BIOLOGY WORK BOOK

CLASS - XII

State Council of Educational Research and Training
Govt. of Tripura

BIOLOGY WORK BOOK

Class - VIII

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রতন লাল নাথ
মন্ত্রী
শিক্ষা দপ্তর
ত্রিপুরা সরকার

বার্তা

শিক্ষার প্রকৃত বিকাশের জন্য, শিক্ষাকে যুগোপযোগী করে তোলার জন্য প্রয়োজন শিক্ষাসংক্রান্ত নিরন্তর গবেষণা। প্রয়োজন শিক্ষা সংশ্লিষ্ট সকলকে সময়ের সঙ্গে সঙ্গে প্রশিক্ষিত করা এবং প্রয়োজনীয় শিখন সামগ্রী, পাঠ্যক্রম ও পাঠ্যপুস্তকের বিকাশ সাধন করা। এস সি ই আর টি ত্রিপুরা রাজ্যের শিক্ষার বিকাশে এসব কাজ সুনামের সঙ্গে করে আসছে। শিক্ষার্থীর মানসিক, বৌদ্ধিক ও সামাজিক বিকাশের জন্য এস সি ই আর টি পাঠ্যক্রমকে আরো বিজ্ঞানসম্মত, নান্দনিক এবং কার্যকর করবার কাজ করে চলেছে। করা হচ্ছে সুনির্দিষ্ট পরিকল্পনার অধীনে।

এই পরিকল্পনার আওতায় পাঠ্যক্রম ও পাঠ্যপুস্তকের পাশাপাশি শিশুদের শিখন সক্ষমতা বৃদ্ধির জন্য তৈরি করা হয়েছে ওয়ার্ক বুক বা অনুশীলন পুস্তক। প্রসঙ্গত উল্লেখ্য, ছাত্র-ছাত্রীদের সমস্যার সমাধানকে সহজতর করার লক্ষ্যে এবং তাদের শিখনকে আরো সহজ ও সাবলীল করার জন্য রাজ্য সরকার একটি উদ্যোগ গ্রহণ করেছে, যার নাম 'প্রয়াস'। এই প্রকল্পের অধীনে এস সি ই আর টি এবং জেলা শিক্ষা আধিকারিকরা বিশিষ্ট শিক্ষকদের সহায়তা গ্রহণের মাধ্যমে প্রথম থেকে দ্বাদশ শ্রেণির ছাত্র-ছাত্রীদের জন্য ওয়ার্ক বুকগুলো সুচারুভাবে তৈরি করেছেন। ষষ্ঠ থেকে অষ্টম শ্রেণি পর্যন্ত বিজ্ঞান, গণিত, ইংরেজি, বাংলা ও সমাজবিদ্যার ওয়ার্ক বুক তৈরি হয়েছে। নবম দশম শ্রেণির জন্য হয়েছে গণিত, বিজ্ঞান, সমাজবিদ্যা, ইংরেজি ও বাংলা। একাদশ দ্বাদশ শ্রেণির ছাত্র-ছাত্রীদের জন্য ইংরেজি, বাংলা, হিসাবশাস্ত্র, পদার্থবিদ্যা, রসায়নবিদ্যা, অর্থনীতি এবং গণিত ইত্যাদি বিষয়ের জন্য তৈরি হয়েছে ওয়ার্ক বুক। এইসব ওয়ার্ক বুকের সাহায্যে ছাত্র-ছাত্রীরা জ্ঞানমূলক বিভিন্ন কার্য সম্পাদন করতে পারবে এবং তাদের চিন্তা প্রক্রিয়ার যে স্বাভাবিক ছন্দ রয়েছে, তাকে ব্যবহার করে বিভিন্ন সমস্যার সমাধান করতে পারবে। বাংলা ও ইংরেজি উভয় ভাষায় লিখিত এইসব অনুশীলন পুস্তক ছাত্র-ছাত্রীদের মধ্যে বিনামূল্যে বিতরণ করা হবে।

এই উদ্যোগে সকল শিক্ষার্থী অতিশয় উপকৃত হবে। আমার বিশ্বাস, আমাদের সকলের সক্রিয় এবং নিরলস অংশগ্রহণের মাধ্যমে ত্রিপুরার শিক্ষাজগতে একটি নতুন দিগন্তের উন্মেষ ঘটবে। ব্যক্তিগত ভাবে আমি চাই যথাযথ জ্ঞানের সঙ্গে সঙ্গে শিক্ষার্থীর সামগ্রিক বিকাশ ঘটুক এবং তার আলো রাজ্যের প্রতিটি কোণে ছড়িয়ে পড়ুক।

(রতন লাল নাথ)

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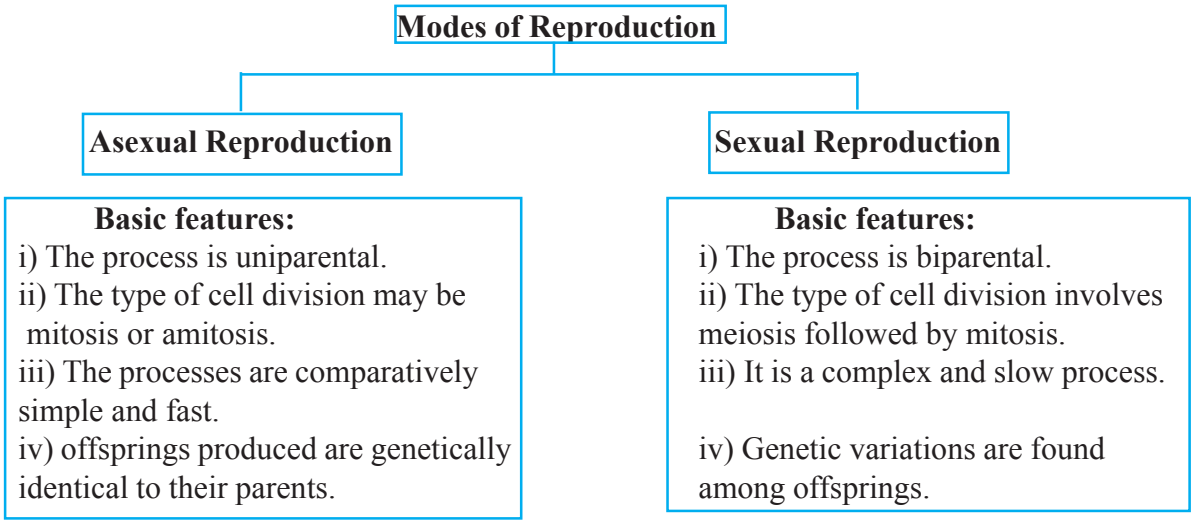
CONTENT

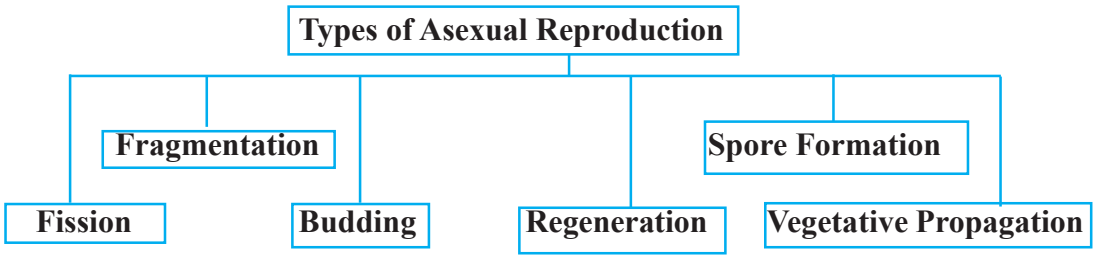
UNIT - VI CHAPTER - I

REPRODUCTION IN ORGANISMS

IMPORTANT CONCEPTS :

- **Reproduction** is a biological process by which living organisms can give rise to new organisms of their own kind.
- Physiological structure, environmental condition, habitat etc. are the several factors that determine the mode of reproduction for that organism.





- **Fission** is the process of splitting of parental cell into two (binary fission) or more (multiple fission) daughter cells. It is common among unicellular organisms like *Amoeba, Parameciam* (shows binary fission), Plasmodium (shows multiple fission) etc.
- In **fragmentation**, if the parental body breaks down finto fragments due to any enternal force then each fragment can develop into a new individual. It is observed among some algae (spirogyra), bryophyte (Riccia) etc.

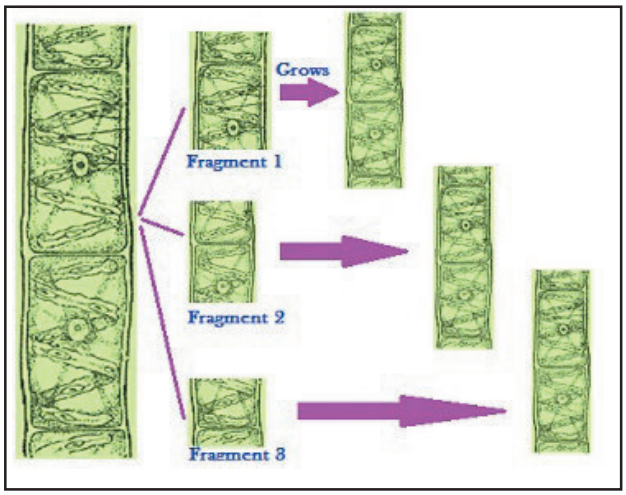


Fig. 1.1 - Fragmentation in spirogyra

- **Buds** are the small outgrowths produced on the surface of the parental cell, that depends on the parental organism during initial growth phase and eventually get separated to grow as a new individual. Example - Yeast, Hydra.
- **Regeneration** is the capacity of some adult organisms to reform new individuals or repair missing body parts from existing body parts through cell division and differentiation. Example - Planaria, Hydra, flatworm etc.

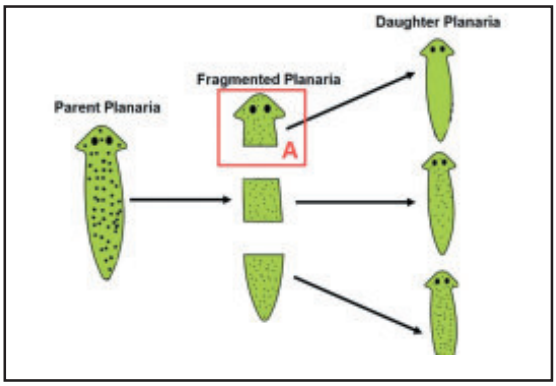
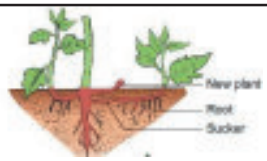
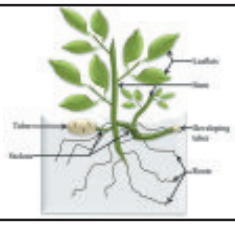
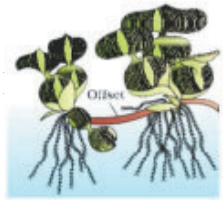
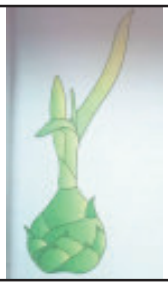
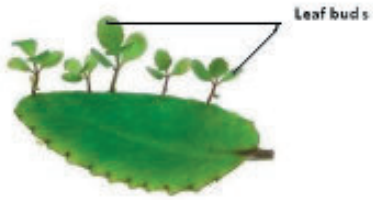


Fig. 1.2 - Regeneration in Planaria

- Spores are the asexual reproductive units that could be of different type;
  i) **Zoospores** - Flagellated, Motile spores produced by some algae like *Chlamydomonas*.
  ii) **Conidia** - Thick walled, non-motile spores produced by some fungi like *Penicillium*, *Aspergillus*.
  iii) **Gemmules** - Small, hard, ball-shaped, double layered structure produced by sponges.
- **Vegetative propagation** is a mode of reproduction in which new plants are produced from vegetatives parts like root, stem, leaf etc. of the mature plants. The units of vegetative propogation are known as vegitative propagulas are given below- Some examples of plants with their vegetative propagules.

Vegetative propogulas	Example of plants	Diagram
i) Runner	Oxalis	
ii) Rhizome	Ginger	
iii) Sucker	Mint	
iv) Tuber	Potato	
v) Offset	Water hyacinth	
vi) Bulb	Onion	
vii) Bulbil	Agave	

viii) Leaf Buds	Bryophyllum	

- **Sexual Reproduction** involves formation of male and female **gamets** by same or different individuals, followed by fertilisation, zygote formation and development of new individuals.
- Organisms have to pass through a phase of growth known as **juvenile phase** or **vegetative phase** (in case of plants) before attaining reproductative maturity.
- Mammals show two types of reproductive cycle during their reproductive phase of life. In non-primate mammals (cows, tiger, rats etc.) the female reproductive cycle is **oestrus cycle**. In case of primates (monkeys, apes, human etc.) the female reproductive cycle is **menstrual cycle**.
- Mammals that exhibit reproductive cycle only during favourable seasons or in a specific period of time in the year are considered as **seasonal breeders**. Example - Sheep, Tiger etc. Whereas, mammals that remain reproductively active throughout their reproductive phase of life irrespective of seasonal conditions are known as **continuous breeders**. Example - Human, Apes etc.
- Pre-fertilisation, fertilisation or syngamy and post-fertilisation are the three sequential stages of sexual reproduction.
- **Pre-fertilisation** involves the formation of male and female gametes (gametogenesis) and gamate transfer.
- If male and female gametes are morphologically similar then these are known as **homogamets or isogamets**. But when both the gametes are morphologically distinct then these are called **heterogametes**. For example, sperm and ovum.
- A single organism bearing both male and female reproductive structures is called **homothallic or monoecious**. Example - Pumpkin, Mango, Rice etc. In case of animals such bisexual condition is denoted by the term **hermaphrodite**. Examples of hermaphrodites are; earthworm, sponge, tapeworm etc.
- Organisms in which male and female gametes are produced by different individiuls, they are called **heterothallic or dioecious**. Example - Papaya, Date palm etc.

Facts to Remember

- Gametes are always haploid in nature.
- Haploid organisms produce gametes through mitotic division.
- In diploid organisms gametes are produced through meiosis division.

- In angiosperms, unisexual male flowers are called **Staminate flower** and unisexual female flowers are called **pistillate flower**.
- In majority of cases, male gametes are motile and female gametes remain static. Whereas, in case of some algae and fungi both male and female gamets are motile.
- Among algae, bryophytes and pteridophytes water acts as the medium for gamete transfer.
- In higher group of plants like angiosperms **pollination** facilitate the transfer of pollen grains from anther to stigma. Pollen grain carries the male gametes.
- Male and female gametes fuse (fertilisation) to form a diploid zygote. On the basis of the site of fusion fertilisation could be of two types; **internal fertilisation** and **external fertilisation**.
- In internal fertilisation, fusion of male and female gamete takes place inside the body of female organism. It occur is birds and mammals. Whereas in external fertilisation, both the gametes fuse in enternal medium like water, i.e., outside the female body. Organisms like fishes and frogs show external fertilisation.
- Animals showing external fertilisation produce much more number of gametes than the animals having internal fertilization to enhance the chances of fertilisation, as the total process and even the newly produced offsprings are extremely vulnerable to environmental stresses and predators.
- In some organisms like rotifers, honeybees and in some lizards and birds (turkey) it is observed that the female gamete undergoes development without fertilisation to form new organisms. This phenomenon is known as **parthenogenesis**.
- During embryogenesis zygote undergoes cell division and cell differentiation, leading to the development of the new individual.
- Based on the whether the embryogenesis takes place outside the mother body or inside, animals can be classified into **oviparous** and **viviparous** respectively.
- Oviparous animals like amphibians, reptiles, birds etc. lay fertilised or unfertilised eggs, whereas viviparous animals i.e., mammals give birth to young ones. So the chances of survival of offsprings are more among viviparous animals.
- In angiosperms, fertilisation and zygote formation takes place inside the **ovule**. The zygote gradually develops into **embryo** and the ovule become **seed**. Simultaneously, the ovary starts converting into a **fruit**.
- The outermost protective covering of fruit is called **pericarp**.

CHAPTER BASED QUESTIONS

A) Objective questions. **(1 mark)**

i) Choose the most appropriate option from the following:

1. *Hydra* asexually reproduce through -
   a) fission b) Fragmentation c) Budding d) Spore formation

2. Number of individuals produced at the end of binary fission is -
   a) Two b) Four c) One d) Eight

3)Spores produced by *Penicillium* are known as -

a) Zoospores b) Conidia c) Endospore d) None of these

4) Vegetative propagation by offset occurs in -

a) Water Hyacinth b) Oxalis c) Ginger d) Agava

5) Which of the following is a pre-fertilisation event ?

a) Syngamy b) Gametogenesis c) Embryogenesis d) None of these

6) In angiosperms, the period of growth between germination of seed and initiation of flowering is termed as -

a) Juvenile phase b) Reproductive phase c) Vegetative phase d) Both 'a' and 'c'

7) Organism that exhibit enternal fertilisation-

a) Earthworm b) Crow c) Lizard d) Frog

8) During fission, the parent cell divides through-

a) Mitosis b) Amitosis c) Meiosis d) none of these

9) Water is the medium of gamete transfer in-

a) Algae b) Bryophytes c) Pteridophytes d) All of these

10) Human beings are-

a) Seasonal breeder b) Continuous breeder c) Both of these d) None of these

11) Chances of survival of offsprings are comparatively less among-

a) Oviparous animals b) Viviparous animals c) Ovoviparous animals d) None of these

12) In angiosperms, the transfer of pollen graines from anther to stigma is known as-

a) Syngamy b) Parthenocarpy c) Embryogenesis d) Pollination

13) Which of the following can propagate through their leaf-

a) *Bryophyllum* b) *Agave* c) Potato d) Onion

14) Sponge asexually reproduced through-

a) Regeneration b) Conidia c) Zoospore d) Gemmules

15) Which of the following is an example of hermaphrodite ?

a) Cockroach b) Lizard c) Earthworm d) Butterfly

Questions from 16-18 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 but R is not the correct explanation of A.

c) A is true but R is false.

d) Both A and R are false.

16. Assertion (A) : Zygote is formed due to the fusion of male and female gametes.

Reason (R) : Formation of male and female gemete is a post fetilization event.

17. Assertion (A) : External fertilization takes place in the uterus of female parent.

Reason (R) : In organisms exhibiting external fertilization, gements are formed in a very limited numbers.

18. Assertion (A) : In vegetative reproduction, a new plant grows from a frugment of the parent plant.

Reason (R) : Vegetative reproduction in Agava Occurs through bulbils.

ii) Fill in the blanks:

1. Development of unfertilised egg into a new individual is called _____.
2. Gametogenesis and gamete transfer are _____ events.
3. In primates the reproductive cycle is known as _____ cycle.
4. Earthworm, tapeworm etc. are _____ animals.
5. In case of plants the term _____ propagation is used instead of asexual reproduction.
6. _____ results in the formation of zygote.
7. In birds, the fertilised eggs remain covered by_____ shell.
8. After fertilisation _____ develops into seed.
9. In angiosperms, the unisexual male flowers are known as _____ flower.
10. _____ are microscopic, motile spores produced by some algae.

B) Very short answer type question:

1. Name one organism in which chain buds are formed.
2. Name two dioecious plants.
3. Name the type of reproductive cycle observed among cats and dogs.
4) what are gametes ?
5) In which type of organisms both male and female gametes show motality?
6) Write one example of bird that shows parthenogenesis.
7) What is the ploidy of zygote ?
8) Name an algae that reproduce asexually through zoospore formation.
9) If the chromosome number of a diploid organism is 24, then what will be the chromosome number in the gametes produced by it ?
10) Name the mode of reproduction that helps in producing genetically identical offsprings.
11) Name the vegetative propagule of *Agave*.

12) Which plant is also known as 'Terror of Bengal' ?
13) Name the mode of reproduction that ensures variation among offsprings.
14) What marks the end of vegetative phase in flowering plants ?
15) Write two examples of animals that exhibit menstrual cycle.
16) Name the cell that is responsible for the development of new individual without fertilisation in honeybees.
17) Mention the site where syngamy occurs in case of fishes and amphibians.
18) What is pericarp ?
19) Name the type of cell division that takes place during gametogenesis among diploid organisms.
20) Where zygote is formed in a flower ?

QUESTION WITH SAMPLE ANSWER

C) Short answer type question. **(2 marks)**

1. Why do algae and fungi shift to sexual mode of reproduction just before the onset of adverse environmental condition ?

Answer: Algae and fungi shift to sexual mode of reproduction for survival during unfavourable conditions. Fusion of gamets helps them to pool their resources for survival. The zygote develops thick wall which is resistant to dessication and damage and can undergo for a period of dormancy until conditions become favourable.

D) Short answer type question. **(3 marks)**

1. Define external fertilisation. Mention its disadvantages.

Answer: The fertilisation in which fusion of both the gametes occur in external medium, outside the body of female individual is known as external fertilisation.

Disadvantages of external fertilisation:

i) A large number of gametes are produced to ensure fertilisation, thus there is wastage.

ii) The offsprings produced are in greater chance of extinction due to environmental stresses and predation.

Do it Yourself

A) Short answer type questions. **(2 marks)**

1. Unicellular organisms are immortal. whereas multicellular organisms are not. Justify. (2)
2. Mention one similarity and one difference between conidia and zoospore. (1+1)
3. What are continuous breeders? Give examples. (1+1)
4. Name any two organisms and the phenomenon, where the female gamete undergoes development to form new organisms without fertilisation. (1+1)

5. Reptiles and frogs, both are oviparous animals; but they differ in certain aspects of reproduction. What are the differences. (2)
6. What are vegetative propagules? Name the vegetative propagules of onion and ginger. (1+ ½ + ½)
7. How do the following organisms reproduce asexually-
(a) Yeast (b) *Spirogyra* (c) Sponge (d) *Hydra* (½×4)
8. What are meiocytes ? What about the ploidy of a meiocyte ? (1+1)
9. Write one advantage and one disadvantage of sexual reproduction. (1+1)
10. Why higher organisms adopted sexual reproduction inspite of its complexity ?

B. Short answer type questions. **(3 marks)**

1. Differentiate between oestrus cycle and menstrual cycle. (3)
2. The type of cell division involved in gamete formation is not of the same type in all organism. Why ? (3)
3. Show the process of binary fission in Amoeba with the help of diagrams. (3)
4. What is meant by the terms 'homothallic' and 'heterothallic'. Illustrate with an example for each. (1+1+½+½)
5. State the advantages of asexual reproduction over sexual reproduction. (3)
6. What is internal fertilisation ? Why the organisms having internal fertilisation produce less number of gemetes than the organisms having external fertilisation ?

Long answer type questions : **(5 marks)**

1. List out the differences between sexual and asexual reproduction. Briefly describe any three methods of asexual reproduction that are observed among unicellular organisms. (2+3)
2. What is syngamy ? Is there any difference between syngamy and fertilisation ? If yes, justify. Write a short note about the post fertilisation events observed among angiosperms. (1+2+2)
3. On the basis of the occurance what are the types of fertilisation ? Define each type. Make a difference between zygote and zoospore. (1+2+2)
4. What is the significance of staminate and pistillate flowers, compared to bisexual flowers ? What is pollination ? Which term is used to indicate the bisexual condition of animals ? Give examples of two bisexual animal. (2+1+1+1)

TEACHER'S NOTE

- Refer paragraph 1.1 of page no. 5 to 6 of NCERT textbook for answering Question no. A.1 and 2.
- Refer paragraph 1.2.2 and 1.2.3.2 of page no. 14-15 and 15-16 respectively of NCERT textbook for answering Question no. A.5.
- Refer paragraph 1.2.2 of page no. 14 - 15 of NCERT textbook for answering Question no. B.6.
- Refer paragraph 1.1 of page no. 5 - 6 of NCERT textbook for answering Question no. C.1.

ANSWER TO THE CHAPTER BASED QUESTIONS

A) Objective questions.

i) 1. c) Budding 2. a) Two 3. c) Conidia 4. a) Water Hyacinth
5.b) Gametogenesis 6. c) Vegetative phase 7. d) Frog 8.b) Amitosis
9. d) All of these 10. b) Cntinuous breeder 11. a) Ovipaous animals
12. d) Pollination 13) a) Bryophyllum 14. d) Gemmules 15. c) Earthworm

ii) 1. Parthenogenesis 2. Pre-fertilisation 3. Menatrual 4. Bisexual
5. Vegetative 6. Fertilisation 7. Calcareous 8. Ovule 9. Staminate
10. Zoospores

iii) a - iii), b - i), c- v), d - ii), e - iv)

B. Very short answer type questions.

1. Yeast 2. Papaya and date palm 3. Oestrus cycle 4. Units of sexual reproduction
5. Algae and fungi 6. Turkey 7. Diploid 8) chlamydomonas 9. 12
10. Asexual reproduction 11. Bulbil 12. Water Hyacinth 13. Sexual reproduction
14. Blooming 15. Human and Ape 16. Egg cell 17. Water 18.
The outermost thick, Protective covering of fruit 19. Meiosis 20. Ovule.

UNIT-VI CHAPTER-2

SEXUAL REPRODUCTION IN FLOWERING PLANTS

IMPORTANT CONCEPTS

- Angiosperms are also known as flowering plants, as they develop flowers at the end of their vegetative phase. Flowers are sexual reproductive structure carrying male and/or female reproductive parts.
- In a flower, four whorls of two different types carry all the parts and remain attached to a central axis called **thalamus.** The different parts of a complete flower are as follows:

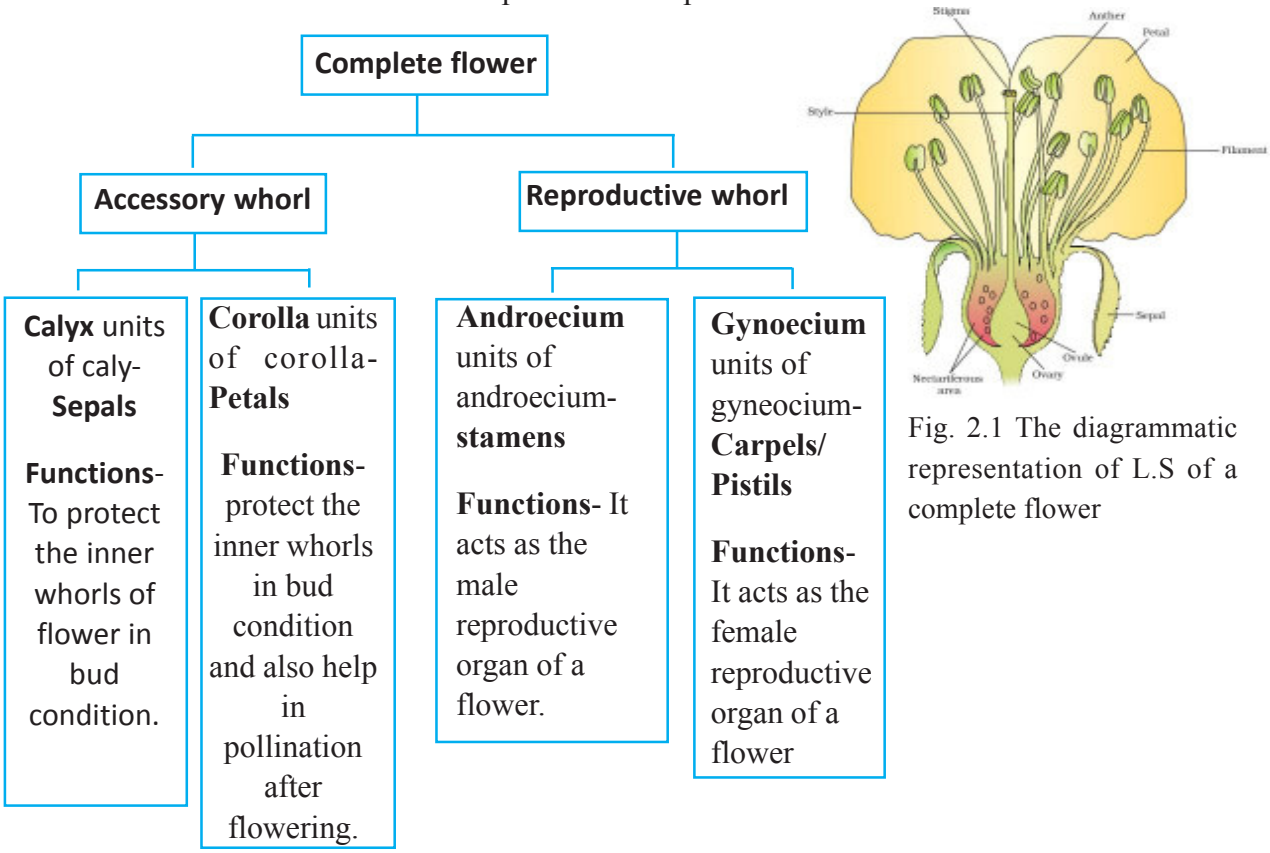


Fig. 2.1 The diagrammatic representation of L.S of a complete flower

- A typical stamen has a long, slender stalk called **filament** and a terminal bilobed structure called **anther**. Anther is the site of pollen grain synthesis.
- Pistil consist of **stigma, style** and **ovary**. Stigma functions as receptive surface of pollen grain. The elongated slender part beneath the stigma is known as style, through which pollen tube grows and reaches to the ovule present in ovary, the basal swollen part of pistil.

- Anther is a tetragonal, **bilobed** and **dithecous** structure, consisting of four microsporangia. The transverse section of a young anther reveals that each theca contains one microsporangia that remain surrounded by four walls i.e, **Epidermis** (outermost protective layer) , **Endothecium** (second layer of thick cells that is protective in nature), **Middle Layer** (third protective layer made of 1-3 layers of cells) and **Tapetum** (innermost layer that provide nourishment to the developing pollen grains).

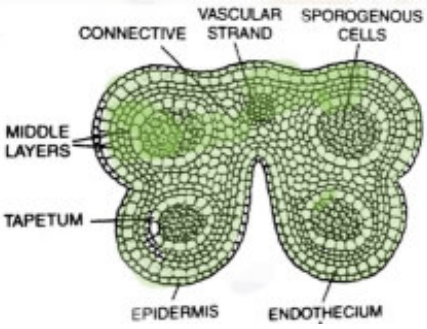


***Fig. 2.2** T.S of a young another*

- The centre of each microsporangium remain filled with **sporogenous cells**.
- Each sporogenous cell is known as **pollen or microspore mother cell** as they can divide meiotically to form microspore tetrad through the process **micrsporogenesis**. Each microspore develop into a pollen grain with further maturation of anther.
- Pollen grains i.e, the male gametophytes of angiosperms are generally spherical in structure.
- Pollen grains have double layered wall around it; the outer **exine** and inner **intine**. Exine is made up of **sporopollenin** which is one of the most resistant organic material present in nature. Intine is made up of **cellulose** and **pectin**.

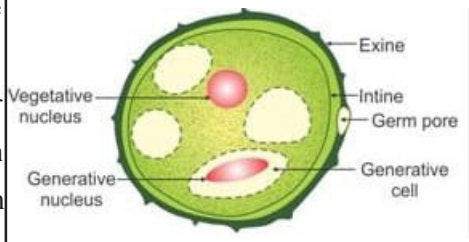


Fig. 2.3 A mature poller grain

- Pollen grain exine has an aperture known as **germ pore**, where sporopollenin remain absent.
- A mature pollen grain contains two unequal cells i.e, a bigger **vegetative cell** that is rich in food reserve and have a large irregularly shaped nucleus and a smaller spindle shaped **generative cell** with dense cytoplasm and a nucleus. This is known as **2-celled stage** of pollen grain.
- In majority of angiosperms pollen grains are released from anther in 2-celled stage. In some species **the generative cell of the pollen grain divides mitotically to form two male gametes** before releasing from the anther. This is known as **3-celled stage** of pollen**.**
- Pollen grains of some species like **Partherium** or carrot grass can cause pollen allergy.
- Pollen grains are nutrient rich and thus used as food supplements in the form of tablets and syrups.
- Pollen grains can be stored in liquid nitrogen at -196^{o}C for several years and can be used later on in breeding programmes.
- The gynoecium of a flower may have single pistil **(monocarpellary)** or more than one pistil **(multicarpellary).**

  In case of more than one, pistils may be fused **(syncarpous)** or free **(apocarpous).**
- The ovary of a pistil have one or more compartments called ovarian cavity that carry **placenta**.

- Ovules or magasporangium arise from this placenta.
- Ovule remain attached to the placenta through a stalk called **funicle**.
- The junction between ovule and funicle is known as **hilum**.
- Each ovule has one or two protective envelops i.e, **integuments** except at the tip resulting in a small opening called **micropyle**.
- **Chalaza** represent the basal part of the ovule.
- A mass of cells with abundant reserve food material that remain enclosed within the integument is known as **nucellus**.
- The female gametophyte or embryo sac remain located within the nucellus and receive nutrients from it.

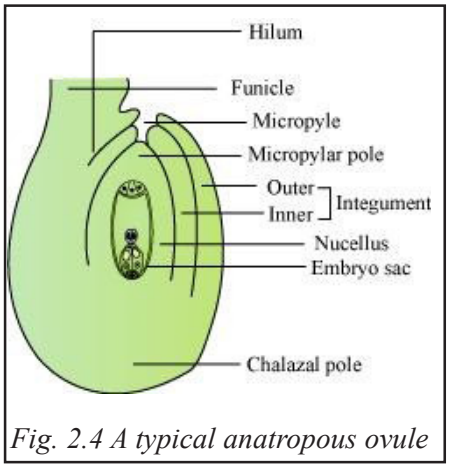


Fig. 2.4 A typical anatropous ovule

- Female gametophyte develops from **megaspore mother cell (MMC)** through the process of **megasporogenesis** and **megagametogenesis.**
- The diploid megaspone mother cell undergoes through reduction division (meiosis) to form **megaspore tetrad**. But in majority of angiosperms out of these four megaspores only one remain functional to form embryo sac. This is known as **monosporic embryo sac development.**
- **Megaspore is the first cell of female gametophyte**. The nucleus of the functional megaspore mitotically divide to form two nuclei, that move to the opposite poles of the embryo sac. These two nuclei again undergo through sequential mitotic divisions to form the 8-nucleate stage.
- Six of the eight nuclei are organised into cells and arrange themselves in micropylar and chalazal pole as groups of three cells, i.e, **egg apparatus** and **antipodals** respectively.
- The remaining two nuclei called **polar nuclei** are situated in the large central cell.

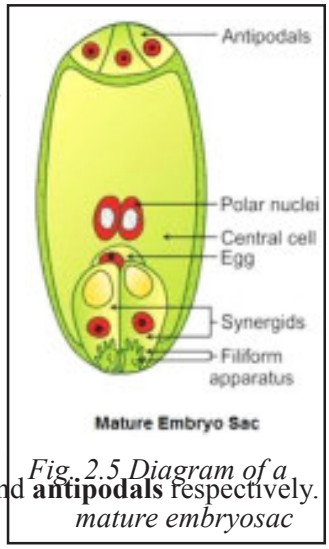
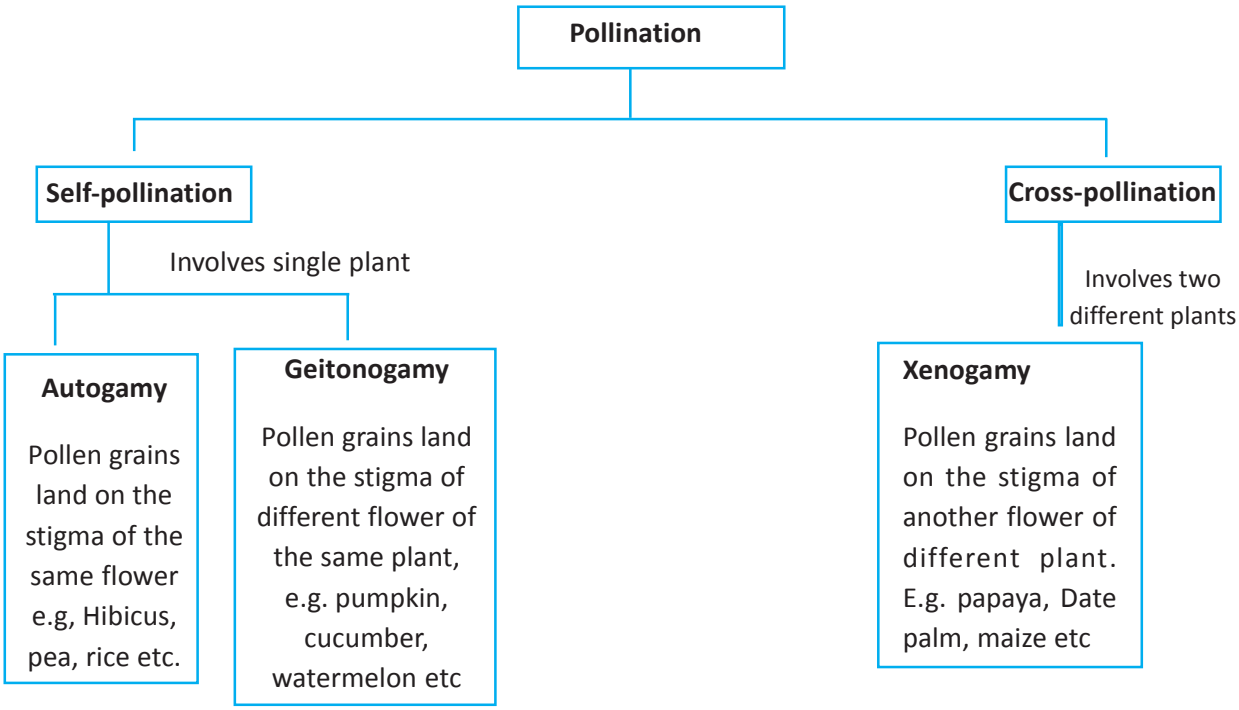


Fig. 2.5 Diagram of a mature embryosac

- In the egg apparatus, the largest middle cell is the **egg cell** and the other two adjoining cells are **synergids**.
- Synergids have special thickening at the micropylar tip called **filiform apparatus** which guide the entry of pollen tube into the synergids.
- Pollination is the release of pollen grains from anther followed by their deposition over stigma. Depending upon the sources of pollen grains pollination could be of three types.



♦ In some plants like **Viola, Oxalis** and **Commelina, two types** of flowers are produced. One is **Chasmogamous flower** that is similar to other flowers with exposed anthers and stigma and the second is cleistogamous flower which are bisexual closed flowers that never open at all. **Cleistogamous flowers** are compulsarily autogamous.

♦ Pollen grains are carried out to the stigma through pollinating agents. Flowers are also adapted differentially with respect to their pollinating agents.

Type of agent	**Agents of pollination**	**Adaptive characters of plants**	**Examples**
Abiotic agents	**Wind**	i)Pollen grains are light weight, non-sticky, dry and often winged. ii)Stamens are well exposed in air iii)Large stigma with sticky surface or often feathery to trap pollen grains. iv)Numerous flowers are packed into an inflorescence,	Grasses, Maize, Rice etc.

	Water	i)Pollen grains are long, ribbon like and are carried passively by water. ii)Pollen grains remain protected by mucilage covering. iii)Flowers are not very much colourful and do not produce nector.	Hydrilla, Vallisneria
Biotic agents	**Insects, Birds, Bats, Snail, Ants etc.**	i) Flowers are large brightly coloured. ii) Flowers have nectar glands and can secret fragrance. iii) The surface of the pollen grain is sticky or spiny. iv) Surface of stigma is also sticky due to mucilaginous secretion.	Euphorbia, Bigonia, Mango, Litchi etc.

- A successful pollination followes germination of pollen grains and development of pollen tube through style. On reaching one of the synergid through micropyle pollen tube releases two male gametes into cytoplasm of synergid. **Filiform apparatus guide the entry of pollen tube.**
- One of the male gametes moves towards the egg cell and fertilise to form **Zygote.**
- The second male gamete fuses with polar nuclei to produce a **triploid (3n) primary endosperm nucleus (PEN)**. As three haploid nuclei fuses to form PEN, hence it is known as **triple fusion**.
- An fertilisation and triple fusion occur simultaneously in the embryo sac, the phenomenon is termed as **double fertilisation**.
- After triple fusion central cell becomes **primary endosperm cell (PEC)** and develop into **endosperm**. Whereas the zygote develops into an **embryo**.
- Many flowering plants have developed **outbreeding devices** to discourage self-pollination. Some outbreeding devices are-
  - Unsynchronised pollen release and stigma receptivity.
  - Different positioning of anther and stigma.
  - Self-incompatibility

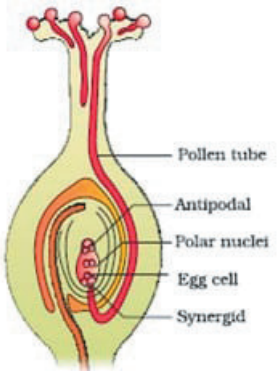


Fig 2.6 L.S of pistil showing entry of pollen tube into the embryo sac

- Production of unisexual flowers

♦ **Pollen-pistil interaction** is a dynamic process of compatible pollen recognition by stigma or pistil. Incompatible pollens or sterile pollens are not allowed to grow pollen tube and thus rejected by the pistil.

♦ **Artificial hybridisation** is a commonly used technique in plant breeding programme. To ensure pollination only by using desired pollen grains **emasculation** and **bagging** techniques are used.

♦ In emasculation anthers are removed or made sterile before dehiscence. After that the emasculated flower is covered with paper bag to prevent pollination by unwanted pollens. This is known as bagging. When bagged flower attains maturity it is pollinated artificially and rebagged.

♦ The events that take place after fertilisation are collectively known as post fertilisation events. These are as follows :

- Development of endosperm from PEN; The PEN undergoes successive nuclear divisions to develop free nuclear endosperm. This division is followed by cytokinesis and thus develop cellular endosperm.
- Development of embryo from zygote; The zygote divides mitotically to form proembryo which later on forms mature embryo.
- Development of seeds from ovule
- Development of fruit from ovary

♦ In dicots during embryo development the zygote divides transversely forming a large basal cell and small terminal cell. The basal cell again transversely divides to form 6-10 celled suspensor. The first cell of the suspensor towards micropyle is the haustorium and the last cell towards chalaza is the hypophysis that develops into radicel.

♦ The small terminal cell forms a 8-celled proembryo (octant) through vertical and transverse divisions. Out of these 8 cells four cells at the apex form the epicotyl which give rise to plumule and the other four cells develop into hypocotyls, that form the radicel or root tip. Epicotyl and hypocotyl together form the embryonal axis and the empryonal axis along with two cotyledons form the embryo.

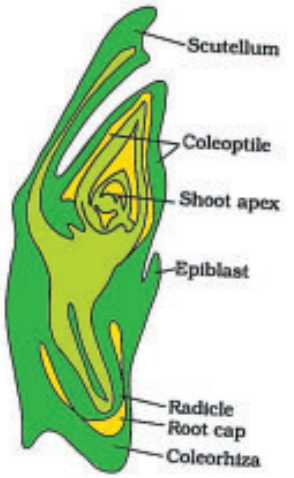


Fig 2.7 L.S of a monocot embryo

■ ¨ A typical monocot embryo consist of embryonal axis and one cotyledon called **scutellum**. An undifferentiated sheath called **coleorhiza** encloses the radicel and root cap at the lower end of embryonal axis. The shoot open and few leaf primordia remain present in the epicotyl region within a hollow foliar structure called coleoptile.

■ Embryonal axis, cotyledon and seed coat together forms a seed. The outer side of seed coat is testa and the inner side is known as tegmen.

- Seeds could be of two types on the basis of presence or absence of endosperm in it. If a seed retain endosperm after embryo development then it is known as albuminous seed. Example wheat, maize, sunflower etc. Whereas the seeds without leaving any endospermic content after embryo development, is known as non-albuminous seed. Example – pea, groundnut etc.
- In some seeds the nucellus may remain persistant. Such persistant nucellus is known as perisperm.
- Simultaneously with the maturation of seed **ovary develops into fruit** and the ovarian wall develops into the wall of fruit i.e, **pericarp**.
- Fruits may be fleshy like mango, orange etc. or may be dry like groundnut, mastard etc.
- In some species like apple, cashew, strawberry etc. the thalamus of flower also contribute in fruit formation along with the ovary. Such fruits are called **false fruit**. On the other hand the fruits that develop only from ovary are known as **true fruit**. Example- mango, rice, pea etc.
- Fruits that develop without fertilisation are known as **parthenocarpic or seedless fruit**. Parthenocarpy can be induced artificially by using growth hormones. As example of natural pathenocarpic fruit is banana.
- In flowering plants, another special phenomenon is observed where seed is formed without fertilisation either due to formation of diploid egg without meiosis division or may due to the development of diploid nucellus cells into embryo. This phenomenon is known as **apomixis**. It is common among the members of Asteraceae, grasses, citrus fruits etc.
- Among many varieties of citrus fruits it is observed that a seed carries more than one embryo. This condition is known as **poly embryony**. There are several reasons behind polyembryonic seed formation, such as-

Ø Development of cells of nucellus, integument, synergids etc. into embryo.

Ø Presence of more than one embryo sac within an ovule.

Ø Presence of more than one egg cell in an embryo sac.

CHAPTER BASED QUESTIONS

[A) Objective questions.(1 mark)]

I) Choose the most appropriate option from the following:

1. Which of the following plants produce unisexual flowers?
   a) Banana b) Papaya c) Rice d) None of the above
2. The fine dust like particles produced within the anther are known as
   a) Pollen grains b) Egg cell c) Tapetum d) Sperms
3. Within a fertilized embryo sac the haploid, diploid and triploid structures are –
   a) Synergid , antipodal and zygote b) Synergid, zygote and PEN

c) Antipodal, polar nuclei and zygote d) Zygote, PEN and polar nuclei

4. Choose the correct statement from the following –
   a) Chasmogamous flowers are always autogamous
   b) Cleistogamous flowers are exhibit xenogamy
   c) Cleistogamous flowers cannot perform autogamy
   d) Chasmogamous flowers exhibit both self and cross pollination
5. In a bisexual flower autogamy can occur if-
   a. Pollen grains dehisces before maturity of ovule
   b. Both pollen grains and ovules mature simultaneously
   c. Ovules mature before maturity of anther
   d. Stamen and pistil are of differential length
6. In angiosperms embryo sac represents-
   a) Female gametophyte b) Male gametophyte c) Sporophyte d) Both (a) and (b)
7. In anther meiosis occurs in -
   a) Endothecial cells b) Tapetal cells c) Pollen mother cells d) Epidermal cell
8. An organic substance that can withstand environmental stresses and are not degraded by any enzyme is-
   a) Sporopollenin b) Lignin c) pectin d) Chitin
9. The edible part of coconut is-
   a) Embryo b) Pericarp c) Endosperm d) Endocarp
10. Which one of the following statements is wrong?
    a. Vegetative cell is larger than generative cell
    b. The nuclei of generative cell divides to form male gametes
    c. Pollen grains can shed in two-celled condition
    d. Exine of pollen is made up of cellulose and pectin
11. Apomictic embryos in citrus arise from –
    a) Cells of nucellus b) Central cell c) Antipodal cells d) None of these
12. Autogamy and geitonogamy both are not possible in –
    a) Rice b) Cucumber c) Papaya d) Lotus
13. Insect pollinated flowers are-
    a) Large with bright coloured petals
    b) Small with light weight, non-sticky pollen grains
    c) Large with feathery stigma
    d) Both (a) and (c)

14. Transfer of pollen grains from the anther to the stigma of another flower of another plant is called-

a) Autogamy b) Xenogamy c) Plasmogamy d) Geitonogamy

15. Plumule and radicle generate from the-

a) Endosperm b) Embryo c) Cotyledon d) Testa

16. The units of androecium are-

a) Stamen b) Pistil c) Sepal d) Petal

17. Pericarp of fruit gets developed from-

a) Ovule b) Funicle c) Placenta d) Ovarian wall

18. Each pollen grain forms-

a) One haploid male gamete

b) Two haploid male gametes

c) Two diploid male gametes

d) One diploid male gametes

19. Indentify the connect sequence of female gametophyte formation-

a) Megaspore mother cell, megaspore tetrad, megaspore, female gametophyte

b) Megaspore, Megaspore mother cell, megaspore tetrad, female gametophyte

c) Megaspore mother cell,megaspore tetrad, female gametophyte, Magaspore

d) Megaspore mother cell, megaspore, megaspore tetrad, female gametophyte

Questions from no. 20 to 23 consist of two statements- Assertion (A) and Reason (R).
Answer these questions selecting the appropriate option given below:-

(a) Both the A and R are true and R is the correct explanation of A.

(b) Both the A and R are true and R is not the correct explanation of A.

(c) A is true but A is false.

(d) Both the A and R are false.

20. **Assertion (A)** : Commelina shows cleistogamy.

Reason (R) : This reduces chances of inbreeding.

21. Assertion (A) : Sexual reproduction is a slower process than the methods of asexual reproduction.

Reason (R) : Sexual reproduction involves gametogenesis and fertilisation.

22. Assertion (A) : The megaspore mother cell (MMC) divide mitotically to produce four megaspores.

Reason (R) : Both the megaspore mother cell and megaspores are diploid in nature.

23. Assertion (A) : Unisexual flowers require pollinating agents for xenogamy.

Reason (R) : Autogamy does not lead to variation.

II. Fill in the blanks:

1. The stalk of the ovule is called_____
2. The exine of pollen grain is made up of _____
3. A bisexual flower that never opens, is called_____
4. Among monocots, the single cotyledon is called_____
5. In apple, the _____ also contribute to fruit formation and becomes edible.
6. Occurrence of more than one embryo in a seed is known as _____
7. _____ is a hollow foliar structure that encloses the leaf primordia in a grass embryo.
8. A typical embryo sac is _____ celled as 8 nucleate.
9. _____ is an example of natural parthenocarpic fruit.
10. A single pollen grain produces _____ male gametes.

[B. Very short answer type question]

1. How many microspore mother cells would be required to produce two hundred pollen grains?
2. What are germ pores?
3. Give an example of a flowering plant which came into India as a contaminant and can cause pollen allergy.
4. Name the protective envelops of an ovule.
5. Name the three haploid cells at the chalazal end of the embryo sac of angiosperms.
6. Name the two types of bisexual flowers produced in *Commelina* .
7. Give the technical term for the type of pollination that occur between different flowers of the same plant.
8. Name the part of the flower, which the tessels of the corn cob represent.
9. How are the pollen grains remain protected from welting by water, in case of hydrophily?
10. Name the part of flower that contribute to fruit formation in mango.
11. Name the mechanism responsible for the formation of seed without fertilisation in angiosperms.
12. Name the structure in the embryo sac that guides the entry of pollen tube into it.
13. Name the type of pollination in self incompatible plants.
14. What are the abiotic agents of pollination?
15. Which part of flower acts as the landing platform for pollen grains?
16. Which cell of male gametophyte produces the male gametes?
17. How many embryo sacs are formed in an ovule?
18. Name the part of pistil that determines the compatible nature of pollen grain.
19. Name the three haploid nuclei that involve in the formation of PEN.
20. Name the two layers of seed coat.

QUESTION WITH SAMPLE ANSWER

C) Short answer type question **(2 mark)**

1. Mention any two out breeding devices developed by flowering plants.

Answer: i) Production of unisexual flowers by dioecious plants.

ii) Unsynchronised pollen release and stigma receptivity i.e., either the anther release pollen before maturation of pistil or pistil mature first before anthers.

D) Short answer type question **(3 marks)**

1. Where does triple fusion take place in a flowering plant? Why is it so called? Mention its significance

Answer: Triple fusion takes place in the central cell of the embryo sac of the ovule.

It is so called because it involves fusion of three nuclei i.e., two polar nuclei and a male gamete. As a result of triple fusion a triploid primary endosperm nucleus forms that later on develops the endosperm, to provide nourishment to the developing embryo.

DO IT YOURSELF

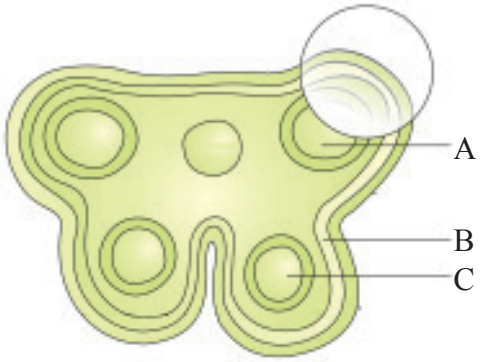
A) Short answer type questions. **(2 marks)**

1. What is bagging technique? How is it useful in plant breeding? (1+1)
2. List out two advantages of cross – pollination. (2)
3. What is false fruit? Why apple is considered as a false fruit? (1+1)
4. What do you understand by monosporic embryo sac development ? (2)
5. Mention two differences between chasmogamous and cleistogamous flowers. (2)
6. Suppose the chromosome number of a flowering plant is 2n=24. So, what will be the chromosome number of the zygote, PEN, synergid and antipodal cells developed within the embryo sac. (1/2 x 4)
7. What is the location and function of tapetum in the microsporangium of angiosperms? (1+1)
8. *Papaver* and *Michelia* both have multicarpellary ovaries. How do they differ from each other?(2)
9. Where is sporopollenin present in plants? Write its significance with reference to its chemical nature. (1+1)
10. Mention the reasons for difference in ploidy of zygote and primary endosperm nucleus in angiosperms. (2)

B) Short answer type questions(3 marks)

1. Briefly describe the structure of a mature pollen grain with labelled diagram. (1+2)

2. Identify A, B and C from the given diagram. (1+1+1)



3. List out any three adaptive characters of wind pollinated flowering plants. (3)
4. Explain the process of emasculation and bagging. Is emasculation essential for unisexual flowers? justify yours answer. (2+1)
5. Draw a diagram of a vertical section of an anatropous ovule of an angiosperm and label the following parts- a) Hilum b) Nucellus c) Micropyle and d) inner integument (1+1/2x4)
6. What is apomixis ? How is it beneficial to the farmers? (1+2)
7. Mention at least three advantages that the seeds offer to angiosperms.
8. What is the function of nucelus? Mention the differences between perisperm and endosperm

C) Long answer type questions. (5 marks)

1. A mature lady finger contains 20 viable seeds produced through sexual reproduction Baded on this information answer the following question with reasons:

a. How many ovules are minimally involved in the reproductive process?
b. How many megaspore mother cells are minimally required for megasporogenesis ?
c. How many pollen grains were minimally involved in pollination?
d. In total how many male gametes undergo through fertilization?
e. How many microspore mother cells are minimally required to produce required number of pollen grains? (1X5)

2. Draw and lebel the longitudinal sectional view of a post pollinated pistil showing the entry of pollen tube into the embryo sac. At the end of sexual reproduction what is the fate of ovule and ovary? (3+2)
3. Briefly describe the steps of a monocotyledonous embryo development. What embryo development always occurs after endosperm development? (3+2)
4. Why the process of fertilization in angiosperms is known as double fertilization? Explain . Write the full form PEC and PMC (3+2)

TEACHERS' NOTE

For answering the Q) A) 6. Must mention the ploidy of each type of cells and then calculate the chromosome number accordingly.

For example, the ploidy of synergid is n(haploid), so the chromosome number will be 24/2=12 ·

Refer figure 2.7 (b) and (c) of NCERT textbook for answering Q)A) 8. ·

Refer paragraph 2.3 of NCERT textbook for answering Q)A) 10. ·

Refer paragraph 2.5 of NCERT textbook for answering Q)B) 6. ·

Refer paragraph 2.4.3 of NCERT textbook for answering Q)B) 7. ·

Hints for the Q)C)1- One microspore mother cell produces four pollens, Each pollen produces two male gametes for double fertilization, one ovule produce one embryo sac from one MMC, A single embryo sac requires a single pollen to get fertilised.

ANSWERS TO THE CHAPTER BASED QUESTIONS

Objective questions:

I) 1.b) Papaya 2.a) Pollen grains 3.b) Synergid, zygote and PEN
4.d) Chasmogamous flowers exhibit both self and cross pollination
5.b) Both pollen grains and ovules mature simultaneously
6.a) Female gametophyte 7.c) Pollen mother cells 8.a) Sporopollenin
9.c) Endosperm 10.d) Exine of pollen is made up of cellulose and pectin
11.a) Cells of nucellus 12.c) Papaya 13.a) Large with bright coloured petals
14.b) Xanogamy 15.b) Embryo 16.a) Stamen 17.d) Ovarian wall
18.b) Two haploid male gametes 19.a) Megaspore mother cell, megaspore tetrad, megaspore, female gametophyte 20.c) A is true but R is false 21.a) Both the A and R are true and R is the correct explanation of A 22.d) Both the A and R are false 23.Both the A and R are true but R is not the correct explanation of A

II) 1. Funicle 2. Sporopollenin 3. Cleistogamous 4. Scutellum 5. Thalamus 6. Polyembryony 7. Coleoptile 8. Seven(7) 9. Banana 10. Two(2)

B) Very short answer type questions.

1. Fifty (50) 2. Germ pores are those places on a pollen grain where sporopollenin remains absent. 3. *Parthenium* 4. Inner integument and outer integument 5.Antipodal cells 6.Chasmogamous and cleistogamous flower 7. Geitonogamy 8. Stigma and style of pistil 9.By a mucilaginous covering 10. Ovary of pistil 11. Apomixis 12. Filiform apparatus 13. Cross pollination or Xenogamy 14. Air and water 15. Stigma of pistil 16. Generative cell 17. One 18. Stigma 19. Two polar nuclei and one male gamete 20. Testa and tegmen

CHAPTER-3

HUMAN REPRODUCTION

IMPORTANCE CONCEPTS :

1. **Human reproduce sexually-**They are viviparous. Human reproduction comprises a number of sequential steps.
2. **Male reproductive system-**

a) **Testes-** A pair of testes are present in the scrotum outside the body, it helps in maintaining an optimal temperature for sperm formation. Sperms are produced in seminiferous tubules . There are two types of cells present in the internal lining of seminiferous tubules: spermatogonia and sertoli cells.

Leydig cells are present in the interstitial spaces outside the seminiferous tubules. They produce androgens**.**

b) **Accessory ducts-** They are vasa efferentia, rete testis, epididymis and vas deferens. These ducts store and transport sperms from the testis to urethra.

c) **Glands-** They are prostate gland, a pair of seminal vesicles and bulbourethal glands. The glands secrete seminal plasma.

3. **Spermatogenesis-** It starts at puberty. There is increased secretion of GnRH from hypothalamus. GnRH stimulates pituitary to secrete LH and FSH. LH stimulates Lydig cells to secrete androgens. The main androgens are testosterone and androstenedione. These hormones stimulates the process of spermatogenesis.
   - ♦ Spermatogenesis is the process of formation of sperms from spermatids.
   - ♦ Spermiation is the process by which sperms are released from seminiferous tubules.

4. **Sperm-** Around 200-300 million sperms are ejaculated at once.
   - (i) Head contains acrosome apically, which contains enzymes that facilitate entry of sperm into ovum.
   - (ii) Middlepiece has multiple mitochondria, that provide energy for the movement of sperms.
   - (iii) Tail is a flagellum that protrudes out of the cell body and is responsible for the vigorous motility of sperms.

5. **Female Reproductive system-**

a) Ovaries- There are two ovaries present . It produce ovum and female reproductive hormones.

b) Fallopian tubes- A pair of fallopian tubes connect ovaries to the uterus.

c) Uterus : It is inverted pear-shaped. Embryo development takes place inside the uterus. A narrow cervix connects the uterus to the vagina. The vagina and cervical canal form the birth canal.

d) External genitalia- Mons pubis, labia minora, labia majora and clitoris form external genitalia.

e) Mammary glands- A pair of breasts are present in females. They contain fat and mammary glands. Alveolar cells secrete milk.

6. **Oogenesis-** Oogenesis is the formation of a mature female gamete called ovum. It starts from the embryonic development as compared to the spermatogenesis, which only starts at puberty.

7. **Menstrual Cycle**- Menarche-First menstruation at puberty. The menstrual cycle is of 28/29 days on an average and an ovum is released at the middle of each cycle.

8. **Menopause** is the stage at which the menstrual cycle ceases (45-50 years).

9. **Fertilization** – It takes place at the ampullary region of the fallopian tube. The sperm and ovum fuse together to form the diploid zygote.

10. **Implantation –** The zygote divides mitotically forming blastocyst after the morula stage. The blastocyst gets embedded in the endometrium. The process is known as implantation.

11. In human gestation period is 9 months. The process of childbirth is known as parturition. It is initiated by neuroendocrine signals. Oxytocin secretes from the pituitary glands helps in the contraction of uterus.

12. **Lactation-** Increased secretion of prolactin from pituitary gland induces milk production in the mammary glands. Colostrum is the first formed (yellowish) milk from the mammary glands. It is rich in antibodies and proteins.

Facts to Remember

- **Gestetion period**
- **Implantation**
- **Foetal ejection reflex**
- **Menstrual Cycle**
- **Menarche**

CHAPTER BASED QUESTIONS

A. Objective Questions **(1 mark)**

I. Choose the most appropriate option from the following:-

1. Spermiation is the process of the release of sperms from
   a) seminiferous tubule
   b) prostate gland
   c) vas deferens
   d) epididymis
2. Which one of the following is not a male accessory gland?
   a) Prostate
   b) Ampulla
   c) Seminal vesicles
   d) bulbourethral glands
3. The vas deferens receives duct from the seminal vesicle and opens into urethra as
   a) ejaculatory duct
   b) ureter
   c) epididymis
   d) efferent ductile
4. Urethral meatus refers to the
   a) urinogenital duct
   b) opening of vas deferens into urethra
   c) external opening of the urinogenital duct
   d) None
5. Identify the odd one from the following
   a) Labia minora
   b) Isthmus
   c) Infundibulum
   d) Fimbriae
6. Temperature of the scrotum which is necessary for the functioning of testis is always
   a) around 4^0c below body temperature
   b) around 2^0c below body temperature
   c) around 8^0c below body temperature
   d) none
7. Which of the following is correct about mammalian testes?
   a) sertoli cells, seminiferous tubules, leydig's cell
   b) graffian follicle, seminiferous tubule, sertoli cell
   c)sertoli cell, leydig's cell, graffian follicle
   d)graffian follicle, leydig's cell, seminiferous tubule

8. Ovulation in the human female normally takes place during the menstrual cycle
    a) at the secretory phase
    b) at the beginning of the proliferative phase
    c) at the end of the proliferative phase
    d) None
9. After ovulation Graffian follicle regresses into
    a) Corpus atresia
    b) Corpus callosum
    c) Corpus luteum
    d) None

10. A human female reaches menopause around the age of
    a) 50 years
    b) 15 years
    c) 25 years
    d) 70 years
11. Which of the following hormones is not secreted by human placenta?
    a) hCG
    b) Estogens
    c) Prolactin
    d) Progesterone
12. Morula is a developmental stage
    a) between the zygote and blastocyst
    b) between the blastocyst and gastrula
    c) after the implantation
    d) between implantation and parturition
13. The function of the secretion of prostate gland is to
    a) inhibit sperm activity
    b) attract sperms
    c) stimulate sperm activity
    d) none of these
14. After birth, colostrum is released from mammary glands which is rich in
    a) fat and lowin proteins
    b) proteins and low in fat
    c) proteins, antibodies and low in fat
    d) proteins, fat and low in antibodies
15. Seminal plasma, the fluid part of semen, is contributed by
    i) seminal vesicle ii) prostate
    iii)urethra iv)bulbourethral gland
    a) (i) and (ii)
    b) (i), (ii) and (iv)

c) (ii), (iii) and (iv)
d) (i) and (iv)

Questions from 16-20 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 but R is the not the correct explanation of A
c) A is true but R is false
d) Both A and R are false

16. A : size of breasts increases at puberty in human female.
R : Prolactin secretion starts at puberty.

17. A : Vagina acts as copulation canal and fertilization canal.
R : Both insemination and fusion of gametes occur in vagina of female.

18. A : At puberty, human male develops secondary sexual characters.
R : At puberty, there is decreased secretion of testosterone in male.

19. A : Penis of male is homologous to clitoris of human female.
R : Both are highly sensitive and both supported by corpora cavernosa.

20. A : During fertilization only head of spermatozoa enters into egg.
R : If several spermatozoa hit the egg at same time, all can enter the egg.

II. Fill in the blanks :-

1. Urine test during pregnancy determines the presence of _____ hormone.
2. Delivary of developed foetus is scientifically called_____.
3. The first movement of the foetus and appearance of hair of it's head are usually observed during _____ month of pregnancy.
4. Ovulation is induced by a hormone called_____.
5. Fertilisation is_____ in humans.
6. The structure which provides vascular connection between foetus and uterus is called_____.
7. Zygote is_____.
8. Zygote divides to form_____which is implanted in uterus.
9. Secondary oocyte has_____number of chromosomes.
10. _____contain the actual genetic part of a sperm.

B. Very Short Answer type Questions:-

1. 1st polar body is formed at which stage of oogenesis?
2. In oogenesis haploid egg is fertilised by sperm at which stage?
3. Which part of ovary in mammals acts as an endocrine gland after ovulation?
4. During the development of embryo, what is occurring first?
5. Name the outermost layer of blastocyst.
6. What is the main function of Sertoli cells?
7. What does head of a sperm consists of?
8. Name the cells which secrets androgens.
9. Name the structure which secretes progesterone?
10. Name one hormone which secretes only during pregnancy?
11. Write the full form of hPL?
12. Which structure connects the foetus to placenta?
13. Which cells secretes milk?
14. Which hormone is involved in induction of parturition?
15. Name the cells present in seminiferous tubule.
16. How many spermatozoa will be produce from 100 primary spermatocytes and how many ova will be produced from 100 primary oocytes?
17. Write one importance of colostrum.
18. After how many days of fertilization implantation takes place?
19. The solid mass of 8-16cells formed from zygote after successive mitotic division – what is it called?
20. Where does Oogenesis occur?
    [Question with sample Answer]

C. Short answer type questions **(2 marks)**

1. Testes normally remain suspended in scrotum in mammals. Why?
Ans: Scrotum helps in maintaining low temperature (2-2.5^{0}c lower than the normal internal body temperature) which is necessary for spermatogenesis.

D. Short answer type question **(3 marks)**

1. Explain the process of fertilization.
Ans:- During fertilization, a sperm comes in contact with zona pellucida layer of ovum and induces changes in the membrane that block the entry of additional sperms. The secretions of acrosome help the sperm enter into the cytoplasm of the ovum through zona pellucida and the plasma membrane. This induces the completion of meiotic division of the secondary oocyte. The second meiotic division is also unequal and results in the formation of a second polar body and a haploid ovum (ootid). Soon the haploid nucleus of the sperms and that of the ovum fuse together to form a diploid zygote.

DO IT YOURSELF

A. Short answer type questions : **(2 marks)**

1. Differentiate between Leydig cell and sertoli cells with reference to their location in the organ and their function.
2. Name the glands associate with male reproductive organs and state their functions.
3. Explain different phases of oogenesis with schematic representation.
4. What is placenta? Justify placenta as a endocrine tissue.
5. What is colostrum? What is it's importance?
6. Mention any two differences between spermatogenesis and oogenesis.
7. What is semniferous tubule? Write the functions of cells present in the semniferous tubule.
8. Define spermiation.
9. What are the major components of seminal plasma.
10. What are the major function of male accessory ducts and glands?

B. Short answer type question: **3 marks**

1. Draw a labelled diagram of a sperm.
2. Draw a labelled diagram of a section through Ovary.
3. Name the functions of the following:-
   a) Acrosome b) sperm tail c) Fimbriae
4. In our society the women are often blamed for giving birth to daughter can you explain why this is not correct?
5. Explain the stages of embryo development from fertilization to implantation
6. Explain the various phases of menstrual cycle with reference to changes in ovary and uterus and hormonal cycle.

C. Long answer type questions. (5 marks)

1. Draw a labelled diagram of female reproductive system. What is glans penis- and foreskin? (3+1+1)
2. What are the main features of the embryonic development in various months of pregnancy? Write two roles of placenta? (3+2)
3. Draw a labelled diagram of male reproductive system? What is LH surge? (3+2)
4. What is parturition? How does this process occur? (2+3)

ANSWER TO THE CHAPTER BASED QUESTION

[A. Objective questions]

(I). 1. a), 2. b), 3. a), 4. c), 5. a), 6.b), 7.a),
8.c), 9.c), 10.a), 11.c), 12.a), 13.c), 14.c),
15.b), 16.b), 17.d), 18.c), 19.a), 20.c)

(II) 1. hCG 2. Parturition 3. 5th 4. LH 5. internal
6. placenta 7. diploid 8. blastocyst 9. 23 no.s 10. Head

[B] 1) 1st meiosis 2) Secondary oocyte 3) Graffian follicle
4) differentiation of cells 5) Trophoblast
6) provide nutrition to the germ cell 7) haploid nucleus, acrosome
8) leydig cell 9) corpus luteum 10) relaxin 11) Human Placental Lactogen
12) umbilical cord 13) alveolar cells 14) oxytocin 15) spermatogonia, sertoli cell
16) 400 spermatozoa,100 eggs 17) contains antibody 18)7 days 19) morulla 20) Ovum

REPRODUCTIVE HEALTH

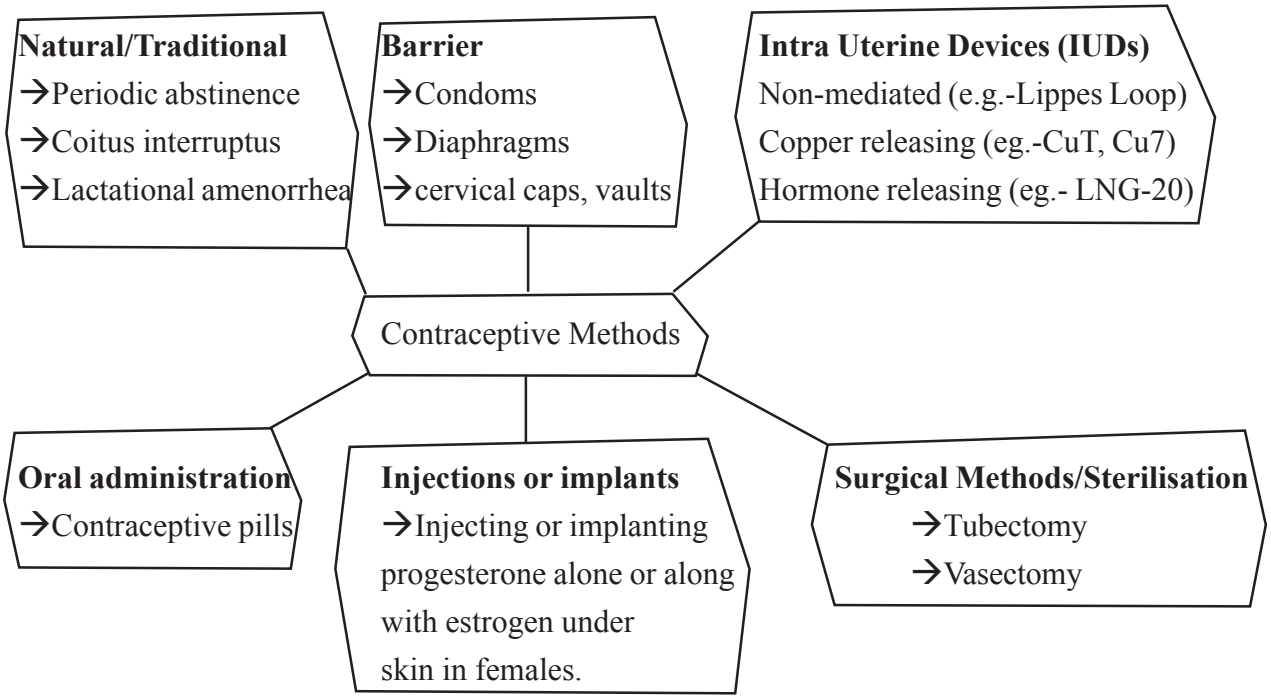
IMPORTANT CONCEPTS:

- **Reproductive health** means a total well-being in all aspects of reproduction, i.e., physical, emotional, behavioural and social.
  World Health Organization.
- In 1951, **'family planning'** programmes were initiated at national level. India has been one of the first countries to initiate such programmes Improved programmes covering wide reproduction related areas are currently in operation under 'Reproductive and Child Health Care (RCH) Programmes'.
  The major tasks of RCH are -
  i) Creating awareness among people about various reproduction related aspects.
  ii) Providing facilities and support for building up a reproductively healthy society.

Problems of reproduction related aspects	**Steps taken by government and non-government agencies to create awarness about reproduction related problems.**
1. Myths and misconception about sex-related aspects among children.	Introduction of sex education in schools.
2. Social evils like sex-abuse, adolescence, sex-related crimes.	Proper information about reproductive organs, adolescence, safe and hygienic sexual practices, sexually transmitted diseases (STDs), AIDS, etc.
3.Population growth.	Educating married couples about available birth control methods.
4. Unhealthy babies.	Educating parents about the importance of breast milk.
5. Sex ratio.	Educating parents about equal oppurtunities for both male and female child.

- **Amniocentesis** is the process of taking out of some amount of the amniotic fluid of the developing foetus in order to analyse the fetal cells for the presence of certain genetic disorders. It can also be used for detection of sex of the developing foetus.

- Use of **amniocentesis for sex determination has been legally banned in India** for stopping the practice of female foeticide. Female foeticide is the practice of abortion of the foetus if it is a girl.
- Population growth rate has increased alarmingly in the last century because of a rapid decline in **death rate, maternal mortality rate (MMR)** and **Infant Mortality Rate (IMR)**. Government had to take some serious measures to check the problem of rapid population growth in order to avoid scarcity of basic requirements like food, shelter, clothing, etc. Some of those measures are-
  i) Use of contraceptive measures.
  ii) Raising of legal marraige age of female to 18 years and that of males to 21 years.
  iii) Incentives given to couples with small families.



- Voluntary termination of pregnancy before full term is called **Medical Termination of pregnancy** (MTR) or induced abortion. It is considered safe in first trimester (12 weeks) of pregnancy.
  MTP is done in order to -
  i) Avoid unwanted pregnancies due to unprotected intercourse or failure of contraceptives used during coitus or rapes.
  ii) Save the mother if the pregnancy could be harmful for the mother or the foetus or both.
- **Sexually transmitted infections** (STI) are the infections or diseases which are transmitted through sexual intercourse. These are also known as Veneral Diseases (VD) or reproductive tract infections (RTI). For example, gonorrhoea, hepatitis- B, AIDs, genital herpes, etc., are

some of the STIs or STDs.

- Couples are called infertile if they are unable to reproduce children. Such couples could be assisted to have children through certain special techniques known as Assisted Reproductive Technologies (ART). Some of these techniques are -
  In vitro Fertilisation (IVF), Gamete Intra fallopian Ttransfer (GIFT), Intra Cytoplasmic Sperm Injection (ICSI), Artificial Insemination, etc.

CHAPTER BASED QUESTIONS

A) Objective Questions **(1 mark)**

I) Choose the most appropriate option from the folowing:

1) By the year 2011, population explotion has occured because of -
   (a) Decline in death rate (b) Decline in maternal mortality rate
   (c) Decline in infant mortality rate (d) All of the above

2) GIFT is recommended to the females who -
   (a) Cannot produce an ovum (b) Cannot provide suitable environment for fertilisation
   (c) Cannot retain the foetus inside the uterus (d) None of these

3) Decrease in MMR and increase in IMR will lead to -
   (a) Result in decline in growth rate (b) Would not couse any significant change in growth rate.
   (c)Result in rapid increase of growth rate (d) Result in an extreme population explotion

4) Lactating mothers do not conceive generally upto 6 months of lactation because of -
   (a) Suppression of gametic transport (b) Hyper secretion of gonadotropins.
   (c) Suppression of fertilisation (d) Suppression of gonadotropins

5) Emergency conteceptives must be used within what time span in order to be effective ?
   (a) 72 hours of coitus (b) 72 hours of menstruation
   (c) 72 hours of ovoution (d) 72 hours of spermiation

6) Choose the correct statement(s) about MTP -
   (a) MTPs are advised during second trimester of pregnancy.
   (b) MTPs are always done by surgical means only.
   (c) MTPs are used as contraceptive method.
   (d) MTPs are generally safe during the first trimester of pregnancy.

7) Generally which of the following STDs cannot be cured by medicine ?
   (i) Hepatitis - B (ii) Syphilis (iii) AIDS (iv) Genital herpes
   (a) (i) and (ii) (b) (i), (iii) and (ii) (c) (ii) and (iv) (d) (i), (iii) and (iv)

8) 'Family planning' programmes were initiated in the year -

(a) 1951 (b) 1961 (c) 1971 (d) 1981

9) Vasectomy is a type of -

(a) Sterilisation in females (b) Sterilisation in males

(c) Sterilisation in both males and females (d) Use of Copper-T in males.

10) 'Test Tube Baby' is the common name of which of the following ARTs ?

(a) ZIFT (b) In-vivo fertilisation (c) In-vitro fertilisation (d) GIFT

Questions from no. 11 to 14 consist of two statements Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below :

(a) Both statements A and R are true and R is the correct explanation of A.

(b) Both statements A and R are true, but R is not the correct explanation of A.

(c) A is true but R is false.

(d) Both A and R are false.

11) Assertion (A) : Sex education in schools should be encouraged.

Reason (R) : This will discourage the students from believing in myths related to sex related aspects.

12) Assertion (A) : Rapid increase in MMR, IMR and death rate has led to enormous population growth.

Reason (R) : Enormous growth in population has led to increase in production of food and shelter facilities in India in 2011.

13) Assertion (A) : Periodic abstinence is a method of natural contraception where couples abstain from having sexual intercourse during the ovalution phase.

Reason (R) : Periodic abstinence is a 100% sure shot method of birth control.

14) Assertion (A) : There is a chance of fertilisation to occur during 10^{th} - 17^{th} days of menstrual cycle as ovulation may occur during this period of time.

Reason (R) : Physical meeting of sperm and ova can be prevented by using barrier methods of contraception.

Fill in the blanks:

1) Condoms are most popularly _____.

2) _____ is the surgical process of sterilisation in females.

3) CuT is a _____ releasing IUD.

4) IUDs increase _____ of sperms within the uterus.

5) In the method of IUDs, sperms motility and the fertilising capacity of sperms is suppressed by _____ ions.

6) _____ are cut and tied in the process of vasectomy.

7) Sterilisation is the other name of _____ method of contraceptive.

8) The medical Termination of Pregnancy (Ammendment) Act was enacted by the government of India in the year _____.

9) _____ hormonal combination is used as contraceptive in females.

10) Statutory ban on amniocentesis in India has been adopted in order to check the increase in _____.

Very Short answer type Questions: **(1 mark)**

1) Write the full form of CDRI.
2) What do you mean by maternal mortality rate ?
3) Write the full form of RCH.
4) Which age group people are more vulnerable to STDs ?
5) Write the full form of ART.
6) Write the full form of ZIFT.
7) At which cell stage embryo transfer takes place within the fallopian tube ?
8) Write the full form of IUDs.
9) Mention one negative application of amniocentesis.
10) Write the full form of MTP.
11) Name the surgical method of sterilisation in females.
12) Write the full form of GIFT.
13) Write one benefit of artificial insemination.

QUESTIONS WITH SAMPLE ANSWERS

A) Short answer type question **(2 marks)**

1) What is in vitro fertilisation ?

Answer :- In vitro fertilisation is the method of assisted reproductive technology in which fertilisation occurs outside the body in almost similar conditions as that in the body with the help of medical technology. This process is also called as test tube baby programme in which ova from the female

and sperm from the male are collected and induced to form zygote under simulated conditions in the laboratory. It is followed by embryo transfer.

B) Short answer type question **(3 marks)**

1) What are the different natural methods of contraception ?

Answer :- The methods by which chances of meeting of ovum and sperm avoided by natural means is called natural method of contraception. The different natural methods of contraception are as follows :-

i) Periodic abstinence - Abstaining from coitus from day 10 to 17 of the menstrual cycle when ovulation is expected is called perioidic abstinence.

ii) Coitus interruptus - It is a method in which the male partner withdraws his penis from the vagina just before ejaculation to avoid insemination.

iii) Lactational amenorrhea - Sexual intercourse during the six months of lactation period starting from parturition is called lactational amenorrhea. Menstruation is absent during this phase.

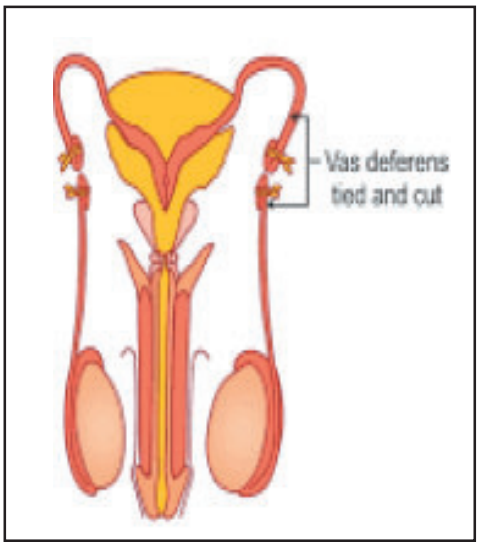
DO IT YOURSELF

A) Short answer type questions **(2 marks)**

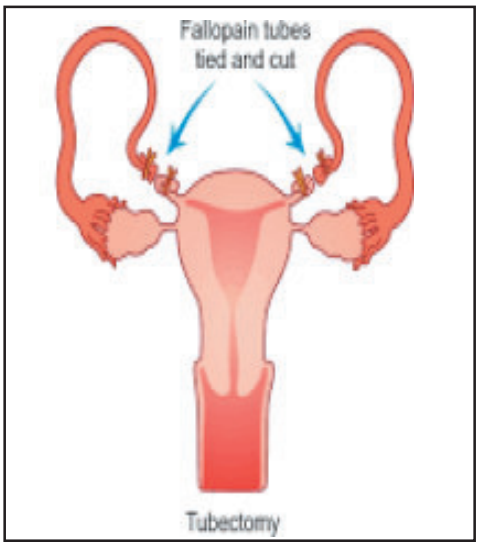
1) What is induced abortion ? (2)
2) What is infertility ? (2)
3) Differentiate between in vitro fertilisation and in vivo fertilisation. (2)
4) What is artificial insemination ? How is it related to intra-uterine insemination ? (1+1)
5) Mention the difference between ZIFT and IUT. (2)
6) Name two hormones that are constituents of contraceptive pills. (1+1)

B) Short answer type questions **(3 marks)**

1) What is amniocentesis ? Do you think it is right to legally ban amniocentesis in India ? Give reasons for your thoughts on this. (1+2)
2) Mention the problems that are taken care by the Reproductive and Child Health Care Programmes. (3)
3) Name a copper releasing IUD. Explain how they act as an effective contraceptive. (1+2)
4) What are the conditions in which medical termination of pregnency is advised ? (3)
5) Identify the method shown by the following diagrams. Name the type off contraceptive methods that has been reflected here ? (1+1+1)



(a)



(b)

C) Long answer type questions **(5 marks)**

1) What are STDs ? Give two examples of STDs . How can you remain free of STDs ? (1+½+½+3)
2) What do you mean by assisted reproductive technology (ART) ? Expalin any three methods of ART. Why adoption is a good option for infertile couples ? (1+3+1)
3) What are contraceptive pills ? Explain the barrier method and surgical methods of contraception. (1+2+2)

TEACHERS NOTE

In 'do it yourself' section,

- While answering Q.A.3, Write the differences in tabular form.
- While answering Q.B.1, your own thought should be reflected in your answer.
- Refer paragraph no. 4.2 of page no. 60 of textbook for answering Q.B.3
- You must remember all the abbreviations and their respective uses given in this chapter.

ANSWERS TO THE 'CHAPTER BASED QUESTIONS' SECTION

A) Objective Questions

I) 1)d 2)a 3)b 4)d 5) a 6) d 7)d 8)a 9)b 10)c 11)a 12)d 13)c 14)b

II) 1) Contraceptives 2) Tubectomy 3) Copper 4) Phagocytosis 5) Copper
6) Vas deferens 7) Surgical 8) 2017 9) Estrogen-Progesterone
10) Female foeticide

Very short answer type questions

1) Central Drug Research Institute.
2) Maternal mortality rate is defined as the death of women due to pregnancy related causes during pregnancy or within 42 days of pregnancy.
3) Reproductive and Child Health Care.
4) Adolescence.
5) Assisted Reproductive Technology.
6) Zygote Intra Fallopian Transfer.
7) 8 - celled blastomere.
8) Intra Uterine Devices.
9) Increasing rate of female foeticide.
10) Medical Termination of pregnancy .
11) Tubectomy.
12) Gamete Intra Fallopian Transfer.
13) Infertility cases due to very low sperm count in the ejaculates could be corrected by artificial insemination.

PRINCIPLES OF INHERITANCE AND VARIATION

IMPORTANT CONCEPTS:

- **Genetics** is the branch of biology that deals with the study of heredity and variation.
- **Heredity** refers to the resemblances or similarities between the parents and their offsprings.
- **Variation** refers to the differences between the parents and their offsprings arising due to chromosamal crossing over.
- **Inheritance** is the transmission of characteristics from parents to their offsprings.
- Gregor Mendel was the first person to provide scientific explanation for the inheritance and hence came up with the principle laws of inheritance. But his study was not given so much recognition as he had used statistical methods with mathematical logic to explain the patterns of inheritance. Moreover his thesis was overlooked as he did not publish it in a very reputed journal.

  Later on, three scientists namely **Hugo De Vries, Carl Correns** and **Erich von Tschermak** had independently rediscovered Mendel's work, and hence Mendel got recognition as the *Father of* **Genetics**.
- Mendel had conducted hybridisation experiments on pea plants with proper planning for 7 years (1856-1863) and hence proposed the laws of inheritance.

- Mendel had selected *7 pairs* of contrasting traits in pea plant for his study -

Character	Seed shape	Seed colour	Flower colour	Pod shape	Pod colour	Flower position	Stem height
Dominant trait	Round	Yellow	Violet	Full	Green	Arial	Tall
Recessive trait	Wrinkled	Green	White	Constricted	Yellow	Terminal	Dwarf

Experiment

Monohybrid Cross

(Inheritance of one gene)

Mendel crossed true breeding tall and dwarf plants (**parental generation**) to generate first monohybrid generation (**F1 generation**).

↓

He had self pollinated F1 generation plants and found that in F2 generation, 3/4th plants were tall and 1/4th plants were dwarf.

(P) Pure tall × Pure dwarf

TT tt

(Gametes) T t

(F1) Tt

(Gametes) T t

↓

(Selfing)

↓

(F_2)

♂ Gametes / ♀ Gametes	T	t
T	TT	Tt
t	Tt	tt

[Punnet's square or Checker's board]

Dihybrid Cross

(Inheritance of two genes)

Mendel crossed Pea plants having yellow coloured round shaped seeds with plants having green coloured wrinkled shaped seeds to generate first dihybrid generation (F1 Generation).

He had self pollinated F1 generation plants and found that in F2 generation,

$9/16^{th}$ plants had round and yellow seeds;

$3/16^{th}$ plants had wrinkled and yellow seeds;

$3/16^{th}$ plants had round and green seeds;

$1/16^{th}$ plants had wrinkled and green seeds.

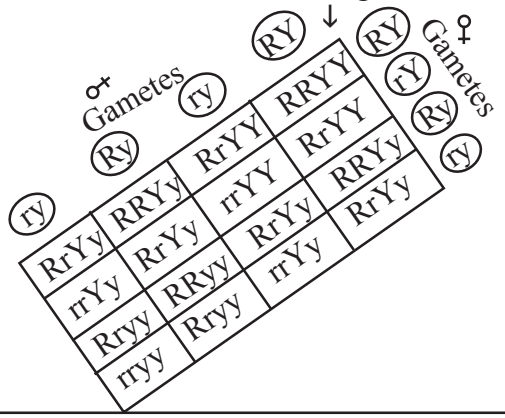
(P) Round yellow × Wrinkled Green.

RRYY rryy

(Gametes) Ry ry

(F1) RrYy

Selfing



Phenotypic ratio	Tall : Dwarf 3 : 1	Round Yellow : Wrinkled Yellow : Round Green : Wrinkled Green 9 : 3 : 3 : 1
Genotypic ratio	Pure homozygous (TT) : Hybrid heterozygous tall (Tt) : Pure homozygous dwarf (tt) 1 : 2 : 1	Pure Round pure Yellow (RRYY) : Pure Round Hybrid Yellow (RRYy) : Pure Round Pure Green (RRyy) : Hybrid Round pure Yellow (RrYY) : Hybrid Round Hybrid yellow (RrYy) : Hybrid Round Pure Green (Rryy) : Pure Round Pure Yellow (RRYY) : Pure Round Hybrid Yellow (RrYy) : Pure Wrinkled Pure Green (rryy) 1 : 2 : 1 : 2 : 4 : 2 : 1 : 2 : 1
Observation	- Dominant factor dominates the recessive character. - Recessive trait is getting expressed in F_2 generation without getting blended.	- Seggregation of one one pair of characters is independent of the other pair of characters.
Laws general rules proposed	- Law of Dominance - Law of Seggregation	-Law of Independent Assortment.

* What we know today as 'genes', were termed as 'factors' by Mendel.

- **Alleles** are the alternative forms of a gene.
- **Dominant character** is the character which gets expressed. It is indicated by capital letter and **recessive character** is the character which gets suppressed during inheritence of a gene. It is indicated with a small letter (e.g.- In 'TT' condition, T denotes dominant tall trait and t denotes recessive dwarf trait).
- The condition in which a chromosome pair carries dissimilar alleles of a gene, is called as **hetrozygous** condition (e.g - Tt, Rr, Yy, etc.).
- The condition in which a chromosome pair Carries similar alleles of a gene, is called as homozygous condition (e.g. TT, RR, YY, etc.).
- Visible characters of an individual is called **phenotype**, and its genetic constitution is called as **genotype**. (e.g. - Both 'TT' and 'Tt' conditions denote tall trait phenotypically, but genotypically, TT denotes pure homozygous tall and Tt denotes hybrid heterozygous tall)
- **Theodor Boveri** observed embryonic development in sea urchins and **Walter Sutton** observed separation of chromosomes into daughter cells during meiosis in grasshopper. They both have independently noted that both chromosomes and genes occur in pair and follows the law of seggregation and independent assortment. Sutton united the knowledge of chromosomal seggregation with Mendelian principles and called it the **chromosomal theory of inheritance.**

*** Refer figure 5.8, 5.9 and table 5.3 of textbook for better understanding**

- Later, **Thomas Hunt Morgan** worked with **Drosophila Melanogaster** (fruit flies) and experimentally proved the chromosomal theory of inheritance. His **discovery of linkage** is a breakthrough in Biology.
- Recombination is the phenomenon which leads to the generation of non parental gene combinations.

POST MENDELIAN CONCEPTS OF HEREDITY

Polygenic inheritance

Multiple genes involved in controlling phenotype of a trait. eg. - 3 genes A,B,C control human skin colour.

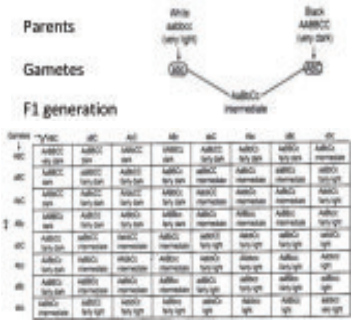


Figure 5.1 Ineritance of skin colour in human beings.

Multiple allelism

Condition in which three of more variants (multiple alleles) of same gene exists in the population. eg. - ABO blood grouping system in humans. Three alleles (I^A, I^B, I^O) determines the blood group.

Pleiotrophy

Single gene exhibits multiple phenotypic expression. e.g. - Single gene mutation of β-chain of haemoglobin leads to liver failure, blindness, heart attack in a condition called sickle-cell a

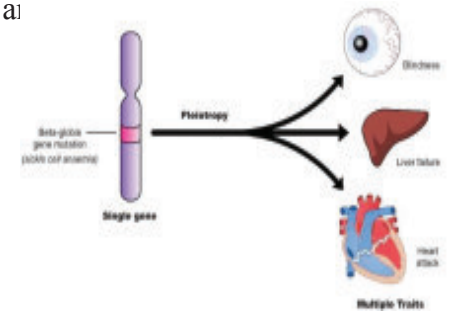


Figure 5.2 Effects of pleiotrophy in sickle cell anaemia.

Incomplete dominance

♦ One allele is not completly dominant over the other.

♦ Both alleles blend to form a new phenotype. e.g.- *Mirabilis jalapa*

(P) RR (Red) × rr (White)

(F1) (Rr) (Pink)

selfing

(F2)

♀ / ♂	R	r
R	RR	Rr
r	Rr	rr

Phenotypic ratio
Red : Pink : White
1 : 2 : 1

Genotypic ratio
RR : Rr : rr
1 : 2 : 1

Figures 5.3 : Incomplete dominance

Linkage

♦ Phenomenon due to which genes on same chromosome tend to be inherited together.

♦ Linkage is inversely proportional to recombination, distance between genes, independent assortment.

* Refer figure 5.11 of textbook for better understanding of linkage.

Condominance

Two alleles get expressed together; neither of these are dominant or recessive. e.g. - In ABO blood grouping system in humans, when alleles I^A and I^B are present together, they both get expressed to form AB blood group.

Allele from Parent 1	Allele from Parent 2	Genotype of Offspring	Blood-types of Offspring
I^A	I^A	$I^A I^A$	A
I^A	I^B	$I^A I^B$	AB
I^A	i	$I^A i$	A
I^B	I^A	$I^A I^B$	AB
I^B	I^B	$I^B I^B$	B
I^B	i	$I^B i$	B
i	i	ii	O

Figure 5.4 Genetic basis of blood groups in human population.

♦ The system of determining the development of sexual characteristics in an organism is known as sex determination. The chromosomes which are involved in determination of sex of an organism are called sex chromosomes. Rest other chromosomes are called autosomes.

♦ **XO type** and **XY type** mechanisms are the two types of sex determining mechanisms. In **XO type**, only one sex chromosome (X chromosome) is involved. **Females have two X chromosomes (XX)** and **males have only one X chromosome (XO)**, where O indicates the lack of second X chromosome. This type of sex determination can be seen in **grasshopper**. In **XY type**, **females have two same kind of sex chromosomes (XX)** and **males have two different kinds of sex chromosomes (XY)**. This type of sex determination is found in humans.

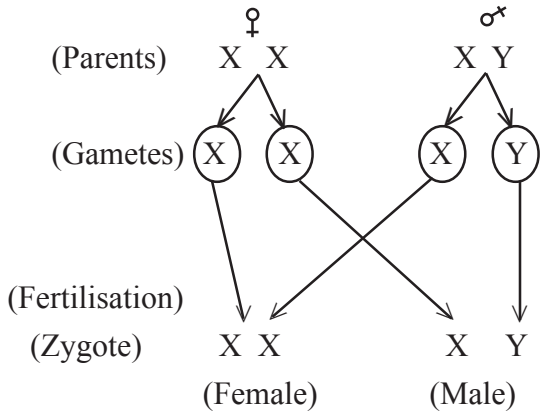


Figure 5.5 Sex determination in humans (XY type).

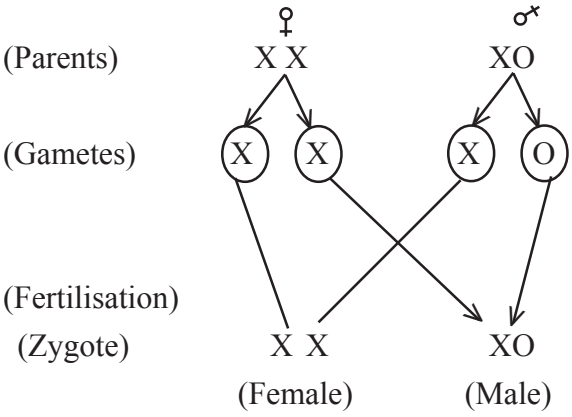


Figure 5.6 Sex determination in Grasshopper (XO type)

♦ The sex determination mechanism in which males produce two different types of gametes,is called **male heterogamety** (as seen in humans).

♦ The sex determination mechanism in which females produce two different types of gamete, is called **female heterogamety** (as seen in birds).

In order to have a distinction from male heterogamety, two different sex chromosomes of a female has been designated as Z and W chromosomes. In this type of mechanism (ZY type), males have a pair of Z chromosomes.

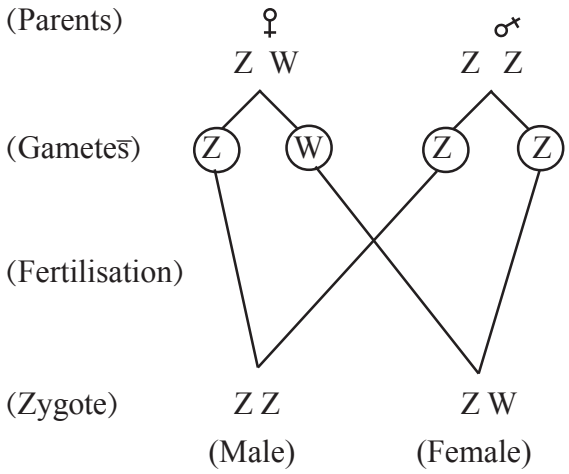


Figure 5.7 Sex determination in birds (ZW type)

♦ In *honey bee*, sex is determined by the number of sets of chromosomes an individual receive. Union of a sperm and an egg produces a female offspring (queen or worker bee), and an unfertilised egg developes as a male (drone bee) by parthenogenesis. Hence, males have half the number of chrosomes than that of a female.

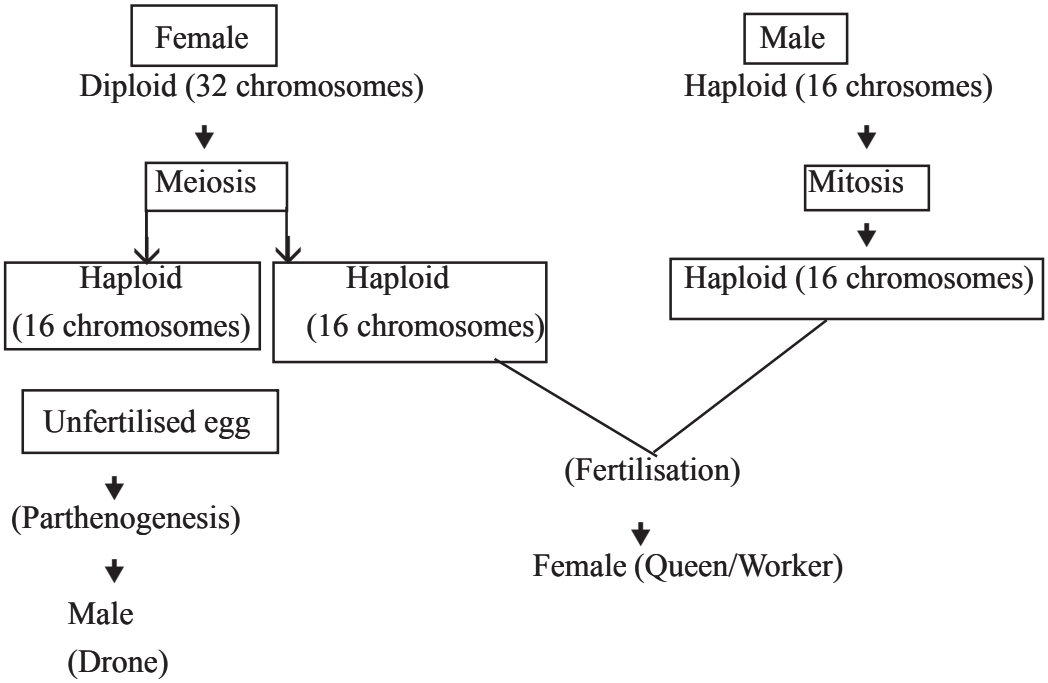


Figure 5.7 Sex determination in honey bee.

Deletion

- Loss of DNA segment
- causes **frame shift mutation.**

Mutation

-Results in alteration of DNA sequences resulting into changes in genotype and phenotype of an organism.

- Leads to variation as well as abnormalities or aberrations.
- Induced by mutagens (e.g.- UV rays)

Insertation/ Duplication

- Gain of DNA segment.
- Causes **frame shift mutation.**

Substitution

- Change in a single base pair.
- causes **point mutation**.

♦ In order to study the inheritance of genes in humans, analysis of traits in several generations of a family can be done. This is known as **pedigree analysis**. It provides as a strong tool for tracing the inheritance of a specific trait responsible for certain abnormalities or diseases.

** Refer Figure 5.13 of textbook to have an idea about different symbols used in pedigree analysis.

Genetic disorders

Mendelian disorders :

♦ Due to mutations, generally.

♦ Transmitted to offspring in line with laws of inheritance.

♦ Colour blindness, haemophilia, cystic fibrosis, sickle-cell anaemia, phenylketonuria, thalassemia, etc., are some of the Mendelian genetic disorders.

Chromosomal disorders :

♦ Due to absence or excess or abnormal arrangement of one or more chromosomes.

♦ Results in aneuploidy (Gain or loss of chromosomes) or polyploidy (Increase in whole set of chromosomes).

♦ Down's syndrome, Kline felter's syndrome, Turner's syndrome are some of the chromosomal genetic disorders.

CHAPTER BASED QUESTIONS

A) Objective questions : (1 mark)

I) Choose the most appropriate option from the following :

1) Linkage and recombination shows -

(a) An inverse relationship (b) A direct relationship

(c) Parallel relationship (d) No relationship

2. Which of the following substitution of amino acids is the cause of sickle cell anaemia ?

(a) GUG to GAG (b) AUG to GUG

(C) GAG to GUG (d) GUG to AUG

3. ZZ/ZW type of sex determination can be seen in which of the following organism ?

(a) Humans (b) Honey bee

(c) Chicken (d) All of the above

4. In a plant, fertilisation between red coloured flower and white coloured flowers of parental generation produces an intermiediate hybrid pink flower in F1 generation. This shows -

(a) Codominance (b) Pleiotropy

(c) Polygenic inheritance (d) Incomplete dominance

5. A genetic disease transferred from a phenotypically normal but carrier female to some of the male progenies, is -

(a) Sex-linked dominant (b) Sex-linked recessive

(c) Autosomal Dominant (d) Autosomal recessive

6. ABO blood grouping system is an example of -

(a) Codominance (b) Multiple allelism

(c) Incomplete dominance (d) Both option 'a' and 'b' are correct.

7. A cross between two tall plants resulted in offsprings having all tall plants. What would be the genotype of both the parents ?

(a) TT × TT (b) tt × tt

(c) Tt × tt (d) Tt × Tt

8. You have got 9:3: 3:1 ratio in a dihybrid cross. It denotes -

(a) Multiple allelism (b) Incomplete dominance of alleles of genes

(c) Codoninance of alleles of 2 genes (d) Independent assortment of alleles of two genes.

9. Which of the following is a test cross -

(a) Rr × rr (b) Rr ×RR

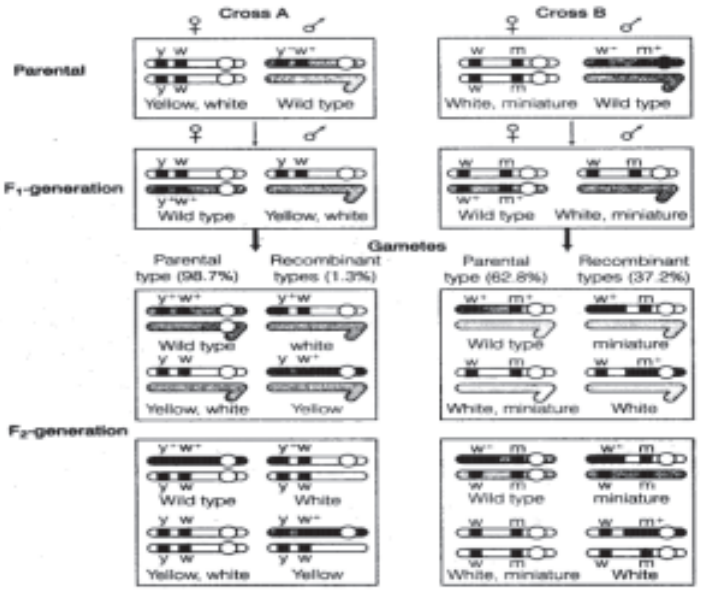
(c) Rr × Rr (d) All of the above

10. The respective phenotypic and genotypic ratio observed in incomplete dominance are -

(a) 1 : 2 : 1 and 1: 1 :1 (b) 1: 2 : 1 and 1 : 2 : 1

(c) 1 : 1 : 1 and 1 : 1 : 1 (d) 1:3:1 and 1:3:1

11. Identify the correct statement after analysing the given diagrams -



(a) The strength of linkage between y and w genes is higher than that of w and m genes.

(b) The strength of linkage between y and w genes is lesser than that of w and m genes.

(c) The percentage of recombination is inversely proportional to linkage in cross A and directly proportional to linkage in cross B.

(d) The percentage of recombination is directly proportional to linkage in cross A and inversely proportional to linkage in cross B.

12. Discovery of X body had played a significant role in understanding the mechanism of sex determination. Among the following scientists, who can be attributed the credit of discovering X body.

(a) Morgan (b) Boveri (c) Mendel (d) Henking

13. Which of the following conditions denote aneuploidy ?

(a) 2n (b) n (c) 2n + 1 (d) All of the above

14. What could be the possible genotype of the mother and father of an offspring whose genotype is hetrozygous for A blood group ?

(a) Mother is homozygous for 'A' blood group and father is homozygous for 'O' blood group.

(b) Mother is heterozygous for 'A' blood group and father is homozygous fo 'O' blood group.

(c) Both mother and father are heterozygous for 'A' blood group.

(d) All of the above.

15. The sugars formed by alleles I^A and I^B are found in -

(a) White blood cells (b) Red blood cells

(c) Platelets (d) All of the above

*** Questions from no. 16 to 25 consists 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, but R is not the correct explanation of A.

c) A is true but R is false.

d) Both A and R are false.

16. Assertion (A) : In Snapdragon, same phenotypic and genotypic ratio is obtained by selfing of F1 pink flower plants.

Reason (R) : Flower colour gene shows incomplete dominance.

17. Assertion (A) : Physical association of genes on a chromosome is called linkage.

Reason (R) : Recombination leads to linkage, hence resulting into parental gene combinations.

18. Assertion (A) : The cross between F_1 progeny and either of two parents is back cross.

Reason (R) : The crossing of F_1 individual with homozygous dominant parent results into test cross.

19. Assertion (A) : Mutation in the gene coding for the enzyme phenyl alanine hydroxylase cause phenylketonuria, hence resulting into skin pigmentation, reduction in hair and mental retardation.

Reason (R) : Pleiotropic gene can exhibit multiple phenotypic expression.

20. Assertion (A) : In female heterogamety, two different types of gametes in terms of sex chromosomes are produced by females.

Reason (R) : Male heterogamety is a condition where males produce some gametes with X-chromosome and some with Y-chromosome, for example.

21. Assertion (A) : Chromosomal theory of inheritance explains the resemblance between behaviour of chromosomes and genes.

Reason (R) : Linkage occurs parallely along with independent assortment.

22. Assertion (A) : Increase in whole set of chromosomes is called polyploidy.

Reason (R) : Failure of cytokinesis results in an increase in a whole set of chromosomes.

23. Assertion (A) : Down's syndrome results in loss of chromosome 21.

Reason (R) : Turner's syndrome is a result of polyploidy.

24. Assertion (A) : Thalassemia is a quantative problem of synthesising very less globin molecules.
Result (R) : Sickle cell anaemia is a qualitative problem of synthesising an incorrectly functioning globin molecule.

25. Assertion (A) : Mendel had cross pollinated several true breeding pea lines.
Reason (R) : True breeding pea lines show stable trait inheritance and expressions for several generations.

II) Fill in the blanks :

1) _____ seed colour of pea is a dominant trait .

2) In honey bee, males produce sperms by _____ cell division.

3) Haemophilia is a _____ recessive disease.

4) Mendel termed genes as _____ .

5) Deletion is a type of mutation that occurs due to _____ of a segment of DNA.

6) Mendel had used _____ pairs of contracting traits for his experiments on inheritance.

7) Hugo de Vries, Carl Correns and _____ had independently rediscovered Mendel's results on inheritance.

8) One or other _____ controls each and every feature in an organism.

9) Sickle cell anaemia is caused by substituion of Glutamic acid by Valine at _____ position of β-globin chain of the haemoglobin molecule.

10) _____ is the carrier of genetic information.

11) Sickle cell anaemia is a _____ linked recessive trait.

12.Turner's syndrome is caused due to _____ of a X chromosome.

13. A total of _____ different genotypes are produced in F2 generation in a dihybrid cross.

14. In patients having sickle cell anaemia, the RBC becomes _____ shaped.

15. Trisomy of chromosome number _____ results into Down's syndrome.

B) Very short answer type questions : (1 mark)

1) Who is called the father of genetics ?

2) What is pleiotropy ?

3) State Mendel's law of independent assortment.

4) Differentiate between aneuploidy and polyploidy.

5) What is linkage ?

6) Differentiate between point mutation and frameshift mutation.

7) Name the organism in which Morgan had studied the phenomenon of linkage.

8) Define genes.

9) How does haemophilia affect the patient ?

10) What is Klinefeltere's syndrome ?

11) Write the genotype for the darkest skin colour.

12) Name the scientists who had given the chromosomal theory of inheritance.

13) Who is known as the father of experimental genetics ?

14) Differentiate between sex chromosomes and autosomes.

15. What is polygenic inheritance ?

QUESTIONS WITH SAMPLE ANSWERS

A) Short answer type question : **(2 marks)**

1) Mention two differences between klinefelter's syndrome and Turner's syndrome.

Ans : Two differences between Klinefelter's syndrome ad Turner's syndrome are as follows :-

Klinefelter's syndrome :	**Turner's syndrome :**
i) It is a genetic disorder caused due to presence of an additional copy of X chromosome resulting into a karyotype of 47 with XXY. ii) Male characters develop in such persons, but female characters (breast development) also develop.	i) It is a genetic disorder caused due to absence of one of the X chromosomes resulting into a karyotype of 45 with XO. ii) Development of ovary is rudimentary and secondary reproductive characters are absent in such females.

B) Short answer type question : (3 marks)

1) Explain the mechanism of sex determination in humans.

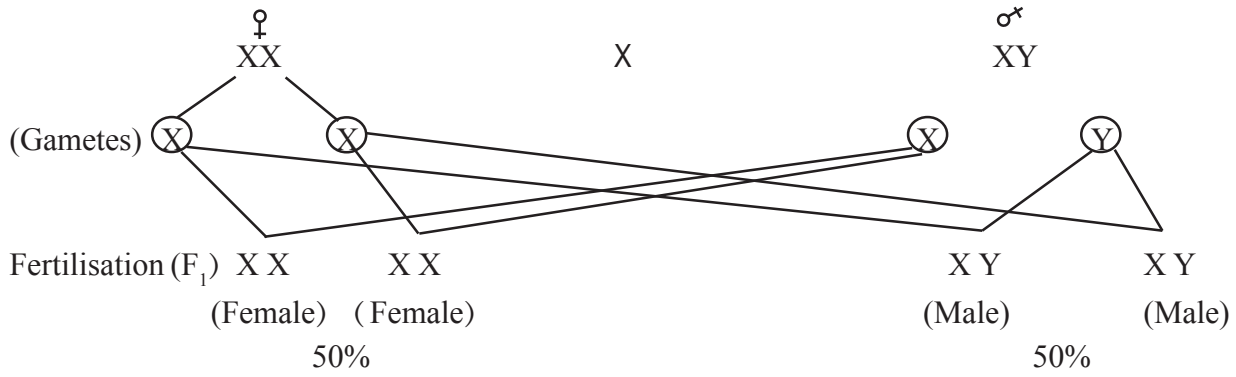
Ans : - ♦ In human beings, all females bear a pair of X chromosomes, whereas, males bear one X chromosome and one Y chromosome.

♦ In a cross between a male and a female, there is equal chance for the offspring to be either male or female.

♦ Sex of the humans are determined by presence or absence of a Y chromosome.

♦ If a Y chromosome and a X chromosome are present in the offspring , then it is a male with XY genotype.

v) If two X chromosomes are present in the offspring, then it is a female with XX genotype.



DO IT YOUR SELF

A) Short answer type questions : **(2 marks)**

1) What is mutagen ? Giv an example . (1+1)

2) What is pedigree analysis ? How is it beneficial to humans ? (1+1)

3) What is female heterogamety ? Give an example . (1+1)

4) Mention two characteristic features of an individual who is affected by Down's syndrome (1+1)

5) How is the phenotypic ratio of F2 generation in a monohybrid cross different from that of a dihybrid cross ? (2)

6) Name one sex-linked recessive and one autosomal recessive Mendelian disorder. (2)

7) Differentiate between incomplete dominance and codominance. (2)

8) Turner's syndrome is a result of aneuploidy. Explain. (2)

9) Mention any two reasons due to which Morgan had chosen fruit flies for his experiments on genetics ?

10) Describe the relatioship between -

i) Linkage and recombination. (1)

ii) Recombination and independent assortment. (1)

B) Short answer type questions : **(3 marks)**

1) State Mendel's law of dominance. Explain it with the help of a monohybrid cross. (1+2)

2) Explain the chromosomal theory of inheritance by showing the relationship between behaviour of genes and chromosomes. (3)

3) Mention any three reasons why Mendel chose pea plants for his experiment ? (3)

4) Why is it extremely rare for a female to become haemophilic ? (3)

5) Mention any three reasons due to which Mendel's work did not get recognition until 1900. (3)

6) Honey bee males do not have father and thus cannot have sons, but have a grandfather and can have grandsons. Explain. (3)

C) Long answer type questions : (5 marks)

1) ABO blood grouping system shows multiple allelism as well as codominance. Explain. (2½ +2½)

2) Explain the law of independent assortment with the help of a dihybrid cross using a Punnett square. Show the relationship between linkage and independent assortment with the help of an example. (3+2)

3) Study the following pedigree chart showing the pattern of blood group inheritance in a family.

a) Write the genotype of parents. (½ + ½)

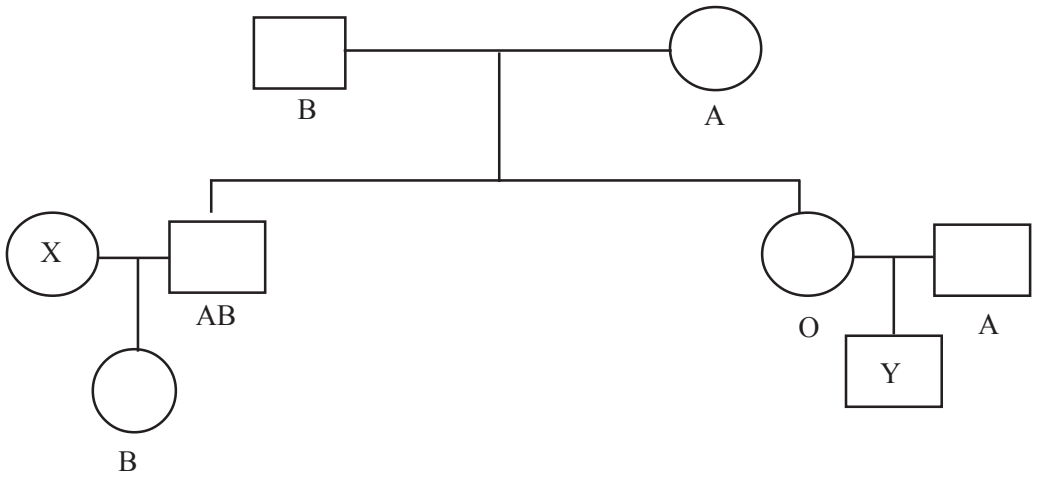
b) Write the possible genotypes of individual 'X' in second generation. (½ + ½)

c) Write the possible blood groups of individual 'Y' in third generation. (½ + ½)

d) How can you explain multiple allelism through this pedigree chart ? (2)

4) What type of sex determination mechanism is used in birds? How is this type of sex determination mechanism different from that of used in humans ? Illustrate sex determination mechanism in birds with the help of a cross. (1+2+2)

5) What is colour blindness ? Why is it more frequent in males ? (2+3)



TEACHER'S NOTE

- Understand and remember the concepts explained in figure 5.1 of page no. -70 of textbook.
- Try to understand and remember the terms related to genetics and inheritance (e.g.- variation, heredity, genes, alleles, dominant and recessive traits, etc.)
- Analyse and understand the laws of genetics and post Mendelian concepts of heredity with help of examples and crosses.
- Do practice as many pedigree chart analysis as you can.
- In the 'Do it yourself' section, take care of the following points -

  - In Q.A.5, explain the ratios in brief by showing phenotypes and zygosity. No need to show the crosses.

  - In Q.B.2, mention the theory, the scientists who had proposed this theory at first. Then explain the chromosomal and genetic behaviour.

  - Refer page no.- 90, 81 and 89 of textbook for answering Q.B.4, Q.B.5, Q.C.6, respectively.

  - Refer important concepts' this workbook for answering Q.B.3.

  - Use Punnett square only while answering Q.C.2 ; don't use normal crosses.

  - Hint for Q.B.6 -
- Haploidiploidy sex determination in honey bees .
- Males developed from unfertilised egg and are haploid whereas females are developed from fertilised egg and are diploid. (Refer figure - 5.7 of this workbook)
- No participation of sperm in formation of male bees, while the queen or mother bee has a father as it is developed from a fertilised egg.

ANSWERS TO THE 'CHAPTER BASED QUESTIONS' SECTION

A) Objective questions.

I)	1) a	2) c	3) c	4) d	5) b	6) d	7) a	8) d
	9) a	10) b	11) a	12) d	13) c	14) d	15) b	16) a
	17) c	18) d	19) a	20) b	21) c	22) a	23) d	24) b

II) 1) Yellow 2) Mitotic 3) Sex-linked 4) Factors 5) Loss
6) Seven 7) Erich Von Tschermak 8) Gene 9) Sixth 10) DNA
11) Autosome 12)Absence 13) Nine 14) Elongated sickle 15) 21

B) Very short answer type questions.

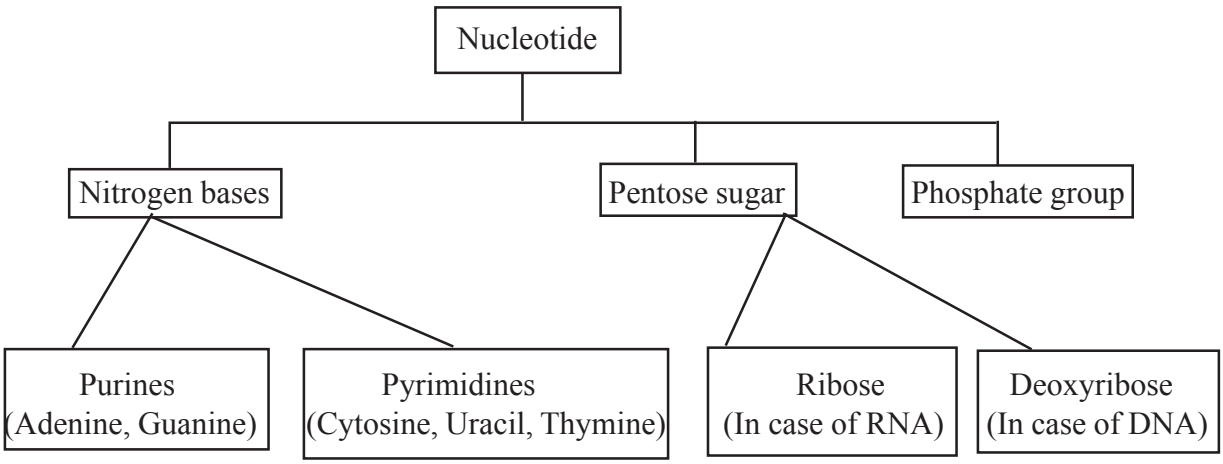
1) Gregor Johan Mendel.
2) Pleiotropy is a condition in which a single gene exhibits multiple phenotypic expressions.
3) Mendel's law of independent assortment states that the alleles of two different genes assort independently during gamete formation.
4) Aneuploidy is the presence of an extra chromosome or the loss of a chromosome leading to abnormal karyotype, whereas, polyploidy is the presence of an extra set of chromosomes in the cell.
5) The tendency of genes on same chromosome to be inherited together is called linkage.
6) Point mutation results into change or substitution of a single base of nucleotide, whereas frameshift mutations are addition of deletion of nucleotides causing a shift in the DNA sequence.
7) *Drosophila melanogaster*
8) Genes are the distinct sequence of nucleotides forming part of a chromosome, which acts as the unit of heredity and gets transferred from parents to the offsprings.
9) Haemophilia results in non-stop bleeding due to a simmple cut in an individual as a single protein part of the cascade protein involved in clotting of blood gets affected.
10) Klinefelter's syndrome is a genetic disorder caused due to presence of an additional copy of X-chromosome in males leading to development of feminine character.
11) AABBCC
12) Walter Sutton and Theodore Boveri
13) The chromosomes involved in determination of sex of an individual are called sex chromosomes and rest other chromosomes are called autosomes.
14. Poligenic inheritance is a condition in which multiple genes control the phenotype of a trait.

UNIT - VII CHAPTER - 6

MOLECULAR BASIS OF INHERITANCE

IMPORTANT CONCEPTS :

♦ The two types of nucleic acid found in living organisms are deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). Both DNA and RNA are polynucleotide chains formed by monomer units called nucleotides.



♦ **In a polynucleotide chain -**

- A nitrogenous base is linked to pentose sugar through a *N-glycosidic bond* to form a *nucleoside*.
- A phosphate group is linked to 5' - OH of a nucleoside through a *phosphoester bond* to form the corresponding *nucleotide*.
- Two nucleotides are linked through 3' - 5' *phosphodiester bond* to form a *dinucleotide.*

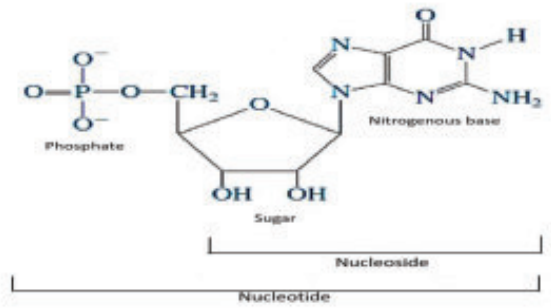


Figure 6.1 Diagramatic representation of nucleoside and nucleotide

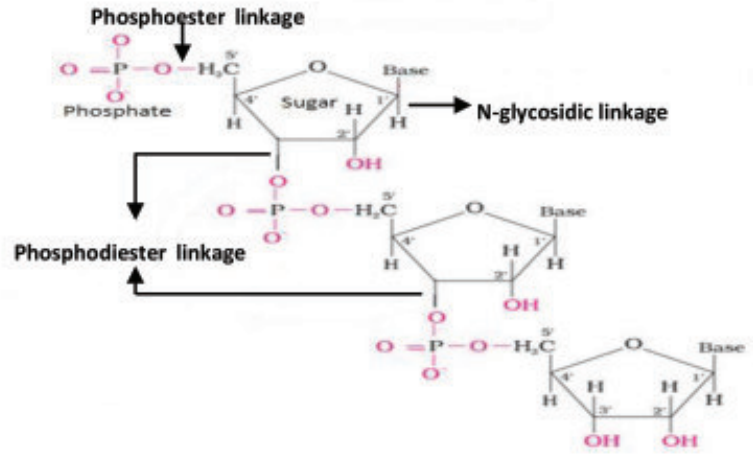
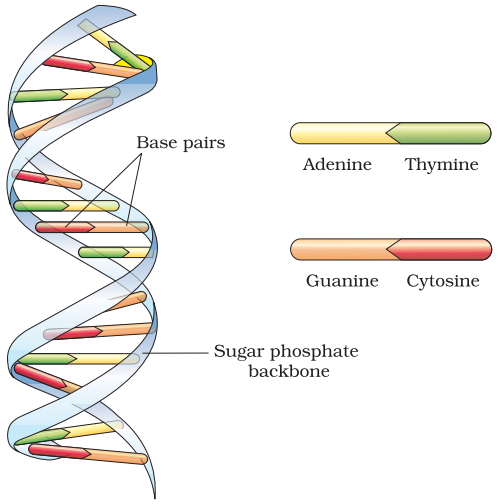


Figure 6.2 Different bonds found in a polynucleotide chain

	DNA	RNA
Sugar present	Deoxyribose sugar	Ribose sugar
Nitrogen base,	Pyrimidine bases- Cytosine(C) and Thyamine (T), Purine bases - Adenine (A) and Guanine (G),	Pyrimidine bases- Cytosine(C) and Uracil (U), Purine bases - Adenine (A) and Guanine (G),
Molecular Structure	Double stranded molecule; antiparallel helix,	Single stranded molecule; can form double stranded structures; hair pin loop.
Function	Replication; controls transmission of hereditary characters.	Protein synthesis; Genetic material in some viruses.
Lifetime	Long	Short
Length	Can be upto 250 million nucleotide pairs long,	Can be only upto a maximum of few thou sands of nucleotides long.
	* DNA has evolved from RNA with chemical modifications of RNA, hence making the DNA more stable and change resistant.	* Every nucleotide residue in a RNA molecule has an additional - OH group present at the 2' position in the ribose sugar.

♦ In 1869, *Friedrich Meischer* had identified DNA as an acidic substance present in nucleus, and had named this substance as *nuclein.*

♦ In 1953, *James Watson* and Francis Crick had proposed the double helix model of DNA based on the X-ray diffraction data produced by *Maurice Wilkins* and Rosalind Franklin. Their proposition of base pairing between the two strands of polynucleotide chains was based on observation of *Erwin Chargaff*. The *Chargaff rule* states that *for a double stranded DNA,* the *ratios between Adenine and Thymine and Guanine and Cytosine are constant* and equal ones.

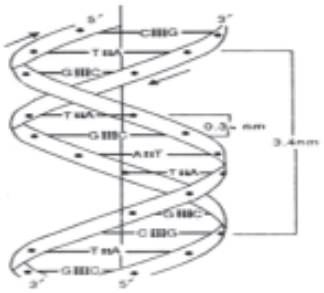


Refer page no.- 97 of textbook for better understanding of the salient features of double helical structure of DNA.

Figure 6.3 Watson and Crick model of double helical structure of DNA.

♦ *Francis Crick* had proposed the *central dogma* of molecular biology, which states that the genetic information flows from DNA → RNA → Polypeptide.

♦ *Histones* (rich in amino acids like lysine and arginine) are the positively charged proteins which organizes to form a unit of eight molecules known as *histone octamer*. Negatively charged DNA is packaged by wrapping around the histone octamer forming the *nucleosome*. Each nucleosome contains 200 base pairs of DNA helix and forms the repeating unit of a structure called *chromatin* in the nucleus. Chromatin appear as *'beads - on -string'* structure when viewed undre electron microscope. *Euchromatin*



Fihure 6.4 Watson and Crick model of double helical structure of DNA

Figure 6.4 Central dogma of molecular biology

are loosely packed regions of chromatin that stains light. And heterochromatin are the tightly packed regions of chromatin that stains dark. The chromatin is packaged to form *chromatin fibres*, which are further coiled and condensed to form *chromosomes*. Euchromatin are transcriptionally active and heterochromatin are trans criptionally inactive. At higher level, packaging of chromatin needs additional set of proteins, known as *Non-histone chromosomal proteins* (NHC).

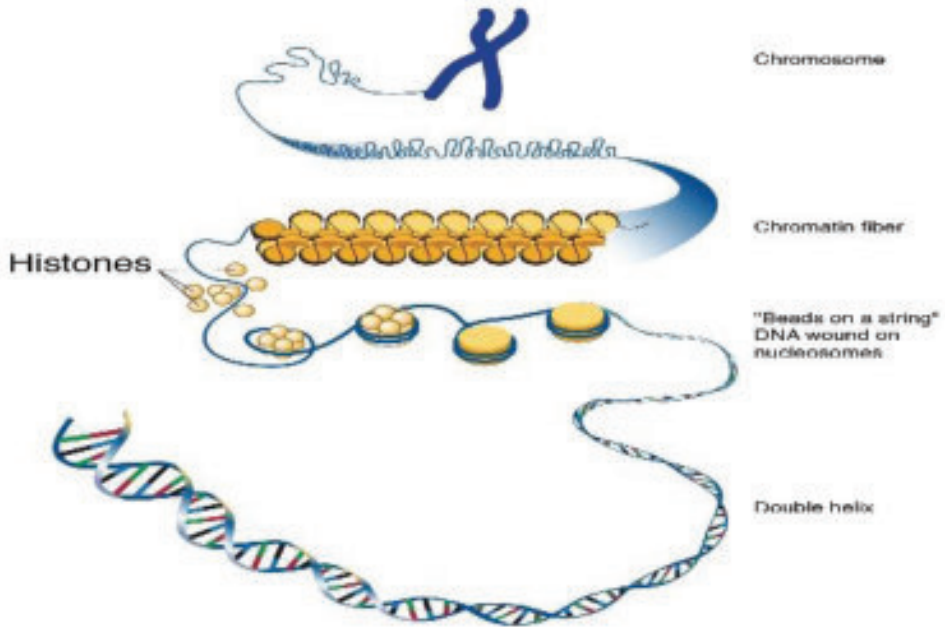


Figure 6.5 Packaging of DNA helix

Experiments conducted in search for genetic material		
1) *Transformation experiment by Frederick Grifith (1928)* with S strain (Virulent) and R strain (Non virulent) of *Streptococcus Pneumoniae* S strain → Inject into mice → Mice die R strain → Inject into mice → Mice live S strain (Heat killed) → Inject into mice → Mice live S strain (Heat killed) + R strain (live) ↓ Inject into mice ↓ Mice die **Conclusion Some** transforming principles transfered from S strain to R strain and enabled R srain to synthesise a smooth polysaccharide coat and become virulent, which must be due to transfer of genetic material.	2) *Biochemical nature* of transforming principle or the *genetic material* was proved to be DNA by *Owald Avery, Colin Macleod and Maclyn McCarty (1994).* ♦ Protein digesting enzymes (Proteases) and RNA digesting enzymes (RNases) did not affect transformation; DNase inhibited this. ♦ Before this the transforming principle was throught to be proteins. ♦ All biologists were not convinced.	3) DNA proved to be the genetic material by Alfred Hershey and Martha Chase (1952). ♦ Radioactive Bacteriophages (virus) were allowed to infect *E.coli* (bacteria). ♦ As the infection proceeded, the viral coats were removed from the bacteria by agitating them in blender. ♦ Bacteria infected with viruses having radio - active proteins were not radioactive. And the bacteria infected with viruses having radioactive DNA were radioactive, hence indicating that DNA is the genetic material , not protein.

DNA Replication

Method :	**Proof :**	**Machinary and enzymes:**
Semiconservative : Proposed by *Watson and Crick* (1953) Two DNA strands separate from each other; each strand act as template for synthesis of new complementary strands. Hence, each DNA molecule has one parental and one newly synthesised strand.	By Messelson and stahl (1958). *E.coli* grown in medium containing $^{15}NH_4Cl$ for several generations, hence ^{15} N got incorporated into the newly synthesised ones. These cells were then transferred to normal $^{14}NH_4Cl$ containing medium.	Replication begins on specific site on the DNA known as *origin of replication*. *Helicase* opens up the DNA double helix resulting into the formation of *replication fork* (small opening of DNA helix within which replication takes place)

	First generation collected after 20 minutes had hybrid DNA (One strand with heavy ^{15}N isotope and the other strand with lighter ^{14}N isotope) Second generation collected after 40 minutes had equal amounts of hybrid DNA and light DNA, hence proving that DNA replication is semiconservative.	*DNA dependent DNA polymerase* catalyses polymerisation only in 5' $\rightarrow$ 3' direction, hence only one continuous strand is formed by the template with 3' $\rightarrow$ 5' polarity, forming the leading strand, which needs only one RNA primer for polymerisation to occur. In the template with 5' $\rightarrow$ 3' polarity, replication is discontinuous and fragment called okazaki fragments are formed by many RNA primers and is called the lagging strand. The fragments are joined by ligase.

♦ The process of copying genetic information from DNA to RNA is called *transcription*.
Transcription in *prokaryotes* is completed in three steps :-

1) Initiation - RNA polymerase binds with initiation factor called sigma factor and then binds to promoter site.

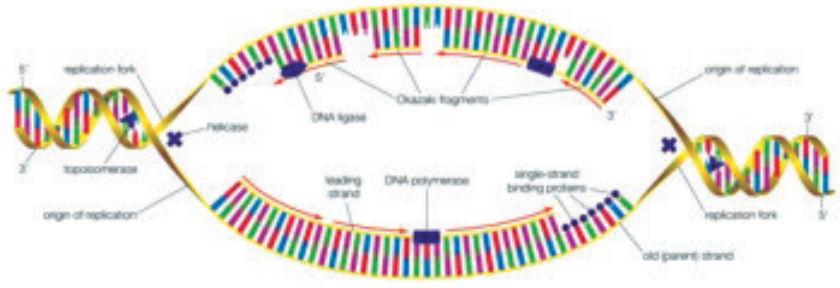


Figure 6.6 DNA Replication

2) Elongation - RNA polymerase gets separated from sigma factor and adds nucleoside triphosphate as the substrate. RNA is formed during this process by following the rule of complementarity and remains bound to enzyme RNA polymerase.

3) Termination - On reaching the site of termination, RNA polymerase binds with the *rho factor* (terminating factor). The RNA formed gets separated as a result.

Transcription in *eukaryotes* involves three types of RNA polymerase apart from RNA polymerase found in the organelles :-

RNA polymerase I - Transcribes RNA.
RNA polymerase II - Transcribes hn RNA (precursor of mRNA).
RNA polymerase III - Transcribes tRNA, 5 srRNA and snRNA.

→The primary transcript has both **exons** (coding region) and **introns** (non coding region) regions. Introns are removed by the process of **spicing**.
→ hnRNA undergoes two additional processes :-

i) *Capping* - An unusual nucleotide **(methylguanosine triphosphate)** is added to 5' end of hnRNA.

ii) *Tailing* - **Adenylate residues** are added at 3' end. It is now called mRNA (fully processed hnRNA) is transported out of the nucleus.

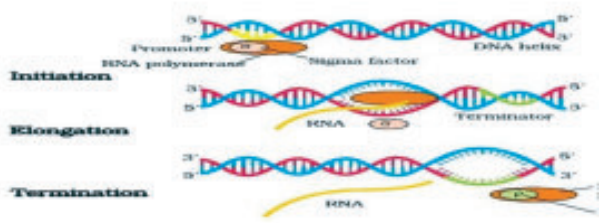


Figure 6.7 Transcription in prokaryotes.

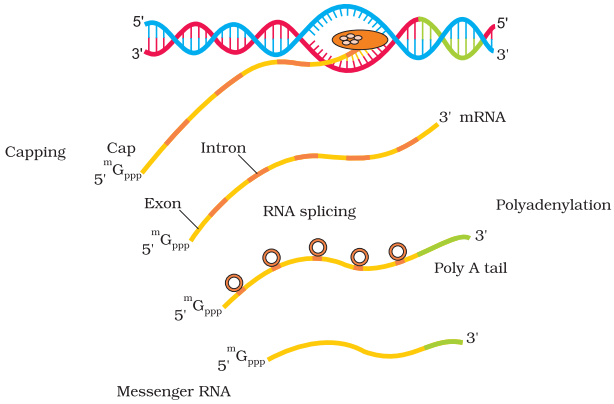


Figure 6.8 Transcription in eukaryotes.

♦ In the year 1961, **Jacob Monod** had proposed the concept of **operon**. Operon is a unit of prokaryotic gene expression. The lac operon consists of one **regulatory gene** *(i - gene)* coding for repressor of lac operon. The lac operon also consists of three **structural genes** (z, y and a). Gene z, y and a codes for β - galactosidase, permease and transacetylase, respectively.

- In absence of inducer (lactose) -

Repressor (i - gene) binds with operator (O)
↓
Operator turns off
↓
RNA polymerase stops transcription
↓
Structural genes (z, y and a) do not produce lac mRNA and enzymes.

- In presence of inducer (lactose) -

Repressor binds to inducer (lactose)

↓

Operator (O) turns on

↓

RNA polymerase starts transcription

↓

Structural genes (z, y and a) produces mRNA and enzymes (β - galactosidase permease and transacetylase, respectively).

♦ **Genetic code** is the sequence of nucleotides in DNA and RNA that determines the amino acid sequence of proteins. A **codon** is a sequence of 3 DNA or RNA nucleotides that corresponds with specific amino acid during protein synthesis.

♦ **George Gamow** had suggested that genetic code should be a combination of 3 nocleotides in order to code for 20 amino acids.

♦ **H.G. Khorana** had developed chemical method of synthesising RNA molecules with defined combination of bases.

♦ **Marshall Nirenberg's** cell free system for protein symthesis finally helped in deciphering the code.

Refer page no.- 112 of textbook for better understanding of salient features of a genetic code.

♦ **tRNA** is called the **adapter molecule**. Because it has an anticodon loop that has bases complementary to the code present on mRNA and also has an amino acid acceptor to which amino acid binds. tRNA is specific for each amino acid. Secondary structure of tRNA depicts that of a clover-leaf structure, whereas the actual tRNA molecule is of L shape.

♦ **Translation** is the process of polymerisation of amino acids to form a polypeptide. The order and sequence of amino acids are defined by the sequence of bases in the mRNA. Translation involves the following steps -:

1) Charging of tRNA - Amino acids are activated in the presence of ATP and linked to specific RNA. This is called **aminoacylation of tRNA**.

2) **Initiation** - Ribosome binds to the mRNA at the site of **start codon (AUG)**, which is recognised by the initiator tRNA.

3) **Elongation** - complexes composed of an amino acid linked to tRNA sequentially binds to the appropriate codon in mRNA by forming complementary base pairs with tRNA codon. The ribosomes move from codon to codon along with the mRNA. Amino acids are added one by one, translated into polypeptide sequences.

4) **Termination** - Release factors bind to the stop codon (UAG or UAA or UGA), hence terminating translation and releasing the complete polypeptide from the ribosome.

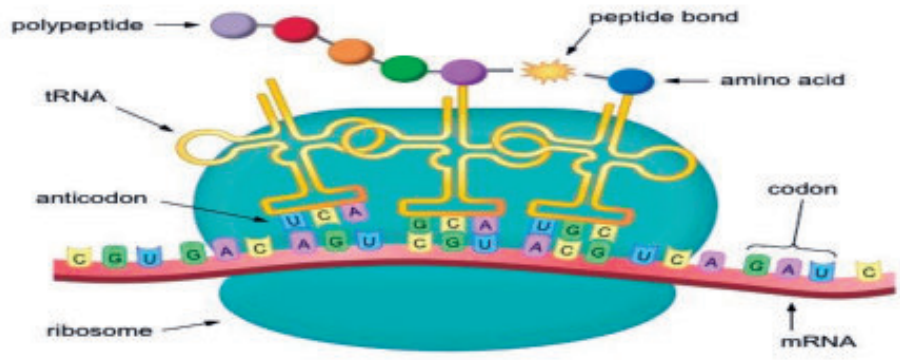
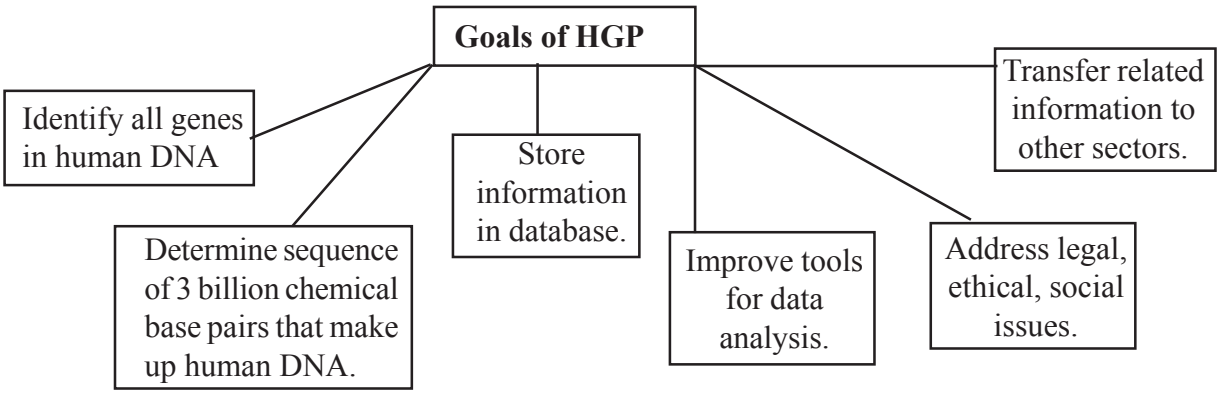


Figure 6.9 Translation

Interesting fact : Transcription occurs in nucleus, whereas, translation occurs in the cytoplasm.

♦ **Human Genome Project (HGP)** was launched in 1990 to find out the complete DNA sequence of human genome using genetic engineering technique and bioinformatics to isolate and clone the DNA segment for determining DNA sequence.



♦ **DNA fingerprinting** is the technique to identify and analyze the variation on the basis of polymorphism in the DNA sequence.

♦ **Alfred Jaffrey** had developed the technique of **DNA fingerprinting** in 1985. He had used **satellite DNA** as a probe. It was called as **Variable Number Tandem Repeats (VNTR)**. Eearlier, Southern blot hybridisation using radiolabelled VNTR as a probe was used.

Steps of DNA fingerprinting :-

1) **Extraction of DNA** using high speed refrigerated centrifuge machine.
2) **Amplification** of DNA by using polymerase chain reaction (PCR).
3) **Digestion** of DNA using restriction enzymes.
4) **Separation** of DNA fragments by using gel electrophoresis.
5) **Southern bloting** is used to transfer separated DNA sequences on to nitrocellulose or nylon membrane.
6) **Hybridisation** using labelled VNTR probes.
7) Detection of hybridized DNA fragments by **autoradiography**.

CHAPTER BASED QUESTIONS

A) Objective questions (1 mark)
I) Choose the most appropriate option from the following :

1) Nitrogen base is linked to pentose sugar through which of the following bonds ?
   a) Phosphodiester bond b) N - glycosidic bond
   c) Hydrogen bond d) Phosphoester bond
2) Electric charge on DNA is -
   a) Positive b) Neutral c) Zero d) Negative
3) Lac operon concept had been proposed by -
   a) Jacob Monod b) Rosalind Franklin
   c) Erwin Chargaff d) Watson and Crick
4) Which of the following RNAs undergo capping ?
   a) rRNA b) tRNA
   c) hn RNA d) All of the above
5) Which of the following steps in transcription is catalysed by RNA polymerase ?
   a) Termination b) Initiation
   c) Elongation d) All of the above
6) The nucleotides differ from nucleosides because of -
   a) Presence of phosphate group in nucleotides.
   b) Presence of phosphate group in nucleosides.
   c) Presence of nitrogen base in nucleotides.
   d) Presence of nitrogen base in nucleosides.
7) The sugar present in DNA and RNA are -
   a) Both RNA and DNA have hexose sugar.

b) Both RNA and DNA have pentose sugar.
c) RNA has hexose sugar and DNA has pentose sugar.
d) RNA has pentose sugar and DNA has hexose sugar.

8) The terminator site for transcription if located at -
a) 3' upstream end of the transcription unit.
b) 5' upstream end of the transcription unit.
c) 3' downstrem end of the transcription unit.
d) 5' downstrem end of the transcription unit.

9) Choose the incorrect statement from the following -
a) AUG is the initiation codon.
b) AUG codes for methionine.
c) UAA is the stop codon.
d) AUG codes for methionine only in eukaryotes, but not in prokaryotes.

10) Which of the following might have evolved first as the genetic material?
a) DNA b) Protein c) RNA d) Lipids

11) Choose the odd one out from the following -
a) AUG b) UAA c) UGA d) UAG

12) RNA differs from DNA in having -
a) Additional -OH group in the 3' position in the ribose sugar.
b) Additional -OH group in the 2' position in the ribose sugar.
c) Additional - OH group in the 3' position of the phosphate end.
d) Additional -OH group in the 2' position of the phosphate end.

13) If the sequence of nitrogen bases of the template stand of DNA in a transcription unit is 3' AACGTGT 5', then the sequence of nitrogen bases in its mRNA transcript would be -
a) 5' UUGCACA 3' b) 3' UUGCACA 3'
c) 5' AACGUGU 3' d) 3' AACGUGU 5'

14) Which of the following statements is true about double helix structure of DNA ?
a) Adenine forms two hydrogen bonds with Thymine from the opposite strand and Guanine forms three hydrogen bonds with cytosine from the opposite strand.
b) The two strands of DNA have antiparallel polarity.
c) The pitch of the helix is 3.4 nm.
d) All of the above.

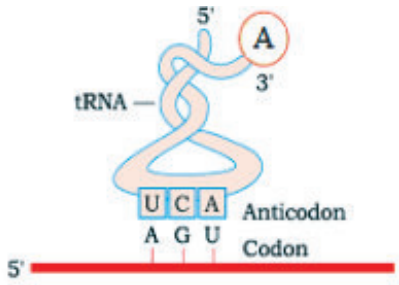
15. If the base sequence of a codon in mRNA is 5' UAC 3', then the sequence of tRNA pairing with it must be -
a) 3' UAG 5' b) 5' UAC 3' c) 3' AUG 5' d) 5' AUG 3'

16) Uniform width is maintained throughout the DNA molecule because -
a) Purine bases always pair with purine bases through hydrogen bonds.
b) Purine bases always pair up with pyrimidine bases through hydrogen bonds.

c) Pyrimidine bases always pair up with pyrimidine bases through hydrogen bonds.
d) None of the above.

17) In the given diagram, Identify A.

a) Tyr b) Lys c) Ser d) Val



18) Splicing is the removal of -

a) Introns from the primary transcript.
b) Axons from the primary transcript.
c) Exons from the primary transcript.
d) Both options 'a' and 'c' are correct.

19) Lac operon concept of gene expression is primarily regulated at which level ?

a) Replication b) Transcription c) Translation d) Reverse translation

20) Match column A with column B -

Column A	**Column B**
i) Helicase	a) Lagging strand
ii) DNA polymerase	b) Replication fork
iii) Ligase	c) rRNA
iv) RNA polymerase I	d) Leading strand

a) i - a; ii- b; iii - c; iv - d
b) i - d; ii - c; iii - b; iv - a
c) i - b; ii - a; iii - d; iv - c
d) i - b; ii - d; iii - a; iv - c

Question from 21 to 30 consists 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, but R is not the correct explanation of A.
c) A is true but R is false.
d) Both A and R are false.

21) Assertion (A) : The two strands of DNA have anti polarity.
Reason (R): In one strand of DNA, ribose sugar consists of a free OH group at 5' end while the other strand of DNA consists of ribose sugar having a free phospate group at 3' end.

22) Assertion (A) : DNA is considered to be better genetic material than RNA in most of the organisms.
Reasons (R) : Additional free OH group present at 2' position in ribose sugar of RNA makes it more reactive and unstable.

23) Assertion (A) : Guanine cannot pair with thymine.
Reason (R): In a DNA molecule , A - T rich parts melt faster than G-C rich parts.

24) Assertion (A) : Histones are acidic in nature.
Reason (R): Non histone proteins are rich in lysine and arginine.

25) Assertion (A) : The distance between a base pair in a DNA helix is approximately 0.34 nm.
Reason (R): The pitch of the DNA helix is 3.4 nm.

26) Assertion (A) : Heterochromatin stains dark.
Reason (R): Heterochromatin is transcriptionally active.

27) Assertion (A) : Hershey and Chase have proved DNA to be the genetic material.
Reason (R): Messelson ans Stahl have proved the semiconservative mode of DNA replication.

28) Assertion (A) : Leading strand is formed in a continuous mode in 5' $\rightarrow$ 3' direction.
Reason (R): DNA dependent DNA polymerase catalyses polymerisation only in 5' $\rightarrow$ 3' direction.

29) Assertion (A) : Maurice Wilkins and Rosalind Franklin had proposed the double helix structure of DNA.
Reason (R) : The double helix structure of DNA was proposed on the basis of X - ray diffraction data produced by Watson and Crick.

30) Assertion (A) : An experimenter had prevented polymerisation of nucleotides in a DNA polymer.
Reason (R): The experimenter had modified the DNA polymer by replacing /removing 3' OH group in deoxy ribose.

II) Fill in the banks :

1) The net electric charge on histones is _____.
2) Haploid content of human DNA is _____ bp.
3) Two nucleotides are linked through _____ linkage to form a dinucleotide.
4) In lac open, the z gene codes for _____.
5) During tailing, _____ residues are added at 3' end of hnRNA.
6) The DNA fragments formed in a lagging strand during DNA replication are called _____ fragments.
7) Transformation experiment has been performed by _____.
8) RNA polymerase binds with initiation factor _____ before binding to the promotor site.
9) Translation occurs in the _____ of the cell.
10) In absence of inducer, repressor binds to the _____.

B) Very short answer type questions (1 mark)

1) What is splicing ?
2) Name the organism used by Griffith for transformation experiment.
3) What are exons ?
4) Write Chargaff's rule.
5) What is cistron ?
6) Why can't stop codons continue the process of transcription ?
7) Name the precursor of mRNA ?
8)What is tailing ?
9) What do you mean by aminoacetylation of tRNA ?
10) What is capping ?
11) What do you mean by untranslated regions ?
12) Write the full form of VNTR.
13) Name the scientist who had developed the method of DNA fingerprinting.

QUESTIONS WITH SAMPLE ANSWER

A) Short answer type question : **(2 marks)**

1) Why both strands of DNA do not get copied during transcription ?

Ans: Both strands of DNA do not get copied during transcription because of the following reasons :-

i) If both strands of DNA gets copied during transcription, then two RNA molecules being complementary to each other would become double stranded RNA, hence preventing protein synthesis.

ii) If both strands of DNA gets copied, then one segment of DNA would be coding for two different proteins, hence complicating the genetic information transfer machinery.

B) Short answer type question : **(3 marks)**

1) Name the three major types of RNAs and specify the function of each during the synthesis of polypeptide.

Ans : The three major types of RNAs and their specific fuctions during the synthesis of polypeptide are as follows -

i) **Messenger RNA (mRNA)** - It is needed for deciding the sequence of amino acid of the polypeptide chain to be formed.

ii) **Transfer RNA (tRNA)** - It recognises the codon on mRNA and transports the amino acid to the site of protein synthesis.

iii) **Ribosomal RNA (rRNA)** - It plays catalytic and structural role during the process of translation.

DO IT YOURSELF

A) Short answer type questions. **(2 marks)**

1) How is a guanosine formed ? Is it same as deoxyguanosine ? justify. (1+1)
2) Why is tRNA called as an adapter modecule ? (2)
3) What is genetic code ? Mention the contribution of H.G. Khorana in deciphering the genetic code. (1+1)
4) What is polymorphism ? (2)
5) Differentiate between repetitive DNA and satellite DNA. (2)
6) Mention two major differences between RNA and DNA. (2)
7) Explain why chromatin appears as 'beads on structure' structure.
8) The following diagram depicts a part of the experiment done by Griffith to prove the transforming principle. Identify A, B, C and D. (½ + ½ + ½ + ½)

S strain → Inject into mice → (A)
(B) → Inject into mice → Mice live
S strain → Inject into mice → Mice live
(c)
S strain (heat - killed) + R strain (D) → Inject into mice → Mice die

B) Short answer type questions. **(3 marks)**

1) What are histone proteins ? Explain their role in packaging of DNA helix in brief . (1+2)
2) Diffrentiate between leading strand and lagging strand. (3)
3) What is a nucleotide ? How is it different from a nucleoside ? (1+2)
4) Briefly explain the central dogma of molecular biology. (3)
5) According to your understanding, which is the most suitable genetic material for living organisms? Give reasons to justify your answer. (1+2)

C) Long answer type questions. **(5 marks)**

1) What is semiconservative mode of DNA replication ? Explain the experiment performed by Meselson and Stahl to prove the semiconservative mode of DNA replication. (1+4)
2) Explain the mechanism of DNA replication with suitable diagram. (3+2)
3) What do you mean by operon concept ? Write the constituents of lac operon along with their respective functions. (1+4)
4) Explain the various steps of transcription in prokaryotes. Explain how different types of RNA polymerase are involved in transcription in eukaryotes, apart from RNA polymerase found in the organelles. (3+2)
5) What is Human Genome Project (HGP) ? Write the goals of HGP. (1+4)

6) Explain the lac operon concept in presence and absence of an inducer. (2½ + 2½)

7) What is translation ? Explain the various steps involved in translation. (1 + 4)

8) What is DNA finger printing ? Write its any three applications. (2+3)

9) Explain the salient features of double - helix structure of DNA as explained by Watson and Crick. (5)

10) Mention the different criteria which must be fulfilled by a molecule in order to act as a genetic material. Name an organism whose genetic material is RNA. (4+1)

TEACHER'S NOTE

In 'Do it yourself' section, take care of the following points -

- Refer page no. - 96, 114, 99, 97, 103 for answering Q.A.1, Q.A.2, Q.B.1, Q.C.9, Q.C.10, respectively.
- You must draw diagrams while answering Q.A.2, Q.B.1, Q.B.2, Q.B.4. Q.C.1, Q.C.2, Q.C.3, Q.C.4, Q.C.6, Q.C.7, Q.C.9 so that your understanding of the concepts get reflected through the scientific diagrams.

ANSWERS TO THE CHAPTER BASED QUESTIONS

(A) Objective Questions

I) 1) b 2) d 3)a 4) c 5) d 6) a 7) b 8) c 9) d 10) c 11) a 12) b 13) a 14) d 15) c
16) b 17) c 18) a 19) b 20) d 21) c 22) a 23) b 24) d 25) a 26) c
27) b 28) a 29) d 30) a.

II) I) Positive 2) 3.3×10^9 bp 3) 3' - 5' phosphodiester
4) β - galactosidase 5) Adenylate 6) Okazaki 7) Fredirick Griffith
8) Sigma factor / σ factor 9) Cytoplasm 10) Operator.

B) Very short answer type questions

1) Slicing is the process of removing introns from precursor mRNA to form mature mRNA.

2) *Streptococcus pneumoniae*.

3) The sequences of mRNA which plays active role in coding amino acids are called exons.

4) Chargaff's rule states that for a double stranded DNA, the ratios between Adenine and Thymine and Guanine and Cytosine are constant and equal.

5) Cistron is a segment of DNA that codes for a specific polypeptide during protein synthesis.

6) Stop codons cannot continue the process of transcription because there are no tRNAs for stop codons.

7) hn RNA

8) Tailing is the process of addition of adenylate residues at 3' end of hn RNA to form fully mature mRNA.
9) The process of activation of amino acids in presence of ATP and linking of these amino acids to their cognate tRNA is called charging of tRNA or aminoacetylation of tRNA.
10) Addition of an unusual nucleotide, methyl guanosine triphosphate to the 5' end of hn RNA is called capping.
11) Untranslated regions are some additional sequences of mRNA that do not get translated.
12) Variable Number of Tandem Repeats.
13) Alfred Jaffrey.

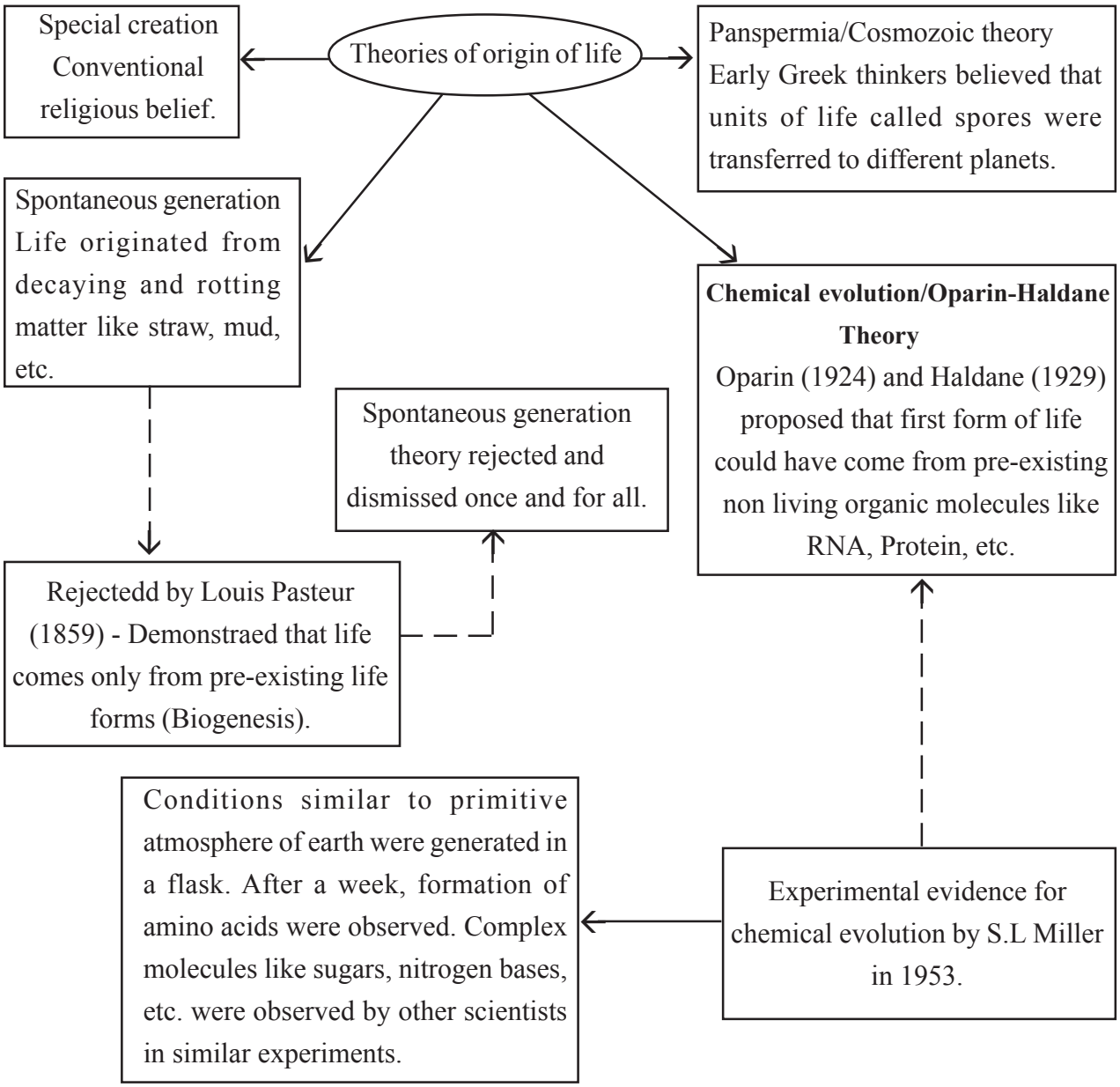
Unit -VII

CHAPTER - 7

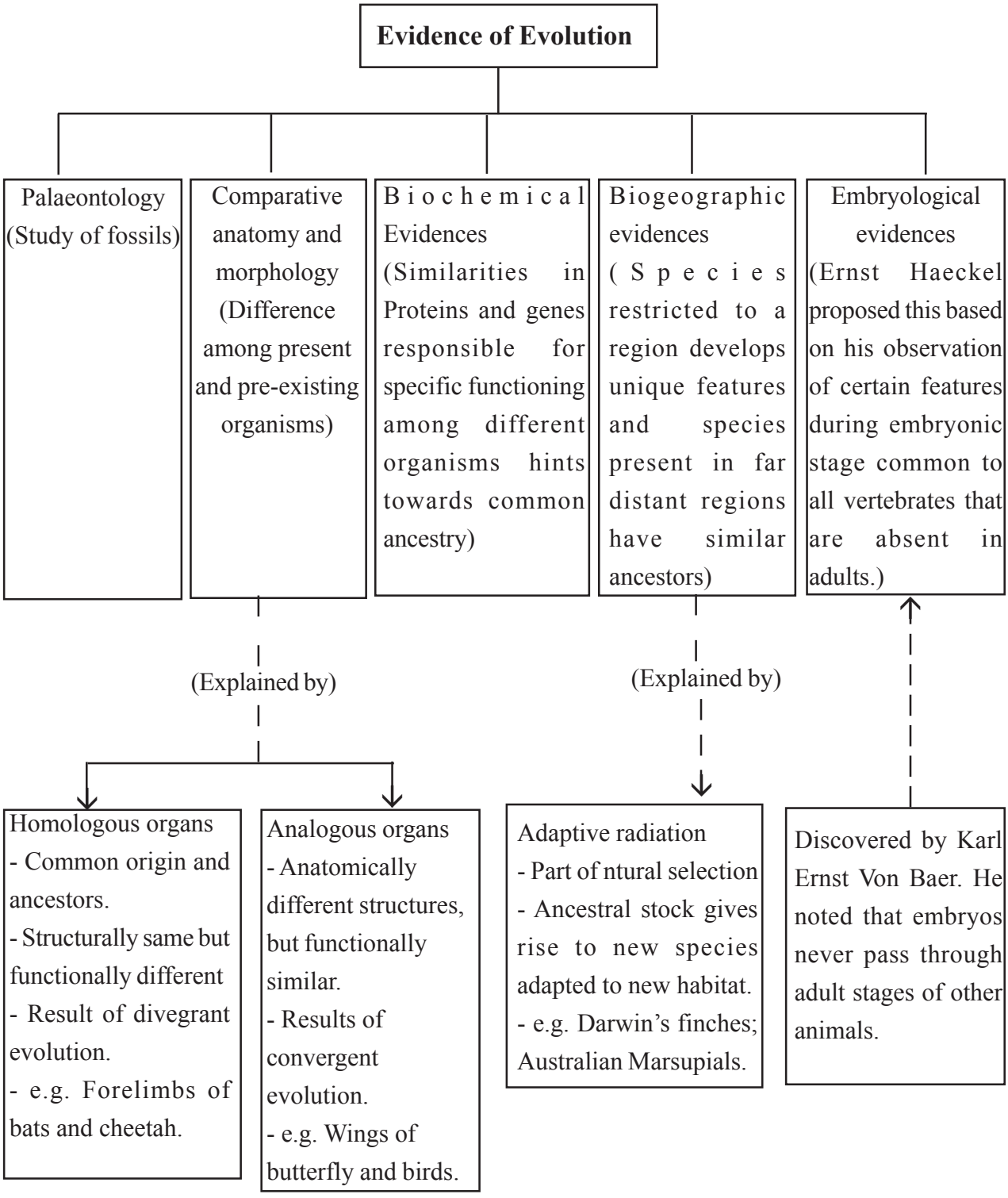
EVOLUTION

IMPORTANT CONCEPTS

- Evolutionary biology is the study of history and evolutionary process of various life forms on earth.
- Evolution is a process that results in biological and heritable changes in a specias over a span of time. This occurs for the survival of the species.
- The Big Bang theory explains the origin of the universe, which is almost 20 billion years old. The Big Bang theory states that a huge explosion occured and the universe got expanded, the temparature decreased, followed by the formation of hydrogen and helium. Then the galaxies were formed due to condensation of gases under gravitation.
- The Earth was supposed to have formed about 4.5 billion years back in the milky way galaxy. Earth had no atmosphere back then. Water vapour, methane, carbon dioxide and ammonia were released from the molten mass that covered the surface of the Earth. The UV rays from the Sun splitted the water into hydrogen and oxyzen. Hydrozen being lighter escaped and oxyzen got combined with ammonia and methane to form water, carbon dioxide and other gases. Gradually the ozone layer was formed. Cooling of the ozone layer resulted into the condensation of water vapour to fall as rain and fill up the depressions to form oceans. Hence the earth's atmosphere was formed.
- Life appeared 500 million years after the formation of the earth.



- Chemical theory of origin of life was more or less accepted. This has also been supported by the anslysis of the meteorite content which had similar compounds like the ones which formed in experiments similar to that of Miller's experiment.
- The first non-cellular forms of life (RNA, proteins, polysaccharides) had originated probably 3 billion years back. Single celled aquatic organisms probably have evolved about 2000 million years ago slowly through evolutionary forces from non-living molecules. This is called abiogenesis. This has been accepted by many scientists.


Evidence of Evolution
Palaeontology (Study of fossils)
Comparative anatomy and morphology (Difference among present and pre-existing organisms)
Biochemical Evidences (Similarities in Proteins and genes responsible for specific functioning among different organisms hints towards common ancestry)
Biogeographic evidences (Species restricted to a region develops unique features and species present in far distant regions have similar ancestors)
Embryological evidences (Ernst Haeckel proposed this based on his observation of certain features during embryonic stage common to all vertebrates that are absent in adults.)
(Explained by)
(Explained by)
Homologous organs
- Common origin and ancestors.
- Structurally same but functionally different
- Result of divegrant evolution.
- e.g. Forelimbs of bats and cheetah.
Analogous organs
- Anatomically different structures, but functionally similar.
- Results of convergent evolution.
- e.g. Wings of butterfly and birds.
Adaptive radiation
- Part of ntural selection
- Ancestral stock gives rise to new species adapted to new habitat.
- e.g. Darwin's finches; Australian Marsupials.
Discovered by Karl Ernst Von Baer. He noted that embryos never pass through adult stages of other animals.

Refer figure 7.3 of page no-131 and figure 7.7 of page no- 134 and figure 7.6 of page no-133 of textbook for better understanding of homologous organs, convergent evolution and adaptive radiation, respectively.

- Change in inherited traits over successive generations in any population of organisms is referred to biological evolution. This can be traced to Darwinian theory of evolution, whose essence is natural selection. As per Darwin, the variations which occur during the course of evolution, are the characteristics which enable the organism to survive better in natural conditions. These characteristics would outbreed the characteristics that are less endowed to survive under such natural conditions, hence, resulting in survival of the fittest (only reproductive fitness). Another key concept of Darwinism is Branching descent, which means that the organisms are descended from common ancestors due to variations. Natural selection can be explained by the example of moths collected in 1850s. Before industrialisation, more white winged moths were there; but after industrialisation, more dark winged moths have been observed in the same area. This variation has occured in order to get saved from the predators.
- Darwin has proposed the term organic evolution. It means that present complex plants and animals have evolved from the earliar simpler forms of life by gradual changes.
- Before Darwin, French naturalist Lamarck had proposed that evolution of organisms occur due to use and disuse of organs. For example, he had explained that giraffes formed long necks in an attempt to search and reach leaves of trees with long height.
- Hugo de Vries proposed that mutation causes evolution, and not the minor variations as suggested by Darwin. Mutation causes large differences and are random and directionless while Darwinian variations are slow, small and directional. Hugo de Vries had proposed the concept of saltation. Saltation is a large and abrupt evolutionary change that has been brought about due to sudden mutation.
- Hardly - Weinberg principle states that allele frequencies in a population are stable and remains consant from generation to generation.

  The gene pool remains constant. This is called genetic equilibrium. Sum total of all the allelic frequencies is 1.

  Mathematically, the principle can be represented as

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

  Where, p and q represents the individual allele frequencies.
- Diffrences in values of p,q and pq indicates the extent of evolutionary change. Disturbance in the genetic equilibrium can be interpreted as change in variations leading to evolution.
- Factors which can affect Hardy-Weinberg equilibrium are –

  Gene migration or gene flow; Genetic drift; Mutation; Genetic recombination; Natural selection.
- Natural selection can lead to stabilisation or directional changes of disruption.

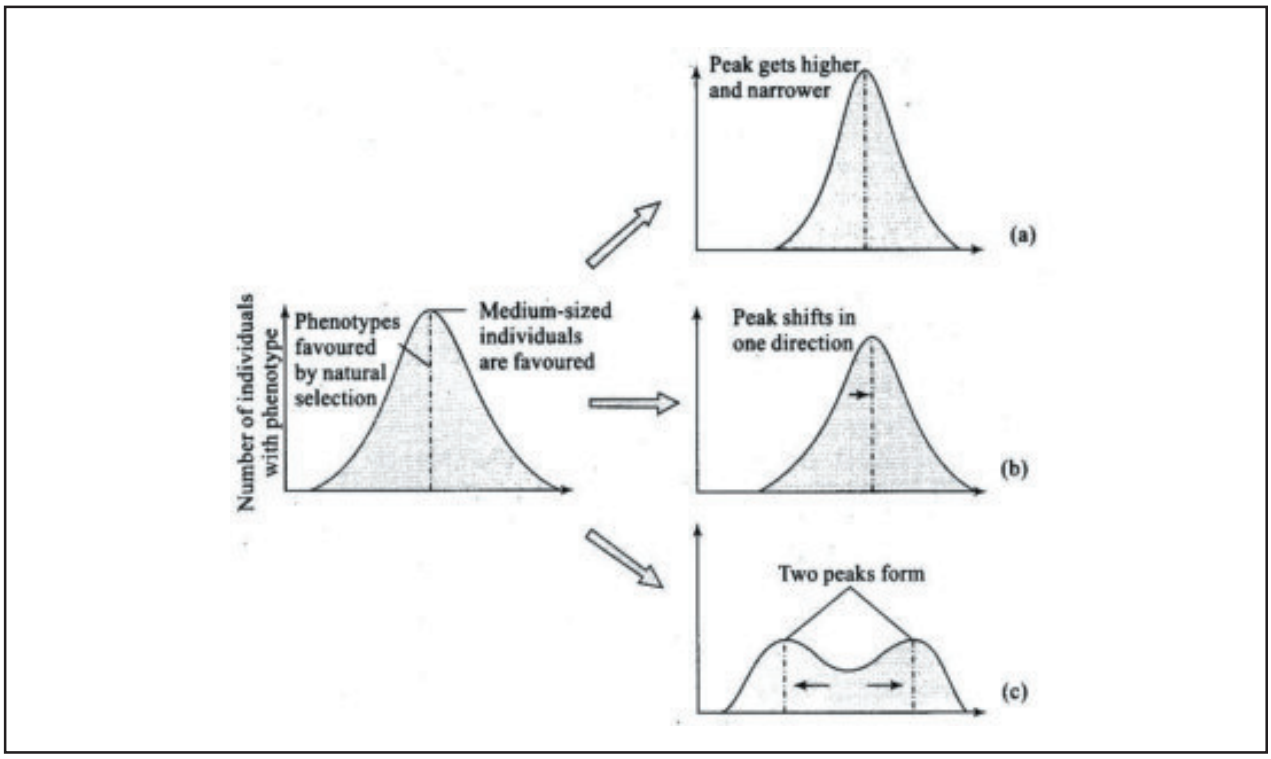


Figure: 7.1 *Operation of natural selection on different traits :*
(a) Stabilising; (b) Directtional and (c) Disruptive

Evolution of man -

→ About 15 million years ago (mya), ***Dryopithecus*** and ***Ramapithecus*** existed. ***Dryopithecus*** were more similar to apes whereas Ramapithecus more man-like.

→ About 2 mya, ***Australopithecus*** existed, who most likely lived in East African grasslands and used stone weapons for haunting, but were having a fruit-based diet essentialy.

→ Hominid was the first man-like organism and was called ***Homo habilis***, who had a brain capacity between 650-800 cc. They survived on plant based food only.

→ The next stage of hominid was ***Homo erectus***, who have evolved 1.5 myo. They had large brain capacity and prabably ate meat.

→ Between 100000-40000 years back, Neanderthal man evolved with a brain size of 1400 cc and probably ate meat. They lived near central asia and used hides to protect their body and burried their dead.

→ ***Homo sapiens*** arose in Africa and migrated accross continents. Modern ***Homo sapiens*** have started living since ice age .

CHAPTER BASED QUESTIONS

A) Objective questions **(1 mark)**

I) Choose the most appropriate option from the following :

1) The finches of Galapagos island provide an evidence in favour of -

(a) Special creation (b) Biogeographical evolution

(c) Evolution by mutation (d) Retrogressive evolution

2) Tasmanian wolf is marsupial, whereas wolf is a placental mammal. This shows -

(a) Divergent evolution (b) Panspermia

(c) Convergent evolution (d) None of these

3) Darwin got influenced by the work of -

(a) Malthus's essay on population (b) Lamarck's theory of acquired traits

(c) Wallace's theory of origin of species (d) Weismann's theory of germplasm

4) The theory of continental drift has been proposed by -

(a) Oparin (b) Darwin (c) Wagner (d) Lamarck

5) The frequency of heterozygous individual in Hardy-weinberg equation is represented by -

(a) pq (b) 2 pq

(c) Both 'a' and 'b' are correct (d) None of these

6) Homologous structures are a result of -

(a) Convergent evolution (b) Embryological evolution

(c) Divergent evolution (d) None of these

7) Evolution of living organisms show that life forms had a trend of moving from -

(a) Dryland to wetland (b) Land to water

(c) Sea water to ocean water (d) Water to land

8) Paleontological evidence for evolution is the study of -

(a) Fossils (b) Homologous organs

(c) Analogous organs (d) Vestigeal organs

9) Which type of selection is the industrial melanism observed in moth ?

(a) Artificial (b) Disruptive (c) Stabilising (d) Directional

10) Which of the following is a linked species ?

(a) Dodo bird (b) Coelacanth lobe (c) Chimpanzee (d) Gorilla

11) Which of the following is the most accepted line of descent in human evolution?

(a) *Ramapithecus - Homo habilis - Homo erectus - Homo sapiens*

(b) *Homo Habilis - Homo erectus - Homo sapiens - Ramapithecus*

(c) *Australopithecus - Homo sapiens - Ramapithecus - Neanderthals*

(d) *Homo Erectus - Ramapithecus - Homo habilis - Homo sapiens*

12) Which of the following is used as an atmospheric pollution indicator ?

(a) Licopodium (b) Leech (c) Lepidoptera (d) Lichens

Questions from no. 13 to 20 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, but R is not the correct explanation of A.

(c) A is true but R is false.

(d) Both A and R are false.

13) Assertion (A) : Spontaneous generation theory explains the basis of origin of life from decaying and rotting matter.

Reason (R) : Chemical evolution theory proves that life has originated from pre-existing non living organic molecules like RNA, Protein, etc.

14) Assertion (A) : A number of different marsupials have evolved from the same ancestral stock within the Australian island continent.

Reason (R) : The different species radiate to different geographical areas from a single species starting from a point in a geographical area by the process of adaptive radiation.

15) Assertion (A) : Before the formation of earth's atmosphere, the UV rays from the sun splitted the water into hydrogen and oxygen.

Reason (R) : Formation of ozone led to the formation of free moleculer oxyzen.

16) Assertion (A) : Homologous organs are having different ancestral origin.

Reason (R) : Homologous organs are formed as a result of convergent evolution.

17) Assertion (A) : Genetic drift leads to evolution.

Reason : Genetic drift leads to selection of animals having most advantageous mutations.

18) Assertion (A) : Study of homologous and analogous organs help to trace the evolutionary relationship.

Reason (R) : Paleontology is the basis of studying homologous and analogous organs.

19) Assertion (A) : Darwin suggested minor variations to be the cause of evolution over a long period of time.

Reason (R) : Saltation brings about abrupt and large evolutionary changes due to sudden mutation.

20) Assertion (A) : According to Hardy-Weinberg, genetic equilibrium is maintained in a population from generation to generation until there is any evolutionary influence on them.

Reason (R) : Hardy-Weinberg equilibrium is affected only by gene migration.

II) Fill in the Blanks:

1) Primates known as _____ was more man-like in the course of human evolution about 15 mya.
2) _____ are the reptiles which retreated back to water to evolve into fish like reptiles.
3) Fossils are generally found in _____rocks.
4) Age of a fossil is computed by using _____ dating.
5) The latin name of first hominid is _____.
6) Hugo de vries worked on _____ flower to study evolution.
7) The earth is believed to form about _____ years ago.
8) _____ theory explains the origin of the universe.
9) The geological history of earth closely correlated with the _____ history of earth.
10) Fitness according to darwin refers only to _____ fitness.
11) Life appeared about _____ years after the formation of earth.
12) First molecular compounds formed in earth's original prebiotic atmosphere were _____ and _____.
13) _____ was absent in earth's original prebiotic atmosphere, but was produced in earth's modern biotic atmosphere.
14) _____ was the first organic compound which formed in earth's original prebiotic atmosphere.

III) Very Short answer type questions: (1 mark)

1) Who had disproved the embryological evidence for evolution ?
2) To which island did Darwin travel and came up with the concept of adaptive radiation ?

3) What is biogenesis ?
4) What is panspermia ?
5) What is founder affect ?
6) What is continental drift ?
7) What is genetic drift ?
8) Name the chemicals used by Miller in his experiment to prove chemical evolution.
9) Who had used the term 'survival of the fittest' for the first time ?
10) What is saltation ?

QUESTIONS WITH SAMPLE ANSWERS

A) Short answer type Question : **(2 marks)**

1) What is divergent evolution ? Give examples. (1½ +½)

Ans :- Divergent evolution is the process of evolution by which homologous organs are formed in two or more species having common ancestor. Homologous organs are similar in structure but perform different functions.

For example, the thorn of *Bougainvillea* and tendrils of *Cucurbita* are homologous organs formed as a result of divergent evolution.

B) Short answer type question : (3 marks)

1) Explain the operation of natural selection on different traits. (3)

Ans: Natural selection is the process by which organisms adapt to their environment in order to survive and produce more offsprings. The operation of natural selection on different traits can be explained by :-

i) Stabilisation - The process in which more individuals acquire mean character value is called stabilisation. e.g. - Human birth.

ii) Directional selection - The process of natural selection in which more individuals acquire value other than mean character value, is called directional selection. e.g.- Beak size in population of finches.

iii) Disruption - The process of natural selection in which more individuals acquire peripheral character value at both ends of the distribution curve, is called disruption. e.g. - Both short and tall organisms are produced, whereas medium height of organisms is not favoured.

DO IT YOURSELF

A) Short answer type questions : (2 marks)

1) Explain the theory of biogenesis proposed by Louis Pasteur. (2)
2) Explain how natural selection operates in nature by taking the example of white winged and dark winged moths of England . (2)
3) Explain convergent evolution with the help of an example. (1+1)
4) What are the key concepts of evolution theory given by Darwin ? (1+1)
5) Explain the Big bang theory of origin of the universe. (2)
6) How did continental drift help the pouched mammals of Australia to survive ? (2)

B) Short answer type questions : (3 marks)

1) Write the mathmatical equation representing the Hardy Weinberg's principle. Explain it in brief. (1+2)
2) Explain the mechanism of formation of Earth's atmosphere. (3)
3) What is abiogenesis ? How does the experiment done by S.L. Miller on chemical evolution supports abiogenesis ? (1+2)
4) What is chemical theory of evolution ? Who proposed it ? Who had provided experimental evidence for this ? (1+1+1)
5) Differentiate between homologous organs and analogous organs. (3)
6) Name the scientist who came to similar conclusion on natural selection as a mechanism of evolution at the same time as that of Darwin. Give an example to explain how Lamarck supported the process of natural selection as the basis of mechanism of evolution. (1+2)

Long answer type questions : (5 marks)

1) Briefly explain the Hugo de Vries theory of mutation. How does it differ from Darwin's theory of natural selection ? (2+3)
2) Briefly explain the chemical evolution theory proposed by Oparin and Haldane. Explain the experimental evidence provided by S.L. Miller and Urey in support of chemical evolution. (2+3)
3) Briefly explain three factors which effects the Hardy-Weinberg equilibrium. How does gene migration and genetic drift effect Hardy Weinberg equilibrium differently ? (3+2)
4) What is the brain capacity of *Homo habilis* ? write the characteristic features of *Australopithecus* and *Homo erectus*. (1+2+2)

TEACHER'S NOTE

In the 'Do it yourself' section, take care of the following points -

- Refer page no- 132 of text book for answering Q.A.2.
- While answering Q.A.3, don't just write example. Rather explain how the example explains convergent evolution.
- Relate the answer of Q.B.5 with ancestry and divergent and convergent evolution.
- Refer page no.- 129 for answering Q.B.6.
- Use examples to answer Q.C.3.
- Explain the experimental set up and experiment while answering Q.B.3.

ANSWER'S TO THE 'CHAPTER BASED QUESTION'S SECTION

A) Objective Questions :

I) 1) b 2) c 3) a 4) c 5) b 6) c 7) d 8) a 9) d 10) b 11) a 12) d 13) b 14) a 15) c 16) d 17) a 18) a 19) b 20) c

II) 1) Ramapithecus 2) Icthyosaurs 3) Sedimentary 4) Carbon 5) Homo habilis 6) Evining primerose 7) 4.5 Billion 8) Big bang 9) Biological 10) Reproductive 11) 500 million 12)Water; Ammonia 13) Free oxyzen 14) Methane

B) Very short answer type questions

1) Karl Ernst Von Baer
2) Galapagos island
3) Biogenesis is the process by which living organism arises from other living matter.
4) Panspermia is the theory of origin of life according to which life is believed to be originated from spores that were transferred to different planets.
5) Founder effect is the phenomenon by which the original population gets drifted and shows large difference in their allelic frequency and hence becomes a new species.
6) The theory that explains how continents shift their positions on Earth's surface, is called continental drift.
7) Genetic drift refers to the change in gene frequency that occurs due to a random event leading to advantageous mutations.
8) Water, ammonia, methane and hydrogen.
9) Charles Darwin.
10) Saltation refers to the large and sudden mutation leading to evolution.

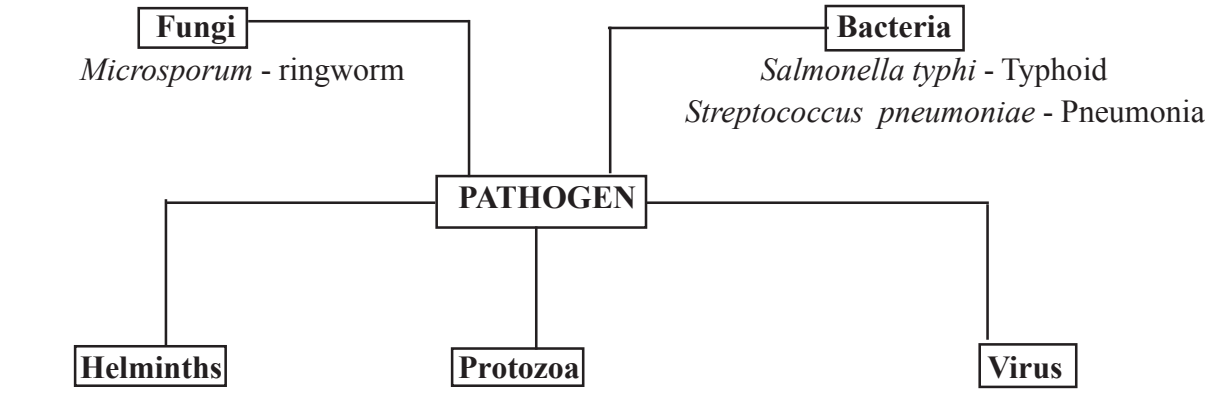
UNIT - VIII

CHAPTER - 8

HUMAN HEALTH AND DISEASE

IMPORTANT CONCEPTS

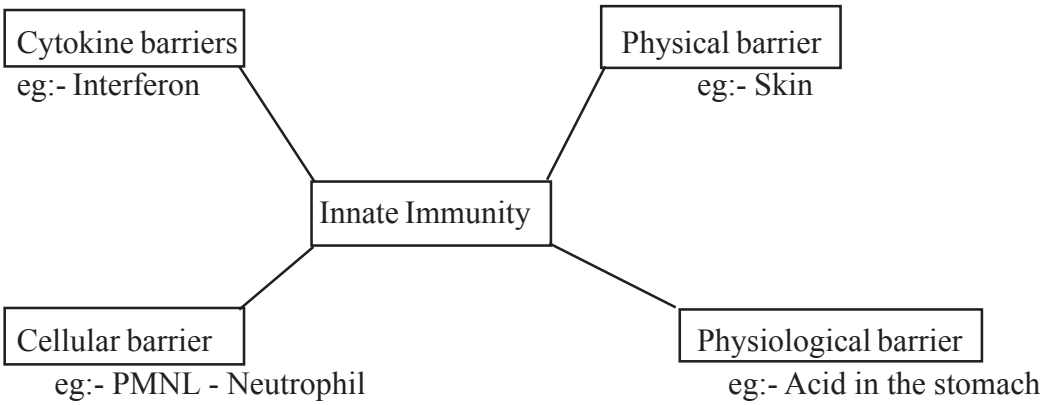
- **Health** does not simply mean 'absence of disease' or 'physical fitness'. It could be defined as state of complete physical, mental and social well being.
- Health is affected by -
  i) Genetic disorders - Deficiencies with which a child is born and deficiencies/defects which the child inherits from parents to birth.
  ii) Infections and
  iii) Life style including food and water we take, rest and exercise we give to our bodies, habits that we have or lack etc.
- Balanced diet, personal hygiene and regular exercise are very important to maintain good health. Yoga has been practised since time immemorial to achive physical and mental health.
- Vaccination against infectious diseases , proper disposal of wastes, control of vectors and maintenance of hygienic food and water resources are necessary for achieving good health.
- A wide range of organisms belonging to bacteria, viruses, fungi, protozoans,helminths etc., could cause diseases in man. Such disease causing organisms are called **pathogens**.



- Maintainance of personal and public hygiene is very important for prevention and control of many infections diseases.
- In cases of water-borne diseases such as amoebiasis and cholera, proper disposal of waste excreta, periodic cleaning and disinfection of water reservoirs, pools, cess pools and tanks and

observing practises of hygiene in addition to that close contact with the infected persons or their belongings should be avoided.

- **Innate immunity** is non-specific type of defence, that is present at the time of birth. This is accomplished by providing different types of barriers to the entry of the foreign agents into our body. Innate immunity consists of four types of barriers. These are -



- Each antibody molecules has four peptide chains two small called light chains [L] and two longer called heavy chains [H]. Hence an antibody is represented as $\mathbf{H_2\ L_2}$.

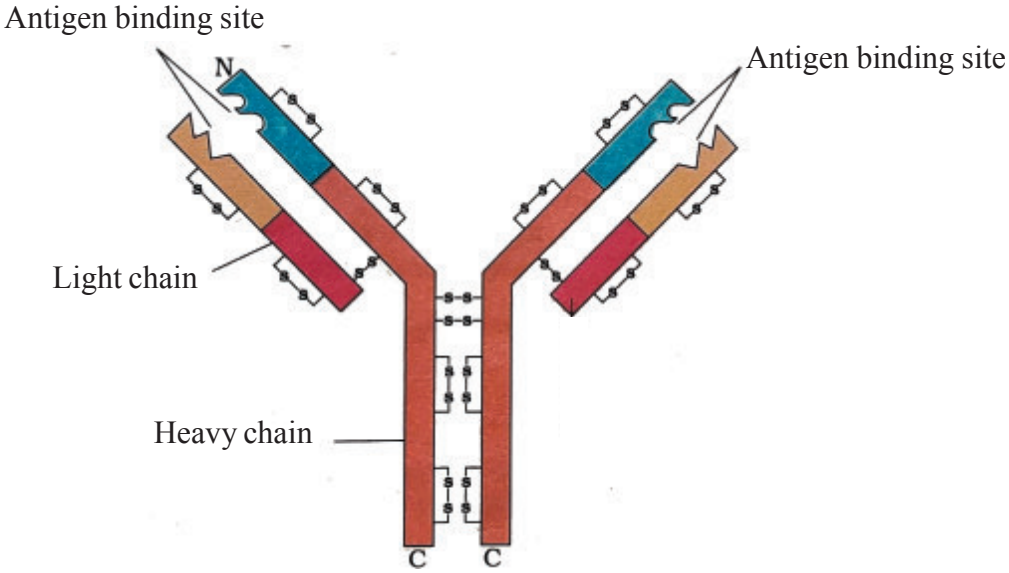


Figure - 8.1 Structure of an antibody molecule.

- Tissue matching, blood group matching are essential before undertaking any graft/Transplant and even after this the patient has to take immuno suppresants all his/her life. The body is able to differentiate '**self**' and '**nonself**' and the cell-mediated immune response is responsible for the graft rejection.
- The yellowish fluid **Colostrum** secreted by mother during the initial days of lactation has abundant antibodies (IgA) to protect the infant.
- The human immune system consists of lymphoid organs, tissues, cells and soluble molecules like antibodies. The immune system also plays an important role in allergic reactions, auto-immune diseases and organ transplantation.
- The **bone marrow** is the main lymphoid organ where all blood cells including lymphoid organ where all blood cells including lymphocytes are produed. The thymus is a lobed organ located near the heart beneath the breastbone.
- **AIDS** is caused by Human Immuno deficiency Virus (HIV), a member of a group of viruses called retrovirus, which have an envolope enclosing the RNA genome.

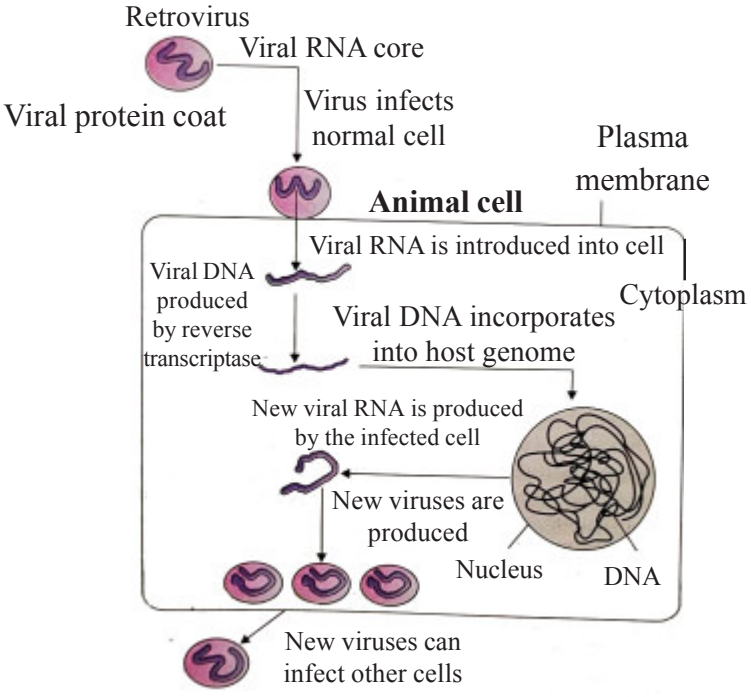


Figure : 8.2 Replication of retrovirus

- **Cancer** is one of the most dreaded disease of human beings and is a major cause of death all over the globe. More than a million Indians suffer from cancer and large number of them die from it annually.
- Transformation of normal cells into cancerous neoplastic cells may be induced by physical, chemical or biological agents. These agents are called Carcinogens.

- **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*.

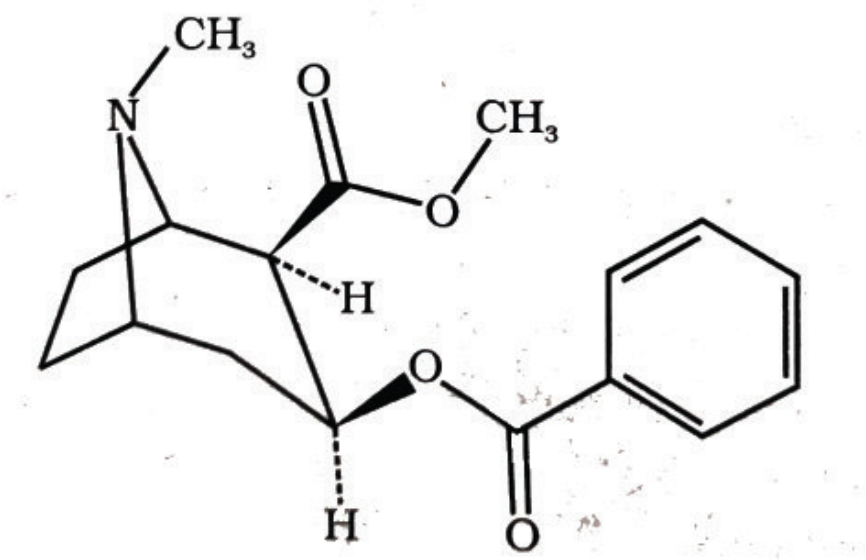


Figure 8.3 : Chemical Structure of Morphine

- **Adolescence** means both 'a period' and a 'process' during which a child become mature interm of his/her attitudes and beliefs for effective participation in society. The period between 12-18 years of age may be thought of as adolesence period. In other words, adolescence is a bridge linking childhood and adulthood.
- Excessive doses of drugs may lead to coma death due to respiratory failure, heart failure or cerebral hemorrhage. A combination of drugs or their intake along with alcohol generally results in overdosing and even deaths.
- Some of the measures mentioned here would be particularly useful for prevention and control of alcohol and drugs abuse among adolescents.
  i) Avoid undue peer pressure.
  ii) Education and counselling.
  iii) Seeking help from parents and peers.
  iv) Looking for danger signs.
  v) Seeking professional and medical help.

CHAPTER BASED QUESTIONS

A) **Objective Questions:** **(1 mark)**

I) **Choose the most appropriate option from the following:-**

1) Typhoid fever in human is caused by -

a) Polio virus b) *Salmonella typhi* c) *Plasmodium ovale* d) *Entamoeba histolytica*

2) Sexual cycle of malarial pathogen occurs in -

a) Female anopheles b) Human c) Both a & b d) None of the above

3) Innate immunity is _____ type of defence.

a) Specific b) passive c) Active d) Non-specific

4) An antibody is represented as -

a) H_2L_3 b) H_1L_1 c) H_4L_3 d) H_2L_2

5) Which of the following is affected by the infection of *Wuchereria bancrofti* -

a) Liver b) Lymphatic Vessels c) Nervous system d) Blood circulation

6) Hepatitis B vaccaine produced from -

a) Yeast b) Protozoa c) Helminths d) Virus

7) Colostrum is a example of -

a) Active immunity b) Passive immunity c) Innate immunity d) All of the above

8) Humoral immunity is associated with -

a) B - cell b) T- cell c) Macrophages d) None.

9) The primary Lymphoid organs are -

a) Bone marrow and Thymus b) Spleen & Thymus c) Bone marrow & Lymphnode
d) Thymus & Spleen

10) Which of the following is a Auto-immune disease -

a) Malaria b) Ascariasis c) Rheumatoid Arthritis d) Filariasis

11) A widely used diagnostic test for AIDS is -

a) Widal Test b) ELISA c) RIA d) All of the above

12) Cancer cell do not exhibit the property of -

a) cell division b) Metastasis c) Contact inhibition d) Generating tumors

13) Which of the following is the most feared property for malignant tumors -

a) Metastasis b) Contact inhibition c) Both a & b d) None of the above

14) which drug is being excessively taken by some sports person now a days -

a) Opioids b) Cannabinoids c) LSD d) Barbiturates

15) Excessive dossage of cocaine causes -

a) Hallucinations b) Insomina c) depression d) None.

16) Cocaine is commonly called as -

a) coke b) crack c) charas d) Both a & b

Questions from no. 17 to 19 consist of two statements - Assertion (A) and Reasons (R). Answer these questions selecting the appropiate option given below :-

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

17) **Assertion (A) :** Excessive dossage of Cocaine causes hallucinations.
Reasons : Cocaine has a potent stimulating action on the CNS.

18) **Assertion (A):** Number of helper T-Lymphocytes decreases in the body of HIV infected person.
Reasons (R) : HIV enters into helper T-Lymphocytes replicate and produce progeny of viruses that attack other T-Lymphocytes.

19) **Assertion (A) :** All antibody molecules have a basic structure composed of four polypeptide chain.
Reasons (R): Polypeptide chains are connected by glycosidic bond.

II) **Fill in the blanks :-** (1 mark)

1. Acquired Immunity is characterised by _____.
2. *Salmonella typhi* enter the _____ through contaminated food & water.
3. Diseases which are easily transmitted from one person to another, are called _____.
4. Maintinance of personal and _____ is very important for prevention and control of many infectious diseases.
5. Virus infected cells secrets proteins called _____.

6. The body is able to differentiate _____ and the cell mediated immune response is responsible for graft rejection.
7. _____ is slow and takes time to give its full effective response.
8. The principle of immunisation or vaccination is based on the property of _____ of the immune system.
9. The exaggerated response of the immune system to certain antigens present in the environment is called _____.
10. MALT constitutes about _____ percent of the Lymphoid tissue in human body.
11. The _____ is a large bean shaped Lymphoid organ.
12. The progeny of viruses released in the blood attack other helper _____.
13. _____ against cancer specific antigens are also used for detection of certain cancers.
14. The common approaches for treatment of cancer are surgery, radiation therapy and _____.
15. Dependence is the tendency of the body to manifest a characteristic and unpleasent _____ if regular dose of drugs/alcohol is abruptly discontinued.
16. The chronic use of drugs and alcohol damages nervous system and _____.

B. Very short answer type questions :-

1. What do you mean by health ?
2. Which test is used for confirmation of Typhoid fever ?
3. Name the protozoa which are resposible for malaria ?
4. What is haemozoin ?
5. What is Ascariasis ?
6. Write one example of cellular barrier incase of innate immunity.
7. What is interferons ?
8. How many peptide chains are present in a antibody molecule ?
9. How many types of antibodies are produced in our body ?
10. What is Colostrum ?
11. Which phenomenon is responsible for the graft rejection ?
12. Give one common example of allergens ?
13. Where immature lymphocytes differentiate into antigen sensitive lymphocyte ?
14. What is **MALT** ?
15. What is Metastasis ?

16. Which drug is very effective sedative and painkiller, and is very useful in patients who have undergone surgery ?
17. Which drug is responsible for depressant and slows down body functions ?
18. What is the source of Cocaine?
19. Which interferon is used for the treatment of Cancer ?

QUESTIONS WITH SAMPLE ANSWERS

A. Short answer type questions : (2 marks)

1. What do you mean by Carcinogens ?

Ans :- Transformation of normal cells into Cancerous neoplastic cells may be induced by physical, chemical or biological agents, these agents are called Carcinogens.

B. Short answer type questions : (3 marks)

1. Write about barriers of innate immunity ?

Ans :- Innate immunity consists of four types of barriers. These are -

(i) **Physical barriers :-** Skin on our body is the main barrier which prevents entry of micro organisms. Mucous coating of the epithelium lining the respiratory, gastro intestinal and urogenital tracts also help in trapping microbes entering the body.

ii) **Physiological barrier :-** Acid in the stomach, saliva in the mouth, tears from eyes - all prevent microbial growth.

iii) **Cellular barriers :-** Certain types of leukocytes (WBC) of our body like polymorpho-nuclear leukocytes (PMNL-neutrophils) and monocytes and natural killer (type of Lymphocytes) in the blood as well as macrophages in the tissues can phagocytose and destroy microbes .

iv) **Cytokine barriers :-** Virus infected cells secrete proteins called interferons which protect non-infected cells from further viral infection.

DO IT YOURSELF

A. Short answer type Question :- (2 marks)

1. What is primary immune response.
2. Differentiate between active and passive immunity.
3. What is allergens? Give one example.
4. Write down the scientific name of different types of malarial parasite.
5. What do you mean by retrovirus ? Give one example.
6. Differentiate between benign tumor and malignant tumor.
7. Write two important characteristic of a cancer cell.
8. Distinguish between normal cell & cancer cell.
9. What is heroin ? Write down its source ?
10. Name two secondary Lymphoid organ.
11. What is filariasis ? Write down its causative organism.
12. What is withdrawl syndrome ?

B. Short answer type question :- (3 marks)

1. Differentiate between innate immunity and acquired immunity.
2. What is Amoebiasis ? Write down the name of its causative organism ? Mentioned one symtoms of its.
3. Write about structure of a typical antibody molecule.
4. Write about the effects of Drug/Alcohol abuse.
5. What is Auto immune disease ? Give example.
6. Write down the role of primary Lymphoid organ in our body ?
7. Describe about different approaches for treatment of cancer ?
8. Mentioned the important measures that are useful for prevention and control of alcohol and drug abuse among adolescents.

C) Long answer type of questions :- (5 marks)

1. Why an antibody molecule is represented as H_2L_2 ? Mentioned two special types of Lymphocytes in our body. How does they differ from each other ? (2+1+2 = 5)
2. How many host are required to complete the life cycle of malarial parasite ? Mentioned them. Show the life cycle of malarial pathogen by using schematic diagram ? (1+1+3 = 5)

3. What is AIDS ? Write down the name of causative organism of AIDS ? Describe about replication of rertovirus ? (1+1+3 = 5)

TEACHER'S NOTE

In 'do it Yourself' section -

- For answering Q. No.A. 4 refer NCERT Page - 147
- For answering Q. No.A. 7 refer NCERT Page - 157
- For answering Q. No.A. 12 refer NCERT Page - 161
- For answering Q. No.B. 2 refer NCERT Page - 148
- For answering Q. No.B. 3 refer NCERT Page - 151
- For answering Q. No.B. 7 refer NCERT Page - 158
- For answering Q. No.B. 8 refer NCERT Page - 162-163
- For answering Q. No.C. 3 refer NCERT Page - 154-155

ANSWER TO THE 'CHAPTER BASED QUESTIONS' SECTION

A. Obective question -

I. Choose the most appropriate option from the following :-

1.b. *Salmonella typhi* 2.a. Female *Anopheles* 3.d. Non specific 4.d. H_2L_2
5.b. Lymphatic vessel 6.a. Yeast 7.b. Passive immunity 8.a. B cell
9.a. Bone marrow & Thymes 10.c. Rheumatoid Arthritis 11.b. ELISA
12.c. Contact inhibition 13.a. Metastasis 14.b. Cannabinoids 15.a. Hallucinations
16.d. Both (a) & (b) 17. (a) 18. (a) 19. (c).

II. Fill in the blanks:-

1. Memory 2. Small intestine 3. Infectious disease 4. Public hygiene 5. Interferons
6. 'Self' and 'non-self' 7.Active immunity 8. Memory 9. Allergy 10. 50%
11. Spleen 12. T-Lymphocytes 13. Antibodies 14. Immunotherapy
15. Withdrawl Syndrome 16. Liver

B.

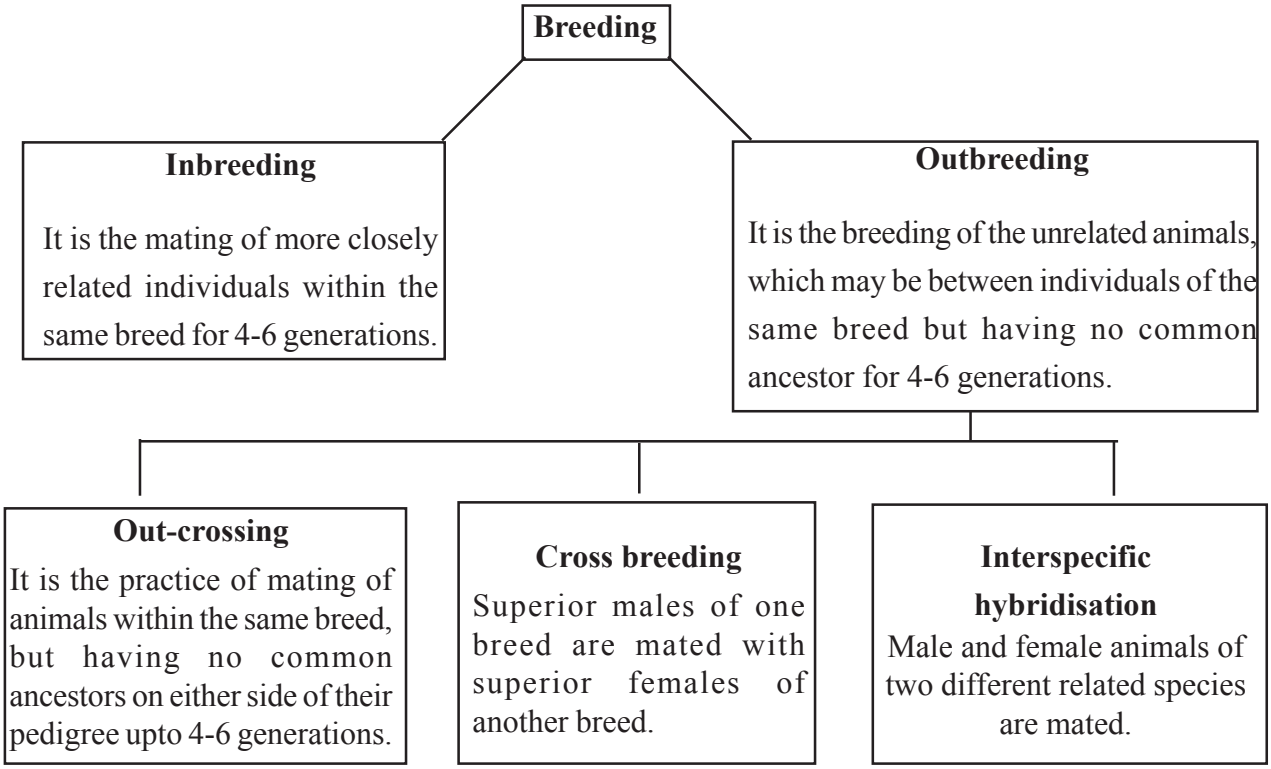
1. Health can be defined as a state of complete physical, mental and social well- being.
2. Widal Test.
3. *Plasmodium vivax*
4. Incase of malarial disease the rupture of RBCs is associated with release of a toxic substance, called haemozoin, which is responsible for the chill and high fever recurring every three to four days.
5. Ascariasis a disease caused by an intestinal parasite *Ascaris lumbricoides*.
6. PMNL - neutrophils.
7. Interferons is a protein secreted from virus infected cells, which protect non-infected cells from further viral infection.
8. Four (Two heavy chains and Two light chains)
9. Five.
10. Colostrum is a yellowish fluid secreted by mother during the initial days of lactation has abundant antibodies (IgA) to protect the infant.

11. The body is able to differentiate ‘self’ and ‘Non-self’ and the cell mediated immune response is responsible for the graft rejection.
12. Mites in dust, Pollens, animal dander etc.
13. Bone marrow and Thymus.
14. Lymphoid tissue which are located within the lining of major tracts (respiratory, digestive and urogenital tracts) called Mucosa Associated Lymphoid Tissue (MALT).
15. Metastasis is the spread of cancer cells to new areas of the body through blood and it is the most feared property of malignant tumors.
16. Morphine
17. Heroine
18. Coca plant (Erythroxylum Coca)
19. α - interferon.

STRATEGIES FOR ENHANCEMENT IN FOOD PRODUCTION

IMPORTANT CONCEPTS

- Animal husbandary is the agricultural practice of breeding and raising livestock. As such it is a vital skill for farmers and is as much science as it is Art.
- Fisheries include rearing, catching, selling, etc. of fish, molluses and crustaceans. Since time immemorial, animal like bees, silkworm, prawns, crabs, fishes, birds, pigs, cattle, sheep and camels have been used by humans for products like milk, eggs, meat, wool, silk, honey etc.
- In dairy farm management, we deal with processes and systems that increase yield and improve quality of milk.
- In dairy farming, selection of disease free and suitable breeds, proper and safe farm conditions, proper feeds and water, hygiene and health care are important components of poultry farm management.
- Animal breeding aims at increasing the yield of an animals and improving the desirable quantities of the produce.



- Controlled breeding experiments are carried out using artificial insemination.
- In MOET, a cow is administered hormones, with FSH-like activity, to induce follicular maturation and Super Ovulation-instead of one egg, the normally yield per cycle, they produce 6-8 eggs.
- Bee keeping can be practiced in any area where there are sufficient bee pastures of some wild shrubs, fruit orchards and cultivated crops.
- The following points are important for successful bee keeping-
  - Knowledge of the nature and habitats of bees.
  - Selection of suitable location for keeping the bee hives.
  - Catching and hiving of Swarms.
  - Management of bee hives during different seasons, and
  - Handling and collection of honey and bees wax.
- Fisheries has an important place in Indian economy. It provides income and employment to millions of fisherman and farmers, particularly in the coastal states.
- The entire collection (of plants/seeds) having all the diverse alleles for all genes in a given crop is called germplasm collection.
- India is mainly an agricultural country. Agriculture accounts for approximately 33% of India's GDP and employs nearly 62% of the population.
- Plant breeding is the purposeful mainpulation of plant species in order to create desired plant types that are better suited for cultivation, give better yields and are disease resistant.
- Plant breeding programmer are carried out in a systematic way world wide in government institutions and commercial companies. The main steps in breeding a new genetic variety of a crops are -
  i) Collection of variability
  ii) Evaluation and selection of parents.
  iii) Cross hybridisution among the selected parents.
  iv) Selection and testing of superior recombinants.
  v) Testing, release and commercialisation of new cultivators.
- Breeding is carried out by the conventional breeding techniques or by mutation breeding. The conventional method of breeding for disease resistance is that of hybridisation and selection. It steps are essentially identical to those for breeding any other agronomic characters such as high yiled. The Various sequential steps are screening germplasm for resistance sources, hybridisation of selected parents, selection and evaluation of the hybrids and testing and release of new varieties.

- Some crop varieties bred by hybridisation and selection, for disease resistance to fungi bacteria and viral diseace are released. (Table- 9.1)

Crop	Variety	Resistance to diseases
Wheat	Himgiri	Leaf and Stripe rust, hill bunt.
Brassica	Pusa Swarnim	White rust
Cauliflower	Pusa Swarnim, Pusa Snowball K-1	Blank rot and curl blight black rot
Cowpea	Pusa Komal	Bacterial blight
Chilli	Pusa Sadabahar	Chilly mossaic virus Tobacco mosaic virus and leaf curl

Table- 9.1

- Breeding method for insect pest resistance involve the same steps as those any other agronomic trait such as yield or quality. Sources of resistance genes may be cultivated varieties, germplasm collections of the crop or wild relatives.
- Some released crop varieties bred by hybridisation and selection, for insect pest resistonce are given in (Table 9.2).

Crop	Variety	Insect Pest
Brassica (rapseed mustard)	Pusa Gaurav	Aphids
Flat bean	Pusa Sem 2, Pusa Sem 3	Jassids, aphids and fruit borer
Okra (Bhindi)	Pusa Swarni, Pusa A-4	Shoot and Fruit borer

Table- 9.2

- The Indian Agricultural Research Institute, New Delhi has also released several vegetable crops that are rich in vitamins and minerals, e.g vitamin-A enriched carrots, Spinach, Purnpkin; Vitamin- C enriched bitter gourd, bathua, mustard, tomato; iron and calcium enriched spinach and bathua, and protein enriched beans broad, lablab, French and garden peas.
- Nobel laureate Norman E.Borlaung, at International centre for wheat and maize improvernat in mexico, developed semi-dwart wheat.

- Mutation is the process by which genetic variations are created through the changes in the base sequence within the series resulting in the creation of a new character or trait not found in the parental type.
- Diets lacking essential micronutrients- particularly iron, vitamin-A,iodine and zinc-increase the risk for disease, reduce life span and reduce mental abilities.
- Biofortification- Breeding crops with higher levels of vitamins and minerals, or higher protein and healthier fats is the most practical means to improve public health.
- Microbes are being grown on an industrial scale as source of good protein.
- Isolated protoplasts from two different varieties of plants-each having a desirable character can be fused to get hybrid protoplasts, which can be further grown to form a new plant.

CHAPTER BASED QUESTION

A. OBJECTIVE QUESTIONS (1 MARK)

I. Multiple Choice Questions:-

1. The breeding carried out between superior males of one breed and superior females of another breed is called-
   a) Inbreeding
   b) out crossing
   c) cross breeding
   d) Intespecific Hybridization
2. MOET stands for-
   a) Multiple Oogonium and Egg Transfer Technology
   b) Multiple Ovulation Embryo Transfer Technology
   c) Method of Egg Transfer Technology
   d) Method of Ovary and Embryo Transfer Technology
3. The term 'apiculture' means-
   a) Culture of fish
   b) Culture of prawn
   c) Culture of Honey bee
   d) Culture of Butterfly
4. Reduced fertility and productivity is related to -
   a) Out breeding
   b) Out crossing
   c) Inbreeding depression
   d) MOET

5. Which of the following is a semi dwart variety of Rice-
   a) Sonalika
   b) Kalyan sona
   c) Golden rice
   d) Jaya
6. Germplasm collection is the collection of-
   a) Plants/seeds
   b) Gamet
   c) Androcium
   d) Flower
7. Single cell protein can be obtained from-
   a) Helminths
   b) Algae
   c) Fungi
   d) Both b and c
8. It is estimated that more than 70% of the world livestock population is in India and China. However their contribution to world farm produce is only-
   a) 70%
   b) 20%
   c) 50%
   d) 25%
9. Which of the following disease is caused by virus-
   a) Red rot of sugarcane
   b) Black rot of crucifers
   c) Turnip mosaic
   d) None of the above
10. Pusa komal variety of cowpea resistance to the disease-
   a) White rust
   b) Bacterial blight
   c) Black rot
   d) Stripe rust
11. Which of the following vegetable crops are enriched with vitamin C-
   a) Carrots
   b) Spinach

c) Lablab

d) Bitter gourd

12. Totipotency refers to-

a) Capacity to generate a whole plant from any plant cell/explants.

b) Capacity to regenerate

c) Capacity to produce fruit

d) Capacity to generate hybrid protoplast

13. Hisradale is a new breed of-

a) Male Horse and Female Donkey

b) Tiger and Lion

c) Bikaneri ewes and Marinorams

d) Cow and Sheep

14. Artificial Insemination involves with-

a) Semen collection

b) Ovary collection

c) Egg collection

d) Sperm and Ovum collection

15. Which of the following is an example of Interspecific Hybridisation-

a) Mule

b) Hirsadale

c) Rohu

d) Sahiwal

Question from no. 16 to 18 consist of two statements Assertion (A) and reason (R). Answer these question selecting the appropiate option given below :

a) Both the A and R are true and are is the correct explanation of A.

b) Both the A and R are true but arem is not the correct explanation of A.

c) A is true but R is false.

d) Both the A and R are false.

16. Assertion (A) : Breeding of an animal is an important aspect of animal husbandry.

Reasons (R) : Animal breeding aims at increasing the yield of animal and improving the desirable quality of the produce.

17. Assertion (A) : To inprove public health the most practical aspect is biofortication.

Reasons (R) : Breeding crops with higher levels of vitamins and minerals, or higher protein and healtheir fats.

18. Assertion (A) : A wide range of fungal, bacterial and viral pathogens, affect the yield of cultivated crops, especially in tropical climates.
Reasons (R) : Resistance of the host plant is the ability to prevent the pathogen from causing disease and is determined by the genetic consitution of the host plant.

II. Fill in the Blanks :- **(1 Mark)**

1. When breeding is between animals of the same breed it is called_____.
2. _____of animals is an important aspect of animal husbandary.
3. It is estimated that more than_____percent of the world livestock population is in India and China.
4. The fertilized eggs at_____cells stages are recovered non-surgically and transferred to surrogate mothers.
5. _____is the root of any breeding programme.
6. Tropical canes grown in South India_____had thicker stems and higher sugar content.
7. Transfer of resistance genes is achieved by sexual hybridisation between the target and source plant followed by_____.
8. High aspartic acid_____and sugar content in maize leads to resistance to maize stem borers.
9. More than_____percent of human population is suffering from hunger and malnutrition.
10. The capacity to generate a whole plant from any cell/explants is called_____.
11. _____of the host plant is the ability to prevent pathogen from causing disease.
12. _____breeding have led to the development of several high yielding varieties resistant to water stress.
13. A wide range of fungal, bacterial and viral pathogen affect the yield of cultivated crop species, especially in_____climates.
14. The conventional method of breeding for disease resistance is that of_____and selection.
15. _____help us overcome several problems of normal matings.

B. Very short answer type question: **(1 mark)**

1. Sonalika and Kalyan sona are varieties of?
2. What is apiculture?
3. Name one honey bee species which are commonly used in apiculture?

4. What is Green Revolution?
5. Write full form of IRRI.
6. Name one variety of wheat which are resistance to leaf and stripe rust.
7. What is micro propagation?
8. Name one protein enriched beans?
9. Major percentage of India Gross domestic product is constituted by?
10. Name one algae which are used in production of SCP.

QUESTION WITH SAMPLE ANSWER

A. **Short Answer type question:-**

(1) What is 'hidden hunger'?

- A far greater number of people suffer from micronutrient, protein and vitamin deficiencies called 'hidden hunger' because they cannot afford buy enough fruits, vegetables legumes, fish and meat.

B.Short Answer type question:- **(3 mark)**

1. Write down the role of microbes as a good source of food.

- Microbes are being grown on an industrial scale as source of good protein microbes like spirulina can be grown easily on materials like waste water from potato processing plants, straw, molasses, animal manure and even sewage, to produce large quantities and serve as food rich in protein, minerals, fats, carbohydrates vitamins. Incidentally ,such utilization also reduces environmental pollution.

DO IT YOURSELF

A. SHORT ANSWER TYPE :-

1. Differentiate between out breeding and out crossing. (2)
2. What is somatic hybridisation? (2)
3. What do you mean by Animal husbandry? (2)
4. What is inbreeding depression. (2)
5. Name two disease caused by fungi. (2)
6. Write two important objectives of animal breeding. (2)
7. What is mutation breeding? (2)

8. Why is the selection process after hybridisation very crucial in breeding programmes? (2)

9. Name the technology used in micro propagation of plants. Give one example where other technology is commercially exploited? (1+1=2)

10. Write two ways in which spirulina is helpful to mankind. (2)

11. Differentiate between Pisiculture and apiculture. (2)

12. You want to propagate virus free plants. Which part of plant will you choose for this purpose. Give reason. (1+1)

13. Mentioned the components of media used for invitro propagation of plant explants. (2)

14. Explain interspecific hybridisation citing the example of mule. (2)

15. Do you think inducing super ovulation in animals in on ethical practice? Give reasons for your answer. (1+1=2)

B. Short Answer Type Question : (3 marks)

1. How Artificial insemination helps us to overcome several problems of normal matings in animals? (3)
2. Write down the various steps involved in successful plant breeding. (3)
3. What is Bio fortification? Write down its objectives. (1+2)=3
4. Mentioned the points which are important for successful bee keeping? (3)
5. Discuss the role of fishery in enhancement of food production. (3)
6. What is an outcross? Write down its significance.
7. What is somatic hybridisation? Write any two importance of somatic hybridisation. (1+2=3)
8. Decribe the hormone regulation and its affect used in MOET. (1+2=3)
9. Differentiate between micropropagation and somatic hybridisation. (3)
10. Your father is a farmer. He is trying to get higher yield form plants, but is unsuccessful to do so because of traditional practices of plantation. Describe how can you help him to get higher yielding plants through micropropagation. (3)

Teacher's Note

- For answering Q.no. A.4 refer to NCERT Page No- 167
- For answering Q.no. A.8 refer to NCERT Page No- 171
- For answering Q.no. B.1 refer to NCERT Page No- 168
- For answering Q.no. B.5 refer to NCERT Page No- 170

ANSWER KEY

A. Objective Questions :

I. Multiple Choice Question :

1. b)
2. b)
3. c)
4. c)
5. d)
6. a)
7. d)
8. d)
9. c)
10. b)
11. d)
12. a)
13. c)
14. a)
15. b)
16. a)
17. a)
18. b)

II. Fill in the Blanks :

1. Inbreeding
2. Breeding
3. 70%
4. 8-32
5. Genetic variability
6. *Saccharum officinarum*
7. Selection
8. Low nitrogen
9. 25%
10. Totipotency
11. Resistance
12. Hybrid
13. Tropical
14. Hybridisation
15. Artificial insemination

B. Very short answer type question:-

1. Wheat
2. Apiculture is the maintenance of hives of honey –bee for the production of honey.
3. *Apis indica*
4. Green revolution can be defined as increase in the productivity of disease resistant crop by introduction of high yielding variety of seeds and increased use of fertilizers and irrigation method.
5. International Rice Research Institute
6. Himgiri.

CHAPTER-10

MICROBES IN HUMAN WELFARE

IMPORTANT CONCEPTS

- *Microbes* are an important component of the biological system which are found everywhere in the world. Protozoa, bacteria, fungus, microscopic animals, and plants, virus, viroid and prions belong to microbes. Some of the microbes are responsible for causing diseases in organisms but some of them are useful to humans in various ways.
- **Microbes used for household products:**

  i) *Lactic acid bacteria* (LAB) (*Lactobacillus* and others) are used to prepare curd from milk. Acids are synthesised by LAB during their growth, which helps to coagulate and the partial digestion of milk protein. LAB also increases the nutrition value of curd by increasing the amount of vitamin B_{12}

  ii) During *fermentation* CO_2 is produced, so by using different microbes, bread, 'Swiss cheese' etc. are prepared where we can see holes.

  iii) Microbes are also used to prepare traditional drinks, ferment fish, soyabean, etc.
- **Microbes used for industrial products:**

  Different types of microbes are used in industries to prepare different products like fermented beverages, antibiotics, etc. For the industrial production of these things microbes are allowed to grow in very large vessels called fermentors.
- **Microbes used for the production of useful chemicals, enzymes and other bioactive molecules:**

Name of microbes	Products
Aspergillus niger (fungus)	Citric acid
Acetobacter aceti (bacteria)	Acetic acid
Clostridium butylicum (bacteria)	Butyric acid
Lactobacillus (bacteria)	Lactic acid

Saccharomyces cerevisiae (yeast)	Ethanol
Streptococcus (bacteria)	Streptokinase
Trichoderma polysporum (fungus)	Cyclosporine-A
Monascus purpureus (fungus)	Statins

Streptokinase is used as clot buster, cyclosporine- A is used in organ transplantation and statins are used as blood cholesterol lowering agent.

♦ **Role of microbes in sewage treatment:**

- *Sewage* means the municipal waste water which contains large amount of organic matters.
- Sewage is poured in sewage treatment plants (STPs) before disposal where heterotrophic microbes make it less polluting.

♦ **Treatment of sewage is carried out in two stages:**

i) **Primary treatment**: It basically involve the removal of small and large particles from the sewage. At first, by sequential filtration process the floating debris are removed and then by sedimentation process the grit are removed from the sewage. Then all solids which are settled forms the primary sludge and effluent is formed by the supernatant. After that, from the primary settling tank effluent is taken for secondary treatment.

ii) **Secondary treatment/Biological treatment**: The soluble organic matter that escapes primary treatment are removed by secondary treatment. Primary effluent is transferred into a large aeration tank with constant air supply and mechanical agitation which allows large growth of useful aerobic microbes into flocs. This will reduce the biochemical oxygen demand (BOD). Then the effluent is allowed to settle in the settling tank. The sediment of bacterial flocs in tank occur which is known as activated sludge. Then in anaerobic sludge digester, the activated sludge is digested and a small amount of activated sludge is pumped back into the aeration tank which serves as an inoculum. During digestion a mixture of gases like methane, CO_2, H_2O, etc,. are produced, which forms biogas and used as fuel. After that, the effluent from the STP is released into rivers and streams.

♦ **Microbes in production of Biogas:**

Methanogens are the bacteria which produces methane gas, e.g. - *Methanobacterium*. They are present in the rumen of cattle and help in the digestion of cellulose. From the dung of cattle gobar gas is produced, which is used for cooking of food by villagers. To develop the biogas production technology, lots of efforts are given by IARI and KVIC in India.

♦ **Microbes as biocontrol agents:**

The use of biological methods to control plant diseases and pests is called biocontrol. Continuous use of chemicals, insecticides and pesticides causes harmful effects on human and on the environment. The use of biocontrol agents reduces these problems.

♦ To control butterflies and caterpillars, a microbial biocontrol agent, Bt is used, which is derived from a bacteria named *Bacillus thuringiensis*. By using Bt genes, Bt crops are prepared which are resistant to insect pests. A free living fungus named *Trichoderma* and *Baculoviruses* of genus *Nucleopolyhedrovirus* in plant roots act as biocontrol agent for different plant pathogens and pests respectively.

♦ **Microbes as bio fertilisers:**

Chemical fertilisers are harmful for the soil, organisms present in the soil and for the environment. So, it is highly recommended to use micro organisms as biofertiliser: *Rhizobium*, *Azotobacter*, *Azospirillum,* etc., are the bacteria which are used as biofertilisers. Fungal association of micorrhiza also increases nutrients in soil. Cyanobacteria like *Nostoc*, *Anabaena*, Oscillatoria etc. are used as biofertilisers in paddy fields.

CHAPTER BASED QUESTIONS

A) Objective Questions: **(1 Mark)**

I. **Choose the most appropriate option from the following:**

1. Which of the following microbes is used for the industrial and commercial production of citric acid?
   a) *Saccharomyces cerevisiae*
   b) *Clostridium butylicum*
   c) *Acetobacter aceti*
   d) *Aspergillus niger*

2) In the treatment of plant disease, which of the following can be used as biocontrol agent?
   a) *Trichoderma*
   b) *Lactobacillus*
   c) *Trichoderma*
   d) *Chlorella*

3) Which of the following statement is wrong about methanogens?
   a) They are found in the rumen of cattle and their excreta.
   b) They grow aerobically and breakdown cellulose rich food.
   c) They produce methane gas.
   d) They can be used to produce biogas.

4) Which type of vitamin is increased during the formation of curd from milk by LAB?
   a) Vitamin K (b) Vitamin D (c) Vitamin B_{12} (d) Vitamin E

5) What was the name of the first antibiotic which was discovered by Alexander Fleming?
   (a) Penicillin (b) Amoxicillin (c) Azithromycin (d) Tetracy Cline

6) During which stage of the purification of sewage water, microorganisms are used?
   (a) Primary treatment (b) Secondary treatment (c) Both a and b (d) None of the above

7) Which of the following alcoholic drinks is produced without distillation of fermented broth?
   (a) Rum (b) Gin (c) Whisky (d) Wine

8) Which of the following is correctly matched for the product produced by them?
   (a) *Trichoderma* : statins

(b) *Lactobacillus* : antibiotics

(c) *Streptococcus* : streptokinase

(d) *Saccharomyces* : citric acid

9) Which organ does get affected by activated Bt toxin in larval stage ?

(a) Small intestine (b) trachea (c) mouth (d) skin

10) Except which of the following products, yeast have been used for the production of all?

(a) Curd (b) Wine c) Whisky (d) Ethanol

Questions from 11 to 15 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 but R is not the correct explanation of A.

(c) A is true but R is false.

(d) Both A and R are false.

11) Assertion (A): Yeast such as *Saccharomyces cerevisae* are used in baking industry.

Reason (R): CO_2 gas is synthesised during fermentation process and is responsible for the rising of bread dough by thermal expansion.

12) Assertion (A): Dragonflies are useful to get rid of mosquitoes.

Reason (R): *Baculoviruse* are the pathogens that attack insects and other arthropods.

13) Assertion (A): In manufacturing of cheese curdling is necessary.

Reason (R): In this process lactic acid bacteria are used.

14) Assertion (A): If Cyclosporin-A is not provided to an organ transplant patient then the transplanted organ may be rejected.

Reason (R): Activation of T-cells is inhibited by Cyclosporin-A and this bioactive molecule interferes with destruction of non-self cells.

15) Assertion (A): Large amount of methanogens are present in cattle dung.

Reason (R): Cattle dung is useful in biogas production.

16) Choose the correct pair:

A	B
I. *Rhizobium*	i) Leguminous plants
II. *Anabaena*	ii) Autotrophic N_2 fixative
III. *Azotobactor*	iii) Free living N_2 fixative
IV. *Glomus*	iv) Absorption of phosphorus

(a) I-i, II-ii, III-iii, IV-iv

(b) I-ii, II-i, III-iii, IV-iv

(c) I-iii, II-i, III-ii, IV—iv

(d) I-i, II-ii, III-iv, IV-iii

17) Which of the following pairs is wrong?

(a) *Penicillium*- Penicillin

(b) *Streptococcus*- Statins

(c) *Methanogens*- Biogas

(d) *Lactobacillus*- Lactic acid

II) Fill in the blanks:

1) The guts of various types of ruminants contain ———————— bacteria.

2) ———————— are effected by antibiotics.

3) *Trichoderma* is a ———————— type of microbe.

4) ———————— enzyme is used as 'clot buster'.

5) ————————is the name of the genus of baculoviruses.

6) *Saccharomyces cerevisiae* is also known as ———————— yeast.

7) Wine and ———————— are produced without distillation of fermented broth.

8) ———————— enzyme is used in the formulation of detergent and helps in removing oily stains from laundry.

9) LAB also checks disease causing microbes in ———————— of our body.

10) Rumen is a part of ———————— of cattles.

B. Very short answer type questions : **(1 mark)**

1. What is the full form of STP?
2. Mention the function which is performed by methanogens in the rumen of cattle.
3. What is the name of the organism used commercially for the production of single cell protein?
4. Which gas is synthesised by *Saccharomyces* that causes doughing of flour?
5. Name the bacteria used for the commercial production of acetic acid.
6. Name any two free living nitrogen fixing bacteria.
7. Mention the name of the process and the name of the gas responsible for puffing up of bread dough when *Saccharomyces cerevisiae* is added to it.
8. What is the name of the biofertiliser used in paddy field?
9. What is a fermentor?
10. Mention the scientific name of the microbe used in fermenting malted cereals and fruit juices.
11. What is the full form of BOD?
12. Write down the full form of IARI.
13. Give an example of methanogenic bacteria.
14. What is the source of butyric acid?
15. Give an example of LAB.

QUESTIONS WITH SAMPLE ANSWERS

A. Short Answer Type Questions: **(2-marks)**

1. Name the microbe used in the preparation of 'Swiss Cheese'. Which gas is produced by the microbe in 'Swiss Cheese' responsible for the formation of big holes? What is activated sludge?

Answer: *Propionibacterium shermanii*

Carbon dioxide (CO_2) gas.

Activated sludge is a mixture of microbes and suspended particles. It is used in the primary treatment of sewage for the breakdown of organic substances to CO_2, water as well as other inorganic ions.

B. Short Answer Type Questions: (3-marks)

1. Mention one commercial use of lipase enzymes. Why distillation is required for producing certain alcoholic beverages? What do you mean by fermentors?

Answer: Lipase enzymes are used in the formulation of detergents which are used for removing oily stains from laundry.

Distillation is required for producing certain alcoholic drinks because, it increases the concentration of alcohol in the alcoholic beverages.

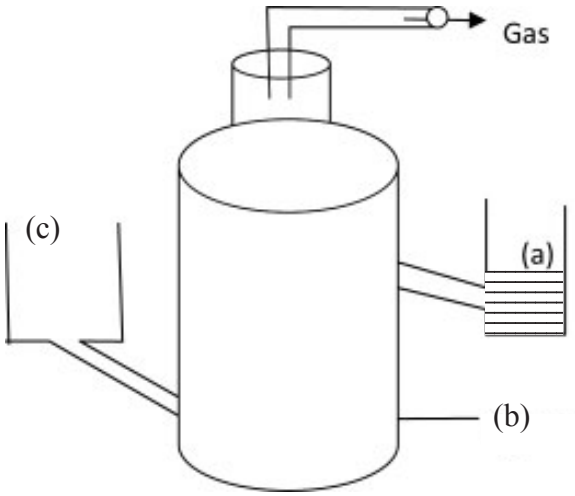
Fermentors are the very large vessels which are used for the microbial growth on a commercial scale. They are extensively used for fermentation, food processing, etc.

DO IT YOURSELF

A. Short Answer Type Questions: (2 marks)

1. Why streptokinase is called 'clot buster'? Why are the fruit juices brought from market clearer than those made at home? (1+1=2)
2. What are the full forms of GAP and YAP? Mention the main objectives of them. (1/2 +1/2+1=2)
3. What do you mean by biogas? Write down the role of KVIC in India? (1+1=2)
4. Mention the role of biological control of pests. Give one example of biological control of pests. (1+1=2)
5. Name the bioactive molecule which is immunosuppressive. What is the source of it? Explain its significance. (1/2+1/2 +1)=2
6. Explain the significance of antibiotics in medicine. (2)
7. Give two examples of cyano bacteria. How are they beneficial for paddy fields ? (1/2+1/2 +1)=2
8. Name the genus of fungus which can form mycorrhiza with plants. Explain the advantages of symbiotic mycorrhizal association with host plant. (1/2+1 ½)=2.
9. Do you think microbes can also be used as source of energy? Justify your answer. (2)
10. State the use of nucleopolyhedrovirus with respect to pest management. (2)

B. Short Answer Type Questions: (Marks-3)



The above diagram is a diagram of a typical biogas plant. Explain the sequence of events occurring in this plant. Identify (a), (b) & (c) in the diagram. (1/2+1/2=3)

1. What is biogas? Explain how biogas is generated from activated sludge. (1+2=3)
2. Write down the steps of sewage treatment. (3)
3. What is BOD? Write down the difference between primary and secondary sewage treatment. (1+2=3)
4. What is Bt-cotton? How is Bt-toxin useful in pest management? (1+2=3)
5. What do you mean by IPM? How do microbes play an important role in medicines. (1+2=3)
6. How are flocs produced during the secondary treatment of sewage? Explain their role. (2+1=3)

A. Long Answer Type Questions: 5-marks

1. What do you mean by organic farming? Explain how it is environment friendly. How is cyanobacteria associated with organic farming? (1+2+3=5)

TEACHER'S NOTE

'In Do it Yourself'

- For answering Q.No.A.1 refer para 10.2.3 of this chapter.
- For answering Q.No.A.2 refer para 10.3
- For answering Q.No.A.3 and 9 refer para 10.4
- For answering Q.No.A.4,8 and 10 refer para 10.5
- For answering Q.No.A.5 refer para 10.2.3
- For answering Q.No.A.6 refer para 10.2.2
- For answering Q.No.A.7 refer para 10.6
- For answering Q.No.B.1 refer para 10.4 (fig.10.8)
- For answering Q.No.B.2, 3, 4 and 7 refer para 10.3
- For answering Q.No.B.5 and 6 refer para 10.5
- For answering Q.No.C.1 refer para 10.6

ANSWER TO THE 'CHAPTER BASED QUESTIONS' SECTION

A. Objective questions (1 marks)

I. 1.(d) 2.(c) 3.(b) 4.(c) 5.(a) 6.(b) 7.(d) 8.(c) 9.(a)
10.(a) 11.(a) 12.(b) 13. (b) 14.(a) 15.(a) 16.(a) 17.(b)

II. 1. Methanogenic 2.Bacteria 3. Fungus 4.Streptokinase
5. Nucleopolyhydrovirus 6. Baker's 7. Beer 8. Lipase
9. Stomach 10. Stomach

B. Very short answer type questions:

1) Sewage Treatment Plant
2) Digestion of cellulose foods
3) Spirulina
4) Carbon dioxide
5) *Acetobacter acetic*
6) *Azobacter* and *Azospirillum*
7) Process: Fermentation
Gas: Carbon dioxide
8) Cyanobacteria
9) They very large vessels where microbes are allowed to grow in industrial scale is called fermenter.
10) *Saccharomyces cerevisiae*
11) Biological oxygen demand
12) Indian Agricultural Research Institute
13) *Methanobacterium*
14) *Clostridium butylicum*
15) *Lactobacillus*

UNIT-IX CHAPTER-11

BIOTECHNOLOGY: PRINCIPLES AND PROCESSES

IMPORTANT CONCEPTS

♦ According to European Federation of Biotechnology (EFB), "The integration of natural science and organisms, cells, parts thereof and molecular analogues for products and services, is called biotechnology.

♦ In modern biotechnology, different types of valuable products are produced with the help of microbiology, biochemistry, tissue culture, chemical engineering and genetic engineering, molecular biology and immunology.

♦ The branch of biology by which important and permanent changes are created in plants and animals by increasing, decreasing, manipulation and transplantation of genetic units, is called genetic engineering.

♦ **Genetic engineering consists of two main steps-**

a) Isolation and study of the properties of desired genetic material through which changes are created in the structure and functions of genes.

b) Discovery of chromosome less genetic material known as vector (carrier of genetic units) molecules such as plasmids, cosmids, lamda phage viruses, BAC, YAC, HAC etc.

♦ Stanley Cohen and Herbert Boyer, isolated the antibiotic resistance gene in 1972, by cutting out a piece of DNA from a plasmid which was responsible for conferring antibiotic resistance.

♦ **Tools of rDNA technology:**

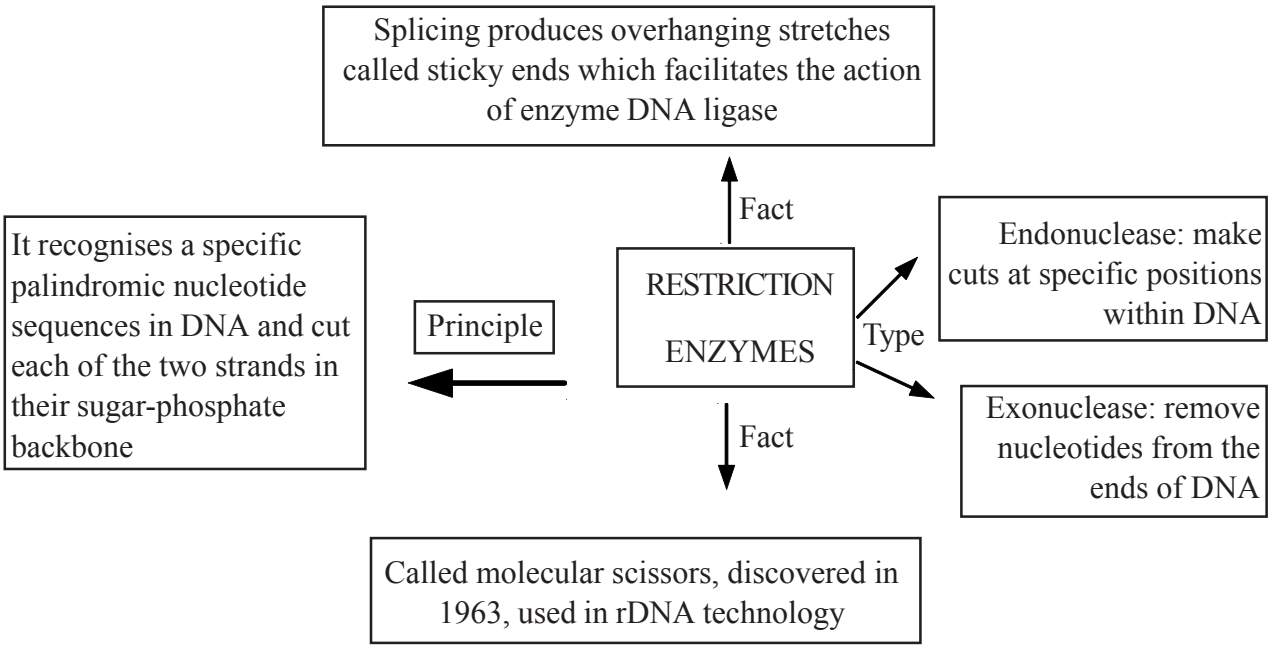
a) Restriction enzymes (for precise cutting at specific points),

b) Polymerase enzymes (for replication),

c) Ligases (for joining of DNA molecules to create recombinant DNA),

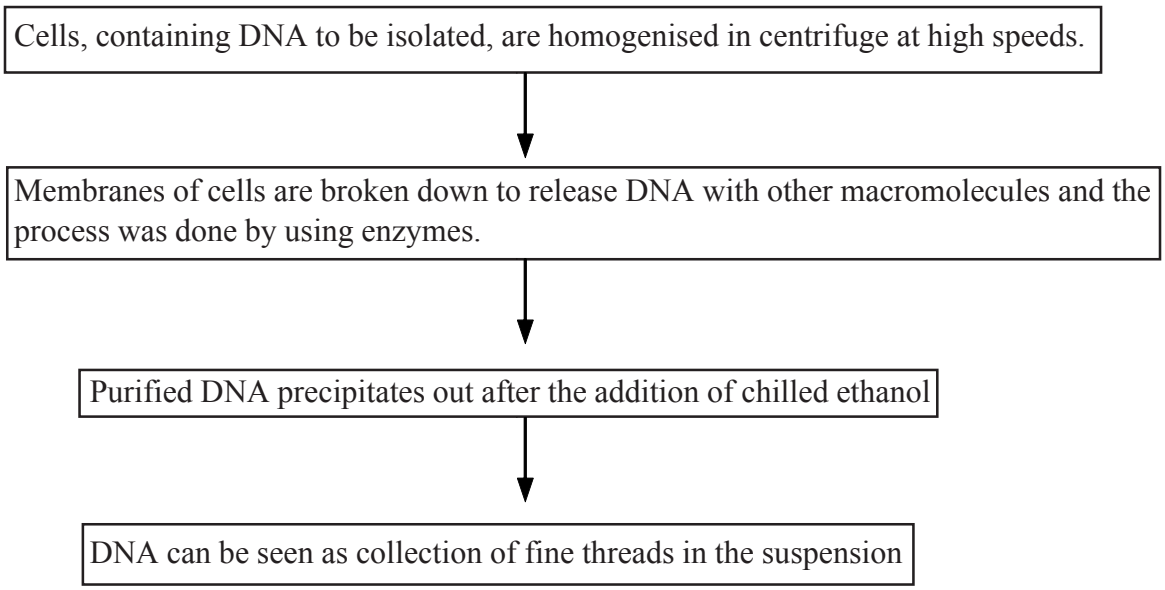
d) Vectors (for transferring the gene of interest into host organism),

e) Host organism (to clone the gene of interest).



♦ Recombinant DNA technology involves several steps in specific sequence such as isolation of DNA, fragmentation of DNA by restriction endonucleases, isolation of a desired DNA fragment, ligation of the DNA fragment into a vector, transferring the recombinant DNA into a host, culturing the host cells in a medium at large scale and extraction of the desired product.

♦ Isolation of Nucleic acid:



♦ DNA is a negatively charged molecule (due to presence of phosphate group), hence during Agarose Gel Electrophoresis it moves towards the anode (positive electrode).

♦ Restriction enzymes belong to a large class of enzymes, called nucleases. Restriction enzyme digestions are performed by incubating purified DNA molecules with the help of different restriction endonucleases.

♦ The separated DNA fragments (after restriction digestion and AGE) can be visualized only after staining the DNA with ethidium bromide (DNA chelating dye), followed by exposure to UV radiation (by UV transluminator)

♦ Tools for rDNA technology:

Cloning Vector (pBR322)
Salient features:
a) Has ori region,
b) Has selectable markers,
c) Has fewer cloning sites

Competent host:
Host is made competent by-
a) Biolistic method or gene gun,
b) Micro injection
c) Disarmed pathogen vector
d) Lipofection
e) Electroporation

Tools for rDNA technology

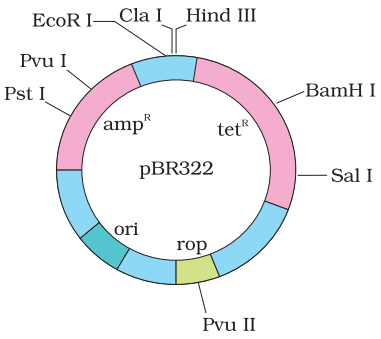
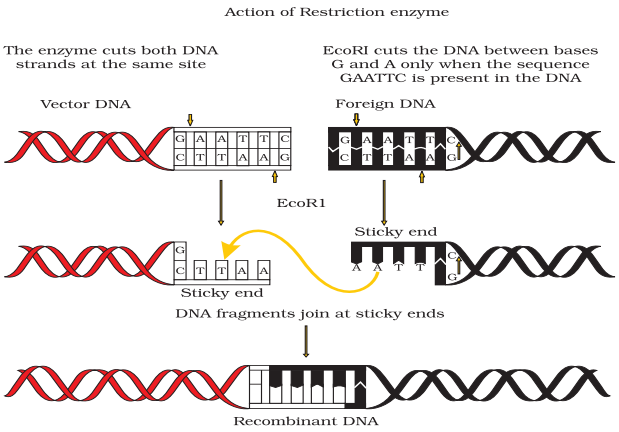


Fig.11.1 Plasmid Vector (pBR322)

Restriction enzymes & its mechanism of action

Name	Recognition sequence
Eco RI	5'-G↓AATTC-3' 3'-CTTAA↑G-5'
Alu I	5'-AG↓CT-3' 3'-TC↑GA-5'



Fif-11.2 Action of restriction enzyme

♦ Insertional inactivation: To differentiate recombinants from non-recombinants, the insertion of an enzyme (like B-galactosidase) within the coding sequence results into inactivation of the enzyme, which is called insertional inactivation.

♦ By using *Agrobacterium tumifaciens* or by using Retroviruses (disarmed) biotechnologists deliver genes of interest into a variety of plants or animal cells.

♦ The bioreactors (stirring type) is usually cylindrical or with a curved base to facilitate the mixing of the reactor contents. In which raw materials are biologically converted into specific products by microbes, plant and animals cells and/or their enzyme.

Facts to Remember:

- ♦ Molecular scissors/chemical scalpes/ chemical knives- Restriction endonuclease.
- ♦ Gene taxi- Plasmid
- ♦ Mdecular glues- Ligases
- ♦ Passenger DNA/Transgene- Foreign DNA
- ♦ Work house for gene cloning- pBR322 (Artificial plasmid)

♦ Paul Berg (1972) successfully transp canted the DNA of virus SV-40 in E.Coli. As a result, an organism was produced which had the characters of SV-40 virus, as well as E. Coli.

♦ Hybridoma is a hybrid cell obtained by fusion of B-lymphocyte and myeloma/carcinoma cell. Hybridoma technology is developed by G. Kohler and C. Mielstein in 1975.

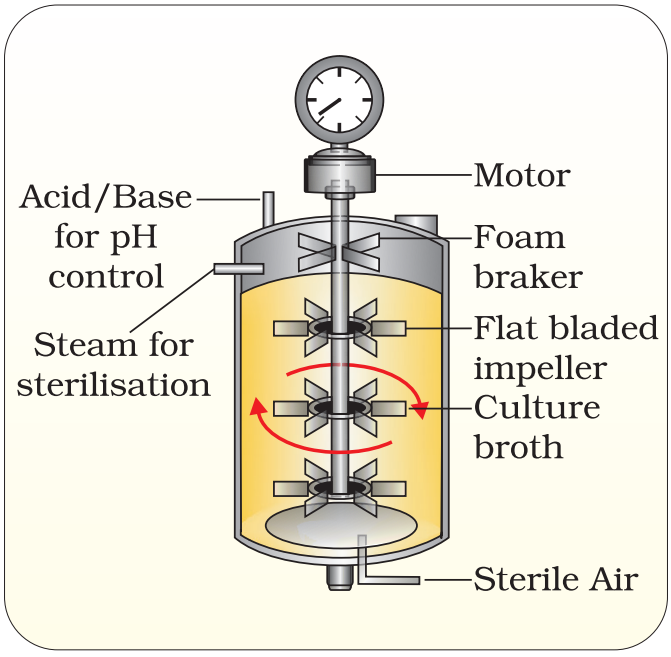


Fig.11.3 Bioreactor

CHAPTER BASED QUESTION

(A) Objective questions **(1 mark)**

(I) Multiple choice question

1) The word 'restriction' in restriction enzyme refers to –
   a) Cutting of DNA at specific positions only.
   b) Cleaving of phosphodiester linkage.
   c) Prevention of the multiplication of bacteriophage in bacteria.
   d) All of the above.

2) Which of the following is being used to precipitate DNA from the suspension obtained from the lysis of cell?
   a) Diavalent cations like calcium.
   b) Chilled ethanol
   c) Ethidium bromide
   d) Antibiotics like kanamycin.

3) In restriction enzymes (like EcoRI) the Roman numbers following the names indicate the-
   a) Order in which enzymes were discovered from that strain of bacteria.
   b) Order in which the enzymes were isolated from that strain of bacteria.
   c) Genus of the prokaryotic cell or bacteria.
   d) Strain of the bacteria.

4) Here are the recognition sites of some restriction endonucleases.

   a) Bam HI 5'-GGATCC-3'
      3'-CCTAGG-5'

   b) SmaI 5'-CCCGGG-3'
      3'-GGGCCC-5'

   c) Hind III 5'-AAGCTT-3'
      3'-TTCGAA-5'

   d) ScaI 5'-AGTACT-3'
      3'-TCATGA-5'

5) Which of the above enzymes will not create compatiable stick ends?

a) A and B

b) B and C

c) B and D

d) A and C

6) All of the following are basic tools of recombinant DNA technology except

a) Cloning vectors

b) Competent host

c) Restriction enzymes

d) RNA polymerase enzymes

7) After the biosynthetic phase, the product is separated and purified by the process called?

a) Agarose gel electrophoresis

b) PCR

c) Downstream processing

d) Insertional inactivation.

8) Stirred tank bioreactors have been made so that-

a) Oxygen is available throughout the process

b) Preservatives are added continuously to the product

c) Purified product is obtained

d) Anaerobic conditions in the culture vessel are ensured.

9) Molecular probes used for identification of recombinant clone carrying the desired DNA insert can be-

a) Denatured double stranded DNA probes

b) dsRNA probes

c) Protein probes

d) ssDNA probes

10) Thermostable enzymes 'Taq' and 'pfu' isolated from thermophilic bacteria are

a) DNA polymerase

b) DNA ligases

c) Restriction endonucleases

d) RNA polymerases.

11) Various enzymes are needed in the process of joining DNA molecules from two different sources and inserting them into a host organism to generate products for human use. The enzymes which are absolutely necessary for facilitating this process are-

a) Restriction endonucleases and topoisomerases.

b) Endonucleases and polymerases.

c) Restriction endonucleases and ligases.

d) Peptidases and ligases.

12)The role of DNA ligase in the construction of a recombinant DNA molecule is-

a) Formation of phosphodiester bond between two DNA fragments.

b) Formation of hydrogen bond between sticky ends of DNA fragments.

c) Ligation of all purine and pyrimidine bases.

d) Formation of hydrogen bond between blunt ends.

13) Indentify the DNA segment which is not a palindromic sequence.

a) 5′GGATCC3′
   3′GGTACC5′

b) 5′GAATTC3′
   3′CTTAAG5′

c) 5′GCGGCCGC3′
   3′CGCCGGCG5′

d) 5′CCCGGG3′
   3′GGGCCC5′

14) Significance of heat shock method in bacterial transformation is to facilitate-

a) Binding of DNA to the cellwall.

b) Uptake of DNA through membrane transport protein.

c) Uptake of DNA through transient pores in the bacterial cellwall.

d) Expression of antibiotic resistance gene.

15) What do you mean by 'elution' during separation and isolation of DNA fragments?

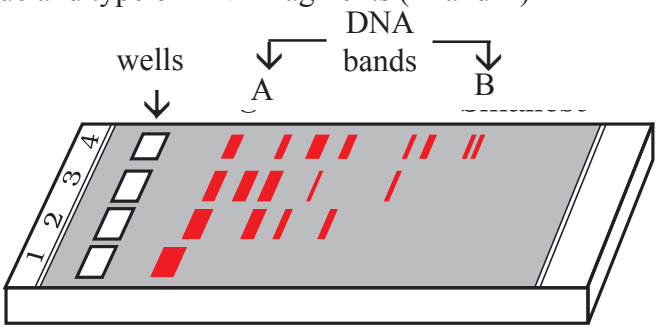
a) It is the action of restriction endonucleases enzyme of DNA

b) It refers to separation of various DNA fragments.

c) Construction of recombinant DNA.

d) Cutting of separated bonds of DNA from agarose gel.

16) Selected the technique and type of DNA fragments (A and B)



Technique	A	B
a) Recombinant DNA technology	Largest	Smallest
b) Recombinant DNA technology.	Smallest	Largest
c) Agarose gel electrophoresis	Largest	Smallest
d) Agarose gel electrophoresis	Smallest	Largest

17) Match each term on the right with the definition on the left.

A. Single stranded proteins left at the ends after restriction enzyme cut.	1. Transformation.
B. Circular pieces of DNA found in bacteria	2. Cloning vector.
C. Bacterial viruses	3. Plasmids.
D. Process by which bacteria take up pieces of DNA from the environment.	4. Stick ends
E. Term used to describe any vehicle that moves DNA from one organism to another.	5. Bacteriophages.

a) A-4, B-3, C-5, D-1, E-2.

b) A-1, B-2, C-3, D-5, E-4.

c) A-3, B-2, C-1, D-4, E-5.

d) A-5, B-4, C-3, D-2, E-1

18) Match the column-

A. Isolation of genetic material.	1. Restriction enzyme.
B. Joining of DNA fragments.	2. DNA polymerase
C. PCR	3. DNA ligase.
D. Cutting of palindromic DNA sequence.	4. Lysozyme.

a) A-3, B-4, C-2, D-1.

b) A-4, B-3, C-2, D-1.

c) A-1, B-2, C-3, D-4.

d) A-3, B-4, C-1, D-2.

19) Steps of PCR technology are shown. Identify steps ABCD correctly

A	B	C	D
Denaturation at 94 -96^0 C	Extension through taq polymerase at 72^0 C	Repetition of Denaturation and polymerazation.	Annealing at 72^0 C
Denaturation at 94 -96^0 C	Annealing at 40-60^{0}C	Extension through taq polymerase at 72^{0}C	Repetition of Denaturation and polymerazation.
Denaturation at 40 -60^0 C	Annealing at 72^{0}C	Extemsopm through taq polymerase at 94-96^{0}C	Repetition of Denaturation and polymerazation.
Extension through taq polymerase at 72^{0}C	Denaturation at 94 -96^0 C	Annealing at 72^{0}C	Repetition of Denaturation and polymerazation

20. Which of the following is an advantage of bioreactor which was uses continuous culture system rather than batch culture?

a) It provides required growth conditions like temperature, pH, substrate, salt, vitamins and oxygen.

b) The transformed recombinant cells are allowed to grow in a large bioreactor till maximum amount of biochemical has been formed.

c) The bioreactor is made empty, clean and a fresh medium is added.

d) There is a regular drainage of the medium and culture cells from one side and fresh medium from other side leading to higher yield of the desired product..

21. Read the following statements for restriction enzymes and choose options which have only correct ones.

A. Restriction enzymes belong to a large class of enzymes called nuclease.

B. Restriction enzymes are of two kinds' exonuclease and endonuclease.

C. Restriction enzymes are so called because these only identify particular nucleotide sequence.

D. In nature approximately 900 restriction enzymes are present

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

22) Choose the incorrect statement:

a) The downstream processing and quality control testing vary from product to product.

b) The ampicillin resistance gene of pBR322 is known as selectable marker.

c) Agarose gel electrophoresis is employeed to check the progression of a restriction enzyme digestion.

d) DNA fragments are negatively charged molecule. They can be separated by forcing them to move towards cathode under the electric field through a medium/ matrix.

23) What is the criterion for DNA fragments movement on agarose gel during gel electrophoresis?

a) The larger the fragment size, the farther it.

b) The smaller the fragment size, the further it moves.

c) Positively charged fragment do not move.

24) Which of the following is an restriction endonuclease?

a) Hind II b) Protease C) DNase d) RNase

25) Which of the following is commonly used as a vector for introducing a DNA fragment in human lymphocytes?

a) Retrovirus b) Ti-plasmid c) λ - phage d) pBR322

26) Which of the following is not a feature of plasmid?

a) Independent replication b) Circular structure

c) Transferable d) single -stranded.

27) Which statement is correct in the context of observing DNA separated by agarose gel electrophoresis?

a) DNA can be seen in visible light.

b) DNA can be seen without staining in visible light.

c) Ethidium bromide strained DNA can be seen in visible light.

d) Ethidium bromide stained DNA can be seen under exposure to UV light.

28) The process of separation and purification of expressed protein before marketing is called -

a) Upstream processing b) Downstream processing

c) Bio processing d) postproduction processing

29) Which of the following is not correctly matched with its use?

a) Taq polymerase DNA polymerase used in polymerase chain reaction

b) Gene gun -used for introducing recombinant DNA into plant cells with the help of fast moving gold or tungsten particles.

c) Ethidium bromide- stain used for observing DNA fragments under UV rays.

d) Chilled ethanol- To precipitate protein from suspension.

30) To correct order of steps in polymerase chain reaction.

a) Extension, denaturation, annealing.

b) Annealing, extension, denaturation

c) Denaturation, extension, annealing.

d) Denaturation, annealing, extension.

31) The colonies of recombinant bacteria appear white in contrast to blue colonies of non-recombinant bacteria because of -

a) Non- recombinant bacteria containing β-galactosidease.

b) Insertional in activation of β- galactosidease in recombinant bacteria.

c) Insertional in activation of α - galactosidease in recombinant bacteria.

d) Inactivation of glycosidase enzyme in recombinant bacteria.

Questions from 32 to 33 consists of two statement Assertion(A) and Reason (R). Answer these question selecting the appropriate option given below:

a) Both the A and R are true and R is the correct explanation of A.

b) Both the A and R are true and R, but R is not the correct explanation of A.

c) A is true but R is false.

d) Both A and R are false.

32. Assertion : Hybridomas are formed by combining a myeloma cell with lymphocyte.

Reason: Hybridomas are generally used to produced Monoclonal antibodies.

33. Assertion : *Agrobacterium tumefaciens* is popular in genetic engineering because this bacterium is associated with the roots of all cereal and pulse crops.

Reason : A gene incorporated in the bacterial chromosomal genome gets automatically transferred to the crop with which the bacterium is associated.

II. Fill in the blank:-

1.The techniques of genetic engineering include creation of _____, by use of gene cloning and gene transfer.

2.Making multiple identical copies of any template DNA is called_____.

3.The first recombinant DNA was made by linking gene encoding antibiotic resistance with native plasmid of _____.

4.The first restriction endonuclease discovered was_____.

5._____enzyme acts on digested DNA molecules and joins their ends.

6.The separated DNA fragments in gel elictrophoresis can be visualised after staining the DNA with compound _____ followed by exposure to_____rays.

7.In biolistic method, the plant cells are bombarded with high velocity micro-particles of_____or_____coated with DNA.

8.Primers used in PCR are small chemically synthesized _____that are complementary to the regions of DNA.

9. If any protein encoding gene is expressed in a heterologous host, it is called_____protein.

10.In sparged stirred-tank reactor, sterile air bubbles increases area for_____.

B. Very short answer type questions:

1. Which enzyme is known as 'molecular scissors"?
2. Name the first plasmid used as vector?
3. Write principle on which electrophoresis is based.
4. What is gene gum?
5. Which enzyme is used to digest walls of bacteria and fungi in genetic engineering?

6. Why is thermostable DNA polymerase needed in PCR?

7. Expand the term : c DNA , YACs.

8. Write the palindromic sequence of EcoRI.

9. Name the endonuclease that was first discovered .

10. Define electroporation.

11. Name the source organism that posses Taq polymerase.

12. What is Ti-plasmid?

13. What do you mean by a clone?

14. Name the technique that is used for separating the fragments of DNA cut by restriction endnucleases.

15. While doing a PCR, denaturation step is missed. What will be its effect on the process?

QUESTIONS WITH SAMPLE ANSWERS

A.Short answer type question **(2 marks)**

Q. List the steps involved in r DNA technology.

Ans: Genetic engineering is manipulation of genetic materials which can be added or deleted through their bases or parts of DNA to introduce them into host organisms. The steps involved to make phenotypically different host organism through r DNA technology are-

i) Isolation of DNA.

ii) Fragmentation or digestion of DNA by restriction endonucleases.

iii) Isolation of desired DNA fragments of gene sequences.

iv) Amplification of gene of interest .

v) Ligation of the DNA fragment into a vector using DNA-ligase enzyme.

vi) Transfer of r DNA into the host organism.

vii) Culturing the host cell on a suitable medium on a large scale.

viii) Extraction of the desired products.

ix) Downstream processing of the products as finished products are ready for marketing.

B. Short answer type question (3 marks)

Q. What are the importance of (a)Ori, (b) ampR and (c) rop in the E.coli cloning vector (pBR3220).

Ans: (a) Ori is a sequence from where replication starts and any piece of DNA when ligated to this sequence can be made to replicate within the host cells. It also controls the copy number of the linked/ligated DNA.

(b) ampR is an antibiotic resistance gene. The ligation of alien DNA is carried out at a restriction site present in any of the antibiotic resistant gene.

(c) rop codes for the proteins involved in the replication of a plasmid.

DO IT YOURSELF

A. Very short answer type questions **(Mark 2)**

1. Write the salient features of vectors molecules. Which are generally used in r DNA technology. (2)

2. What is DNA cloning? State the different methods for DNA cloning. (1+1)

3. What is cDNA Library? Write its significance. (1+1)

4. How foreign gene is incorporated through microinjection into a host cell? (2)

5. Differentiate between cDNA and rDNA technology. (2)

6. What are the significances of Bioreactor. (2)

7. Define downstream processing with its importance. (1+1)

8. What is monoclonal antibodies? How it is so important in medical science? (1+1)

9. Show recognition site of two restriction endonuclease one with sticky end and the other with blunt end. (1+1)

10. Describe the role of $CaCl_2$ in preparation of competent cells. (2)

11. Mention the role of vectors in rDNA technology. (2)

B. Short answer type questions **(Mark 3)**

1. Name five important tools for accomplishing the tasks of recombinant DNA technology and also mention their functions too. (1/2+1 1/2)

2.Describe the principle and process of PCR technique . (3)

3.How are the DNA fragments separated and isolated for DNA finger printing? Explain. (3)

4.Draw and lebel an ideal plasmid vector (pBR322). (3)

5.What are recombinant proteins? How do bioreactors help in their production? (1+2)

6.Explain in brief-

(a) Bioreactors (b) Restriction enzymes. (1/2+1/2)

7.List 5 recombinant proteins and write their therapeutic uses. (3)

8.Complete the following analogy given below and write short notes one both of the technique-
Southern blotting : DNA ::_____: RNA (1+2)

9.Describe the principle of Bioreactor. What is the role of bubbles present within the bioreactor. (2+1)

10.A cosmid is constructed using A+B. What are those A and B? In pBR322, What do B and R represent? Name the antibiotic resistant sites of pBR322. (1+1+1)

TEACHER'S NOTE

In 'Do it yourself'section, take care of the following points-

A.

1. See NCERT, p-198

2.See NCERT, p-194

3. cDNA is created from mRNA by using reverse transcriptase enzyme. A cDNA library represents the collection of only genes that are encoded into proteins by an organism. Generally cDNA library is generated using DNA cloning technology.

4. See NCERT, p-201

5. Need conceptual development first, then you can prepare by yourself.

6. See NCERT, p-203,204

7. See NCERT, p-204,205

8. A monoclonal antibodies is a man made antibodies and this can be made by cloning a unique white blood cell. Monoclonal antibodies can have monovalent affinity, binding only to the same epitope. For different viral infection, treatment of cancer, scientists are preparing monoclonal antibodied even for SARs CoV-2 also.

9. See NCERT, p-196, 197 and chapter at a glance of this workbook.

10. $CaCl_2$ increase the efficiency of DNA uptake to produce transformed bacteria.

11. See NCERT, p-199.

B. 1. Need conceptual development first , then you can prepare by yourself.

2. See NCERT, p-202

3. See NCERT, p-198

4. See NCERT, p-199,200

5. See NCERT, p-203,204

6. (a)See NCERT, p-203,204

(b)See NCERT, p-195,196

7. Need conceptual development first, then you can prepare by yourself.

8. Northern blotting;

Need conceptual development regarding 'Southern blotting' and "Northern blotting".

9. See NCERT, p-203,204

10. Need conceptual development regarding different 'çloning vectors'.

ANSWERS TO THE 'CHAPTER BASED QUESTIONS' SECTION

A) Objective questions

(I) 1) c 2) b 3) b 4) c 5) d

6) c 7) a 8) c 9) a 10) c

11) a 12) a 13) c 14) d 15) c

16) a 17) b 18) b 19) d 20) b

21) d 22) b 23) a 24) a 25) d

26) d 27) b 28) d 29) d 30)b

(II) 1) Recombinant DNA, 2) cloning, 3) Salmonella typhimurium,

4) Hind II, 5)DNA ligase, 6) ethidium bromide, UV,

7) gold or tungsten, 8) oligonucleotides, 9) recombinant 10) oxygen transfer

B) Very Short answer type questions:

1) Restriction endonucleases, 2) pBR322,

3) The principle of elestrophoresis is based on that, charged particles move under the influence of electric current to oppositely charged electrodes.

4) The instrument for bombarding micro-projectile particles (gold/tungsten particles) coated with foreign DNA with great velocity into a target cell, is called gene gun.

5) Lysozyme digests bacterial wall and chitinase digests fungal cell wall.

6) Because thermostable DNA polymerase remains active even at high temperature.

7) cDNA- complementary Deoxyribo Nucleic Acid

YAC- Yeast Artificial Chromosomes.

8) 5'-G↓AATTC-3'

3'-CTTAA↑G-5'

9) Hind II

10) The process in which transient holes are produced in the plasma foreign DNA, is called electroporation.

11) *Thermus aquaticus*

12) An extra- chromosomal DNA which delivers gene of interest into variety of plants and acts as a cloning vector, is called Ti-plsmid (tumour inducing plasmid of *Agrobacterium tumifaciens*)

13) The cell or organism derived from the same parents by asexual mean of reproduction, which are genetically identical to each other and to the parent also, are called clones.

14) Agarose Gel Electrophoresis and Polyacrylamide Gel Electrophoresis (AGE and PAGE).

15) If denaturation of double-stranded DNA does not take place, then primers will not be able to bind with the template, hence no extension and no amplification.

UNIT-IX CHAPTER-12

BIOTECHNOLOGY AND ITS APPLICATION

IMPORTANT CONCEPTS

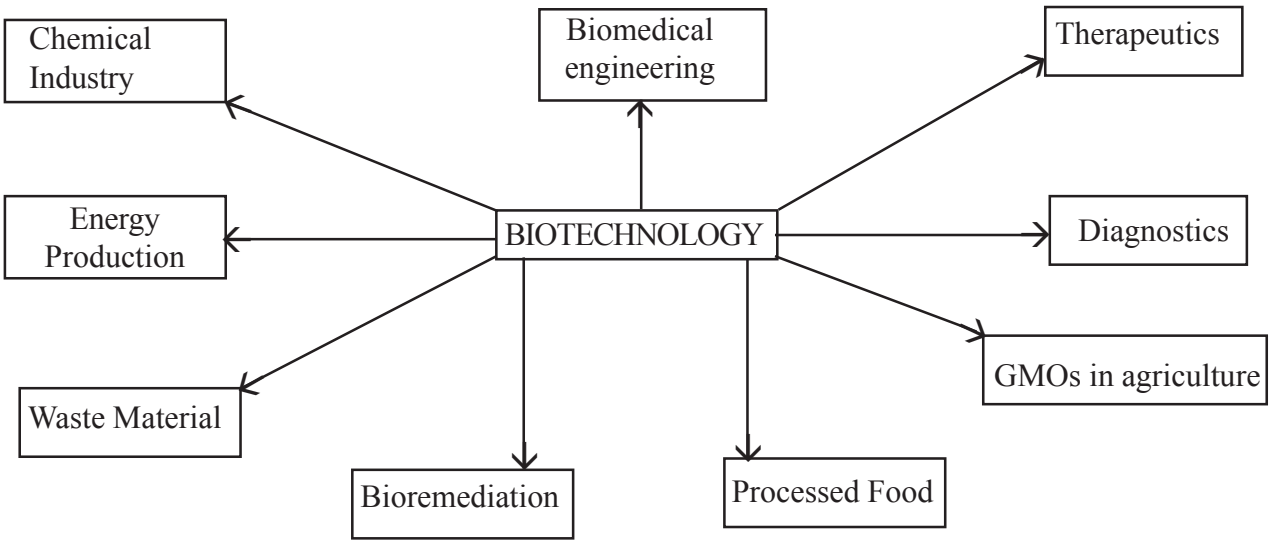
♦ A recombinant DNA molecule is produced with the following objectives:
i) To obtain large number of copies of specific DNA fragments.
ii) To recover large quantities of the protein produced by the concerned gene
iii)To integrate the gene into the host chromosome

♦ Many valuable recombinant proteins are also being produced, using transgenic animal cell lines and transgenic plants.

♦ Plants, bacteria, fungi, animals whose genes are altered by manipulation are called genetically modified organisms (GMOs).

♦ Two unique advantages of GMOs or transgenic crops are-
i) Any desired gene can be used for transfer.
ii) The change in genotype can be precisely controlled since only the transgene is added into the crop genome.

♦ Application of biotechnology:



♦ RNA Interference (RNAi) takes place in all eukaryotic organisms as a method of cellular defence. This method involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA (silencing).

- Strains of *Bacillus thuringiensis* produce proteins that kill certain insects such lepidopterans (tobaccobud worms, armyworm), Coleopterans (beetles) and dipterans (flies, mosquitoes).
- Bt toxin (crystal proteins) are of different types, for example,the proteins encoded by the genes cryIAC and cryIAb control the cotton bollworms, that of cryIAb controls corn borer.
- Transgenic variety of Tomato Flavr Savr remains fresh and retains flavour much longer due to the inhibition of the enzyme polygalacturonase which degrades pectin.
- Biowar or biological war is the use of biological weapons against humans or their crops and animals. Bioweapons are devices that carries and delivers organism to the target in the form of pathological biological agents or toxins.
- Potential biological weapons are-
  i) Anthrax- *Bacillus anthacis*
  ii)Botulinum toxin (Botulin) - *Clostridium botulinum*.
  iii) Plague- Yersinia pestis.
  iv) Encephalitides- *Alpha* virus.
- Bioethics are a set of standards that may be used to regulate our activities in relation to biological works, like-
  i) Transfer of human genes to other animals and vice versa is against bioethics.
  ii) Making of clone (human clone).
  iii) Suffering to animals used in biotechnology will never be permitted.
  iv) Introduction of transgenes from one species to another violates the genetic integrity and may cause risk to biodiversity.
- Biofertilizers have the following advantages over chemical fertilizers
  i) They do not disturb the naturally occuring food chains in the ecosystem.
  ii) They do not cause any denger to the natural resources.
  iii) They are safe and moreover do not pollute the atmosphere.
  iv) They are low cost as compared to chemical fertilizers and pesticides.
- The Indian Government had set up organisations such as GEAC, which will make decision regarding the validity of GM research and the safety of introducing GMOs for public services.

Facts to remember:

- Blood Clotting Factor-VIII is a recombinant protein, for treatment of Haemophilia B.
- Tissue Plasminogen Activator (TPA) is produced through rDNA technology, for acute myocardial infraction.
- PGF (Platelet Growth Factor) stimulates wound healing

Facts to remember:

A west African plant, *Pentadiplandra* brazzeana produces a protein (BRAZZEIN), which is approximately 2000 times as sweet as sugar with low calorie sweetener. The protein brazzein was parented in USA

CHAPTER BASED QUESTIONS

(A) Objective questions (1 marks)

I. Choose the most appropriate option from the following:

1. Plant, bacteria, fungi and animals whose genes have been altered by manipulation are called genetically modified organisms (GMO). Which of the following statement is not applicable to GM Plants?

a) Reduced reliance on chemical pesticides.
b) Prevent early exhaustion of fertility of soil.
c) Crops less tolerant to abiotic stress (cold, drought, salt, heat).
d) Enhanced nutritional value of food.

2. Which one of the following is an example of carrying out biological control of pests/diseases using fungal microbes?

a) Nucleopolyhedrovirus against white rust in *Brassica*.
b) Bt. Cotton to increase cotton yield.
c) Lady bird beetle against aphids in mustard.
d) *Trichoderma* sp. Against certain plant pathogens.

3. A west African plant, *Pentadiplandra brazzeana* producing brazzein, was patented in USA which proposed to transfer the brazzein gene into maize and express it in maize kernels. Mark the incorrect statement about this plant:

a) Brazzein, a protein, is approximately 2000 times as sweet as sugar.
b) It is a high calorie sweetener.
c) The development of brazzein could have serious implications for countries exporting large quantities of sugar.
d) Local people have known and used super sweet berries of this plant for centuries.

4. CryIIAb and cryIAb produce toxins that control

a) Cotton bollworm and corn borer respectively
b) Corn borer and cotton bollworms respectively
c) Tobacco bud-worms and nematodes respectively
d) Nematodes and tobacco bud-worms respectively

5. Golden rice is a transgenic crop of the future with the following improved trait

a) High lysine (essential amino acid) content
b) Insect resistance
c) High protein content
d) High vitamin-A content

6. ADA is an enzyme which is deficient in a genetic disorder SCID. What is the full form of ADA?

a) Adenosine Deoxy Aminase

b) Adenosine Deaminase
c) Aspartate Deaminase
d) Arginine Deaminase

7. Main objective of producing herbicide resistant GM crops is to:
a) Encourage eco-friendly herbicides
b) Reduce herbicide accumulation in food articles for health safety
c) Eliminate weeds from fields without the use manual labour
d) Eliminate weeds from the field without the use of herbicides

8. GEAC makes decisions regarding
a) The validity of GM research
b) The safety of introducing GM organisms for public services
c) The validity of biopatents
d) More than one options are correct

9. Which of the following is a powerful technique to identify many genetic disorders and detect mutations in genes in suspected cancer patients?
a) ELISA based on the principle of antigenati body interaction
b) PCR
c) Serum and urine analysis
d) Both (a) and (b)

10. The Bt toxin is not toxic to human beings because
a) The pro Bt toxin activation requires temperature above human body temperature
b) The Bt toxin recognizes only insect specific targets
c) The Bt toxin formation from pre Bt toxin requires pH lower than that present in human stomach
d) Conversion of pro Bt toxin to Bt toxin takes place only in highly alkaline conditions

11. The novel strategy of _____was adopted to prevent *Meloidegyne incognitia* infection in tobacco plants.
a) DNA interference
b) RNA interference
c) RNA intiation
d) DNA intiation

12. Eli Lilly, an American company, prepared two DNA sequences corresponding to A and B, chains of human insulin and introduced them in plasmids of *E.coli* to produce insulin chains, chains A and B were produced separately, extracted and combined by creating
a) Peptide bonds
b) Ionic bonds
c) H-bonds

d) Disulfide bonds

13. The genetic defect adenosine deaminase (ADA) deficiency may be cured permanently by :-
    a) Enzyme replacement therapy
    b) Periodic infusion of genetically engineered lymphocytes having functional ADA c DNA
    c) Administering, adenosine deaminase activators
    d) Introducing bone marrow cells producing ADA into cells at early embryonic stages

14. Match the columns and find out the correct combination:

A. CryIAc	1. *Escherichia coil*
B. CryIAb	2. *Agrobacterium*
C. Hirudin	3. *Control cotton bollworms*
D. Ti-Plasmid	4. *Control corn borer*
	5. *Introduced in Brassica napus*

a. A-2 B-3 C-1 D-5 c. A-1 B-2 C-3 D-4
b. A-3 B-2 C-4 D-1 d. A-3 B-4 C-5 D-2

Questions from 16 to 18 consists of two statements-
Assertion (A) and Reason (R) . Answer these questions selecting the appropriate option given below:
    a) Both the A and R are true and R is the correct explanation of A.
    b) Both the A and R are true , but R is not the correct explanation of A.
    c) A is true but R is false.
    d) Both A and R are false.

15.Assertion : Insulin is a type of injectable vaccine.
Reason : It is synthesized by the process of filtration.

16. Assertion : DNA segments can be excised by 'molecular scissors' that biotechnologists call restriction endonucleases.
Reason : Restriction endonucleases are synthesized by microbes as a defence mechanism, which are specific to cleave double stranded DNA in a specific recognition site.

17. Assertion : Biopiracy refers to unauthorised use of bio-resources by developing countries.
Reason : Traditional knowledge related to bio-resources is exploited to develop daily needed products.

II. Fill in the blanks:- (1 mark)

1. Organisms (plants, animals, bacteria) whose genes have been altered by manipulation are called_____.
2. The Bt toxin protein encoded by genes_____and_____ controls bollworms while that of_____ controls corn borer.

3. _____method involves silencing of specific mRNA due to complementary dsRNA molecule that binds to and prevents translation of the mRNA.

4. In gene therapy for ADA deficiency, a functional ADA, CDNA using a _____ vector is introduced in lymphocytes of blood grown in culture.

5. ELISA is based on the principle of _____interaction.

6. Transgenic_____are being developed for use in testing the safety of vaccines before they are used on humans.

7. A nematode_____infects the roots of tobacco plants and causes a great reduction in the yield.

8. Insulin consists of two short polypeptide chains_____and_____, that are linked together by _____.

9. The Indian government has set up organization,_____, which make decision regarding the validity of GM research and safety of introducing GMOs.

10. A single stranded RNA or DNA molecule tagged with a radioactive molecule is called a_____.

B. Very short answers type questions: **(1 mark)**

1. Name the first transgenic cow.
2. Define chimeric DNA.
3. Name the molecular diagnostic technique to detect the presence of a pathogen in its early stage of infection.
4. Explain the term-'SCID' and 'GEAC'.
5. What is Bt-cotton?
6. For which variety of Indian rice, patent was filed by a USA company?
7. How does cryIAC gene express itself in its host?
8. What do the differently written 'cry' and 'Cry' represent respectively?
9. Name the nematode that infects and damages tabacoo roots.
11. Name one inter-specific hybrid animal (mammal).
12. Name one transgenic rice variety enrich with β-carotene.
13. What is humulin?
14. Why *Brassica napus* is so famous.
15. Who give birth to 'Dolly', the cloned sheep?
16. Define transgene.

Facts to remember

♦ Unlike 'Dolly',Polly and Molly are transgenic, due to carrying human proteingene.

♦ 'Polly' and 'Molly' were born in July, 1997.

QUESTIONS WITH SAMPLE ANSWERS

A. Short answer type questions: (2 marks)

Q. What are GMOs? How is it different from a hybrid? (1+1)

Ans: Genetically Modified Organisms: When plants, animals, fungi, bacteria etc. have had their own DNA but the DNA manipulated to possess and express an extra (foreign) gene, then they are called GMOs or transgenic organisms.

Difference between GMOs and hybrid:

In GMOs , foreign genes are introduced in an organism and is usually maintained as extra-chromosomal entity, whereas in a hybrid, a cross is done between total genomes of two varieties or strain or species.

B. Short answer type question: (3 marks)

Q. What do you mean by biopesticide? Name and explain the mode of action of a popular biospesticide. (1+2).

Ans: Biopesticide: A pesticide which is not chemical in nature, more specific in action against the pest and safer for environment than chemical pesticides, are called biopesticide.

Popular biopesticide and its mode of action: A popular biopesticide is Bt toxin (crystal protein) produced by a bacterium called *Bacillus thuringiesis*. The cry proteins are toxic to larvae of insects like tobacco bollworms, armyworms, beetles and mosquitoes. The activated toxin binds to the surface of epithelial cells of midgut and create pores. This causes swelling and lysis of cells leading to the death of the insects. CryIAc and cryIAb control cotton bollworms, cryIIIAb controls potato beetle.

DO IT YOURSELF

A. Short answer type question (2 marks)

1. Write briefly the role of biotechnology in medical science. (1+1)
2. Compare and contrast the advantages and disadvantages of GMOs. (1+1)
3. What is gene therapy? Illustrate using the example of ADA deficiency. (1+1)
4. Name the source organism from which Ti plasmid is isolated. Explain the use of this plasmid in biotechnology. (1+1)
5. Explain the process of RNA interference. (2)
6. Describe the role of baculovirus in the integrated pest management. (2)
7. Define biopiracy with example. (2)
8. Write short notes on the benefits of transgenic animals in vaccine safety testing. (2)
9. Write the application of ELISA technique in molecular diagnosis with suitable example. (2)
10. Mention two transgenic plants and their potential applications. (1+1)

B. Short answer type questions (3 marks)

1. Describe the various stages of commercial production for human insulin (humulin).(3)
2. How is transgenic tobacco plants protected against *Meloidegyne incognitia*? Explain. (3)
3. Define transgenic animals. Explain in details any three areas where they can be utilised. (1+2)
4. What is patent? Write its significance in biotechnology? (1+2)

Facts to remember

- Agrobacterium tumifaciens is a natural genetic engineer.
- Bt-cotton, Bt-brinjal etc. produces Cry protein, that kills insects and pests.

5. Define C-DNA library. Write its significance in biotechnology? (1+2)
6. Diagrammatically explain how genetically engineered insulin is prepared? (3)
7. Explain the different uses of biotechnology in medical field. (3)
8. What is GEAC? What are the objectives of GEAC. What are the conditions for which patent is given? (1+1+1)
9. Differentiate between PCR and Gene cloning. (3)
10. Make a flow chart of the steps that you would follow to transfer a useful gene from a bacteria to a plant. (3)

TEACHER'S NOTE

In 'Do it yourself' section, take care of the following points-

- Need conceptual development first, then you can prepare by yourself.
- NCERT text book page-207-215.
- Application of biotechnology in agriculture, medicine and treatment purpose. Needs for transgenic animals, ethical issues etc. should be properly revisioned and then prepare the answers from 'Do it yourself' section.

ANSWER TO THE "CHAPTER BASED QUESTION" SECTION:

a) Objective questions

I. 1) c 2) d 3) b 4) a 5) d 6) b 7) b 8) d 9) d 10) d 11) b 12) d 13) d 14) d 15) d 16) a 17) b

II. 1) GMOs, 2) cryIAC and cryIAb; cry IAb 3) RNA interference (RNAI), 4) retroviral, 5) antigen- antibody, 6) mice 7) *Meloidegyne incognitia*, 8) chain A and chain B, disulphide bridges, 9) GEAC (Genetic Engineering Approval committee), 10) Probe.

B) Very short answer type questions:

1. Rosie was the first transgenic cow.

2. Inserting a foreign DNA segment into the DNA molecule of a vector, then the newly synthesized DNA molecule is known as chimeric DNA.
3. Enzyme Linked Immune sorbent Assay (ELISA), RT-PCR(reverse transcription polymerase chain reaction), RIA(Radio Immune Assay) etc.
4. SCID- Severe Combined immune Deficiency. GEAC- Genetic Engineering Approval Committee
5. The transgenic variety of cotton which contains foreign gene obtained from bacterium *Bacillus thuringiensis*.
6. Indian Basmati was Crossed with a semi-dwarf variety and was claimed as anew variety, for which the patent was filled by a USA company.
7. Cry IAC gene codes for a toxin insecticidal protein, that controls the cotton bollworms.
8. 'Cry' represents crystal protein, while "cry" refer to the gene encoding crystal proteins.
9. Nematode *Meloidegyne incognita*
10. Tigon/Liger/Mule/ Hinmy
11. Golden rice
12. Gene for coding human insulin was transferred to *E.coli* bacteria(plasmid clone) and produced genetically engineered insulin, Which is called humulin.
13. The gene encoding hirudin (protein to prevent blood coagulation) was transferred into *Brassica napus*, resulting accumulation of hirudin within their seeds the hirudin in then purified and used as medicine
14. Dr. I an Wilmut(1995)
15. A gene prepared by genetic engineering and can be administered into another organism, then such genes are called transgene and the newly developed organism are called transgenic organism.

CHAPTER-13

ORGANISMS AND POPULATION

Important Concepts :

1. Ecology is the study of relationships of living organisms with abiotic and biotic components of their environment.
2. Temperature, light, water and soil are the most important physical factors of the environment to which the organisms are adapted in various ways.
3. Evolutionary changes through natural selection take place at the population level and hence population ecology is an important area of ecology.
4. Populations grow through births and immigration and decline through deaths and emigration.
5. When resources are unlimited, the growth is usually exponential but when resources become progressively limiting the growth patterns turns logistic.
6. The intrinsic rate of natural increase (r) is a measure of the inherent potential of a population to grow.
7. In nature populations of different species in a habitat do not live in isolation but interact in many ways.
8. The interaction between two species are classified as competition, predation and parasitism, commensalism, amensalism and mutualism.
9. Plants have evolved diverse morphological and chemical defenses against herbivory.
10. Some of the most fascinating cases of mutualism in nature are seen in plant-pollinator interactions.

Facts to Remember :

- Homeostasis
- Biomes
- Population
- Aestivation
- Age distribution
- Population density

CHAPTER BASED QUESTIONS

A. Objective Questions **(1 mark)**

I. Choose the most appropriate option from the following:

1) Homeostasis is

a) tendency to change with change in environment
b) tendency to resist change
c) disturbance in regulatory control
d) None.

2) The most ecologically relevant environmental factor is

a) Temperature
b) Water
c) Light
d) Soil

3) If global warming continues, how would the distributional range of some species be affected?

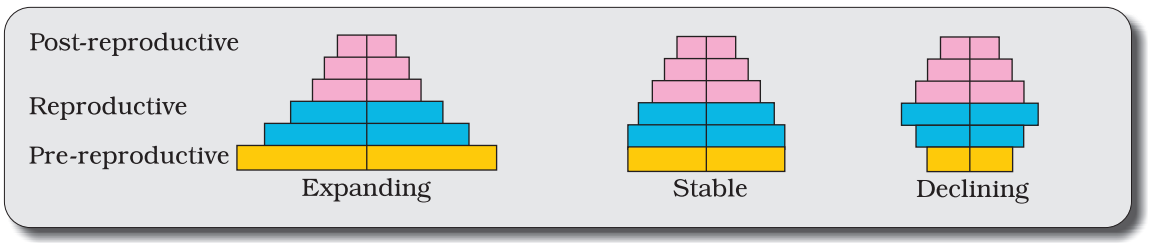
a) There will be a pole ward shift
b) There will be an equatorial shift
c) No change expected for any species
d) Shift to marine water from land

4) Many fresh water animals cannot live for long in sea water and vice versa because of:

a) Osmotic considerations
b) Themo liable enzymes
c) Lack of impermeable skin
d) None of these

5) Under unfavourable conditions, many 200 plankton species in lakes and ponds are known to enter a stage of suspended development called as:

a) Hibernation
b) Diapause
c) Aestivation
d) Dormancy



6) The given age pyramid represents a :

a) Fast expanding population
b) Slowly expanding population
c) Stable population
d) Declining population

7) Darwinian fitness is represented by:

a) Low r value
b) High r value
c) High k value
d) Low k value

8) Under a particular set of selection pressures, organisms evolve towards the most efficient:

a) Respiration
b) Reproduction strategy
c) Water conservation
d) None of these

9) A population interaction where one species is harmed where as the other is unaffected is called as:

a) Predation
b) Amensalism
c) Competition
d) Mutualism

10) Which of the following is not an ectoparasite?

a) Lice on humans
b) Copepods on marine fishes
c) Mistletoe on other plants
d) Female Anopheles on humans

Questions from 11 to 15 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 but R is not the correct explanation of A
c) A is true but R is false
d) Both A and R are false

11) A: Certain exotic species, introduced into a geographical area, become invasive.
R: The exotic species that become invasive can only be plants that can reproduce asexually very rapidly.

12) A: Milk - weeds are particularly favoured as their food by most herbivores.
R: Milk- weeds produce cardiac glycosides that are very good for the heart of the herbivores.

13) A: The newly acquired predators and parasites are often more damaging than the older ones
R: The older ones are familiar and the species getting affected have adjusted.
14) A: Mammals with smaller body size find thermoregulation more challenging than those with larger body size.
R: Mammals with smaller body size are ectotherms and mammals with larger body size are endotherms.
15) A: The human population is no longer growing exponentially but is still increasing rapidly.
R: Most countries of the world have undergone demographic transition.

II. Fill in the blanks:-

1. The shifting of an organism temporarily from stressful habitat to a more hospitable area and return where stressful period is over is called as ----------
2. Winter sleep is also called----------
3. To avoid summer-related problems heat and dessication by organism is called----------
4. A stage of suspended development is called----------
5. Both the species benefit in----------
6. Parasites that feed on the external surface of the host organism are called----------
7. The number of birth during a given period in the population that are added to the initial density is referred to----------
8. The size of the population tells us a lot about its status in the----------
9. Tapeworm is a----------
10. ---------- interactions arise from the interaction of populations of two different species.

B. Very short answer type questions:-

1. What are the two primary requirements of a parasite from host?
2. Name the mechanism employed by ophrys to get it's flowers pollinated?
3. List any two factors which determine the nature of soil?
4. What does J-shaped curve indicate?
5. Give an example of hibernating animal ?
6. With which population growth model is the Verhulst Pearl equation associated?
7. Name the type of interaction that is detrimental to both the interaction?
8. What type of interaction is shown by sparrows eating the seeds?
9. "Cuckoo bird lays egg in the nest of crow". Which thpe of interaction is shown in this relation?
10. Write the equation for Verhulst-pearl logistic growth of population.
11. Give one function of arenchyma in aquatic plants.

12. What adaptations occur in the mammals from colder climates to minimise heat loss ?
13. Why do plants in arid regions have sunken stomata?
14. How would the growth rate pattern be affected by infinite resources?
15. What are stenohaline species?
16. Name entities that can sustain on parts of plants and plant sup.
17. Give two examples of population.
18. Can the age of a population be undestood by the size of a pyramid ?
19. How can the population density be increased ?
20. What is the sex ratio of a population ?

QUESTIONS WITH SAMPLE ANSWER

C. Short answer type questions ***(2 marks)***

1. Differentiate between Hibernation and aestivation?

Ans :- Hibernation is the phenomenon of spending cold period in inactive stage by an animal where as aestivation is the phenomenon of spending dry and hot conditions in an inactive stage by animal.

D. Short answer type questions **(3 marks)**

1. Mention the specific adaptations of hydrophytes with respect to roots and stem.

Ans:- Roots:- Root system is feebly developed and unbranched. Some floating plants or submerged plants lack roots. Root hairs are absent except rooted floating hygrophyte. True root caps are absent.

Stem:- In submerged hydrophytes, stems are long slender and flexible whereas in the free-floating hydrophytes stems are modified as thick, stout, stoloniferous and occur horizontal on water surface.

DO IT YOURSELF

A. Short answer type questions: (2 marks)

1. Out of the two population growth models, which one is more realistic and why?
2. If a marine fish is placed in fresh water aquarium, will the fish be able to survive. Why or why not?
3. Define carrying capacity?
4. Name the bond of interaction present between the following:-
   a) Indian Nightingale and Crow
   b) Nodulated roots and rhizobium
   c) Plasmodium and Man
   d) Orchids and Mango tree

5) How do desert lizards maintain a fairly constant body temperature?
6) State Gause's competitive exclusion principle?
7) Give any two examples of defence mechanism in plants against herbivore?
8) Distinguish between ectotherms and Endotherms?

9) What are the four levels of biological organisation with which ecology basically deals?
10) List four features which enable the xeric plants to survive in the desert conditions.

B. Short answer type questions: **(3 marks)**

1. Define ectoparasite and endoparasite with suitable examples.
2. What is high altitude sickness? Write it's symptoms.
3. Give one example for each of the following types:-
   a) Migratory animal
   b) Camouflaged animal
   c) Predator animal
   d) Biological control agent
   e) Phytophagous animal
   f) Chemical defence agent
4) What role do predators play in an ecosystem?
5) Differentiate between regulators and conformers?

C. Long answer type questions (5 marks)

1. What is Age pyramid? What are the different types of age pyramid?
2. Orchid flower, ophrys co-evolves to maintain resemblance of it's petal to female bee. Explain how and why does it do so?
3. Describe the exponential growth model of a diagram with a curve?
4. Is the distribution of organisms affected by light? Explain briefly with suitable examples of animals or plants.

TEACHER'S NOTE

- For answering Q.No. A.3, refer the page no. 231 of NCERT Text Book.
- For answering Q.No. A.7, refer the page no. 234 of NCERT Text Book.
- For answering Q.No. B.4, refer the page no. 233 of NCERT Text Book.

ANSWERS TO THE CHAPTER BASED QUESTIONS

A. Objective questions

I. 1.b), 2. a), 3.a), 4.a), 5.b), 6.c), 7.b), 8.b), 9.b), 10.d), 11.c), 12.d), 13.a), 14.c), 15.c),

II. 1. Migrate, 2. Hibernation, 3. Aestivation, 4. Diapause, 5. Mutualism, 6. Ectoparasite, 7. Natality, 8. Habitat, 9. Endoparasite, 10. Interspecific

B. 1. Food and shelter
2. Mutualism
3. Climate and weathering process
4. Resources are unlimited in a habited

5. Hibernation in frogs, reptiles or polar bear
6. Logistic Growth
7. Competition
8. Predation
9. Brood parasitism
10. $dN/dt = rN \left(\frac{K - N}{K} \right)$
11. Provides buoyancy and helps them in floating
12. Shorter ears and limbs
13. To minimize water loss by transpiration.
14. It would be exponential
15. These species exhibit a narrow range of salinity tolerance
16. Phytoghagous
17. Bacterial growth in culture medium, lotus plant in pond.
18. The population is stable, expanding or declining.
19. Birth rate and migrant.
20. Number of male and female organism present in a population.

UNIT -X

CHAPTER - 14

ECOSYSTEM

IMPORTANT CONCEPTS :

- A structural and functional unit of nature comprising both biotic and abiotic components is called an ecosystem. Inorganic materials such as air, water and soil are biotic and producers, consumers and decomposers are biotic components.
- Two main structural features of an ecosystem are - i) Species composition and ii) Stratification.
- The four important components of ecosystem are - i) Productivity, ii) Decomposition, iii) Energy flow and iv) Nutrients cycling.
- Productivity is divided into two parts - i) Primary productivity - which is the rate capturing of solar energy or biomass production of the producers and ii) Secondary productivity - which is the rate of assimilation of food energy by the consumers.
- Primary productivity are of two types - i) Gross Primary Productivity (GPP) and ii) Net Primary Productivity (NPP).
- Decomposition is the process by which complex organic compounds of detritus are converted to Co_2, H_2o and inorganic nutrients by the decomposers. There are three processes in decomposition - i) Fragmentation of detritus, ii) Leaching and iii) catabolism.

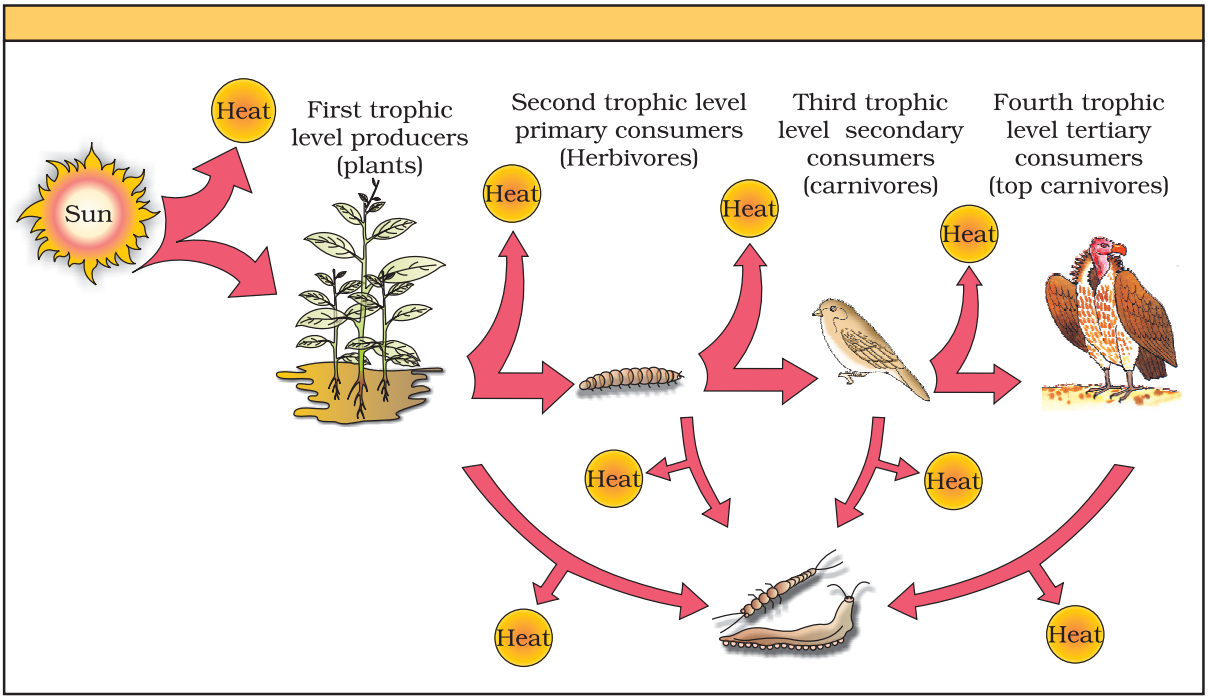


Fig. 14. 1 Energy flow through different trophic levels.

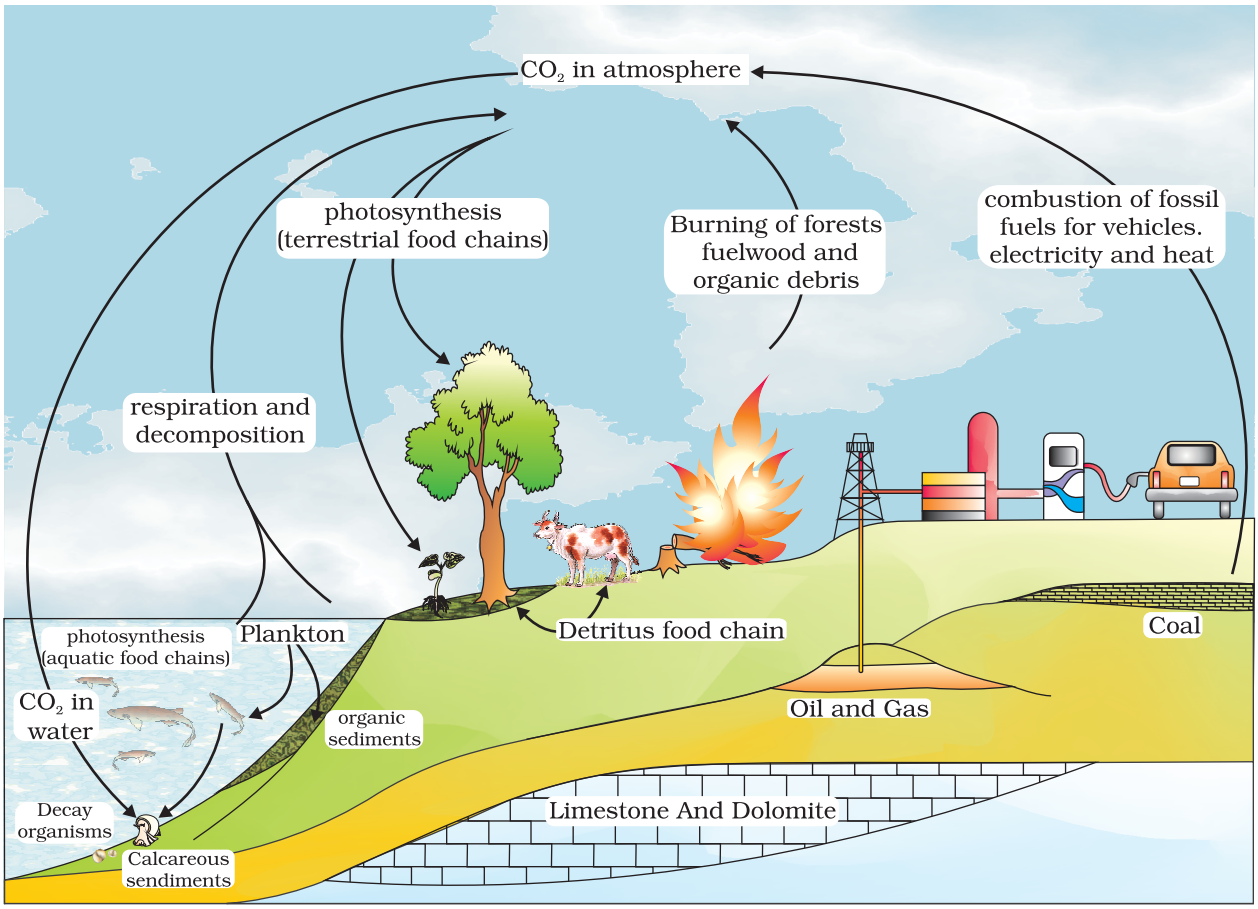


Fig. 14. 2- Simplified model of carbon cycle in the biosphere.

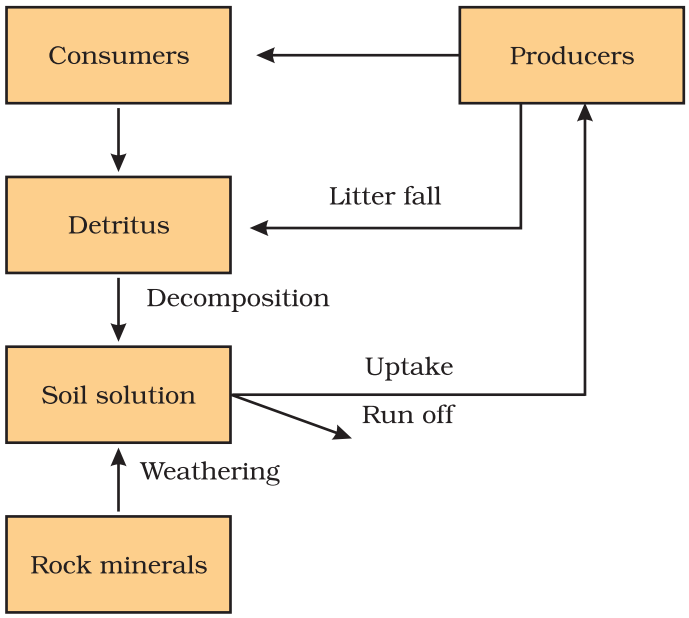


Fig. 14.3- A simplified model of phosphorus cycling in a terrestrial ecosystem.

- Undirectional flows of energy is found in an ecosystem. Solar energy is captured by the plants to produce food and this food is transferred from producers to consumers and at last to decomposers which ultimately make a food chain.
- Nutrient cycling is the storage and movement of nutrient elements through the various components of the ecosystem. It is of two types - i) Gaseous and ii) sedimentary.
- In gaseous type of cycle, atmosphere or hydrosphere is the researvoir and in sedimentary type of cycle, earth's crust is the reservoir. Products of ecosystem processes are named as ecosystem services.
- The living or biotic community undergoes changes with the passage of time. These changes are sequentially ordered and they constitute ecological succession.
- A stable climax community is formed with invasion of bare lifeless area by pioneers and if the environment remains unchanged, only then the climax community remains stable.

CHAPTER BASED QUESTIONS

A. Objective Questions (1 mark)

I. Choose the most appropriate option from the following :

1) Forest, grassland and desert are some example of -
(a) Man-made ecosystem (b) Terrestrial ecosystem
(c) Aquatic ecosystem (d) None of these

2) Vertical distribution of different species occupying different levels is called -
(a) Conservation (b) Decomposition (c) Stratification (d) None of these

3) An example of decomposer is -
(a) Fungi (b) Algae (c) Zooplankton (d) None of these

4) The rate of biomass production is called -
(a) Energy flow (b) Productivity (c) Nutrient cycling (d) None of these

5) Detrivores break down detritus into smaller particles, the process is called -
(a) Stratification (b) Humification (c) Fragmentation (d) None of these

6) Another name of nutrient cycling is -
(a) Biogeochemical cycle (b) Carbon cycle (c) Phosphorus cycle (d) None of these

7) The green plants in the ecosystem are called -
(a) Consumers (b) Producers (c) Detritus (d) None of these

8) The largest population in a food chain are -

(a) Producers (b) Primary Consumers

(c) Secondary Consumers (d) None of these

9) Healthy forest ecosystem purifies -

(a) Rock and soil (b) Carbon and Hydrogen (c) Air and Water (d) None of these

10) In water or very wet areas, succession of plants is called -

(a) Ecological succession (b) Hydrarch succession

(c) Xerarch succession (d) None of these

11) 'Rivet popper hypothesis' was used by -

(a) Paul Edger (b) Paul Ehrlich (c) Paul Robinson (d) None of these

12) The IUCN Red list (2004) documented the extinction of species which was -

(a) 784 (b) 874 (c) 487 (d) None of these

Questions from no. 13 to no. 15 consist of two statements - **Assertion (A)** and **Reason (R)**. Answer the 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 but **R** is not the correct explanation of **A**.

c) A is true but **R** is false.

d) Both **A** and **R** are false.

13. **Assertion (A)** : Detritus food chain starts with dead organic matter called detritus.

Reason (R) : Heterotrophic organisms like fungi and bacteria act as major decomposers in the detritus food chain.

14. **Assertion (A)** : In secondary productivity new organisms matter is formed.

Reason (R) : It is not utilising part of food manufactured by primary producers to building of consumer biomass.

15. **Assertion (A)** : Vertical distribution of diffrent species occupying different levels is stratification.

Reason (R): Trees occupy bottom vertical layer of a forest and herbs & grasses occupy the top layers.

II. Fill in the blanks :

1. Phytoplankton is an _____ component.

2. A constant input of _____ energy is the basic requirement for any ecosystem to function.

3. The rate of _____ production is called productivity.

4. GPP - R = _____

5. Decomposers secrete _____ enzymes that breakdown dead and waste materials.

6. _____ are omnivores.

7. The two basic categories of ecosystem are terrestrial and _____.

8. Description of ecological succession usually focuses on changes in _____.

9. Xerarch succession takes place in _____ areas.

10. Fossil fuels represent a reservoir of _____.

11. The base of ecological pyramid represents the _____.

12. The pyramid of biomass in sea is generally _____.

B. Very short answer type questions : **(1 mark)**

1. What is the full form of GPP ?
2. Which animal is called as 'farmer's friend' ?
3. Give an example of detrivores ?
4. Which process is called as Catabolism ?
5. What is the full form of PAR ?
6. Where is the reservoir located for sedimentary cycle ?
7. What is the natural reservoir of Phosphorus ?
8. Give an example of grazing food chain ?
9. What is the full form of DFC ?
10. Give an example of pioneer species.
11. Give the full form of NPP.
12. Give two examples of terrestrial ecosystem.

QUESTIONS WITH SAMPLE ANSWERS

A. Short answer type questions : (2 mark)

1. What is the difference between upright and inverted pyramid ?

upright pyramid	Inverted pyramid
1. The number of producers is maximum in an ecosystem.	1. The number of producers are minimum in an ecosystem.
2. Number of producers decreases in each trophic level in a food chain. eg. the pyramid of energy.	2. Producer's level increases progressively at each trophic level in a food chain. eg. the pyramid of biomass in sea.

B. Short answer type questions : **(3 marks)**

1. What is food chain ? Write about different types of food chain in the ecosystem.

Ans : A network of links in a food wave which explains the flow of energy in an ecosystem is called food chain.

In a food chain, the producers are consumed by the primary consumers which are consumed by the secondary consumers. Both of them are consumed by detrivores after their death and finally by decomposers.

There are two types of food chain in the ecosystem - i) Grazing and ii) detritus. Grazing food chain starts with producers and ends with consumers while detritus food chain starts with dead organisms and ends with decomposers.

A. Short answer type questions: (2 marks)

1. What is humus ? (2)
2. What are the components of ecosystem ? (2)
3. What is 10% law ? (2)
4. What is the function of reservoir of nutrient cycle ? (2)
5. Write the important steps in the process of decompositions. (2)
6. What are ecosystem services ? (2)
7. Distinguish between food chain and food web. (2)
8. What is standing crop ? How is it measured ? (1+1)

9. Write two important differences between carbon and phosphorus cycle. (2)

10. Why are nutrient cycles called as biogeochemical cycle ? (2)

B. Short answer type questions : (3 marks)

1. What is decomposition ? What are the process and products of decomposition ? (1+2)
2. Show a simplified model of phosphrus cycling in a terrestrial ecosystem. (3)
3. Give two examples of man-made (artificial) ecosystem. Distinguish between man-made ecosystem and natural ecosystem. (1+2)
4. What is ecological pyramid ? What are the different types of ecological pyramid ? (1+2)
5. How have human activities significantly influenced the carbon cycle. (3)
6. What are biotic and abiotic components ? Give examples of each. (2+1)
7. Write the environmental factors which regulate the rate of release of nutrients into the atmosphere. Give an example of Saprotroph ? (2+1)
8. What is ecological succession ? What are two types of ecological succession ? (1+2)

C. Long answer type questions : (5 marks)

1. Show diagramatically the energy flow through different trophic level. Name two sedimentary type of nutrient cycle. (3+2)
2. Represent diagramatically a simplified model of carbon cycle in the biosphere. Define carbon cycle. (4+1)
3. What is trophic level ? Show with diagram the energy flow through different trophic levels.
4. Draw an ideal pyramid of energy that supports 10% law. What are the important differences between carbon and phosphorus cycle. (3+2)

TEACHER'S NOTE

In the 'Do it yourself' section, take care of the following points :

- ♦ Give examples for answering the definitions.
- ♦ Give diagrams and examples while answering Q.B-2 and Q. B -4 and C-4 .
- ♦ Refer and draw the diagrams of figure 14.3 and 14.6 of textbook for answering Q.C-1, C-2 and C-3.
- ♦ Answer to the point with example and diagrams will help you fetch more marks.

ANSWER TO THE 'CHAPTER BASED QUESTIONS' SECTION

A. **Objective questions :**

(I) 1-(b); 2-(c); 3-(a); 4-(b); 5-(c); 6-(a); 7-(b); 8-(d); 9-(c); 10-(b); 11-(b); 12-(a); 13-(a); 14-(c); 15-(c).

(II) 1- Autotrophic; 2- Solar ; 3-Biomass; 4- NPP; 5-digestive enzymes; 6- Cockroaches crows; 7-aquatic; 8-vegetation; 9-dry; 10- carbon; 11- producers; 12- inverted.

B. **Very short answer type questions:** (1 mark)

1) Gross primary productivity 2) Earthworm 3) Fungi 4) Degradation of detritus by bacterial and fungal enzymes into simpler inorganic substances. 5) Photo synthetically active radiation. 6) In earth's crust. 7) Rock 8) Grass (producer) →Goat (Primary consumer) →man (secondary consumer). 9)Detritus food chain. 10) Lichens11) Net primary productivity
12) Forest and grassland.

BIODIVERSITY AND CONSERVATION

IMPORTANT CONCEPTS:

- The sum total of diversity that exists at all level of biological organisation is called as Biodiversity. Diversity at genetic, species and eco-system levels is given importance and conservation efforts are aimed at protecting diversity at all the mentioned levels.
- Out of total species in the earth, more than 1.5 million species have been recorded but there might be nearly 6 million species on earth waiting to be discovered and named. Among the named species, 70% are animals of which insects are 70%.
- Fungi has more species than all the vertebrate species and in India, about 45,000 species of plants and twice as many species of animals are found. India is one of the twelve mega diversity countries of the world.
- On earth, species diversity is not uniformly distributed. It is found highest in the tropics and decreases towards the poles. Tropics had more evolutionary time and they provide a relatively constant environment and receive more solar energy contributing greater productivity.
- Communities with high diversity tend to be less variable, more productive and more resistant to biological invasions. According to earth's fossil history, inclidence of mass extinctions were found in the past but at present, extinctions are largely attributed to human activities which are 100 to 1000 times higher.
- The causes of high extinction rate at present include - i) habitat loss and fragmentation, ii) over -exploitation biological invasions and iii) co-extinction. Nearly 700 species have become extinct in recent times and more than 15,000 species currently face the threat of extinction.
- The rich diversity of earth is vital for the survival of mankind and we must have a moral responsibility to take good care of earth's biodiversity and passion in good order to our next generation. We enjoy both direct and indirect benefits by conserving biodiversity for utilitarian and ethical reasons.
- There are two types of biodiversity conservation- i) in situ conservation and ii) ex situ conservation. In insitu conservation, the endangered species are protected in their natural habitat for the protection of entire ecosystem. Out of 34 biodiversity hotspots, three are in India. The efforts of India's in situ conservation are reflected in its 14 nos. of biosphere reserves. 9 (nine) national parks and 450 wildlife sanctuaries and many sacred groves.
- In ex situ conservation, protective maintainance of threatened species in zoological parks and botanical gardens are done. Besides, in vitro fertilisation, tissue culture propagation and cryopreservation of gametes are also included.
- Collective responsibilities of all nations must be there for protection of biodiversity. The Earth Summit held in Rio de Janeino in 1992 called upon all nations to take appropriate measures for conservation of biodiversity and sustainable utilisation of its benefit. Again in 2002 in

Johannesburg, South Africa 190 countries pledged their commitment to achieve it by 2010 where a significant reduction in the current rate of biodiversity loss at all levels i.e., global, regional and local levels.

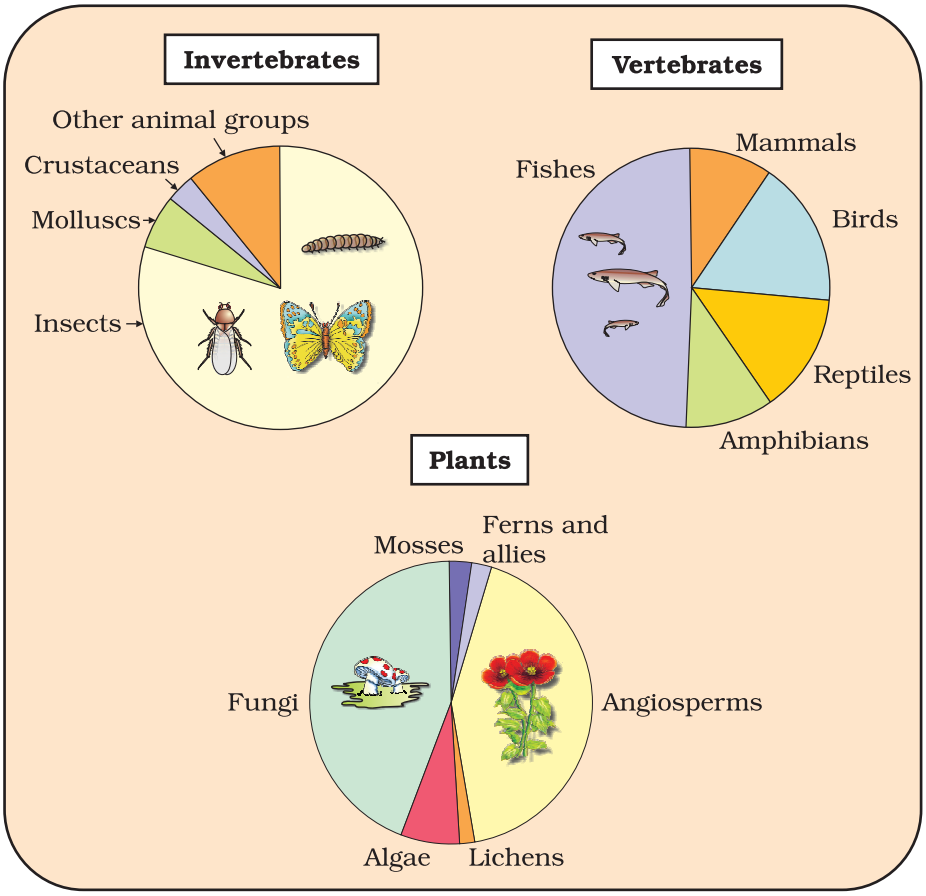


Figure 15.1. Representing global biodiversity : proportionate number of species of major taxa of plants, invertebrates and vertebrates.

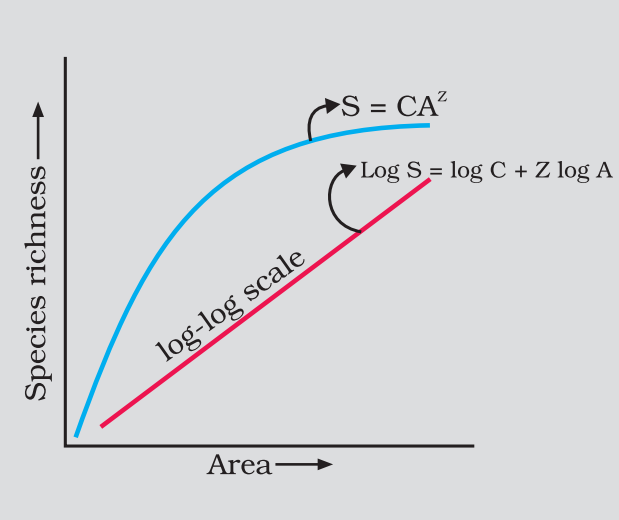


Figure 15.2 Showing species area relationship.
Note that on log scale the relationship becomes linear

CHAPTER BASED QUESTIONS

A) Objective questions. (1 mark)

I. Choose the most appropriate option from the following.

1. Biodiversity is a term popularised by-
   a) Edward Jennen
   b) Edward Wilson
   c) Edward Aldrin
   d) None of these
2. Indian's share of the global species diversity is-
   a) 6.1 per cent
   b) 7.1 per cent
   c) 8.1 per cent
   d) None of these
3. There is more solar energy available in the-
   a) Tropics
   b) Poles
   c) Equator
   d) None of these
4. LogS=logC+Z logA, here'A' stands for-
   a) Angle
   b) Area

c) All
d) None of these

5. Frugivorous means-
a) Fruit-plucking
b) Fruit -eating
c) Fruit-carrying
d) None of these

6. 'Increased diversity contributed to higher productivity', told by-
a) David Gower
b) David Still
c) David Tilman
d) None of these

7. 'Lungs of the planet' is-
a) Amazon rain forest
b) Himalayan rain forest
c) Africam rain forest
d) None of these

8. Extinction of passenger pigeon was due to-
a) Over-gathering
b) Over-exploitation
c) Over-grazing
d) None of these

9. The total numbers of biodiversity hotspots in the world is-
a) 14
b) 24
c) 34
d) None of these

10. Total number of wildlife sanctuaries that India possesses is-
a) 448
b) 558
c) 668
d) None of these

11. Seeds of different genetic strains of commercially important plants can be kept for long periods in-
a) Seed-bags
b) Seed banks
c) Seed warehouse
d) None of these

12. 'The Earth Summit' was held in Rio de Janeiro in-
a) 1972
b) 1982

c) 1992
d) None of these

Questions from no. 13 to no. 15 consist of two statements-Assertion (A) and Reason (R). Answer the 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 but R is not the correct explanation of A.
c) A is true but R is false
d) Both A and R are false.

13. Assertion (A): A biosphere reserve is surely a specified area.
Reason(R): Restriction on human activities has been imposed in biosphere reserve.
14. Assertion (A): A stable community should not show too much variation in productivity from one year to another.
Reason(R): A stable community must not be resistant to invasions by the alien species.
15. Assertion (A):Threatened animals and plants are taken out from their natural habitat and placed in special setting where they can be protected and given special care.
Reason(R): The approach of Ex situ conservation is to identify region to save the plants and animals from extinction.

II. Fill in the blanks:

1. Out of every 10 animals of this planet, _____are insects.
2. Presently, _____% of all mammal species in the world face the threat of extinction.
3. India has only_____per cent of the world's land area.
4. India's share of the global species diversity is_____ per cent.
5. According to David Tilman, increased diversity contributed to_____.
6. The current species extinction rates are estimated to be _____to _____times faster than in the pre-human times.
7. The Earth summit was held in_____in 1992.
8. The world summit on sustainable development was held in Johannesburg, South Africa in _____.

9. _____ _____ are found in Khasi and Jaintia hills in Meghalaya.

10. Earth's rich biodiversity is vital for the survival of _____

11. The species area relationship is generally a rectangular _____ function.

12. Earth's fossil history reveals incidence of much _____ in the past.

B. very short answers type questions. **(1 mark)**

1. What is the full form of IUCN?
2. Who popularised the term 'Biodiversity'?
3. Give two example of recent extinction of animals.
4. Which rain forest is called as the 'lungs of the planet'?
5. Where is the lowest biodiversity found?
6. Where was the world summit on sustainable Development held in 2002?
7. Give an example of species diversity area in India.
8. What biodiversity are hotspots?
9. Write the full form of WWF and IBWL.
10. What are the two conventional methods of ex-situ conservation?

QUESTION WITH SAMPLE ANSWERS

A. Short answer type questions: **(2 marks)**

1. What are sacred grooves? Write their role in conservation.

Ans:- Sacred grooves are sacred forest are around the places of worship People specially tribal people never allow to cut a single branch of the tree from the sacred grooves. As a result, many endemic species flourish in these region. e.g. Khasi and Jaintia Hills of Meghalaya.

B. Short Answer type questions: **(3 marks)**

1. Give a short note on co-extinctions with suitable example.

Ans: Extinctions of plants and animals associated with a particular species which becomes extinct is called co-extinctions. It is an obligatory way because when a host fish species becomes extinct, its unique assemblage of parasites also meets the same fate. The case of a coevolved plant pollinator mutualism is another example of co-extinctions where extinction of one leads to the extinction of the other invariably. Co -extinction of the fellow-species with the extinct species is one of the causes of biodiversity loss.

DO IT YOURSELF

A. Short answer type questions. ***(2 marks)***

1. What are in situ and ex-situ conservation? (2)
2. What is the difference between species diversity and ecological diversity? (2)
3. What is the ethical argument? (2)
4. What is IUCN red list? Give two uses of it . (1+1)
5. What is species diversity? What are the two important measures of species diversity? (1+1)
6. What are the two biodiversity hotspots on rich zones in India? (2)
7. Do humans get benefit from diversity of life? Give two examples. (2)
8. Is there more solar energy available in the tropics? Explain briefly. (2)
9. What is the difference between endemic and exotic species? (2)
10. What are the important attributes of a stable community? (2)

B. Short answer type questions **(3 marks)**

1. What are sacred groves? What is their role in conservation? (1+2)
2. What is conservation? What are the objectives of in situ and ex situ conservation? (1+2)
3. Justify that animals are not essential in an ecosystem. (3)
4. What are the three important components of biodiversity? Briefly discuss with example.(2+1)
5. What is an endangered species? Give example on an endangered plant and animal species.(1+2)
6. What do you mean by co-extinction? Give explanation with a suitable example. (1+2)
7. Show species area relationship with an appropriate diagram. (3)

C. Long answer type questions ***(5 marks)***

1. What is diversity? Discuss the major causes for loss of diversity. (1+4)
2. What are alien species? How does alien species reduce the species diversity of an area? What is the scientific name of African catfish? (1+3+1)
3. Why do we conserve biodiversity and how? (2+3)
4. Draw a diagram representing global biodiversity and label it (3+2)

TEACHERS NOTE

In the 'Do it yourself section' take care of the following point:

- Give example for answering the definitions
- Give diagrams and examples while answering Q. B-7
- Refer and draw the diagrams of figure 15.1 of the text book for answering Q No. C-4.
- Answer to the point with example and diagram will help you fetch more marks.

ANSWER TO THE 'CHAPTER BASED QUESTION' SECTION

A. Objective questions:

I) 1- (b) 2- (c) 3-(a) 4-(b) 5-(b) 6- (c) 7-(a) 8- (b) 9-(c) 10-(a) 11-(b) 12-(c) 13-(a) 14-(c) 15-(c)

II) 1-7, 2-23%, 3-2.4%, 4-8.1%, 5- higher productivity, 6-100,1000, 7-Rio de Janeiro, 8-2002. 9-Jhum cultivation, 10-Mankind 11-hyperbola

B. Very short answer type questions (1 mark)

1. International Union for conservation of Nature.
2. Edward Wilson, a sociobiologist.
3. Dodo of Mauritius and quagga of Africa
4. Amazon rain forest
5. In polar region
6. Johannesburg , South Africa
7. Western ghat area
8. A bio geographic region with significant level of biodiversity threatened by habitation created by human being
9. World Wide Fund for Nature, Indian Board of wildlife
10. Botanical gardens and Zoological Parks.

UNIT-X CHAPTER-16

ENVIRONMENTAL ISSUES

IMPORTANT CONCEPTS :

- Environmental pollution and depletion of valuable natural resources are major issues today. They vary in dimension from local, regional to global levels.
- Maximum air pollution results from burning of fossil fuels in industries and in automobiles. They must be removed to keep air clean because they are harmful to humans, animals and plants too.
- The most common source of water pollution is domestic sewage which reduces dissolved oxygen and increases biochemical oxygen demand of receiving water. As the domestic sewage is rich in nutrients with nitrogen and phosphorus, it causes eutriphication and nuisance algal growth.
- Industrial waste waters are often abundant in harmful toxic chemicals consisting heavy metals and organic compounds which can harm living organisms.
- Municipal wastes also create great problems and they must be disposed off in a particular space like landfills. Besides, disposal of hazardous wastes like dead ships, radioactive wastes and e-wastes needs extra efforts.
- Agricultural chemicals like pesticides, insecticides, herbicides, etc. result in soil pollution which leachates from solid wastes deposited over it.
- Rapidly increasing greenhouse effect and depletion of ozone layer in the stratosphere are the two major environmental issues. Greenhouse effect is warming earth which causes melting of iceberg and increase of water level in the seas and oceans.
- Increase of greenhouse gases is due to higher emission of CO_2, methane, nitrous oxide and CFCs and of course, deforestation. Rainfall pattern, global temperature are affecting living organisms deleteriously.
- In stratosphere, ozone which protects us from harmful effects of ultraviolet radiation, is depleting very fast due to emission of CFCs. It increases the risks of skin cancer, mutation and other several disorder.

- Degradation by improper resource utilisation and maintenance is happened almost everywhere. Soil erosion and desertification, water logging and soil salinity are the effects of it.
- Deforestation occurs due to a number of human activities such as cutting of trees for timber, fire wood, cattle rearing and several other purposes. Jhum cultivation in the north-eastern states also causes deforestation.
- Reforestation is the process of restoring a forest again both naturally and artificially by planting trees in order to bring back biodiversity.
- The sacrifice of Amrita Devi Bishnoi and Chipko movement created awareness for protecting of trees among the people. Joint Forest Management (JFM) was introduced in 1980 to work closely with the local communities for protecting and managing forests where local people are benefitted using various plants as well as animals products.

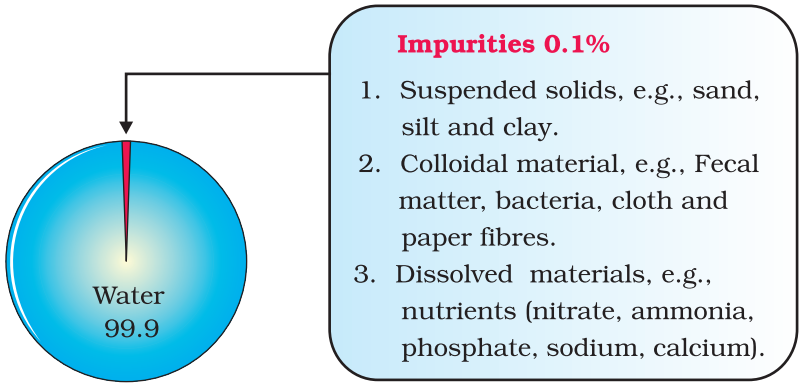


Figure 16.1 Composition of waste water

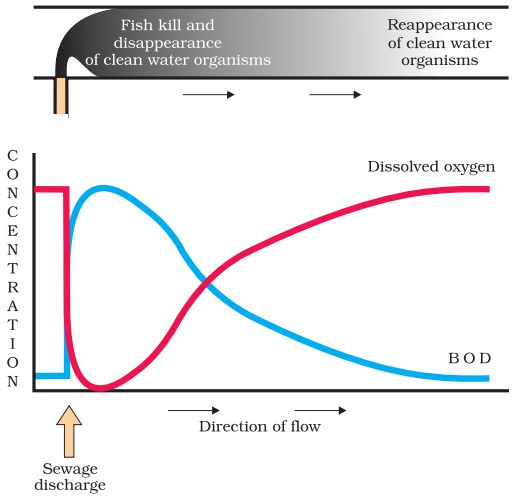


Figure 16.2 Effect of sewage discharge on some important characteristics of a river

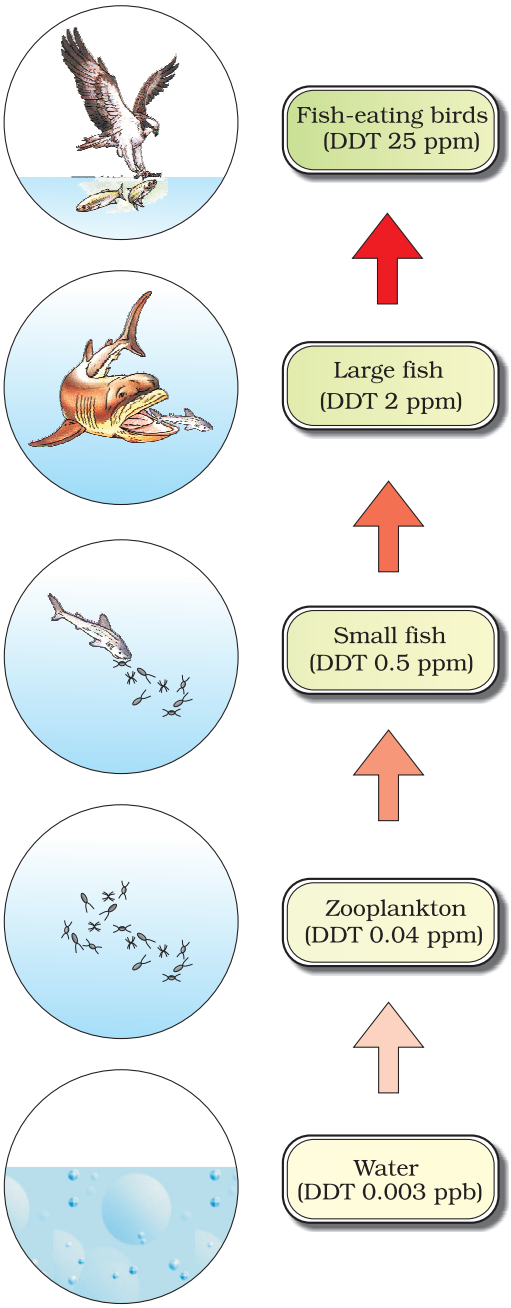


Figure 16.3 Biomagnification of DDT in an aquatic food chain

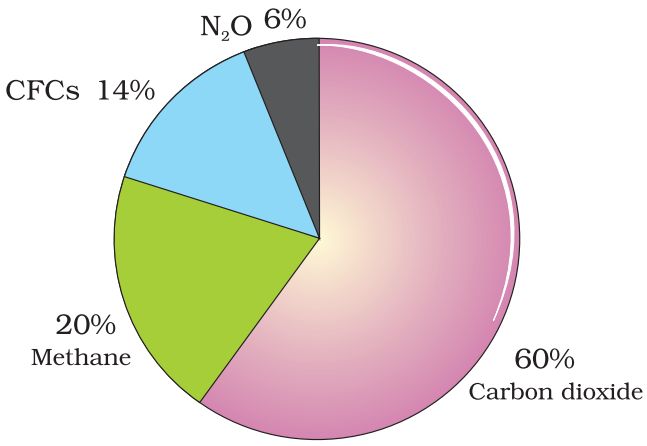


Figure 16.7 Relative contribution of various greenhouse gases to total global warming

CHAPTER BASED QUESTIONS

A) Objective questions **(1 mark)**

I. Choose the most appropriate option from the following:

1. Harmful effects of pollution depend on the concentration of -
   a) Sewage
   b) Pollutants
   c) Garbage
   d) None of these
2. Air (Prevention and Control of pollution) Act came into force in-
   a) 1961
   b) 1971
   c) 1981
   d) None of these
3. Undesired high level of sound is called -
   a) Noise
   b) Sound
   c) Loudness
   d) None of these
4. For controlling vehicular air pollution diesel-run buses are converted to-
   a) PMG
   b) CNG
   c) LPG
   d) None of these
5. Water (Prevention and Control of Pollution) Act was passed in-
   a) 1954
   b) 1964
   c) 1974
   d) None of these
6. It is possible to estimate the amount of biodegradable organic matter in sewage water by measuring-
   a) BOD
   b) COD
   c) POD
   d) None of these

7. Presence of large amount of planktonic algae in water is called=
   a) Fungal bloom
   b) Algal bloom
   c) Protozoan bloom
   d) None of these
8. *Eichhornia crassipes* is also called-
   a) Terror of Blagladesh
   b) Terror of Bihar
   c) Terror of Bengal
   d) None of these
9. Electrostatic precipitation can remove the particulate matter over-
   a) 79%
   b) 89%
   c) 99%
   d) None of these
10. Thinning of eggshell in birds is due to presence of high concentnation of -
   a) DDT
   b) BHC
   c) Bleaching powder
   d) None of these
11. The natural aging of a lake by nutrient enrichment of its water is called-
   a) Biomagnification
   b) Precipitation
   c) Eutrophication
   d) None of these
12. The substitute for open-burning dumps is-
   a) Open ground
   b) Sanitary land fills
   c) Garbage-box
   d) None of these
13. Commonly known green house gases are-
   a) CO_2 and methane
   b) O_2 and N_2

c) H_2O and O_2

d) None of these

Questions from no. 14 to 16 consist of two statements-Assertion(A) and Reason(A). Answer the 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 but R is rot the correct explanation of A.

c) A is true but R is false.

d) Both A and R are false.

14. Assertion(A) : Water pollutants are measured by BOD.
    Reason(R) : If BOD is less, the water is polluted.
15. Assertion(A) : Eutrophication shows increase in productivity in water-logged area.
    Reason(R) : The diversity of the phytoplankton increases with the increasing eutrophication.
16. Assertion(A) : Micro organisms involved in biodegradation of organic matter in the receiving water body consume a lot of oxygen.
    Reason(R) : A sharp decline in dissolved oxygen downstream from the point of sewage discharge causes mortality of fish and other aquatic creatures.

II. Fill in the blanks:-

1. _____are a major cause for atmospheric pollution at least in metro cities.
2. Presence of large amount of nutrients in waters also causes excessive growth of _____ algae.
3. There are working _____ toilets in many areas of Kerala and Sri Lanka.
4. The use of _____is crucial to disposal of hospital wastes.
5. _____ is the only solution for treatment of e-waste.
6. Agents that bring about an undesirable change are called as _____.
7. _____ is undesired high level of sound.
8. A mere _____ per cent impurities make domestic sewage unfit for human use.
9. Irreparable computers and other electronic goods are known as _____.
10. Green house gases absorb _____ infrared radiation from the earth.
11. Clouds and gases reflect about _____ of the incoming solar radiation.

12. The development of the fertile top-soil takes _____.
13. When large barren patches extend and meet over time, a _____is created.
14. The increased salt content in the soil is extremely damaging to _____.
15. _____ in the north-eastern states of India has contributed to deforestation.

B. Very short answer type questions. (1 mark)

1. What is the full form of CPCB?
2. When was Bharat Stage-III implemented throughout the country?
3. What is the full form of CNG?
4. When did Air (prevention and control of pollution) Act come into force?
5. What is the full form of BOD?
6. Name the world's most problematic aquatic weed.
7. What is the full form of DU?
8. When has the Government of India passed the water (prevention and control of pollution) Act?
9. What is called 'Terror of Bengal'?
10. What is El Nino effect?
11. What is the full form of JFM?
12. When was Chipko Movement happened?
13. Name the award which Indian Government instituted for individuals or communities from rural areas for protecting wildlife.
14. Name two pollutants emitted from vehicles.
15. What metals are used in catalytic converters?

QUESTIONS WITH SAMPLE ANSWERS

A. Short Answer Type Question. (2 marks)

1. What will happen if we dispose domestic sewage into water without proper treatment?

Ans : Domestic sewage contains many undesirable pathogenic micro organisms. If we dispose them into water without proper treatment, they may cause outbreak of serious diseases like dysentery, typhoid, Jaundice, Cholera etc.

B. Short Answer Type Question. (3 marks)

1. What are Municipal Solid Wastes? What do they contain? What are adopted as the substitute for open-burning dumps?

Ans: The wastes from homes, offices, stores, schools, hospitals, markets etc. that are collected and disposed by the municipality are called Municipal Solid Wastes.

Municipal Solid Wastes contain paper, food wastes, plastics, glass, metals, rubbers, leathers etc.

Sanitary landfills are adopted as the substitute for open-burning dumps where wastes are dumped in a depression or trench after compaction and covered with dirt everyday.

DO IT YOURSELF

A. Short Answer Type Questions ***(2 marks)***

1. What is sanitary landfills? (2)
2. What is Biomagnification? (2)
3. How does noise cause harmful? (2)
4. How is CNG better than petrol and diesel? (2)
5. What is deforestation? Write two consequences of deforestation. (1+1)
6. What is snow-blindness? What is its cause? (1+1)
7. What is algal bloom? What is its effect? (1+1)
8. What is UV-B? How does it affect on human being? (1+1)

B. Short Answer Type Questions ***(3 marks)***

1. What is cultural Eutrophication? How does it affect a lake? (1+2)
2. What is global warming? What are the effects of global warming? (1+2)
3. What is ozone hole? How it is formed? (1+2)
4. What is organic farming? What is its benefit? (1+2)
5. What are radioactive wastes?how can they damage the organisms? (1+2)
6. How can all wastes we generate be categorised ? Give example of each. (2+1)
7. What is noise? How does it affect the body of an organism? (1+2)
8. What measures can be taken to control vehicular air pollution. (3)

C. Long Answer Type Questions ***(5 marks)***

1. What is ozone hole? Why does ozone hole form over Antarctica? How can ultraviolet rays affect us? (1+2+2)
2. What is environmental pollution? What measures can we take to reduce environmental pollution? What is snow-blindness? (1+3+1)

3. What is electrostatic precipitator? How does it work? What is the size of particulate matter responsible for causing harm to human health? (1+3+1)
4. How do you categorise all waste that we generate? Give example of each. How do we manage all the above waste? (3+2)

TEACHER'S NOTE

In the 'Do it yourself' section, take care of the following points:

- Give examples for answering the definitions.
- Give diagrams and examples while answering Q.A-2
- Refer and draw the diagrams of figure 16.1 of the text book for answering Q.no C-3.
- Answer to the point with example and diagrams will help you fetch more marks.

ANSWERS TO THE 'CHAPTER BASED QUESTION' SECTION

A. Objective questions:

I. 1-(b), 2-(c), 3-(a), 4-(b), 5-(c), 6-(a), 7-(b), 8-(c), 9-(c), 10-(a), 11-(c), 12-(b), 13-(a), 14-(c), 15-(a), 16-(a)

II. 1-Automobiles, 2-Planktonic, 3-Ecosan, 4-Incinerators, 5-Re-cycling, 6-Pollutants, 7-Noise, 8-0.1, 9-e-wastes, 10-Longwave, 11-One-fourth, 12-Centuries, 13-Desert, 14-Agriculture, 15-Jhum cultivation.

B. Very Short Answer Type Questions (1 mark)

1-Central Pollution Control Board, 2-October,2010, 3-Compressed Natural Gas, 4-1981, 5-Biochemical Oxygen Demand, 6- Eichhornia crassipes or water hyacinth, 7-Dobson Units, 8-1974, 9- Eichhornia crassipes or water hyacinth, 10-Uneven climatic changes due to rise in temperature, 11-Joint Forest Management, 12-In 1974, 13-Amrita Devi Bishnoi Wildlife Protection award, 14-carbon monoxide and sulphur dioxide, 15-Plantinum-palladium and Rhodium.

Sample Paper
Class - XII
Biology : Theory

Time : 3 hours Maximum Marks : 70

General Instructions :

(i) All questions are compulsory.

(ii) The question paper has five sections : Section A, Section B, Section C, Section D and Section E. There are 31 questions in the question paper.

(iii) Section 'A' has 14 questions of 1 mark each (including 10 MCQs and 04 Assertion Reasoning type questions). Section B has 03 case based or passage based questions. Two questions of 5 marks each and 01 question of 4 marks. Section C has 06 questions of 2 marks each. Section D has 05 questions of 3 marks each. Section E has 3 Questions of 5 marks each.

(iv) There is no overall choice. However, internal choices has been provided in some questions. A student has to attempt only one of the alternatives in such questions.

(v) Whenever necessary, neat and properly labelled diagrams should be drawn.

Section - A

Questions: **Mark - 1**

1. Transfer of pollen grains from anther to the stigma of another flower of same plant is –

(a) Autogamy (b) Xenogamy (c) Geitonogamy (d) Allogamy

2. Males are homogametic and females are heterogametic among –

(a) Human (b) Birds (c) *Drosophila* (d) Grasshopper

3. The components of the nucleosome are –

(a) RNA (b) DNA (c) Histone protein (d) Both b and c

4. Miller and Urey in their experiment used –

(a) Rain water (b) Distilled water (c) Ocean water (d) Fresh water

5. Match the following diseases with the causative organisms and select the correct option from the following:

Column I	**Column II**
(A) Pneumonia	(i) *Wuchereria*
(B) Amoebiasis	(ii) *Plasmodium*
(C) Elephantiasis	(iii) *Entamoeba*
(d) Malaria	(iv) *Haemophilus*

	A	B	C	D
a)	(iv)	(iii)	(i)	(ii)
b)	(iii)	(i)	(ii)	(iv)
c)	(iv)	(iii)	(ii)	(i)
d)	(ii)	(iii)	(i)	(iv)

6. To obtain virus free healthy plants from a diseased plant through tissue culture, which part of plant has to be taken ?

(a) Mesophyll tissue (b) Apical meristem (c) Vascular tissue (d) Anther

7. Identify the wrongly matched pair -

(a) Rhizobium – Biofertilizer (b) Spirulina – Single cell protein

(c) Lactobacillus – Curd formation (d) Acetobacter – Citric acid

8. Find out the incorrect statement –

(a) DNA fragments are negatively charged.

(b) DNA fragments are separated according to their molecular size.

(c) DNA ligase is used as molecular scissor in biotechnology.

(d) PCR technique is used for amplification of DNA fragments.

9. Cru genes are obtained from –

(a) *E.coli* (b) Cotton plant (c) Tobacco plant (d) *Bacillus thuringiensis*

10. The broad base of age pyramid indicates –

(a) Increase in the percentage of young individuals.

(b) Increase in the percentage of old individuals.

(c) Decrease in the percentage of old individuals.

(d) Decrease in the percentage of young individuals.

11. Assertion (A) : Food web is a complex network of various food chains.

Reason (R) : Various food chains exist in a given ecosystem.

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) Both A and R are false.

12. Assertion (A): Through the process of amniocentesis the sex of a foetus can be determined.

Reason (R) : Metabolic disorders and other genetic disorders can also be detected by this process.

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) Both A and R are false.

13. Assertion (A): In eukaryotic cells, chromosomes are double stranded.

Reason (R) : Eukaryotic chromosomes are composed of DNA, RNA and protein molecules.

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) Both A and R are false.

14. Assertion (A): Siphilis and AIDS are sexually transmitted diseases.

Reason (R) : There is no cure for both of the diseases.

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) Both A and R are false.

Section - B

15. Read the passages and answer the following questions from 15 (i) to 17 (iii)

Bacteria are included in the group of microorganisms. Based on staining they could be of two types i.e., gram possitive and gram negetive. All bacteria are not harmful to us, many of them are useful too. Lactic acid bacteria (LAB) are one of this kind of useful bacterial group. They are gram positive, rod–shaped bacteria. *Lactobacillus* is a very common example of LAB, that can convert lactose sugar of milk into lactic acid. As a result, due to coagulation and partial digestion of milk protein casein, milk is converted into curd. *Lactobacillus* act as probiotic to improve gut ecosystem and can naturally synthesise vit. B_{12} in our gut. (1+1+1+2 = 5)

(i) How bacteria are classified on the basis of their staining property ?

(ii) Mention the cell shape of *Lactobacillus*.

(iii) How LAB are useful in the preparation of curd ?

(iv) Why consumption of curd is beneficial to us ?

16. Different animals develop different mechanisms to cope up with their surrounding environments. Some plants and animals like cactus, desert lizard etc., develop different adaptive characters. For example, in case of cactus plants, leaves are modified into spines, stem become thick and fleshy, fleshy stems carrying sufficient chlorophyll content also performs the function of photosynthesis. Some animals like Siberian birds migrate from their natural habitat during unfavourable seasons for survival or for the purpose of sexual reproduction. On the other hand desert lizards escape the harsh day time by going down in the sand level. (2+2+1 = 5)

(i) Mention the adaptive characters developed by cactus plants to cope up with the surrounding environment.

(ii) Why Siberian birds migrate from their natural habitat ?

(iii) How the small desert animals cope up with the extreme hot climate ?

17. An woman and her husband went to a gynocologist as they have some complications regarding family planning. Doctor suggested them to go for IVF technique. During the process of IVF, both male and female gametes are collected from them and fertilized artificially under laboratory condition and the zygote is placed into the fallopian tube of the woman. (1+1+2 = 4)

(i) Expand IVF.

(ii) Which IVF technique is used for the couple in above mentioned case ?

(iii) For what reasons the IVF techniques are suggested ?

Section - C

Marks - 2

18. What is Down's syndrome ? Write its cause. (1+1=2)

19. What is central dogma in molecular biology ? (2)

20. Mention any two causes that can lead to speciation. (1+1=2)

21. What is inbreeding ? Write the major disadvantage of inbreeding. (1+1=2)

or,

What are the two main categories of mutagens ? Give one example for each.

22. How algal bloom can destroy the ecosystem of a water body ? (2)

23. What is cryopreservation ? Write its one use in biodiversity conservation. (2)

or,

Differentiate between the terms 'standing state' and 'standing crop'.

Section - D

Marks -3

24. Briefly explain the mechanism of hormonal control of spermatogenesis in human males. (3)

25. Define the term 'transcription'. Construct a complete transcription unit with promoter and terminator on the basis of the given template strand. (1+1+1) =3

T T G A C G A T A A C C G A T A G G

3' 5'

Construct the RNA that will be transcribed from the above transcription unit.

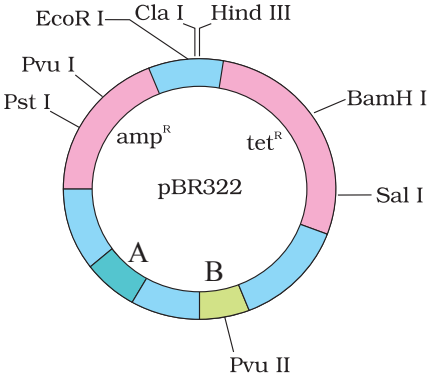
26. Write the full form of IARI. Identify A, B, C and D in the table given below. (1+½ x 4=3)

Crop	Variety	Resistance to diseases
Cowpea	A	Bacterial blight
B	Himgiri	Leaf and stripe rust
Brassica	Pusa swarnim	C
Chilli	D	Chilly mosaic virus

or,

What are the advantages of using biopesticides over chemical pesticides ? (3)

27. Identify A and B from the given *E.coli* cloning vector $_{p}$BR322 and also mention the functions of both. ½+½+2=3



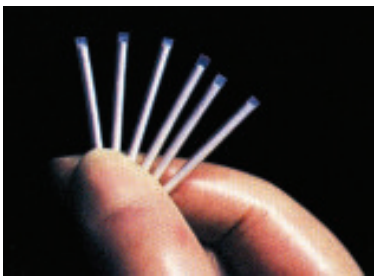
or,

What is the contribution of *Bacillus thuringiensis* in developing cotton bollworm resistant cotton plants ? (3)

28. What is meant by ecological succession ? Distinguish between pioneer community and climax community based on their properties. (1+2=3)

Section - E **Marks-5**

29. Identify the given diagram. Why and how it is used for ? (1+2+2=5)



Why vasectomy and tubectomy are considered as contraceptive method ?

or,

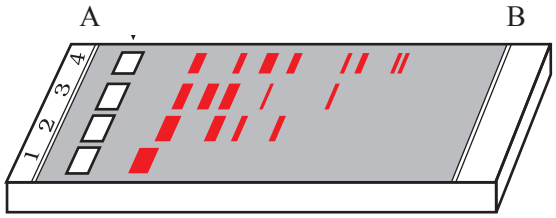
Draw, label and describe the 7– celled 8– nucleate structure of an embryo sac. (1+2+2=5)

30. Name one sex linked and one autosome linked recessive disease. Why do the sons of a haemophilic father never suffer from this trait ? A haemophilic man marries a normal woman whose father was haemophilic. Work out a cross to show the genotype of the couple and their offsprings. (1+2+2=5)

or,

Why DNA replication is semiconservative in nature ? Draw and describe the discontinuous synthesis of DNA. How the okazaki fragments join to form a continuos strand ? (2+2+1=5)

31.



Mark the positive and negative terminals. How the separation of DNA molecules take place through gel electrophoresis ? How the separated DNA fragments are finally isolated ? (1+2+2=5)

or,

What is meant by ADA deficiency ? How gene therapy became a solution to this problem ? Why gene therapy is not a permanent cure to ADA deficiency ? (1+3+1=5)