CBSE-2015-Biology-Solutions

SECTION A

1. Drones of honey bee possess 16 chromosomes. The sperms in honey bee are produced by mitosis.

2. A cistron is a segment of DNA which codes for a polypeptide.

3. Retroviruses have RNA as genetic material. After the entry of a virus into the body of the host, the virus attacks the macrophage cells of the body where the RNA genome of the virus replicates to form viral DNA with the help of the reverse transcriptase enzyme.

4. Adenosine deaminase deficiency can be cured by enzyme replacement therapy, but the cure is not permanent even after infusion of genetically engineered lymphocytes into a patient as cells do not always remain alive.

5. Advantages of unleaded petrol in automobiles as fuel:

(i) Automobiles equipped with a catalytic converter should use unleaded petrol because lead in the petrol inactivates the catalysts of the converter.

(ii) Use of unleaded petrol prevents the release of poisonous gases (e.g. nitrous oxide) in the environment.

SECTION B

6. Moss plants produce a large number of male gametes to increase the chances of fertilisation, as the eggs are located in the archegonium and the male gametes have to swim in water to reach the eggs for fertilisation to occur. The male gametes are called antherozoids.

7.

(a) The combinations with homologous structures are

(i) Forelimbs of whales and bats

(ii) Thorns of *Bougainvillea* and tendrils of Cucurbita

(b) These homologous structures represent divergent evolution.

8.

(a) Plants raised through micropropagation are termed somaclones because they are genetically identical to the original plant from which they are grown.

(b) Advantages of micropropagation:

(i) A large number of plants can be raised from a single individual plant within a relatively short period and in a limited space.

(ii) Virus-free healthy plants can be produced from the shoot apical meristem.

9. The primary treatment phase of sewage involves the removal of coarse solid materials through filtration and sedimentation. The diluted sewage is passed through a series of filters of sequentially small pore sizes to remove large floating objects. Then the filtered sewage is passed into the grit chamber where the coarse solid materials settle by gravity. After this, the sewage is allowed to pass into a sedimentation tank where the suspended materials settle and form the primary sludge. The effluent is then taken for the secondary treatment.

10. Mutualism is the relationship between two organisms where both organisms are benefited in terms of food, shelter and substratum for attachment.

Two examples:

(i) Mycorrhizae are the mutualistic relationship between fungi and roots of higher plants. The fungus helps in mineral nutrition of the plant with which they are associated and obtains, in turn, carbohydrates from the plant.

(ii) Nitrogen-fixing bacteria, *Rhizobium*, live in the root nodules of legumes where the bacterium derives nutrition from the host plant but fixes the atmospheric nitrogen and makes it available to the plants.

OR

Ex situ conservation is the conservation of selected rare plants or animals in places outside their natural homes. Ex situ conservation of biodiversity has been employed in

(i) Gene banks: These are the institutes which maintain stocks of viable seeds, live growing plants, tissue culture and frozen germplasm with the whole range of genetic variability.

(ii) Cryopreservation: Cryopreservation can maintain tissue culture, embryos, gametes, animal cells or tissues. Endangered organisms are being cryopreserved so that they can be revived to help in conservation.

(iii) Orchards: Plants with recalcitrant seeds are grown in orchards where all possible strains and varieties are maintained.

(iv) Tissue culture: It is carried out through callus formation, embryoids, pollen grain culture and shoot tip culture in plants which are either seedless, have recalcitrant seeds, variable seed progeny or where clones are to be maintained.

SECTION C

11. Apomixis is the mode of reproduction which does not involve formation of zygote through gametic fusion.

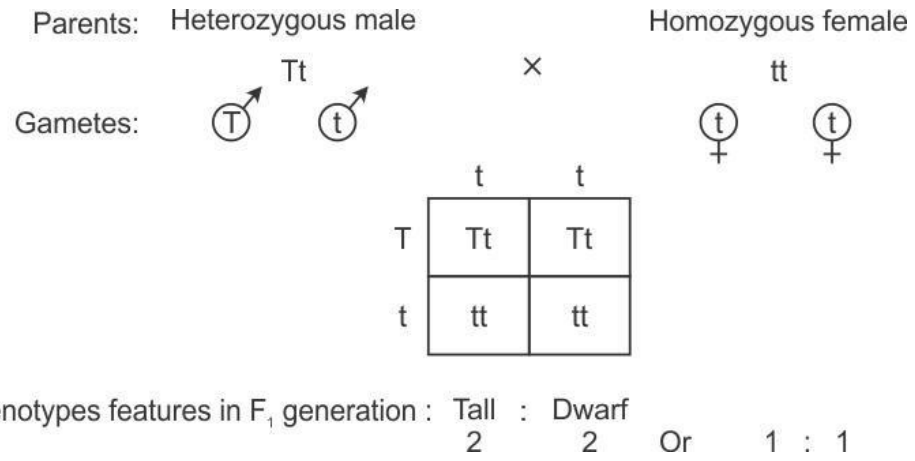
Significance of apomixis:

(i) Adventives embryos are better clones than cuttings.

(ii) Embryos formed through apomixes are generally free from infections.

Hybrid varieties provide higher and better yield. If hybrid seeds are produced every year, they do not maintain hybrid characters because of segregation of traits. Moreover, production of hybrid seeds every year is very costly. This can be avoided by introducing apomixes in hybrid seeds.

12. 50% of dominant traits and 50% of recessive traits during a monohybrid cross can be obtained by a test cross between a homozygous pea plant and a heterozygous pea plant.



Phenotypes features in F_1 generation : Tall : Dwarf
2 2 Or 1 : 1

13. Satellite DNA are small non-coding but inheritable sequences of bases which can be separated as satellite from bulk DNA during density gradient centrifugation. Satellite DNA shows polymorphism which forms the basis of DNA fingerprinting. There are short nucleotide repeats in the DNA which are specific in each individual and vary in number from person to person but are not inherited. These are called 'variable number tandem repeats' or mini-satellites. Individuals inherit these repeats from their parents which are used as genetic markers in a personal identity test.

14. The given equation represents the gene frequency of the total population according to Hardy–Weinberg law. In this equation, suppose a gene has two alleles *A* and *a*, and *p* is the frequency of occurrence of dominant allele *A* and *q* is the frequency of occurrence of recessive allele *a* in the parental generation.

Then according to the equation,

$p^2 + 2pq + q^2 = 1$

where p^2 = frequency of occurrence of individuals with homozygous dominant alleles (*AA*)

$2pq$ = frequency of occurrence of heterozygous individuals (*Aa*)

q^2 = frequency of occurrence of individuals with homozygous recessive alleles (*aa*)

15.

(a) The doctor injects the preformed antitoxin into the patient's body.

(b) The vaccine stimulates the production of antibodies against the antigen for inducing active acquired immunity.

(c) The injection was given to prevent tetanus. It provides acquired immunity.

16. Essentials of good, effective dairy farm management practices are

(i) Good breeds of dairy farm animals should be selected.

(ii) Suitable environmental conditions such as adequate ventilation, suitable temperature, sufficient light, water, air and well-drained housing accommodation should be provided.

(iii) Each animal should be fed on a balanced ration.

(iv) Hygiene and proper cleanliness should be included in the housing of animals.

(v) Animals should be vaccinated at regular time intervals in order to protect them from diseases.

(vi) Regular visits by a veterinary doctor are must.

17.

Organism	Medicinal value	Bioactive molecule
a. *Streptococcus*	Clot buster for removing clots from blood vessels of heart attack patients	Enzyme
b. *Monascus*	Blood cholesterol lowering agents	Statins
c. *Trichoderma*	Immunosuppressant drug	Cyclosporine A

OR

Methanogens are the methane-producing bacteria used during the production of biogas. The methanogenic bacteria digest the organic mass to produce marsh gas during the secondary treatment of sewage. Marsh gas is a mixture of gases containing methane, hydrogen sulphide and carbon dioxide which form biogas.

18. The correct sequence of the steps involved in biotechnological reaction are

Genomic DNA template

Denaturation of ds-DNA

↓

Nucleotides provided

↓

Primers

↓

Thermostable DNA polymerase (from *Thermus aquaticus*)

↓

Enzyme DNA polymerase

↓

Chemically synthesised oligonucleotides

↓

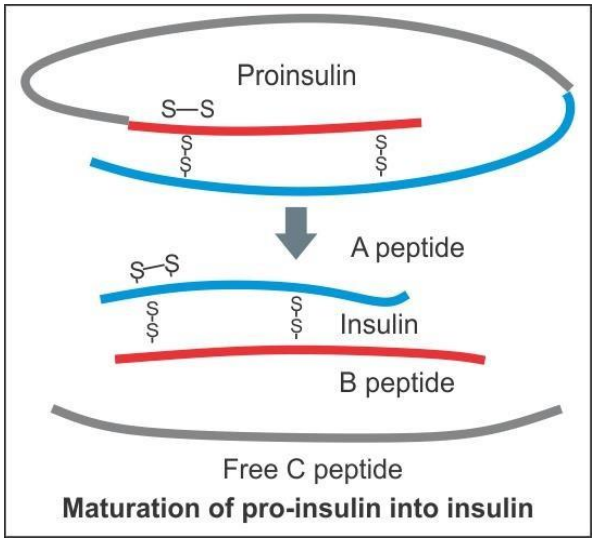
Complementary region of DNA

↓

In vitro synthesis of copies of DNA of interest

19. Potential applications of genetically modified plants:
    (i) GMO crops are more tolerant to abiotic stresses.
    (ii) They have reduced the dependency on chemical pesticides.
    (iii) They have enhanced the nutritional value of food such as vitamin A-enriched rice.

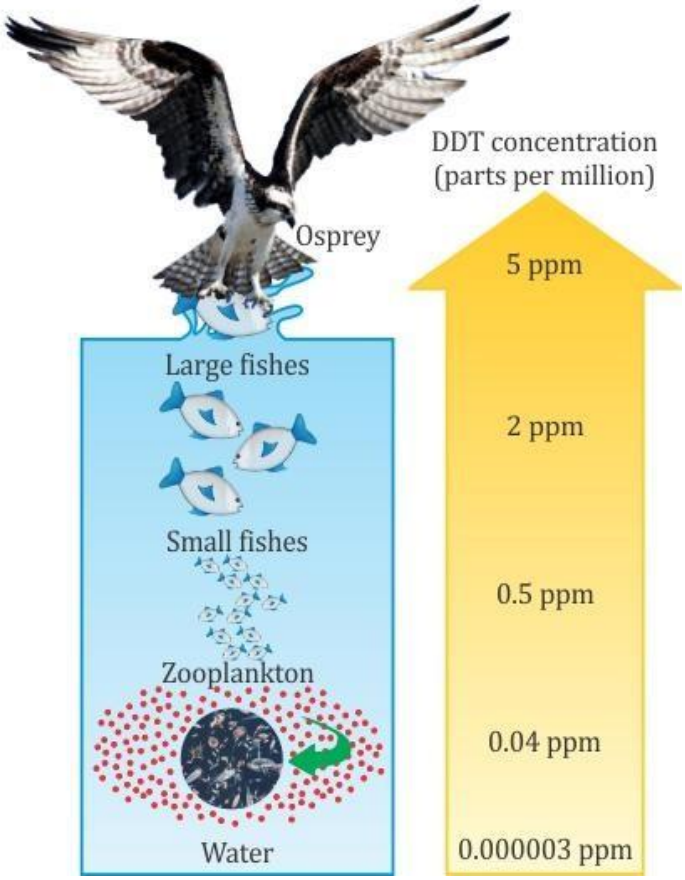
20. The structure of insulin consists of two short polypeptide chains—chain A and chain B—linked together by disulphide bridges. In mammals, including human beings, insulin is synthesised as a pro-hormone which contains an extra stretch called the C peptide which is removed during maturation into insulin. The rDNA technique is used for assembling insulin into the mature form.
In 1983, Eli Lily, an American company, prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in the plasmids of *E. coli* to produce insulin chains. Chains A and B were produced separately, extracted and combined by creating disulphide bonds to form human insulin.



Maturation of pro-insulin into insulin

21. Adaptations in unfavourable conditions in the following organisms:
   (i) Snails: Snails undergo aestivation to avoid summer-related problems such as heat and desiccation.
   (ii) Seeds: The seeds undergo dormancy to tide over the adverse environmental conditions. They reduce their metabolic activity and remain quiescent till the suitable environmental conditions return.
   (iii) Bears: They undergo hibernation during winters to escape harsh winter conditions.
   (iv) Zooplankton: Under unfavourable conditions, zooplankton species in lakes and ponds enter diapause, a stage of suspended development.
   (v) Fungi: Various kinds of thick-walled spores are formed which help them to survive in unfavourable conditions. The spores germinate on return of favourable conditions.
   (vi) Bacteria: Bacteria form thick spores which help them to survive under unfavourable conditions.

22. The increased concentration of toxic materials at each trophic level of a food chain is called biomagnification or biological concentration.
When the agricultural fields are sprayed with dichlorodiphenyltrichloroethane (DDT), it is carried into water bodies with low concentration. It gets accumulated by the zooplankton and its concentration goes on increasing at each trophic level in a food chain—from small fish to large fish and birds.



SECTION D

23. It is very important to attend the seminar on 'Reproductive Health – Problems and Practices' as it deals with the problems and strategies of reproductive health. It makes children aware of the following points:
(i) It makes them aware about reproduction.
(ii) It prevents sex abuse and sex-related crime. People should think and take up necessary steps to prevent sex abuse and build up a reproductively healthy society.
(iii) Students will have proper knowledge of reproductive organs, adolescence and sexually transmitted diseases.
(iv) It provides information about reproduction-related problems and menstrual problems so students can seek timely medical help.

SECTION E

24.

(a) Artificial hybridisation is a technique which ensures that the seeds are formed only from the desired set of pollen grains. It includes emasculation and bagging. Removal of stamens or anthers or killing of pollen grains of a bisexual flower without affecting the female reproductive organs is called emasculation. The emasculated flower is immediately enclosed in a plastic or butter paper bag to avoid pollination by unwanted pollen. This process is called bagging.

Experiment and flow chart of artificial hybridisation:

Remove the anthers of a bisexual flower using a pair of forceps.

↓

Immediately cover the emasculated flower with a plastic or butter paper bag.

↓

Collect the mature and viable pollen grains from the anthers of the male parent.

↓

Dust the pollen grains on the stigma of the female plant.

↓

Replace the bag immediately and allow the fruits to develop.

(b) Importance of artificial hybridisation:

(i) It helps plant breeders to cross a particular plant with desired pollen grains.

(ii) This technique helps in the production of hybrids without contamination by unwanted pollen grains.

OR

Follicle-stimulating hormone (FSH) and luteinising hormone are pituitary hormones. Oestrogen and progesterone are ovarian hormones.

Functions of pituitary and ovarian hormones:

Hormone	Functions
FSH	i. Stimulates the ovarian follicles to secrete oestrogen. ii. Stimulates the proliferation of the endometrium of the uterine wall. iii. Stimulates the maturation of Graafian follicles.
LH	i. Stimulates the release of ovum. ii. Develops corpus luteum and secretion of progesterone. iii. Maintains pregnancy.
Oestrogen	i. Controls the changes in the secondary sex organs in the first half of the menstrual cycle. ii. Stimulates growth, maturation and functions of secondary sex organs. iii. Repairs the damaged tissues of the uterus and fallopian tubes after menstruation. iv. Stimulates the maturation of ova development of uterine lining and mammary glands.
Progesterone	i. Facilitates the preparation of the endometrium for implantation. ii. Inhibits the contraction of the uterus and the development of new follicles.

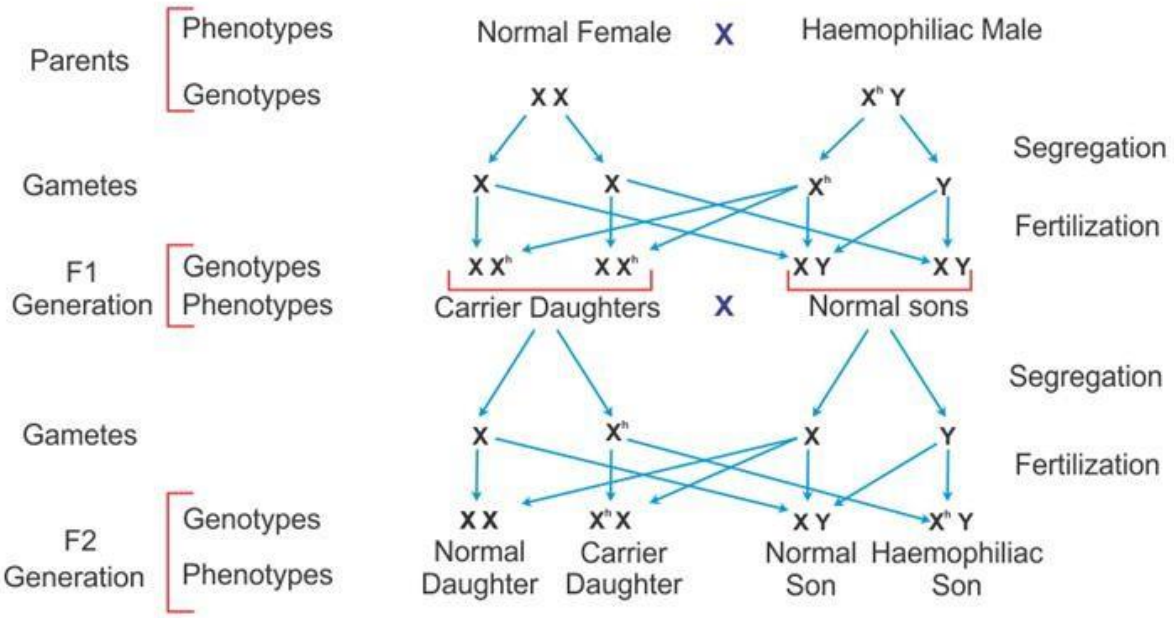
25.

(a) Thalassaemia and haemophilia are categorised as Mendelian disorders because these are determined by alternation or mutation in a single gene.

Symptoms of thalassaemia: The main symptoms of thalassaemia are anaemia, jaundice, hepatosplenomegaly, cardiac enlargement and skeletal deformities.

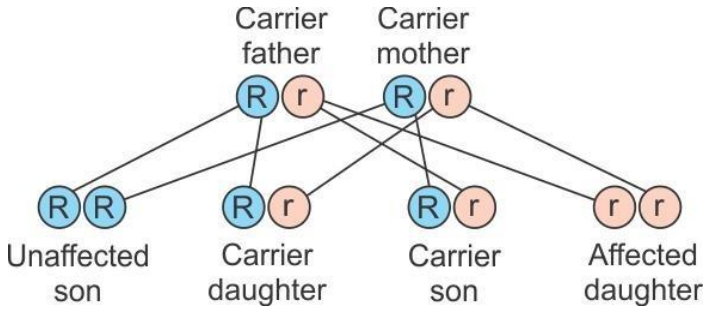
Symptoms of haemophilia: Haemophilia is also called bleeder's disease in which a single cut leads to non-stop bleeding. It prevents clotting of blood. A seriously affected person may bleed to death after even a minor skin cut.

Inheritance pattern of haemophilia:
This is a sex-linked recessive disease which shows its transmission from an unaffected carrier female to some of the male progeny. It shows criss-cross inheritance. The heterozygous female (carrier) for haemophilia may transmit the disease to sons. The possibility of a female becoming a haemophilic is extremely rare because the mother of such a female would have to be at least a carrier and the father should be haemophilic.

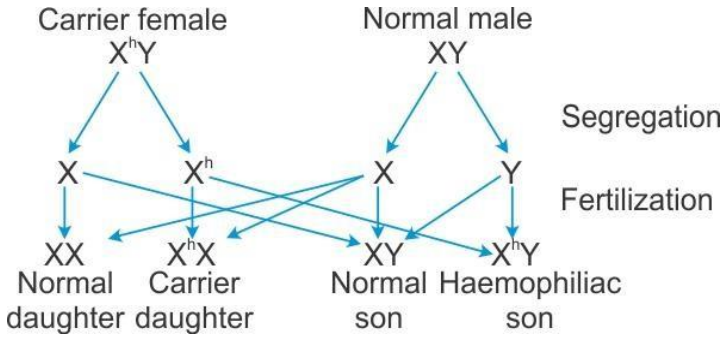


Inheritance pattern of thalassaemia:

Thalassaemia is an autosomal, recessively inherited blood disorder transmitted to the offspring when both parents are heterozygous. The defect arises because of either mutation or deletion which results in the reduced rate of synthesis of one of the globin chains of haemoglobin.



(b) The genotype of the parents producing a haemophilic son will be X^hX (carrier female) and XY (normal male).



OR

Role of m-RNA, t-RNA and ribosomes in protein synthesis:

(i) m-RNA: The messenger RNA brings coded information from DNA and takes part in its translation by bringing amino acids in a particular sequence during the synthesis of a polypeptide. The same m-RNA can be reused many times.

(ii) t-RNA: They transfer RNAs which pick up particular amino acids in the process called charging, and they carry them to m-RNA over particular codons corresponding to their anticodons. Each t-RNA has an area for coming in contact with ribosome and the enzyme amino acyl tRNA synthetase.

(iii) Ribosomes: Ribosomes are protein factories. Each ribosome has two subunits— smaller and larger subunits. The larger subunit has a groove for pushing out the newly formed polypeptide and for protecting the same from cellular enzymes. The smaller subunit fits like a cap over the larger one and leaves a tunnel for m-RNA. The smaller subunit has a point for recognising m-RNA and binding area for initiation factors.

26.

Natality, mortality, population density, population growth, population dispersal, sex ratio and age distribution are the different attributes which a population has but not an individual organism.

(a) Population density: It is defined as the number of individuals present in a unit area at a given time. The different ways by which population density can be measured are

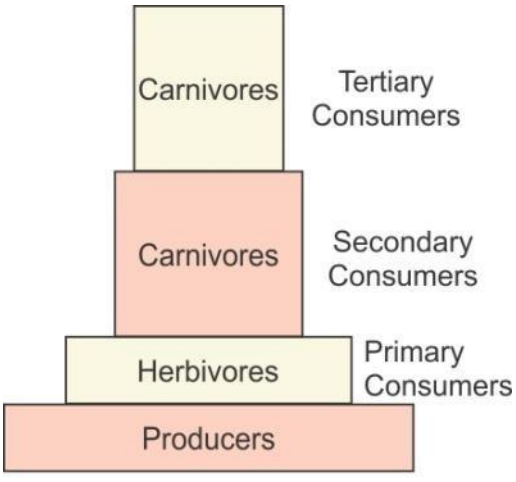
Population density can be measured by counting all the individuals in a region, but if the population is large, then counting may not be possible. Example: Counting Siberian cranes at Bharatpur wetlands.

(i) Percent cover or biomass is also used to measure the population density in huge populations. Example: Dense laboratory culture of bacteria in a Petri dish can be measured only by biomass.

(ii) Relative density is also used to measure population density. Example: The number of fish caught per trap is used to measure its total population density in a lake.

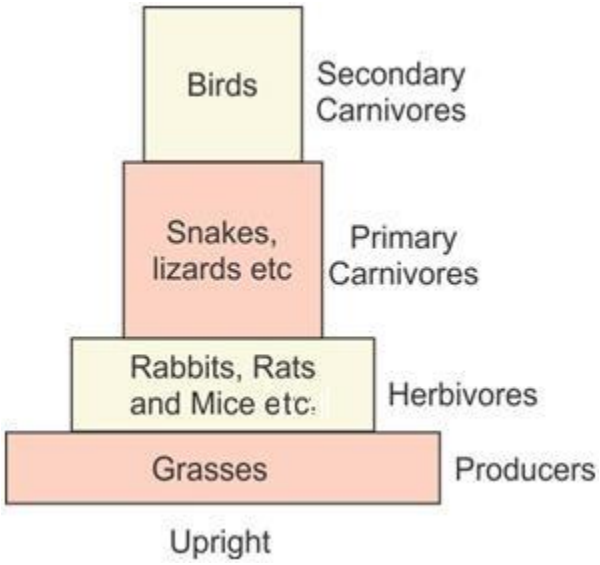
OR

Pyramid of energy is a graphical representation of amount of accumulated energy per unit area in different trophic levels of a food chain. An energy pyramid is always upright because there is a gradual decrease in energy at successive trophic levels. This happens according to the 10% law of energy transfer, where only 10% of the total energy is transferred from one trophic level to another. The energy is the highest at the producer level, and it gradually decreases on moving from herbivores to carnivores.



Pyramid of Energy

Pyramid of biomass is a graphic representation of biomass present per unit area in different trophic levels. It can be both upright and inverted. Examples: In a grassland forest ecosystem, there is a gradual decrease in biomass of organisms at successive trophic levels from producers to top carnivores which shows a straight or upright pyramid.



In a pond ecosystem, the pyramid is inverted as there is a gradual increase in biomass of organisms at successive trophic levels from producers to top carnivores. The producers are the smallest organisms, while the carnivores are larger in size.