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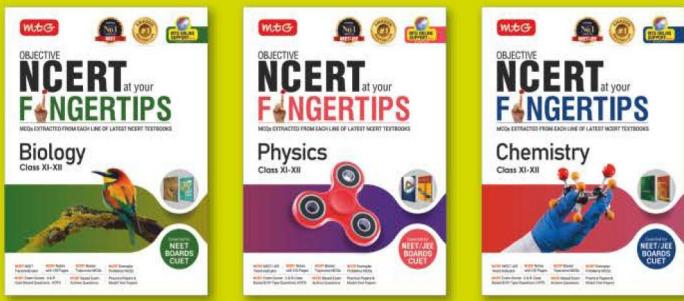
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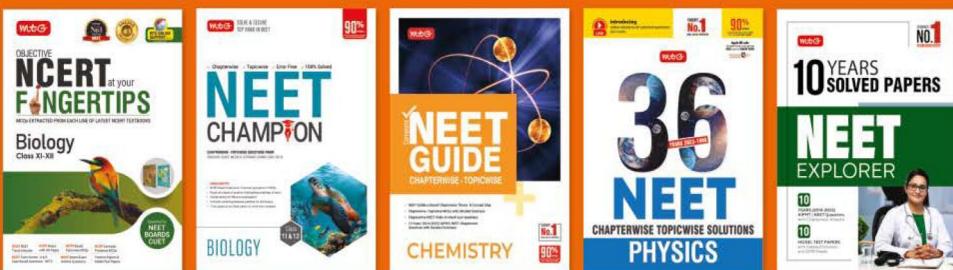
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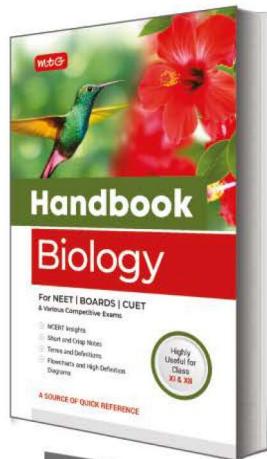
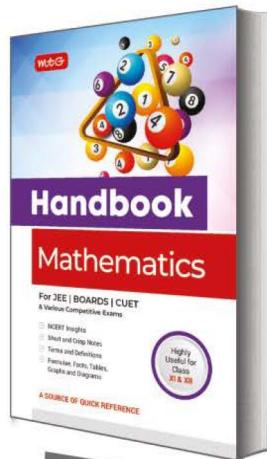
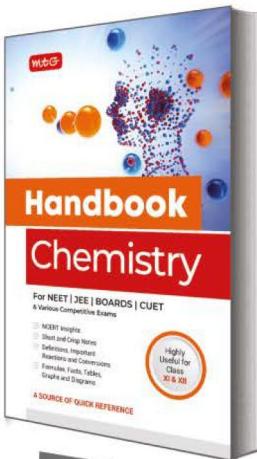
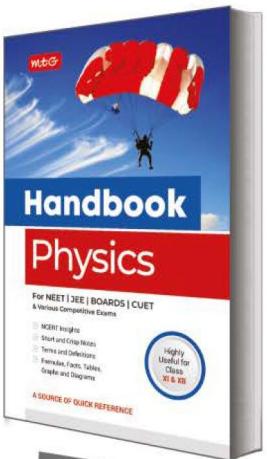
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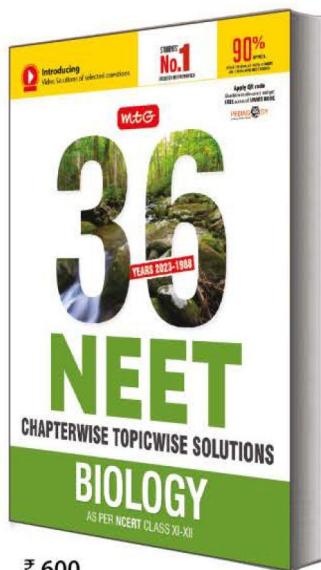
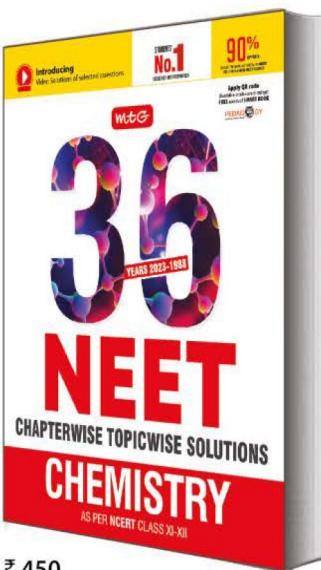
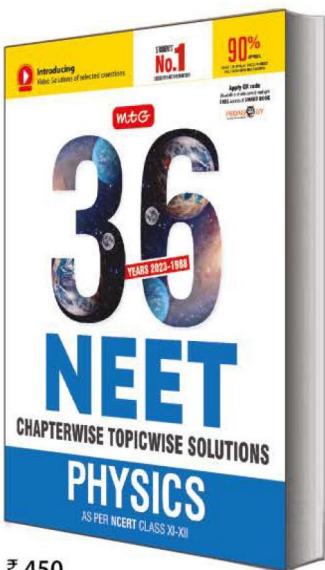
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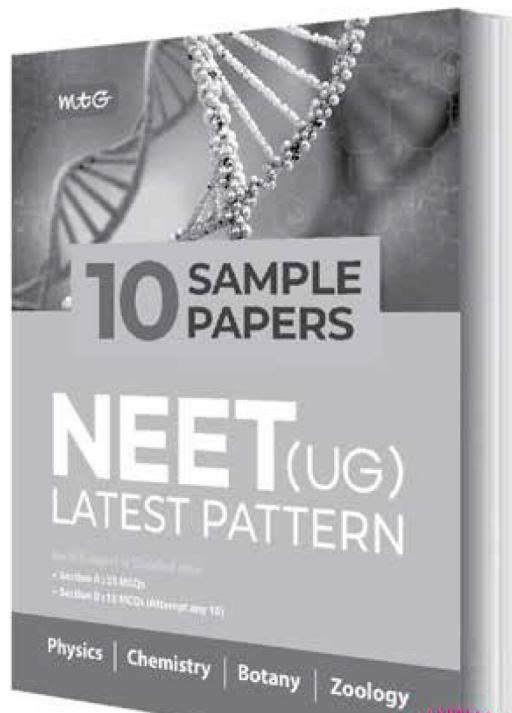
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SECTION - A (BOTANY)

1. Match List-I with List-II.

- | List I | List II |
|----------------------------|--------------------------|
| (A) Protein | (I) C = C double bonds |
| (B) Unsaturated fatty acid | (II) Phosphodiester bond |
| (C) Nucleic acid | (III) Glycosidic bonds |
| (D) Polysaccharide | (IV) Peptide bonds |

Choose the correct answer from the options given below.

- (a) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)
- (b) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)
- (c) (A)-(IV), (B)-(I), (C)-(II), (D)-(III)
- (d) (A)-(I), (B)-(IV), (C)-(III), (D)-(II)

2. Match List-I with List-II.

- | List I | List II |
|---------------------------|---|
| (A) Hydrarch succession | (I) Gradual change in the species composition |
| (B) Xerarch succession | (II) Faster and climax reached quickly |
| (C) Ecological succession | (III) Lichens to mesic conditions |
| (D) Secondary succession | (IV) Phytoplankton to mesic conditions |

Choose the answer from the options given below.

- (a) (A)-(IV), (B)-(II), (C)-(III), (D)-(I)
- (b) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
- (c) (A)-(I), (B)-(IV), (C)-(II), (D)-(III)
- (d) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

3. In *Calotropis*, aestivation is

- (a) valvate
- (b) vexillary
- (c) imbricate
- (d) twisted.

4. Match List-I with List-II.

- | List I | List II |
|-------------------|-----------------------------|
| (A) Chlorophyll a | (I) Yellow to yellow orange |
| (B) Chlorophyll b | (II) Yellow green |
| (C) Xanthophyll | (III) Blue green |
| (D) Carotenoid | (IV) Yellow |

Choose the correct answer from the options given below.

- (a) (A)-(III), (B)-(II), (C)-(IV), (D)-(I)
- (b) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

- (c) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)
- (d) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)

5. Nitrates and phosphates flowing from agricultural farms into water bodies are a significant cause of

- (a) eutrophication
- (b) humification
- (c) mineralisation
- (d) stratification.

6. Match List-I with List-II.

- | List I
(Type of cross) | List II
(Phenotypic ratio) |
|---|---|
| (A) Monohybrid cross | (I) 1 : 1 |
| (B) Dihybrid cross | (II) 1 : 2 : 1 |
| (C) Incomplete dominance | (III) 3 : 1 |
| (D) Test cross | (IV) 9 : 3 : 3 : 1 |

Choose the correct answer from the options given below.

- (a) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)
- (b) (A)-(II), (B)-(IV), (C)-(III), (D)-(I)
- (c) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
- (d) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

7. How many times decarboxylation occurs during each TCA cycle?

- (a) Thrice
- (b) Many
- (c) Once
- (d) Twice

8. The dissolution of synaptonemal complex occurs during

- (a) pachytene
- (b) diplotene
- (c) diakinesis
- (d) leptotene.

9. Identify the correct statements regarding mass flow hypothesis.

- (A) Mass flow is faster than diffusion.
- (B) Mass flow is the result of pressure difference between the end points.
- (C) Different substances involved in mass flow move at different paces.
- (D) Mass flow can result through either a positive or a negative hydrostatic pressure gradient.

Choose the correct answer from the options given below.

- (a) (A), (C), (D) only
- (b) (B), (C), (D) only
- (c) (A), (B), (C) only
- (d) (A), (B), (D) only

10. Doubling of the number of chromosomes can be achieved by disrupting mitotic cell division soon after

- (a) anaphase
- (b) telophase
- (c) prophase
- (d) metaphase.

11. Given below are two statements.

Statement I : RuBisCO is the most abundant enzyme in the world.

Statement II : Photorespiration does not occur in C₄ plants.

In the light of the above statements, choose the most appropriate answer from the options given below.

- (a) Statement I is correct but statement II is incorrect.
- (b) Statement I is incorrect but statement II is correct.
- (c) Both statement I and statement II are correct.
- (d) Both statement I and statement II are incorrect.

12. In 'Rivet Popper hypothesis', Paul Ehrlich compared the rivets in an airplane to

- (a) species within a genus
- (b) genetic diversity
- (c) ecosystem
- (d) genera within a family.

13. In a pea flower, five petals are arranged in a specialised manner with one posterior, two lateral and two anterior. These are named as _____ and _____ respectively.

- (a) Keel, Wings and Standard
- (b) Vexillum, Keel and Standard
- (c) Keel, Standard and Carina
- (d) Standard, Wings and Keel

14. In which of the following sets of families, the pollen grains are viable for months?

- (a) Solanaceae, Poaceae and Liliaceae
- (b) Brassicaceae, Liliaceae and Poaceae
- (c) Rosaceae, Liliaceae and Poaceae
- (d) Leguminosae, Solanaceae and Rosaceae

15. Transfer of pollen grains from anther to stigma of another flower of same plant is known as

- (a) geitonogamy
- (b) xenogamy
- (c) autogamy
- (d) cleistogamy.

16. The phenomenon which is influenced by auxin and also played a major role in its discovery.

- (a) Phototropism
- (b) Root initiation
- (c) Gravitropism
- (d) Apical Dominance

17. The transverse section of a plant part showed polyarch, radial and exarch xylem, with endodermis and pericycle. The plant part is identified as

- (a) monocot root
- (b) dicot root
- (c) dicot stem
- (d) monocot stem.

18. What will happen if fresh water lake gets contaminated by addition of polluted water with high BOD?

- (a) Amount of dissolved oxygen in the lake will decrease.
- (b) The lake will remain unaffected.

- (c) Number of submerged aquatic plants in the lake will increase.
- (d) Number of aquatic animals in the lake will increase.

19. The last chromosome sequenced in Human Genome Project was

- (a) chromosome 6
- (b) chromosome 1
- (c) chromosome 22
- (d) chromosome 14.

20. The amount of nutrients such as carbon, nitrogen, potassium and calcium present in the soil at any given time is referred to as

- (a) standing state
- (b) standing crop
- (c) humus
- (d) detritus.

21. Plants offer rewards to animals in the form of pollen and nectar and the animals facilitate the pollination process.

This is an example of

- (a) amensalism
- (b) competition
- (c) commensalism
- (d) mutualism.

22. The species of plants that plays a vital role in controlling the relative abundance of other species in a community is called _____.

- (a) alien species
- (b) endemic species
- (c) exotic species
- (d) keystone species

23. Match List-I with List-II.

List I

- (A) Pteropsida
- (B) Lycopsida
- (C) Psilopsida
- (D) Sphenopsida

List II

- (I) *Psilotum*
- (II) *Equisetum*
- (III) *Adiantum*
- (IV) *Selaginella*

Choose the correct answer from the options given below.

- (a) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)
- (b) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
- (c) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
- (d) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

24. Inulin is a polymer of

- (a) fructose
- (b) galactose
- (c) amino acids
- (d) glucose.

25. Thermostable DNA polymerase used in PCR was isolated from

- (a) *Thermus aquaticus*
- (b) *Escherichia coli*
- (c) *Agrobacterium tumefaciens*
- (d) *Bacillus thuringiensis*.

26. Name the component that binds to the operator region of an operon and prevents RNA polymerase from transcribing the operon.

- (a) Promotor
- (b) Regular protein
- (c) Repressor protein
- (d) Inducer

- 27.** A heterozygous pea plant with violet flowers was crossed with homozygous pea plant with white flower. Violet is dominant over white. Which one of the following represents the expected combinations among 40 progenies formed?
- 30 produced violet and 10 produced white flowers
 - 20 produced violet and 20 produced white flowers
 - All 40 produced violet flowers
 - All 40 produced white flowers
- 28.** Fatty acids are connected with the respiratory pathway through
- acetyl CoA
 - α -Ketoglutaric acid
 - di-hydroxy acetone phosphate
 - pyruvic acid.
- 29.** Ligation of foreign DNA at which of the following site will result in loss of tetracyclin resistance of pBR322?
- Pst I
 - Pvu I
 - EcoR I
 - BamH I

30. Match List-I with List-II.

List I	List II
(A) Auxin	(I) Promotes female flower formation in cucumber
(B) Gibberellin	(II) Overcoming apical dominance
(C) Cytokinin	(III) Increase in the length of grape stalks
(D) Ethylene	(IV) Promotes flowering in pineapple

Choose the correct answer from the options given below.

- (A)-(II), (B)-(I), (C)-(IV), (D)-(III)
- (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
- (A)-(I), (B)-(III), (C)-(IV), (D)-(II)
- (A)-(III), (B)-(II), (C)-(I), (D)-(IV)

31. During symport two different molecules move across the membrane

- in same direction with the help of different carriers located at a common site
- in same direction with the help of different carriers located at different sites in the same cell
- in same direction with the help of same carrier
- in opposite direction with the help of same carrier.

32. Which classes of algae possess pigment fucoxanthin and pigment phycoerythrin, respectively?

- Phaeophyceae and Chlorophyceae
- Phaeophyceae and Rhodophyceae
- Chlorophyceae and Rhodophyceae
- Rhodophyceae and Phaeophyceae

- 33.** In which disorder change of single base pair in the gene for beta globin chain results in change of glutamic acid to valine?
- Thalassemia
 - Sickle cell anemia
 - Haemophilia
 - Phenylketonuria
- 34.** For chemical defence against herbivores, *Calotropis* has
- cardiac glycosides
 - strychnine
 - toxic ricin
 - distasteful quinine.
- 35.** Consider the following tissues in the stelar region of a stem showing secondary growth.
- Primary xylem
 - Secondary xylem
 - Primary phloem
 - Secondary phloem
- Arrange these in the correct sequence of their position from pith towards cortex.
- (A), (B), (D), (C)
 - (B), (A), (C), (D)
 - (A), (B), (C), (D)
 - (B), (A), (D), (C)

SECTION - B

Attempt any 10 questions out of 15.

- 36.** Which of the following mineral ion is not remobilised in plants?
- Potassium
 - Calcium
 - Nitrogen
 - Phosphorus
- 37.** Which out of the following statements is incorrect?
- Grana lamellae have both PS I and PS II.
 - Cyclic photophosphorylation involves both PS I and PS II.
 - Both ATP and NADPH + H⁺ are synthesised during non-cyclic photophosphorylation.
 - Stroma lamellae lack PS II and NADP reductase.

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38. Match Column-I with Column-II.

Column-I	Column-II
(A) <i>Nitrococcus</i>	(I) Denitrification
(B) <i>Rhizobium</i>	(II) Conversion of ammonia to nitrite
(C) <i>Thiobacillus</i>	(III) Conversion of nitrite to nitrate
(D) <i>Nitrobacter</i>	(IV) Conversion of atmospheric nitrogen to ammonia

Choose the correct answer from the options given below.

- (a) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
- (b) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
- (c) (A)-(II), (B)-(IV), (C)-(I), (D)-(III)
- (d) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)

39. In angiosperms the correct sequence of events in formation of female gametophyte in the ovule is

- (A) 3 successive free nuclear divisions functional megasporangium.
- (B) Degeneration of 3 megasporangia.
- (C) Meiotic division in megasporangium mother cell.
- (D) Migration of 3 nuclei towards each pole.

(E) Formation of wall resulting in seven celled embryo sac.

Choose the correct answer from the options given below.

- (a) (A), (B), (C), (D), (E)
- (b) (C), (E), (A), (D), (B)
- (c) (B), (C), (A), (D), (E)
- (d) (C), (B), (A), (D), (E)

40. Which of the following statements is true?

- (a) All pteridophytes exhibit haplo-diplontic pattern.
- (b) Seed bearing plants follow haplontic pattern.
- (c) Most algal genera are diplontic.
- (d) Most bryophytes do not have haplo-diplontic life cycle.

41. Which of the following statement is incorrect about *Agrobacterium tumefaciens*?

- (a) It is used to deliver gene of interest in both prokaryotic as well as eukaryotic host cells.
- (b) 'Ti' plasmid from *Agrobacterium tumefaciens* used for gene transfer is not pathogenic to plant cell.
- (c) It transforms normal plant cells into tumor cells.
- (d) It delivers 'T-DNA' into plant cell.

42. Consider the following plant tissues:

- (A) Axillary buds
- (B) Fascicular vascular cambium
- (C) Interfascicular cambium
- (D) Cork cambium
- (E) Intercalary meristem

Identify the lateral meristems among the above.

- (a) (A), (C) and (D) only
- (b) (B), (C) and (D) only

- (c) (A), (B), (C) and (E) only

- (d) (A), (B), (D) and (E) only

43. Match List I with List II.

List I	List II
(A) Kanamycin	(I) Delivers genes into animal cells
(B) <i>Cla</i> I	(II) Selectable marker
(C) Disarmed retroviruses	(III) Restriction site
(D) Kanamycin ^R gene	(IV) Antibiotic resistance

Choose the correct answer from the options given below.

- (a) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)
- (b) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
- (c) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)
- (d) (A)-(II), (B)-(IV), (C)-(I), (D)-(III)

44. Given below are two statements :

Statement I : The process of copying genetic information from one strand of the DNA into RNA is termed as transcription.

Statement II : A transcription unit in DNA is defined primarily by the three regions in the DNA i.e., a promotor, the structural gene and a terminator.

In the light of the above statements, choose the correct answer from the options given below.

- (a) Statement I is true but statement II is false.
- (b) Statement I is false but statement II is true.
- (c) Both statement I and statement II are true.
- (d) Both statement I and statement II are false.

45. Which scientist conducted an experiment with ^{32}P and ^{35}S labelled phages for demonstrating that DNA is the genetic material?

- (a) James D. Watson and F.H.C. Crick
- (b) A.D Hershey and M.J. Chase
- (c) F. Griffith
- (d) O.T. Avery, C.M. MacLeod and M. McCarty

46. A certain plant homozygous for yellow seeds and red flowers was crossed with a plant homozygous for green seeds and white flowers. The F_1 plants had yellow seeds and pink flowers. The F_1 plants were selfed to get F_2 progeny. Assuming independent assortment of the two characters, how many phenotypic categories are expected for these characters in the F_2 generation?

- (a) 9
- (b) 16
- (c) 4
- (d) 6

47. During which stages of mitosis and meiosis respectively does the centromere of each chromosome split?

- (a) Metaphase, Metaphase II
- (b) Prophase, Telophase I
- (c) Telophase, Anaphase I
- (d) Anaphase, Anaphase II

- 48.** Which of the following statements is not correct?
- Phase of cell elongation of plant cells is characterised by increased vacuolation.
 - Cells in the meristematic phase of growth exhibit abundant plasmodesmatal connections.
 - Plant growth is generally determinate.
 - Plant growth is measurable.

- 49.** Match List I with List II.

Type of flower	Example
(A) Zygomorphic	(I) Mustard
(B) Hypogynous	(II) Plum
(C) Perigynous	(III) <i>Cassia</i>
(D) Epigynous	(IV) Cucumber

Select the correct option.

- (A)-(I), (B)-(II), (C)-(IV), (D)-(III)
- (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
- (A)-(IV), (B)-(I), (C)-(III), (D)-(II)
- (A)-(III), (B)-(I), (C)-(II), (D)-(IV)

- 50.** Given below are two statements.

Statement I : The process of translocation through phloem is unidirectional but through xylem, it is bidirectional.

Statement II : The most readily mobilised elements are phosphorus, sulphur, nitrogen and potassium.

In the light of the above statements, choose the most appropriate answer from the options given below:

- Statement I is correct but statement II is incorrect.
- Statement I is incorrect but statement II is correct.
- Both statement I and statement II are correct.
- Both statement I and statement II are incorrect.

SECTION - A (ZOOLOGY)

- 51.** Which of the following sexually transmitted infections are completely curable?

- HIV infection and Trichomoniasis
- Syphilis and Trichomoniasis
- Hepatitis-B and Genital herpes
- Genital herpes and Genital warts

- 52.** Match List I with List II.

List I	List II
(A) Typhoid	(I) Protozoan
(B) Elephantiasis	(II) <i>Salmonella</i>
(C) Ringworm	(III) Aschelminthes
(D) Malaria	(IV) <i>Microsporum</i>

Choose the correct answer from the options given below.

- (A)-(I), (B)-(IV), (C)-(III), (D)-(II)
- (A)-(I), (B)-(III), (C)-(IV), (D)-(I)
- (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
- (A)-(II), (B)-(IV), (C)-(III), (D)-(I)

- 53.** Which of the following is not a secondary metabolite?

- Curcumin
- Morphine
- Anthocyanin
- Lecithin

- 54.** Arrange the sequence of different hormones for their role during gametogenesis.

- Gonadotropin LH stimulates synthesis and secretion of androgen.
- Gonadotropin releasing hormone from hypothalamus
- Androgen stimulates spermatogenesis.
- Gonadotropin FSH helps in the process of spermiogenesis.
- Gonadotropins from anterior pituitary gland.

Choose the correct answer from the options given below :

- (E), (A), (D), (B), (C)
- (C), (A), (D), (E), (B)
- (B), (E), (A), (C), (D)
- (D), (B), (A), (C), (E)

- 55.** House fly belongs to _____ Family.

- Cyprinidae
- Hominidae
- Calliphoridae
- Muscidae

- 56.** Select incorrect statement regarding chemical structure of insulin.

- Mature insulin molecule consists of three polypeptide chains-A, B and C.
- Insulin is synthesised as prohormone which contains extra stretch of C-peptide.
- C-peptide is not present in mature insulin molecule.
- Polypeptide chains A and B are linked by disulphide bridges.

- 57.** Which one of the following is the quiescent stage of cell cycle?

- M
- G₂
- G₁
- G₀

- 58.** Given below are two statements.

Statement I : RNA being unstable, mutate at a faster rate.

Statement II : RNA can directly code for synthesis of proteins hence can easily express the characters.

In the light of the above statements, choose the correct answer from the options given below.

- Statement I is correct but statement II is false.
- Statement I is incorrect but statement II is true.
- Both statement I and statement II are true.
- Both statement I and statement II are false.

- 59.** Given below are two statements.

One is labelled as Assertion (A) and the other is labelled as Reason (R)

Assertion (A) : Ascending limb of loop of Henle is impermeable to water and allows transport of electrolytes actively or passively.

Reason (R) : Dilution of filtrate takes place due to efflux of electrolytes in the medullary fluid.

In the light of the above statement, choose the correct answer from the options given below.

- (a) (A) is true but (R) is false.
- (b) (A) is false but (R) is true.
- (c) Both (A) and (R) are true and (R) is the correct explanation of (A).
- (d) Both (A) and (R) are true and (R) is not the correct explanation of (A).

60. The cockroach is

- (a) ammonotelic only (b) uricotelic only
- (c) ureotelic only (d) ureotelic and uricotelic.

61. Which of the following statements are correct with respect to the hormone and its function?

- (A) Thyrocalcitonin (TCT) regulates the blood calcium level.
- (B) In males, FSH and androgens regulate spermatogenesis.
- (C) Hyperthyroidism can lead to goitre.
- (D) Glucocorticoids are secreted in adrenal medulla.
- (E) Parathyroid hormone is regulated by circulating levels of sodium ions.

Choose the most appropriate answer from the options given below.

- (a) (C) and (E) only (b) (A) and (B) only
- (c) (B) and (C) only (d) (A) and (D) only

62. Select the sequence of steps in respiration.

- (A) Diffusion of gases (O_2 and CO_2) across alveolar membrane.
- (B) Diffusion of O_2 and CO_2 between blood and tissues.
- (C) Transport of gases by the blood.
- (D) Pulmonary ventilation by which atmospheric air is drawn in and CO_2 rich alveolar air is released out.
- (E) Utilisation of O_2 by the cells for catabolic reactions are resultant release of CO_2 .

Choose the correct answer from the options given below.

- (a) (D), (A), (C), (B), (E) (b) (C), (B), (A), (E), (D)
- (c) (B), (C), (E), (D), (A) (d) (A), (C), (B), (E), (D)

63. Which of the following is/are cause(s) of biodiversity losses?

- (a) Over-exploitation, habitat loss and fragmentation
- (b) Climate change only
- (c) Over-exploitation only
- (d) Habitat loss and fragmentation only

64. Match List I with List II.

List I	List II
(A) Contractile vacuole	(I) <i>Asterias</i>
(B) Water vascular system	(II) <i>Amoeba</i>
(C) Canal system	(III) <i>Spongilla</i>
(D) Flame cells	(IV) <i>Taenia</i>

Choose the correct answer from the options given below.

- (a) (A)-(IV), (B)-(II), (C)-(I), (D)-(III)
- (b) (A)-(I), (B)-(III), (C)-(II), (D)-(IV)

- (c) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)
- (d) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)

65. Match List I with List II.

List I	List II
(A) Palm bones	(I) Phalanges
(B) Wrist bones	(II) Metacarpals
(C) Ankle bones	(III) Carpal
(D) Digit bones	(IV) Tarsals

Choose the correct answer from the options given below.

- (a) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)
- (b) (A)-(IV), (B)-(I), (C)-(II), (D)-(III)
- (c) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
- (d) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)

66. Match List I with List II.

List I	List II
(A) Non-medicated IUDs	(I) Multiload 375
(B) Copper releasing IUDs	(II) Rubber barrier
(C) Hormone releasing IUDs	(III) Lippes' loop
(D) Vaults	(IV) LNG-20

Choose the correct answer from the options given below.

- (a) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)
- (b) (A)-(II), (B)-(IV), (C)-(III), (D)-(I)
- (c) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
- (d) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

67. Which of the following can act as molecular scissors?

- (a) Restriction enzymes (b) DNA ligase
- (c) RNA polymerase (d) DNA polymerase

68. Select the correct statements about sickle cell anaemia

- (A) There is a change in gene for beta globin.
- (B) In the beta globin, there is valine in the place of lysine.
- (C) It is an example of point mutation.
- (D) In the normal gene U is replaced by (A)

Choose the correct answer from the options given below.

- (a) (B), (C) and (D) only (b) (B) and (D) only
- (c) (A), (B) and (D) only (d) (A) and (C) only

69. Given below are two statements.

Statement I : Intra Cytoplasmic Sperm Injection (ICSI) is another specialised procedure of *in-vivo* fertilisation.

Statement II : Infertility cases due to inability of the male partner to inseminate female can be corrected by artificial insemination (AI).

In the light of the above statements, choose the correct answer from the options given below.

- (a) Statement I is correct but statement II is false.
- (b) Statement I is incorrect but statement II is true.
- (c) Both statement I and statement II are true.
- (d) Both statement I and statement II are false.

70. Match List I with List II.

List I (ECG)	List II (Electrical activity of heart)
(A) P-wave	(I) Depolarisation of ventricles
(B) QRS complex	(II) End of systole
(C) T wave	(III) Depolarisation of atria
(D) End of T wave	(IV) Repolarisation of ventricles

Choose the correct answer from the options given below.

- (a) (A)-(IV), (B)-(I), (C)-(III), (D)-(II)
- (b) (A)-(I), (B)-(IV), (C)-(III), (D)-(II)
- (c) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)
- (d) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

71. Match List I with List II.

List I	List II
(A) Eosinophils	(I) 6 – 8%
(B) Lymphocytes	(II) 2 – 3%
(C) Neutrophils	(III) 20 – 25%
(D) Monocytes	(IV) 60 – 65 %

Choose the correct answer from the options given below.

- (a) (A)-(IV), (B)-(I), (C)-(III), (D)-(III)
- (b) (A)-(IV), (B)-(I), (C)-(III), (D)-(II)
- (c) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
- (d) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

72. Given below are two statements.

Statement I : Goblet cells are unicellular glands.

Statement II : Earwax is the secretion of exocrine gland. In the light of the above statements, choose the correct answer from the options given below.

- (a) Statement I is true but statement II is false.
- (b) Statement I is false but statement II is true.
- (c) Both statement I and statement II are true.
- (d) Both statement I and statement II are false.

73. Given below are two statements regarding oogenesis.

Statement I : The primary follicles get surrounded by more layers of granulosa cells, a theca and shows fluid filled cavity antrum. Now it is called secondary follicle.

Statement II : Graafian follicle ruptures to release the secondary oocyte from the ovary by the process called ovulation.

In the light of the above statements, choose the correct answer from the options given below.

- (a) Statement I is correct but statement II is false.
- (b) Statement I is incorrect but statement II is true.
- (c) Both statement I and statement II are true.
- (d) Both statement I and statement II are false.

74. If there are 250 snails in a pond, and within a year their number increases to 2500 by reproduction. What should be their birth rate per snail per year?

- (a) 10
- (b) 9
- (c) 25
- (d) 15

75. Given below are two statements.

Statement I : The nose contains mucus-coated receptors which are specialised for receiving the sense of smell and are called olfactory receptors.

Statement II : Wall of the eye ball has three layers. The external layer is called choroid (dense connective tissue), middle layer is sclera (thin pigmented layer) and internal layer is retina (ganglion cells, bipolar cells and photoreceptor cells). In the light of the above statements, choose the correct answer from the options given below.

- (a) Statement I is true but statement II is false.
- (b) Statement I is false but statement II is true.
- (c) Both statement I and statement II are true.
- (d) Both statement I and statement II are false.

76. Which one of the following acts as an inducer for lac operon?

- (a) Sucrose
- (b) Lactose
- (c) Glucose
- (d) Galactose

77. Match List I with List II.

List I	List II
(A) Deforestation	(I) Responsible for heating of Earth's surface and atmosphere
(B) Reforestation	(II) Conversion of forested areas to non-forested areas
(C) Green-house effect	(III) Natural ageing of lake by nutrient enrichment of its water
(D) Eutrophication	(IV) Process of restoring a forest that once existed but was removed

Choose the correct answer from the options given below.

- (a) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
- (b) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
- (c) (A)-(III), (B)-(I), (C)-(II), (D)-(IV)
- (d) (A)-(II), (B)-(IV), (C)-(I), (D)-(III)

78. Diacetyl morphine is also called as

- (a) amphetamine
- (b) barbiturate
- (c) crack
- (d) smack.

79. 'X' and 'Y' are the components of Binomial nomenclature. This naming system was proposed by 'Z'.

- (a) X-Generic name, Y-Specific epithet, Z-Carolus Linnaeus
- (b) X-Specific epithet, Y-Generic name, Z-R.H. Whittaker

- (c) X-Specific epithet, Y-Generic name, Z-Carolus Linnaeus
 (d) X-Generic name, Y-Specific epithet, Z-R.H. Whittaker
- 80.** Which of the following statements are correct?
 (A) Reproductive health refers to total well-being in all aspects of reproduction.
 (B) Amniocentesis is legally banned for sex determination in India.
 (C) "Saheli" a new oral contraceptive for females was developed in collaboration with ICMR (New Delhi).
 (D) Amniocentesis is used to determine genetic disorders and survivability of foetus.
 Choose the most appropriate answer from the options given below.
 (a) (B) and (C) only (b) (D) and (C) only
 (c) (A), (B) and (D) only (d) (A) and (C) only
- 81.** Match List I with List II.
- | List I | List II |
|-----------------|---------------------|
| (A) Terpenoides | (I) Codeine |
| (B) Lectins | (II) Diterpenes |
| (C) Alkaloids | (III) Ricin |
| (D) Toxins | (IV) Concanavalin A |
- Choose the correct answer from the options given below.
 (a) (A)-(II), (B)-(IV), (C)-(III), (D)-(I)
 (b) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)
 (c) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)
 (d) (A)-(II), (B)-(IV), (C)-(I), (D)-(III)
- 82.** Given below are two statements.
Statement I : In bacteria, the mesosomes are formed by the extensions of plasma membrane.
Statement II : The mesosomes, in bacteria, help in DNA replication and cell wall formation.
 In the light of the above statements, choose the most appropriate answer from the options given below.
 (a) Statement I is correct but statement II is incorrect.
 (b) Statement I is incorrect but statement II is correct.
 (c) Both statement I and statement II are correct.
 (d) Both statement I and statement II are incorrect.
- 83.** Select correct sequence of substages of Prophase-I of meiotic division.
 (A) Zygote (B) Pachytene
 (C) Diakinesis (D) Leptotene
 (E) Diplotene
 Choose the correct answer from the options given below.
 (a) (D), (B), (A), (E), (C) (b) (A), (B), (D), (E), (C)
 (c) (D), (A), (B), (E), (C) (d) (A), (D), (B), (C), (E)
- 84.** Brainstem of human brain consists of
 (a) Mid-brain, Pons and Medulla oblongata
 (b) Forebrain, Cerebellum and Pons
- (c) Thalamus, Hypothalamus and Corpora quadrigemina
 (d) Amygdala, Hippocampus and Corpus callosum.
- 85.** Identify the fossil of man who showed the following characteristics.
 (A) Brain capacity of 1400 cc
 (B) Used hides to protect their body
 (C) Buried their dead bodies
 In the light of above statements, choose the correct answer from the options given below.
 (a) *Homo erectus* (b) Neanderthal man
 (c) *Homo habilis* (d) *Australopithecus*

SECTION - B (ZOOLOGY)

Attempt any 10 questions out of 15.

- 86.** With reference to Hershey and Chase experiments. Select the correct statements.
 (A) Viruses grown in the presence of radioactive phosphorus contained radioactive DNA.
 (B) Viruses grown on radioactive sulphur contained radioactive proteins.
 (C) Viruses grown on radioactive phosphorus contained radioactive protein.
 (D) Viruses grown on radioactive sulphur contained radioactive DNA.
 (E) Viruses grown on radioactive protein contained radioactive DNA.
 Choose the most appropriate answer from the options given below.
 (a) (D) and (E) only (b) (A) and (B) only
 (c) (A) and (C) only (d) (B) and (D) only
- 87.** Select the correct sequential steps regarding absorption of fatty acids and glycerol, in intestine.
 (A) Micelles are reformed into small protein coated fat globules called chylomicrons.
 (B) Micelles move into intestinal mucosa.
 (C) Fatty acids and glycerol are incorporated into small droplets called micelles.
 (D) Lacteals release the absorbed substances into blood stream.
 (E) Chylomicrons are transported into lacteals.
 Choose the correct answer from the options given below.
 (a) (A), (E), (B), (D), (C) (b) (D), (E), (B), (C), (A)
 (c) (C), (B), (A), (E), (D) (d) (B), (C), (E), (A), (D)
- 88.** Given below are two statements. One is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): A person goes to high altitude and experiences "Altitude Sickness" with symptoms like breathing difficulty and heart palpitations.

Reason (R) : Due to low atmospheric pressure at high altitude, the body does not get sufficient oxygen.

In the light of the above statements, choose the correct answer from the options given below.

- (a) (A) is true but (R) is false.
- (b) (A) is false but (R) is true.
- (c) Both (A) and (R) are true and (R) is the correct explanation of (A).
- (d) Both (A) and (R) are true but (R) is not the correct explanation of (A).

89. The salient features of genetic code are

- (A) The code is palindromic.
- (B) UGA act as initiator codon.
- (C) The code is unambiguous and specific.
- (D) The code is nearly universal.

Choose the most appropriate answer from the options given below.

- (a) (A) and (D) only (b) (B) and (C) only
- (c) (A) and (B) only (d) (C) and (D) only

90. Arrange the events of Renin - Angiotensin mechanism in correct sequence.

- (A) Activation of JG cells and release of renin.
- (B) Angiotensin II activates release of aldosterone.
- (C) Fall in glomerular blood pressure.
- (D) Reabsorption of Na^+ and water from distal convoluted tubule.
- (E) Angiotensinogen is converted to Angiotensin I and then to Angiotensin II.

Choose the correct answer from the options given below.

- (a) (C), (A), (E), (B), (D) (b) (A), (D), (E), (C), (B)
- (c) (A), (D), (C), (B), (E) (d) (B), (A), (E), (D), (C)

91. Select the correct statements regarding dissolved oxygen and Biochemical Oxygen Demand.

- (A) BOD is inversely related to dissolved oxygen.
- (B) Low dissolved oxygen and high BOD lead to loss of aquatic life.
- (C) High BOD leads to high dissolved oxygen.
- (D) Both BOD and dissolved oxygen are indicator of health of a water body.
- (E) Both BOD and dissolved oxygen are affected by amount of organic matter in the water body.

Choose the most appropriate answer from the options given below.

- (a) (A), (B), (C), (E) only (b) (A), (B), (D), (E) only
- (c) (A), (B), (C), (D) only (d) (B), (C), (D), (E) only

92. Given below are two statements :

Statement I : Parathyroid hormone acts on bones and stimulates the process of bone resorption.

Statement II : Parathyroid hormone along with Thyrocalcitonin plays a significant role in carbohydrate metabolism.

In the light of the above statements, choose the correct answer from the options given below :

- (a) Statement I is correct but statement II is false.
- (b) Statement I is incorrect but statement II is true.
- (c) Both statement I and statement II are true.
- (d) Both statement I and statement II are false.

93. Select the correct statements.

- (A) Platyhelminthes are triploblastic pseudocoelomate and bilaterally symmetrical organisms.
- (B) Ctenophores reproduced only sexually and fertilisation is external.
- (C) In tapeworm, fertilisation is internal but sexes are not separate.
- (D) Ctenophores are exclusively marine diploblastic and bioluminescent organisms.
- (E) In sponges, fertilisation is external and development direct.

Choose the correct answer from the option given below.

- (a) (A), (C) and (D) only (b) (B), (C) and (D) only
- (c) (A) and (E) only (d) (B) and (D) only

94. Match List I with List II.

List I	List II
--------	---------

- | | |
|-------------------------|---|
| (A) Gene therapy | (I) Separation of DNA fragments |
| (B) RNA interference | (II) Diagnostic test for AIDS |
| (C) ELISA | (III) Cellular defence |
| (D) Gel Electrophoresis | (IV) Allows correction of a gene defect |

Choose the correct answer from the options given below.

- (a) (A)-(IV), (B)-(I), (C)-(II), (D)-(III)
- (b) (A)-(IV), (B)-(II), (C)-(III), (D)-(I)
- (c) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
- (d) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

95. Which of the following statements are correct with respect of Golgi apparatus?

- (A) It is the important site of formation of glycoprotein and glycolipids.
- (B) It produced cellular energy in from of ATP.
- (C) It modifies the protein synthesised by ribosomes on ER.
- (D) It facilities the transport of ions.
- (E) It provides mechanical support.

Choose the most appropriate answer from the options given below.

- (a) (B) and (C) only (b) (A) and (C) only
- (c) (A) and (D) only (d) (D) and (E) only

- 96.** Select the incorrect statement with respect to Multiple Ovulation Embryo Transfer (MOET) Technology.
- Fertilised eggs at 4 to 6 cells - stages are recovered non-surgically from super-ovulation cow transferred to surrogate mother.
 - It is used to increase herd size in a short time.
 - Cow is administered with hormones to induce super-ovulation.
 - Super-ovulating cow is either mated with elite bull or is artificially inseminated.

- 97.** Given below are two statements.

Statement I : In cockroach, the forewings are transparent and prothoracic in origin.

Statement II : In cockroach, the hind wings are opaque, leathery and mesothoracic in origin.

In the light of the above statements, choose the correct answer from the options given below.

- Statement I is correct but statement II is false.
- Statement I is incorrect but statement II is true.
- Both statement I and statement II are true.
- Both statement I and statement II are false.

- 98.** Match List I with List II.

List I	List II
(A) Columnar epithelium	(I) Ducts of glands
(B) Ciliated epithelium	(II) Inner lining of stomach and intestine
(C) Squamous epithelium	(III) Inner lining of bronchioles
(D) Cuboidal epithelium	(IV) Endothelium

Choose the correct answer from the options given below :

- (A)-(III), (B)-(II), (C)-(I), (D)-(IV)
- (A)-(III), (B)-(II), (C)-(IV), (D)-(I)
- (A)-(II), (B)-(III), (C)-(I), (D)-(IV)
- (A)-(II), (B)-(III), (C)-(IV), (D)-(I)

- 99.** Match List I with List II.

List I	List II
(A) Cytokine barriers	(I) Mucus coating of respiratory tract
(B) Cellular barriers	(II) Interferons
(C) Physiological barriers	(III) Neutrophils and macrophages
(D) Physical barriers	(IV) Tears and saliva

Choose the correct answer from the options given below :

- (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
- (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
- (A)-(III), (B)-(I), (C)-(II), (D)-(IV)
- (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

- 100.** Select the correct statement(s) with respect to mechanism of sex determination in grasshopper.

- It is an example of female heterogamety.
- Male produces two different types of gametes either with or without X chromosome.
- Total number of chromosomes (autosomes and sex chromosomes) is same in both males and females.

- All eggs bear an additional X chromosome besides the autosomes.

Choose the correct answer from the options given below :

- (B) and (D) only
- (A), (C) and (D) only
- (A) only
- (A) and (C) only

SOLUTIONS

1. **(c)** : Protein – Peptide bonds
Unsaturated fatty acids – C = C double bonds
Nucleic acid – Phosphodiester bond
Polysaccharide – Glycosidic bond
2. **(d)**
3. **(a)** : In *Calotropis*, sepals or petals in a whorl just touch one another at the margin, without overlapping, thus, type of aestivation is called valvate.
4. **(a)** : A chromatographic separation of the leaf pigments shows variety of colours in the chromatogram due to presence of four pigments: Chlorophyll a (bright or blue green), chlorophyll b (yellow green), xanthophylls (yellow) and carotenoids (yellow to yellow-orange).
5. **(a)** : Aging of a lake by nutrient enrichment of its water due to human activities such as agricultural and industrial waste is called cultural eutrophication. Agricultural waste contains nitrogen and phosphorus in the form of nitrates and phosphates. These nutrients help in the formation of algal bloom. Increased growth of algae uses up dissolved oxygen in the water body, killing other aquatic organisms like fish.
6. **(a)**
7. **(d)** : In each TCA cycle, isocitrate produced from citrate undergoes two successive decarboxylation reactions, leading to the formation of α -ketoglutaric acid and then succinyl Co-A. Two CO_2 molecules are released during these steps.
8. **(b)** : During diplotene in prophase I of meiosis I, dissolution of the nucleoprotein synaptonemal complex occurs. Therefore, homologous chromosomes separate except in the region of crossing over.
9. **(d)** : Mass flow is the movement of substances in bulk from one point to another as a result of pressure differences between the two points. In mass flow, different substances, whether in solution or in suspension, are swept along at the same pace, as in a flowing river.
10. **(d)** : Doubling of the number of chromosomes can be achieved by disrupting mitotic cell division soon after metaphase stage. Soon after metaphase, each chromosome arranged at the metaphase plate is split simultaneously and the two daughter chromatids begin their migration towards the two opposite poles. If this is prevented, chromosome number will be doubled.

- 11. (c)**: Ribulose Bisphosphate Carboxylase-Oxygenase (RuBisCO) is the most abundant protein in the whole of the biosphere. C₄ plants lack photorespiration as they have a mechanism that increases the concentration of CO₂ at the enzyme site, so RuBisCO does not bind to oxygen.
- 12. (a)**: The Rivet popper hypothesis was proposed by Stanford ecologist Paul Ehrlich as an analogy. He compared the rivets in an airplane to species within a genus. According to him, in an airplane (ecosystem), all parts are joined together using thousands of rivets (species). If every passenger travelling in it starts popping a rivet (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. Loss of rivets on the wings (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.
- 13. (d)**: In flowers of pea, there are five petals which are arranged in a specialised manner, the largest (standard) posterior petal overlaps the two lateral petals (wings) which in turn overlap the two smallest anterior petals (keel). This type of aestivation is known as vexillary or papilionaceous.
- 14. (d)**: In some members of Families Rosaceae, Leguminosae and Solanaceae, pollen grains maintain viability for months.
- 15. (a)**: Geitonogamy involves transfer of pollen grains from the anther to the stigma of another flower of the same plant. Autogamy is a type of self pollination in which an intersexual or perfect flower is pollinated by its own pollen, i.e., it involves the transfer of pollen grains from anther to stigma of the same flower. Xenogamy involves transfer of pollen grains from anther to the stigma of a different plant. Cleistogamy is a phenomenon in which flowers do not open at all, therefore show self-fertilisation and autogamy.
- 16. (a)**: Phototropism is the movement of shoot towards the light. Auxins get accumulated towards the shady region of the stem and stimulate the cells on that side to grow longer. This results in the bending of stem towards the light. This was seen in the experiments conducted by F.W. Went on *Avena* coleoptile tips.
- 17. (a)**: Monocot roots have more than six xylem bundles (polyarch) while dicot roots have 2-4 vascular bundles. Radial vascular bundle is a characteristic feature of both monocot and dicot roots. Pericycle produce lateral roots and vascular cambium during secondary growth in dicot plants.
- 18. (a)**: Biochemical Oxygen Demand (BOD) is a measure of oxygen required by aerobic decomposers for the biochemical degradation of organic materials. A high BOD in fresh water means high levels of nutrients are present, along with high number of microorganisms feeding the nutrients. It depletes the oxygen content of fresh water and as a result there is a sharp decline in dissolved oxygen.
- 19. (b)**: In Human Genome Project, the sequencing of last chromosome i.e., chromosome 1 was completed in May 2006.
- 20. (a)**: The amount of nutrients, such as carbon, nitrogen, phosphorus, calcium, etc., present in the soil at any given time, is referred to as the standing state. It varies in different kinds of ecosystems and also on seasonal basis.
- 21. (d)**: The relationship between plants and animals is the most spectacular and evolutionarily fascinating examples of mutualism. Plants need the help of animals for pollinating their flowers and dispersing their seeds. Animals get rewards in the form of pollen and nectar for pollinators and juicy and nutritious fruits for seed dispersers.
- 22. (d)**: Keystone species are those species which has significant and disproportionately large influence on the community structure and characteristics. It has often considerably low abundance and biomass as compared to dominant species. Removal of such species causes serious disruption in structure and function of community.
- 23. (d)**: The pteridophytes are classified into four classes: Psilosida (*Psilotum*); Lycopsida (*Selaginella*, *Lycopodium*); Sphenopsida (*Equisetum*) and Pteropsida (*Dryopteris*, *Pteris*, *Adiantum*).
- 24. (a)**: Inulin is a polymer of monosaccharide fructose.
- 25. (a)**: In PCR, the repeated amplification is achieved by the use of a thermostable DNA polymerase enzyme *Taq* polymerase which is obtained from bacterium *Thermus aquaticus*. This enzyme remains active during the high temperature induced for denaturation of double stranded DNA.

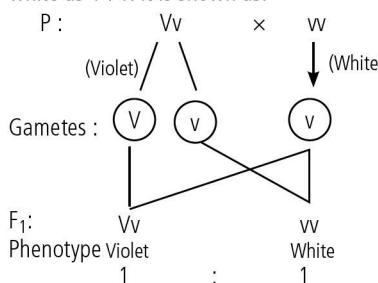
SOLUTIONS TO JUNE 2023 QUIZ CLUB

- | | |
|---------------------------------------|---------------------------------|
| 1. Ophiocordyceps | 10. Dairy farmers |
| 2. DNA | 11. Tripura |
| 3. Stapedius | 12. Hypochondria |
| 4. Three | 13. Azerbaijan and Tajikistan |
| 5. Theobromine | 14. Oxford |
| 6. Influenza flue | 15. Tamil Nadu |
| 7. Primary amebic meningoencephalitis | 16. MeFeego Pack |
| 8. Indore | 17. <i>Mimeusemia ceylonica</i> |
| 9. 30 th March | 18. Malabar banded peacock |
| | 19. Arboriculture |
| | 20. Svante Pääbo |

Winner: Arpan Bhattacharya (West Bengal)

26. (c): The repressor protein synthesised from regulatory gene (*i* gene) binds to the operator region of the operon and prevents RNA polymerase from transcribing the operon.

27. (b): Violet is dominant over white. So, heterozygous violet flowers will have the genotype of (Vv) and white flowers will have genotype of (vv). When these two plants are crossed, the F₁ generation will have the ratio of violet: white as 1 : 1. It is shown as:



Thus, 20 violet and 20 white flowers are produced among 40 progenies.

28. (a): Fats are broken down into glycerol and fatty acids first. If fatty acids were to be respired they would first be degraded to acetyl CoA and then enter the Krebs' cycle. Glycerol would enter the pathway after being converted to 3-phosphoglyceraledehyde (PGAL). Thus, fatty acids are connected with the respiratory pathway through acetyl CoA.

29. (d): In the plasmid vector, pBR322, tetracycline resistance gene contains recognition sites for two restriction enzymes *Bam* H I and *Sal* I. The recombinant plasmids will lose tetracycline resistance due to insertion of foreign DNA at one of these sites.

30. (b)

31. (c): In symport method of transport, two different molecules cross the membrane in the same direction at the same time with the help of same carrier.

32. (b): Phaeophyceae vary in colour from olive green to various shades of brown due to presence of varying amount of the xanthophyll and fucoxanthin pigment. The members of rhodophyceae are commonly called red algae because of the predominance of the red pigment, *r*-phycoerythrin in their body.

33. (b): Sickle cell anemia is caused by the substitution of Glutamic acid (Glu) by Valine (Val) at the sixth position of the beta globin chain of the haemoglobin molecule. The substitution of amino acid in the globin protein results due to the single base substitution at the sixth codon of the beta globin gene from GAG to GUG.

34. (a): *Calotropis* plant produces highly poisonous cardiac glycosides as defence against herbivores. Thus, herbivores do not browse on this plant.

35. (a)

36. (b): Calcium is a part of the structural component of the cell and hence, is not easily remobilised.

37. (b): Cyclic photophosphorylation is a process of light reaction in which an electron expelled by the excited photocentre is returned to it after passing through a series of electron carriers. It occurs under conditions of low light intensity, wavelength longer than 680 nm and when carbon dioxide fixation is inhibited. It is performed by photosystem I only. The cyclic flow hence, results only in the synthesis of ATP, but not of NADPH + H⁺.

38. (c)

39. (d): The sequence of events in formation of female gametophyte in the ovule in an angiosperm is as follows:

- (i) Megasporangium or megasporocyte is a diploid (2n) cell which undergoes meiosis to form a linear tetrad of four haploid megaspores (n).
- (ii) Normally, the chalazal megasporangium is the functional megasporangium while the other three degenerate. The functional megasporangium is the first cell of female gametophyte.
- (iii) The nucleus of the functional megasporangium divides mitotically to form 2-nucleate embryo sac. Two more sequential mitotic nuclear divisions result in the formation of the 4-nucleate and later the 8-nucleate stages of the embryo sac. These mitotic divisions are strictly free nuclear, which means nuclear divisions are not followed immediately by cell wall formation.
- (iv) After the 8-nucleate stage, cell walls are laid down leading to the organisation of the typical female gametophyte or embryo sac with 7-cells.

40. (a): Pteridophytes exhibit haplo-diplontic pattern in their life cycle. The diploid sporophyte represented by a dominant, independent, photosynthetic, vascular plant body alternates with multicellular, saprophytic or autotrophic, independent but short-lived haploid gametophyte. All seed bearing plants i.e., gymnosperms and angiosperms, follow diplontic pattern. Most algal genera are haplontic, some of them such as *Ectocarpus*, *Polysiphonia*, kelps are haplo-diplontic and *Fucus* is diplontic. All bryophytes have haplo-diplontic life cycle.

41. (a): Ti plasmid (tumour inducing) from the soil bacterium *Agrobacterium tumefaciens* is effectively used as vector for gene transfer to eukaryotic (plant) cells. The part of Ti plasmid transferred into plant cell DNA, is called the T-DNA.

42. (b): Fascicular vascular cambium, interfascicular cambium and cork-cambium are examples of lateral meristems as these are responsible for producing the secondary tissues. Axillary buds are present in the axils of leaves and are capable of forming a branch or a flower. Intercalary meristem is a primary meristem as they appear early in life

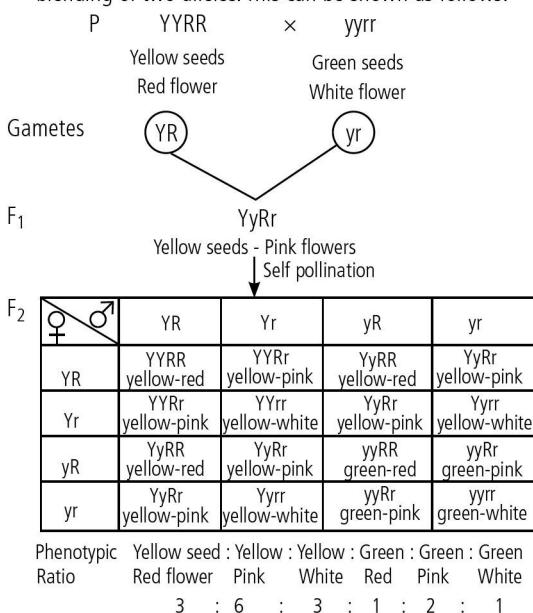
of a plant and contribute to the formation of the primary plant body.

43. (c)

44. (c)

45. (b): Hershey and Chase conducted an experiment with ^{32}P and ^{35}S labelled T-2 type bacteriophage and concluded that DNA is the genetic material.

46. (d): When the plant homozygous for yellow seeds and red flowers (YYRR) was crossed with a plant homozygous for green seeds and white flowers (yyrr), F_1 plants produced with yellow seeds and pink flowers. This means inheritance of seed colour shows complete dominance while inheritance of flower colour shows incomplete dominance due to blending of two alleles. This can be shown as follows:



Therefore, six phenotypic categories are obtained in the F_2 generation.

47. (d): In anaphase stage of mitosis, centromeres split and chromatids separate and move to opposite poles. In anaphase II of meiosis, the centromere of each chromosome split, allowing them to move toward opposite poles of the cell by shortening of microtubules attached to kinetochores.

48. (c): Plant growth is generally indeterminate, i.e., continued throughout life.

49. (d)

50. (b): The direction of movement in the phloem can be upwards or downwards, i.e., bi-directional while in xylem, movement is always unidirectional, i.e., upwards.

51. (b): Except for hepatitis-B, genital herpes and HIV infections, other STDs are completely curable if detected early and treated properly.

52. (c): Typhoid is caused by a pathogenic bacterium *Salmonella typhi*. Elephantiasis is caused by filarial worm *Wuchereria bancrofti* and *malayi* which are aschelminthes. Ringworm is caused by fungi belonging to genera *Microsporum*, *Trichophyton* and *Epidermophyton*. Malaria is caused by a protozoan *Plasmodium*.

53. (d): Secondary metabolites are derivatives of primary metabolites which have no direct function in growth and development of plants. Lecithin is a phospholipid and a primary metabolite.

54. (c): Spermatogenesis starts at the age of puberty due to significant increase in the secretion of a hypothalamic hormone, gonadotropin releasing hormone (GnRH). The increased levels of GnRH then act at the anterior pituitary gland and stimulates secretion of two gonadotropins – luteinising hormone (LH) and follicle stimulating hormone (FSH). LH acts at the Leydig cells and stimulates synthesis and secretion of androgens. Androgens, in turn, stimulate the process of spermatogenesis. FSH acts on the Sertoli cells and stimulates secretion of some factors which help in the process of spermiogenesis.

55. (d): Housefly belongs to Family Muscidae.

56. (a): Insulin consists of two short polypeptide chains- chain A and chain B which are linked together by disulphide bonds. Insulin, in mammals is synthesised as a prohormone which contains an extra stretch called the C-peptide. During maturation into insulin, this C-peptide is removed.

57. (d): The cells that do not divide further exit G_1 phase to enter an inactive stage called quiescent stage (G_0) of the cell cycle. Cells in this stage remain metabolically active but no longer proliferate unless called on to do so depending on the requirement of the organism.

58. (c)

59. (c): Since the ascending limb of loop of henle is impermeable to water and permeable to electrolytes, the concentrated filtrate becomes diluted due to passage of electrolytes out from Henle's loop into the medullary fluid.

60. (b): Cockroach is uricotelic. They absorb nitrogenous waste products and convert them into uric acid which is excreted out through the hindgut.

61. (b): Goitre is caused due to deficiency of iodine in diet because iodine is needed for the synthesis of thyroid hormone. Hypothyroidism leads to goitre. Adrenal cortex of adrenal gland secretes glucocorticoids which regulates carbohydrate metabolism. The secretion of parathyroid hormone (PTH) is regulated by the circulating levels of calcium ions.

62. (a): Respiration involves the following steps: (i) Breathing or pulmonary ventilation by which atmospheric air is drawn in and CO_2 rich alveolar air is released out. (ii) Diffusion of gases (O_2 and CO_2) across alveolar membrane.

- (iii) Transport of gases by the blood. (iv) Diffusion of O₂ and CO₂ between blood and tissues. (v) Utilisation of O₂ by the cells for catabolic reactions and resultant release of CO₂ i.e., cellular respiration.
- 63. (a):** There are four major causes of biodiversity losses which are collectively called as-the evil quartet. These are habitat loss and fragmentation, over-exploitation, alien species invasion and co-extinctions. However, other factors are also intensifying extinctions like disturbance and degradation, pollution, intensive agriculture and forestry.
- 64. (d)** **65. (d)** **66. (c)**
- 67. (a):** Restriction enzymes act as molecular scissors as these enzymes cut DNA duplex at some certain specific points called restriction sites.
- 68. (d):** Sickle cell anaemia is caused by the substitution of Glutamic acid (Glu) by Valine (Val) at the sixth position of the beta globin chain of the haemoglobin molecule. The substitution of amino acid in the globin protein results due to the single base substitution at the sixth codon of the beta globin gene from GAG to GUG. Thus, it is an example of point mutation.
- 69. (b):** Intra cytoplasmic sperm injection (ICSI) is a specialised procedure to form an embryo in the laboratory in which a sperm is directly injected into the ovum. Thus, it is *in-vitro* procedure.
- 70. (d)** **71. (c)**
- 72. (c):** Goblet cells of the alimentary canal are unicellular glands consisting of isolated glandular cells. Earwax is the secretion of exocrine gland which is secreted through ducts or tubes.
- 73. (b):** The primary follicles get surrounded by more layers of granulosa cells and a new theca and are called secondary follicles. The secondary follicle soon transforms into a tertiary follicle which is characterised by a fluid filled cavity called antrum.
- 74. (b):** Total number of snails in a pond (in the beginning) = 250
 Total number of snails after a year = 2500
 Number of snails added = 2500-250 = 2250
 Birth rate = New snails added/Total number of snails in the beginning = 2250/250 = 9 individuals per snail per year
- 75. (a):** The wall of the eye ball is composed of three layers. The external layer is composed of a dense connective tissue called the sclera. The anterior portion of this layer is called the cornea. The middle layer, choroid, contains many blood vessels and looks bluish in colour. The inner layer is the retina and it contains three layers of neural cells – from inside to outside – ganglion cells, bipolar cells and photoreceptor cells.
- 76. (b):** Lactose is the substrate for the enzyme beta-galactosidase and it regulates switching on and off of the *Lac* operon. Therefore, it acts as inducer.
- 77. (d)**
- 78. (d):** Heroin, commonly called smack is chemically diacetylmorphine which is a white, odourless, bitter crystalline compound. This is obtained by acetylation of morphine, which is extracted from the latex of poppy plant *Papaver somniferum*.
- 79. (a):** Binomial nomenclature is a system of providing a name with two components– the Generic name(X) and the specific epithet(Y). This naming system given by Carolus Linnaeus (Z) is being practised by biologists all over the world.
- 80. (c) :** *Saheli* is a new oral contraceptive for the females was developed by scientists at Central Drug Research Institute (CDRI) in Lucknow, India.
- 81. (d)** **82. (c)**
- 83. (c) :** The first stage prophase-I of meiotic division is subdivided into the following five phases based on chromosomal behaviour, i.e., Leptonene, Zygotene, Pachytene, Diplotene and Diakinesis.
- 84. (a):** Three major regions make up the brain stem-mid brain, pons and medulla oblongata. Brain stem forms the connections between the brain and spinal cord.
- 85. (b):** The given characteristics are of Neanderthal man which had a brain size of 1400cc and lived in near east and central Asia between 1,00,000-40,000 years back. They used hides to protect their body and buried their dead.
- 86. (b):** The experiments of Hershey and Chase on bacteriophages proved that DNA is a genetic material. They incorporated radioactive isotope of phosphorus (³²P) into phage DNA and that of sulphur (³⁵S) into proteins of a separate phage culture. Viruses grown in the presence of radioactive phosphorus contained radioactive DNA but not radioactive protein because DNA contains phosphorus but proteins do not. Similarly, viruses grown on radioactive sulphur contain radioactive protein but not radioactive DNA because DNA does not contain sulphur. After blending and centrifugation, they found that bacteria which was infected with viruses that had radioactive DNA were radioactive while bacteria that were infected with viruses that had radioactive proteins were not radioactive which indicated that proteins did not enter the bacteria from the viruses rather, DNA passed from virus to bacteria.
- 87. (c) :** Fatty acids and glycerol being insoluble, cannot be absorbed into the blood. So, they are first incorporated into small droplets called micelles which move into the intestinal mucosa. They are re-formed into very small protein coated fat globules called the chylomicrons which are transported into the lymph vessels (lacteals) in the villi. These lymph vessels ultimately release the absorbed substances into the blood stream.

88. (c)

89. (d): The palindromes in DNA are base pair sequences that are same when read forward (left to right) or backward (right to left) from a central axis of symmetry. Genetic code is not a palindrome. The codon which initiates the protein synthesis is mostly AUG which codes for methionine. UGA, UAG, UAA are terminator codons which do not code for any amino acids. The code is nearly universal. For example, from bacteria to human UUU would code for Phenylalanine (phe). The code is unambiguous and specific which means that one codon specifies only one amino acid and not any other.

90. (a)

91. (b): High BOD means high amount of organic matter in water. The more the BOD, the lesser will be the dissolved oxygen, as it gets used up.

92. (a): Parathyroid hormone along with TCT plays a significant role in calcium balance in the body.

93. (b): Platyhelminthes are triploblastic, acoelomate and bilaterally symmetrical organisms. In sponges, fertilisation is internal and development is indirect.

94. (c)

95. (b): Mitochondria are the sites of aerobic respiration. They produce cellular energy in the form of ATP, hence they are called 'power house' of the cell. Cytoskeleton in a cell provides mechanical support.

96. (a): In Multiple Ovulation Embryo Transfer Technology (MOET), the fertilised eggs at 8–32 cells stages, are recovered non-surgically and transferred to surrogate mothers.

97. (d): In cockroach, forewings (mesothoracic) called tegmina are opaque, dark and leathery and cover the hind wings when at rest while the hind wings are transparent, membranous and are used in flight.

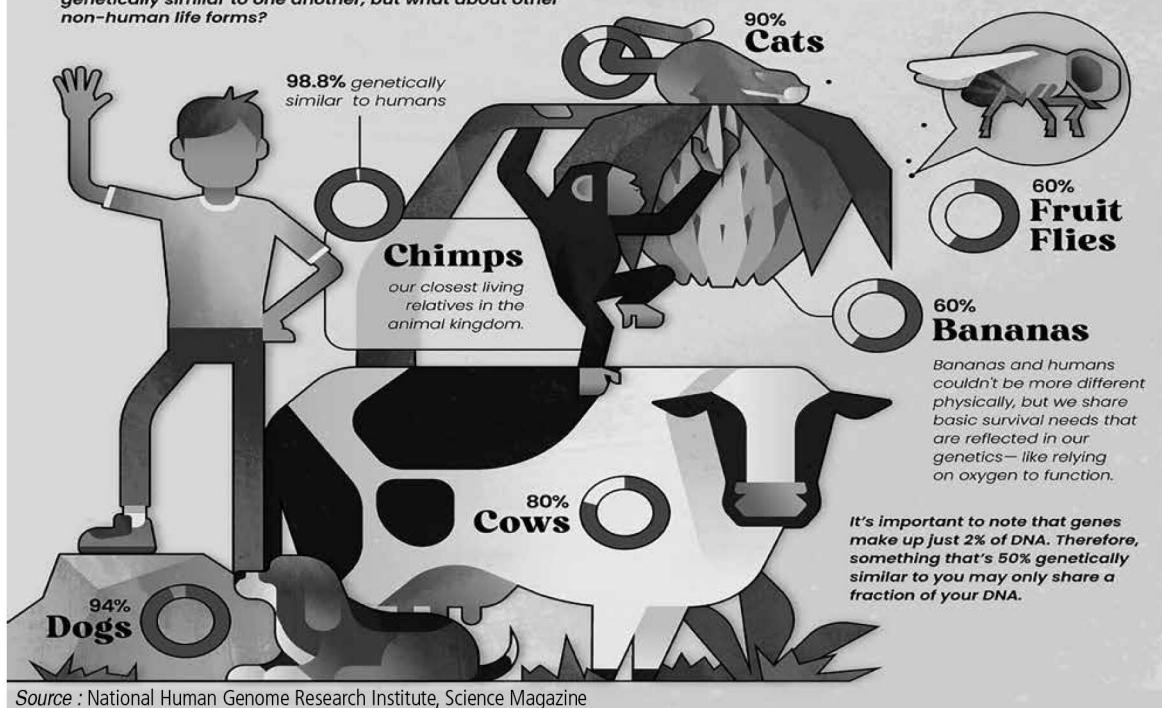
98. (d)

99. (a)
100.(a): In grasshopper, males are heterogametic, i.e., some sperms bear X-chromosome whereas some do not and female is homogametic (XX). Eggs fertilised by sperms having an X-chromosome become female, and eggs fertilised by sperms without X-become males. Thus, female is (2A + XX) and male is (2A + XO). Thus, females have more number chromosomes than male grasshopper.



How Genetically Similar Are We To Other Life Forms?

Of the 3 billion genetic building blocks that make us living things, only a handful are uniquely ours. Humans are 99.9% genetically similar to one another, but what about other non-human life forms?



Source : National Human Genome Research Institute, Science Magazine



Unlock Your Knowledge!



1. Which of the following in partnership with Indian National and State government launched Rejuvenating Watersheds for Agricultural Resilience through Innovative Development (REWARD) program to improve land and water conservation within the country?
 (a) World Bank (b) WEF
 (c) IMF (d) WTO
2. Which institution released the Environmental Guidelines for Stone Crushing units to maintain the National Ambient Air Quality Standards?
 (a) NGT (b) CPCB
 (c) UNFCCC (d) NAEB
3. Lipizzans belong to which group?
 (a) Duck (b) Dog
 (c) Horse (d) Cat
4. Global Polio Eradication Initiative (GPEI) was launched in which year?
 (a) 1988 (b) 1998 (c) 2018 (d) 2008
5. Which of the following published the report for the second session of Intergovernmental Negotiation Committee Meet in Paris titled "Forever Toxic: The science on health threats from plastic recycling"?
 (a) WMO (b) UNEP
 (c) WHO (d) Greenpeace
6. Which state recently launched the 'Solar Project' in order to turn every rooftop into a solar energy-producing station?
 (a) Rajasthan (b) Kerala
 (c) Goa (d) Telangana
7. 'Rimegepant' is the first oral medication recommended by National Institute for Health and Care Excellence (NICE) for which medical condition?
 (a) Anxiety (b) Migraine
 (c) Depression (d) Hypertension
8. What is the name given to a new group of ancient marsupials with distinctive leg and foot characteristics?
 (a) Ambulator (b) Monotremes
 (c) Armadillo (d) Alligator
9. Which of the following states/UTs hosted the 'Lavender Festival' to support the domestic aromatic crop based agro-economy and promote entrepreneurship?
 (a) Sikkim
 (b) Mizoram
 (c) Jammu and Kashmir
 (d) Arunachal Pradesh
10. Osimertinib is a new drug capable of cutting the risk of death from which disease?
 (a) COVID 19 (b) Lung cancer
 (c) Dementia (d) Typhoid
11. Which insect has been reared in Himachal Pradesh for apple pollination?
 (a) Italian bee (b) Moth
 (c) Dragonfly (d) Beetle
12. What is '*Acinetobacter baumannii*', which was named after Paul Baumann?
 (a) Fungi (b) Virus
 (c) Bacteria (d) Protozoa
13. Which disease can be detected by Galleri test?
 (a) Cancer (b) COVID 19
 (c) Diabetes (d) Pertussis
14. Which state launched buses equipped with 'Shuddha Vayu' devices that measure air quality along their routes?
 (a) Odisha (b) Telangana
 (c) West Bengal (d) Kerala
15. What was the theme of 'World Earth Day 2023'?
 (a) Our Planet; Our Pride
 (b) Invest in our planet
 (c) Earnest Earth
 (d) Earth and Environment



Readers can send their responses at editor@mtg.in or post us with complete address by 10th of every month. Winners' names and answers will be published in next issue.



Unique Career in Demand

Explore the available Unique Career Options!



Bachelor of Hospital Management (BHM)

As hospitals grew into speciality, super speciality and new corporate hospitals emerged, the requirements to consult qualified experts in administrative positions shifted. Since then, the need for hospital management professionals has increased rapidly.

Bachelor of Hospital Management is a three-year undergraduate course with six semesters. It deals with applying management techniques to solve problems arising in the field of healthcare. The course focuses on aspects of management of healthcare services in hospitals, nursing homes, clinics, diagnostic centres and other institutions related to the healthcare industry.

Some of the important topics covered in BHM course are - Principles of Management, Hospitals Operations, Healthcare Economics, Quality Management, Human Resource Management, Medical Ethics and Financial Management.

Eligibility

1. Candidates should have completed 10+2 or an equivalent examination from a recognised board with a minimum aggregate of 50% marks. Some institutions may have specific subject requirements, such as Biology or Mathematics.
2. Candidates should be atleast 17 years old at the time of admission. There is generally no upper age limit for BHM courses.

Job Perspectives

- After completing this course, one has the opportunity to undertake various postgraduate programs such as Masters in Hospital Administration, MBA in Hospital Management, PG Diploma in Health and Law (PGDHL), PG Diploma in Healthcare Operations and Quality Management (PGD HQQM) and PG Certificate in Quality Management & Accreditation (PGQM A).
- In various government and private sectors, the top profiles include Healthcare Consultant, Healthcare Quality Manager, Hospital Administrator, Facility Manager - Healthcare/Hospital, Medical and Health Services Manager, Healthcare Education and Training Manager.
- The multinational corporations that hire Bachelor of Hospital Management graduates are Max, Fortis Healthcare Ltd., Apollo Health Care, ANM Speciality, AmiCare, etc.

Selection Criteria

- Entrance examinations and merit-based selection are two options to get admission in Bachelor of Hospital Management course.
- CET and AIMA UGAT(Undergraduate Aptitude Test) are the national level entrance exams for admission to BHM course. The entrance examination may include multiple-choice questions on subjects such as English, General Knowledge, Reasoning and Quantitative aptitude. The examination may also include a personal interview.

Top Colleges in India for Bachelor of Hospital Management (BHM)

College Name	City
Haldia Institute of Management	Haldia, West Bengal
Guru Nanak Institute of Technology (GNIT)	Kolkata, West Bengal
All India Institute of Medical Sciences	Delhi
Amity University	Noida, Uttar Pradesh
Madurai Kamaraj University	Madurai, Tamil Nadu
Tripura Institute of Paramedical Sciences	Agartala, Tripura
Inspiria Knowledge Campus	Siliguri, West Bengal
Athar Institute of Health and Management Studies (AIHMS)	New Delhi

College Info

Haldia Institute of Management, West Bengal

Haldia Institute of Management is affiliated to Maulana Abul Kalam Azad University of Technology (MAKAUT, formerly known as West Bengal University of Technology) and is situated at R&D Building, ICARE Knowledge Campus, Hatiberia, Haldia. The institute was established in 2004 keeping in mind the growing need of healthcare managers and administrators. The institute is running successfully over a decade and has been able to place students in numerous hospitals in West Bengal as well as in different parts of India. The institute earnestly strives to achieve academic excellence and places great emphasis on inclusion, equality, integrity, sustainability and professionalism.



- Bachelors in Hospital Management is a full time 3 year course which is divided into 6 semesters of 6 months each. Students pursuing this course develop communication skills and in-depth knowledge regarding the healthcare sector.

SELECTION CRITERIA

Candidates should have completed 10+2 (any stream) from recognised board (CBSE/ICSE/State Board or equivalent). Admission to this undergraduate course occurs through Common Entrance Test (CET) conducted by MAKAUT, West Bengal.

UNSCRAMBLE ME

Unscramble the words given in column I and match them with their explanations in column II.

- | Column I |
|-----------------|
| 1. OMEMSANCSILM |
| 2. PTONEYCTIOT |
| 3. HMTNIORCA |
| 4. CEGOMINURAH |
| 5. LAESSHTAMAI |
| 6. RAEPICPR |
| 7. IRUAME |
| 8. UFINLCE |
| 9. ELETHYEN |
| 10. SUCUCAT |

- | Column II |
|---|
| (a) Thread like structure in nucleus which is made of repeating units called nucleosomes. |
| (b) An autosomal linked recessive disease in which synthesis of haemoglobin molecules is reduced due to mutation or deletion. |
| (c) The capacity to generate a whole plant from any cell or explant. |
| (d) The interaction in which one species benefits and the other is neither harmed nor benefitted. |
| (e) The wall of the ovary which develops into the wall of fruit. |
| (f) A stalk by which ovule is attached to the placenta. |
| (g) A parasitic plant commonly found growing on hedge plants, has lost its chlorophyll and leaves in the course of evolution. |
| (h) It is a simple gaseous plant growth hormone which causes senescence and ripening of fruits. |
| (i) The female sex organ of bryophytes which is flask-shaped structure and produces a single cell. |
| (j) A condition where malfunctioning of kidneys can lead to accumulation of urea in blood. |

Readers can send their responses at editor@mtg.in or post us with complete address by 10th of every month.
Winners' names and answers will be published in next issue.

GK CORNER

Enhance Your General Knowledge with Current Updates!



DAYS AND DATES

- **World Haemophilia Day** is observed globally on April 17 to raise awareness about haemophilia, a rare genetic blood disorder that inhibits the clotting of blood. The first-ever World Haemophilia Day was established in 1989 by the World Federation of Haemophilia (WFH) to raise awareness about haemophilia and other bleeding disorders. April 17 was chosen as the date in memory of Frank Schnabel, who was born on that day in 1942 and dedicated his life to improving the lives of people affected by bleeding disorders. The World Haemophilia Federation will celebrate World Haemophilia Day this year on the theme "**Access for All: Prevention of Bleeds as the Global Standard of Care.**"
- **World AIDS Vaccine Day** is observed on May 18 to highlight the need to develop a vaccine for the incurable disease. The day is also called HIV Vaccine Awareness Day. On May 18, 1997, former US President Bill Clinton delivered a speech at the Morgan State University in Maryland. He said that only a "truly effective, preventive HIV vaccine" would help control the spread of and eradicate HIV. The day was first observed a year later in 1998.
- **International Women's Health Day**, also known as International Day of Action for Women's Health, is dedicated to women raising awareness about their right to health. Every year on 28th May, women and health organisations worldwide commemorate this unique day. The theme for International Women's Day 2023 is "**DigitALL: Innovation and technology for gender equality**".
- **World No Tobacco Day** is celebrated annually on 31st May and is also known as Anti-Tobacco Day. According to WHO, globally, nearly 60% of tobacco users want to quit smoking, but only 30% of the world population have access to quality tobacco cessation services. COVID-19 pandemic led millions of tobacco users to quit. Therefore, to celebrate World No Tobacco Day 2023, WHO launched a theme globally, "**Grow Food, Not Tobacco**". This theme aims to raise awareness about alternative crop production and marketing opportunities for tobacco farmers and encourage them to grow sustainable, nutritious crops.
- **World Environment Day** is celebrated on June 5 every year to raise awareness and encourage action for the protection of our planet. It was first established by the United Nations General Assembly in 1972, and since then, over 150 countries participate in various activities to celebrate this day.
- **World Food Safety Day** is celebrated on June 7 annually across the globe to highlight the importance of maintaining food standards. The day was aimed at inspiring the UN member nations to prioritise food safety standards and work collaboratively to protect consumers from foodborne diseases. The theme of World Food Safety Day 2023 is "**Food Standards Save Lives.**" It will focus on the importance of food standards in preventing foodborne illness.
- **World Oceans' Day** is an international day celebrated annually on 8 June to raise awareness of the importance of oceans in our lives and the ways through which we can protect it. The concept was originally proposed in 1992 by Canada's International Centre for Ocean Development (ICOD) and the Ocean Institute of Canada (OIC) at the Earth Summit – UN Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil. World Oceans' Day was officially recognised by the United Nations in 2008. The theme of World Oceans' Day 2023 is "**Planet Ocean: The Tides are Changing.**"
- **World Blood Donor Day** is observed on 14th June to mark the anniversary of Karl Landsteiner. This event was first initiated and established to be celebrated on 14 June, 2004 by the

"World Health Organisation, the International Federation of Red Cross and Red Crescent Societies" with an aim to raise public awareness about the need for safe blood donation voluntarily and unpaid by the healthy person. The theme for World Blood Donor Day 2023 is "**Give Blood, Give Plasma, Share Life, Share Often.**"

- International Yoga Day, also known as **World Yoga Day**, is observed on June 21st every year. It is a global event celebrated to promote the practice of yoga and raise awareness about its numerous benefits. The theme of International Yoga Day 2023 is "**Humanity.**"
- **World Population Day** 2023 is celebrated on 11th July every year. The theme of World Population Day 2023 is "How to safeguard the health and rights of women and

girls now". For the first time, this day was celebrated in the year 1989. World Population Day is used to celebrate to make every people aware of the Population in every Country and their effects on the daily life of the people.

- **Paper Bag Day** is celebrated on 12th July every year to spread awareness about using paper bags instead of plastic to help reduce plastic pollution and the serious threat that it poses to the natural environment.
- The world celebrates **International Tiger Day** or Global Tiger Day every year on July 29. This day was established in 2010 at Saint Petersburg Tiger Summit in Russia to raise awareness about the decline of wild tiger numbers, leaving them on the brink of extinction and to encourage the work of Tiger conservation.

Test Yourself!

1. World Blood Donor Day is celebrated on the work anniversary of?
(a) Karl Landsteiner (b) James Watson
(c) John Dalton (d) Gregor Mendel
2. On which date World Malaria Day is celebrated?
(a) 22nd March (b) 18th January
(c) 16th November (d) 25th April
3. On which date World AIDS Vaccine Day is celebrated?
(a) 18th July (b) 18th April
(c) 18th May (d) 18th June
4. What was theme of World Food Safety Day 2021?
(a) Safer Food, Better Health
(b) Safe Food Today for a Healthy Tomorrow
(c) Food Standards Save Lives
(d) Safe Standard Food for Better Health
5. "Celebrate Biodiversity" is the theme of World Environment Day in the year
(a) 2023 (b) 2022
(c) 2021 (d) 2020.
6. On which date World Population Day is celebrated?
(a) 11th June (b) 10th July
(c) 11th July (d) 12th July
7. Which day is celebrated as World Day to Combat Desertification and Drought?
(a) 17th June (b) 30th May
(c) 12th July (d) 29th August
8. Which day is celebrated on 21st June every year?
(a) World Cancer Day (b) World Yoga Day
(c) World Hepatitis Day (d) World Diabetes Day
9. On which date World Nature Conservation Day is celebrated?
(a) 28th July (b) 10th July
(c) 20th July (d) 11th July
10. Which day is celebrated as International Day for Biological Diversity?
(a) 22nd May (b) 1st April
(c) 15th December (d) 10th November

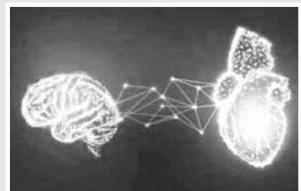
Answer Key

6. (c) 7. (a) 8. (b) 9. (a) 10. (a)
1. (a) 2. (d) 3. (c) 4. (b) 5. (d)



MRI data reveals connections between heart, brain health

Multiorgan MRI from over 40,000 U.K. Biobank participants reveal the intertwined nature of heart and brain health (Science). The findings provide insights into a multiorgan perspectives on human health and could help identify new potential therapeutic targets. Cardiovascular diseases have been implicated in the pathology of several brain diseases, and patients with mental and cognitive problems shown an increased incidence of cardiovascular disease.



WORD GRID



Readers are
requested to send
their responses of
word grid to be
the winner.

Find and encircle the words in the given grid, running in one of the possible directions; horizontal, vertical or diagonal by reading the clues given below.

Clues

1. A hallucinogenic alkaloid also known as crack having a stimulating action on central nervous system.
2. A type of inflorescence where the main axis continues to grow and the flowers are borne laterally in an acropetal succession.
3. The finger-like projections in female reproductive system that helps in collection of ovum after ovulation.
4. It is the assemblage of families which exhibit a few similar characters.
5. The first transgenic cow which produced human alpha-lactalbumin enriched milk.
6. A protein hormone secreted by thyroid gland which regulates the blood calcium levels.
7. An enzyme that codes for 'a' gene in *lac* operon which is required for metabolism of lactose.
8. A stage of suspended development when zooplankton enter unfavourable conditions.
9. It is the process of fusion of protoplasms between two motile or non-motile gametes.
10. Enzyme used in detergent formulations for removing oily stains from the laundry.
11. A muscular disorder which causes rapid spasms in muscle due to low Ca^{++} in body fluids.
12. The disease of rice seedlings which was caused by a fungal pathogen *Gibberella fujikuroi*.
13. The phenomenon in which the *Amoeba* withdraws its pseudopodia and secretes a hard covering around itself.
14. A complex polysaccharide mainly found in exoskeleton of arthropods.
15. Barrier made of latex sheath used to cover cervix in the female so as to prevent conception.
16. A white blood cell that secretes histamine, serotonin, heparin during allergic reactions.
17. It is a condition produced by simultaneous deficiency of proteins and calories.
18. It is a positively charged protein, rich in basic amino acid residues lysine and arginine.
19. A subspecies of tiger which got extinct.
20. The protein secreted from viral infected cell which protects other cells from further viral infections.

O	T	R	A	N	S	A	C	E	T	Y	L	A	S	E
A	E	C	H	I	T	I	N	C	S	R	I	E	M	B
C	T	C	B	Z	Q	G	P	O	R	A	P	S	A	N
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*Please send entries of solutions both with words and scanned copy of the grid within 10th of every month.

BIO Digest



This article covers high yield facts of the given topic.

Morphology of Flowering Plants

- Plant morphology (Gk. *morphe*-form, *logos*-study) is the branch of botany that deals with the study of forms and features of different plant organs like roots, stems, leaves, flowers, fruits, seeds, etc.
- A flowering plant has a long, cylindrical, unbranched or branched axis that bears a number of lateral appendages. Plant axis is differentiated into an **underground root system** and an **above ground shoot system**.
- Flowering plants contain vegetative parts (*i.e.*, root, stem and leaves) and reproductive parts, (*i.e.*, flowers, fruits and seeds).
- Plants can be classified on the basis of height and nature of stem (**herbs**, **shrubs**, and **trees**), life span (**annuals**, **biennials** and **perennials**) and frequency of flowering or fruiting (**monocarpic** and **polycarpic**).

MORPHOLOGY OF ROOT

- The root is typically a non-green, underground, descending portion of the plant axis which gives rise to similar types of endogenous lateral branches and does not possess nodes and internodes. They are positively geotropic,

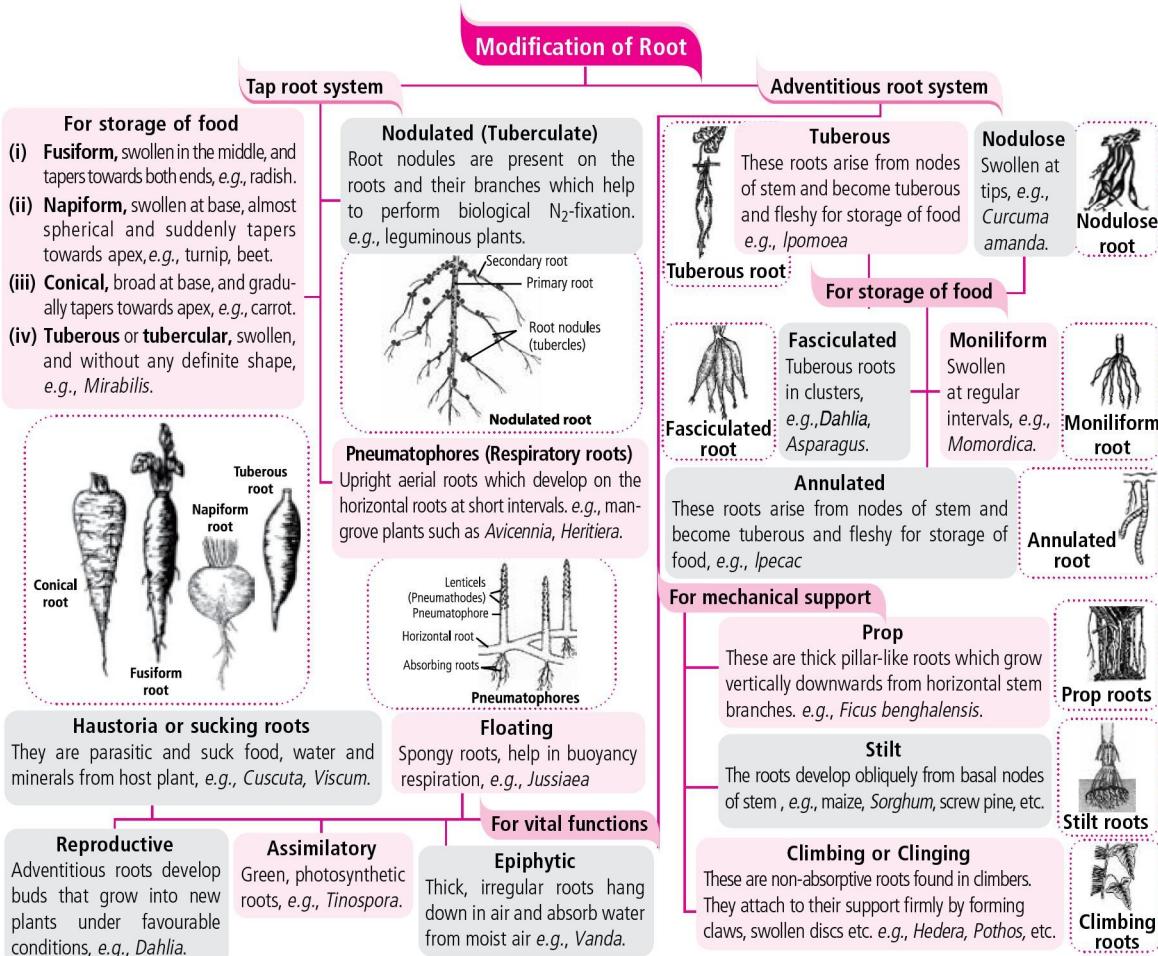
- positively hydrotropic and negatively phototropic.
- A typical root consists of **five major zones** :
 - Root cap** - It covers the root apex and protects the young growing cells of the apical region.
 - Meristematic zone** - It is present just above the root cap and made up of compact cells having dense protoplasm with large nucleus.
 - Region of cell elongation** - It is situated above the meristematic zone. Here the cells elongate rapidly and increase the length of the root.
 - Root hair zone or zone of differentiation** - Here different types of primary tissues differentiate. Unicellular and ephemeral root hairs are formed from the epidermal cells in this zone.
 - Zone of mature cells** - Constitutes the major portion of root, where cells do not undergo any further change.
- There are three types of root systems occurring in plants: **tap root system**, **fibrous root system** and **adventitious root system**. A comparative account between the three is summarised in the given table.

Table: Comparison between tap root system, fibrous root system and adventitious root system

	Tap root system	Fibrous root system	Adventitious root system
(i)	It is formed from the radicle of the embryo.	It is formed in place of tap root system at the base of main stem.	It may develop from any part of the plant other than radicle.
(ii)	It is always underground.	It is always underground.	It may be underground or aerial.
(iii)	It consists of a single primary (main) root.	Primary root is short lived. Instead underground roots arise in groups from base of stem.	Primary root is absent and it consists of roots forming a cluster.
(iv)	Primary root produces distinct secondary roots, tertiary roots and rootlets in acropetal succession.	The main roots are of equal length and give off small branches. Main roots and their branches are thin and thread like.	The roots may be thick, thin or variously modified.
(v)	It may be surface or deep feeder, the deep feeder being the usual feature.	It is usually surface feeder.	It is usually surface feeder.
(vi)	It is commonly found in dicots. E.g., mustard.	It is commonly found in monocots. E.g., wheat.	It is found both in dicots and monocots. E.g., grass, <i>Monstera</i> , banyan.

Modifications of Roots

- Primary functions of roots are anchorage (or fixation) of the plant and absorption of water and minerals from the soil for their transport to the shoot system. However, roots undergo morphological modifications to perform various functions such as food storage, mechanical support, etc., as discussed briefly in the given flow chart.





INTEXT PRACTICE QUESTIONS

1. What are the primary functions performed by roots?
2. Give an example of moniliform root.

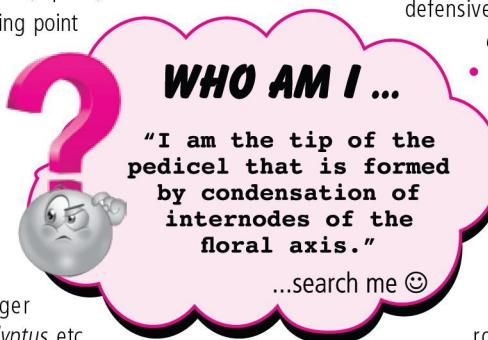
- **Rootless plants** - Many plants growing in aquatic habitats do not possess roots because there is little requirement for absorption of water and mineral salts that is fulfilled by the general surface of plant itself. e.g., *Wolffia*, *Utricularia*, *Ceratophyllum*, etc.
- **Plants that are all roots** - *Podostemón*, a hydrophytic plant, is made mainly of green (photosynthetic) flattened roots growing along rocky surface in shallow water which are fixed on rocks at intervals by holdfasts called **heptera**. However, these plants develop small flowering shoots at intervals on the root from time to time.

MORPHOLOGY OF STEM

- Stem is an ascending part of the plant body that develops from the plumule of the embryo and is usually negatively geotropic and positively phototropic.
- Stem grows by means of a terminal bud which represents a condensed immature or embryonic shoot possessing a growing point. The stem bears nodes and internodes.
- The buds are generally small in size. The largest bud is that of cabbage. According to their nature/structure buds can be **vegetative** (form leafy shoots only), **floral** (reproductive buds that develop into flowers) and **mixed** (both vegetative and floral branches).

Branching Patterns of the Stem

- There are two main patterns of branching shown by the stem of a plant — dichotomous and lateral.
- In **dichotomous branching**, the growing point gets divided into two in the region of branching. The dichotomous branching is rare in angiosperms, e.g., *Asclepias syriaca*, *Pandanus* (screw pine), *Hyphaene* (a palm).
- In **lateral branching**, the growing point does not get divided. Lateral branching is of two kinds: racemose and cymose.
- In racemose or monopodial branching the terminal bud continues its activity indefinitely. Lateral branches are borne in acropetal succession, i.e., older towards the base and younger towards the tip, e.g., *Pinus*, *Eucalyptus*, etc.



- In cymose or sympodial branching, the terminal bud stops its activity after forming a small portion of axis. Further growth of axis is continued by one or more axillary branches. Cymose branching is of three types : **Uniparous** or **monochasial**, **biparous** or **dichasial** and **multiparous** or **polychasial**.

Modifications of Stem

- Stems of flowering plants attain diverse forms in order to perform various functions. These are of three types - **underground**, **aerial** and **subaerial**.
- **Underground modifications** : (a) **Stem tuber** : Swollen end of underground branch of main stem which possesses eyes/nodes, e.g., *Solanum tuberosum*. (b) **Sucker** : Formed from the nodes of underground stem and comes up obliquely in the form of leafy shoot, e.g., *Chrysanthemum*, mint. (c) **Rhizome** : A perennial fleshy underground stem having nodes and internodes, e.g., ginger. (d) **Corm** : A subspherical, underground stem growing vertically inside soil, possesses adventitious roots at base and axillary buds in axils of scale leaves, e.g., *Colocasia*. (e) **Bulb** : Highly reduced disc like stem with numerous fleshy scale leaves covering a central terminal bud, adventitious roots arise from the under surface, e.g., onion.
- **Aerial modifications**: (a) **Stem tendrils** : Fine, sensitive thread like structures which can coil around a support e.g., *Cucurbita* (b) **Phylloclades** : Flattened (e.g., *Opuntia*) or cylindrical (e.g., *Casuarina*), green, fleshy structures which have taken over the photosynthetic function of leaves. (c) **Cladodes (Cladophylls)** : Green stems of limited growth, generally one or two internodes long and perform the function of photosynthesis, e.g., *Asparagus* (one internode long). (d) **Thorns** : Stiff, hard pointed structures that perform defensive functions and check transpiration, e.g., *Citrus*, *Bougainvillea*.
- **Subaerial modifications** : (a) **Runners** : Green, above ground horizontal branches which develop at the bases of erect shoots which are called crowns, e.g., *Oxalis*. (b) **Stolons** : Elongated horizontal arched runners; lower portion of nodes gives rise to roots, e.g., *Fragaria* (strawberry).

(c) **Offset**: One internode long, short and thickened special horizontal branches, that develop a tuft or rosette of leaves at nodes, e.g., *Pistia, Eichhornia*.

MORPHOLOGY OF LEAF

- Leaf is a green lateral flattened outgrowth borne on the node of a stem or its branch and is characteristically photosynthetic. Leaves originate from the shoot meristem as leaf primordia and gradually enlarge. They are the most important vegetative organs of a plant as they synthesise food in them.
- A leaf consists of three parts – leaf base, petiole and lamina.
- Leaf base** (hypopodium) is the lowermost part of the leaf and is joined to the node of the stem. In **pulvinate** leaves, leaf base is swollen and is called as **pulvinus**; leaf is easy to pluck due to weak attachment with stem, e.g., gram. In some plants, leaf base consists of small appendages on both sides, these are called **stipules** which protect young leaves and axillary buds.
- Petiole** (mesopodium) is a cylindrical or subcylindrical smooth or grooved stalk of the leaf which connects the lamina with the base. Leaf having petiole is called **petiolate** and the one without it is called **sessile**.
- Lamina** (epipodium) or leaf blade is green, flattened part of leaf performing the important functions of photosynthesis, transpiration and respiration. Depending upon the incision of lamina, leaves can be **simple** (smooth or incised margins, incisions not deep upto midrib) or **compound** (incisions reach midrib dividing leaf into leaflets).
- Venation** (arrangement of veins and veinlets on the lamina) is of two types (i) In **parallel venation**, the veins run parallel to each other, common in monocots and rare

in dicots, e.g., *Eryngium*, etc. (ii) In **reticulate venation**, the main vein by forming a number of branches gives rise to a net like structure in the leaf, common in dicots and rare in monocots, e.g., *Smilax*, etc.

- **Phyllotaxy** (arrangement of leaves on the true stem and its branches) facilitates the leaves to obtain maximum light for photosynthesis. It may be of 3 types:
 - (i) **Alternate** or **spiral** : Only one leaf is borne on a node and the leaves of the adjacent nodes roughly lie towards the opposite side, e.g., shoe flower.
 - (ii) **Opposite** : Each node gives rise to two leaves, arranged opposite to each other e.g., *Syzygium, Calotropis*.
 - (iii) **Whorled** : More than two leaves are formed from each node, which are arranged in a whorl, e.g., *Alstonia, Nerium*.

Types of Leaves

- A leaf is said to be **simple**, when its lamina is entire or when incised, the incisions do not touch the midrib. When the incisions of the lamina reach up to the midrib breaking it into a number of leaflets, the leaf is called **compound**. A bud is present in the axil of petiole in both simple and compound leaves, but not in the axil of leaflets of the compound leaf.
- The compound leaves may be of two types : pinnately and palmately compound leaves.
- In a **pinnately compound leaf** a number of leaflets are present on a common axis, the **rachis**, which represents the midrib of the leaf as in neem. In **palmately compound leaves**, the leaflets are attached at a common point, i.e., at the tip of petiole, as in silk cotton.

Bio CAPSULES

(0-13 years)

Boys talk more in 1st year, girls in 2nd

Male infants babble more than female infants in the first year, according to research by D. Kimbrough Oller of the University of Memphis, Tennessee. Male infants' apparent early advantage in language development doesn't last, however. "While boys showed higher rates of vocalisation in the first year, the girls caught up and passed the boys by the end of the second year," Oller says. Overall, the data showed that male infants made 10 per cent more utterances in the first year compared to females. In the second year, the difference switched directions, with female infants making about 7 per cent more sounds than males.

(13-18 years)

Soccer headers need not worry much

Repeatedly heading a soccer ball has been previously associated with negative long-term brain health for professional players. However, in a new study by the Minds Matter Concussion Programme at Children's Hospital of Philadelphia (CHOP), a small number of repeated soccer headers, equivalent to a throw-in did not cause immediate neurophysiological deficits for teens, suggesting that limited soccer heading exposure in youth sports may not result in irreversible harm if players are properly trained. The findings are reassuring as they represent the most comprehensive real-time study of soccer headers in adolescent athletes.

(18-50 years)

Cut breakfast carbs to lower blood sugar

An international team, led by UBC Okanagan researcher, suggests that a simple tweak to the first meal of the day might help people living with Type 2 diabetes control their blood sugar levels better. It shows that switching from a traditional Western-style, low-fat breakfast, like oatmeal, toast and fruit, to a low-carb meal higher in protein and fat, like eggs with bacon or cheese, can help them better manage their blood sugar for most of the day. In fact, changing just one meal helped keep the blood sugar in check. Controlling glucose levels is critical for reducing the complications of diabetes, including inflammation and cardiovascular disease.

(50 + years)

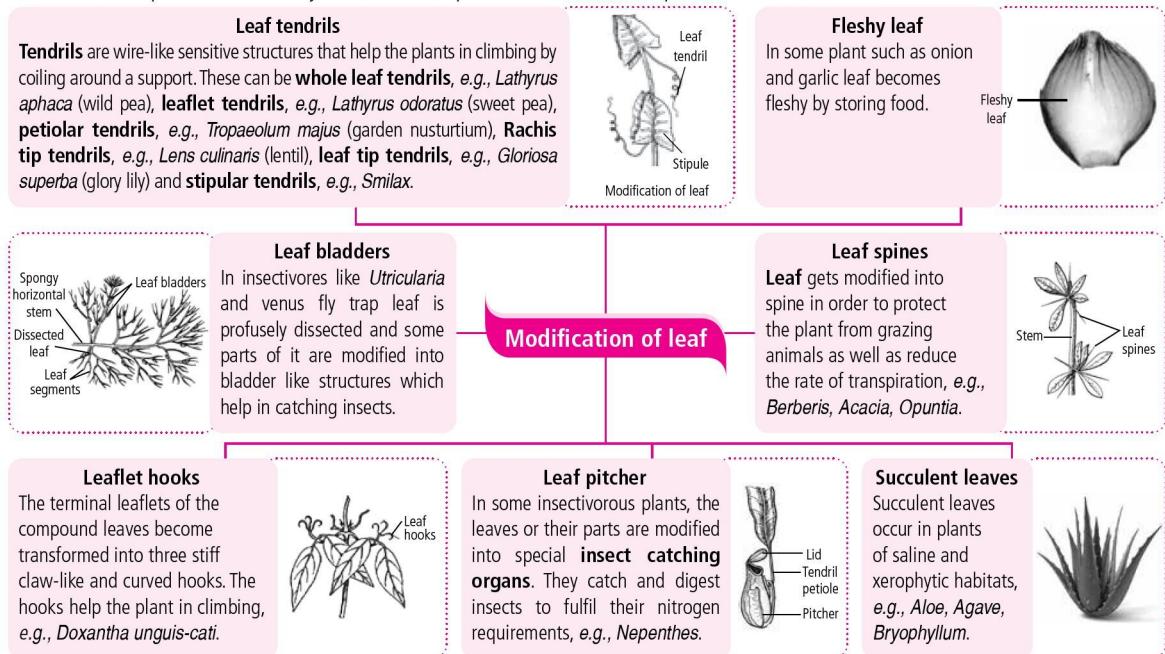
Track early signs of Alzheimer's

About two-thirds of the risk for Alzheimer's Disease (AD) is thought to arise from genetic influences but about a third could be influenced by environment and lifestyle, opening the door for behavioural interventions that could delay or prevent pathophysiological changes that occur with it. Now, a new study in a mouse model of AD examines the effects of environmental enrichment on AD symptom progression and pathology. They did not respond normally to the offerings of their environment. This finding is important because it will help in working out preventive measures during the pre-clinical phase.

Courtesy : The Indian Express

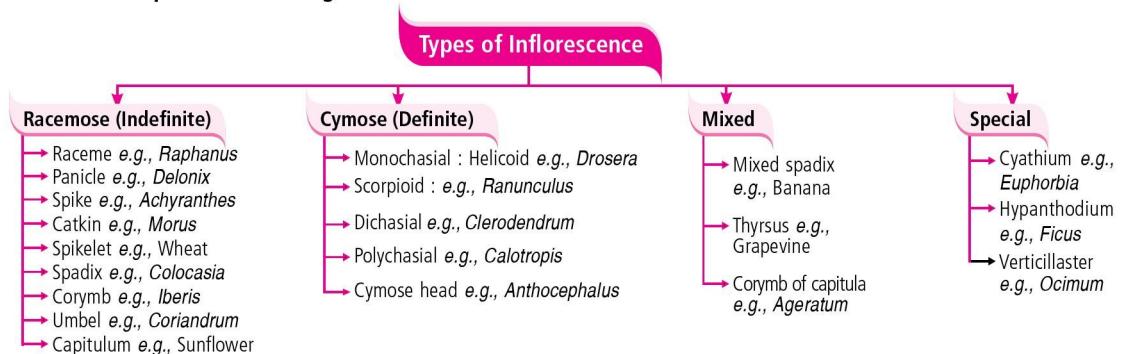
Modifications of Leaf

- A leaf or its part is occasionally modified into specialised structures to perform some functions.



INFLORESCENCE

- A group of flowers borne on a common axis is called inflorescence. The common axis bearing the flowers is called **peduncle**. Stalk of the individual flower is called **pedicel**. Flowers develop on the peduncle in the axils of bracts.
- Inflorescence can be **racemose**, **cymose**, **mixed** and **specialised** types.
- In **racemose type**, main axis of inflorescence has an indefinite (indeterminate) growth and it gives rise to (lateral or axillary) flowers in an **acropetal order** (i.e., the youngest flower is at the apex while the oldest is at the base) or **centripetal order**. In **cymose** inflorescence, the growth of the main axis is limited as it is terminated by a flower, the arrangement of flowers is **basipetal** or **centrifugal**.



INTEXT PRACTICE QUESTIONS

- What are cladodes?
- Define sporophylls.
- What are the types of mixed inflorescence ? Give suitable examples.

FLOWER

- It is a **specialised condensed shoot** meant for carrying out the **sexual reproduction**. It bears floral leaves and gives rise to seeds and fruits. The study of flowers is called **anthology**.
- Solitary flowers can be terminal (e.g., poppy) or axillary (e.g., *Petunia*) in position.

They constitute the lower accessory whorl of mostly green, flattened or foliaceous floral organs called **calyx** which is mainly meant for **protecting** other floral parts in the bud condition.

Carpel or female reproductive part forms the innermost whorl of a flower. The free occurring unit of gynoecium is called pistil, which consists of basal swollen **ovary**, a stalk like **style** and a terminal receptive part called **stigma**.

Ovary has one or more chambers or loculi bearing ovules. **Ovules** are attached to cushion-like **placenta**.

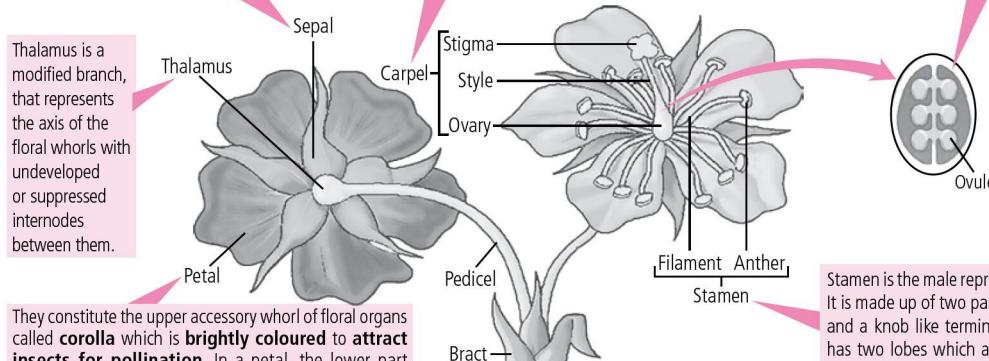


Fig. : Parts of a typical flower

- Flower bears floral leaves (sepals, petals, stamens and carpels), carries on sexual reproduction and gives rise to seeds and fruits. **Pedicel** is the stalk of flower. The tip of the pedicel is called **thalamus (torus or receptacle)** which is formed by the **condensation of internodes of the floral axis**.
- Actinomorphic flowers** can be cut into two equal parts in any vertical plane, e.g., *Solanum*. **Zygomorphic flowers** can be cut into two equal parts in only one vertical plane, e.g., *Pisum*. **Asymmetric flowers** cannot be cut into two equal parts in any plane, e.g., *Canna*.
- The corolla can have free petals (polypetalous) or united petals (gamopetalous).
- The calyx may be with free sepals (polysepalous) or united sepals (gamocephalous).
- A flower with superior ovary is called **hypogynous**, e.g., mustard, with inferior ovary is **epigynous**, e.g., guava, with sub-inferior ovary is **perigynous**, e.g., rose. In **pentamerous** flower each whorl especially calyx and corolla possesses 5 members.
- In **trimerous** and **tetramerous** flowers, each whorl possesses 3 and 4 members, respectively.
- The mode of arrangement of sepals or petals or tepals in relation to one another in a flower bud is called **aestivation**. When these units are not overlapping it is **valvate**

aestivation. When out of the total number of units, one is completely out, one is completely in and the rest are in and out it is **imbricate aestivation**. In **descending imbricate** (vexillary) or papilionaceous **aestivation**, the standard petal is large and overlaps the two wing petals which in turn overlap the keel petal. In **ascending imbricate**, posterior petal is overlapped by two lateral ones which are being overlapped by two anterior ones. When of the total number of units, two are completely out, two are completely in and the fifth one is in and out, it is **quincuncial aestivation**. In **contorted** or **twisted aestivation** all units are in and out.

- On the basis of arrangement of more than one carpel ovary can be **Apocarpous** (carpel may be free as in lotus, rose) or **Syncarpous** (carpel may be fused as in mustard, tomato).
- On the basis of cohesion of their parts, stamens may be **monadelphous** (e.g., *Hibiscus*, *Abutilon*), **diadelphous** (e.g., *Pisum*, *Indigofera*), **polyadelphous** (e.g., *Citrus*), **syngenesious** (e.g., *Tridax*, *Helianthus*), **synandrous** (e.g., *Cucurbita*, *Coccinia*). When stamens adhere to either sepals or petals the condition is known as **episepalous** (e.g., *Quisqualis indica*) or **epipetalous**, (e.g., *Solanum*) respectively.
- Placenta** refers to the parenchymatous cushion present inside the ovary where ovules are borne. Number,

WHO AM I ...

"I am a small opening present at one end of the seed."

...search me ☺

position, and arrangement of placentae inside an ovary is called **placentation**. It can be : **marginal** (placenta on ventral suture in monocarpellary ovary, e.g., pea), **basal** (single placenta on floor of unilocular ovary, e.g., sunflower), **axile** (placenta along axis, radial septa present, e.g., *Hibiscus*), **free central** (placenta along axis, no radial septa, e.g., *Dianthus*) and **parietal** (placenta on inner wall of syncarpous ovary, e.g., *Brassica*).

FRUIT

- True fruit or **eucarp** is a structure formed from ripened ovary under the influence of ripening ovules and is meant for protecting them. It consists of pericarp formed from the wall of the ovary and seeds formed from ovules. E.g., mango, brinjal, tomato, cucumber, pea, etc. When in formation of a fruit other floral parts, (e.g., thalamus, base of sepal, petals, etc.) participate, it is called false fruit or **pseudocarp**, e.g., apple, pear etc.

A fruit formed without fertilisation, i.e., a seedless fruit is called **parthenocarp**, e.g., banana.

Types of Fruit

Fruits can be classified as:

- Simple fruits** : Develop from mono or multicarpellary, syncarpous ovary. They can be classified into dry and fleshy fruits.
 - (i) **Dry fruits** are further classified into (a) **Dehiscent**: **Pod** (e.g., gram), **Follicle** (e.g., *Delphinium*), **Siliqua** (e.g., Mustard), **Silicula** (e.g., *Iberis*), **Capsule** (e.g., cotton). (b) **Indehiscent** : **Cypsela** (e.g., marigold), **Caryopsis** (e.g., maize), **Achene** (e.g., *Mirabilis*), **Samara** (e.g., *Holoptelia*), **Nut** (e.g., *Litchi*). (c) **Schizocarpic** : **Lomentum** (e.g., *Mimosa*), **Cremocarp** (e.g., coriander), **Double samara** (e.g., *Acer*), **Regma** (e.g., *Ricinus*), **Carcerulus** (e.g., *Althaea*).
 - (ii) **Fleshy fruits** are **Drupe** (e.g., mango), **Berry** (e.g., Tomato), **Pepo** (e.g., cucumber), **Pome** (e.g., pear), **Hesperidium** (e.g., orange), **Balausta** (e.g., pomegranate).
- Aggregate fruits** : Develop from multicarpellary apocarpous ovary. Types of aggregate fruits are **Etaerio of achenes** (e.g., rose), **Etaerio of follicles** (e.g., *Michelia*), **Etaerio of drupes** (e.g., raspberry), **Etaerio of berries** (e.g., custard apple).
- Composite fruits** : Develop from complete inflorescence and include **Sorosis** (e.g., pineapple) and **Syconus** (e.g., banyan).

SEED

- Morphologically, seed is the integumented, mature, megasporangium which is developed from fertilised ovule and contains an embryo. A seed may have one or two

coverings called **seed coats**— outer, thick, hard, leathery **testa** and the inner, thin, papery **tegmen**.

- With the help of a stalk called **funicle**, a seed is attached to the fruit wall and funicle is attached to seed at **hilum**. **Raphe** is the part of funicle that is fused with the seed coats or integuments. **Chalaza** is that region from which the seed coats originate. **Microple** is a small opening present at one end of the seed. **Kernel** is obtained by removing the seed coat and it mainly consists of the embryo. Kernel may also contain endosperm (reserve food), present in **endospermic or albuminous seeds** like cereals, castor, coconut, etc. In **exalbuminous or non-endospermic seeds** like gram, pea, mustard, etc., endosperm is fully consumed by the embryo. There is one cotyledon in monocots and two cotyledons in dicots. In some seeds (called perispermic seeds e.g., *Ricinus communis*), below the seed coat a very thin membrane is found over kernel called **perisperm** (the **persistent nucellus**). The embryonal axis is differentiated into radicle and plumule. In monocot seeds, the radicle is protected by a sheath called **coleorhiza** and the plumule is protected by **coleoptile**.

DESCRIPTION OF SOME IMPORTANT ANGIOSPERM FAMILIES

- Various morphological features are used to describe a flowering plant. After describing various parts of plant, a floral diagram and a floral formula are presented.
- Floral formula** is the summarised account of the floral characters of a plant or a family represented by symbols, whereas **floral diagram** is a diagrammatic representation of the pooled up information from transverse sections of the flower bud in relation to mother axis.



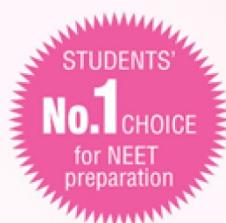
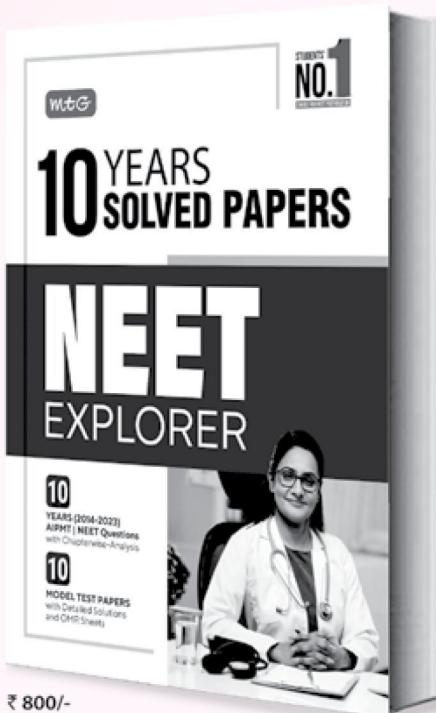
FIRE BOLT

How fast you can answer

ANSWERS

1. No	3. Yes	5. No
2. Yes	4. Lizard	

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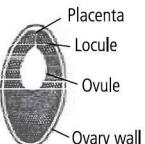
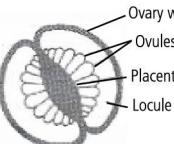
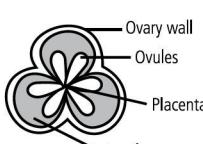


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Table : A comparative account of Families Fabaceae, Solanaceae and Liliaceae

Characters	Fabaceae	Solanaceae	Liliaceae
Systematic position	Class – Dicotyledonae Subclass – Polypetalae Series – Calyciflorae Order – Rosales Family – Fabaceae	Class – Dicotyledonae Subclass – Gamopetalae Series – Bicarpellatae Order – Polemoniales Family – Solanaceae	Class – Monocotyledonae Series – Coronarieae Order – Liliales Family – Liliaceae
Vegetative characters	Trees, shrubs, herbs; roots with root nodules. Stem : erect or climber. Leaves : alternate, pinnately compound or simple; leaf base, pulvinate; stipulate; venation reticulate.	Plants mostly herbs, shrubs and rarely small trees. Stem : herbaceous (rarely woody) aerial, erect, cylindrical, branched, solid or hollows, hairy or glabrous. Leaves : alternate, simple, rarely pinnately compound, exstipulate; venation reticulate.	Perennial herbs with underground bulbs/corms/rhizomes Leaves : mostly basal, alternate linear, exstipulate with parallel venation
Inflorescence	Raceme or spike (panicle in <i>Dalbergia</i>)	Axillary or extra-axillary cyme, rarely solitary axillary (<i>Petunia</i>) or terminal (<i>Datura</i>)	Racemose, sometimes solitary or umbellate condensed cymes
Flower	Bisexual, zygomorphic, bracteate or ebracteate, pedicellate or sessile, perigynous or occasionally hypogynous, pentamerous	Bisexual, actinomorphic, ebracteate or bracteate, pedicellate, hypogynous, pentamerous, cyclic	Bisexual, actinomorphic, zygomorphic in few cases, bracteate or ebracteate, pedicellate, complete or incomplete, unisexual in <i>Ruscus</i> and <i>Smilax</i> , hypogynous, generally pentacyclic, trimerous
Calyx	Sepals five, gamosepalous, valvate or imbricate aestivation, usually campanulate	Sepals five, gamosepalous, valvate aestivation, persistent, accrescent (<i>Physalis</i>), campanulate or tubular, hairy	Perianth : Tepals six (3 + 3), often united into tube, valvate or imbricate aestivation, sepaloid or petaloid
Corolla	Petals five, polypetalous, papilionaceous, imbricate aestivation	Petals five, variously shaped, infundibulum, campanulate, rotate, united, valvate aestivation, plicate or folded like a fan in bud	
Androecium	Ten, usually diadelphous [(9) + 1], anthers dithecos, introrse, dehiscence longitudinal	Stamens five, epipetalous, filaments free, anthers bithecous, basifixated or dorsifixated, introrse, longitudinal or porous dehiscence.	Stamens six (3 + 3), free or monadelphous (e.g., <i>Ruscus</i>), epiphyllous, basifixated, dorsifixated, or versatile anther, longitudinal dehiscence
Gynoecium	Ovary superior, monocarpellary, unilocular with many ovules, marginal placentation	Bicarpellary, syncarpous, ovary superior, bilocular, sometimes tetralocular due to false septum, placenta swollen with many ovules, axile placentation, ovary is obliquely placed	Tricarpellary, syncarpous, superior ovary, trilocular with 2-many ovules, axile placentation, rarely parietal, styles united or separate, stigma free or fused, trilobed
Fruit	Legume, rarely lomentum	Berry or capsule	Capsule, rarely berry
Seeds	One to many, non-endospermic	Many, endospermous	Endospermous
Floral formula	% ♀ K ₍₅₎ C ₁₊₂₊₍₂₎ A ₍₉₎₊₁ G ₁	⊕ ♀ K ₍₅₎ C ₍₅₎ A ₅ G ₍₂₎	Br ⊕ ♀ P ₃₊₃ or (3+3) A ₃₊₃ G ₍₃₎

Economic importance	Pulses : E.g., Gram, arhar, sem, moong, soybean Edible oil : E.g., Soybean, groundnut Dye : E.g., Indigofera Fodder: E.g., <i>Sesbania</i> , <i>Trifolium</i> Ornamentals : E.g., Lupin, sweet pea Medicine : E.g., <i>Muliathia</i>	Food : E.g., Tomato, brinjal, potato Spice : E.g., Chilli Medicine : E.g., Belladonna, <i>Ashwagandha</i> Fumigatory : E.g., Tobacco Ornamentals : E.g., <i>Petunia</i>	Ornamentals : E.g., Tulip, <i>Gloriosa</i> Medicine : E.g., <i>Aloe</i> Vegetables : E.g., <i>Asparagus</i> Colchicines : <i>Colchicum autumnale</i>
Floral diagram			
T.S. Ovary			



A genetic test for the heart

The purpose of a Polygenic Risk Score is to look at genetic variations in a person to determine the future course of treatment.

Can a genetic test predict a person's overall risk of getting cardiovascular diseases in the future? Scientists have been working on something called a Polygenic Risk Score (PRS) that looks at small genetic variations a person has inherited and assigns scores to them to determine whether a person may benefit from lifestyle changes, continued imaging or statin therapy.

Years of research have shown that beside risk factors like obesity, diabetes or smoking, there is a hereditary component to atherosclerotic diseases that accelerate the build-up of plaques and cholesterol, leading to heart attack. Researchers think that a test like PRS that takes into account this genetic history, is likely to better predict the future. Doctors currently determine the risk of heart attack by analysing a person's risk factors.

Practising cardiologists, however, are still not convinced of its use, especially as a broad screening mechanism. "Genetic history is important but if you have a good lifestyle — if you have been eating healthy, exercising regularly, not smoking — then you will overcome this genetic predisposition," says Dr. RR Kasliwal, Chairman of Clinical and Preventive Cardiology at Medanta Hospital, Gurugram. "If we talk about India, we see heart attacks at a very young age — nearly 25 per cent of all heart attacks happen in people below the age of 45 years. This means the plaque formation started in them at a very early age. So,

we have to ensure that even as children, parents ensure a healthy diet and exercise," he adds.

For now, he feels the test may have a limited use and help predict interventions in people who already have several risk factors. "The only meaningful intervention, other than lifestyle changes, is to prescribe statins. And, when we talk about early prescription of statins, we are already doing it in India because of the young heart attacks. We prescribe statins even at the age of say 35 years if a person has several risk factors and a high calcium scoring. Lifestyle changes in such people may not help in preventing heart attacks in the immediate future," he says.

Dr. Kasliwal says that his studies have shown CT calcium scoring to be a very good predictor of heart attacks. "If you do a treadmill test, for example, it will detect a blockage only when it is over 70 per cent but a CT calcium scoring can show the true picture of plaque formation in the heart. And, when done in the high risk individuals it can help us determine the course of action."

Dr. VK Bahl, Principal Director of Cardiac Sciences at Max Hospital, and former Head of Cardiology at AIIMS-Delhi, agreed that the test has a limited role at present. "You have to show that an intervention actually helps us detect cases where we can make meaningful changes and reduce morbidity and mortality from the disease. Now, let's say we have a way to detect early plaque formation — what will

you do with this information? Several studies have shown that in people with asymptomatic plaques or even stable angina — chest pain on exertion — even a procedure like stenting doesn't help in reducing mortality. That is because someone might have a big plaque that blocks 70 per cent of a vessel and not get a heart attack while someone with 10 per cent blockage might. This is because heart attacks happen when a plaque becomes unstable and breaks up. So, a pre-emptive stenting doesn't help. Only prescribing statins helps — it not only reduces the cholesterol levels, it also stabilises the plaques".

However, he adds a disclaimer, saying that stenting when a person has a heart attack is absolutely life-saving but it is not of any use before that point. According to him, statins may be prescribed even at a young age if a person has multiple risk factors.

Small Wins Everyday

Nothing is as daunting as a goal. Many of us struggle with achieving them, be it in life, health, love and career. When you set unrealistic goals and keep failing, your brain tries to protect you from the pain and negative emotions that come with it. The hack? Break down your goals into small wins that you can achieve every day. Stacked over time, these contribute to significant lifestyle changes, good health and happiness. Simple and bite-sized but packed with a punch, here are 100 wins to change your life.

Courtesy : The Hindu

NCERT Xtract

This Section
Covers Questions
Extracted from
Latest NCERT
Textbook of
Class XI

UNIT-I : DIVERSITY IN THE LIVING WORLD

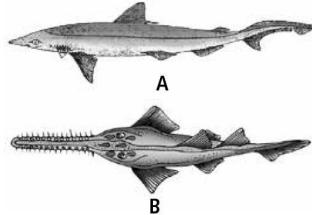
- ▶ The Living World
- ▶ Plant Kingdom
- ▶ Biological Classification
- ▶ Animal Kingdom

1. Identify the correct sequence of taxonomical categories.
 - (a) Class → Phylum → Order → Family → Genus → Species
 - (b) Division → Class → Order → Family → Genus → Species
 - (c) Division → Class → Family → Order → Genus → Species
 - (d) Phylum → Order → Class → Family → Genus → Species
2. Study the four statements (A-D) given below and select the two correct ones out of them.
 - A. Definition of biological species was given by Ernst Mayr.
 - B. Photoperiod does not affect reproduction in plants.
 - C. Binomial nomenclature system was given by R.H. Whittaker.
 - D. In unicellular organisms, reproduction is synonymous with growth.

The two correct statements are

 - (a) B and C
 - (b) C and D
 - (c) A and D
 - (d) A and B.
3. Name the scientist who gave binomial nomenclature.
 - (a) John Ray
 - (b) Aristotle
 - (c) Darwin
 - (d) Carolus Linnaeus
4. Choose the correct sequence of taxonomical categories of wheat.
 - (a) *Triticum* → Poaceae → Poales → Monocotyledonae → Angiospermae
 - (b) Poaceae → *Triticum* → Monocotyledonae → Poales → Angiospermae
 - (c) Poales → *Triticum* → Monocotyledonae → Poaceae → Angiospermae
 - (d) Angiospermae → *Triticum* → Monocotyledonae → Poaceae → Poales
5. Choose the correct statements regarding amoeboid protozoans.
 - I. These are actively moving organisms because of the presence of thousands of cilia.
 - II. The members of this group are multicellular eukaryotes.
 - III. These organisms live in fresh water, sea water or moist soil.
 - IV. These organisms move and capture their prey by putting out pseudopodia.
 - (a) I and III
 - (b) II and IV
 - (c) I only IV
 - (d) III and IV
6. Name the specialised cells present in blue-green algae that can fix atmospheric nitrogen.
 - (a) Mesosome
 - (b) Heterocysts
 - (c) Hyphae
 - (d) None of these
7. Which of the following characters belongs to Kingdom Protista?
 - (a) Prokaryotic
 - (b) Both autotrophic and heterotrophic
 - (c) Absence of cell wall
 - (d) Absence of nuclear membrane
8. Fusion of protoplasts between two motile gametes is called _____.
 - (a) karyogamy
 - (b) isogamy
 - (c) plasmogamy
 - (d) fragmentation
9. *Mucor*, *Rhizopus* and *Albugo* belongs to
 - (a) ascomycetes
 - (b) basidiomycetes
 - (c) deuteromycetes
 - (d) phycomycetes.
10. Following are some characters given:
 - I. Unicellular protist found in freshwater
 - II. Possess a protein-rich outer layer called pellicle

- III. Have two flagella
IV. Possess pigments identical to those in higher plants
These characters apply to the Genus
(a) *Alternaria* (b) *Nostoc*
(c) *Chlorella* (d) *Euglena*.
11. Two kingdom classification system did not distinguish between
(a) eukaryotes and prokaryotes
(b) unicellular and multicellular organisms
(c) photosynthetic and non-photosynthetic organisms
(d) all of these.
12. Select the wrong statement.
(a) The term '*contagium vivum fluidum*' was coined by M. W. Beijerinck.
(b) Mosaic disease in tobacco and AIDS in human being are caused by viruses.
(c) The viroids were discovered by D. J. Ivanovsky.
(d) W. M. Stanley showed that viruses could be crystallised.
13. Identify the group to which of the bacteria shown belongs.

(a) *Coccus* (b) *Vibrium*
(c) *Spirillum* (d) *Bacillus*
14. Which of the following is not correct about methanogens?
(a) They are present in the gut of several ruminant animals.
(b) They are responsible for the production of methane.
(c) They are responsible for the production of methanol.
(d) These are found in marshy areas.
15. Which of the following statements is wrong with respect to mycoplasma?
(a) These organisms completely lack a cell wall.
(b) They are the smallest living cells known.
(c) They cannot survive without oxygen.
(d) They are pathogenic in animals and plants.
16. Choose the correct sequence of events with respect to the sexual cycle of fungi.
(a) Karyogamy, plasmogamy and meiosis
(b) Meiosis, karyogamy and plasmogamy
(c) Plasmogamy, karyogamy and meiosis
(d) Meiosis, plasmogamy and karyogamy
17. Match the column I with column II and select the correct option.
- | Column I | Column II |
|-------------------|-------------------------|
| A. Phycomycetes | (I) <i>Trichoderma</i> |
| B. Ascomycetes | (II) <i>Aspergillus</i> |
| C. Basidiomycetes | (III) <i>Agaricus</i> |
| D. Deuteromycetes | (IV) <i>Mucor</i> |
18. Which of the following is an imperfect fungus or fungus without a sexual stage?
(a) *Albugo* (b) *Penicillium*
(c) *Ustilago* (d) *Colletotrichum*
19. Read the following statements regarding slime moulds.
A. The main body is wall less.
B. The true wall found around spores.
C. Spores are dispersed by air currents.
D. They are autotrophic.
Select the correct pair of statements.
(a) A and D (b) B and C
(c) A and C (d) C and D
20. Which of the following are heterosporous pteridophytes?
I. *Lycopodium* II. *Selaginella*
III. *Equisetum* IV. *Salvinia*
(a) I and II only (b) II and III only
(c) III and IV only (d) II and IV only
21. Select the mismatched pair.
(a) Amphibia — Heart is three-chambered
(b) Aves — They are oviparous
(c) Reptilia — They are homoiothermous
(d) Mammalia — Heart is four-chambered
22. Select the correct statements regarding chordates.
A. Notochord is present
B. Heart is dorsal
C. A post-anal part is present
D. Gill slits are absent
(a) A and B (b) B and C
(c) C and D (d) A and C
23. Identify A and B.

(a) A – *Pristis*, B – *Petromyzon*
(b) A – *Scoliodon*, B – *Pristis*
(c) A – *Scoliodon*, B – *Petromyzon*
(d) A – *Hippocampus*, B – *Catla*
24. The process of fusion of two gametes dissimilar in size, as in species of *Eudorina* is termed as
(a) isogamy (b) oogamy
(c) anisogamy (d) none of these.

- 25.** Read the given statements and select the correct option.
Statement I : *Gelidium* and *Gracilaria* are used in preparations of jellies.
Statement II : *Chlorella* is used as food supplement by space travellers.
 (a) Both statements I and II are correct.
 (b) Both statements I and II are incorrect.
 (c) Statement I is correct but statement II is incorrect.
 (d) Statement I is incorrect but statement II is correct.
- 26.** Which of the following groups of algae belongs to Class Rhodophyceae?
 (a) *Laminaria*, *Fucus*, *Porphyra*, *Volvox*
 (b) *Gelidium*, *Porphyra*, *Dictyota*, *Fucus*
 (c) *Gracilaria*, *Gelidium*, *Porphyra*, *Polysiphonia*
 (d) *Volvox*, *Spirogyra*, *Ulothrix*, *Sargassum*
- 27.** Which of the following covers the cellulosic wall of members belonging to phaeophyceae?
 (a) Mannitol (b) Pectin
 (c) Algin (d) Starch
- 28.** Select the correct statements regarding bryophytes.
 A. They are called amphibians of plant kingdom.
 B. They play an important role in plant succession on bare rocks or soil.
 C. They possess true roots, stem or leaves.
 D. The main plant body is haploid.
 (a) A, B, C (b) A, B, D
 (c) A, C, D (d) A, B, C
- 29.** Choose the wrong statement(s) regarding liverworts.
 (a) They grow usually in moist, shady habitats.
 (b) Asexual reproduction takes place by budding.
 (c) The plant body is thalloid.
 (d) Both (b) and (c)
- 30.** Match the column I and II and select the correct option.
- | Column I | Column II |
|------------------------------|-------------------------|
| A. Liverworts | (i) <i>Funaria</i> |
| B. Mosses | (ii) <i>Lycopodium</i> |
| C. Lycopsida | (iii) <i>Marchantia</i> |
| (a) A - II ; B - III ; C - I | |
| (b) A - I ; B - II ; C - III | |
| (c) A - III ; B - II ; C - I | |
| (d) A - III ; B - I ; C - II | |
- 31.** Name the specialised structures formed in liverworts during asexual reproduction.
 (a) Sporophyte (b) Rhizoids
 (c) Seta (d) Gemmae
- 32.** Which among the following is one of tallest tree species among gymnosperms?
 (a) *Pinus* (b) *Ginkgo*
 (c) *Cedrus* (d) *Sequoia*

- 33.** Match the following column I and column II regarding the classes of pteridophytes.

Column I	Column II
A. Psilopsida	(I) <i>Dryopteris</i>
B. Lycopsida	(II) <i>Selaginella</i>
C. Sphenopsida	(III) <i>Psilotum</i>
D. Pteropsida	(IV) <i>Equisetum</i>
(a) A - III ; B - II ; C - IV ; D - I	
(b) A - IV ; B - II ; C - I ; D - III	
(c) A - II ; B - I ; C - III ; D - IV	
(d) A - IV ; B - III ; C - II ; D - I	

- 34.** Select the correct statement(s) regarding gymnosperms.
 (a) They are heterosporous.
 (b) The seeds developed after fertilisation are not covered.
 (c) The ovules are not enclosed by any ovary wall.
 (d) All of these

- 35.** What is common in *Funaria*, *Dryopteris* and *Ginkgo*?
 (a) Presence of archegonia
 (b) Well-developed vascular tissues
 (c) Independent gametophyte
 (d) Independent sporophyte

- 36.** In which of the following the male or female cones or strobili are borne on same tree?
 (a) *Cycas*
 (b) *Salvinia*
 (c) *Pinus*
 (d) All of these



The same THREE LETTERS will complete these four words.

Can you find the three-letter sequence?

C Y — — — B A C T E R I A

M E T H — — — G E N

G U — — — S I N E

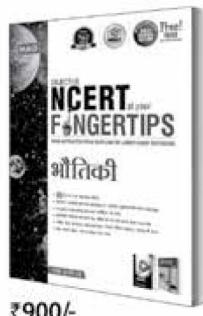
M E L — — — G A S T E R

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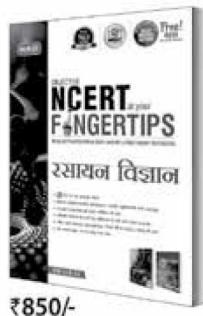
NEET में हिंदी माध्यम के विद्यार्थियों के लिए सफलता मंत्र

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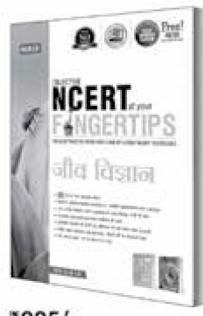
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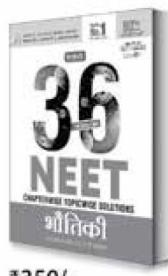
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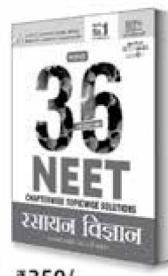
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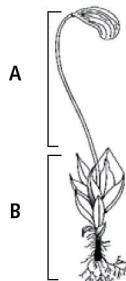


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37. Identify A and B in given diagram of moss.



- (a) A – Gametophyte, B – Sporophyte
- (b) A – Sporophyte, B – Gametophyte
- (c) A – Gametophyte, B – Rhizoids
- (d) A – Seta, B – Sporophyte

38. Which structure can be used for anchorage, defense and for the capture of the prey in Cnidarians?

- (a) Hypostome (b) Medusa
- (c) Spicules (d) Cnidoblast

39. Portuguese man-of-war belongs to Phylum

- (a) Coelenterata (b) Porifera
- (c) Platyhelminthes (d) Annelida.

40. Match the following column I and column II.

Column I	Column II
----------	-----------

- | | |
|---|----------------------------|
| A. Porifera | (I) <i>Ascaris</i> |
| B. Aschelminthes | (II) <i>Pleurobranchia</i> |
| C. Annelida | (III) <i>Nereis</i> |
| D. Ctenophora | (IV) <i>Spongilla</i> |
| E. Platyhelminthes | (V) <i>Taenia</i> |
| (a) A - I ; B - II ; C - III ; D - IV ; E - V | |
| (b) A - IV ; B - I ; C - III ; D - II ; E - V | |
| (c) A - III ; B - II ; C - V ; D - IV ; E - I | |
| (d) A - II ; B - III ; C - I ; D - V ; E - IV | |

41. Choose the wrong statements regarding Phylum Arthropoda.

- A. It is the largest phylum of Animal Kingdom.
 - B. They have jointed appendages.
 - C. Excretion takes place through Malpighian tubules.
 - D. They possess water vascular system for respiration.
 - E. They are diploblastic, metamerically segmented and coelomate animals.
- (a) A and C (b) B and D
 - (c) C and E (d) D and E

42. In hemichordates, a rudimentary structure in the collar region similar to notochord is present. Identify the structure.

- (a) Proboscis (b) Radula
- (c) Parapodia (d) Stomochord

43. 'X' is the excretory organ in *Balanoglossus*. Identify 'X'.

- (a) Malpighian tubules (b) Radula
- (c) Proboscis gland (d) Nephridia

44. Select the option that correctly matches characteristic features with the group of three animals.

- (a) Skeleton of spicules - *Sycon, Adamsia, Spongilla*
- (b) Excretion by flame cells - *Taenia, Fasciola, Ancylostoma*
- (c) Mouth contains radula - *Dentalium, Octopus, Ophiura*
- (d) Jointed appendages - *Limulus, Apis, Laccifer*

45. Match the following column I and column II and select the correct option.

Column I	Column II
----------	-----------

- | | |
|---|------------------|
| A. <i>Echinus</i> | (I) Brittle star |
| B. <i>Ophiura</i> | (II) Sea urchin |
| C. <i>Antedon</i> | (III) Star fish |
| D. <i>Cucumaria</i> | (IV) Sea lily |
| E. <i>Asterias</i> | (V) Sea cucumber |
| (a) A - IV ; B - V ; C - III ; D - I ; E - II | |
| (b) A - II ; B - I ; C - IV ; D - V ; E - III | |
| (c) A - III ; B - I ; C - V ; D - IV ; E - II | |
| (d) A - I ; B - II ; C - III ; D - IV ; E - V | |

46. Which one of the following options is correct with respect to the body cavity?

- (a) Platyhelminthes - Acoelomates
- (b) Aschelminthes - Coelomates
- (c) Annelida - Pseudocoelomates
- (d) Mollusca - Acoelomates

47. Identify the phylum on the basis of following characteristics.

- A. These animals have an endoskeleton of calcareous ossicles.
 - B. All are marine with organ-system level of organisation.
 - C. They are triploblastic and coelomate animals.
 - D. They possess water vascular system for locomotion.
- (a) Mollusca (b) Arthropoda
 - (c) Annelida (d) Echinodermata

48. Which of the following mammals is oviparous?

- (a) Flying fox (b) *Delphinus*
- (c) Platypus (d) *Balaenoptera*

49. How many pairs of gill slits are present in members of Class Cyclostomata?

- (a) 6 - 15 (b) 7 - 10
- (c) 8 - 15 (d) 6 - 10

50. Chelone and Testudo belong to which Phylum?

- (a) Echinodermata (b) Mollusca
- (c) Chordata (d) Platyhelminthes

WHO AM I ...

- | | |
|--------------|--------|
| 1. Thalamus | Pg. 32 |
| 2. Micropyle | Pg. 35 |
| 3. Solenoid | Pg. 74 |
| 4. Promoter | Pg. 77 |

SOLUTIONS

- (b)**: The correct sequence of taxonomical categories in descending order is:
Kingdom → Division Phylum → Class → Order → Family → Genus → Species
- (c)**: Photoperiod affects flowering and reproduction in angiosperms. Binomial nomenclature system was given by Carolus Linnaeus.
- (d)**: Binomial nomenclature is a system of providing a name with two components. This naming system was given by Carolus Linnaeus.
- (a)**: The correct sequence of wheat with their taxonomic category is as follows:
Genus (*Triticum*) → Family (Poaceae) → Order (Poales) → Class (Monocotyledonae) → Phylum (Angiospermae)
- (d)**: All members belonging to Kingdom Protista are single-celled eukaryotes. Cilia is present in ciliated protozoans. They move and capture their prey by putting out pseudopodia (false feet).
- (b)**: Heterocysts are specialised cells found in some blue-green algae, *Nostoc* and *Anabaena* which are responsible for atmospheric nitrogen fixation.
- (b)**: All single-celled eukaryotes are placed under Protista, but the boundaries of this kingdom are not well defined. Cell wall is present in some protists, (e.g., dinoflagellates). Being eukaryotes, the protistan cell body contains a well defined nucleus and other membrane-bound organelles.

Some protists are autotrophic, (e.g., some dinoflagellates) while some are heterotrophic, (e.g., protozoans).

- (c)**
- (d)**
- (d)**: In Linnaeus' time, a two kingdom system of classification with plant and animal kingdoms was developed that included all plants and animals respectively. This system did not distinguish between the eukaryotes and prokaryotes, unicellular and multicellular organisms and photosynthetic (green algae) and non-photosynthetic (fungi) organisms.
- (c)**: Viroids are infectious RNA particles which were discovered by T. O Diener (1971). These are devoid of protein coat and cause disease in plants only, e.g., potato spindle tuber, *Chrysanthemum* stunt, etc.
- (b)**: Bacteria are grouped under four categories based on their shape: the spherical Coccus (pl.: cocci), the rod-shaped Bacillus (pl.: bacilli), the comma-shaped Vibrium (pl.: vibrio) and the spiral Spirillum (pl.: spirilla).
- (c)**
- (c)**: Mycoplasma can survive without oxygen.
- (c)**: The sexual cycle of fungi involves the following three steps :
 - Fusion of protoplasts between two motile or non-motile gametes called plasmogamy.
 - Fusion of two nuclei called karyogamy.
 - Meiosis in zygote resulting in haploid spores.
- (a)**
- (d)**: Deuteromycetes (Fungi imperfecti) is the class of fungi which includes all those fungi in which sexual



**ANSWERS
JUNE 2023**

Across

- ① Human heart
- ③ Human brain
- ⑤ Nerve fiber
- ⑦ Human kidney

Fill the grid with words related to given images.

		② C	④ G				
① A	O	R	T	⑥ A			
	T	A		L			
	Y	N		V			
	L	U	⑥ M	E	D	U	L
	E	M		O		O	
	D	H	I	L	U	M	R
⑤ A	X	O	N	I			
	N						

Down

- ② Human liver
- ④ Human lung
- ⑥ Human heart
- ⑧ Human stomach

Winner : Vedanti Barik

- stage is whether absent or not known. Examples include *Colletotrichum*, *Helminthosporium*, etc.
- Albugo*, *Penicillium* and *Ustilago* belong to Oomycetes, Ascomycetes and Basidiomycetes respectively.
19. (b) : Slime moulds are saprophytic protists. The spores possess true walls and are dispersed by air currents.
20. (d)
21. (c) : Animals belonging to Class Reptilia are poikilotherms (i.e., cold blooded animals).
22. (d) : Animals belonging to Phylum Chordata are fundamentally characterised by the presence of a notochord, a dorsal hollow nerve cord and paired pharyngeal gill slits. These are bilaterally symmetrical, triploblastic, coelomate with organ-system level of organisation. They possess a post anal tail and a closed circulatory system.
23. (b) 24. (c) 25. (a)
26. (c) : Red algae are eukaryotic autotrophs with chl-a and d, phycobilins as pigments, floridean starch as food reserve and abundant phycocolloids (like, agar, carrageenin, funori) but they lack flagellate cells. They are mostly marine. Common red algae are *Gracilaria*, *Gelidium*, *Porphyra*, *Polysiphonia*, *Batrachospermum*, *Chondrus*, etc.
27. (c) : The vegetative cells of brown algae have a cellulosic wall usually covered on the outside by a gelatinous coating of algin.
28. (b) : Bryophytes lack true roots, stem or leaves. It is thallus-like and prostrate or erect and attached to the substratum by unicellular or multicellular rhizoids.
29. (b) : Asexual reproduction in liverworts takes place by fragmentation of thalli, or by the formation of specialised structures called gemmae.
30. (d)
31. (d) : In liverworts, gemmae are green, multicellular, asexual buds, which develop in small receptacles called gemma cups located on the thalli. The gemmae become detached from the parent body and germinate to form new individuals.
32. (d)
33. (a)
34. (d)
35. (a) : In *Funaria* (Bryophyta), *Dryopteris* (Pteridophyta) and *Ginkgo* (Gymnosperm) female sex organ *archaeogonium* is formed. *Funaria* lacks independent sporophyte and vascular tissues, while independent gametophyte is absent in *Ginkgo*.
36. (c) 37. (b)
- (d) : In coelenterates or cnidarians, cnidoblasts or cnidocytes which contain the stinging capsules or nematocysts are present on the tentacles and the body. These are used for anchorage, defense and capture of prey.
39. (a) : Portuguese man-of-war is a common name of *Physalia*, which belongs to Phylum Coelenterata.
40. (b)
41. (d) : Water vascular system is present in echinoderms. Arthropods are triploblastic animals.
42. (d) : Hemichordates have a rudimentary structure in the collar region called stomochord, a structure similar to notochord.
43. (c) : 'X' = Proboscis gland, which is the excretory organ of member belonging to Phylum Hemichordata.
44. (d) : In poriferans, the body is supported by a skeleton made up of spicules or spongin fibres. *Sycon* and *Spongilla* are examples of poriferan, whereas *Adamsia* is a coelenterate. In platyhelminths, specialised cells called flame cells help in excretion. *Taenia* and *Fasciola* are platyhelminths whereas *Ancylostoma* is an aschelminth. In molluscs, mouth contains a file-like rasping organ for feeding called radula. *Dentalium* and octopus are molluscs whereas *Ophiura* is an echinoderm. Arthropods have jointed appendages. *Limulus*, *Apis* and *Laccifer* all three are arthropods.
45. (b)
46. (a) : Aschelminthes are pseudocoelomates, annelids and molluscs are coelomates.
47. (d)
48. (c) : *Ornithorhynchus* (Platypus) is an oviparous mammal.
49. (a) : All living members of the Class Cyclostomata have an elongated body bearing 6-15 pairs of gill slits for respiration.
50. (c) : *Chelone* is scientific name of turtle and *Testudo* is scientific name of tortoise. Both of them belong to Class Reptilia of Phylum chordata.

XX

MONTHLY TEST DRIVE CLASS XI					ANSWER	KEY
1. (a)	2. (c)	3. (d)	4. (a)	5. (d)		
6. (c)	7. (a)	8. (c)	9. (b)	10. (d)		
11. (d)	12. (b)	13. (d)	14. (b)	15. (b)		
16. (d)	17. (a)	18. (a)	19. (a)	20. (c)		
21. (d)	22. (b)	23. (a)	24. (d)	25. (d)		
26. (c)	27. (a)	28. (d)	29. (b)	30. (b)		
31. (d)	32. (d)	33. (d)	34. (c)	35. (b)		
36. (a)	37. (c)	38. (c)	39. (a)	40. (c)		

ZOOM IN BIO



The Sensory System

The sensory system is a part of the nervous system responsible for processing sensory information. A sensory system consists of **sensory receptors** that receive stimuli from external or internal environment, **neural pathway** that conducts information from the receptors to the brain (i.e., the ascending or sensory tracts in the spinal cord) and **parts of the brain**, that deal primarily with processing the information (i.e., somatosensory cortex) in the parietal lobe.

The commonly recognised sensory systems are those for **vision, hearing, touch, taste** and **olfaction**.

Sensory Receptors

All sensory receptors are similar in basic structure. The simplest and most primitive type of sensory receptor is a single afferent neuron with its receptor endings meant for detection of stimuli called **primary sense cell** or 1st order neuron, e.g., olfactory cells.

Secondary sense cells or 2nd order neurons are modified epithelial cells that form synaptic connections and transmit impulses to CNS, e.g., taste buds.

Sensory organs are the most complex sensory receptors, e.g., eye and ear.

Functioning of Sensory Receptors

The energy or chemical that impinges upon and activates a sensory receptor is known as a **stimulus**, e.g., light, sound, pressure, heat, osmotic potential, electric current, etc.

Each type of receptors is sensitive to a specific stimulus and almost non-responsive to other stimuli.

An animal responds to a stimulus in a four-step process:

1 Sensory transduction	2 Transmission	3 Integration	4 Response
Sensory receptors transduce (transform) the energy of a stimulus into a localised nonpropagated electrical response which initiates nerve impulses in the neuron leaving the receptor.	The sensory neuron relays the nerve impulse to the brain directly or through the spinal cord.	Nerve impulses (action potentials, often called receptor or generator potentials) that reach the brain via sensory neurons are termed as sensations . In the brain, the sensations are analysed and interpreted as perceptions . Thalamus is the main centre and cerebral cortex is the subsidiary centre of this analysis. The brain transmits motor impulses to appropriate effectors -muscles or glands.	Effectors produce suitable responses. Muscles contract, or glands secrete chemicals, in response to the information sent to the brain by the receptors.

Classification of receptors according to the type of stimuli they receive

These receptors are of five main types: mechanoreceptors, photoreceptors, chemoreceptors, electroreceptors and thermoreceptors as shown in the table.

Types of Receptors		
Name of receptor	Types and Stimulated by	Examples
Thermoreceptors respond to alteration in temperature	(a) For cold (low temperature) (b) For heat (high temperature)	Both are more numerous on face and hands than elsewhere End bulb of Krause in skin (frigidoreceptors) Ruffini's organs in skin (caloreceptor)
Mechanoreceptors stimulated by mechanical deformation like touch, pressure	(a) Tangoreceptors (located in the skin): Touch and pressure (b) Phonoreceptors : Air borne sound waves (c) Statoreceptors : Acceleration and gravity (d) Proprioreceptors : Position of parts of body (e) Rheoreceptors : Pressure waves and water currents (f) Baroreceptors : Blood pressure	(i) Meissner's corpuscles (ii) Merkel's discs (iii) Basket nerve ending (iv) Pacinian corpuscles – for pressure For light, touch and air movement Organ of Corti in internal ear Hair cells in cristae and maculae in internal ear Free nerve endings, neuromuscular and neurotendinous spindles Lateral line sense organs in fish Nerve endings in walls of atria, vena cava, carotid sinuses, aortic arch.
Photoreceptors stimulated by light	Light wavelengths (electromagnetic)	Retina in vertebrate eye, Ommatidia in compound eyes of arthropods
Chemoreceptors stimulated by chemicals	(a) Gustatoreceptors Taste due to chemicals in solution (b) Olfactory receptors (Olfactoreceptors) Smell due to volatile chemicals (c) Humidoreceptors Humidity	Taste buds of tongue Olfactory epithelium, Ampulla of Lorenzini (<i>Scoliodon</i>) Skin
Nociceptors	Pain, damage or injuries of the body tissue	Free nerve endings
Electroreceptors	Effective currents in surrounding water	Skin of some fishes

Skin Receptors

The skin contains receptors called the cutaneous receptors that respond to touch, pressure, pain and temperature. Cutaneous receptors are mainly of three types— mechanoreceptors, thermoreceptors and pain receptors.

Most of the skin receptors possess connective tissue sheaths and mostly occur in the dermis. Some are with free nerve endings may penetrate the epidermis.

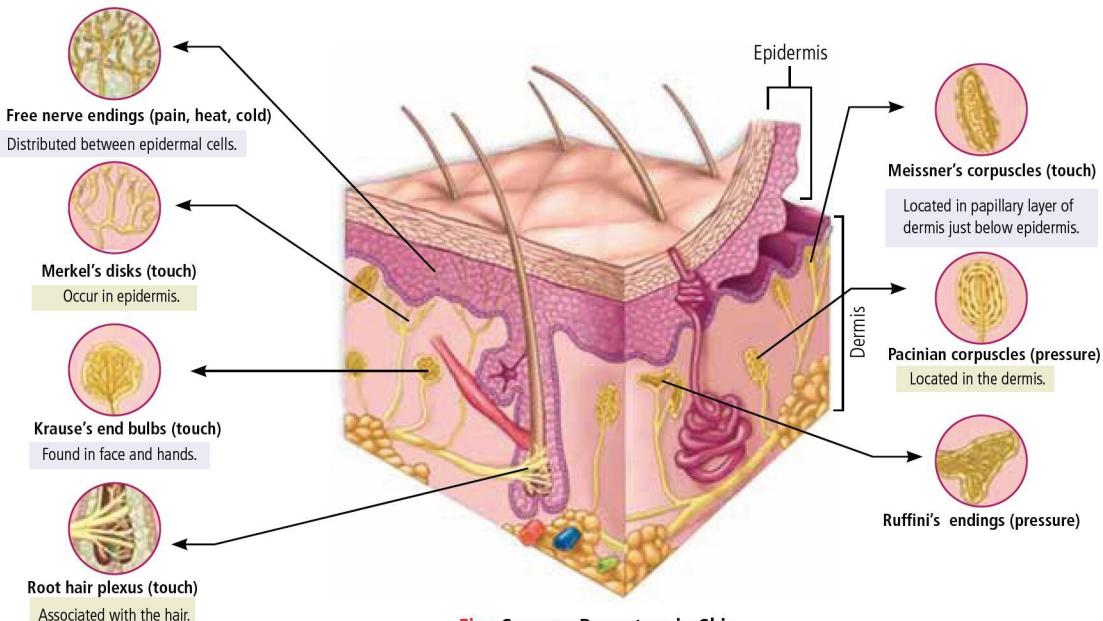


Fig.: Sensory Receptors in Skin

Smell Receptors

The sense of smell arises from stimulation of receptors in the olfactory mucous membrane.

Olfactory sensation is the most primitive of all special senses and is much more acute than taste, with smell receptor as much as 3,400 times more sensitive than taste receptors.

The receptors for smell occur in a small (about 5 cm^2) patch of **olfactory neuroepithelium** (pseudostratified epithelium) located in the roof of the nasal cavity, with nearly 20 million olfactory receptors.

Structure of Olfactoreceptor

Olfactory epithelium (also called Schneiderian membrane) is a **modified pseudostratified epithelium**. It is yellowish in colour and has three types of cells : **receptor cells**, **supporting cells** and **basal cells**, resting on a thick **lamina propria**.

Receptor cells

These are also called **olfactory cells**, or **olfactoreceptors**. They act as sensory receptors as well as conducting neurons. They are receptors for chemicals. They are spindle-shaped, **bipolar neurons** with rounded nuclei in the middle region. Olfactory receptor cells are unique in that they are the only neurons that undergo turnover throughout adult life. The olfactory cells survive only for about 2 months.

Supporting cells

These are columnar cells with large oval nuclei. They lie between the olfactory cells to support them.

Basal cells

These are small cells that do not reach the surface. They give rise to new olfactory cells to replace the worn out ones.

Olfactory glands (Bowman's glands) – Many olfactory glands occur below the olfactory epithelium, that secrete mucus to spread over the epithelium, to keep it moist. The mucus also protects the cells from dust and bacteria.

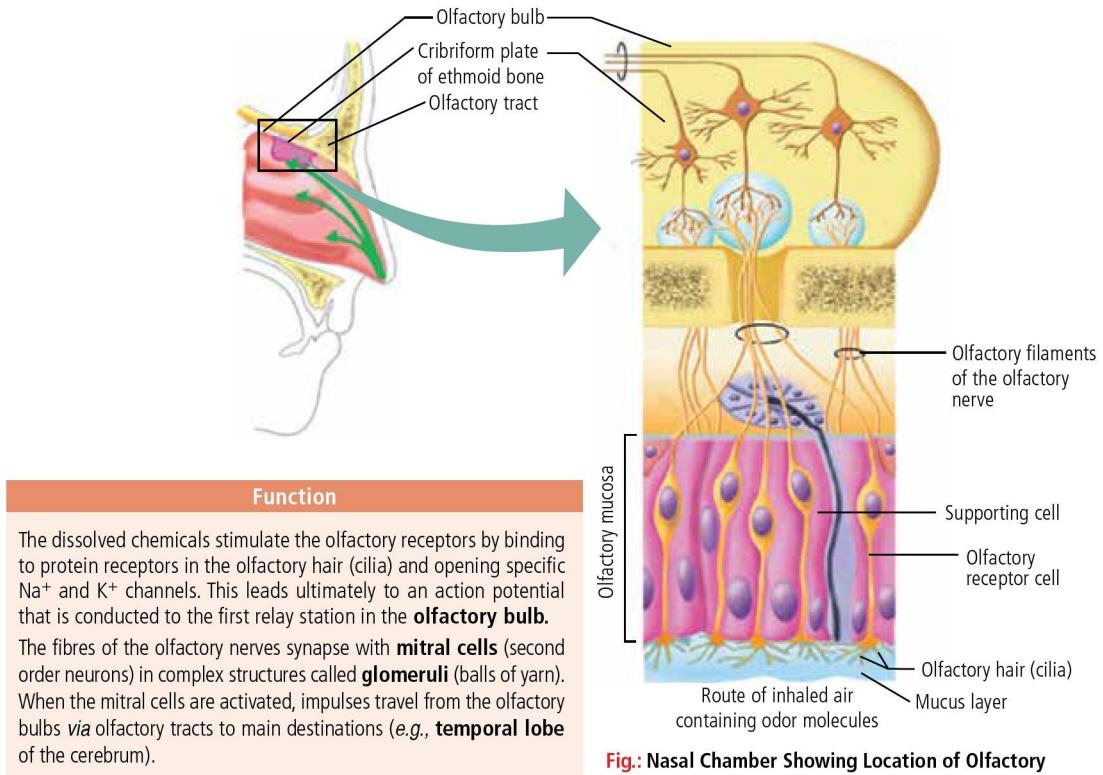


Fig.: Nasal Chamber Showing Location of Olfactory Epithelium with Detailed Structure

Taste Receptors

The receptors for taste are found in about 10,000 taste buds, mostly located on the tongue but also found on the palate, pharynx and epiglottis, and even in the proximal part of oesophagus. The number of taste buds declines after 45 years of age.

At least 13 possible chemical receptors are found in taste cells such as 2 sodium receptors, 2 potassium receptors, 1 chloride receptor, 1 adenosine receptor, 1 inosine receptor, 2 sweet receptors, 2 bitter receptor, 1 glutamate receptor and 1 hydrogen ion receptor.

Anterior surface of the tongue is covered with numerous small projections called **papillae**.

Taste buds are located in the walls of papillae. There are 4 types of papillae - fungiform, filiform, vallate and foliate. Filiform papillae do not contain taste buds.

Structure of taste bud

Each taste bud is an oval body consisting of three kinds of cells:

1. Gustatory receptor cells

They bear microvilli at the free end projecting into the **taste pore**. The microvilli have special protein receptor sites for taste-producing molecules when come in contact with the food being eaten. Nerve fibres of the **cranial nerves VII (Facial), IX (Glossopharyngeal) or X (Vagus)** end around the gustatory receptor cells, forming synapses with them. The gustatory receptor cells (taste cells) survive only about 10 days and are then replaced by new cells.

2. Supporting cells

These cells lie between the gustatory receptor cells in the taste bud. They bear microvilli but lack nerve endings.

3. Basal cells

These cells are found at the periphery of the taste bud. They produce supporting cells, which then develop into gustatory receptor cells.

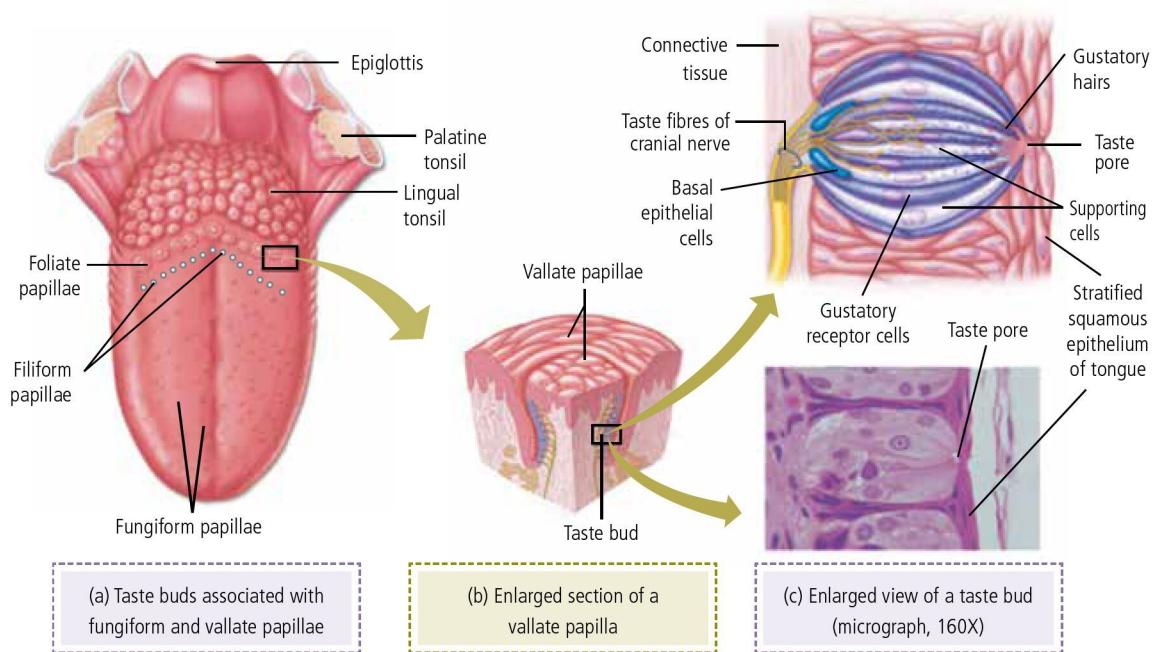


Fig.: Position of Taste Buds and Section through a Taste Bud Showing Detailed Structure

Snap Shots

- Taste buds degenerate and disappear within a week after the nerve to the taste bud is cut.
- Umami, a fifth taste sense has been added to the four classical taste modalities (sweet, salt, sour and bitter). This taste is pleasant and sweet but differs from the standard sweet taste.

Function

Specific chemicals in solution, pass into the taste bud through the taste pore, to come in contact with the protein receptor sites on the microvilli of the gustatory receptor cells. The latter set up nerve impulses in the sensory nerve fibres.

The facial nerve (VII) serves the anterior two-thirds of the tongue, the glossopharyngeal nerve (IX) serves the posterior one-third of the tongue and the vagus nerve (X) serves the pharynx and epiglottis but not the tongue.

Ear : The Organ of Hearing

The ear is the organ that detects sound. It not only acts as a receiver for sound, but plays a major role in the sense of balance and body position. It contains both receptors that respond to movements of the head and receptors that convert sound waves into nerve impulses.

Structure of Human Ear

The human ear consists of three parts: the external ear, the middle ear and the internal ear.

External ear

It comprises a pinna and external auditory meatus (canal).

1. Pinna

It serves to direct sound waves to the **auditory meatus**. It is attached by ligaments and muscles to the skull. It consists of a **cartilaginous framework** of elastic connective tissue covered with skin. Its most prominent outer ridge is called the **helix**. The **lobule** is the soft pliable part at its lower end, composed of fibrous and adipose tissue, richly supplied with blood capillaries. It is sensitive as well as effective in **collecting sound waves**.

2. External auditory meatus

It is a tubular passage supported by cartilage in its external part and by bone in its inner part. The meatus (canal) is internally lined by **hairy skin** (stratified epithelium) and **ceruminous glands** (wax glands). The latter are modified sweat glands which secrete a waxy substance - the **cerumen** (ear wax) which prevents the foreign bodies entering the ear.

Functions of external ear

It directs sound waves towards the tympanic membrane. The sound waves produce pressure changes over the surface of the tympanic membrane. The cerumen (ear wax) prevents the entry of the foreign bodies into the ear.

Middle ear

The middle ear is an air-filled cavity called tympanic cavity, located in the temporal bone of skull, behind the ear drum (tympanic membrane). It includes the three **ear bones** or **ossicles**. The opening of the Eustachian tube is also within the middle ear.

1. Tympanic membrane

The tympanum (tympanic membrane) or ear drum is a thin, double-layered, epithelial partition between the external auditory meatus and the middle ear. The handle of the malleus (**manubrium**) is firmly attached to the membrane's inner surface. The tympanic membrane is innervated by the auriculotemporal nerve, a branch of the mandibular portion of the **Trigeminal (V)** cranial nerve and the auricular nerve, *i.e.*, a branch of the **Vagus (X)** cranial nerve.

2. Eustachian tube

The tympanic cavity, filled with air is connected with the nasopharynx through the **Eustachian tube** (auditory tube), which serves to equalise the air pressure in the tympanic cavity with that on the outside.

3. Ear ossicles

A chain of three small, movable, articulated bones, the ear or **auditory ossicles** are located in the middle ear. The outer ossicle is **hammer-shaped**. It is called the **malleus**. It is attached to the inner surface of the tympanic membrane.

The inner ossicle is **stirrup-shaped**. It is known as the **stapes**. Its foot plate is attached by an angular ligament to the walls of oval window or fenestra ovalis. Stapes is the smallest bone in the body. The middle ossicle is **anvil-shaped**. It is called the **incus**. It is joined to the malleus, at the outer end and stapes, at the inner end. The three ossicles articulate by synovial joints.

Two small skeletal muscles, **tensor tympani** and **stapedius**, are joined to the malleus and stapes respectively. Contraction of former pulls the manubrium of the malleus medially and decreases the vibrations of the tympanic membrane and contraction of latter pulls the foot plate of the stapes out of the oval window.

Hence, they prevent damage to the delicate internal ear when the ear is exposed to loud sounds. They dampen sound by controlling amplitude, *e.g.*, while chewing and talking.

Stapedius is the smallest muscle in the body.

The middle ear is connected with the inner ear through two small openings closed by the membranes. These openings are (i) **fenestra ovalis** (oval window) and (ii) **fenestra rotunda** (round window).

The fenestra ovalis is covered by foot plate of the stapes. The fenestra rotunda is closed by a flexible secondary tympanic membrane. The latter is responsible for equalising the pressure on either side of the tympanic membrane.

Functions of middle ear

The ossicles transmit and amplify sound waves across the tympanic cavity from the tympanic membrane to the oval window.

The ossicles are connected in such a way so as to act as a lever system, to increase the force of the vibration from the ear drum.

In addition, the force of vibration is intensified, as it is transmitted from the relatively large surface of the eardrum, to the smaller surface area of the oval window.

The combined effect increases the force of vibrations roughly twenty times. It may be noted that the frequency of sound does not change.

From the tympanic cavity, extra sound is carried to the pharynx through Eustachian tube.

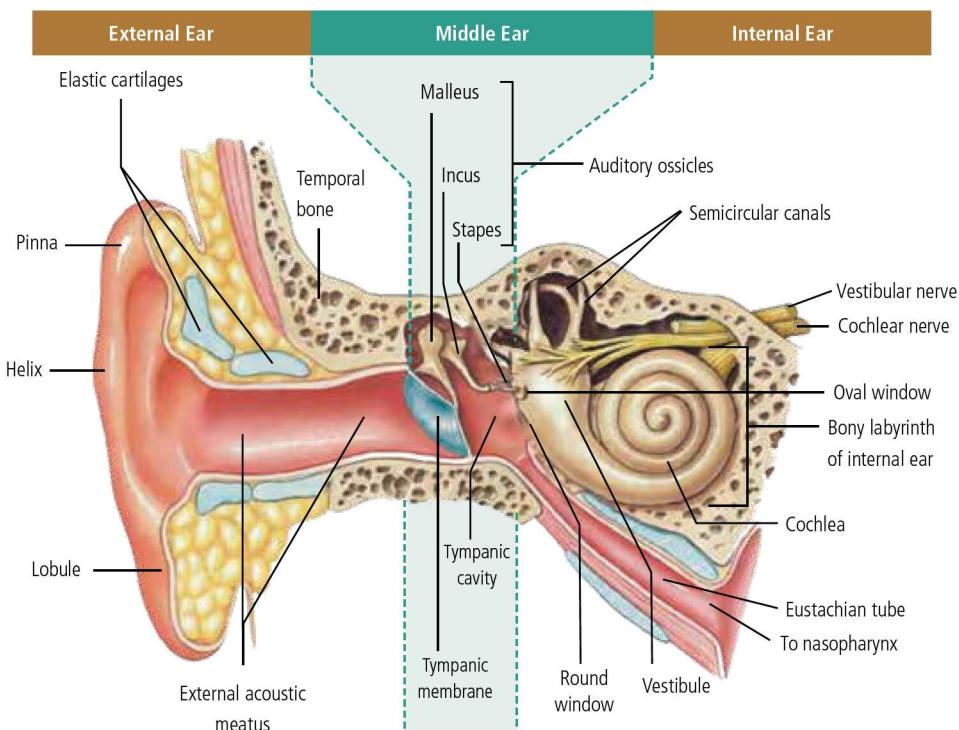


Fig.: Ear Anatomy

Internal ear

The inner ear includes both the organ of hearing (**cochlea**) and a sense organ that is attuned to the effects of both gravity and motion (**vestibular apparatus**).

The internal ear (**labyrinth**) is made up of two parts: bony labyrinth and membranous labyrinth, one within the other.

The **bony labyrinth** is a series of channels in the petrous portion of temporal bone.

Inside these channels, surrounded by a fluid called **perilymph** (similar in composition to cerebrospinal fluid) is the **membranous labyrinth**. This membranous structure more or less duplicates the shape of the bony channels. It is filled with a fluid called **endolymph** (similar in electrolyte composition to intracellular fluid) and there is no communication between the spaces filled with endolymph and those filled with perilymph.

These fluids provide the media for vibrations involved in hearing and maintenance of equilibrium.

The membranous labyrinth consists of **three semicircular ducts, utricle, saccule, endolymphaticus** and **cochlea**.

Semicircular Ducts

Three semicircular ducts are present: the **anterior**, the **posterior** and the **lateral** semicircular ducts. The three bony semicircular ducts arise from the utricle and are oriented at **right angles** to each other. Each semicircular duct is enlarged at one end to give rise to a small rounded **ampulla**. The anterior and lateral semicircular ducts bear ampullae at their anterior ends, while the posterior duct contains an ampulla at its posterior end. Each ampulla contains a sensory patch of cells, the **crista**. Each crista consists of two kinds of cells, the **sensory** and **supporting cells**. The sensory cells bear long sensory hair at their free ends and nerve fibres at the other end. The sensory hair are partly embedded in a dome shaped gelatinous mass, the **cupula**.

The cristae are concerned with balance of the body.

Utricle, Endolymphaticus and Saccule

The utricle is a dorsally placed structure to which all the three semicircular ducts are connected. The saccule is a ventrally situated structure which is joined with the utricle by a narrow **utriculosaccular duct**. From this duct a long tube, the **ductus endolymphaticus** arises which ends blindly as the **saccus endolymphaticus**. Both utricle and saccule contain sensory patches, the **maculae**. A macula comprises sensory and supporting cells similar to those of the crista. The hair are not actually motile and are embedded in a gelatinous membrane, the **otolith membrane** in which small crystals of calcium carbonate are also found, called **otolith**. The cristae and maculae are the receptors of balance therefore, they are concerned with equilibrium.

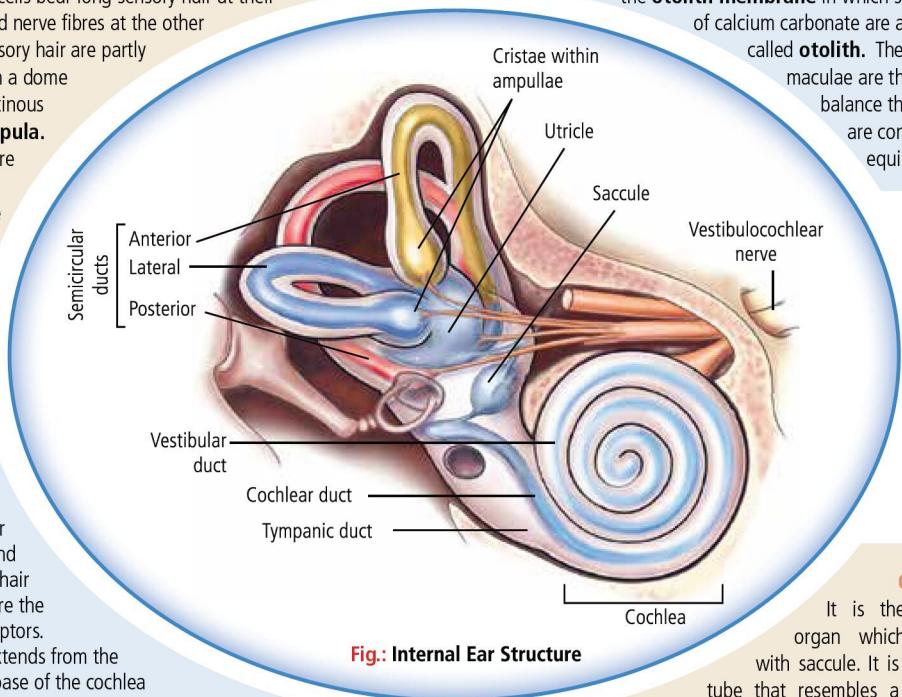


Fig.: Internal Ear Structure

Organ of Corti

It is located on the basilar membrane and contains the hair cells which are the auditory receptors.

This organ extends from the apex to the base of the cochlea and consequently has a spiral shape.

The processes of the hair cells pierce the tough, membrane-like **reticular lamina** that is supported by the **rods of Corti**. The cochlea contains 16,000 to 24,000 hair cells arranged in four rows. In three of the rows, the hair form V-shaped patterns called outer hair cells. In, the fourth row, the hair cells form a straight line called inner hair cells. The inner hair cells are supported by inner **phalangeal cells**, while the outer hair cells are supported by Deiter's cells (outer phalangeal cells). From the upper surface of the hair cell project tiny 'cilia', also called **stereocilia**.

Covering the rows of hair cells is a thin, viscous, but elastic **tectorial membrane** in which the tips of the hairs of the outer, not the inner hair cells, are embedded. The cell bodies of the afferent neurons that arborise around the bases of the hair cells are located in the **spiral ganglion** within the **modiolus**, the bony core around which the cochlea is wound. 90 to 95% of these afferent neurons innervate the inner hair cells; only 5 – 10% innervate the more numerous outer hair cells, and each neuron innervates several of these outer cells. By contrast, most of the efferent fibres in the auditory nerve terminate on the outer hair cells rather than on the inner hair cells. More than 30,000 neurons and nerve fibres emerging from chain cells, convey the electrical signals to the brain, just 2 cm away via auditory (vestibulo-cochlear) nerve.

Cochlea

It is the main hearing organ which is connected with saccule. It is a spirally coiled tube that resembles a **snail shell** in appearance.

It tapers from a broad base to an almost pointed apex. Internally, it consists of three fluid filled chambers or canals, the upper **scala vestibuli**, lower **scala tympani**, and the middle **scala media** (cochlear duct). Both scala vestibuli and scala tympani are filled with **perilymph**. However, scala media is filled with **endolymph**. Both the scala vestibuli and scala tympani are connected with each other at the apex of the cochlea by a small canal, the **helicotrema**. It is important to mention that near the base of the scala vestibuli the wall of the membranous labyrinth comes in contact with the **fenestra ovalis**, while at the lower end of the scala tympani lies the **fenestra rotunda**. The scala media is the most important canal or channel of the cochlea. It bears an upper membrane, the **Reissner's membrane**, and lower membrane, **basilar membrane**. On the basilar membrane a sensory ridge, the **Organ of Corti** is present.

Snap Shots

- The stereocilia, which pass through reticular lamina are bathed in endolymph whereas the bases of the hair cells are bathed in perilymph.
- Tectorial membrane is an elastic structure attached at one end to the limbus and its outer edge is attached to the Hensen's cells (supporting cells of organ of Corti which lie outside the outer hair cells).

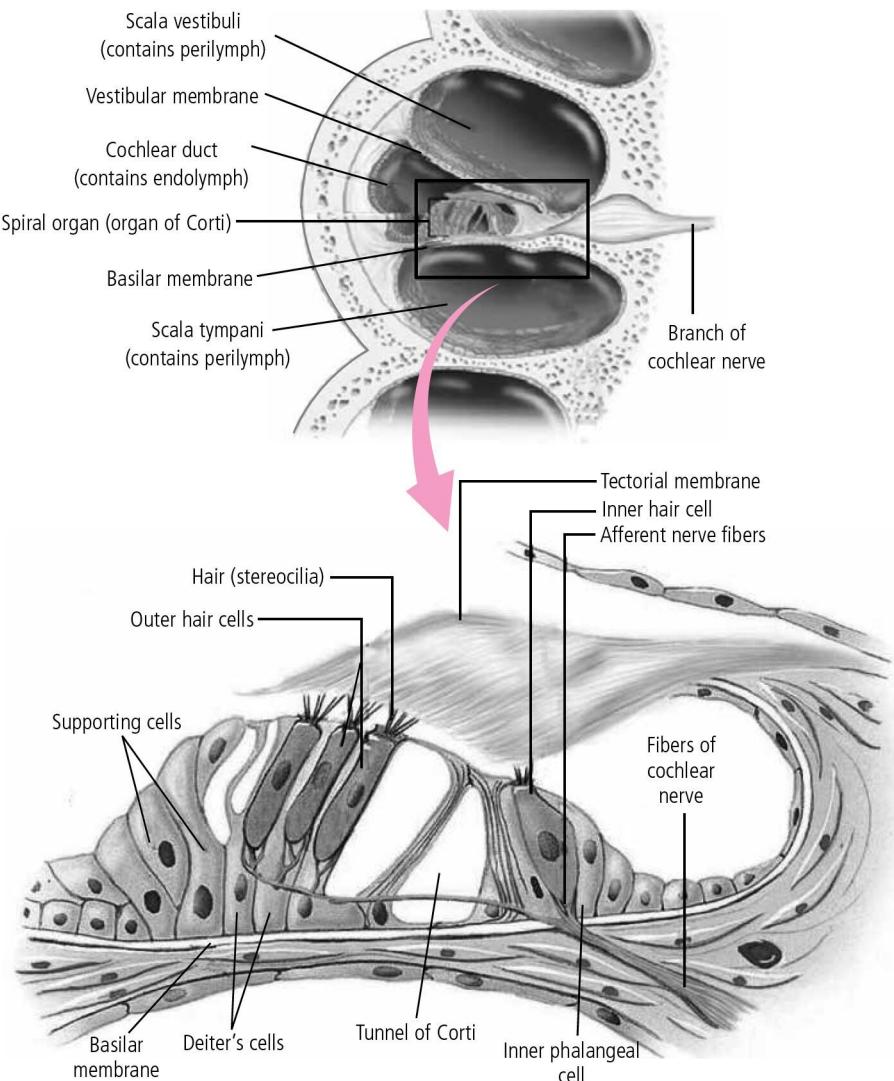


Fig.: Cross Section of the Membrane and Compartment of the Inner Ear with Detailed View of the Hair Cells and Other Structures on the Basilar Membrane

Functions of ear

The ear performs two important functions : hearing and balancing (equilibrium).

1. Mechanism of hearing

The given flowchart describes the working of ear:

External ear receives sound waves → Directs it towards the eardrum → When waves strike the tympanic membrane, it vibrates → Vibrations are transmitted through ear ossicles to oval window → Movement of oval window sets up wave in the perilymph of scala vestibuli → Vibrations of endolymph of scala media → Waves in endolymph induces a ripple in basilar membrane → Basilar movements bends the hair cells pressing them against tectorial membrane → Nerve impulse generated in the associated afferent neurons → Impulse transmitted to auditory region via auditory nerve → Impulse gets analysed and sound is recognised.

2. Equilibrium

Two types of equilibrium are discussed here in the given table.

Dynamic equilibrium	Static equilibrium and linear acceleration
<p>Cristae in the ampullae, at the end of semicircular canals detect turning or rotational movements of the head (angular acceleration).</p> <p>Movements in any direction will stimulate the sensory cells of atleast one crista, since the three semicircular ducts are arranged in three different planes. This causes bending of cupula, as well as hair cells in a particular crista.</p> <p>This disturbance stimulates the sensory cells and sets up action potential in the vestibular branch of the auditory nerve, which transmits it to the brain, for interpretation.</p> <p>Dizziness after spinning or travel is due to disturbance in endolymph or excessive sensitisation.</p>	<p>Maculae detect changes in the head (or body) with respect to gravity (static equilibrium) and in the movement in one direction (linear acceleration).</p> <p>With a change in the position of the body, the otoliths, being heavier than the endolymph, press upon the sensory hair of the maculae.</p> <p>This stimulates the sensory cells which initiates nerve impulse in the fibres of the vestibular branch of auditory nerve to the cerebellum for interpretation. Cerebellum then sends reflex signals for restoring static balance.</p> <p>The macula of utricle responds to vertical movements of the head and the macula of saccule responds to lateral (sideways) movements of the head.</p>

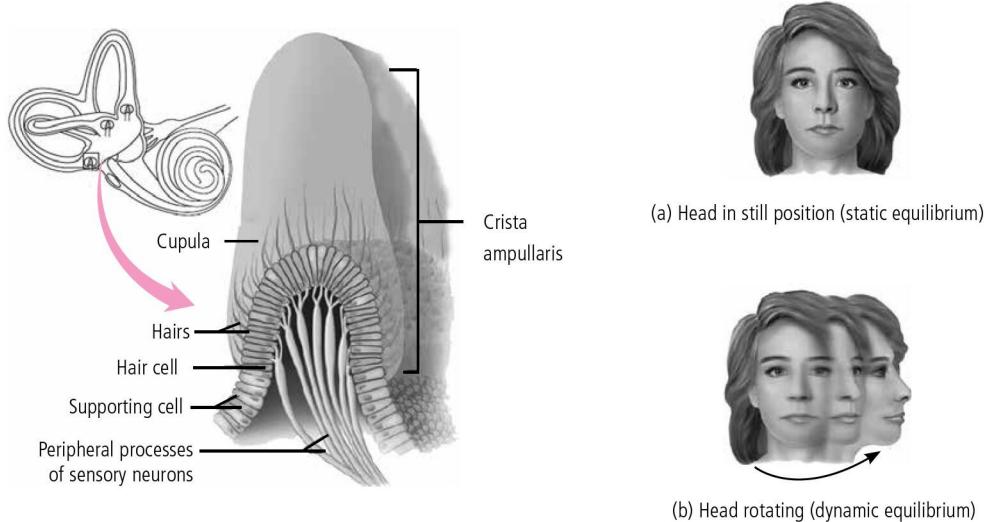


Fig.: Structure of Crista Ampullaris Involved in Equilibrium

Eye : The Organ of Sight

Structure of Human Eye

The eye is an important and delicate structure located in orbits which are formed by the skull bones. The orbits protect the eye from physical damage and a pad of fat behind the eyeball helps to cushion it from shocks. Each eye weighs approximately only 7.5 gm and measures about 2.5 cm in diameter.

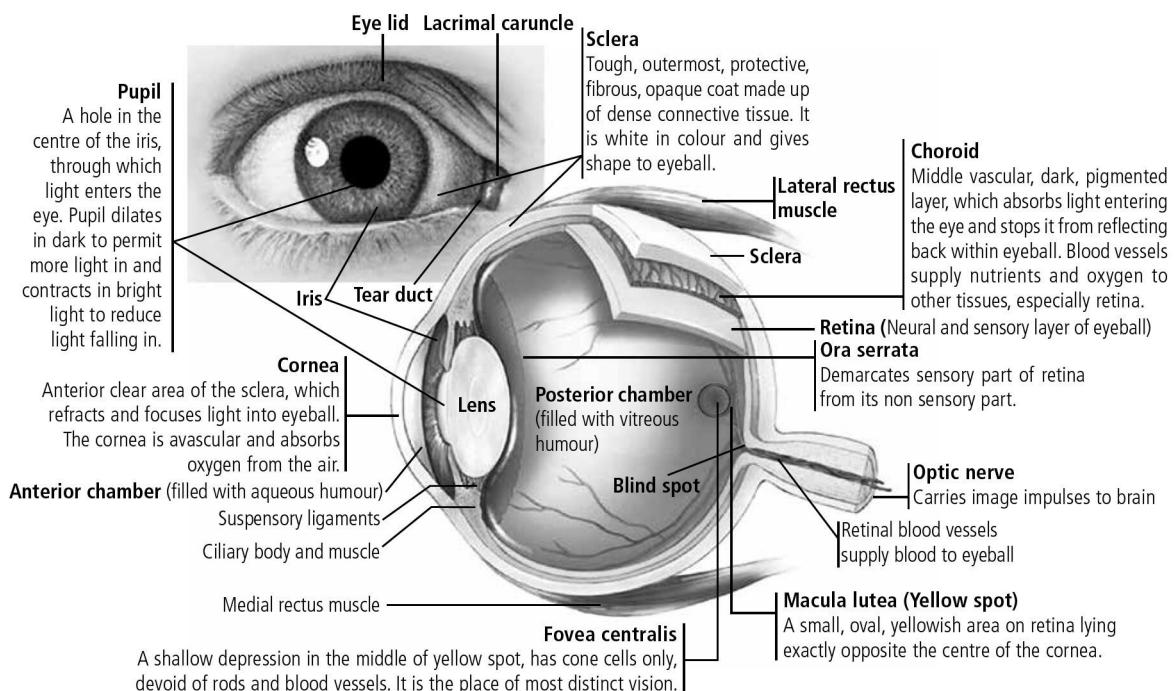


Fig.: Detailed Structure of Eye

Each eyeball is composed of three concentric layers. From outside to inside, they are: (i) The sclera and cornea - outer fibrous coat, (ii) The choroid, ciliary body and iris-middle vascular coat and (iii) The retina - inner nervous coat.

(i) **The outer fibrous coat** is divided into 2 parts : Sclera and Cornea. The sclera is a tough, fibrous opaque coat made up of elastic sheath of dense connective tissue and is white in colour. It protects and provides shape to the eyeball. In the central portion of eye, sclera gets modified to form a clear transparent and avascular cornea. It refracts and helps to focus light waves on the retina as they enter the eye.

(ii) **The middle vascular coat** comprises of choroid, ciliary body and iris. Choroid contains blood vessels and pigment in abundance. The ciliary body is formed by thickenings of the choroid. It contains two types of smooth muscles : circular and meridional. The ciliary muscle plays an important role during accommodation for near vision. The ciliary body itself continues forward to form the iris. The iris is a circular muscular diaphragm containing the pigment which gives eye its colour. It separates the aqueous humour region into anterior and posterior chambers. The iris attaches to the ciliary body and extends from here across the eyeball in front of lens but it is incomplete centrally. The opening in the centre is called pupil. Constriction of pupil is produced by contraction of circular muscles (sphincters), which results from parasympathetic stimulation. The iris controls the amount of light entering the eye by the radial muscle contracting in dim light and circular muscles contracting in bright light. These sets of muscles are under the control of autonomic nervous system. Dilatation is produced by contraction of radial muscles (dilators) and results from sympathetic stimulation.

(iii) **The inner nervous coat** is called retina. It is the sensory layer containing light sensitive cells. Three layers of neuron make up the major portion of retina and conduct impulses. They are photoreceptor cells, bipolar cell and ganglion cell. Two types of lateral interneurons are horizontal cells and amacrine cells.

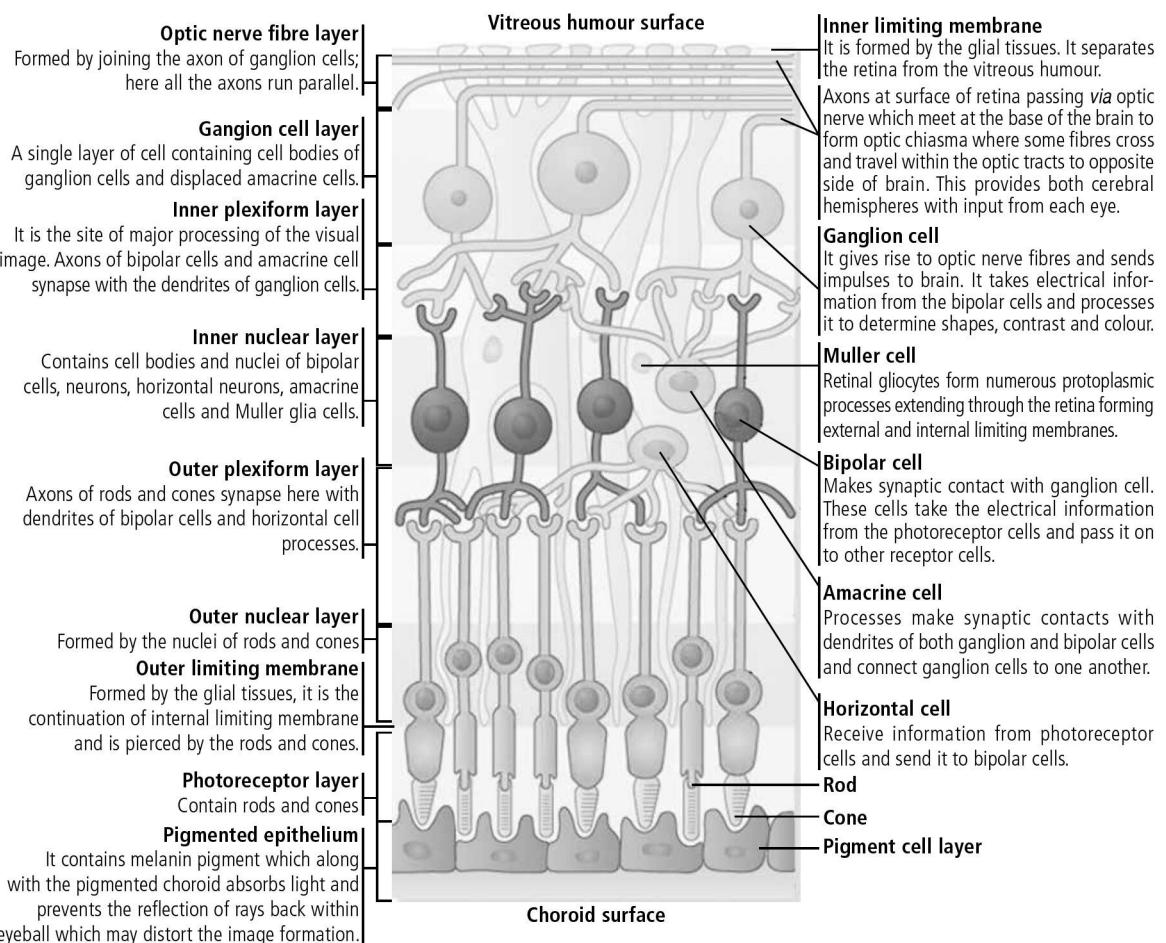


Fig.: Layers of Retina and Main Structures Therein

The photoreceptor cells consist of **rods** and **cones**. The rods are more sensitive towards light as compared to cones. Rods are used for vision in dim light (scotopic vision; lacking the ability to detect colour). The photosensitive chemical pigment in rods is called **rhodopsin**. Cones are used for bright light vision (photopic vision), with the ability to produce coloured image of the object. Cone pigments are specific for the basic colours; blue (cyanopsin, short wavelength sensitive), green (iodopsin, medium wavelength sensitive) and red (porphyrosin, long wavelength sensitive).

The membranous discs of the outer segment of rod and cone are arranged parallel to the surface of the retina. This is so because this arrangement increases the membrane surface area. Each photoreceptor contains billion of photopigments, providing an extremely effective trap for light.

Optic nerve contains the fibres of the sensory neurons and leaves the eye ball from the back side. The point of departure of optic nerve through the retina does not have any rods or cones and thus produces a **blind spot** or **optic disc**. At the posterior pole of the eye lateral to the blind spot, there is a yellowish pigmented spot called **macula lutea** with a central pit called the **fovea centralis**. The fovea centralis is a thinned-out portion of the retina where only the cones are densely packed. It is the point where the visual acuity (resolution) is the greatest.

Contents of eyeball

The eyeball is mainly composed of the crystalline lens aqueous chamber and vitreous humour.

The space between the cornea and the lens is called the **aqueous chamber** which contains a thin watery fluid called **aqueous humour**. It helps to maintain the shape of the front part of the eye and provides nutrients to the lens and cornea. The space between the lens and retina is called the **vitreous chamber** which is filled with a transparent gel called the **vitreous humour**.

Glands of eye

Three types of glands are present in eye : **glands of Zeis, Meibomian or tarsal glands** and **glands of Moll**. Glands of Zeis are modified sebaceous glands. They are associated with the follicles of eye lashes and open into the latter. Meibomian or tarsal glands are modified sebaceous glands which are present along the edge of the eyelids. They produce an oily secretion which serves to lubricate the corneal surface and hold a thin layer of tears over the cornea. Glands of Moll are modified sweat glands found at the edge of the eyelid.

Mechanism of Vision

The light rays pass through cornea, aqueous humour, lens and vitreous humour and focus on retina where they generate impulses in rods and cones. Human eyes have remarkable power of accommodation by changing the convexity of the lens. By the action of iris muscles the size of pupil can be increased or decreased. In bright light, the pupil is constricted whereas in dim light, it is dilated. Due to the action of the muscles of the ciliary body and the suspensory ligament, the focal length of the lens can be changed. Then the objects can be focussed in different intensity of light from varying distances. Light induces the photopigments of photoreceptors to dissociate into **opsin** (a protein) and **retinal** (an aldehyde of vitamin-A). This dissociation brings changes in the three dimensional structure of opsin which causes activation of a regulatory protein called **transducin**. Transducin activates an enzyme phosphodiesterase which changes C-GMP (which bind Na⁺ channel) into 5'-GMP (which does not bind Na⁺ channel) so the concentration of C-GMP in the cytosol declines. This light induced rapid decline in C-GMP results in the closure of Na⁺ channels so the photoreceptors become **hyperpolarised**. The hyperpolarisation of the cell membrane produces a signal which generates action potential in the ganglion cells through the bipolar neurons. The action potentials are conducted to the visual area of the cerebrum by the optic nerve fibres. Nerve impulses are analysed in the visual area and the image formed is recognised. In the darkness, rhodopsin is resynthesised from opsin and retinene to restore the dark vision. It is called **dark adaptation**.



HEPATITIS DAY

World Hepatitis Day is celebrated on 28th July. World Hepatitis Day (WHD) is recognized annually on July 28th, the birthday of Dr. Baruch Blumberg (1925–2011). Dr. Blumberg discovered the hepatitis B virus in 1967, and 2 years later he developed the first hepatitis B vaccine. Here's a quiz regarding this day.

Q. What is the theme of Hepatitis Day 2023?

Ans. In 2023, on World Hepatitis Day, the theme is 'We are not Waiting'.

Q. Which organ is affected in hepatitis?

Ans. Liver

Q. Which laboratory tests are used in diagnosis of hepatitis?

Ans. LFTs - Liver function test

The Hepatitis virus panel - Antigen and Antibody test.

Q. Which medicines are used in treatment of Hepatitis?

Ans. According to National Laboratory of Medicine, combination of GS-4774 and Tenofovir is used in treatment of Hepatitis.

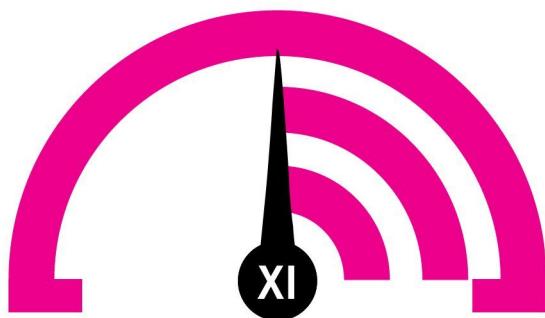
Q. What is the genome of Hepatitis B virus?

Ans. Double-stranded circular DNA

Q. Hepatitis G virus belongs to which family?

Ans. Flaviviridae

MONTHLY TEST DRIVE



This specially designed column enables students to self analyse their extent of understanding of specified chapter. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

Total Marks : 160

Series 4 : Structural Organisation in Animals Cell : The Unit of Life

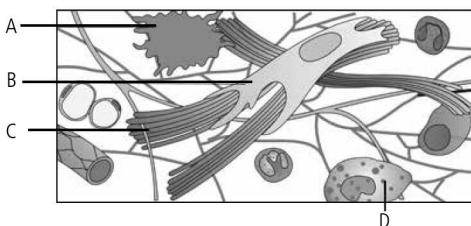
Time : 40 Min.

- Identify the animal tissue that possess modified free surface to perform functions like secretion and absorption.
(a) Epithelial tissue (b) Muscular tissue
(c) Connective tissue (d) Both (a) and (c)
- The number of chloroplasts per cell varies from _____ in *Chlamydomonas* to _____ in mesophyll cells of leaves.
(a) one; 10-20 (b) five; 5-10
(c) one; 20-40 (d) two; 0-5
- Match column I with column II and select the correct option.

Column I

- | | |
|---|------------------------------|
| A. Proventriculus | (i) 10 th segment |
| B. Anal cerci | (ii) Hypopharynx |
| C. Tongue | (iii) Six chitinous teeth |
| D. Gonapophysis | (iv) Boat-shaped |
| E. 7 th sternum | (v) External genitalia |
| (a) A-(iii), B-(i), C-(iv), D-(ii), E-(v) | |
| (b) A-(iv), B-(v), C-(ii), D-(i), E-(iii) | |
| (c) A-(iv), B-(i), C-(ii), D-(v), E-(iii) | |
| (d) A-(iii), B-(i), C-(ii), D-(v), E-(iv) | |

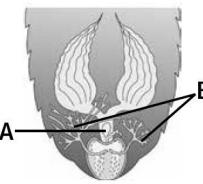
- Which of the following is correct for (A), (B), (C) and (D) in the given diagram?



A	B	C	D
(a) Macrophage	Fibroblast	Collagen fibres	Mast cell
(b) Macrophage	Collagen fibres	Fibroblast	Mast cell

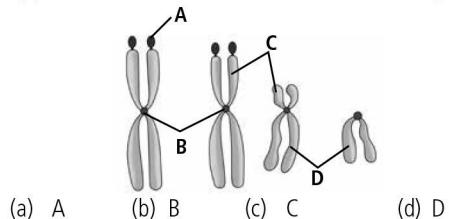
(c)	Mast cell	Fibroblast	Collagen fibres	Macrophage
(d)	Mast cell	Collagen fibres	Fibroblast	Macrophage

- Modified proteins are released from which face of Golgi apparatus?
(a) *cis* face (b) *trans* face
(c) Maturing face (d) Both (b) and (c)
- Read the given statements and select the correct option.
Statement 1 : The centrioles form the basal body of cilia or flagella.
Statement 2 : Arrangement of microtubules in centrosome is referred to as the 9 + 2 array.
(a) Both statements 1 and 2 are correct.
(b) Both statements 1 and 2 are incorrect.
(c) Statement 1 is correct but statement 2 is incorrect.
(d) Statement 1 is incorrect but statement 2 is correct.
- Select the incorrect statement about Na⁺/K⁺ pump.
(a) It transports neutral solutes along the concentration gradient across the membrane.
(b) Pump can transport ions from their lower to higher concentration across membrane.
(c) Pumps are specialised to transport polar molecules and ions across the membranes.
(d) Transport ions across Na⁺/K⁺ pump with expenditure of ATP.
- Middle lamella is mainly made up of
(a) hemicellulose (b) pectins
(c) calcium pectate (d) galactans.
- Select the correctly matched pair.
(a) Cardiac muscle – Non-contractile tissue
(b) Cardiac muscle – Multinucleated fibres
(c) Smooth muscle – Voluntary
(d) Skeletal muscle – Fusiform in shape

- 10.** Select the mismatched pair from the following options.
- Golgi apparatus – Protein modification
 - Centriole – Formation of spindle fibres
 - Nucleolus – Ribosomal RNA synthesis
 - Chromatophore – Formation of glycoproteins and glycolipids
- 11.** Which of the following cells lack nucleus in their mature form?
- Erythrocytes of many mammals
 - Sieve tube cells of vascular plants
 - Nerve cell of vertebrates
 - Both (a) and (b)
- 12.** Which of the following epithelia lines the fallopian tubes and bronchioles?
- Non-ciliated columnar epithelium
 - Ciliated columnar epithelium
 - Cuboidal epithelium
 - Simple squamous epithelium
- 13.** In addition to Malpighian tubules, which of the following structures help in excretion in cockroach?
- Nephrocytes
 - Urecose gland
 - Kidney
 - Both (a) and (b)
- 14.** Select the correct sequence of organs in the alimentary canal of cockroach starting from mouth.
- Pharynx → Oesophagus → Ileum → Crop → Gizzard → Colon → Rectum
 - Pharynx → Oesophagus → Crop → Gizzard → Ileum → Colon → Rectum
 - Pharynx → Oesophagus → Gizzard → Crop → Ileum → Colon → Rectum
 - Pharynx → Oesophagus → Gizzard → Ileum → Crop → Colon → Rectum
- 15.** How many eggs are present in each ootheca of female cockroach?
- 18-20 eggs
 - 14-16 eggs
 - 10-12 eggs
 - 9-10 eggs
- 16.** Which of the following epithelial tissue is found in the surface of buccal cavity and pancreatic ducts?
- Glandular epithelium
 - Columnar epithelium
 - Cuboidal epithelium
 - Compound epithelium
- 17.** Identify the structures A and B in given reproductive system of female cockroach.
- 
- A – Spermatheca, B – Collateral glands
 - A – Spermatheca, B – Phallic glands

- A – Genital pouch, B – Collateral glands
- A – Spermatheca, B – Gonapophyses

- 18.** The diagram shows structures of different types of chromosomes. Which of the following labelled structures appear as non-stained constriction while staining?



- 19.** Read the given statements and select the correct option.

Statement 1 : The development of *Periplaneta americana* is paurometabolous.

Statement 2 : Development occurs through nymphal stage where nymph grows by moulting about 13 times to reach the adult form.

- Both statements 1 and 2 are correct.
- Both statements 1 and 2 are incorrect.
- Statement 1 is correct but statement 2 is incorrect.
- Statement 1 is incorrect but statement 2 is correct.

- 20.** Match column I with column II and select the correct option.

Column I	Column II
A. Acrocentric chromosome	(i) Stores starch
B. Elaioplasts	(ii) Stores oil and fats
C. Nucleoplasm	(iii) Very long and very short arm
D. Amyloplasts	(iv) Nuclear matrix

- A-(iv), B-(iii), C-(ii), D-(i)
- A-(iv), B-(ii), C-(iii), D-(i)
- A-(iii), B-(ii), C-(iv), D-(i)
- A-(iii), B-(i), C-(iv), D-(ii)

- 21.** Choose the correct option that together constitutes the genital pouch of female cockroach.

- Gonapophyses and vestibulum
- Vestibulum and caudal style
- Genital chamber and caudal style
- Genital chamber and vestibulum

- 22.** Blood cells are

- dense connective tissue
- specialised connective tissue
- dense irregular connective tissue
- areolar tissue.

- 23.** Dense irregular connective tissue is found in

- skin
- bones
- cartilage
- blood.

- 24.** Read the given statements and identify them as true (T) or false (F).

- Thread-like anal styles are absent in female cockroach.
- Mesothoracic wings called tegmina are used in flight.

- (iii) A ring of 6-8 blind tubules called hepatic caeca is present at the junction of midgut and ileum.
- (iv) Male cockroach stores its sperms in the spermatheca in the forms of spermatophores.
- (i) (ii) (iii) (iv)
- (a) F F F T
 (b) T F T T
 (c) T F T T
 (d) T F F F
- 25.** In which bacteria, gas vacuoles are found?
- (a) Blue-green bacteria
 (b) Purple photosynthetic bacteria
 (c) Green photosynthetic bacteria
 (d) All of these
- 26.** What is the size of a typical eukaryotic cell?
- (a) 1-2 μm (b) About 0.1 μm
 (c) 10-20 μm (d) 0.02-0.2 μm
- 27.** Pseudopenis and titillator in male cockroach is a part of
- (a) left phallomere (b) ventral phallomere
 (c) right phallomere (d) anal cercus.
- 28.** Which structure perform the function of mitochondria in bacteria?
- (a) Nucleoid (b) Ribosomes
 (c) Cell wall (d) Mesosome
- 29.** Consider the following statements and select the correct option.
- (I) Major lipids found in cell membrane are phospholipids.
 (II) Peripheral proteins are totally buried in the membrane.
 (III) Integral proteins lie on the surface of membrane.
 (IV) Cell membrane also contains cholesterol.
- Select the incorrect pair of statements.
- (a) II and IV (b) II and III
 (c) I and III (d) I and IV
- 30.** Identify on the basis of following characteristics.
- (I) They have hard and non-pliable ground substance.
 (II) Calcium salts and collagen fibres provide strength.
 (III) They support and protect softer tissues and organs.
- (a) Blood (b) Bone
 (c) Muscle (d) Neuron
- 31.** In which abdominal segments in a male cockroach, a mushroom shaped gland is present?
- (a) 2nd - 6th (b) 4th - 6th (c) 9th - 10th (d) 6th - 7th
- 32.** Ribosomes are chemically composed of
- (a) protein (b) DNA
 (c) RNA (d) both (a) and (c).
- 33.** Which of the following consists of smooth muscle?
- (a) Blood vessels (b) Stomach
 (c) Intestine (d) All of these
- 34.** Which tissue is shown in given diagram?
- (a) Areolar tissue
 (b) Adipose tissue
 (c) Dense regular connective tissue
 (d) Dense irregular connective tissue
- 
- 35.** How many radial spokes and doublets of radially arranged peripheral microtubules are found in the structure of cilia or flagella respectively?
- (a) 9 and 2 (b) 9 and 9 (c) 2 and 9 (d) 9 and 0
- 36.** Which type of epithelial tissue possess microvilli in intestine?
- (a) Columnar (b) Cuboidal
 (c) Squamous (d) Both (a) and (b)
- 37.** Where are the sperms stored in cockroaches before copulation?
- (a) Vas deferens (b) Ejaculatory duct
 (c) Seminal vesicles (d) Titillator
- 38.** Read the statements and select the correct option.
- Statement 1:** Mesosome is a special membranous structure formed by the extensions of plasma membrane into the cell of prokaryotes.
- Statement 2:** The extensions of plasma membrane are in the form of cisternae and cristae.
- (a) Both statements 1 and 2 are correct.
 (b) Both statements 1 and 2 are incorrect.
 (c) Statement 1 is correct but statement 2 is incorrect.
 (d) Statement 1 is incorrect but statement 2 is correct.
- 39.** Which of the following statements is not correct?
- (a) Lysosomes are formed by the process of packaging in the endoplasmic reticulum.
 (b) Lysosomes have numerous hydrolytic enzymes.
 (c) The hydrolytic enzymes of lysosomes are active under acidic pH.
 (d) Lysosomes are membrane-bound structures.
- 40.** In body of cockroach, spiracles are present on the
- (a) ventral side (b) dorsal side
 (c) lateral side (d) posterior part.



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CBSE warm-up!

CLASS-XI

Chapterwise practice questions for CBSE Exams as per the latest pattern and rationalised syllabus by CBSE for the academic session 2023-24.

UNIT-II : STRUCTURAL ORGANISATION IN PLANTS AND ANIMALS

Series-2

- Morphology of Flowering Plants
- Anatomy of Flowering Plants
- Structural Organisation in Animals

GENERAL INSTRUCTIONS

- All questions are compulsory.
- The question paper has five sections and 33 questions.
- Section-A has 16 questions of 1 mark each; Section-B has 5 questions of 2 marks each; Section-C has 7 questions of 3 marks each; Section-D has 2 case-based questions of 4 marks each; and Section-E has 3 questions of 5 marks each.
- There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.
- Wherever necessary, neat and properly labelled diagrams should be drawn.

Time Allowed : 3 hours

Maximum Marks : 70

SECTION-A

- Which one of the following is wrong?
(a) Radicle – Roots (b) Plumule – Root cap
(c) Coconut – Drupe (d) Pea – Dicot
- The roots that originate from the base of the stem are
(a) fibrous roots (b) primary roots
(c) prop roots (d) lateral roots.
- Which of the following statements is not true for stomatal apparatus?
(a) Guard cells invariably possess chloroplasts and mitochondria.
(b) Guard cells are always surrounded by four subsidiary cells.
(c) Stomata are involved in gaseous exchange.
(d) Inner walls of guard cells are thick.
- Floral formula of tomato/tobacco is
(a) $\oplus \text{♀}^\rightarrow K_{4-5} A_{10} G_{(2)}$ (b) $\oplus \text{♀}^\rightarrow K_{2+2} C_4 A_{2+4} G_1$
(c) $\oplus \text{♀}^\rightarrow P_2 A_3 G_1$ (d) $\oplus \text{♀}^\rightarrow K_{(5)} C_{(5)} A_5 G_{(2)}$.
- How many plants among China rose, sunflower, mustard, *Alstonia*, guava and *Calotropis* have opposite phyllotaxy?
(a) Three (b) Four (c) Five (d) Two

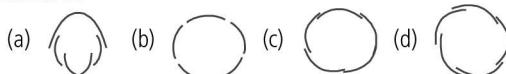
- Cortex is the region found between
(a) epidermis and stele
(b) pericycle and endodermis
(c) endodermis and pith
(d) endodermis and vascular bundle.
- Frogs
(a) are uricotelic
(b) have olfactory lobes in the midbrain
(c) do not have renal portal system
(d) have lymphatic system
- Free central placentation is found in
(a) *Dianthus* (b) *Argemone*
(c) *Brassica* (d) *Citrus*.
- The transverse section of a plant shows following anatomical features :
(i) Large number of scattered vascular bundles surrounded by bundle sheath
(ii) Large conspicuous parenchymatous ground tissue
(iii) Vascular bundles conjoint and closed
(iv) Phloem parenchyma absent
Identify the category of plant and its part.
(a) Monocotyledonous stem
(b) Monocotyledonous root
(c) Dicotyledonous stem (d) Dicotyledonous root

10. Frog's heart when taken out of the body continues to beat for sometime.

Select the best option from the following statements.

- (1) Frog is a poikilotherm.
- (2) Frog does not have any coronary circulation.
- (3) Heart is "myogenic" in nature.
- (4) Heart is autoexcitable.
- (a) Only (4) (b) (1) and (2)
- (c) (3) and (4) (d) Only (3)

11. Aestivation of petals in the flower of cotton is correctly shown in



12. Ureters act as urinogenital ducts in

- (a) human males
- (b) human females
- (c) both male and female frogs
- (d) male frogs.

Q. No. 13 to 16 consist of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

- (a) Both A and R are true and R is the correct explanation of A.
- (b) Both A and R are true and R is not the correct explanation of A.
- (c) A is true but R is false.
- (d) A is false but R is true.

13. **Assertion :** A flower can exist even without calyx and corolla.

Reason : Calyx and corolla are the reproductive organs.

14. **Assertion :** The alternate type of phyllotaxy is the arrangement of leaves in which a single leaf arises at each node in alternate manner.

Reason : The alternate type of phyllotaxy is seen in China rose and mustard plant.

15. **Assertion :** In dicot leaf, epidermis covers both the upper surface (adaxial epidermis) and lower surface (abaxial epidermis).

Reason : The adaxial epidermis bears more stomata than the abaxial epidermis.

16. **Assertion :** There is hepatic portal system in frogs.

Reason : Hepatic portal system is venous connection between liver and intestine in frog.

SECTION-B

17. (a) Why alimentary canal of the frog is short?

(b) Where is Bidder's canal found in frog?

18. What are the features that distinguish a stem from a root?

19. Briefly describe structure and functions of hypodermis of a primary dicot stem.

20. Mention the function of ureters in frog.

21. "Flower is a modified shoot." Justify the statement.

OR

- (a) Define trichome.

- (b) Name the type of tissue that constitutes the pith.

SECTION-C

22. Describe the arrangement of floral members in relation to their insertion on thalamus.

23. The stomatal pore is guarded by two kidney shaped guard cells. Name the epidermal cells surrounding the guard cells. How does a guard cell differ from an epidermal cell? Use a diagram to illustrate your answer.

24. Describe a few plants of economic importance of the Family Solanaceae.

25. Differentiate between palisade and spongy parenchyma.

26. Differentiate between monocot seed and dicot seed.

27. Draw a neat diagram of digestive system of frog.

OR

Point out the differences in the anatomy of leaf of peepal (*Ficus religiosa*) and maize (*Zea mays*). Draw the diagrams and label the differences.

28. Define the term inflorescence. Explain the basis for the different types of inflorescence in flowering plants.

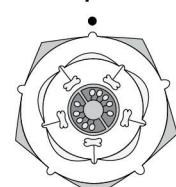
SECTION-D

Q. No. 29 and 30 are case based questions. Each question has 3 subparts with internal choice in one subpart.

29. Refer to the given floral diagram and answer the following questions.

- (a) Identify the plant and the family to which the floral diagram belongs.

- (b) State the characteristics of androecium and gynoecium that can be inferred from the above given floral diagram.

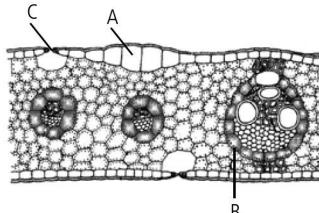


OR

Write the floral formula for the given floral diagram.

- (c) Give any two economical importance of plants of this family.

30. Study the given figure of T.S. of monocot leaf and answer the following questions.



- (a) Identify A, B and C in this figure.
- (b) C is present on both the surfaces of leaf, which type of leaf is this called? What type of guard cells are present in this leaf?
- (c) What is the function of A in this type of leaf?

OR

Based on the availability of cambium, what is the type of B present in this diagram?

SECTION-E

31. Describe the various types of placentation found in flowering plants.

OR

- (a) What is epidermis? Explain.
- (b) Briefly describe the structure of stomata with the help of a labelled diagram and state its functions.
32. (a) What is leaf? Describe briefly the structure of a typical angiospermic leaf.
- (b) Give two examples each of endospermic and non-endospermic seed.
- (c) What is a floral formula?

OR

With the help of a labelled diagram, explain the anatomy of a typical monocot stem.

33. (a) Draw a well labelled diagram of urinogenital system of female frog.
- (b) How can a male frog be distinguished from a female frog?
- (c) Name the different types of sensory organs present in frog.

OR

Define aestivation. Briefly describe its various types with the help of labelled diagrams.

SOLUTIONS

1. (b) : Radicle is the part of the embryo in a seed which gives rise to root. Radicle has two protective sheaths - inner root cap and outer coleorhiza. Plumule is the part of the embryo that gives rise to shoot. The protective sheath of plumule is called coleoptile.
2. (a) : In monocotyledonous plants, the primary root is short lived and is replaced by a large number of roots. These roots originate from the base of the stem and constitute the fibrous root system, e.g., wheat plant.
3. (b) : The epidermal surface of the leaf exhibits 1,000 to 60,000 minute openings called stomata. The stomata are bordered by two specialised epidermal cells - the guard cells which in some cases are accompanied by subsidiary

cells. They may differ in number. The walls of guard cells are unevenly thickened. Each guard cell has thick, inelastic inner wall and thin, elastic outer wall. Stomatal aperture is present in between the guard cells. Guard cells are not always surrounded by accessory cells or subsidiary cells.

4. (d) : Tomato and tobacco belong to the Family Solanaceae.
5. (d) : In opposite phyllotaxy, two leaves are borne on the opposite sides of a single node. China rose, mustard sunflower plants shows alternate phyllotaxy while *Alstonia* shows whorled phyllotaxy. Guava and *Calotropis* have opposite phyllotaxy.
6. (a) : All tissues towards the inside of endodermis form stele.
7. (d) : Frogs are ureotelic, i.e., they excrete urea as their nitrogenous waste. Two olfactory lobes are present in the forebrain of frog. They have renal portal system in which the blood from the hind parts of the body goes into post caval and then to the heart after getting filtered in the kidneys. Lymphatic system of frogs comprises of lymph, lymph capillaries, lymph sinuses and lymph heart. Liver secretes bile which is transferred to the gall bladder for storage through many hepatic ducts.
8. (a) : Free central placentation is found in *Dianthus*. Parietal placentation is present in *Argemone* and *Brassica* whereas *Citrus* has axile placentation in ovary.
9. (a)
10. (c) : Frog's heart is myogenic, i.e., heartbeat originates from muscles of heart. Hence, it is autorhythmic. Wave of contraction originates from sinus venosus and spreads to wall of sinus venosus and both auricles. This compels the heart to beat. Due to this reason, frog's heart will continue to beat as long as it gets supply of ATP.
11. (d) : In cotton, China rose and lady's finger margins of sepals or petals overlap that of the next one, this mode of arrangement (aestivation) is called twisted.
12. (d)
13. (c) : Sepals or calyx and petals or corolla are non-essential or accessory floral organs or floral leaves which do not take any direct part in sexual reproduction.

MONTHLY TEST DRIVE CLASS XII ANSWER KEY

- | | | | | |
|---------|---------|---------|---------|---------|
| 1. (a) | 2. (c) | 3. (a) | 4. (b) | 5. (c) |
| 6. (b) | 7. (a) | 8. (a) | 9. (c) | 10. (a) |
| 11. (a) | 12. (b) | 13. (a) | 14. (c) | 15. (c) |
| 16. (b) | 17. (c) | 18. (b) | 19. (b) | 20. (b) |
| 21. (b) | 22. (a) | 23. (b) | 24. (a) | 25. (c) |
| 26. (d) | 27. (a) | 28. (b) | 29. (c) | 30. (d) |
| 31. (b) | 32. (d) | 33. (d) | 34. (c) | 35. (a) |
| 36. (d) | 37. (b) | 38. (c) | 39. (b) | 40. (d) |

14. (b)

15. (c) : Most of the dicotyledonous leaves are dorsiventral. Epidermis covers both the upper and lower surfaces of the leaf. Both upper and lower epidermis consists of rectangular parenchymatous cells. The abaxial epidermis generally bears more stomata than adaxial epidermis. Sometimes adaxial epidermis may even lack stomata.

16. (b) : In frog, venous system has hepatic portal system. This system carries blood from the alimentary canal and its associated glands to the liver. It consists of a large hepatic portal vein that receives a number of tributaries from many organs.

17. (a) The alimentary canal of frog is short because frog is a carnivorous animal and length of its intestine is reduced.

(b) Bidder's canal is found in the kidneys of frog.

18. Features that distinguish a stem from a root:

- (i) The ascending portion of the axis of the plant, bears leaves, branches and flowers.
- (ii) When young, it is normally green in colour.
- (iii) The stem often bears multicellular hairs of different kinds.
- (iv) Presence of nodes and internodes.
- (v) Leaves and branches normally develop from the nodes.
- (vi) Presence of buds.

19. The hypodermis of primary dicot stem is made of 3–4 layered sub-epidermal collenchyma tissue. Its cells possess extra cellulose thickening in various regions – on the tangential walls, at the angles and near the intercellular spaces. Collenchyma cells are green and enclose small intercellular spaces.

Hypodermis functions in (i) providing mechanical strength as well as flexibility, (ii) storage of food and (iii) manufacture of food with the help of chloroplasts.

20. Ureter is a transparent duct that arises from outer portion of the kidney. In the male frogs, ureter acts as urinogenital duct which runs backwards from kidneys and opens into the cloaca. It carries both urine and spermatozoa from kidney to the cloaca. In female, ureter conducts only urine from kidneys to the cloaca.

21. Flower is a modified shoot consisting of a highly reduced stem branch to form thalamus in which the nodes are condensed and borne only towards the tip. The floral parts, i.e., sepals, petals, stamens and carpels are arranged in their respective whorls and arise from nodes. The growing point of floral bud is used up in the production of floral organs.

OR

(a) Trichome is unicellular or multicellular outgrowth which is strictly epidermal in origin.

(b) Parenchyma tissue is present in pith.

22. Based on the position of calyx, corolla and androecium in respect of the ovary on thalamus, the flowers are described as hypogynous, perigynous and epigynous.

(i) Hypogynous : The thalamus is convex or conical. Gynoecium or ovary develops at its top while stamens, petals and sepals are borne successively below. Ovary is superior. E.g., *Ranunculus*, Mustard, *Petunia*, shoe flower.

(ii) Perigynous : If gynoecium is situated in the centre and other parts of the flower are located on the rim of the thalamus almost at the same level, it is called perigynous. The ovary here is said to be half inferior, e.g., plum, rose, peach.

(iii) Epigynous : The thalamus is hollowed out in the form of a flask but its internal wall is fused with wall of the ovary. Only the style and stigma of the pistil is observable from the upper side. The other floral organs are borne at the top of the ovary. The flowers having epigyny are called epigynous. The ovary or gynoecium is said to be inferior while other floral organs are called superior, e.g., apple, sunflower, cucumber, guava.

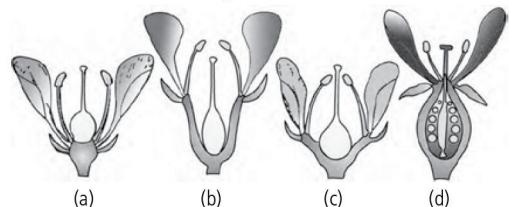


Fig.: Position of floral parts on thalamus :

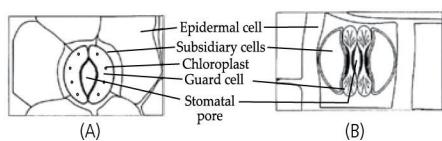
(a) Hypogynous; (b) and (c) Perigynous; (d) Epigynous

23. The epidermal cells surrounding the guard cells of stomata are called subsidiary cells.

Differences between guard cells and epidermal cells are as follows:

	Guard cells	Epidermal cells
(i)	They are bean or kidney shaped.	They are barrel shaped.
(ii)	They possess chloroplasts.	They lack chloroplasts.
(iii)	They are smaller.	They are bigger.
(iv)	Inner walls of guard cells are thick while the outer ones are thin.	Epidermal cells are uniformly thin.

The diagrammatic representation of (A) stomata with bean-shaped guard cells and (B) stomata with dumb-bell shaped guard cells is as follows:



24. Economic importance of the Family Solanaceae are as follows:

- The family includes many species cultivated for their edible fruits or tubers, such as the tomato, potato, eggplant and chilli pepper.
- Deadly nightshade (*Atropa belladonna*) yield belladonna for relieving pain externally, cough and excessive perspiration internally and atropine for dilating pupil. The root is the basis of the principal preparation of belladonna.
- Tobacco comes from the dried and cured leaves of *Nicotiana tabacum*. It is chewed, smoked or snuffed. Tobacco is intoxicant and stimulant but is habit forming and increases the incidence of heart trouble, lung cancer, and gum cancer, impotency in males and infant deformities in smoking mothers. Tobacco contains the alkaloid nicotine, a powerful neurotoxin that is particularly harmful to insects.
- Roots of *Ashwagandha* (*Withania somnifera*) are used to cure rheumatism and general weakness.
- Some plants like night jasmine (*Cestrum nocturnum*), *Petunia*, are grown in garden for their beautiful flowers.

25. Differences between palisade and spongy parenchyma are as follows:

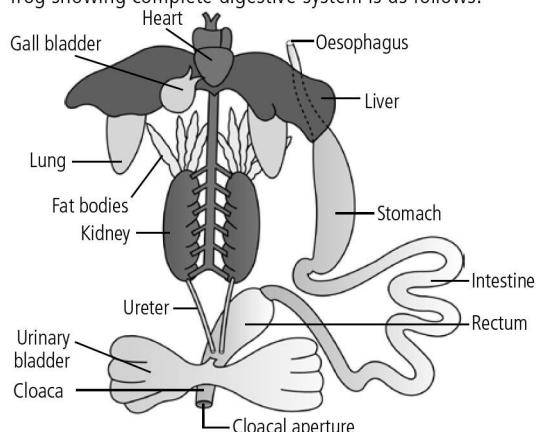
	Palisade parenchyma	Spongy parenchyma
(i)	Occurs towards upper epidermis of leaf.	Occurs towards lower epidermis of leaf.
(ii)	Formed of columnar cells.	Formed of rounded, isodiametric or lobed cells.
(iii)	Abundant chloroplasts occur in these cells.	Chloroplasts occur in average amount.
(iv)	Intercellular spaces are narrow.	Encloses large intercellular spaces.

26. Differences between monocot seed and dicot seed are as follows:

	Monocot seed	Dicot seed
(i)	The seed contains a single cotyledon.	The seed possesses two cotyledons.
(ii)	The food is commonly stored inside endosperm, (exception-orchids).	The food may be stored inside endosperm or cotyledons.
(iii)	An aleurone layer of special protein-rich cells is found on the outside of endosperm.	This layer is absent.
(iv)	The embryo tips may bear special sheaths, coleoptile over plumule and coleorhiza over radicle.	Coleoptile and coleorhiza are absent.

(v)	Embryo occupies one side of the seed.	Embryo occupies the whole interior or only the central part of the seed.
(vi)	Plumule lies at one end near the cotyledon.	Plumule lies in between the two cotyledons.

27. The diagrammatic representation of internal organs of frog showing complete digestive system is as follows:



OR

Differences between pepal (dicot) and maize (monocot) leaves are as follows:

	Peepal (dicot) leaf	Maize (monocot)leaf
(i)	Leaves are dorsiventral.	Leaves are isobilateral.
(ii)	Venation is reticulate.	Venation is parallel.
(iii)	Stomata are absent or less abundant on the upper side.	The stomata are equally distributed on the two sides.
(iv)	The stomata have kidney-shaped guard cells.	The stomata have dumb bell-shaped guard cells.
(v)	Mesophyll is differentiated into two parts, upper palisade and lower spongy.	Mesophyll is undifferentiated.
(vi)	Protoxylem is indistinguishable.	Larger vascular bundles may show distinction into protoxylem and metaxylem.
(vii)	Bulliform cells are absent.	Bulliform cells are present to minimise water loss.
(viii)	Hypodermis of the midrib region is collenchymatous.	Hypodermis of the midrib region is sclerenchymatous.

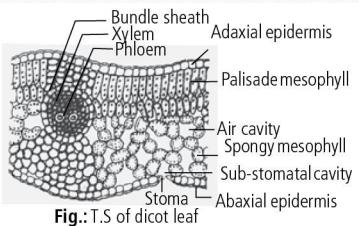


Fig.: T.S. of dicot leaf

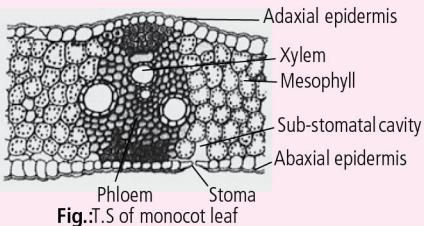


Fig.: T.S. of monocot leaf

28. The arrangement of flowers on the floral axis is termed as inflorescence. A flower is a modified shoot wherein internodes do not elongate and the axis gets condensed. The apex produces different kinds of floral appendages laterally at successive nodes instead of leaves. When a shoot tip transforms into a flower, it is always solitary. Depending on whether the apex gets converted into a flower or continues to grow, two major types of inflorescence are defined – racemose and cymose. In racemose type of inflorescence, the main axis continues to grow, the flowers are borne laterally in an acropetal succession. In cymose type of inflorescence, the main axis terminates in a flower, hence is limited in growth. The flowers are borne in a basipetal order.

29. (a) The given floral diagram is of *Solanum nigrum* which belongs to Family Solanaceae.

(b) Androecium of this flower possess five stamens, polyandrous and epipetalous. Gynoecium is bicarpellary, syncarpous, ovary is superior, placed obliquely and bilocular. Placenta is axile with many ovules in each loculus.

OR

Floral formula for Family Solanaceae is

$$\oplus \textcircled{♀} \textcircled{♂} K_{(5)} C_{(5)} A_5 G_{(2)}$$

(c) Plants of this family are used as

- (i) Vegetables e.g., Potato, tomato, brinjal, etc.
- (ii) Medicines e.g., *Atropa belladonna* yields belladonna which is used as topical pain reliever for dilation of pupil of the eye. Roots of *Withania somnifera* (*Ashwagandha*) are used to cure rheumatism and general weakness. Different parts of *Solanum surattense* are useful in treating asthma, bronchitis, leucoderma, etc.

30. (a) In the given figure A is bulliform cell, B is vascular bundle and C is stoma.

(b) In isobilateral leaf, stomata is present on both surfaces of the leaf. This leaf is monocot leaf and dumbbell shaped guard cells are present in these leaves.

(c) Function of bulliform cell (A) is to store water as it is highly vacuolated. However, in case of water deficiency bulliform cells loose water and become flaccid. As a result, the leaf gets rolled up to reduce the exposed surface. Bulliform cells are also useful in unrolling of leaf during its development.

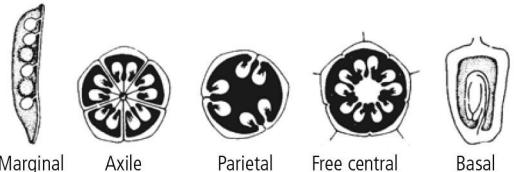
OR

In this vascular bundle, cambium is absent and hence these are called closed vascular bundles. They are not involved in secondary growth. In monocots, secondary growth is absent.

31. Placenta is a parenchymatous cushion present inside the ovary where ovules are borne. The arrangements of ovules within the ovary is known as placentation.

- (i) Marginal placentation : In marginal placentation the placenta forms a ridge along the ventral suture of the ovary and the ovules are borne on this ridge forming two rows, as in pea.
- (ii) Axile placentation : When the placenta is axial and the ovules are attached to it in a multilocular ovary, the placentation is said to be axile, as in china rose, tomato and lemon.
- (iii) Parietal placentation: In parietal placentation, the ovules develop on the inner wall of the ovary or on peripheral part. Ovary is one-chambered but it becomes two chambered due to the formation of the false septum, e.g., mustard and *Argemone*.
- (iv) Free central placentation : When the ovules are borne on central axis and septa are absent, as in *Dianthus* and *Primrose* the placentation is called free central.
- (v) Basal placentation : In basal placentation, the placenta develops at the base of ovary and a single ovule is attached to it, as in sunflower, marigold.

The diagrams of various types of placentations are as follows :



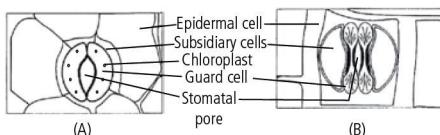
OR

- (a)** Epidermis is the outermost protective layer of primary plant body. It is usually single layered. Multilayered epidermis occurs in the leaves of some tropical plants

and aerial roots of orchids. Epidermis is a conspicuous layer of elongated, compactly arranged living cells which do not enclose intercellular spaces. The cells possess large central vacuoles and thin peripheral cytoplasm. They remain thin walled in roots and plants growing under moist conditions. Epidermal cells of the aerial parts of the plants have wavy lateral walls in dicots and straight walls in monocots. Their outer walls are cutinised. Cutin is a fatty-waxy substance. The cutinised walls are less permeable to water. In addition to these, it bears numerous minute pores called stomata and various epidermal appendages viz. trichomes and emergences.

- (b) The epidermis of aerial parts usually bears a number of minute pores called stomata. Stomata are absent in the surface layer of roots. They are fewer in case of stems but are abundant in case of leaves. Each stoma (singular of stomata) is surrounded by a pair of specialised epidermal cells called guard cells. Guard cells differ from rest of the cells in shape, size and thickenings. They also have a few small chloroplasts. The guard cells are generally bean or kidney shaped in most plants. They are dumb-bell shaped in grasses. Inner walls of the guard cells (towards the stomatal pore) are thick while the outer ones are thin. The latter expand and contract in response to their turgidity and thus, open or close the stomatal aperture. In some cases the guard cells are surrounded or overtapped by another category of less modified epidermal cells called subsidiary cells. When subsidiary cells lie above the guard cells, the stomata are called sunken. Stomatal aperture, guard cells and subsidiary cells together constitute a complex called stomatal apparatus.

The diagrammatic representation of (A) stomata with bean-shaped guard cells and (B) stomata with dumb-bell shaped guard cells is as follows:



Stomata are the sites of gaseous exchange and transpiration (loss of water in the form of vapour) in plants.

32. (a) The leaf is a flattened lateral outgrowth of the stem and bears a bud in its axil. It is green in colour due to the presence of chlorophyll and constitutes the main photosynthetic organ of the plants. They develop acropetally and exogenously. A typical angiospermic leaf consists of three parts, namely (i) a leaf base, (ii) a petiole and (iii) a lamina.

- (i) Leaf base attaches the leaf with the stem. In monocotyledons the leaf base expands into a sheath

that partially or wholly covers the stem while in many dicotyledonous plants it bears two outgrowths called the stipules. Depending on the presence or absence of stipules, a leaf may be stipulate or exstipulate. In many plants the leaf base is swollen and is termed pulvinus.

- (ii) Petiole is the stalk of the leaf. A long petiole pushes out the leaf-blade and thus helps it to secure more sunlight. When the petiole is absent, the leaf is said to be sessile, and when present, it is said to be petiolate or stalked.
- (iii) Lamina is the expanded, generally prominent part of the leaf carried at the tip of the petiole. It is traversed by a number of veins and veinlets. There is usually a middle prominent vein, which is known as the midrib. Veins provide rigidity to the lamina and act as channels of transport of the food materials in and out of the leaf.
- (b) Endospermic seed – Castor, Coconut.
Non-Endospermic seed - Pea, Gram.
- (c) Floral formula is symbolic representation of floral symmetry, presence or absence, number, cohesion and adhesion of various parts.

OR

Monocots lack secondary growth. They, therefore, possess only the primary permanent tissues. The T.S. of monocot stem is as follows:

MIRROR GRAM

Use a mirror to read each word and record it on answer sheet

MONOCOT

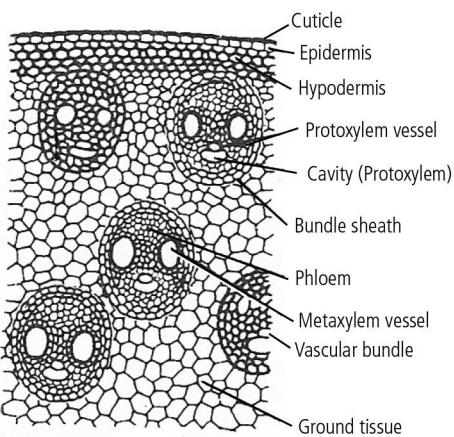
THALAMUS

BIODIVERSITY CONJUGATION

PLACENTA

ANSWERS

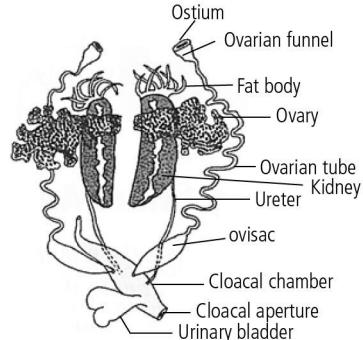
1. MONOCOT
2. THALAMUS
3. CONJUGATION
4. BIODIVERSITY
5. PLACENTA



A typical monocot stem (e.g., Maize) consists of the following tissues.

- Epidermis :** It is the outermost layer of the stem which is made up of compactly arranged transparent, elongated and rectangular-barrel-shaped living parenchyma cells. The outer walls of epidermal cells possess deposition of silica and cutin. A separate layer of cuticle also occurs on the outside. The cutinised epidermal cells prevent the evaporation of water from the stem. Silica provides stiffness. Hairs are usually absent. At places the epidermis possesses stomata for gaseous exchange. Each stoma has two dumb-bell shaped guard cells.
 - Hypodermis :** It is 2-3 layered thick and lies below the epidermis. Hypodermis is made up of thick walled lignified sclerenchyma fibres. It acts as heat screen and provides rigidity and mechanical strength to the stem.
 - Ground tissue :** The ground tissue stores food.
 - Vascular strand :** The vascular strand is in the form of a tracheostele where a large number of vascular bundles lie scattered throughout the ground tissue. The vascular bundles are oval or rounded in outline. They contain both phloem and xylem. Phloem lies towards the outside and the xylem on the inner side. Cambium is absent as the whole procambium is consumed in the formation of vascular tissues. The vascular bundles are, therefore, conjoint, collateral but closed. Each vascular bundle is surrounded by a sheath of sclerenchyma known as bundle sheath.
- Phloem consists of sieve tubes, companion cells and a few phloem fibres. Phloem parenchyma is absent. Xylem is in the form of letter Y. It is endarch, i.e., protoxylem lies towards the centre of the stem. Xylem is made up of vessels, tracheids, xylem parenchyma and a few xylem fibres. Some of the protoxylem vessels and xylem parenchyma cells dissolve or separate during the rapid growth of the stem to form a cavity called protoxylem cavity or lacuna.

- 33. (a)** The diagram of urinogenital system of female frog is as follows :



- (b)** The male frogs may be distinguished by presence of sound producing vocal sacs. They also have a copulatory pad on the first digit of the forelimbs. Vocal sacs and copulatory pads are absent in female frogs.
- (c)** Frog has different types of sense organs, namely organs of touch (sensory papillae), taste (taste buds), smell (nasal epithelium), vision (eyes) and hearing (tympanum with internal ears).

OR

Aestivation is the arrangement of accessory floral organs (sepals or petals) in relation to one another in the floral bud. It is of four types:

- Valvate :** Margins of the adjacent petals touch each other but without overlapping e.g., *calotropis*.
- Twisted or contorted :** One margin of a petal overlaps regularly the margin of an adjacent petal; the other margin being overlapped by margin of another adjacent petal e.g., corolla of China Rose, lady's finger and cotton.
- Imbricate :** If the margins of sepals or petals overlap one another out but not in any particular direction, as in *Cassia* and gulmohur.
- Vexillary :** The posterior petal overlapping the two lateral petals, the latter overlapping the two smallest anterior petals, e.g., pea and bean. It is also called papilionaceous corolla.

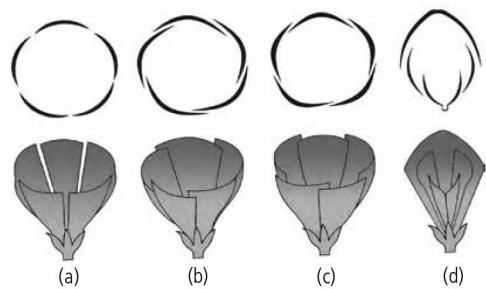


Fig.: Types of aestivation in corolla :

(a) Valvate; (b) Twisted; (c) Imbricate; (d) Vexillary



BIO Digest



This article covers high yield facts of the given topic.

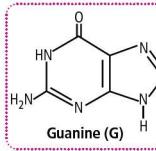
Molecular Basis of Inheritance

- Genetic material is the substance which controls the formation and expression of traits in an organism. Inheritance of characters from one generation to the next is also based upon the transfer of **genetic material** from parents to progenies. **Genetic material must possess four major characteristics** - replication, storage of information, expression of information and variation by mutation.
- The genetic material must be able to serve as a **repository of genetic information**, whether it is expressed or not. It should be able to accurately pass its copies into the progeny. **Replication** allows the genetic material to precisely duplicate itself forming the exact copies.
- Expression of stored genetic information is the basis for the concept of **information flow** within the cell.
- The genetic material must also serve as the basis of newly arising variability among organisms through the process of **mutation**.

DEOXYRIBONUCLEIC ACID (DNA)

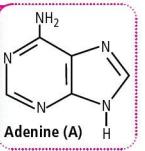
- DNA is the **largest macromolecule** which consists of two complementary strands of **deoxyribonucleotides** that run antiparallelly.
- It is composed of small monomeric units called **nucleotides** (deoxyribonucleotides) made up of a **pentose sugar**

(deoxyribose type), a **phosphate group** and a **nitrogenous base**.



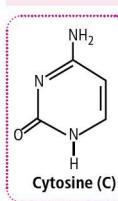
Purines

Two ringed, heterocyclic nitrogenous compounds (nine-membered double rings). Further a purine has four N-atoms at 1', 3', 7' and 9' positions.



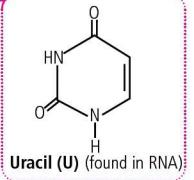
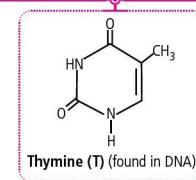
Nitrogenous Bases

Single ringed nitrogenous compounds (six-membered single ring). Further, a pyrimidine has two N-atoms at 1' and 3' positions.



Pyrimidines

- The pentose sugar and the nitrogenous base constitute **nucleosides**. Nitrogen base is linked to pentose sugar through N-glycosidic linkage to form a nucleoside. There are four nucleosides in DNA, differ from each other in the



type of the nitrogenous base which could be **adenine** (A), **guanine** (G), **thymine** (T) or **cytosine** (C).

Structure and Function of DNA

- The linkage between two nucleotides consists of a phosphate group linked to two sugars. A **phosphodiester bond** is formed between C-3 and C-5 of different deoxyribose sugars of two adjacent nucleotides.
- One end of the polynucleotide chain has a sugar residue with C-3, not linked to another nucleotide having free 3'-OH group and the other end has sugar residue with C-5, linked to a phosphate group thus, showing **polarity**. These are named as 3' and 5' ends respectively.
- The two polynucleotide chains are **antiparallel** to each other. One has phosphodiester linkage in 3' → 5' direction while the other has phosphodiester linkage in 5' – 3' direction. The two polynucleotide chains are held together by **hydrogen bonding** between specific pairs of purines and pyrimidines.
- The pairing is always between **A** and **T**, and **G** and **C**.
- There are **two** hydrogen bonds between A and T and **three** hydrogen bonds between G and C.
- The two chains are coiled in a right-handed fashion. The pitch of the helix is 3.4 nm (a nanometre is one billionth of a metre, that is 10^{-9} m) and there are roughly 10 bp in each turn. Consequently, the distance between a bp in a helix is approximately 0.34 nm.
- The stacking of bases creates two types of grooves — **major** and **minor grooves**.

Chargaff's Rules

- The purines and pyrimidines are always in equal amounts i.e., **A + G = T + C**.
- The amount of adenine is always equal to that of thymine and the amount of guanine is always equal to that of cytosine, i.e., **A = T** and **G = C**. However, amount of **A + T** is not necessarily equal to **G + C**.
- The deoxyribose sugar and phosphate components occur in equal proportions.
- The base ratio **A + T / G + C** may vary from one species to another, but is constant for a given species. This ratio can be used to identify the source of DNA and can help in classification.
- In human DNA, **A = 30.9%**, **T = 29.4%**, **G = 19.9%** and **C = 19.8%**.
- DNA carries all the **hereditary information** coded in the arrangement of its nitrogen bases i.e., **genetic code**.

Types of DNA

- There are five types of DNA : B, Z, A, C and D. B, A (widest diameter of helix), C and D DNA are right handed helix while Z-DNA (thinnest diameter of helix) is left handed.

PACKAGING OF DNA HELIX

- Long sized DNA molecules are compacted in small areas (about 1 μm in *E.coli* and 5 μm nucleus in human beings) only through packing.
- DNA is acidic due to presence of a large number of phosphate groups.** Compaction occurs by folding and attachment of DNA with basic proteins, non-histone in prokaryotes and histones in eukaryotes.

DNA Packaging in Prokaryotes

- Bacterial DNA is relatively simpler in form, double-stranded molecule compacted into a structure referred to as nucleoid.
- DNA in bacterial chromosome is found to be associated with RNA and non-histone basic proteins like polyamines.

DNA Packaging in Eukaryotes

- DNA packaging in eukaryotes follow **nucleosome-solenoid model**. DNA is complexed with lysine and arginine rich basic proteins called **histones** to form **nucleosomes**.
- Each nucleosome consists of eight histone proteins (2 molecules of each H₂A, H₂B, H₃ and H₄) around which the DNA wraps 1.65 times.
- Histone H₁, is a linker protein which binds DNA of two adjacent nucleosomes.
- 10 nm fibre of nucleosomes gets coiled upon itself to form 30 nm wide helix with five or six nucleosomes per helix. This 30 nm structure is called a **solenoid**. The packing of DNA has the 'beads on a string' appearance.
- Solenoid further condenses to form loops averaging 300 nm in length.
- The 300 nm **chromatin fibres** are compressed and folded to produce a 700 nm wide **chromatid** fibre of a chromosome.
- Two types of chromatin material form chromosomes — (i) **euchromatin**, that is loosely packed and lightly stained and transcriptionally active; (ii) **heterochromatin**, that is densely packed, darkly stained and transcriptionally inactive.

EVIDENCES FAVOURING DNA AS GENETIC MATERIAL

- The concept of DNA as the genetic material of most organisms has been developed and supported by following direct and indirect evidences.

Direct Evidences

- The most convincing evidences in support of DNA as the genetic material came from the three approaches on

microorganisms – **transformation in bacteria**, **mode of infection of bacteriophages** (transduction) and **conjugation in bacteria**.

(i) Transformation - The Griffith's experiment

- Transformation is the **mode of exchange or transfer of genetic information** from one strain of bacterium to another **strain of bacterium** without involving any direct contact between them.
- Griffith found that extracts of dead pathogenic strains of the bacterium *Streptococcus pneumoniae* can transform live harmless strains into live pathogenic strains. Later,

Avery, MacLeod and McCarty analysed the extract and demonstrated that the material was DNA.

- The bacterium has two strains — **virulent** (S-strain) and **non-virulent** (R-strain).
- S-strain** : They form smooth glistening colonies. They have a smooth, gummy polysaccharide coating so they are **capsulated**. This coating protects the bacteria from the host's defenses. Virulent or pathogenic, *i.e.*, has the disease producing capacity.
- R-strain** : They form rough colonies with dull appearance. They do not have the polysaccharide coating so they are **non-capsulated**. Non-virulent or non pathogenic, *i.e.*, could not cause disease.

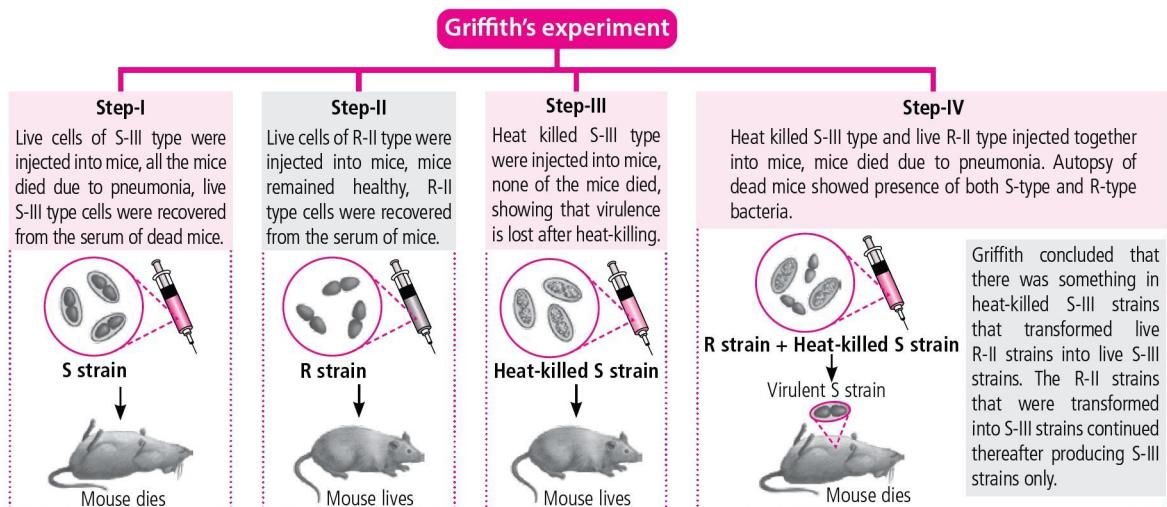


Fig. : Griffith's experiment on transformation in *Streptococcus pneumoniae*

(ii) The Avery, MacLeod and McCarty experiment

- Three scientists Avery, MacLeod and McCarty gave biochemical characterisation of transforming principle. They fractionated the killed S-type bacteria into three components-DNA, carbohydrate and protein and performed the following experiment :
 - Removed the polysaccharide capsule from heat killed S-III type and R-II type → Mice died
 - Removed protein fraction from heat killed S-III type + R-II type → Mice died
 - Added deoxyribonuclease enzyme into heat killed S-III type + R-II type → Mice survived
 - Added proteases into heat killed S-III type + R-II type → Mice died
- In experiments (i), (ii) and (iv), DNA of heat killed S-III type was intact and so it transformed live R-II type into S-III types, but in experiment (iii) the enzyme disintegrated the DNA and so R-II type were not transformed.

- It clearly showed that the DNA component of heat killed S-III type transformed live R-II type into live S-III type and thus, DNA forms molecular basis of heredity.

(iii) Transduction - The Hershey-Chase experiment

- It is the process in which bacterium infecting virus (bacteriophage) serves as a vector transferring DNA from one bacterium cell to another, *e.g.*, T₂ bacteriophage. **Alfred Hershey** and **Martha Chase** performed an experiment to confirm that DNA of **bacteriophage** (virus infecting bacteria) enters into host (bacterial) cell and carries the necessary information for formation of new phages. Their experiment was based on the fact that DNA contains phosphorus but no sulphur whereas proteins contain sulphur but no phosphorus.

Hershey and Chase's Experimental Steps

- Step-I** : T₂ bacteriophages are labelled with radioactive isotopes. Protein coats of phages are labelled with ³⁵S and DNA of phages are labelled with ³²P.

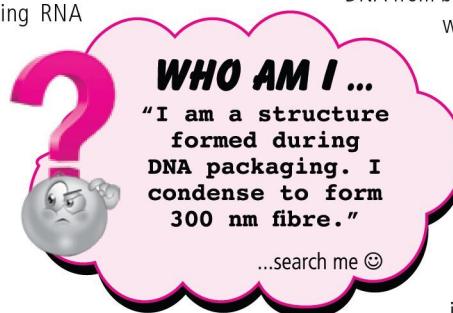
- Step-II :** Two cultures of *E.coli* were grown. Bacteriophages infect bacterial cells. In culture, infected with radioactive ^{35}S , radioactive sulphur gets incorporated into sulphur containing amino acids and becomes part of bacterial proteins. In culture, infected with radioactive ^{32}P , radioactive phosphorus gets incorporated into nucleotides.
- Step-III :** Bacterial cells are agitated to remove protein coats and centrifuged. ^{35}S radioactivity was found in the supernatant, which contain only empty phage capsids or ghosts. ^{32}P radioactivity was found in the bacterial cells, proving only DNA of the phage entered the bacteria.
- Radioactivity was absent in the viruses derived from parents having labelled protein. The viruses derived from parents having labelled DNA possessed radioactivity. This experiment demonstrated clearly that genetic material is DNA and not the protein.

Indirect Evidences

- DNA is capable of controlling the cell structure and cell functions through transcription and translation.
- DNA replicates prior to cell division and is equitably distributed in the daughter cells.
- DNA has a system of repair.
- DNA is capable of replication. DNA copies are similar to the original DNA.
- DNA can show infinite variations due to changes in its nucleotide type, sequence and length.

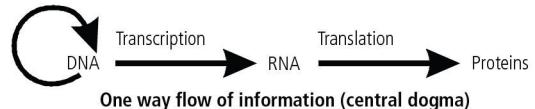
DNA Versus RNA

- The 2'-OH group present at every nucleotide in RNA is a reactive group and makes RNA labile and easily degradable. RNA is also now known to be catalytic, hence reactive. Therefore, DNA chemically is less reactive and structurally more stable when compared to RNA. Hence, among the two nucleic acids, DNA is a better genetic material.
- The presence of thymine at the place of uracil also confers additional stability to DNA. Both DNA and RNA are able to mutate. In fact, RNA being unstable, mutate at a faster rate. Consequently, viruses having RNA genome and having shorter life span mutate and evolve faster. RNA can directly code for the synthesis of proteins, hence can easily express the characters. DNA, however, is dependent on RNA for synthesis of proteins. The protein synthesising machinery has evolved around RNA.



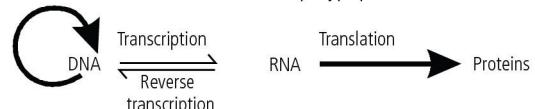
CENTRAL DOGMA OF MOLECULAR BIOLOGY

- Crick (1958) proposed the central dogma of molecular biology.



One way flow of information (central dogma)

- Central dogma says there is the unidirectional flow of information from DNA to RNA and from RNA to polypeptide.
- Many tumor viruses contain RNA as genetic material and replicate by first synthesising a complementary DNA. This process is called **reverse transcription**.
- It is carried out by an RNA-dependent DNA polymerase called **reverse transcriptase**. RNA of these viruses first synthesises DNA through reverse transcription. Now, DNA transfers information to RNA which takes part in translation of coded information to form polypeptide.



Reverse flow of information

DNA REPLICATION

- In replication, DNA acts as its own template and produce exact copies of itself which is an autocatalytic function of DNA.
- DNA replicates by **semiconservative** method in which one strand of the daughter duplex is derived from the parent while the other strand is newly formed.
- Semiconservative replication of DNA was proved by the work of Meselson and Stahl. In their experiment, *E.coli* was grown in ^{15}N medium having heavy isotope of nitrogen, for many generations. After that the labelled bacteria was transferred to fresh ^{14}N medium and they were allowed to grow in that medium. DNA samples were tested for heavy isotope of nitrogen.

- DNA from bacteria that had been grown on medium with ^{15}N , contained only ^{15}N isotope. DNA of the first generation, grew on ^{14}N medium, was hybrid or intermediate (^{15}N and ^{14}N). The second generation of bacteria after 40 minutes contained two types of DNA, 50% light ($^{14}\text{N}^{14}\text{N}$) and 50% intermediate ($^{15}\text{N}^{14}\text{N}$). It proved the DNA replication in *E.coli* is semiconservative.

- Very similar experiments involving use of radioactive thymidine to detect distribution of newly synthesised DNA in the chromosomes was performed on *Vicia faba* by Taylor and colleagues in 1958. They proved that the DNA in chromosomes also replicate semi-conservatively.

Steps of DNA Replication

- Replication originated from the **origin of replication**.
- Enzyme helicase unwinds the parental double helix.
- Molecules of single strand binding protein stabilise the unwound template strands.
- Topoisomerase releases tension of DNA strand.
- Replication over the two templates proceeds in opposite directions.
- One strand with polarity $3' \rightarrow 5'$ forms its complementary strand continuously because $3'$ end of the latter is always open for elongation. It is called **leading strand**.
- Replication is discontinuous on the other template with polarity $5' \rightarrow 3'$ because only a short segment of DNA strand can be built in $5' \rightarrow 3'$ direction due to exposure of a small stretch of template at one time. Short segments of replicated DNA are called **Okazaki fragments**.
- RNA primer is also required every time a new Okazaki fragment is to be built. Okazaki fragments are joined together by means of enzyme DNA ligase. DNA strand built up of Okazaki fragments is called **lagging strand**.

DNA polymerases in prokaryotes

- DNA dependent DNA polymerase uses a DNA template to catalyse the polymerisation of deoxynucleotides. These enzymes are highly efficient enzymes as they have to catalyse polymerisation of a large number of nucleotides in a very short time. *E. coli* that has only 4.6×10^6 bp (compare it with human whose diploid content is 6.6×10^9 bp), completes the process of replication within 18 minutes; that means the average rate of polymerisation has to be approximately 2000 bp per second. Any mistake during replication would result into mutations.

- DNA polymerase I** has $5' \rightarrow 3'$ polymerising activity (due to which it removes or excises RNA primers from Okazaki fragments and fills it with DNA) as well as $5' \rightarrow 3'$ and $3' \rightarrow 5'$ exonuclease activity due to which mispaired nucleotide is removed. This is called **proofreading function**.
- DNA polymerase II** has $5' \rightarrow 3'$ polymerising activity as well as $3' \rightarrow 5'$ exonuclease activity but lacks $5' \rightarrow 3'$ exonuclease activity.
- DNA polymerase III** has essential role in DNA replication. It has both $5' \rightarrow 3'$ polymerising activity as well as $3' \rightarrow 5'$ exonuclease activity (proofreading activity).

DNA polymerases in eukaryotes

- In eukaryotes, the replication of DNA takes place at S-phase of the cell cycle.
- DNA polymerase α** - is largest and main enzyme of DNA replication, synthesise DNA on lagging strand.
- DNA polymerase β** -nuclear polymerase studied most extensively in vertebrates and is primarily involved in DNA repair.
- DNA polymerase γ** - replicate mitochondrial DNA.
- DNA polymerase δ** -synthesises DNA on leading strand.
- DNA polymerase ϵ** -help in elongation of lagging strand.

Proofreading and DNA repair

- DNA polymerase III** sense a wrong base introduced during replication. It goes back, removes the wrong base, allows addition of proper base and then proceeds forward.
- There is a separate repair mechanism for any damage caused to DNA due to mutation, UV exposure or mismatching that escapes proof-reading mechanism.
- A nick or break is caused by an endonuclease near the region of repair. **DNA polymerase I** removes the mismatched or wrong nucleotides if present and synthesises a correct replacement by using the intact strand as template. The newly formed segment is sealed by **DNA ligase**.



INTEXT PRACTICE QUESTIONS

- In Griffith's transformation experiment injection of which bacterial strain resulted in death of mice?
- Who proved semi-conservative nature of DNA replication? Name the medium used in experiment.
- Name the histone proteins that form core of nucleosome.

One gene-one enzyme hypothesis given by **Beadle and Tatum** states that a gene controls a structural or functional trait through controlling the synthesis of a specific protein or enzyme.

Later, it has been proved that a single protein may have number of polypeptides and each polypeptide is controlled by a separate gene. As a result, one gene - one enzyme hypothesis was replaced by **one gene-one polypeptide hypothesis**.

Further, when gene was identified as a functional unit or cistron, the same was termed as **one cistron-one polypeptide hypothesis**.

TRANSCRIPTION

- The process of transferring genetic information from template strand of the DNA to RNA is called **transcription**.
- A transcription unit in DNA is defined primarily by the three regions in the DNA: (i) A promoter, (ii) The structural gene, (iii) A terminator. Cistron is a segment of DNA coding for a polypeptide, the structural gene in the transcription unit could be said as monocistronic (mostly in eukaryotes) or polycistronic (mostly in prokaryotes).
- DNA-dependent RNA polymerase catalyse the polymerisation in only one direction, *i.e.*, $5' \rightarrow 3'$. The strand that has the polarity $3' \rightarrow 5'$ acts as a template and is referred to as template strand. The other strand which has the polarity $(5' \rightarrow 3')$ and the sequence same as RNA (except thymine at the place of uracil), is displaced during transcription. Strangely, this strand (which does not code for anything) is referred to as coding strand.

Transcription in Prokaryote

- In prokaryotes, transcription occurs in the cytoplasm with the help of DNA dependent RNA polymerase and takes place in following three steps :
 - Initiation** : The σ factor of RNA polymerase recognises specific DNA sequences called promoters at -35 region. RNA polymerase initiates transcription. It uses nucleoside triphosphate as substrate and polymerase in template dependent fashion following rule of complementarity and also facilitates opening of helix.
 - Elongation** : Subsequent ribonucleotide complements are inserted and linked together by phosphodiester bonds, chain elongation continues in $5' \rightarrow 3'$ direction creating a temporary DNA/RNA hybrid, RNA synthesis continues till the enzyme reaches the terminator.
 - Termination** : As polymerase transcribes away from the promoter, rho factor binds to RNA and follows the polymerase when polymerase reaches some sort of pause site, rho factor catches up with polymerase and unwinds the DNA-RNA hybrid, resulting in release of polymerase.

Transcription in Eukaryotes

- In eukaryotes, transcription occurs within the nucleus.
- There are at least three RNA polymerases in the nucleus (in addition to the RNA polymerase found in the organelles). There is a clear cut division of labour. The RNA polymerase I transcribes rRNAs (28S, 18S, and 5.8S), whereas the RNA polymerase III is responsible for transcription of tRNA, 5SrRNA, and snRNAs (small nuclear RNAs). The RNA polymerase II transcribes precursor of mRNA, the heterogeneous nuclear RNA (hnRNA).
- Sigma factor is absent and no primer is required to start transcription. The nascent RNA synthesised by RNA polymerase II, called primary transcript, contains both unwanted and wanted base sequences. Primary transcript is converted into functional mRNA after post-transcription processing which involves 3 steps.

Post-transcriptional processing

- Initially a **cap** (consisting of 7-methyl guanosine or 7 mG) is added at the 5' end known as **capping**. The cap is a chemically modified molecule of guanosine triphosphate.
- Tail of poly A at the 3' end is added with the help of poly A polymerase and is known as **tailing**.
- Splicing** - Removal of introns through cutting and joining of exons in defined order.

RIBONUCLEIC ACID (RNA)

- RNA is a single stranded polyribonucleotide which functions as carrier of coded genetic information from DNA to cytoplasm for taking part in protein and enzyme synthesis. In some viruses, they may appear partially double stranded due to folding or coiling of single strand. dsRNA can be seen in viruses only.
- The axis or backbone of RNA is formed of alternate residues of phosphate and ribose sugar. Phosphate combines with 5' carbon of its sugar and 3' carbon of next sugar similar to the arrangement found in DNA strand. Nitrogen bases are attached to sugars at 1' carbon of the latter and are of four types — adenine (A), guanine (G), cytosine (C) and uracil (U).

Types of RNA

- There are two types of RNA :
 - Genetic RNA** : It takes part in genetic transmission. It is further divided into two types : double stranded (mammalian reovirus) and single stranded (TMV).
 - Non-genetic RNA** : It is of three types :
 - mRNA (Messenger RNA)** : Brings coded information from DNA and takes part in its translation by bringing amino acids in a particular sequence while synthesising polypeptide.
 - tRNA (Transfer RNA)** - Transfers an amino acid from cytoplasm to the site of protein synthesis. It has

a clover leaf shaped structure with four recognisable sites - **amino acid binding** site at 3', **anticodon loop** (codon recognition sites), **DHU loop** (amino acid recognition site) and **T_ΨC loop** (ribosome recognition site).

- (iii) **rRNA (Ribosomal RNA)** - It is involved in the translation of message of DNA. rRNA forms the structural bench work on which a polypeptide is formed, during protein synthesis.
- **Other non-genetic RNA** : snRNA, scRNA, hnRNA and antisense RNA.

GENETIC CODE

- The genetic code is made up of **codons** through which information in RNA is decoded in a polypeptide chain. A codon is three letter sequence.
- The codons which initiate the protein synthesis are called **initiation codons**. They are **AUG** (methionine) and **GUG** (valine).
- The codons which do not code for any amino acid are called **non-sense codons** or **termination codons**. They are **UAG**, **UAA** and **UGA**.

Characteristics of Genetic Code

- **Universal** : A codon specifies the same amino acid in all organisms ranging from a bacterium to human beings.
- **Non-overlapping** : One letter or base cannot be used for two different adjacent codons while reading a polynucleotide chain.
- **Degenerate** : **61 out of 64 codons code for only 20 amino acids**. For a particular amino acid more than one codon can be used.
- **Non-ambiguous** : A particular codon will always code for same amino acid.
- **Triplet codon** : Three adjacent nitrogen bases constitute a codon which specifies placement of one amino acid in a polypeptide.
- **Commaless** : No punctuations are needed between any two words i.e., after one amino acid is coded, the second amino acid will be automatically coded by the next three letters.

TRANSLATION (PROTEIN

SYNTHESIS)

- It is the process in which the genetic information encoded in mRNA in the form of a sequence of nucleotide triplets is translated into a sequence of amino acids in a polypeptide chain during protein synthesis.
- Before translation can proceed, the tRNA molecules must be chemically

linked to their respective amino acids. This activation process, called **charging**, occurs under the influence of **aminoacyl tRNA synthetases**. It takes place in three steps:

(i) Initiation

- The translation of mRNA begins with the formation of **initiation complex**. The 30S ribosomal subunit binds with two initiation factors (IF-1 and IF-3), then with the mRNA. The initiating codon (5') AUG is guided to its correct position by the **Shine-Dalgarno Sequence** in the mRNA.
- In the second step, both GTP-bound IF-2 and the initiating fMet-tRNA bind with this complex.
- In third step, this large complex combines with the 50S ribosomal subunit. Simultaneously, the GTP bound to IF-2 is hydrolysed to GDP and Pi, which are released from the complex. All three initiation factors depart from the ribosome at this point.
- Functional 70S ribosome called the **initiation complex** is formed and it includes the mRNA and the initiating fMet-tRNA.

(ii) Elongation

- In the first step of the elongation cycle, the appropriate incoming aminoacyl-tRNA binds to a complex of **GTP-bound EF-Tu** forming a complex aminoacyl-tRNA-EF-Tu-GTP that binds to the **A site** of the 70S initiation complex.
- The GTP is hydrolysed and an EF-Tu-GDP complex is released from the 70S ribosome. The EF-Tu-GTP complex is regenerated in a process involving **EF-Ts** and **GTP**.
- In the next step, a **peptide bond** is formed between the two amino acids bound by their tRNAs to the **A** and **P sites** on the ribosome. This occurs by the transfer of the initiating N-formylmethionyl group from its tRNA to the amino group of the second amino acid, now in the A site.
- This reaction produces a dipeptidyl-tRNA in the A site and the now uncharged (deacylated) tRNA^{fMet} remains bound to the P site. The enzymatic activity that catalyses peptide bond formation has been referred to as **peptidyl transferase**.
- In the **final step** of the elongation cycle (translocation), the ribosome moves one codon towards the 3' end of the mRNA. This movement shifts the anticodon of the dipeptidyl-tRNA from the A site to the P site and shifts the deacylated tRNA from the P site to the E site, from where the **deacylated tRNA** is released into the **cytosol**.
- The third codon of the mRNA now lies in the A site and the second codon in the P site.

(iii) Termination

- Termination, is signalled by the presence of one of three **termination**



codons in the mRNA (**UAA, UAG, UGA**), immediately following the final coded amino acid and releasing the complete polypeptide from the ribosome.

THE OPERON SYSTEM

- Operon is a part of genetic material (DNA) which acts as a single regulated unit having one or more

structural genes, an **operator gene**, a **promoter gene**, a **regulator gene**, a **repressor** and an **inducer**. Operator, promoter and regulator genes constitute the regulatory region. Operon system are common in prokaryotes. Operons are of two types : inducible and repressible.

Table : Differences among regulator, operator, promoter and structural genes

	Regulator Gene	Operator Gene	Promoter Gene	Structural Gene
(i)	It controls the functioning of operator gene.	It determines the functioning of structural genes.	It is site for binding of RNA polymerase.	The gene is connected with transcription or formation of mRNA for synthesis of particular polypeptide.
(ii)	This produces a repressor or aporepressor for blocking operator gene.	This gene functions only when it is not blocked by repressor.	It is functional only when operator gene allows passage of RNA-polymerase to structural genes.	It functions only when it receives complementary nucleotides and RNA polymerase.
(iii)	It is commonly a large gene.	The gene is small.	The gene is small.	The gene is moderately long to large depending upon the polypeptide to be synthesised.
(iv)	It functions through the formation of an mRNA of repressor.	It functions through the presence or absence of repressor.	It functions by providing recognition and binding sites for RNA polymerase.	It functions through the formation of mRNA for structural or enzymatic polypeptide.

(i) Inducible Operon

- An inducible operon system is a regulated unit of genetic material which is switched on in response to the presence of an inducer. It is usually found in catabolic pathways.
- The lac **operon** consists of the regulator (l), promoter (P), operator (O) sites and structural genes (*lac z, y and a*) that code for the protein (enzymes).
- In **absence of lactose**, the regulator protein (repressor) binds to the operator and **inhibits transcription**.
- When **lactose is present**, some of it is converted into allolactose. The inducer, allolactose binds to the repressor protein, the inactivated repressor can no longer block transcription. The structural genes are transcribed, ultimately resulting in the production of the enzymes (**β -galactosidase, permease and transacetylase**) needed for lactose catabolism.

(ii) Repressible Operon

- Repression is blocking of the operator gene of operon through a complex repressor that is formed by union of aporepressor formed by regulator gene and corepressor, a product of anabolic pathway.
- Tryptophan (*trp*) operon** consists of regulator (R), promoter (P), operator (O) and structural (*trp - E, D, C, B, A*) genes.
- In **absence of corepressor**, the repressor become inactive, the structural genes are transcribed and tryptophan is produced ultimately.

- In **presence of corepressor**, repressor becomes activated which binds to the operator and blocks the same thus, the structural genes stop transcription. This is called **feedback repressor** and it also exerts **negative control**.

HUMAN GENOME PROJECT (HGP)

- It is called **International Human Genome Sequencing Consortium** and is aimed at finding out all the genes in each of the human chromosomes determining their function and hopefully understanding how they together form the complete organism.
- The HGP was a 13-year project coordinated by the U.S. Department of Energy and the National Institute of Health. Human Genome Project was closely associated with the rapid development of a new area in biology called **bioinformatics**.
- The two factors that made this possible are : (i) Genetic engineering techniques, which made it possible to isolate and clone any segment of DNA, (ii) Availability of simple and fast techniques, for determining the DNA sequences.
- The goals of the human genome project are as follows : (i) To develop a genetic linkage map of human genome by identifying thousands of genetic markers and mapping them in the genome. (ii) To obtain a physical map of human genome by cloning genomic DNA into YACs and cosmids. (iii) To sequence the entire human genome.
- Duchenne Muscular Dystrophy** on X chromosome is the largest gene and **TDF (Testis Determining Factor)** is the smallest gene.

Methodologies

- Expressed Sequence Tags (ESTs, i.e., Focused on identifying all the genes that are expressed as RNA) and Sequence Annotation. Sequence the whole set of genome, that included all the coding and non-coding sequences and later assigning functions to different regions in the sequences are the methods used to sequence human genome.
- The commonly used hosts were bacteria and yeast, and the vectors were called as BAC (Bacterial Artificial Chromosomes) and YAC (Yeast Artificial Chromosomes).
- The fragments were sequenced using automated DNA sequencers that worked on the principle of a method developed by Frederick Sanger.
- The sequence of chromosome 1 was completed only in May 2006 which was the last of the 24 human chromosomes.

SALIENT FEATURES OF HGP

- Some of the salient observations drawn from human genome project are as follows:
 - The human genome contains 3164.7 million nucleotide bases pairs.
 - The average gene consists of 3000 bases, but sizes vary greatly, with the largest known human gene being dystrophin at 2.4 million bases.
 - The total number of genes is estimated at 30,000. Almost all (99.9 per cent) nucleotide bases are exactly the same in all people.
 - The functions of over 50 per cent of the discovered genes are unknown.
 - Less than 2 per cent of the genome codes for proteins.
 - Repeated sequences (stretches of DNA sequences that are repeated many times, sometimes hundred to thousand times) make up very large portion of the human genome.
 - Chromosome 1 has most genes (2968) and the Y has the fewest (231).
 - Scientists have identified about 1.4 million locations where single base DNA differences (SNPs – **single nucleotide polymorphism**, pronounced as 'snips') occur in humans.

DNA FINGERPRINTING

- DNA fingerprinting is a technique of determining certain nucleotide sequences, generally repeated sequences (Satellite DNA) in the human genome that produce a pattern of bands which is unique for every individual. The

basis of DNA fingerprinting are short nucleotide repeats in DNA called the **Variable Number of Tandem Repeats** or **VNTRs** that vary in number from person to person, but are inherited.

- The technique of DNA fingerprinting was initially developed by Alec Jeffreys.

Technique for DNA Fingerprinting

- DNA fingerprints can be prepared from extremely minute amounts of blood, semen, hair bulb or any other cells of the body. The major steps are as follows :
 - DNA is extracted from the cells in high-speed refrigerated centrifuge.
 - DNA molecules are broken with help of enzyme restriction endonuclease that cut them into fragments.
 - These DNA fragments are separated through **gel electrophoresis**. The separated fragments can be visualised by staining them with a dye that fluoresces under ultraviolet radiation.
 - Double-stranded DNA, is then split into single-stranded DNA using alkaline chemicals. Separated DNA sequences are transferred from gel onto a nitrocellulose or nylon membrane (**Southern blotting**).
 - The nylon sheet is then exposed to probes or markers that are radioactive, synthetic DNA segments and complementary to known sequences. The probes target a specific nucleotide sequence, which is complementary to VNTR sequences and hybridise them.
 - Lastly, X-ray film is exposed to the nylon sheet containing radioactive probes. Dark bands develop at the probe bound DNA sites. Thus, hybridised fragments are detected by **autoradiography** and the film developed represents **DNA fingerprint**.

Applications of DNA Fingerprinting

- For identifying the true (biological) father/mother, DNA samples of the child, mother and father are taken. The bands of child's DNA should match the DNA prints of the biological parents.
- DNA fingerprints of suspects from blood or hair or semen picked up from the scene of crime are prepared and compared. The DNA fingerprint of the person matching the one obtained from sample obtained from the scene of crime can give a clue to the actual criminal.
- It is used to determine and study human lineages.
- It can be used to identify genes associated with hereditary disorders.
- It is useful in determining population and genetic diversities.



INTEXT PRACTICE QUESTIONS

- By which technique are hybridised DNA fragments visualised in DNA fingerprinting?
- Name the factor which identifies promoter region in DNA for initiating transcription.



Check Your Vitals for NEET

Maximise your chance of success in medical entrance exams by reading this article. This section is specially designed to optimise your preparation by practising more and more. It is a unitwise series having chapterwise question bank, allowing you to prepare systematically and become more competent.

- 👉 Recall question or single concept question – indicated by a single finger.
- 👉 Application question or question which requires 2 or 3 concepts - indicated by 2 fingers.
- 👉 Application question or question which requires 3 or more concepts - indicated by 3 fingers.

UNIT-VII : GENETICS AND EVOLUTION

CHAPTER-5 : PRINCIPLES OF INHERITANCE AND VARIATION

Multiple Choice Questions

1. If a tall heterozygous pea plant is test crossed, the ratio of tall to dwarf offspring will be
 (a) 3 : 1 (b) 1 : 3
 (c) 1 : 1 (d) 1 : 0.
2. How many of the following traits of pea plant studied by Mendel are dominant?
 Round seed, Constricted pod, Yellow seed, White flower,
 Green pod, Terminal flower
 (a) 2 (b) 3 (c) 4 (d) 5
3. ABO blood grouping is an example of
 (a) incomplete dominance (b) co-dominance
 (c) multiple allelism (d) both (b) and (c).
4. Which of the following can be explained by the phenotypic ratio 9 : 3 : 3 : 1 in the dihybrid cross conducted by Mendel?
 (a) Law of dominance
 (b) Law of segregation
 (c) Law of independent assortment
 (d) Polygenic inheritance
5. Chromosomal theory of inheritance was given by
 (a) T.H. Morgan (b) Gregor Mendel
 (c) James Watson (d) Sutton and Boveri.
6. Which characteristic of fruit flies made them ideal for linkage studies by T.H Morgan?

- I. They can be grown on simple synthetic medium in lab.
- II. They complete their life cycle in two weeks.
- III. They produce a large numbers of progeny flies from a single mating.
- IV. Male and female flies are easily distinguishable.
 (a) I, II and III (b) II, III and IV
 (c) I, III and IV (d) I, II, III and IV

7. Given below is a genetic map with 3 genes : x, y, z.



According to genetic map shown, which of the following statement is incorrect?

- (a) The strength of linkage between y and z is stronger than x and z.
 - (b) The chances of recombination between x and y are higher than x and z.
 - (c) The strength of linkage between x and y is weaker than y and z.
 - (d) The chances of recombination between y and z is lower than x and z.
8. Select the incorrect statement.
 (a) Skin colour is an example of pleiotropy.
 (b) Phenylketonuria is an example of pleiotropy.
 (c) T. H. Morgan is associated with the phenomenon linkage.
 (d) ABO blood group is an example of multiple alleles.
9. When females produce two different types of gametes, it is known as
 (a) male heterogamety (b) polygenic inheritance
 (c) female heterogamety (d) consanguineous mating.

10. Select the correct statement.

- (a) In *Drosophila*, the males have XX chromosomes and females have XY chromosomes.
- (b) In grasshopper, the males have XX chromosomes and females have XO chromosomes.
- (c) In bees, male is haploid and the female is diploid.
- (d) In birds, the males have ZW chromosomes and females have ZZ chromosomes.

11. Which of the following is a sex-linked recessive trait?

- (a) Sickle-cell anaemia
- (b) Phenylketonuria
- (c) Thalassemia
- (d) Colour blindness

12. Number of different type of gametes formed from the parent with genotype AaBb will be

- (a) 1
- (b) 2
- (c) 4
- (d) 8.

13. Myotonic dystrophy is an example of

- (a) autosomal dominant disorder
- (b) autosomal recessive disorder
- (c) sex-linked recessive disorder
- (d) sex-linked dominant disorder.

14. Select the incorrect statement.

- (a) Mental retardation, decreased pigmentation of hair and skin are symptoms of phenylketonuria.
- (b) The effect of each allele is additive in polygenic inheritance.
- (c) The mother determines the sex of the child in humans.
- (d) In bees, the males produce sperms by mitosis.

15. If the mother has blood group B and the father has blood group A, and their child has blood group A, then the genotype of the mother could be

- (a) $I^B i$
- (b) $I^B I^B$
- (c) ii
- (d) $I^A I^B$

Match The Columns

16. Match Column I with Column II.

Column I	Column II
A. Test cross	(i) Unit of inheritance
B. Mutation	(ii) Alteration of DNA sequence
C. Gene	(iii) Predict unknown genotype
D. Linkage	(iv) Physical association of genes on a chromosome

17. Match the column I with column II. (There can be more than one match for items in column I).

Column I	Column II
A. Male heterogamety	(i) Sickle cell anaemia
B. Autosomal recessive trait	(ii) Haemophilia
C. Sex-linked recessive trait	(iii) Humans
D. Aneuploidy	(iv) Colour blindness
	(v) Thalassemia
	(vi) <i>Drosophila</i>
	(vii) Turner's syndrome
	(viii) Phenylketonuria
	(ix) Down's syndrome

Passage Based Questions

18.(A) Complete the given passage with appropriate words.

The chromosomal theory of inheritance was proposed by (i) and experimentally proved by (ii). The theory states that (iii) constitute bridge between the present and the next generation. Hereditary traits are carried by (iv), present in nucleus. Both (iv) and (v) occur in pairs in all somatic cells. The latter are located at specific loci on the chromosomes, which segregate and assort independently during (vi) and later fusion of gametes restore the number of (vii) chromosome in the offspring. Both chromosomes and alleles follows law of (viii) but only those gene pairs present on different chromosomes shows law of (ix).

(B) Read the given passage and correct the errors, wherever present. In a pedigree chart, a square represents the female, a circle represents the male, solid (blackened) symbol shows the trait under study or affected individual; unaffected or normal individuals are shown by crossed or shaded symbol and open or clear symbol signifies the carrier individual. Parents are shown by vertical line while their offsprings are connected to it by a horizontal line. The offsprings are then shown in the form of a horizontal line above the parents and numbered with roman numerals. Each generation is given an arabic numeral and a separate row or horizontal line.

Assertion & Reason

In each of the following questions, a statement of Assertion (A) is given and a corresponding statement of Reason (R) is given just below it. Of the statements, mark the correct answer as :

- (a) If both A and R are true and R is the correct explanation of A.
- (b) If both A and R are true but R is not the correct explanation of A.
- (c) If A is true but R is false. (d) If A is false but R is true.

19. **Assertion :** When red and white flowers of snapdragon are crossed, F_1 offspring obtained are pink coloured flowers.

Reason : The dominant allele for flower colour is incompletely dominant.

20. **Assertion :** Colour blindness is only detected in males.

Reason : The gene for colour blindness is found on X-chromosome.

21. **Assertion :** When a tall and dwarf plant is crossed, the ratio of tall to dwarf plants in the progenies is 1:1.

Reason : One parent is heterozygous for tallness while the other is a homozygous recessive.

22. **Assertion :** All four chromatids of homologous chromosomes undergo crossing over.

Reason : In homologous chromosomes, one set is maternal and other paternal.

23. **Assertion :** Down's syndrome is an example of aneuploidy.

Reason : Aneuploidy occurs as a result of failure of segregation of chromatids during cell division leading to gain or loss of chromosomes.

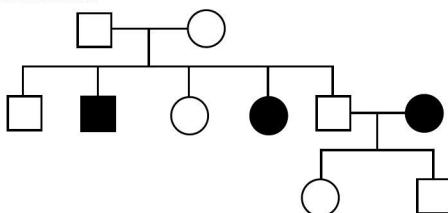
- 24. Assertion :** Person with genotype $I^A I^B$ would show blood group AB.
Reason : ABO blood grouping demonstrates co-dominance.
- 25. Assertion :** The genotype of darkest skin colour will have all dominant alleles.
Reason : The effect of each allele in a polygenic trait is additive.
- 26. Assertion :** Emasculation was an important step in the hybridisation experiments conducted by Mendel.
Reason : Emasculation involves removal of carpel.
- 27. Assertion :** Genes and alleles are interchangeable terms.
Reason : Genes contain the information required for expression of a particular trait in an organism.
- 28. Assertion :** In a test cross, unknown genotype is determined by crossing with a homozygous recessive parent.
Reason : Segregation of alleles is a random process.

Figure Based Questions

- 29.** Refer to the cross below and answer the following questions.

Parent generation	Round seeds (R ₋)	×	Wrinkled seeds (rr)
↓			
F ₁ generation	Round seeds	Wrinkled seeds	
	Round seeds	Wrinkled seeds	

- (a) Which type of cross is depicted above and what is its importance?
(b) Work out the unknown genotype of the parent.
(c) What would be the genotype of dominant parent if all offspring in F₁ generation were round?
- 30.** Refer to the figure given below and answer the questions that follow.



- (a) What does the figure represent?
(b) Which type of disease/trait is represented here?
(c) Give few examples of a trait that could be represented by the above diagram.

CHAPTER-6 : MOLECULAR BASIS OF INHERITANCE

Multiple Choice Questions

- 1.** Which of the following is not a component of a nucleotide?
(a) Nitrogenous base (b) Disulphide group
(c) Phosphate group (d) Pentose sugar

- 2.** In a double stranded DNA, 30% cytosine is present. What is the percentage of thymine in this dsDNA?
(a) 60 % (b) 30 % (c) 40 % (d) 20 %
- 3.** Which of the following is incorrect?
(a) Cytosine is common for both DNA and RNA.
(b) A dinucleotide contains 3' → 5' phosphodiester linkage.
(c) The two strands of DNA have parallel polarity.
(d) The nitrogenous bases in two strands of dsDNA are paired through H-bonding.
- 4.** Number of base pairs in each helical turn of dsDNA is
(a) 1 (b) 10
(c) 200 (d) 34.
- 5.** Which of the following is incorrect statement with regard to histones?
(a) They are rich in basic amino acids.
(b) Histone octamer unit consists of eight molecules.
(c) Histones are wrapped around DNA to form nucleosome.
(d) They are positively charged proteins.
- 6.** 'Beads-on-string' structure observed under the electron microscope is
(a) nucleosomes (b) chromatin
(c) histone octamer (d) nuclein.
- 7.** Heavy isotope of nitrogen used in experiment conducted by Meselson and Stahl was
(a) ¹⁴N (b) ¹⁵N
(c) ¹³N (d) ¹⁶N.
- 8.** Transcription unit in DNA does not have which of the following region?
(a) Promoter (b) Terminator
(c) Adapter (d) Structural gene.
- 9.** The discontinuous strand synthesised during DNA replication is joined by enzyme
(a) DNA ligase (b) DNA polymerase
(c) RNA polymerase (d) primase.
- 10.** Replication of DNA does not require
(a) Origin of replication
(b) DNA-dependent DNA polymerase
(c) DNA-dependent RNA polymerase
(d) DNA-template.
- 11.** Select the incorrect statement.
(a) Splicing mechanism performs removal of introns from hnRNA.
(b) RNA polymerase II is responsible for synthesis of hnRNA.
(c) Addition of adenylate at 3' end of RNA is called capping.
(d) RNA polymerase III is responsible for synthesis of 5S rRNA.

12. How many amino acids will be coded by the following mRNA?

5' — AAUCCUAUGCAUUGUGUUUGA — 3'
(a) 7 (b) 4 (c) 5 (d) 6

13. The 'anticodon loop' is a characteristic of which of the following RNA?

(b) rRNA (b) tRNA
(c) mRNA (d) hnRNA

14. The amino acids are joined by

(a) peptide bond (b) disulphide bond
(c) DNA ligase (d) phosphodiester bond.

15. According to the central dogma, genetic information flows from

(a) Protein → RNA → DNA
(b) DNA → Protein → RNA
(c) RNA → Protein → DNA
(d) DNA → RNA → Protein.

Match The Columns

16. Match the column I with column II.

Column I	Column II
A. Transforming principle	(i) RNA
B. First genetic material	(ii) Bacteriophage
C. Polycistronic gene	(iii) <i>Streptococcus pneumoniae</i>
D. Hershey-Chase experiment	(iv) Lactose
E. Inducer	(v) Prokaryotes

17. Match the column I with column II. (There can be more than one match for items in column I).

Column I	Column II
A. DNA	(i) Repressor
B. Genetic code	(ii) Nuclein
C. RNA	(iii) Degenerate
D. i gene	(iv) Catalyst
	(v) Deoxyribonucleotides
	(vi) Unstable and reactive
	(vii) Regulatory gene
	(viii) Universal

Passage Based Questions

18. (A) Complete the given passage with appropriate words or phrases.

Double helix model for the structure of DNA was proposed by (i) and (ii) in year (iii), based on the (iv) data produced by (v) and (vi). One of the hallmarks of their proposition was (vii) between the two strands of polynucleotide chains. However, this proposition was also based on the observation of (viii) that for a double stranded DNA, the ratios between adenine and (ix) and guanine and (x) are constant and equals to one.

(B) Read the given passage and correct the errors, wherever present.

Translation refers to the process of polymerisation of nucleotides to form amino acids. The order and sequence of amino acids are defined by the sequence of bases in the tRNA. Eukaryotic translation occurs on 70S ribosomes. It is a discontinuous process as transcription occurs in cytoplasm while translation takes place in nucleus.

Assertion & Reason

In each of the following questions, a statement of Assertion (A) is given and a corresponding statement of Reason (R) is given just below it. Of the statements, mark the correct answer as :

- (a) If both A and R are true and R is the correct explanation of A.
(b) If both A and R are true but R is not the correct explanation of A.
(c) If A is true but R is false.
(d) If A is false but R is true.

19. **Assertion :** mRNA is called informational or genetic RNA.
Reason : mRNA brings instructions from the DNA for the formation of a particular type of polypeptide.

20. **Assertion :** The opposite strands of DNA chains are not identical but complementary to each other.
Reason : Specific base pairing occurs between a purine lying opposite to a pyrimidine.

21. **Assertion :** The genetic code is degenerate.
Reason : 64 codons code for 20 amino acids.

22. **Assertion :** In semi-conservative DNA replication, one of the strand of newly synthesised DNA is discontinuous.
Reason : DNA-dependent DNA polymerase catalyse polymerisation only in one direction.

23. **Assertion :** During transcription, both strands of DNA act as template to produce double-stranded RNA.
Reason : Double-stranded RNA is not translated into proteins.

24. **Assertion :** In bacteria, translation of mRNA begins before it is fully transcribed.
Reason : There is no spatial separation of cytosol and nucleus in bacteria.

25. **Assertion :** The anticodon sequence of initiator tRNA is always UAC.
Reason : The initiator tRNA binds to the start codon AUG.

26. **Assertion :** Lac operon is a case of negative regulation of genes.
Reason : The repressor binds to the promoter region of operon and prevents RNA polymerase from transcribing the operon.

27. **Assertion :** Polymorphism forms the basis of DNA fingerprinting.
Reason : Polymorphism arises due to non-inheritable mutations.

28. **Assertion :** Less than 2% of human genome code for proteins.
Reason : Repeated sequences make up very large portion of the human genome.

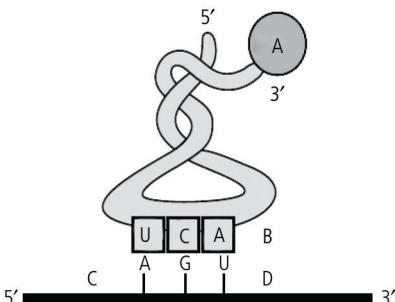
Figure Based Questions

29. Observe the figure given below and answer the following questions.



- (a) What does the diagram represent?
 (b) Identify A, B, C and D.
 (c) What will happen if position of A and B are switched?

30. Refer to the given figure and answer the following questions.



- (a) What does the structure depict? Identify A, B, C and D.
 (b) Name the process of linking of A to the given structure.
 (c) What will be the sequence of B if the corresponding sequence on C is UAA?

CHAPTER-7 : EVOLUTION

Multiple Choice Questions

1. Which of the following was not present on early earth?
 (a) Ammonia (b) Methane
 (c) Oxygen (d) Water vapour
2. Who first proposed that first form of life originated from non-living organic molecules?
 (a) Hershey and Chase (b) Oparin and Haldane
 (c) S. L. Miller (d) Darwin and Wallace
3. Which of the following is true for homologous organs?
 (a) They indicate different ancestry.
 (b) They perform different functions but have same origin.
 (c) They perform same function but have different origin.
 (d) Eye of octopus and mammals are homologous organs.
4. Which is the correct order of increasing geological time-scale for a hypothetical vertebrate evolution?
 (a) Cenozoic, mesozoic, palaeozoic, precambrian
 (b) Cenozoic, palaeozoic, mesozoic, precambrian
 (c) Precambrian, cenozoic, palaeozoic, mesozoic
 (d) Precambrian, palaeozoic, mesozoic, cenozoic

5. A single step large mutation causing speciation proposed by de Vries is called
 (a) natural selection (b) saltation
 (c) founder effect (d) genetic equilibrium.

6. Which of the following does not affect Hardy-Weinberg equilibrium?
 (a) Genetic drift (b) Natural selection
 (c) Mutation (d) None of these.

7. Refer to the main features of theory of natural selection.
 (i) Limited food and space
 (ii) Formation of new species
 (iii) Variations
 (iv) Natural selection
 (v) Struggle for existence
 (vi) Inheritance of useful variations over many generations
 (vii) Rapid multiplication

Select the correct sequence of speciation.

- (a) (vii) → (i) → (vi) → (iii) → (iv) → (v) → (ii)
 (b) (vii) → (i) → (v) → (iii) → (iv) → (vi) → (ii)
 (c) (vii) → (i) → (v) → (iii) → (vi) → (iv) → (ii)
 (d) (vii) → (i) → (iii) → (v) → (iv) → (vi) → (ii)

Contributed by: Sharon M Dsouza, Udupi, Karnataka

SOLUTIONS TO JUNE 2023 WORD GRID

T	A	M	B	I	O	L	I	S	T	I	C	S	F	A
E	A	X	O	N	E	M	E	S	I	S	X	A	P	T
E	P	F	R	Y	O	M	O	L	Y	B	D	N	L	E
T	P	C	O	C	A	I	N	E	A	R	I	T	R	P
H	L	A	N	V	T	L	M	R	A	A	N	A	I	H
Y	E	P	I	N	E	S	O	M	E	T	E	T	S	L
L	O	P	R	E	D	A	T	I	N	S	I	P	O	
E	O	I	N	T	O	M	I	E	S	A	I	O	E	S
N	O	N	A	N	O	E	S	T	A	T	I	N	R	O
E	P	G	U	T	T	A	T	I	N	S	I	M	L	
F	E	R	N	S	I	X	H	O	M	E	G	H	I	E
R	E	P	I	B	L	E	M	A	E	A	N	I	S	T
O	M	L	G	H	W	T	U	V	X	N	T	N	N	E
M	O	R	E	S	F	A	S	C	I	A	A	T	O	A
P	O	L	Y	C	I	S	T	R	O	N	I	C	O	M

- | | | | |
|-----|---------------|-----|-----------|
| 1. | Axoneme | 11. | Ethylene |
| 2. | Biolistics | 12. | Cocaine |
| 3. | Typhlosole | 13. | Angina |
| 4. | Saltation | 14. | Ratna |
| 5. | Epiblema | 15. | Renin |
| 6. | Capping | 16. | Statin |
| 7. | Guttation | 17. | Fascia |
| 8. | Isthmus | 18. | Predation |
| 9. | Boron | 19. | Fovea |
| 10. | Polycistronic | 20. | Perisperm |

8. The extinct human ancestor, whose fossil was discovered by Edward Lewis from Pliocene rocks of *Shivalik Hills* of India was
(a) *Ramapithecus* (b) *Australopithecus*
(c) *Dryopithecus* (d) *Homo erectus*.

9. Which of the following was the reptile?
(a) *Ichthyosaurs* (b) *Tyrannosaurus*
(c) *Archaeopteryx* (d) *Pteranodon*

10. Which of the following is an industrial pollution indicator?
(a) White winged moth (b) Melanised moth
(c) Lichen (d) Horsetail ferns.

11. According to Hardy-Weinberg equation, allelic frequency of heterozygotes is
(a) p^2 (b) 1 (c) $2pq$ (d) q^2 .

12. Blue-eye color is recessive to brown-eye color. In a population of 100 individuals, how many individuals will have blue-eye color if the allelic frequency is 0.2, given that the population is in Hardy-Weinberg equilibrium?
(a) 32 (b) 64 (c) 8 (d) 4

13. Which of the following is/are true regarding Hardy-Weinberg population?
I. Allele frequencies remains constant from generation to generation.
II. Sum of total allelic frequencies is 1.
III. Trinomial expansion of $(p+q)^3$ gives Hardy-Weinberg equation.
IV. Gene pool varies from generations to generations.
(a) I and II (b) III and IV
(c) IV only (d) III only

14. According to Oparin, coacervates are
(a) non-living collection of organic macromolecules with double-layered membrane.
(b) protein-like structures consisting of branched chains of amino acids.
(c) lipid molecules enclosed by a living protein membrane.
(d) non-living structures comprising of organic biomolecules, surrounded by a film of water.

15. Brain size of Neanderthals is
(a) 650 cc (b) 800 cc (c) 900 cc (d) 1400 cc.

Match The Columns

16. Match the column I with column II.

Column I	Column II
A. Malay Archipelago	(i) Hugo de Vries
B. Saltation	(ii) Lamarck
C. H.M.S. Beagle	(iii) Miller
D. Use and disuse of organs	(iv) Charles Darwin
E. Formation of simple organic molecules	(v) Alfred Wallace

17. Match the column I with column II. (There can be more than one match for items in column I).

Column I	Column II
A. Connecting link	(i) Australian Marsupials
B. Missing link	(ii) Prosimians
C. Adaptive radiation	(iii) <i>Ornithorhynchus</i>
D. Analogous organs	(iv) Flippers of Dolphin and pectoral fins of shark
E. Primates	(v) <i>Ichthyostega</i>
	(vi) Simians
	(vii) <i>Protopterus</i>
	(viii) Sting of honey bee and scorpion
	(ix) Darwin's finches
	(x) <i>Seymouria</i>

Passage Based Questions

18. (A) Complete the given passage with appropriate words or phrases.

The process by which the organisms that appear physically, physiologically and behaviorally better adapted to the environment, survive and reproduce is called (i). This process depends upon the existence of (ii) variation within the population. In (iii) selection, average sized individuals are favoured over small sized ones, reduces (iv) and thus evolutionary change does not occur. Graphical curve obtained from such population is (v). During progressive selection, the (vi) size of population changes. (vii) selection favours both small and large sized individuals. It produces two peaks in distribution of traits, leading to development of different (viii). (vii) selection is rare in nature but plays an important role in (ix). Evolution of DDT resistant mosquitoes is an example of (x) selection.

(B) Read the given passage and correct the errors, wherever present.

Each gorilla somatic cell contains 46 chromosomes. Out of these chromosomes, 44 are autosomes and 2 are sex chromosomes. In female XY and in male XX are sex chromosomes. Human chromosomes are normally taken from Red blood corpuscles (RBCs) from the peripheral blood. The banding patterns of chromosomes indicate that all human races such as Asian, African and European possess different chromosome number.

Assertion & Reason

In each of the following questions, a statement of Assertion (A) is given and a corresponding statement of Reason (R) is given just below it. Of the statements, mark the correct answer as :

- (a) If both A and R are true and R is the correct explanation of A.
(b) If both A and R are true but R is not the correct explanation of A.
(c) If A is true but R is false. (d) If A is false but R is true.

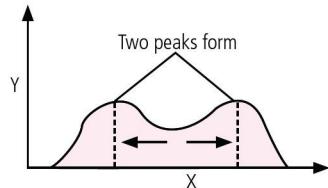
19. **Assertion :** Cro-Magnon man is regarded as most primitive ancestor of *Homo erectus*.

Reason : Cro-Magnon man was tool maker and used tools of chipped stones.

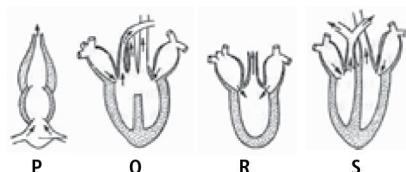
- 20.** **Assertion :** *Ichthyostega* is regarded as a link between the fishes and amphibians.
Reason : It exhibits characteristics of both reptiles and mammals.
- 21.** **Assertion :** Sweet potato and potato are analogous structure.
Reason : Both sweet potato and potato are anatomically different but perform similar functions.
- 22.** **Assertion :** Primitive atmosphere of Earth was reducing in nature.
Reason : Hydrogen atoms present in primitive atmosphere combined with all oxygen atoms to form water, leaving no free oxygen.
- 23.** **Assertion :** An organism which is fit to survive in a hostile environment gets selected during natural selection.
Reason : Darwinian variations are small and directional.
- 24.** **Assertion :** Recombination during gametogenesis can lead to change in allelic frequency in later generations.
Reason : Recombination does not lead to variation.
- 25.** **Assertion :** Jurassic period is also called the age of reptiles.
Reason : Amphibians flourished during Jurassic period.
- 26.** **Assertion :** All extinct organisms become fossils.
Reason : Age of fossils is determined by radioactive carbon dating.
- 27.** **Assertion :** Acquired characters are inheritable.
Reason : Acquired characters can help individuals survive in harsh conditions.
- 28.** **Assertion :** Reptiles have dry skin and lay shelled-eggs.
Reason : Reptiles are evolved from amphibians.

Figure Based Questions

- 29.** Refer to the graph shown below and answer the following questions.



- (a) What type of selection does the graph represent?
(b) What does the X and Y represent?
(c) Which type of selection will be generated if one of the peaks start to grow?
- 30.** Refer to the figures given below and answer the following questions.



- (a) Identify the diagrammatic structures P, Q, R and S.
(b) What do these structures signify?
(c) Give an example of organs showing similar relationship.
(d) What type of evolution do these structures represent?



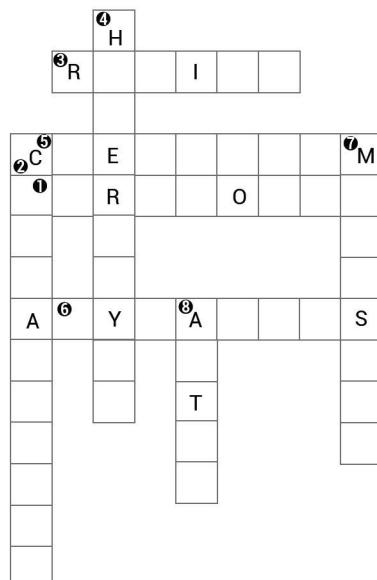
Readers can send their responses at editor@mtg.in or post us with complete address by 10th of every month. Winners' name and answers will be published in next issue.

Across



Fill the grid with words related to given images.

Down

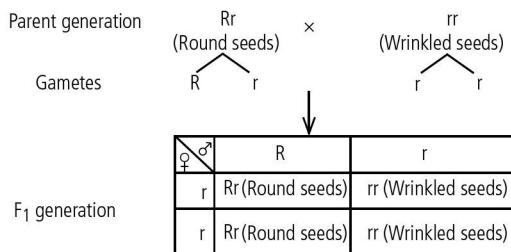


SOLUTIONS

CHAPTER-5 : PRINCIPLES OF INHERITANCE AND VARIATION

1. (c) 2. (b) 3. (d) 4. (c) 5. (d)
 6. (d) 7. (b) 8. (a) 9. (c) 10. (c)
 11. (d) 12. (c) 13. (a) 14. (c) 15. (a)
 16. A-(iii); B-(ii); C-(i); D-(iv)
 17. A-(iii, vi); B-(i, v, viii); C-(ii, iv); D-(vii, ix)
18.(A) (i) Sutton and Boveri (ii) T.H. Morgan
 (iii) gametes (iv) chromosomes
 (v) genes (vi) meiosis
 (vii) diploid
 (viii) segregation
 (ix) Independent assortment

- (B)** In a pedigree chart, a square represents the female male, a circle represents the male female, solid (blackened) symbol shows the trait under study or affected individual; unaffected or normal individuals are shown by crossed open or shaded clear symbol and open crossed or clear shaded symbol signifies the carrier individual. Parents are shown by vertical horizontal line while their offsprings are connected to it by a horizontal vertical line. The offsprings are then shown in the form of a horizontal line above below the parents and numbered with roman arabic numerals. Each generation is given a separate row or horizontal line.
19. (a) 20. (d) 21. (a) 22. (d) 23. (a)
 24. (a) 25. (a) 26. (c) 27. (d) 28. (b)
 29. **(a)** Test cross is depicted. It is used to determine the unknown genotype of parent by crossing a plant with an unknown genotype and recessive parent.
(b) Since wrinkled seeds are obtained in their F₁ progeny, the cross will be the following.



So, the genotype of unknown parent will be Rr.

- (c)** Since round and wrinkled seeds are in the ratio of 1 : 1, thus parent with unknown genotype would be heterozygous (Rr). In a test cross, if all the progenies

obtained are dominant, then the parent is homozygous dominant. In this case, the genotype would be RR.

30. **(a)** The figure represents a pedigree analysis of a family.
(b) The trait represented in pedigree analysis is autosomal recessive trait since both males and females are affected by it. This trait can be transmitted, when both the parents are heterozygous or carriers for the gene.
(c) Sickle cell anaemia, phenylketonuria and thalassemia are examples of autosomal recessive trait.

CHAPTER-6 : MOLECULAR BASIS OF INHERITANCE

1. (b) 2. (d) 3. (c) 4. (b) 5. (c)
 6. (a) 7. (b) 8. (c) 9. (a) 10. (c)
 11. (c) 12. (b) 13. (b) 14. (a) 15. (d)
 16. A-(iii); B-(i); C-(v); D-(ii); E-(iv)
 17. A-(ii, v), B-(iii, viii), C-(iv, vi), D-(i, vii)
18.(A) (i) James Watson (ii) Francis Crick
 (iii) 1953 (iv) X-ray diffraction
 (v) Maurice Wilkins (vi) Rosalind Franklin
 (vii) base pairing (viii) Erwin Chargaff
 (ix) Thymine (x) Cytosine
(B) Translation refers to the process of polymerisation of nucleotides amino acids to form amino-acids polypeptide. The order and sequence of amino acids are defined by the sequence of bases in the mRNA. Eukaryotic translation occurs on 80S ribosomes. It is a discontinuous process as transcription occurs in cytoplasm nucleus while translation takes place in nucleus cytoplasm.
 19. (a) 20. (a) 21. (c) 22. (a) 23. (d)
 24. (a) 25. (a) 26. (c) 27. (c) 28. (b)
29.(a) The diagram represents a schematic structure of a transcription unit.
(b) In the schematic structure of a transcription unit, A is the promoter, B is the terminator, C is the template strand and D is the coding strand.
(c) If the position of promoter (A) and terminator (B) are switched, then coding and template strands would be reversed as the promoter is always present towards the 5'- end and the terminator is towards the 3' end of the coding strand.
30. (a) Given structure depicts tRNA which is an adapter molecule. A is the amino acid. B is the anticodon. C is the mRNA. D is a codon.
(b) The process of linking of amino acid to the tRNA is known as aminoacylation of tRNA or charging of tRNA.

In this phase, amino acids are activated in the presence of ATP.

- (c) Since UAA is a stop codon and there are no tRNA for stop codons, the anticodon for UAA would be unavailable.

CHAPTER-7 : EVOLUTION

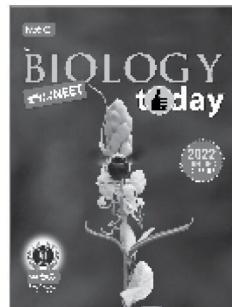
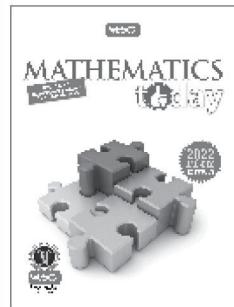
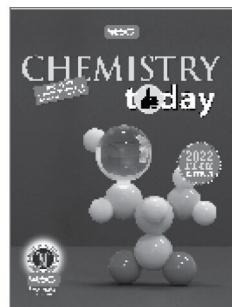
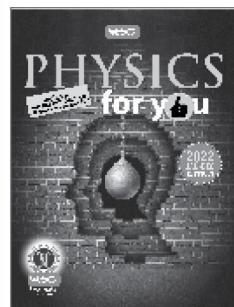
1. (c) 2. (b) 3. (b) 4. (d) 5. (b)
6. (d) 7. (b) 8. (a) 9. (b) 10. (c)
11. (c) 12. (d) 13. (a) 14. (d) 15. (d)
16. A-(v), B-(i), C-(iv), D-(ii), E-(iii)
17. A-(iii, vii), B-(v, x), C-(i, ix), D-(iv, viii), E-(ii, vi)
18. (A) (i) natural selection (ii) phenotypic
 (iii) stabilising (iv) variation
 (v) bell-shaped (vi) mean
 (vii) Disruptive (viii) populations
 (ix) evolution (x) directional

- (B) Each gorilla human somatic cell contains 46 chromosomes. Out of these chromosomes, 44 are **autosomes** autosomes and 2 are **allosomes** allosomes. In female XY XX and in male XX XY are the sex chromosomes. Human chromosomes are normally taken from **Red blood corpuscles (RBCs)** White blood corpuscles (WBCs) from the peripheral blood. The

banding patterns of chromosomes indicate that all human races such as Asian, African and European possess different same chromosome number.

19. (d) 20. (c) 21. (a) 22. (a) 23. (b)
24. (c) 25. (c) 26. (d) 27. (d) 28. (b)
29. (a) The graph represents disruptive selection.
- (b) The X represents phenotypes in a population while Y represents number of individuals in the population.
- (c) If one of peak starts grow then directional selection will be obtained where more individuals acquire value other than the mean character value.
30. (a) P-Heart of fish; Q-Heart of reptiles; R-Heart of amphibians; S-Heart of mammal/bird.
- (b) All these hearts show the same fundamental structure, hence are homologous organs. Since, these are adapted to function differently in different environment, they represent divergent evolution.
- (c) Thorns of *Bougainvillea* and tendrils of *Cucurbita* also show divergent evolution. They are similar in structure as they arise from nodes, in axillary position but have different functions, hence are homologous organs.
- (d) These structures represent divergent evolution. ☺☺

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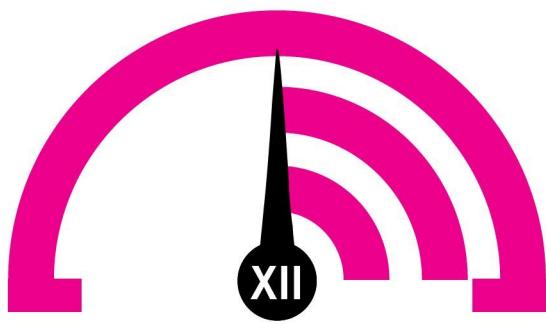
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MONTHLY TEST DRIVE



This specially designed column enables students to self analyse their extent of understanding of specified chapter. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

Total Marks : 160

Series 4 : Evolution Human Health and Diseases

Time : 40 Min.

- 1.** Match column I (Placental mammals) with column II (Australian marsupials).

Column I	Column II
(A) Mole	(i) Tasmanian tiger cat
(B) Anteater	(ii) Flying phalanger
(C) Lemur	(iii) Marsupial mole
(D) Flying squirrel	(iv) Numbat
	(v) Spotted cuscus
	(vi) Tasmanian wolf
	(vii) Marsupial mouse

(a) (A)-(iii), (B)-(iv), (C)-(v), (D)-(ii)
 (b) (A)-(vii), (B)-(v), (C)-(ii), (D)-(iii)
 (c) (A)-(ii), (B)-(iii), (C)-(iv), (D)-(vii)
 (d) (A)-(iii), (B)-(ii), (C)-(v), (D)-(iv)

2. Which of the following techniques could not detect the cancer of internal organs?

 - Magnetic resonance imaging
 - Computed tomography (CT)
 - Antigen antibody agglutination test
 - Radiography

3. Which animal evolved into the first amphibian that lived on both land and water?

 - Coelacanth
 - Stegosaurus*
 - Ichthyostega*
 - Brachiosaurus*

4. Read the following statements and select the correct one.

 - The property of contact inhibition is shown by cancerous cell.
 - The cancer patients are administrated with α -interferon to destroy the tumour.
 - The most feared property of benign tumours is metastasis.
 - Cancerous cells divide in a regulated manner.

5. In a population of 1000 individuals, 360 belong to genotype AA, 480 to Aa and the remaining 160 to aa. Based on this data, the frequency of allele A in the population is

 - 0.4
 - 0.5
 - 0.6
 - 0.7.

6. Select the mismatched pair.

(a) Physiological barrier	– Saliva in mouth
(b) Physical barrier	– Acid in the stomach
(c) Cellular barrier	– Polymorphonuclear leukocytes
(d) Cytokine barrier	– Interferons

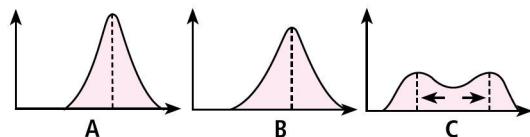
7. Study the given graphs and select the correct statements.


 - (i) In A, the population changes towards one particular direction.
 - (ii) B favours selection of average sized individuals while eliminates small-sized individuals.
 - (iii) C favours both small-sized and large-sized individuals.
 - (iv) In A, the mean value from generation to generation is maintained.
 - (iii) and (iv)
 - (i), (ii) and (iii)
 - (ii) only
 - (ii) and (iv)

8. Read the following statements and select the correct option.

Statement A : Theory of spontaneous generation proposed that life arises from decaying and rotting matter like straw, mud.

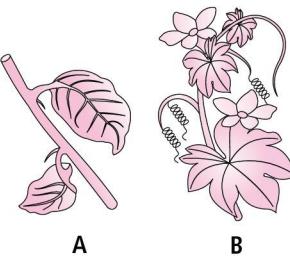
Statement B : Spontaneous generation theory did not explain how the first life form came on earth.



8. Read the following statements and select the correct option.

Statement A : Theory of spontaneous generation proposed that life arises from decaying and rotting matter like straw, mud.

Statement B : Spontaneous generation theory did not explain how the first life form came on earth.

- (a) Both statements A and B are correct.
 (b) Statement A is incorrect but B is correct.
 (c) Statement A is correct but B is incorrect.
 (d) Both statements A and B are incorrect.
- 9.** Which of the following are key concepts of Darwinian theory of evolution?
 (a) Gene flow and genetic drift
 (b) Mutation and natural selection
 (c) Branching descent and natural selection
 (d) Branching descent and genetic drift
- 10.** Which of the following hormones is released in response to nicotine resulting in increase in blood pressure and heart rate?
 (a) Adrenaline and nor-adrenaline
 (b) Atrial natriuretic factor
 (c) Acetylcholine
 (d) Aldosterone
- 11.** Which of the following statements is not correct regarding mutation theory as believed by Hugo de Vries?
 (a) Mutations are small and directional.
 (b) Evolution occurs as a result of single step large mutations.
 (c) Mutations are random and inheritable.
 (d) Observations of mutation theory are based on the studies of evening primrose.
- 12.** Where is lymphoid organ 'thymus' located in the body?
 (a) Below the right lung
 (b) Beneath the breastbone
 (c) Lower side of abdomen
 (d) Above the anterior region of kidney
- 13.** Refer to the given figure and select the correct statement regarding it.
- 
- 14.** Which of the following had huge dagger like teeth?
 (a) *Ichthyosaurs* (b) *Pelycosaurs*
 (c) *Tyrannosaurus* (d) *Apatosaurus*
- 15.** The fish used as a biological control agent against mosquito larvae is
 (a) *Catla* (b) *Labeo*
 (c) *Gambusia* (d) *Carcharodon*.
- 16.** Which of the following is correct sequence for evolution of man?
 (a) *Australopithecus* → *Ramapithecus* → *Homo erectus* → *Homo habilis* → Neanderthal man
 (b) *Ramapithecus* → *Australopithecus* → *Homo habilis* → *Homo erectus* → Neanderthal man
 (c) Neanderthal man → *Homo habilis* → *Australopithecus* → *Ramapithecus* → *Homo erectus*
 (d) *Homo habilis* → *Australopithecus* → Neanderthal man → *Homo erectus* → *Homo sapiens*
- 17.** Which of the following toxins is responsible for the chill and high fever in malaria?
 (a) Amanitin (b) Saxitoxin
 (c) Haemotoxin (d) Aflatoxin
- 18.** The analysis of meteorite content has similar results with the experiment performed by
 (a) Oparin and Haldane (b) S.L. Miller
 (c) Thomas Malthus (d) Louis Pasteur.
- 19.** Select the wrong statement one with respect to industrial melanism.
 (a) The peppered moth existed in two forms-light coloured (white) and melanin (black).
 (b) Industrial melanism supports evolution by speciation.
 (c) Before industrialisation, bark of trees were covered by whitish lichens, so white moths escaped unnoticed from predatory birds.
 (d) After industrialisation, barks got covered by smoke, so the white moths were selectively picked up by birds.
- 20.** Where does the sexual stage (gametocytes) of *Plasmodium* form?
 (a) Salivary glands of mosquito
 (b) Human RBCs
 (c) Intestine of mosquito
 (d) Human liver

ANSWERS JUNE 2023

The three letter word is M O S.

CHROMOSOME

CYMOSE

ABELMOSCHUS

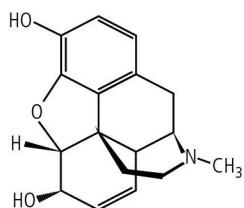
MOSS

Winner: Nilanjana Hota, Ichchapur (West Bengal)

- 21.** Read the given statements and select the option stating which ones are true (T) and which ones are false (F).
- Typhoid fever can be confirmed by Widal test.
 - Entamoeba histolytica* resides in jejunum and ileum parts of the small intestine and is more common in females than males.
 - Elephantiasis is caused by a protozoan parasite *Trichophyton*.
 - Plant yielding 'cocaine' is native to South America.

I	II	III	IV
(a) T F	F F		
(b) T F	F T		
(c) F T	F T		
(d) F T	T T		

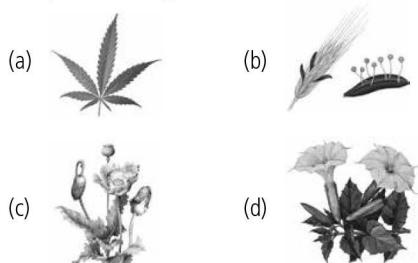
- 22.** The chemical compound whose chemical structure is given below is obtained from which plant?



- (a) *Papaver somniferum* (b) *Erythroxylum coca*
(c) *Atropa belladonna* (d) *Cannabis sativa*

- 23.** Which out of the following represents autoimmune disorder?
- Cancer
 - Rheumatoid arthritis
 - Cholera
 - Diphtheria
- 24.** Study of fossils is
- palaeontology
 - herpetology
 - saurology
 - organic evolution.

- 25.** Which of the following is a source for depressant, sedative and painkiller drug?



- 26.** Fossils are
- preserved hard parts of organisms in rock layers only
 - prints of organisms of remote past in layer of rocks
 - mineralised part of past organisms
 - all of these.

- 27.** Given below are four statements regarding evolution of life forms.

- Lobe-fins are the ancestor of modern day amphibians.
- Sea weeds and plants evolved around 500 mya.
- Fish like reptiles evolved around 65 mya.
- Jawless fish probably evolved around 350 mya.

Which of the above two statements are correct?

- (i) and (iv)
- (ii) and (iii)
- (ii) and (iv)
- (i) and (iii)

- 28.** Read the given statements and select the correct option.

Statement A : Chronic alcoholism can lead to cirrhosis.

Statement B : A combination of drug with alcohol may sometimes become a cause of death.

- Statement A is incorrect but statement B is correct.
- Both statements A and B are correct.
- Statement A is correct but statement B is incorrect.
- Both statements A and B are incorrect.

- 29.** Which of the following refer to correct example(s) of organisms which have evolved due to changes in environment brought about by anthropogenic action?

- Darwin's Finches of Galapagos islands.
 - Herbicide resistant weeds.
 - Drug resistant eukaryotes.
 - Man-created breeds of domesticated animals like dogs.
- Only (1)
 - (1) and (3)
 - (2), (3) and (4)
 - Only (4)

- 30.** An isolated population of humans with approximately equal number of blue-eyed and brown-eyed individuals was affected by flood. The brown-eyed people split off from the population and later formed a new colony. This kind of change in the gene pool is called a

- Hardy-Weinberg equilibrium
- blocked gene flow
- bottleneck effect
- Founder effect.

- 31.** Which of the following statements is true about amoebiasis causing organism?

- It is caused by virus.
- It is acquired through food contaminated with parasite.

UNSCRAMBLED WORDS

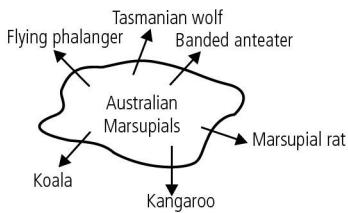
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- | | |
|----------------|----------------|
| 1-i-BULLIFORM | 2-d-HILUM |
| 3-j- CONFORMER | 4-b-MEIOCYTE |
| 5-e- OSCULUM | 6-a-INSULIN |
| 7-f-ANTRUM | 8-c-SPOROPHYLL |
| 9-g-PULVINUS | 10-h-POLYBLEND |

Winner : Kasturi Samanta

- (c) It affects lymphatic vessels of lower limbs.
 (d) It can be characterised by scaly lesions on skin.

32. Following diagram provides an example of



- (a) convergent evolution
 (b) parallel evolution
 (c) recapitulation
 (d) divergent evolution.

33. Match the hominids with their correct brain size.

- | | |
|----------------------------------|------------------|
| (A) <i>Homo habilis</i> | (i) 900 cc |
| (B) <i>Homo neanderthalensis</i> | (ii) 1350 cc |
| (C) <i>Homo erectus</i> | (iii) 650-800 cc |
| (D) <i>Homo sapiens</i> | (iv) 1400 cc |

Select the correct option.

- | (A) | (B) | (C) | (D) |
|-----------|-------|------|------|
| (a) (iv) | (iii) | (i) | (ii) |
| (b) (iii) | (i) | (iv) | (ii) |
| (c) (iii) | (ii) | (i) | (iv) |
| (d) (iii) | (iv) | (i) | (ii) |

34. Fill up the blanks and select the correct option.

(i) is a CNS stimulant as it interferes with the transport of the neuro-transmitter (ii).

- (a) (i) - Cocaine, (ii) - acetylcholine
 (b) (i) - Barbiturate, (ii) - glutamate
 (c) (i) - Cocaine, (ii) - dopamine
 (d) (i) - Barbiturate, (ii) - glycine

35. Select the correct statements regarding the characteristics of acquired immunity.

- (i) Cell-mediated immunity is responsible for acquired immunity.
 (ii) It produces a primary response of low intensity.
 (iii) Active and passive immunity are types of acquired immunity.
 (iv) Polymorphonuclear leukocytes and natural killer cells are involved in acquired immunity.

- (a) (i), (ii) and (iii)
 (b) (i), (iii) and (iv)
 (c) (i) and (iv)
 (d) (i) and (iii)

36. Given: 1 = natural selection; 2 = Favourable variations and their inheritance; 3 = survival of the fittest; 4 = struggle for existence. According to Darwinism, which of the following represents the correct sequence of events in the origin of new species?

- (a) 3, 4, 1, 2
 (b) 2, 3, 1, 4
 (c) 1, 2, 3, 4
 (d) 4, 2, 1, 3

37. Which one of the following options gives the correct matching of a disease with its causative organism and mode of infection?

Disease	Causative organism	Mode of infection
(a) Typhoid	<i>Salmonella typhi</i>	With inspired air
(b) Pneumonia	<i>Streptococcus pneumoniae</i>	Droplet infection
(c) Elephantiasis	<i>Wuchereria bancrofti</i>	With infected water and food
(d) Malaria	<i>Plasmodium vivax</i>	Bite of male <i>Anopheles</i> mosquito

38. Select the mismatched pair.

- | | |
|----------------------|---|
| (a) Typhoid | - Mary Mallon |
| (b) Antibodies | - Humoral immune response |
| (c) Analogous organs | - Thorn of <i>Bougainvillea</i> and tendril of <i>Cucurbita</i> |
| (d) Invertebrates | - Evolved 500 mya |

39. What is the correct arrangement of periods of palaeozoic era in geological time scale in ascending order?

- (a) Silurian → Carboniferous → Devonian → Permian
 (b) Silurian → Devonian → Carboniferous → Permian
 (c) Devonian → Silurian → Carboniferous → Permian
 (d) Silurian → Devonian → Permian → Carboniferous

40. Grafted kidney may be rejected in a patient due to

- (a) passive immune response
 (b) innate immune response
 (c) humoral immune response
 (d) cell-mediated immune response.



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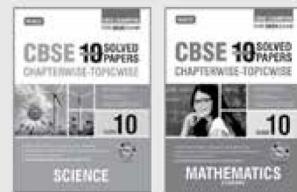
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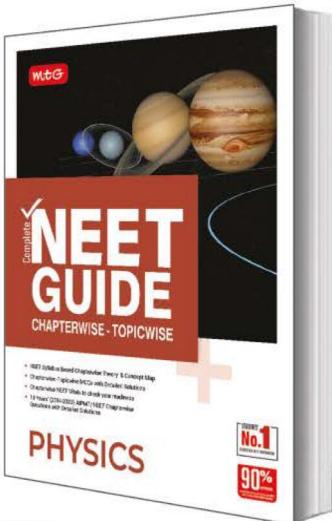


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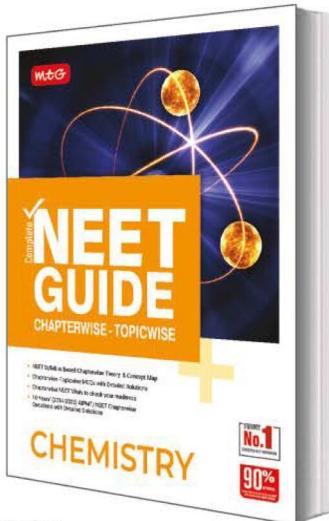


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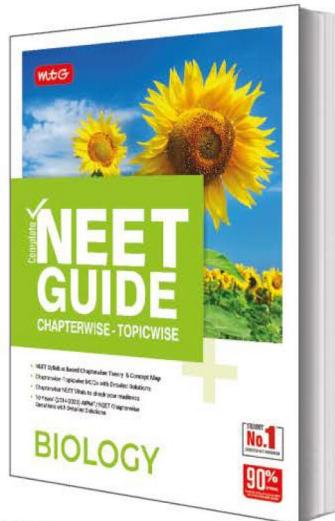
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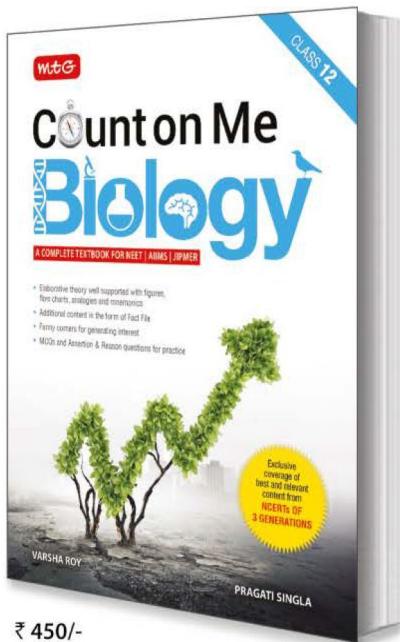
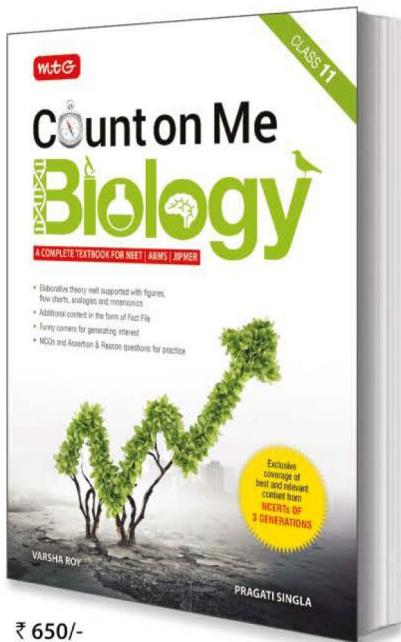
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