 PARTURITION AND LACTATION

The average duration of human pregnancy is about 9 months which is called the gestation period. Vigorous contraction of the uterus at the end of pregnancy causes expulsion/delivery of the foetus. This process of delivery of the foetus (childbirth) is called parturition. Parturition is induced by a complex neuroendocrine mechanism. The signals for parturition originate from the fully developed fetus and the placenta which induce mild uterine contractions called foetal ejection reflex. This triggers release of oxytocin from the maternal pituitary. Oxytocin acts on the uterine muscle and causes stronger uterine contractions, which in turn stimulates further secretion of oxytocin. The stimulatory reflex between the uterine contraction and oxytocin secretion continues resulting in stronger and stronger contractions. This leads to expulsion of the baby out of the uterus through the birth canal – parturition. Soon after the infant is delivered, the placenta is also expelled out of the uterus. What do you think the doctors inject to induce delivery? The mammary glands of the female undergo differentiation during pregnancy and starts producing milk towards the end of pregnancy by the process called lactation. This helps the mother in feeding the newborn. The milk produced during the initial few days of lactation is called colostrum which contains several antibodies absolutely essential to develop resistance for the new-born babies. Breast-feeding during the initial period of infant growth is recommended by doctors for bringing up a healthy baby.

5.5 MUTATION

Mutation is a phenomenon which results in alteration of DNA sequences and consequently results in changes in the genotype and the phenotype of an organism. In addition to recombination, mutation is another phenomenon that leads to variation in DNA. As you will learn in Chapter 6, one DNA helix runs continuously from one end to the other in each chromatid, in a highly supercoiled form. Therefore loss (deletions) or gain (insertion/duplication) of a segment of DNA, result in alteration in chromosomes. Since genes are known to be located on chromosomes, alteration in chromosomes results in abnormalities or aberrations. Chromosomal aberrations are commonly observed in cancer cells.In addition to the above, mutation also arise due to change in a single base pair of DNA. This is known as point mutation. A classical example of such a mutation is sickle cell anemia. Deletions and insertions of base pairs of DNA, causes frame-shift mutations (see Chapter 6). The mechanism of mutation is beyond the scope of this discussion, at this level. However, there are many chemical and physical factors that induce mutations. These are referred to as mutagens. UV radiations can cause mutations in organisms – it is a mutagen.

5.6 GENETIC DISORDERS

5.6.1 Pedigree Analysis

The idea that disorders are inherited has been prevailing in the human society since long. This was based on the heritability of certain characteristic features in families. After the rediscovery of Mendel's work the practice of analysing inheritance pattern of traits in human beings began. Since it is evident that control crosses that can be performed in pea plant or some other organisms,

are not possible in case of human beings, study of the family history about inheritance of a particular trait provides an alternative. Such an analysis of traits in a several of generations of a family is called the pedigree analysis. In the pedigree analysis the inheritance of a particular trait is represented in the family tree over generations. In human genetics, pedigree study provides a strong tool, which isutilised to trace the inheritance of a specific trait, abnormality or disease. Some of the important standard symbols used in the pedigree analysis have been shown .

Botany

As per the instructions of BIE, Hyd – The NEET question bank preparation committee – Botany – met at o/o BIE, Hyd on 27/06/2016 and compatibility of curriculum in between NCERT and BIE text books had been checked, the following additions were suggested to be included in BIE syllabus to prepare question bank for NEET.

Additions to BIE I year text book from NCERT class XI

1. Chapter – 2, Page no. 25: 2.6 second para to page no 26 complete

26 Viruses, Viroids and Lichens

All of us who has suffered the ill effects of common cold or 'flu' know what effects viruses can have on us, even if we do not associate it with our condition. Viruses did not find a place in classification since they are not truly 'living', if we understand living as those organisms that have a cell structure. The viruses are non-cellular organisms that are characterized by having an inert crystalline structure outside the living cell. Once they infect a cell they take over the machinery of the host cell to replicate themselves, killing the host. Would you call viruses living or non-living?

The name virus that means or poisonous fluid as given by Pasteur. D.J. Ivanowsky (1892) recognized certain microbes as causal organism of the mosaic disease of tobacco (Figure 2.6a). These were found to be smaller than bacteria because they passed through bacteria –proof filters. M.W. Beijerinck (1898) demonstrated that the extract of the infected plants of tobacco could cause infection in healthy plants and called the fluid as *Contagium vivum fluidum* (infectious living fluid). W.M. Stanley (1935) showed that viruses could be crystallised and crystals consist largely of proteins. They are inert outside their specific host cell. Viruses are obligate parasites.

In addition to proteins, viruses also contain genetic material, that could be either RNA or DNA. No virus contains both RNA and DNA. A virus is a nucleoprotein and the genetic material is infectious. In general, viruses that infect plants have single stranded RNA and viruses that infect animals have either single or double stranded RNA or double stranded DNA. Bacterial viruses or bacteriophages (viruses that infect the bacteria) are usually double stranded DNA viruses (Figure 2.6b). The protein coat called capsid made of small subunits called capsomeres, protects the nucleic acid. These capsomeres are arranged in helical or polyhedral geometric forms. Viruses cause diseases like mumps, small pox, herpes and influenza. AIDS in humans is also caused by a virus. In plants, the symptoms

can be mosaic formation, leaf rolling and curling, yellowing and vein clearing, dwarfing and stunted growth.

2. Chapter – 4, Page no.41: before 4.1 algae in BIE book addition form NCERT book, page. 29 last paragraph and page No. 30 first paragraph has to be included:

Let us also look at classification within angiosperms to understand some of the concerns that influenced the classification systems. The earliest system of classification used only gross superficial morphological characters such as habit, colour, number and shape of leaves, etc. They were based mainly on vegetative characters or on the adroecium structure (system given by Linnaeus). Such systems were artificial; they separated the closely related species since they were based on a few characteristics. Also, the artificial systems gave equal weightage to vegetative and sexual characteristics, this is not acceptable since we know that often the vegetative characters are more easily affected by environment. As against this, natural classification systems developed, which were based on natural affinities among the organisms and consider, not only the external features, but also internal features, like ultrastructure, anatomy, embryology and phytochemistry. Such a classification for flowering plants was given by George Bentham and Joseph Dalton Hooker.

At present **phylogenetic classification systems** based on evolutionary relationships between the various organisms are acceptable. This assumes that organisms belonging to the same taxa have a common ancestor. We now use information from many other sources too to help resolve difficulties in classification. These become more important when there is on supporting fossil evidence. **Numerical Taxonomy** which is now easily carried out using computers is based on all observable characteristics. Number and codes are assigned to all the characters and the data are then processed. In this way each character is given equal importance and at the same time hundreds of characters can be considered. **Cytotoxonomy** that is based on cytological information like chromosome number, structure, behavior and chemotoxonomy that uses the chemical constituents of the plant to resolve confustions, are also used by taxonomists these days.

3. Chapter – 4, Page no. 54 in the continuation of paragraph 2 in BIE book addition form NCERT book class XI supplementary material Unit I: Chapter 3 has to be included.

Classification of angiosperms up to class and then characteristics feature

The dicotyledons are chateacterised by seeds having two cotyledons, reticulate venation in leaves and tetramerous and pentamerous flowers, i.e., having four or five members in each whorls. The monocotyledons on the other hand are charectirized by single

cotyledanous seeds, parallel venation in leaves, and trimerous flowers having three numbers in each whorl.

Additions to II year BIE text book from NCERT class XII

1. Chapter – 4, Photosynthesis Page no. 57, n first paragraph after 4th line NCERT class XI supplementary material page No. 343 UNIT IV has to be included:

Phytosynthesis as a means of autotrophic nutrition

The green plants make or rather synthesize the food they need through photosynthesis and are therefore called autotrophs. You have already learnt that the autotrophic nutrition is found only in plants and all other organisms depend on the green plants for food are heterotrophs.

2. Chapter – 6, Seed Dormancy, after 6.5 in the Page no. 119, NCERT Class XI supplementary material page No. 344 UNIT IV Chapter 15 has to be included:

There are certain seeds which fail to germinate even when external conditions are favourable. Such seeds are understood to be undergoing a period of dormancy which is controlled not by external environment but are under endogenous control or conditions within the seed itself. Impermeable and hard seed coat; presence of chemical inhibitors such as abseisic seids, phenolic acids, para ascorbic acids; and immature embryos are some of the reasons which causes seed dormancy. This dormancy however can be overcome through natural means and various other man made measures. For example the seed coat barrier in some seeds can be broken by mechanical abrasions using knives, sand paper etc., or vigorous shaking. In nature those abrasions are caused by microbial action and passage through digestive tract of animals. Effect of inhibitory substances can be removed by subjecting the seeds to chilling condition or by application of certain chemicals like gibbirellie acid and nitrates. Changing the environmental conditions, such as light and temperature are other methods to overcome seed dormancy.

Chemistry-I

12.19 Sterochemistry: Introduction of isomerism, Recapitulation of Geometrical Isomerism and Conformation.

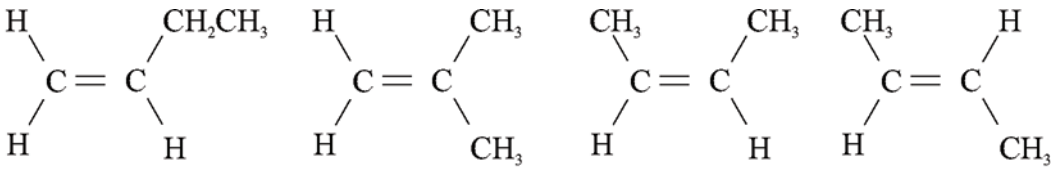
12.19.1 Introduction of isomerism

Sterioisomers are of two types known as configurational isomers and conformational isomers. Configurational sterioisomers differe from conformations in that the first type of isomers possess certain types of rigidity in the molecules and these can be interconverted by bond breaking and reforming of covalent bonds. The second type isomers i.e., conformations are simply interconverted by rotation about 'σ' bonds. In this chapter we limit ourselves to the configurational isomers.

Configurational isomers are stereoisomers. They are classified as geometrical isomers and optical isomers.

12.19.2 Recapitulation of Geometrical Isomerism and Conformation

A two carbon alkene is only ethene and its molecular formula is C_3H_3, C_3H_6 a three carbon alkene is propene. However C_4H_g stands for four carbon alkenes as shown below.



1- Butene *2- Methyl Propene* *Cis-2-Butene* *Trans-2-Butene*

I II III IV

I & III differe in the position of double bond and they are position isomers. I and II differe in the carbon chain length and they are chain isomers. The position and chain isomers differe in the constitution or structure i.e., their atoms are bonded in different order. Therefore, they are called structural isomers. On the other hand III and IV have their atoms bonded in the same order (same constitution or structure). Both of them have an unbranched carbon chain with a double bond between C–2 and C–3. They differ from each other in that one isomer has both of its methyl groups on the same side of the double bond and it is called *cis -isomer* while while the methyl groups in the other are on opposite sides of the double bond and it is called the trans-isomer.

Isomers which have the same constitution but differ in the arrangement of their atoms or groups in space are sterioisomers. Cis - 2 - Butene and trans-2-Butene are therefore sterioisomers. The prefixes 'cis' and 'trans' are from the Latin in which cis means 'on this side' and trans means 'across'.

Sterioisomers of the cis-trans type are also called geometrical isomers and the phenomenon is called geometrical isomerism or cis-trans isomerism. This is because of the fixed geometry around "C–C". Cis-trans sterioisomerism is not possible in alkenes if one of the doubly bonded carbon bears two

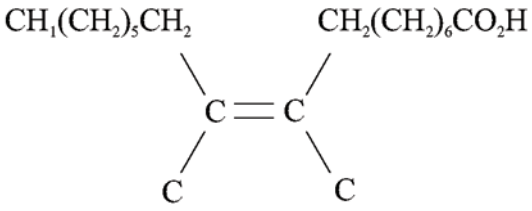
identical substituents. 1-Butene and 2–Methyl propene are not capable of possessing stereoisomers. It is not possible under laboratory conditions to provide heat energy sufficient for rotation about a double bond in 2-butene as it requires the p-orbitals of C–2 and C–3 to be twisted from their stable parallel alignment in a perpendicular direction to plane of the molecule. This is to say that π bond of the double bond which must be broken at the transition state interferes with the free rotation for the interconversion of geometric isomers. The activation energy for rotation about a carbon - at the transition state interferes with the free rotation for the interconversion of geometric isomers. The activation energy for rotation about a carbon - carbon double bond is very high-on the order of 250 kJ mol^{-1}. This is the contribution of π bond to the total C – C bond energy of 605 kJ mol^{-1} in ethylene. Rotation about $C_2 – C_1$ bond in butane is very fast under these conditions. Because of the difficulty of rotation about C + C two possible arrangements of groups attached to the doubly bonded carbon atoms are possible which results in cis trans isomers.

Geometrical isomerism requires the two groups attached to the same carbon to the different. Alkenes of the type abC + Cab, abC = Ccd, abC = Cax and abC show geometrical isomerism.

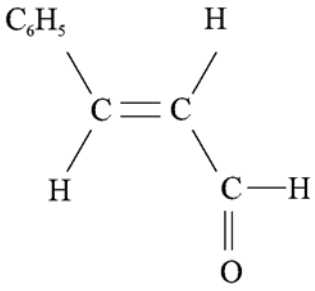
Naming of sterioisomeric alkenes by the E – Z notational system

When the substitutents on either end of the double bond are the same (H. H: Cl. Cl) or structurally similar or same (CH_3, CH_3 : C_6H_5, CHO) it is easier to describe the configuration of the molecule as cis or trans.

Example:



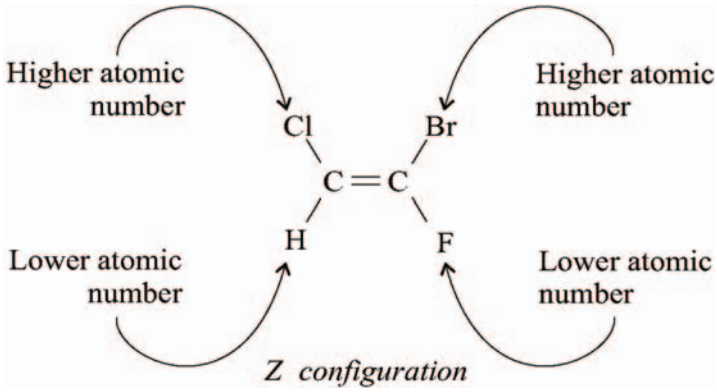
Cis-oleic acid



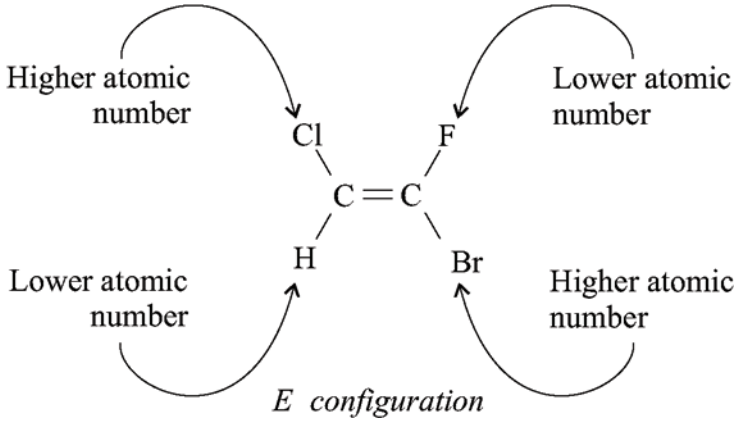
Trans-Cinnamaldehyde

However, when it is not very clear which substituent on one carbon is similar or analogous to a reference substituent on the other cis and trans are ambiguous. To avoid this confusion a completely clear system for specifying double bond stereochemistry has been introduced. This system is called E–Z system. THis is based on *atomic number ranking* method. According to this "when atoms of higher atomic number are on the same side of the double bond, the double bond is said to have 'Z' configuration. 'Z' stands for the German word "Zusammen" which means "together". When atoms of higher atomic number are on opposite sides of the double bond it is said to have "E" configuration. "E" stands for the German word "Entgegen" which means opposite.

Example 1:

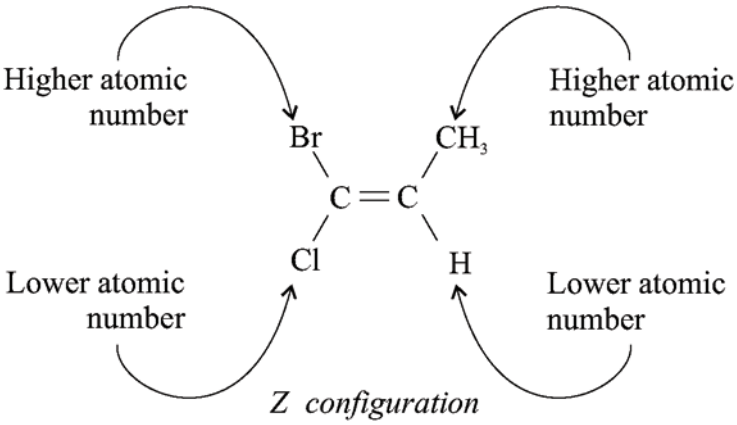


(Since, $_{17}Cl_{35}$ and $_{35}Br$ with higher atomic number are on the same side of the double bond compared to $_{1}$ & $_{9}F$ at respective carbon atoms)



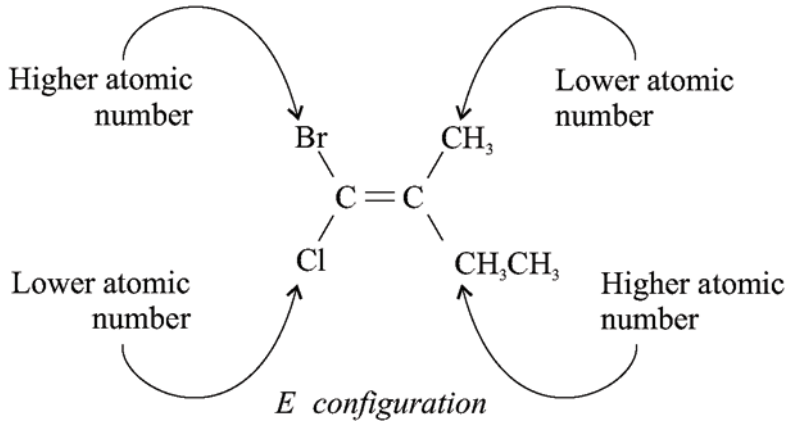
(Since higher ranked $_{17}Cl$, $_{35}Br$ are on opposite sides of the double bond)

Example 2:



(Higher atomic number takes precedence over the lower. $_{35}Br$ out ranks $_{17}Cl$ and $_{6}C$ of methyl out ranks $_{1}H$. Higher ranked $_{35}Br$ and $_{6}C$ of CH_3 are on same side)

Example 3:



E configuration

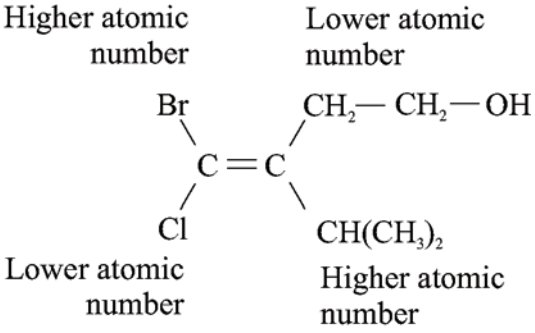
(when two atoms directly attached to the double bonded 'C' are same, compare the atoms attached to these atoms on the basis of atomic number and precedence is to be determined at the first point of difference).

Ethyl [C(C, H H)] out ranks Methyl [C(H, H, H)]

Similarly $C(CH_3)_3$ > $CH(CH_3)_2$ > CH_2CH_3

C(C, C, C) > C(C, C, H) > C (C, H, H)

Example 4:

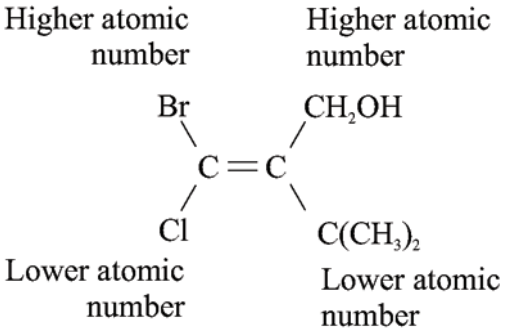


E configuration

(work outward from the point of attachment, comparing all the atoms attached to particular atom before proceeding further along the chain).

$-CH(CH_3)_2$ [–C(C, C, H)] out ranks – CH_2 – CH_2OH [–C (C, H, H)]

Example 5:

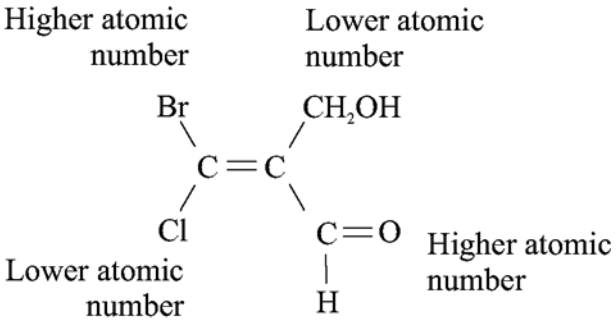


Z configuration

(while working outward from the point of attachement evaluate substituent atoms one by one but not as a group).

$-CH_2OH$ [C(O, H, H)] out ranks – C $(CH_3)_3$ [–C, (C, C, C)]

Example 6:



E configuration

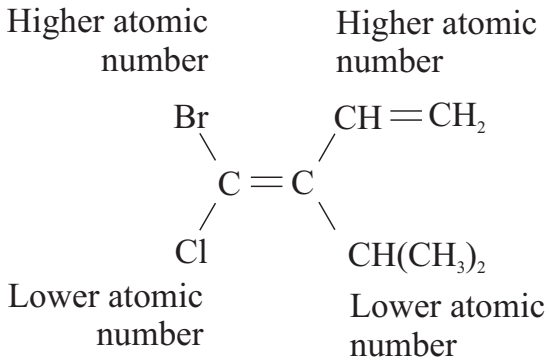
(an atom which is multiply bonded to another atom is considered to be replicated as a substituent on that atom)

– C = O [–C(O, O, H) out ranks – CH_2OH [–C(O, H, H)]

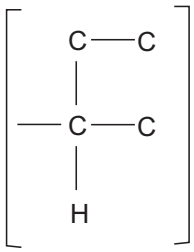
|

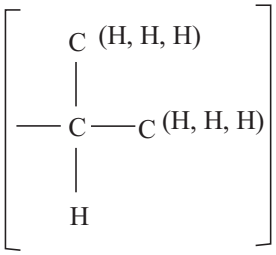
H

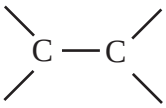
Example 7:



'Z' configuration

vinyl (–CH=CH_2) is treated as  and it out ranks

isopropyl –$CH(CH_3)_2$ 

Note : You will learn at higher classes that geometrical isomerism is possible even in molecules which donot possess a 

12.20 Optical activity - discovery, determination using a Polarimeter, Specific rotation, Chiralty: Chiral objects, Chiral molecules.

12.20.1 Plane polarised light and optical activity

Ordinary light, an electromagnetic wave has its photons vibrating in all the directions perpendicular to the path of its propagation. If this light is passed through a Nicol prism, a prism made from Calcite, a special crystaline formed calcium carbonate, the transmitted light photons possess vibrations only in one perpendicular direction to the path of propagation, Nicol prism polarises the light i.e., it permits the passage of only those components of light that have the same plan of polarisation. This type of light which has its photons virating in only one perpendicular direction to the path of propagation is called

plane polarised light. Now, if the plane polarised light is passed through a polarimeter tube containing optically active compound, its plane of polarisation is rotated. If one isomer rotates plane of polarised light in clockwise direction i.e., to the right it is said to be dextrorotatory (Greek dexmo = right) ord - form and it is represented by putting positive (+) sign before the degrees of rotation. If light is rotated to anticlockwisedirection i.e., left then the isomer is called Laevo isomer (Greek laevo = left) or 1-form and a negative sign (–) is placed before the degrees of rotation. The names of the isomers carry d, l symbols before them. In modern literature d, l are replaced by (+), (–).

The extent of rotation depends on the wavelength of the light, the light, the number of optically active molecules in the path of the length beam i.e., the concentration of the sample, the length of the polarimeter tube, the nature of the solvent and the temperature.

If α_{abs} is the observed angle of rotation, a the specific rotation, then

$$[a]^{T}_{\lambda} = \frac{\alpha_{abc}}{\text{length of the tube x conc. of the solution (gm } L^{-1})}$$

T = temperature, λ = wavelength, their values to be mentioned

A chiral object is that object which possesses the property of handedness (Greek, chair means hand). A chiral object, is one that cannot be superimposable on its mirror image. It is like each one of our hand. If the objects are superimposable, then if one object is placed over the other all parts of each object must coincide with the parts of the other. If our left hand is viewed in a mirror its mirror image is exctly like our right hand but the object and its mirror image are not superimposable.

If we consider the chirality in molecules that have chiral centres, they would differ in their optical activity, if one rotates plane of polarised light in clock-wise direction the other would rotate it in anti clock wise directiohn. If one chiral molecule is a most effective drug its mirror image molecule si generally least effective and may result in side effects. Because of the importance of things like this, the study of chirality among chemical molecules is very important. For example, all but one of the 20 amino acids that make up naturally occurring proteins are chiral and all are classified as being left handed.

12.21 Configuration and Fischer projections

Emil Fischer describhed a method to convey stereochemical information in an abbreviated form. In Fischer projection formulae the molecule is oriented in such a way that

1. The vertical bonds at the stereogenic center are directed away from the viewer and the horizontal bonds point towards him and the projection of the bonds onto a page is by a cross.
2. If the carbon chain is with more than one carbon atom, the chain is written vertically.
3. The steriogenic carbon or other carbon atoms of the chain are at the centres of crosses and are not shown through symbols but understood.

Stereoisomerism

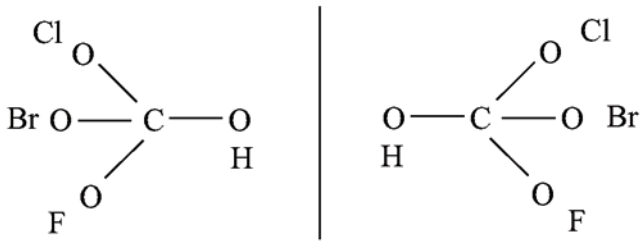
The prefix "stereo" is derived from the Greek word stereos which means 'solid and stereochemistry deals with the spatial arrangements of atoms or groups of atoms in molecules in three dimensions.

The foundations of organic stereochemistry were laid by Jacobus van't Hoff and Charles Le Bel in 1874. They independently proposed that the four bonds formed by a carbon atom direct towards the four corners of a regular tetrahedron when the carbon atom is assumed to be at the centre of the tetrahedron. Because of this tetrahedral arrangement of bonds to carbon, the given two compounds with the same structure may be different when the arrangement of their atoms in space is different. Molecules that have the same constitution but differ in the spatial called stereoisomerism.

12.23. Compound containing one chiral centre, enantiomers Optical Isomerism

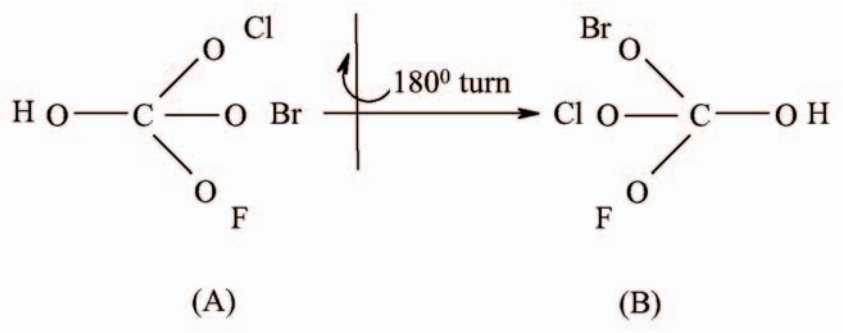
A sphere, a cube, a cone, a tetrahedron, a fork, a spoon are all identical with and can be superimposed point for point on their mirror images. There are some objects like your left and right hands which cannot be superimposed on their mirror images. In geometry, an object that is not super imposable on its mirror image is called dissymmetric object where 'dis' signifies an opposite quantity. In stereochemistry the word used for "dissymmetric" is "chiral" is derived from the Greek word "cheir" meaning "hand" in that it refers to the "handedness" of molecules. The opposite word for chiral is achiral. A molecule which is superimposable on its mirror image is achiral. According to van't Hoff an organic molecule is asymmetric (without symmetry) if one of the caron atoms has four different groups around it. All asymmetric structures are definitely dissymmetric and they can not be superimposed on their mirror images.

Example: Bromo chlorofluoromethane molecule is depicted in its two mirror image forms as in figure given below.



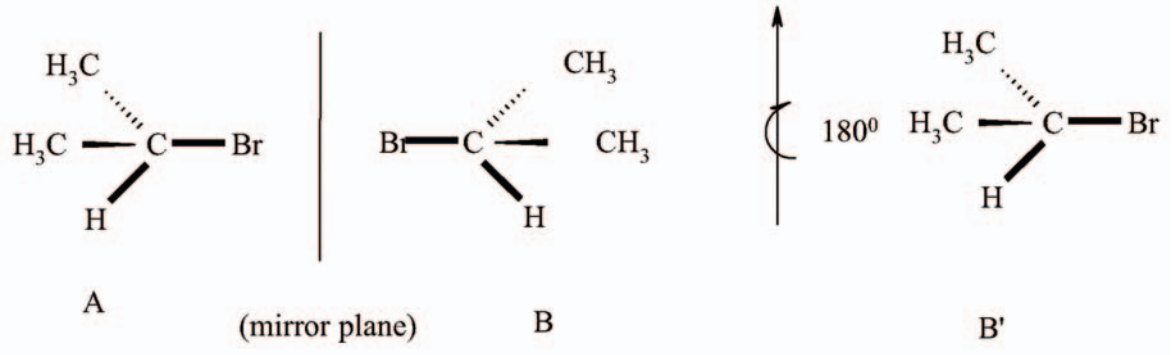
(A) (B)

Structure A and B are mirror images



To test for superimposability. Reorient 'B' by turning its 180^0.

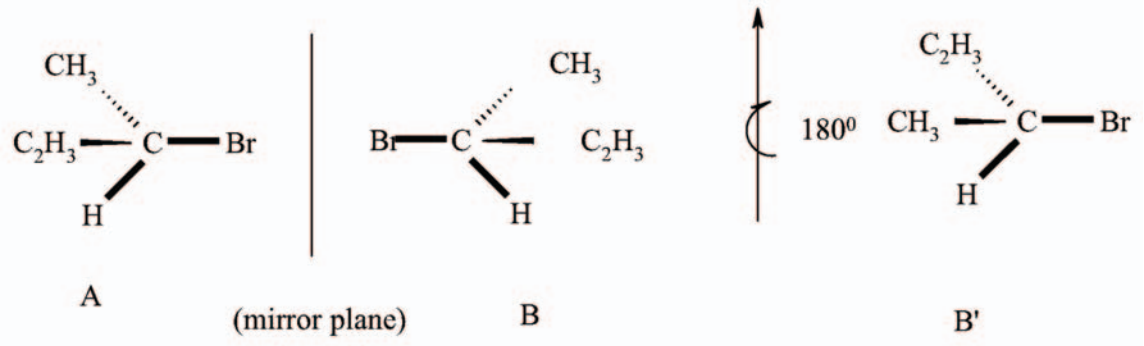
A and B cannot be superimposed on each other. Therefore bromo chlorofluoromethane is a chiral molecule. The two mirror image forms are called enantiomers of each other. The two mirror images A, B of bromochlorofluoromethane have the same atoms connected to carbon atom but the molecules differ in the arrangement of their atoms in space. Therefore they are stereoisomers. The stereoisomers that are related as an object and its non superimposable mirror image are called enantiomers.



The two mirror image forms of 2 – bromopropane are A and B as shown in the above figure. To test the superimposability B is reoriented rotating it by 180^0. It gives B'. B' and A are superimposable. Therefore, 2-bromo-propane is achiral. Two substituents at C – 2 are the same and they are CH_3, CH_3.

Take 2-bromobutane. It contains a carbon attached to four different groups or atoms H, Br, CH_3 and C_2H_5.

$$CH_3 - \underset{\displaystyle Br}{\underset{|}{CH}} - CH_2CH_2$$



The mirror image of A is B' is reoriented by rotating through 180^0 B' is obtained. If A and B' are compared, in 'A' ethyl is pointing towards the observer while in B', the ethyl is pointing away. Therefore A and B' are non – superimposable and 2 – bromobutane is a chiral molecule.

Enantiomers possess same physical properties like melting point, boiling point, refractive index, but differ in their action towards plane of polarized light.

12.24. Racemic forms, Racemization, R – S and D – L nomenclature

If two enantiomers (dextro and laevo) are present in equal concentrations, then the solution of the mixture shows zero optical activity due to external compensation. External compensation means the optical rotation of one optical isomer getting cancelled by the other optically active

Chemistry-II

Radius ratio [r_{small}/r_{large}]

The radius ration is the ratio of the smaller ion radius to that of the larger ion. i.e., p = [$r_{small}\backslash r_{large}$]. In many cases r_{small} is the cation radius and r_{large} is that of anion. The minimum radius ratio, that can give a specific coordination number and hence the shape to the compound, is 0.15. The table given below gives the radius ratio and its related shape and coordination number possible.

Table 2.1 Radius ratio, the shape of the molecule and coordination number

S. No.	Radius ratio ($r = r_{small}/ r_{large}$)	Geometric shape of the crystall formed	Coordination number of the ion
1.	Upto 0.15	Linear	2
2.	0.15 to 0.22	Trigonal planar	3
3.	0.22 to 0.41	Tetrahedral	4
4.	0.41 to 0.73	Sqare pyramidal	4
5.	0.41 to 0.73	Octahedral	6
6.	> 0.73	Cubic	8

Physics

No changes in NEET Syllabus