Sample Paper – 02 (2016-17)
Class 12 Biology

General Instructions:

(i) All questions are compulsory.

(ii) This question paper consists of four Sections A, B, C and D. Section A contains 5 questions of one mark each, Section B is of 5 questions of two marks each, Section C is of 12 questions of three marks each and 1 question of four mark and Section D is of 3 questions of five marks each.

(iii) There is no overall choice. However, an internal choice has been provided in one question of 2 marks, one question of 3 marks and all the three questions of 5 marks weightage. A student has to attempt only one of the alternatives in such questions.

(iv) Wherever necessary, the diagrams drawn should be neat and properly labelled.

Section A

1. Define isogametes
2. What is the number of chromosome in human zygote?
3. What are purines and pyrimidines?
4. What is adaptive radiation?
5. What is germplasmcollection.

Section B

6. What are
   (a) Intine
   (b) locule
7. Give an account of surgical sterilization methods in males and females.
8. What is meant by meristem culture?

   Or

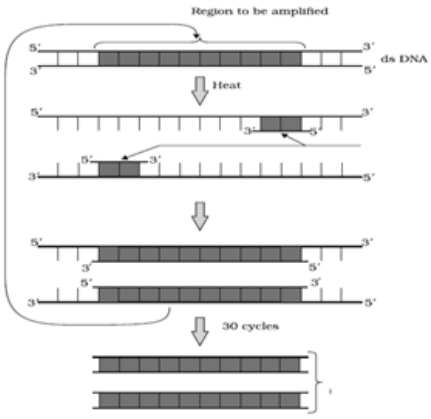
   What are histones?
9. Complete the steps for separation and isolation of DNA fragments.
   (a) DNA fragment separates in matrix of.....
   (b) DNA fragments are stained with.....
   (c) DNA fragments are viewed under.....
   (d) Fragments are extruded from gel piece. This is called.....
10. How do bio-fertilizers enrich the fertility of soil? Explain giving examples.

Section C

11. Discuss the barrier methods for contraception.
12. An individual has genotype with an extra chromosome 21.
    (a) What is this disorder called?
    (b) What will be the physical appearance?
13. Discuss the role of microbes in sewage treatment.
14. What is DNA fingerprinting? On what principle does it work? Mention its two applications.

    Or

    Explain Miller's experiment to prove the 'theory of chemical origin of life' as proposed by Oparin and Haldane.
15. Differentiate between spermatogenesis and oogenesis with a diagram.
16. Label the diagram below and explain the technology.



17. What are the advantages of genetically modified organisms?
18. How will you select for transform ants if you introduce a foreign gene at BamHI site in pBR322?
19. What are the factors that contribute to Population density?
20. What is an auto immune disorder?
21. Haploid content of human DNA is 3.3 x10 ^{9} bp and the distance between 2 consecutive bp is 0.34 x 10 $^{-9}$. What is the length of the DNA molecule?
22. Explain convergent evolution with examples.
23. Rakhi and her parents were watching a TV serial in the evening. During a commercial break, an advertisement flashed on the screen which was promoting use of sanitary napkins. Rakhi was still watching the TV. The parents got embarrassed and changed the channel. Rakhi objected to her parents' behavior and explained the need for these advertisements.
    (a) What values did the parents show?
    (b) Briefly describe the phases of a menstrual cycle.

Section D

24. (a) What may be the probable reasons for the greater biodiversity of tropics?
    (b) Explain the importance of species diversity in reference to the "rivet popper hypothesis".

Or

Give the journey of sperm formation with diagram. What are the hormones involved?

25. In a medium where E.coli was growing, lactose was added ,which induced the lac operon. Then why does the lac operon shut down after some time after the addition of lactose in the medium. Explain.

Or

Answer the following:
(a) Represent schematically the independent assortment of chromosomes.
(b) What are the requisites for a molecule to be a genetic material?

26. How do you represent the food and energy relationships between organisms?

Or

What are biogeochemical cycles? Explain the carbon cycle.

Sample Paper – 02 (2016-17)
Class 12 Biology

Answers

Section A

1. In some algae the two gametes are so similar in appearance that it is not possible to categorise them into male and female gametes. Eg: Chlamydomonas.

2. 46.
3. A nucleotide has three components – a nitrogenous base, a pentose sugar (ribose in case of RNA, and deoxyribose for DNA), and a phosphate group. There are two types of nitrogenous bases – Purines (Adenine and Guanine), and Pyrimidines (Cytosine, Uracil and Thymine).
4. The process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called **adaptive radiation**. Darwin's finches represent one of the best examples of this phenomenon.
5. The entire collection (of plants/seeds) having all the diverse alleles for all genes in a given crop is called germplasmcollection.

Section B

6. In tine: The inner wall of the pollen grain is called the **in tine.** It is a thin and continuous layer made up of cellulose and pectin.
   Locule: The basal bulged part of the pistil is the **ovary.** Inside the ovary is the **ovarian cavity** (**locule)**. **The placenta** is located inside the ovarian cavity.
7. Surgical methods, also called **sterilisation**, are generally advised for the male/female partner as a terminal method to prevent any more pregnancies. Surgical intervention blocks gamete transport and thereby prevent conception. Sterilisation procedure in the male is called 'vasectomy'and that in the female, 'tubectomy'. In vasectomy, a small part of the vas deferens is removed or tied up through a small incision on the scrotum whereas in tubectomy, a small part of the fallopian tube is removed or tied up through a small incision in the abdomen or through vagina.
8. Although the plant is infected with a virus, the meristem (apical and axillary) is free of virus. Hence, one can remove the meristem and grow it *in vitro* to obtain virus-free plants. Scientists have succeeded in culturing meristem of banana, sugarcane, potato, etc.

   Or

   Histones are positively charged, basic proteins. They organize to form a unit of eight molecules called as histone octamer. The negatively charged DNA is wrapped around the positively charged histone octamer to form a structure called nucleosome.
9. (a) DNA fragment separates in matrix of **agarose.**
   (b) DNA fragments are stained with **ethidium bromide.**
   (c) DNA fragments are viewed under **UV light.**
   (d) Fragments are extruded from gel piece. This is called **elution.**
10. Biofertilisers are organisms that enrich the nutrient quality of the soil. The main sources of biofertilisers are bacteria, fungi and cyanobacteria.

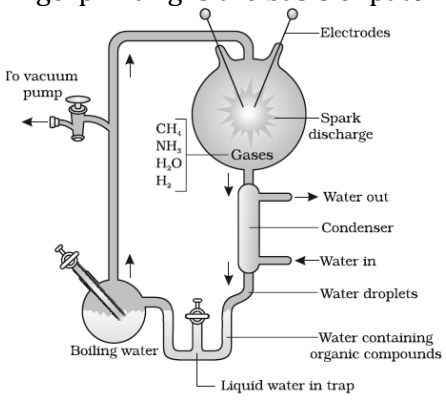
Bacteria form nodules on the roots of leguminous plants formed by the symbiotic association of Rhizobium. These bacteria fix atmospheric nitrogen into organic forms, which is used by the plant as nutrient. Other bacteria can fix atmospheric nitrogen while free-living in the soil (examples Azospirillum and Azotobacter), thus enriching the nitrogen content of the soil.

Section C

11. In **barrier** methods, ovum and sperms are prevented from physically meeting with the help of barriers. Such methods are available for both males and females.
    Condoms are barriers made of thin rubber/ latex sheath that are used to cover the penis in the male or vagina and cervix in the female, just before coitus so that the ejaculated semen would not enter into the female reproductive tract. This can prevent conception.
    Diaphragms, cervical caps and **vaults** are also barriers made of rubber that are inserted into the female reproductive tract to cover the cervix during coitus. They prevent conception by blocking the entry of sperms through them cervix. They are reusable.
    Spermicidal creams, jellies and foams are usually used along with these barriers to increase their contraceptive efficiency.
    Intra Uterine Devices (IUDs). These devices are inserted by doctors or expert nurses in the uterus through vagina. These Intra Uterine Devices are presently available as the non-medicated IUDs (e.g., Lippes loop), copper releasing IUDs (CuT, Cu7, Multiload 375) and the hormone releasing IUDs (Progestasert, LNG-20). IUDs increase phagocytosis of sperms within the uterus and the Cu ions released suppress sperm motility and the fertilising capacity of sperms. The hormone releasing IUDs, in addition, make the uterus unsuitable for implantation and the cervix hostile to the sperms.
12. An individual has genotype with an extra chromosome 21.
    (a) The disorder is called Down's syndrome or trisomy of 21.
    (b) The affected individual is short statured with small round head, furrowed tongue and partially open mouth. Palm is broad with characteristic palm crease. Physical, psychomotor and mental development is retarded.
13. Treatment of waste water is done by the heterotrophic microbes naturally present in the sewage. This treatment is carried out in two stages:
    Primary treatment: These treatment steps basically involve physical removal of particles – large and small – from the sewage through filtration and sedimentation. These are removed in stages; initially, floating debris is removed by sequential filtration. Then the grit (soil and small pebbles) are removed by sedimentation. All solids that settle form the primary sludge, and the supernatant forms the effluent. The effluent from the primary settling tank is taken for secondary treatment.
    Secondary treatment or Biological treatment : The primary effluent is passed into large aeration tanks where it is constantly agitated mechanically and air is pumped into it. This allows vigorous growth of useful aerobic microbes into flocs (masses of bacteria associated with fungal filaments to form mesh like structures). While growing, these microbes consume the major part of the organic matter in the effluent. This significantly reduces the BOD (biochemical oxygen demand) of the effluent. BOD refers to the amount of the oxygen that would be consumed if all the organic matter in one liter of water were oxidized by bacteria. The sewage water is treated till the BOD is reduced. Once the BOD of sewage or waste water is reduced significantly, the effluent is then passed into a settling tank where the bacterial 'flocs' are allowed to sediment. This sediment is called activated sludge. A small part of the activated sludge is pumped back into the aeration tank to serve as the inoculum. The remaining major part of the sludge is pumped into large tanks called anaerobic sludge digesters. Here, other kinds of bacteria, which grow an aerobically, digest the bacteria and

the fungi in the sludge. During this digestion, bacteria produce a mixture of gases such as methane, hydrogen sulphide and carbon dioxide. These gases form biogas and can be used as source of energy as it is inflammable.

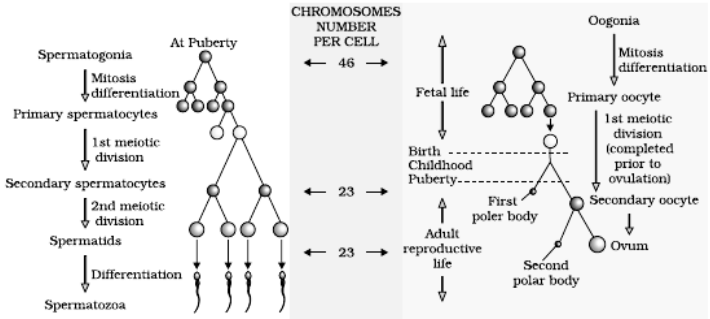
14. DNA fingerprinting involves identifying differences in some specific regions in DNA sequence called as repetitive DNA, because in these sequences, a small stretch of DNA is repeated many times. These repetitive DNA are separated from bulk genomic DNA as different peaks during density gradient centrifugation. The bulk DNA forms a major peak and the other small peaks are referred to as satellite DNA. Depending on base composition (A : T rich or G:C rich), length of segment, and number of repetitive units, the satellite DNA is classified into many categories, such as micro-satellites, mini-satellites etc. These sequences normally do not code for any proteins, but they form a large portion of human genome. These sequence show high degree of polymorphism and form the basis of DNA fingerprinting. Since DNA from every tissue (such as blood, hair-follicle, skin, bone, saliva, sperm etc.), from an individual show the same degree of polymorphism, they become very useful identification tool in forensic applications. Further, as the polymorphisms are inheritable from parents to children, DNA fingerprinting is the basis of paternity testing, in case of disputes.



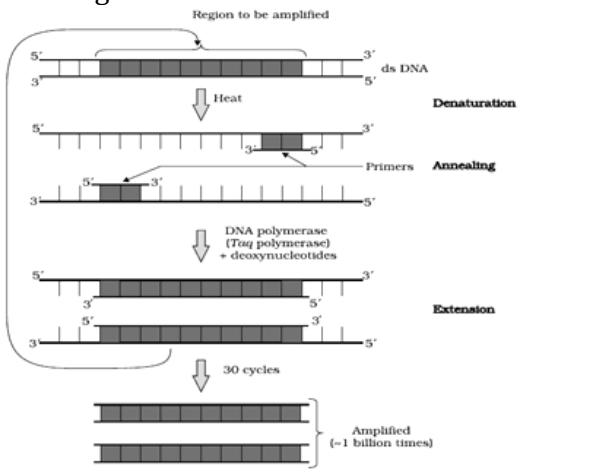
Or

Oparin and Haldane proposed that the first form of life could have come from pre-existing non-living organic molecules (e.g. RNA, protein, etc.) and that formation of life was preceded by chemical evolution, i.e., formation of diverse organic molecules from inorganic constituents. The conditions on earth were – high temperature, volcanic storms, reducing atmosphere containing CH4, NH3, etc. Miller created similar conditions in a laboratory scale. He created electric discharge in a closed flask containing CH4, H2, NH3 and water vapaur at 8000C. He observed formation of amino acids. In similar experiments others observed, formation of sugars, nitrogen bases, pigment and fats. Analysis of meteorite content also revealed similar compounds indicating that similar processes are occurring elsewhere in space

15. Difference between spermatogenesis and oogenesis



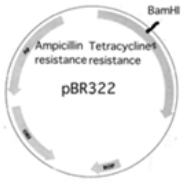
16. The diagram is of PCR



Polymerase chain reaction (PCR) : Each cycle has three steps: (i) Denaturation; (ii) Primer annealing; and (iii) Extension of primers

PCR stands for **Polymerase Chain Reaction**. In this reaction, multiple copies of the gene (or DNA) of interest is synthesized *in vitro* using two sets of primers (small chemically synthesised oligo nucleotides that are complementary to the regions of DNA) and the enzyme DNA polymerase. The enzyme extends the primers using the nucleotides provided in the reaction and the genomic DNA as template. If the process of replication of DNA is repeated many times, the segment of DNA can be amplified to approximately billion times, i.e., 1 billion copies are made. Such repeated amplification is achieved by the use of a thermostable DNA polymerase (isolated from a bacterium, *Thermusaquaticus*), which remain active during the high temperature induced denaturation of double stranded DNA. The amplified fragment if desired can now be used to ligate with a vector for further cloning.

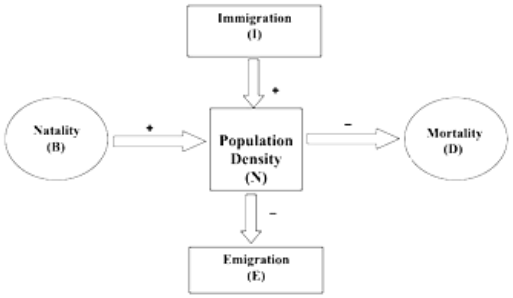
17. Plants, bacteria, fungi and animals whose genes have been altered by manipulation are called Genetically Modified Organisms (GMO). GM plants have been useful in many ways. Genetic modification has:
    (i) made crops more tolerant to abiotic stresses (cold, drought, salt, heat).
    (ii) reduced reliance on chemical pesticides (pest-resistant crops).
    (iii) helped to reduce post harvest losses.
    (iv) increased efficiency of mineral usage by plants (this prevents early exhaustion of fertility of soil).
    (v) enhanced nutritional value of food, e.g., Vitamin 'A' enriched rice.
    In addition to these uses, GM has been used to create tailor-made plants to supply alternative resources to industries, in the form of starches, fuels and pharmaceuticals.
18. A foreign DNA is introduced at the BamH I site of tetracycline resistance gene in the vector pBR322.



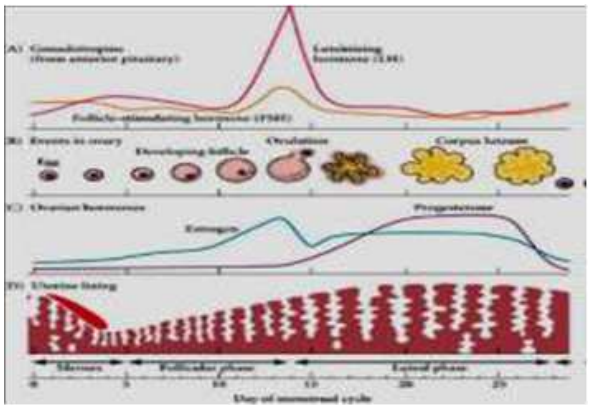
The recombinant plasmids will lose tetracycline resistance due to insertion of foreign DNA but can still be selected out from non-recombinant ones by plating the transformants on ampicillin containing medium. The transformants growing on ampicillin containing medium are then transferred on a medium containing tetracycline. The recombinants will grow in ampicillin containing medium but not on that containing tetracycline. But, non-recombinants

will grow on the medium containing both the antibiotics. In this case, one antibiotic resistance gene helps in selecting the transformants, whereas the other antibiotic resistance gene gets 'inactivated due to insertion' of alien DNA, and helps in selection of recombinants.

19. The density of a population in a given habitat during a given period, fluctuates due to changes in four basic processes,
    (i) ***Natality*** refers to the number of births during a given period in the population that are added to the initial density.
    (ii) ***Mortality*** is the number of deaths in the population during a given period.
    (iii) ***Immigration*** is the number of individuals of the same species that have come into the habitat from elsewhere during the time period under consideration.
    (iii) ***Emigration*** is the number of individuals of the population who left the habitat and gone elsewhere during the time period under consideration.



20. Due to genetic and other unknown reasons, the body attacks self-cells. This results in damage to the body and is called **auto-immune** disease. Rheumatoid arthritis which affects many people in our society is an auto-immune disease.
21. Haploid content is 3.3×10^{9}
    Therefore, diploid content is 6.6×10^{9}
    Distance between bp is 0.34×10^{-9}
    Therefore length is diploid content x distance between bp $6.6\times10^{9}\times0.34\times10^{-9} = 2.24m$.
22. Respect for nature, scientific attitude with a vision of the future is called as convergent evolution.
    We should conserve Biodiversity since it provides us:
    (i) Main source of food.
    (ii) Source of economically important fibers (cotton, flax, hemp, jute etc).
    (iii) Plant products (gum, resin, dye, fragrance, waxes, wool, leather, honey, lac, pearl, ivory, silk, horns).
    (iv) Drugs and medicine.
    (v) Sports and recreation.
    (vi) Aesthetic value.
    (vii) Cultural value.
    (viii) Scientific research.
    (ix) Eco system services.
23. (a) The parents were traditional but understood the need for such advertisements. They showed maturity and openness later.
    (b) (i) Menstrual phase
        (ii) Proliferative phase
        (iii) Secretory phase
    (c)



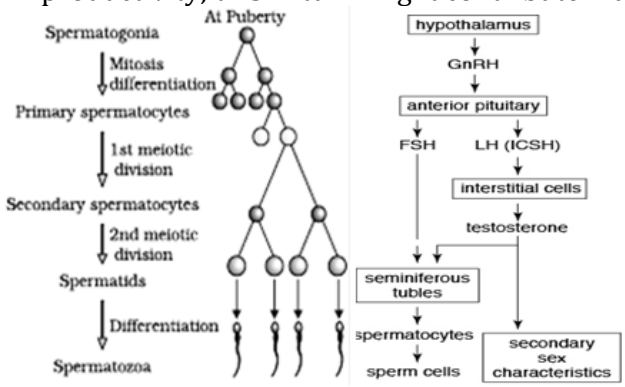
Section D

24. (a) Reasons for the greater biodiversity of tropics

(i) Speciation is generally a function of time, unlike temperate regions subjected to frequent glaciations in the past, tropical latitudes have remained relatively undisturbed for millions of years and thus, had a long evolutionary time for species diversification,

(ii) Tropical environments, unlike temperate ones, are less seasonal, relatively more constant and predictable. Such constant environments promote niche specialisation and lead to a greater species diversity and

(iii) There is more solar energy available in the tropics, which contributes to higher productivity; this in turn might contribute indirectly to greater diversity.



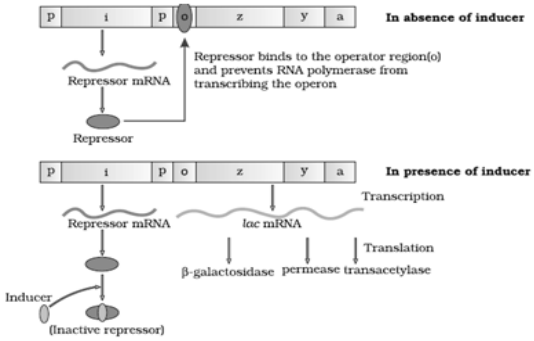
(b) The 'rivet popper hypothesis was used by Paul Ehrlich. In an airplane (ecosystem) all parts are joined together using thousands of rivets (species). If every passenger travelling in it starts popping a rivet to take home (causing a species to become extinct), it may not affect flight safety (proper functioning of the ecosystem) initially, but as more and more rivets are removed, the plane becomes dangerously weak over a period of time. Furthermore, which rivet is removed may also be critical. Loss of rivets on the wings (key species that drive major ecosystem functions) is obviously a more serious threat to flight safety than loss of a few rivets on the seats or windows inside the plane.

Or

In testis, the immature male germ cells (spermatogonia) produce sperms by spermatogenesis that begins at puberty. The spermatogonia (sing. spermatogonium) present on the inside wall of seminiferous tubules multiply by mitotic division and increase in numbers. Each spermatogonium is diploid and contains 46 chromosomes. Some of the spermatogonia called primary spermatocytes periodically undergo meiosis. A primary spermatocyte completes the first meiotic division (reduction division) leading to formation of two equal, haploid cells

called secondary spermatocytes, which have only 23 chromosomes each. The secondary spermatocytes undergo the second meiotic division to produce four equal, haploid spermatids. The spermatids are transformed into spermatozoa (sperms) by the process called spermiogenesis. After spermiogenesis, sperm heads become embedded in the Sertoli cells, and are finally released from the seminiferous tubules by the process called spermiation.

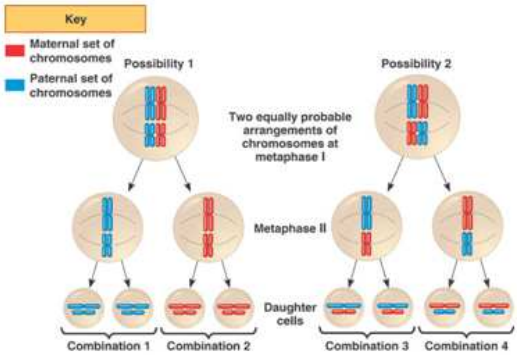
25. The lac operon consists of one regulatory gene (the i gene) and three structural genes (z, y, and a). The i gene codes for the repressor of the lac operon. The z gene codes for beta-galactosidase (β-gal), which is primarily responsible for the hydrolysis of the disaccharide, lactose into its monomeric units, galactose and glucose. The y gene codes for permease, which increases permeability of the cell to β-galactosides. The 'a' gene encodes a transacetylase. Hence, all the three gene products in lac operon are required for metabolism of lactose.



Lactose is the substrate for the enzyme beta-galactosidase and it regulates switching on and off of the operon. Hence, it is termed as inducer. In the absence of a preferred carbon source such as glucose, if lactose is provided in the growth medium of the bacteria, the lactose is transported into the cells through the action of permease The lactose then induces the operon in the following manner. The repressor of the operon is synthesised (all-the-time – constitutively) from the i gene. The repressor protein binds to the operator region of the operon and prevents RNA polymerase from transcribing the operon. In the presence of an inducer, such as lactose or allolactose, the repressor is inactivated by interaction with the inducer. This allows RNA polymerase access to the promoter and transcription proceeds.. Essentially, regulation of lac operon can also be visualised as regulation of enzyme synthesis by its substrate. Glucose or galactose cannot act as inducers for lac operon. Regulation of lac operon by repressor is referred to as negative regulation.

Or

(a) Representation of the independent assortment of chromosomes..



(b) A molecule that can act as a genetic material must fulfill the following criteria:

(i) It should be able to generate its replica (Replication).

(ii) It should chemically and structurally be stable.

(iii) It should provide the scope for slow changes (mutation) that are required for evolution.

(iv) It should be able to express itself in the form of 'Mendelian Characters'.

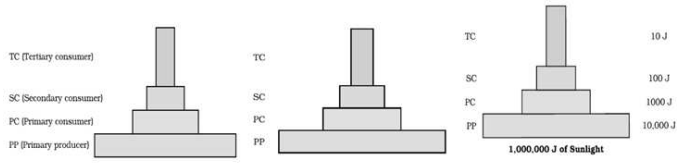
26. The food or energy relationship is expressed in terms of number, biomass or energy. The base of each pyramid represents the producers or the first trophic level while the apex represents tertiary or top level consumer. The three ecological pyramids that are usually studied are (a) pyramid of number; (b) pyramid of biomass and (c) pyramid of energy

Any calculations of energy content, biomass, or numbers has to include all organisms at that trophic level. No generalisations we make will be true if we take only a few individuals at any trophic level into account. Also a given organism may occupy more than one trophic level simultaneously. One must remember that the trophic level represents a functional level, not a species as such. A given species may occupy more than one trophic level in the same ecosystem at the same time; for example, a sparrow is a primary consumer when it eats seeds, fruits, peas, and a secondary consumer when it eats insects and worms.

In most ecosystems, all the pyramids, of number, of energy and biomass are upright, i.e., producers are more in number and biomass than the herbivores, and herbivores are more in number and biomass than the carnivores. Also energy at a lower trophic level is always more than at a higher level.

The pyramid of biomass in sea is also generally inverted because the biomass of fishes far exceeds that of phytoplankton.

Pyramid of energy is always upright, can never be inverted, because when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step. Each bar in the energypyramid indicates the amount of energy present at each trophic level in a given time or annually per unit area there are certain limitations of ecological pyramids such as it does not take into account the same species belonging to two or more trophic levels. It assumes a simple food chain, something that almost never exists in nature; it does not accommodate a food web. Moreover, saprophytes are not given any place in ecological pyramids even though they play a vital role in the ecosystem.



Pyramid of number Pyramid of biomass Pyramid of energy

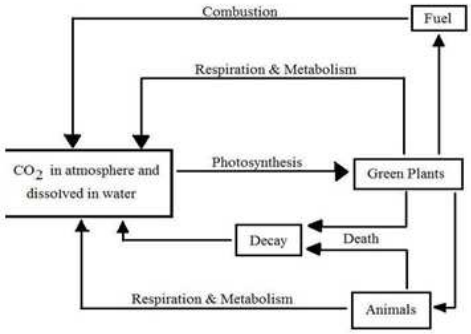
Or

The movement of nutrient elements through the various components of an ecosystem is called **nutrient cycling** or **biogeochemical** cycles.

Nutrient cycles are of two types: (a) **gaseous** and (b) **sedimentary.**

Carbon cycling occurs through atmosphere, ocean and through living and dead organisms.

A considerable amount of carbon returns to the atmosphere as CO_2 through respiratory activities of the producers and consumers. Decomposers also contribute substantially to CO_2 pool by their processing of waste materials and dead organic matter of land or oceans. Some amount of the fixed carbon is lost to sediments and removed from circulation. Burning of wood, forest fire and combustion of organic matter, fossil fuel, volcanic activity are additional sources for releasing CO_2 in the atmosphere.


Combustion
Fuel
Respiration & Metabolism
CO_2 in atmosphere and dissolved in water
Photosynthesis
Green Plants
Decay
Death
Respiration & Metabolism
Animals