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12th BIO-ZOOLGY FULL MATERIAL



BASED ON NEW SYLLABUS 2020-2021

- PTA QUESTIONS WITH ANSWER
- PREVIOUS YEAR QUESTIONS WITH ANSWER
- CREATIVE QUESTIONS WITH ANSWER

NAME:

CLASS:

SCHOOL:

Rana Sakthi Durga
Puducherry

Bio-Zoology

Unit-1

Chapter: 1 Reproduction in organisms

Textbook questions and answers:

1. In which type of parthenogenesis are only male produced **Arrhenotoky**.

2. The mode of reproduction in bacteria by **Conjugation**.

3. In which mode of reproduction variation are seen **Sexual**.

4. Assertion and reasoning questions:

In each of the following questions there are two statements. One is assertion (A) and other is reasoning (R). Mark the correct answer as

- A. If both A and R are true and R is correct explanation for A
- B. If both A and R are true but R is not the correct explanation for A
- C. If A is true but R is false
- D. If both A and R are false.

I) Assertion: In bee society, all the members are diploid except drones.

Reason: Drones are produced by parthenogenesis.

Answer: A) If both A and R are true and R is correct explanation for A.

II) Assertion: Offspring's produced by asexual reproduction are genetically identical to the parent.

Reason: Asexual reproduction involves only mitosis and no meiosis.

Answer: A) If both A and R are true and R is correct explanation for A.

5. Name an organism where cell division is itself a mode of reproduction.

Unicellular organisms like Amoeba, Bacteria, Paramecium and Vorticella.

6. Name the phenomenon where the female gamete directly develops into a new organism with an avian example.

Turkey bird reproduces by parthenogenesis as the female egg develops into fully developed organ without fertilization.

7. What is parthenogenesis? Give two examples from animals

Parthenogenesis is a form of asexual reproduction in which an unfertilized egg develops into a new individual. **Example:** Honey bee, Wasps and Gall fly.

8. Which type of reproduction is effective Asexual or Sexual and why? (PTA-2019-2020)

1. Sexual reproduction is more effective than an asexual reproduction. In a sexual reproduction the offspring will have the chances of having genes of both the parents whereas is an asexual reproduction.
2. The offspring will genetically be identical to only one of the parent.
3. Sexual reproduction is better mode of reproduction as it produces variations which are necessary for evolution and there are better chances for survival. Whereas in asexual mode of reproduction no variation.

9. The unicellular organisms which reproduce by binary fission are considered immortal.

Justify.

Actually single celled organisms are considered to be biologically immortal. This is because they don't die as they grow old. They usually undergo mitosis (Asexual reproduction) to produce in which the organism itself gets divided into two (cell division).

10. Why is the offspring formed by asexual reproduction referred as a clone ?

1. The offspring formed by asexual reproduction referred to as clone because the offspring morphologically and genetically similar to each other and parent.
2. In asexual reproduction, the mixing of genetic material does not occur, as the offspring is produced by mitotic or amitotic cell division hence they are called clone.

11. Give reasons for the following:**a) Some organisms like honey bees are called parthenogenetic animals.**

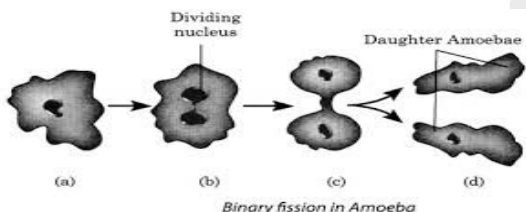
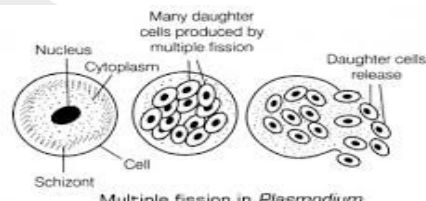
1. Some animals like honey bees are called parthenogenetic animals.
2. The organisms produced without fertilization of the egg are called parthenogenetic organisms. The male honey bees are forms from unfertilized eggs.

b) A male honey bee has 16 chromosomes where as its female has 32 chromosomes.

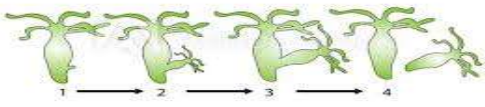
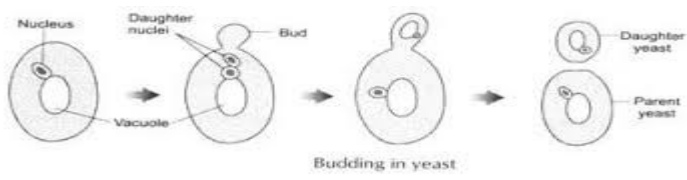
If is because of Haploid which is a sex determination system in which males develop from unfertilized eggs and are haploid and females develop from fertilized eggs and diploid.

12. Differentiate between the following:

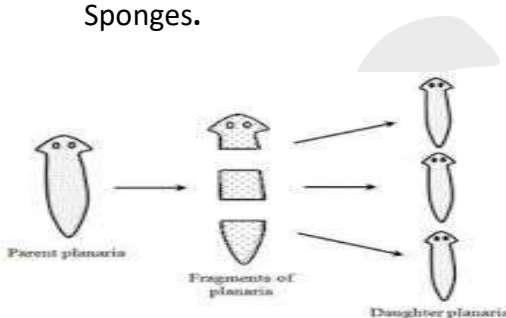
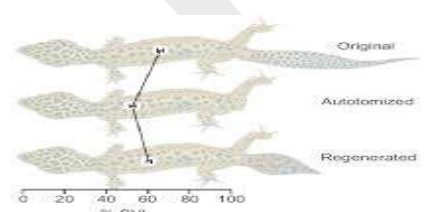
a) Binary fission in amoeba and multiple fission in plasmodium.

Binary fission in amoeba	Multiple fission in plasmodium
1. Forms two daughter individuals. 2. Nucleus and cytoplasm divided only once. 3. Takes place in favorable conditions. Example: Amoeba reproduces by binary fission.  Binary fission in Amoeba	1. Forms many daughter individuals. 2. Nucleus and cytoplasm divided repeatedly. 3. Take place in favorable as well as unfavorable conditions. Example: Plasmodium reproduces through multiple fission.  Multiple fission in Plasmodium

b) Budding in yeast and budding in Hydra.

Budding in Hydra	Budding in Yeast
1. Hydra is a multicellular organism. 2. Budding starts on the parent organism and then offspring gets detached from the parent surviving as an independent organisms. 3. Multiple mitotic divisions are required for the formation of a bud. 4. Uses regenerative cells for reproduction.  Hydra Budding	1. Yeast is unicellular and it itself is divided into one larger cell and a smaller daughter cell. 2. Budding here is similar to mitosis except that cytokinesis is unequal resulting in a unicellular bud. 3. When a yeast cell becomes mature then only it divides to form the mother cell and daughter cell. 4. If the size is not achieved mother cell will spend the cell cycle.  Budding in yeast

c) Regeneration in lizard and planaria.

Regeneration in planaria	Regeneration in lizard
1. Organisms that are fragmented result in each fragment into an individual organism. 2. A new individual emerges from each fragment. 3. Only a few organisms can fragment and form new individuals. 4. This type of regeneration is observed in organism such as Flatworms and Sponges. 	1. occur when an organisms a lost limb or any other part of the body. 2. No new organisms are formed. 3. All organism exhibit the bility to regenerate to some degree 4. Example of regeneration include regrowing a lost limb, such as the tail of a lizard. 

13. How is juvenile phase different from reproductive phase?

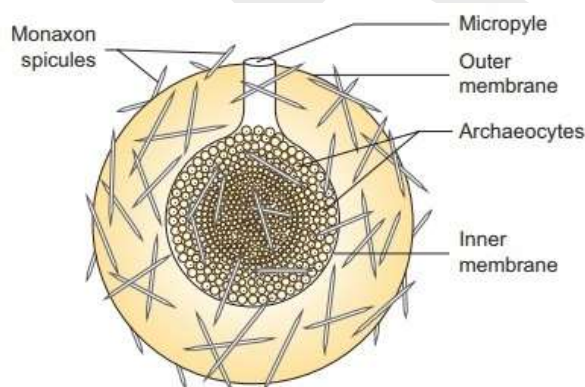
Juvenile phase	Reproductive phase
This vegetative phase is the period of growth between the birth of the individual up to reproductive maturity.	The organisms reproduce and their offsprings reach maturity period. On the basis of time, breeders animals are of two types. i) Seasonal breeders (Frogs, Lizards, Most birds) ii) Continuous breeders (Honey bees, poultry, rabbit)

14. What is the difference between syngamy and fertilization?

Syngamy	Fertilization
1. Syngamy is a type of sexual reproduction in which the fusion of two haploid gametes takes place to produce a diploid zygote. 2. Different kinds of syngamy are prevalent in animals such as autogamy in which the male and female gametes are produced by the same cell or same organisms.	1. Fertilization is the fusion of male and female and female haploid gametes to form a diploid zygote. 2. The fertilization is of two types depending on the place where fertilization takes place, the external fertilization and the internal fertilization.

❖ **Other important 2 and 3 marks questions and answer:****1. Differentiate merozoites from sporozoites. (PTA-2019-2020)**

Merozoites	Sporozoites
When multiple fission occurs in the schizont, the process is called schizogony and the daughter individuals are called merozoites.	When multiple fission occurs in the oocyte, it is called sporogony and the daughter individuals are called sporozoites.

2. Draw the diagram of gemmule and label the parts. (PTA-2019-2020)**3. Zygote is not formed during the conjugation of paramecia, but we call it as sexual reproduction why? (PTA-2019-2020)**

Conjugation is a form of sexual reproduction. It is a temporary union of two individuals of same species for mutual exchange of genetic materials.

4. Meiosis cell division does not take place during the gametes formation of drone bees. Give reason. (PTA-2019-2020)

1. Meiosis occurs during its post zygotic stage. As the organism is haploid meiosis cannot occur during gametogenesis.
2. In haploid organisms meiosis occurs during the gametogenesis. In haploid organisms meiosis occurs during the germination of zygote because the zygote is the only diploid cell in the life cycle of such organisms.

5. Write the differences between multiple fission and sporulation in amoeba. (PTA-2019-2020)

Multiple fission amoeba	Sporulation amoeba
1. Amoeba reproduces primarily by binary fission. However a method known as multiple fission is adopted by the unicellular organism amoeba to survive and reproduce under unfavorable conditions. 2. When the conditions are unfavorable, amoeba its pseudopodia and becomes almost round	1. Sporulation is the process of production of spores which germinates under favorable condition. 2. During favorable condition the encysted amoeba divides by multiple fission and produces pseudopodiospores. This phenomenon is known as sporulation

❖ Creative questions and answers:

1. What is the significance of reproduction?

Reproduction results in continuation of species and introduces variations in organisms which are essential for adaption and evolution of their own kind.

2. Mention the basic features of reproduction?

1. Synthesis of RNA and Proteins.
2. Replication of DNA.
3. Cell division and growth.
4. Formation of reproductive units and their fertilization to form new individuals.

3. Mention any two types of binary fission.

- i) Transverse binary fission.
- ii) Longitudinal binary fission.

4. Difference between Asexual reproduction and Sexual reproduction.

Asexual reproduction	Sexual reproduction
1. Reproduction by a single parent without the involvement of gamete formation. 2. The offspring produced are genetically identical.	1. Reproduction by two parents participate in the reproductive process involving two types of gametes (Ova and Sperm) 2. The offspring produced are genetically non identical.

5. What is Blastogenic or somatogenic reproduction?

Asexual reproduction by amitotic or mitotic division of the somatic (Body) cells.

6. Define binary fission.

Binary fission is the process in which the parent organism divides into two halves and each half grows into a daughter individual

Example: Amoeba

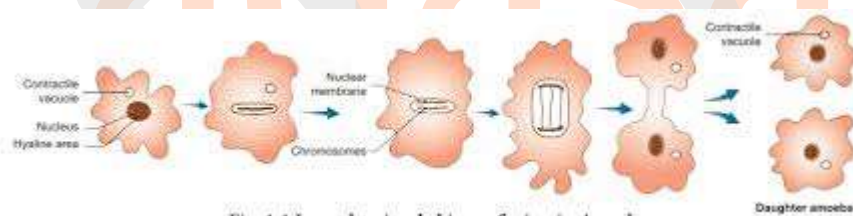


Fig. 1.1 Irregular simple binary fission in *Amoeba*

7. What type of binary fission is seen in dinoflagellates? Explain briefly.

The asexual reproduction seen in dinoflagellates is through oblique binary fission, in which the plane of division is oblique.



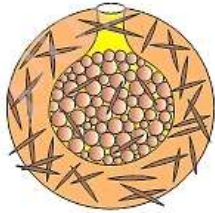
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8. Define plasmotomy.

Plasmotomy is the reproductive process in which the division of multinucleated parent into many multinucleate daughter individuals with division of nuclei

9. What is gemmules?

Gemmules are the endogenous buds produced by freshwater sponges for asexual reproduction.



This picture is only for your understanding

10. What is Archeocytes?

Archeocytes are the fully grown gemmules and are hard ball like structure consisting of an internal food laden mass, seen in freshwater sponges.

11. Mention briefly about fragmentation type of reproduction.

In fragmentation type of asexual reproduction the parent body breaks into many pieces and each piece has the potential to grow into a new individual.

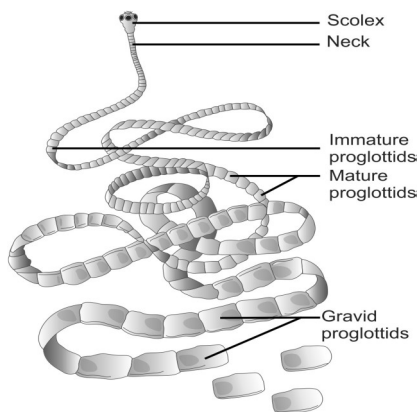
12. Define hologamy.

Hologamy is the type of sexual reproduction in lower organisms in which the entire mature organisms acts as gamete and fusion of such gametes takes place.

Example: *Trichonympha*

13. What is apolysis?

Apolysis is the process in which the gravid proglottids of *Taenia solium* are regularly detached either singly or in groups from the posterior end.



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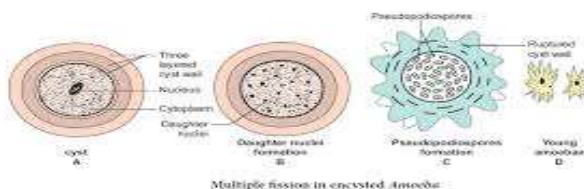
14. Write short notes on multiple fission.

1. The nucleus divides repeatedly without the division of the cytoplasm later the cytoplasm divides into as many parts.
2. Each cytoplasmic part encircles one daughter nucleus. This results in the formation of many smaller individuals from a single parent organism.
3. If multiple fission produces four or many daughter individuals by equal cell division and the young ones do not separate until the process is complete then this division is called repeated fission

Example: Vorticella

15. What is encystment? How is it useful to amoeba to tolerate unfavorable condition?❖ **Encystment:**

This is a phenomenon during unfavorable conditions amoeba withdraws its pseudopodia and secretes a three layered protective chitinous cyst wall around it and becomes inactive.

❖ **Adaptations:**

1. When conditions become favorable the encysted amoeba divides by multiple fission and produces many minute amoebae called pseudopodiospore or amoebulae.
2. The cyst wall absorbs water and breaks off liberating the young pseudopodiospores with pseudopodia.
3. They feed and grow rapidly to lead an independent life.

16. How does amoeba reproduce during unfavorable condition without encystment?

1. Amoeba multiplies by sporulation without encystment.
2. Nucleus breaks into several small fragments or chromatin blocks.
3. Each fragment develops a nuclear membrane becomes surrounded by cytoplasm and develops a spore- case around it.
4. When conditions become favorable the parent body disintegrates and the spores are liberated each hatching into a young amoeba.

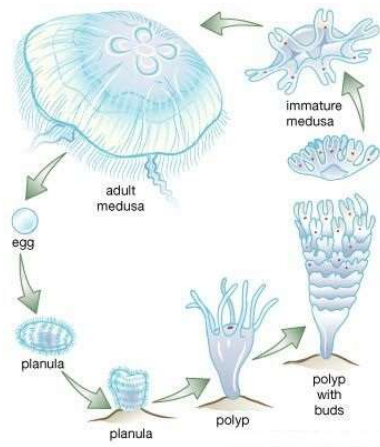
17. Mention the types of asexual reproduction seen in amoeba.

1. Binary fission
2. Encystment and spore formation-Unfavorable condition
3. Sporulation – Unfavorable conditions

18. What is strobilation?

In some metazoan animals several transverse fission occur simultaneously giving rise to a number of individuals which often do not separate immediately from each other.

Example: Aurelia.

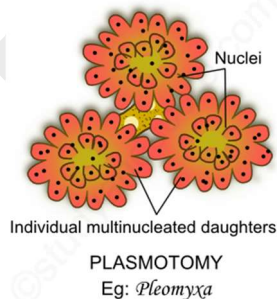


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19. What is plasmotomy?

It is the division of multinucleated parent into many multinucleated daughter individuals with the division of nuclei. Nuclear division occurs later to maintain normal number of nuclei.

Example: Opalina and Pelomyxa (Giant amoeba)



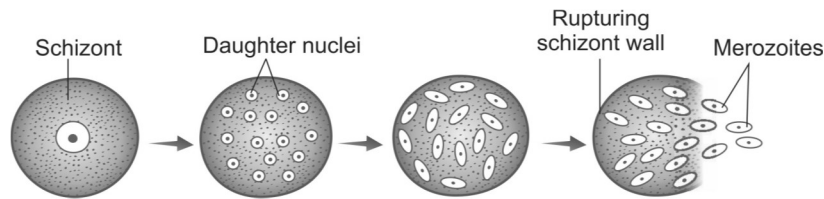
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20. Differentiate exogenous and endogenous budding.

Exogenous budding	Endogenous budding
✧ When buds are formed on the outer surface of the parent body. Example: Hydra Hydra Budding	✧ Buds are formed inside the cytoplasm and remain within the body of parent. Example: Noctiluca

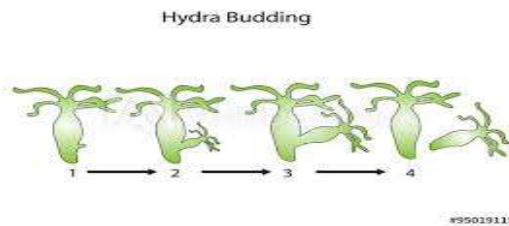
21. During which stages does multiple fission occur in plasmodium?

In plasmodium multiple fission occurs in the schizont and oocyte stages.

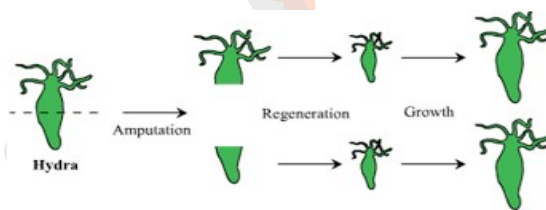


22. With regard to asexual reproduction mention two phenomena seen in Hydra.

i) Budding



ii) Regeneration.



Mention the phases in the life cycle of an organism.

1. Juvenile phase/Vegetative phase
2. Reproductive phase/ maturity phase
3. Senescent phase.

23. What are the two types of regeneration?

Regeneration is two types there are

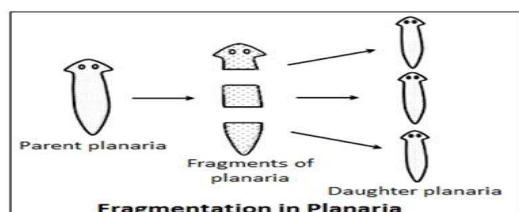
- ☛ Morphallaxis
- ☛ Epimorphosis

Morphallaxis:

The whole body grows from a small fragment.

Example: Hydra and planaria

When Hydra is cut into several pieces each piece can regenerate the lost parts and develop into a whole new individual.



Epimorphosis:

Replacement of lost body parts. There are two types there are

Reparative:

Regeneration only certain damaged tissue can be regenerated.

Restorative:

Regenerated severed body parts can develop.

Example: Star fish and tail of wall lizard

**24. Define senescent phase.**

Begins at the end of reproductive phase when degeneration sets in the structure and functioning of the body.

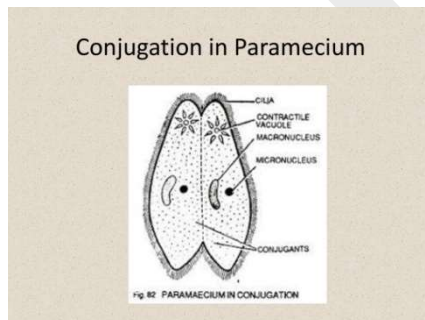
25. Differentiate external fertilization and internal fertilization.

External fertilization	Internal fertilization
The fusion of male and female gametes takes place outside the body of female organisms in the water medium. Example: Sponges, Fishes and Amphibians.	The fusion of male and female gametes takes place within the body of female organisms. Example: Reptiles, Aves and Mammals.

26. What is conjugation?

1. It is the temporary union of the two individuals of the same species.
2. During their union both individuals, exchange certain amount of nuclear material (DNA) and then get separated.

Example: Paramecium, Vorticella and Bacteria(Prokaryotes)



27. What are the two types of breeding animals?**1. Seasonal breeders:**

It reproduces at particular period of the year.

Example: Frog, Lizards, Most birds, Deer's.

2. Continuous breeders:

It continues to breed throughout their sexual maturity.

Example: Honey bees, Poultry, Rabbit.

28. Give one example where gemmule helps in reproduction. Mention the importance of its formation during reproduction.

1. In freshwater sponges and marine sponges asexual reproduction occurs by internal buds called gemmules.
2. A completely grown gemmule is a hard ball consisting of an internal mass of food laden archaeocytes.

Importance:

During unfavorable conditions the sponge disintegrates but the gemmule can withstand adverse condition. When conditions become favorable the gemmules begin to hatch.

29. How does tape worm complete its life cycle?

1. In the tapeworm *teania solium* the gravid proglottids are at the posterior end of the strobila.
2. They are regularly cut off from the posterior end by a process called apolysis.
3. It helps in transferring the developed embryos from the primary host (Man) to find a secondary host (Pig).

30. Differentiate natural parthenogenesis and artificial parthenogenesis.

Natural parthenogenesis	Artificial parthenogenesis
It occurs regularly constantly and naturally in their life cycle.	The unfertilized egg (Ovum) is induced to develop into a complete individual by physical or chemical stimuli.

31. What is paedogenetic parthenogenesis or paedogenesis?

The larvae produce a new generation of larvae by parthenogenesis. Sporocyst and Redia larvae of liver fluke and larvae of insects.

Example: Gall fly.

32. Differentiate complete parthenogenesis and incomplete parthenogenesis.

Complete parthenogenesis	Incomplete parthenogenesis
It is the only form of reproduction in certain animals and there is no biparental sexual reproduction. There are no male organisms and so such individuals are represented by females only.	It is found in animals in which both sexual reproduction and parthenogenesis occurs. Example: ▪ In honeybees fertilized eggs (zygotes) develop into queen and workers. ▪ Unfertilized eggs develop into drones (male)

33. Differentiate Oviparous and Viviparous.

Oviparous	Viviparous
The young ones hatch from eggs laid outside the mothers body. Example: Reptiles and birds	The young ones are born alive after being nourished in the uterus through the placenta. Example: Mammals including human beings.

34. What is Ovoviviparous? How is it different from viviparous.

1. In Ovoviviparous animals the embryo develops inside the egg and remains in the mother's body until they are ready to hatch.
2. It is similar to viviparity but the embryos have no placental connection with the mother and receive their nourishment from the egg yolk

Example: Fish like shark.

35. Mention the different modes of asexual reproduction.

The different modes of asexual reproduction seen in animals are fission, sporulation, budding, gemmule formation, fragmentation and regeneration.

36. Mention the three types of sexual reproduction in animals with example.

- i) Oviparous- Reptiles and Aves
- ii) Viviparous- Mammals
- iii) Ovoviviparous- Shark

37. Distinguish between fragmentation and regeneration.

Fragmentation	Regeneration
1. Fragmentation is the process in which the parental body breaks into many fragments and each fragment has the potential to grow into a new individual.	1. Regeneration is the growth of injured region. In morphallaxis the whole body grows from a small fragment Example: Planaria
2. This type of reproduction occurs in sea anemone.	2. In epimorphosis the severed part or tissue is restored by regeneration. Example: Lizard

38. Name the three types of natural parthenogenesis.

- i) Arrhenotoky- Honey bees.
- ii) Thelytoky- Solenobia.
- iii) Amphitoky- Aphids.

39. Is the presence of large number of chromosomes in an organism a hindrance to sexual reproduction?

No, presence of large number of chromosomes in an organism is not a hindrance to sexual reproduction.

Example:

Ophioglossum has chromosome number 1260, still it can reproduce sexually..

40. Why is reproduction essential for the organisms?

- 1. It maintains life on earth.
- 2. It results in addition of new individuals to the population which finally leads to perpetuation of species.
- 3. It creates variation among populations.

41. Which is the most critical event in sexual reproduction?

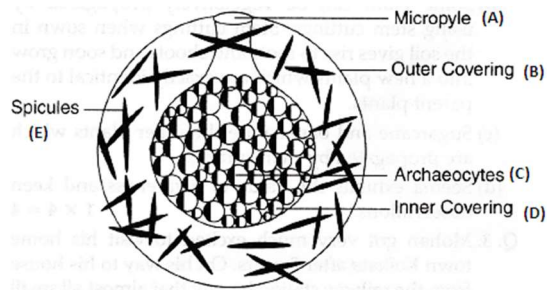
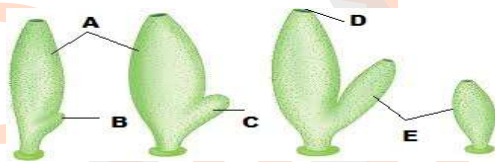
Fertilization of gametes is the most critical events in sexual reproduction

42. How will an organism be benefitted if it reproduces through spores?

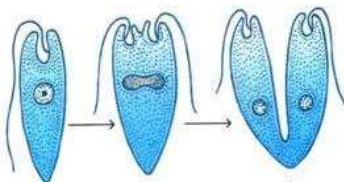
- 1. Reproduction through spores is simple as well as faster mode of reproduction.
- 2. The spores are light in weight thus, keep floating in the air. This helps in their dispersal.

43. What are the disadvantages of external fertilization?

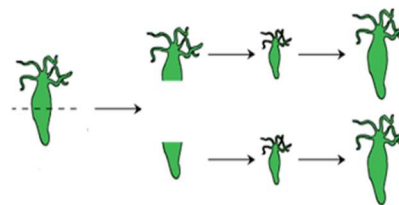
1. Eggs have less chances of fertilization. This can lead to wastage of large number of eggs.
2. There is an absence of proper parental care of the offsprings. It results in low rate of survival of the progenies.

44. Identify the parts marked as A, B, C, D and E for the below diagram.**45. Identify the parts marked as A, B, C, D and E for the below diagram.**

- A-Individual parent
 B-Bud forming
 C-Bud growing
 D-Osculum
 E-Daughter individual

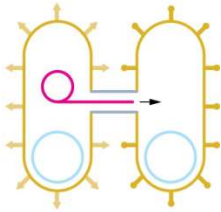
46.i) Identify the process ii) Name the organism

- i) Longitudinal binary fission
 ii) Euglena



- i) Regeneration
 ii) Hydra

47. i) identify the process ii) Name the organism



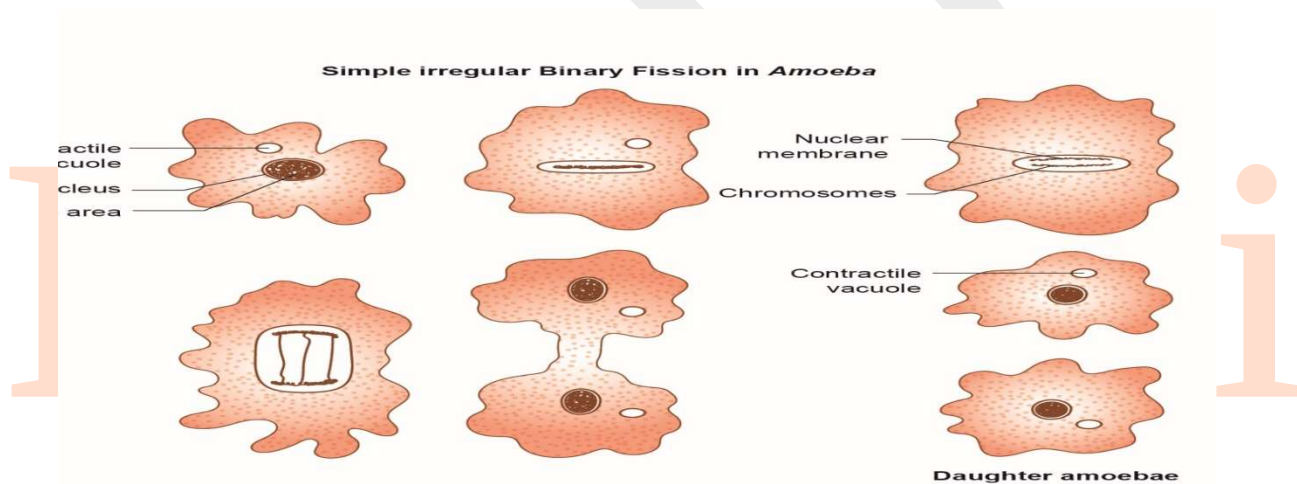
i) Conjugation
ii) Bacteria



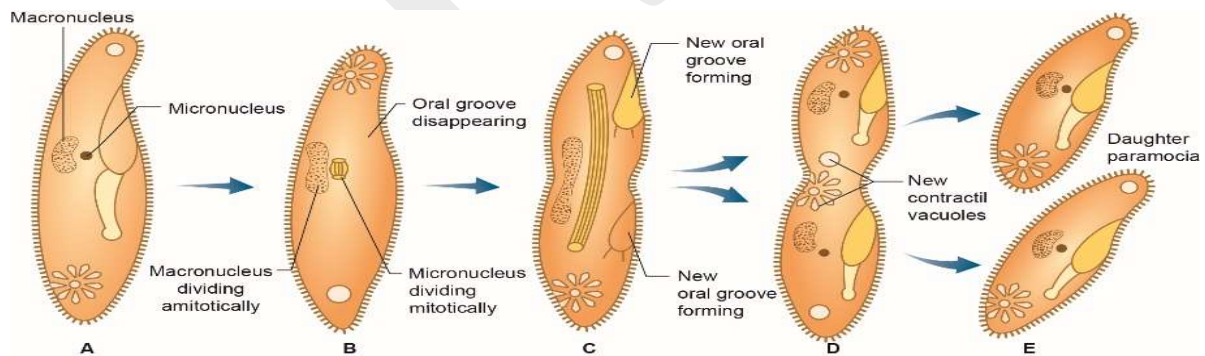
i) Reparative regeneration
ii) Star Fish

48. Draw and label the events of binary fission in Amoeba and paramecium.

i) Binary fission in amoeba



ii) Binary fission in paramecium



Five mark questions;

1. What are the types of binary fission? Explain each with an example.

Binary fission:

The parent organism divides into two halves and each half forms a daughter individual. Depending on the plane of fission, binary fission is of the following types.

- Simple irregular binary fission
- Transverse binary fission
- Longitudinal binary fission
- Oblique binary fission

Simple irregular binary fission:

The simple irregular binary fission is seen in Amoeba shaped organisms.

1. The plane of division is hard to observe. The contractile vacuoles cease to function and disappear.
 2. The nucleoli disintegrate and the nucleus divides mitotically.
- The cell then constricts in the middle, so the cytoplasm divides and forms two daughter cells.

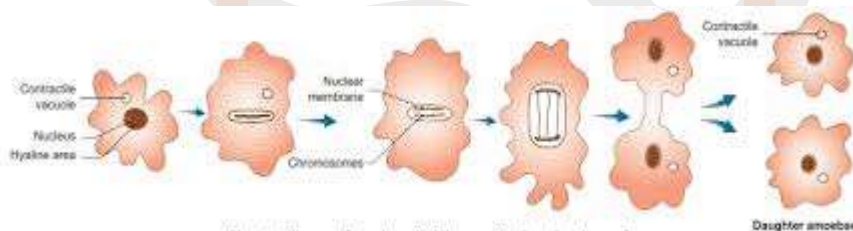


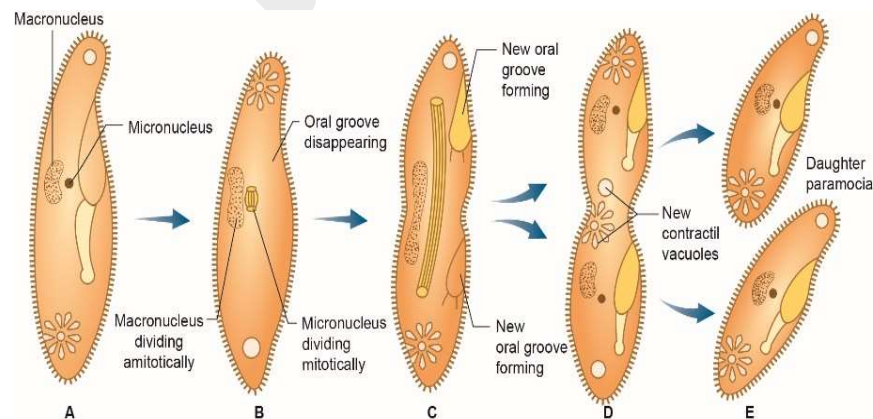
Fig. 1.1 Irregular simple binary fission in Amoeba

Transverse binary fission:

The plane of the division runs along the transverse axis of the individual.

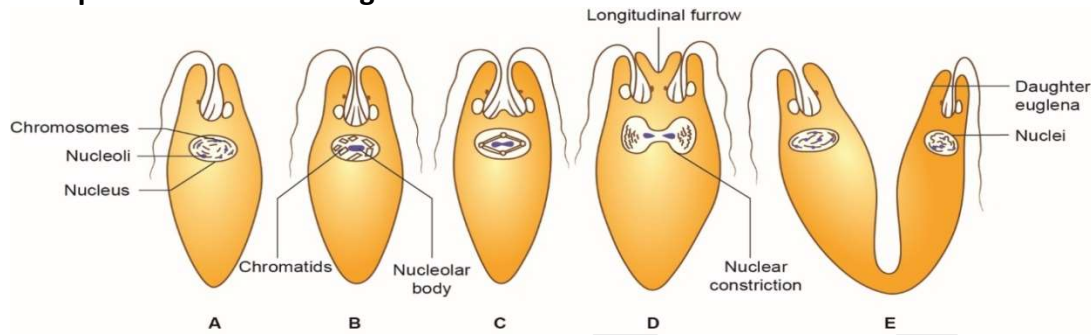
Example: Paramecium and Planaria.

The macronucleus divides by amitosis and the micronucleus divides by mitosis.

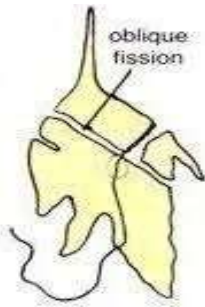


Longitudinal binary fission:

1. The nucleus and the cytoplasm divide in the longitudinal axis of the organism.
2. In flagellates, the flagellum is retained usually by one daughter cell.
3. The basal granule is divided into two and the new basal granule forms a flagellum in the other daughter individual.

Example: Vorticella and Euglena**Oblique binary fission:**

The plane of division is oblique. It's seen in dinoflagellates.

**2. Write a note on regeneration. (2019-2020)**

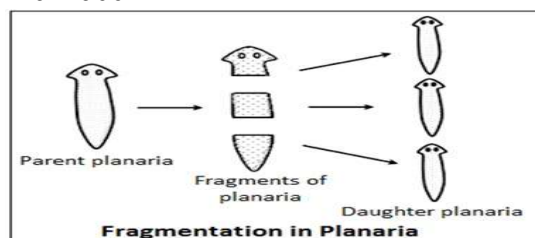
1. Regeneration is regrowth in the injured region. Regeneration was first studied in Hydra by Abraham Trembley in 1740.
2. Regeneration is of two types
 - i) Morphallaxis
 - ii) Epimorphosis

i) Morphallaxis:

The whole body grows from a small fragment.

Example: Hydra and planaria.

Planaria is accidentally cut into several pieces, each piece can regenerate the lost parts and develop into a whole new individual.



ii) Epimorphosis:

The replacement of lost body parts. It is of two types, namely reparative and restorative regeneration.

- **Reparative Regeneration:**

Only certain damaged tissue can be regenerated.

- **Restorative Regeneration:**

Severed body parts can develop.

Example: Star fish, tail of wall lizard

**3. Explain parthenogenesis**

1. The development of an egg into a complete individual without fertilization is known as parthenogenesis
2. It was first discovered by Charles Bonnet in 1745.
3. Parthenogenesis is of two main types namely
 - i) **Natural parthenogenesis**
 - ii) **Artificial parthenogenesis**

i) Natural parthenogenesis:

In certain animals, parthenogenesis occurs regularly, constantly and naturally in their life cycle and is known as natural parthenogenesis.

Natural parthenogenesis are of different types:

i) Arrhenotoky: In this type only males are produced by parthenogenesis.

Example: Honey bees

ii) Thelytoky: In this type only female are produced by parthenogenesis.

Example: Solenobia

iii) Amphitoky: In this type parthenogenetic egg may develop into individuals of any sex.

Example: Aphids

Natural parthenogenesis may be of two types **complete** and **incomplete**.

Complete parthenogenesis:

1. The complete parthenogenesis is only form of reproduction in certain animals and there is no biparental sexual reproduction.
2. There are no male organisms and so such individuals are represented by females only.

Incomplete parthenogenesis:

Incomplete parthenogenesis is found in some animals in which both sexual reproduction and parthenogenesis occurs.

Example: Honey bees fertilized eggs(zygotes) develop into queen and workers, whereas unfertilized eggs develop into drones (male)

Paedogenetic parthenogenesis (paedogenesis):

The larvae produce a new generation of larvae by parthenogenesis. It is also seen in the larvae of some insects.

Example: Gall fly.

Artificial parthenogenesis:

The unfertilized egg is induced to develop into a complete individual by physical or chemical stimuli.

Example: Annelid and seurchin eggs.

4. Enumerate the process and types of syngamy.

Different kinds of syngamy (fertilization) are prevalent among living organisms.

❖ **Autogamy:**

The male and female gametes are produced by the same cell or same organism and both the gametes fuse together to form a zygote

Example: *Actinosphaerium* and *paramecium*.

❖ **Exogamy:**

The male and female gametes are produced by different parents and they fuse to form a zygote. So it is biparental.

Example: Human-dioecious or unisexual animals.

❖ **Hologamy:**

In lower organisms, sometimes the entire mature organisms do not form gametes but they themselves behave as gametes and the fusion of such mature individuals is known as hologamy.

Example: *Trichonympha*.

❖ **Paedogamy:**

The sexual union of young individuals produced immediately after the division of adult parent cell by mitosis.

❖ **Merogamy:**

The fusion of small sized and morphologically different gametes (merogametes) takes place.

❖ **Isogamy:**

The fusion of morphological and physiological identical gametes (isogametes).

Example: *Monocystis*.

❖ **Anisogamy: (An-without, Iso-Equeal, Gam-Marriage)**

The fusion of dissimilar gametes.

Anisogamy occurs in higher animals but it is customary to use the term fertilization instead of anisogamy or syngamy.

Example: Higher invertebrates and all vertebrates.

5. comment on the different forms of asexual reproduction.

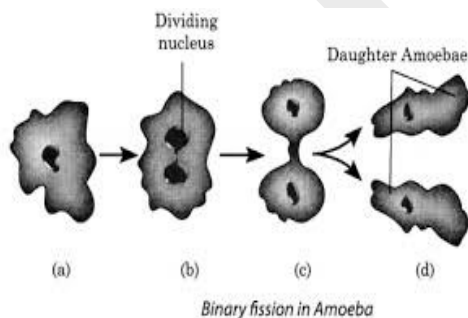
Asexual Reproduction:

1. Reproduction by a single parent without the involvement of gamete formation is asexual reproduction and the offspring produced are genetically identical.
2. The different modes of asexual reproduction seen in animals are fission, sporulation, budding, gemmule formation, fragmentation and regeneration.

❖ **Fission:**

The division of the parent body into two or more identical daughter individuals. Four types of fission are seen in animals.

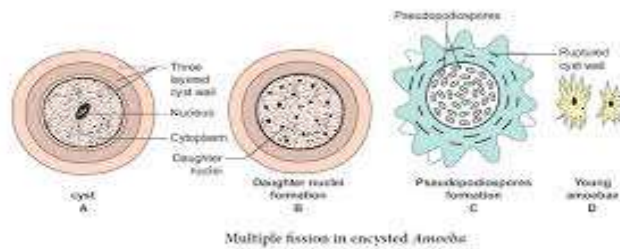
- 1) Binary fission
- 2) Multiple fission
- 3) Sporulation
- 4) Strobilation



❖ **Sporulation:**

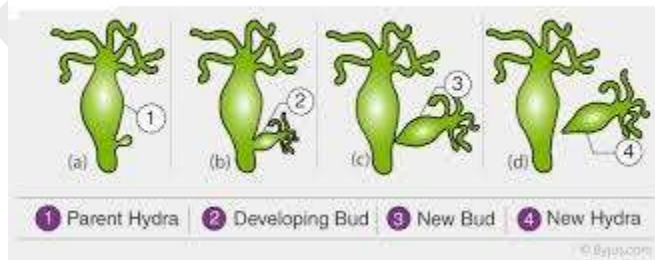
1. Unfavorable conditions amoeba multiplies by sporulation without encystment.

2. Nucleus breaks into several small fragments or chromatin blocks.
3. Each fragment develops a nuclear membrane, becomes surrounded by cytoplasm and develops a spore-case around it.
4. When conditions become favorable the parent body disintegrates and the spores are liberated each hatching into a young amoeba.



❖ Budding:

- 1) The parent body produces one or more buds and each bud grows into a young one.
- 2) The buds separate from the parent to lead a normal life.
- 3) In sponges the buds constrict and detach from the parent body and the bud develops into a new sponge.



Exogenous budding:

Buds are formed on the outer surface of the parent body it is known as exogenous budding.

Example: Hydra

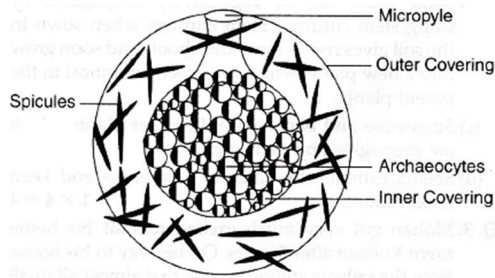
Endogenous budding:

Nactiluca hundreds of buds are formed inside the cytoplasm and many remain within the body of the parent. This is called endogenous budding

❖ Gemmule formation:

1. In freshwater sponges and in some marine sponges a regular and peculiar mode of asexual reproduction occurs by internal buds called gemmules.
2. A completely grown gemmule is a hard ball, consisting of an internal mass of food laden archaeocytes.

3. During unfavorable conditions the sponge disintegrates but the gemmule can withstand adverse conditions.
4. When conditions become favorable the gemmule begin to hatch.



❖ **Fragmentation:**

The parent body breaks into fragments (pieces) and each of the fragment has the potential to develop into a new individual.

Example: Sea anemones.

❖ **Regeneration:**

1. Regeneration is regrowth in the injured region.
2. Regeneration was first studied in Hydra by Abraham Trembley in 1740.
3. Regeneration is of two types

i) **Morphallaxis:**

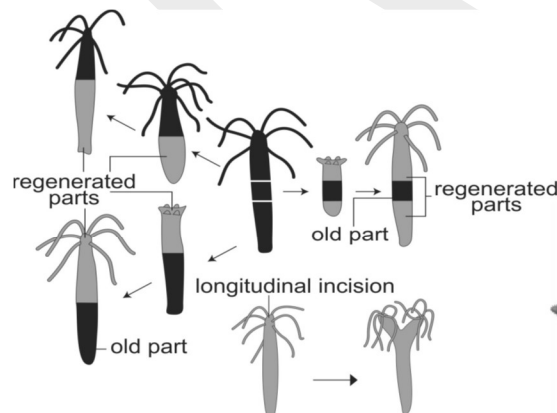
The whole body grows from a small fragment .

Example: Hydra and Planaria

ii) **Epimorphosis:**

The replacement of lost body parts. It is two types namely

- i) Reparative
- ii) Restorative



Morphallaxis



Epimorphosis

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Bio-Zoology

Unit-1

Chapter: 2 Human Reproduction

Textbook question and answers:

1. The mature sperms are stored in the **Epididymis**.
2. The male sex hormone testosterone is secreted from **Leydig cell**.
3. The glandular accessory organ which produces the largest proportion of semen is **Seminal vesicle**.
4. The male homologue of the female clitoris is **Penis**.
5. The site of embryo implantation is the **Uterus**.
6. The foetal membrane that forms the basis of the umbilical cord is **Allantois**.
7. The most important hormone in initiating and maintaining lactation after birth is **Prolactin**.
8. Mammalian egg is **Alecithal and non cleidoic**.
9. The process which the sperm undergoes before penetrating the ovum is **Capacitation**.
10. The milk secreted by the mammary glands soon after child birth is called **Colostrum**.
11. Colostrum is rich in **IgA**.
12. The Androgen binding protein (ABP) IS PRODUCED BY **Sertoli cells**.
13. Find the wrongly matched pair
 - a) Bleeding phase –fall in oestrogen and progesterone.
 - b) Follicular phase-rise in oestrogen.
 - c) **Luteal phase-rise in FSH level**
 - d) Ovulatory phase-LH surge

Answer the following type of questions

Assertion (A) and Reason (R)

- a) A and R are true, are is the correct explanation of A
 - b) A and R are true, R is not the correct explanation of A
 - c) A is true, R is false
 - d) Both A and R are false
14. **A-** In human male, testes are extra abdominal and lie in scrotal sacs.

R- Scrotum acts as thermoregulator and keeps temperature lower by 2°C for normal sperm production.

Answer: A) A and R are true, R is the correct explanation of A

15. **A-** Ovulation is the release of ovum from the Graafian follicle.

R- It occurs during the follicular phase the menstrual cycle.

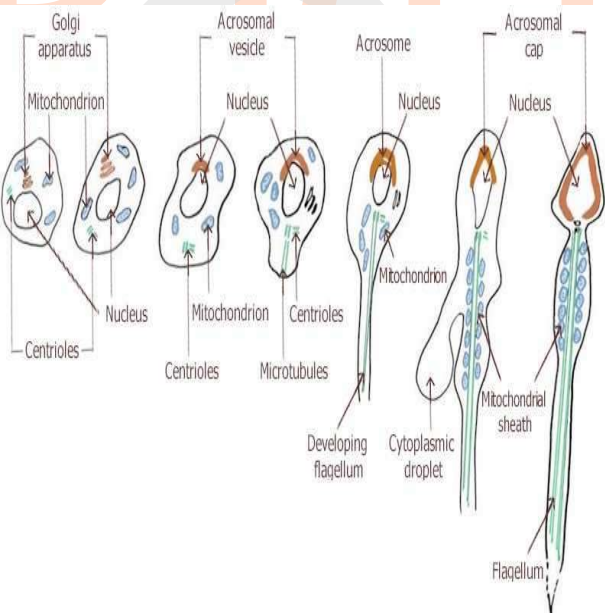
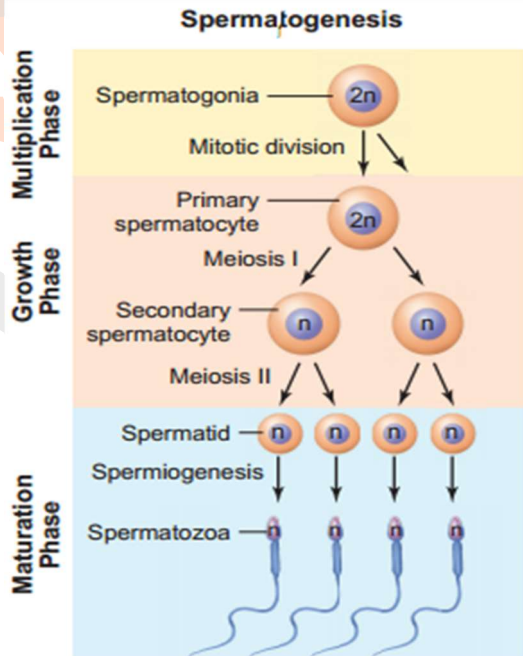
Answer: c) A is true, R is false.

16. **A-** Head of the sperm consists acrosome and mitochondria.

R- Acrosome contains spiral rows mitochondria.

Answer: d) Both A and R are false.

17. **Mention the differences between spermiogenesis and spermatogenesis.**

Spermiogenesis	Spermatogenesis
1) It is one of the very crucial step in spermatogenesis.	1) It is the process of production of sperms from immature germ cells in males.
2) There are no changes in the number of cells are only one spermatid develops into a spermatozoa.	2) Numbers of cell are increased as each spermatogonium produces four spermatids.
3) No effects on the genetic material of the germ cells.	3) The genetic composition primary sperm cells change from diploid to haploid status during spermatogenesis
	

18. At what stage of development are the gametes formed in new born male and female?

Zygotic stage:

1. The male gamete (sperm)
2. Female gamete (ovum)

Blastocyst stage:

The single celled zygote begins to divide into a solid ball of cells.

Then it becomes a hollow ball of cells called a blastocyst attaching to the lining of the mothers uterus.

19. Expand the acronyms.

- a) **FSH**- Follicle Stimulating Hormone.
- b) **LH**- Leutinsing Hormone.
- c) **hCG**- human Chorionic Gonadotropin.
- d) **hPL**- human Placenta Lactogen.

20. How is polyspermy avoided in humans?

When a sperm comes in contact with the zonapellucida layer of the ovum.

It induces changes in the membrane of the ovum to block the entry of additional sperms.

This prevents the polyspermy and ensures that only one sperm can fertilise an ovum.

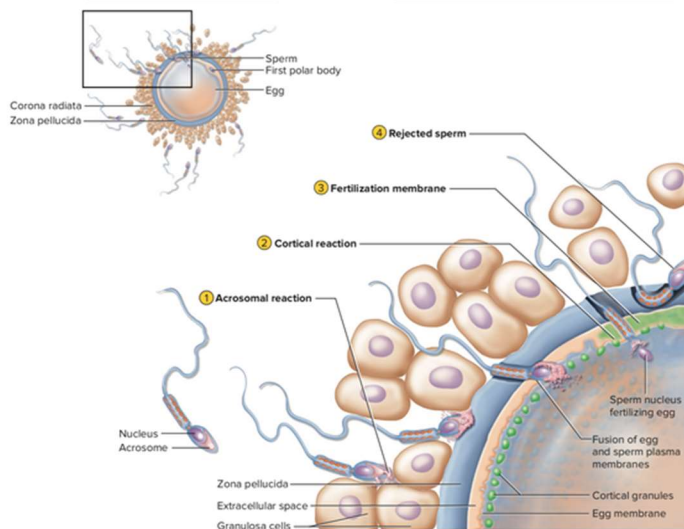


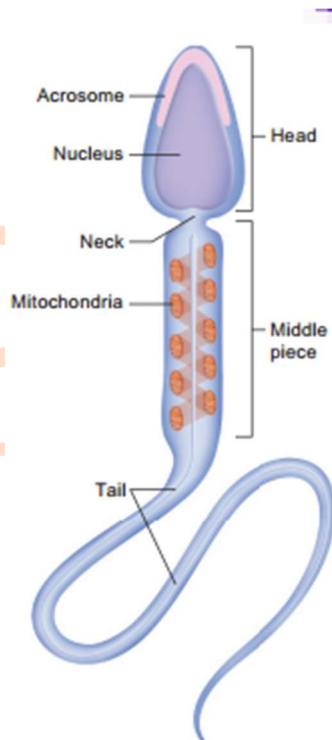
FIGURE 29.1 Fertilization and the Slow Block to Polyspermy.

This picture is only for your understanding

21. What is colostrums? Write its significance.(2019-2020)

1. The mammary glands secrete a yellowish fluid called colostrums during the initial few days after parturition.
2. Colostrum has less lactose than milk and almost no fat.
3. Colostrum contains more proteins, vitamin- **A** and minerals.
4. Colostrum is also rich in **IgA** antibodies.

5. It is fully sufficient till about 6 months of age and all infants must be breast fed by the mother to ensure the growth of a healthy baby.
22. **Placenta is an endocrine tissue. Justify. (2019-2020)**
- 1) Placenta is connected to the embryo through an umbilical cord which helps in the transport of substance (Nutrients, Oxygen) and removing metabolites from the foetus.
 - 2) Placenta acts as an endocrine tissue. and produces several hormones like
human Chorionic Gonadotropin (hCG)
human Placental Lactogen (hPL)
human Chorionic Somatomammotropin (hCS)
Oestrogens and Progesterone.
23. **Draw a labeled sketch of a spermatozoan.**



24. **What is inhibin? State its functions.**

Inhibin is one of two hormone secreted by the gonads (by sertoli cells in the male and the granulosa cells in the female) and that inhibit (negative feedback mechanism) the production of follicle stimulating hormone (FSH) by the pituitary gland.

25. Mention the importance of the position of the testes in humans.

1. Testes are paired male sex organs lying in the scrotum, which hangs outside the abdominal cavity, because viable sperms cannot be produced at normal body temperature.
2. The scrotum is placed outside the abdominal cavity to create a temperature 2-3°C lower than the normal internal body temperature.
3. Thus the testes are placed in the scrotum, Which acts as a thermo regulator for better spermatogenesis

26. What is the composition of semen?

1. Semen contains sperms and the seminal plasma (Secreted from the seminal vesicles, prostate gland and the bulbourethral glands)
2. The seminal fluid acts as a transport medium, provides nutrients and contains chemicals that protect and activate the sperms and also facilitate their movement.

27. Name the hormones produced from the placenta during pregnancy.

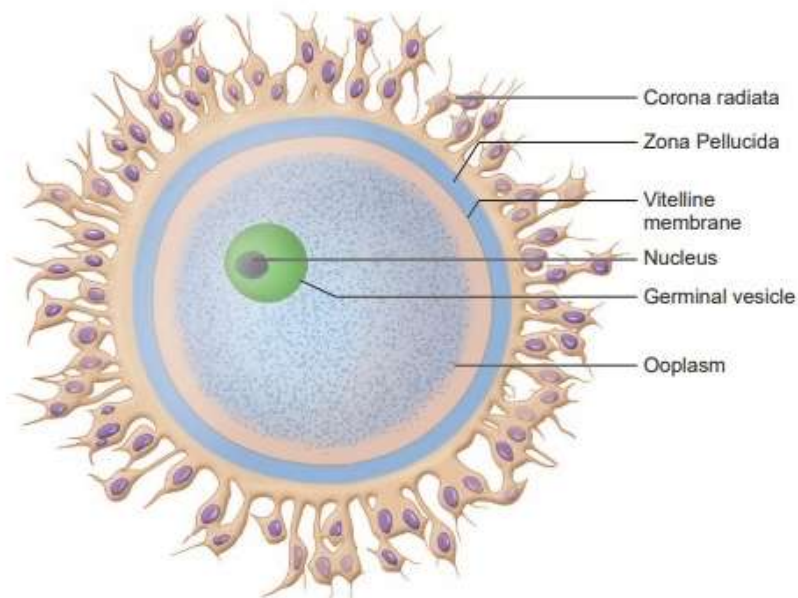
1. **human Chorionic Gonadotropin (hCG)**
2. **human Chorionic Somatomammotropin (hCS)**
3. **human placental Lactogen (hPL)**
4. **Oestrogens**
5. **Progesterone**
6. **Relaxin:**
 - i) Relaxin secreted during the later phase of pregnancy
 - ii) It help in relaxation of the pelvic ligaments at the time of parturition

28. Define gametogenesis.

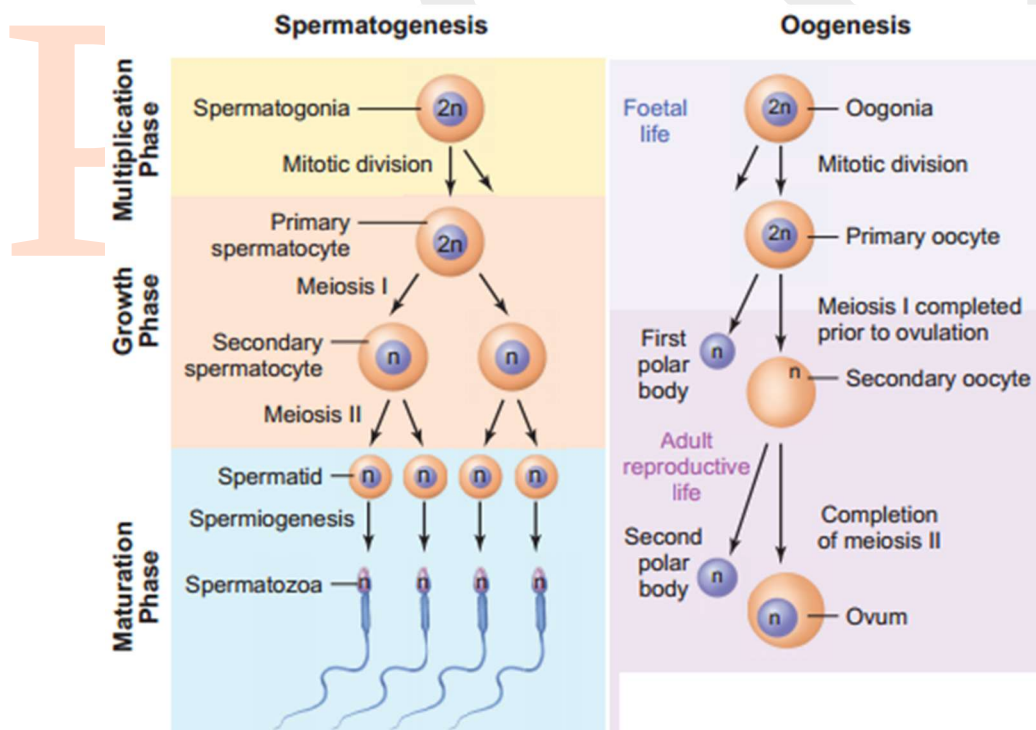
1. Gametogenesis is the process whereby a haploid cell (n) is formed from a diploid cell (2n) through meiosis and cell differentiation.
2. Gametogenesis in the male is known as spermatogenesis and produce spermatozoa.
3. Gametogenesis in the female is known as oogenesis and result in the formation of ovum.

29. Describe the structure of the human ovum with a neat labeled diagram.

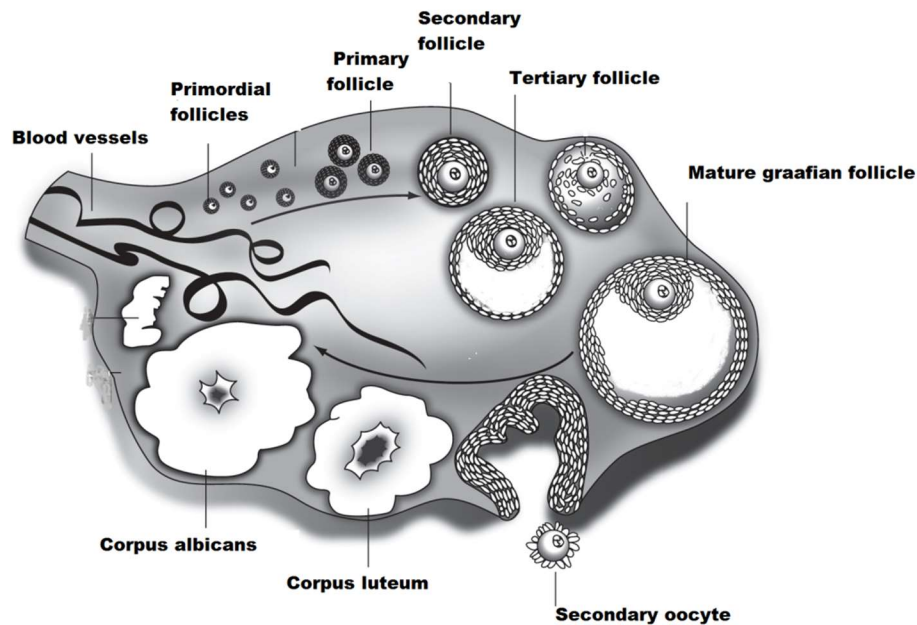
1. Human ovum is non-cleidoic, alecithal and microscopic in nature.
2. Its cytoplasm called ooplasm contains a large nucleus called the germinal vesicle.
3. The ovum is surrounded by three coverings namely an inner thin transparent **vitelline** membrane, middle thick **zona pellucida** and outer thick coat of follicular cells called **corona radiata**.
4. The **vitelline** membrane and **zona pellucida** is a narrow perivitelline space.



30. Give a schematic representation of Spermatogenesis and Oogenesis in humans.



31. **Explain the various phases of the menstrual cycle.** **Menstrual cycle:** The menstrual or ovarian cycle occurs approximately one in every 28/29 days during the reproductive life of the female from menarche (puberty) to menopause except during preg



Menstrual cycle comprises of the following phases:

1. Menstrual phase
2. Follicular or proliferative phase
3. Ovulatory phase
4. Luteal or secretory phase

1. Menstrual phase:

1. The cycle starts with the menstrual phase when menstrual flow occurs and lasts for **3-5** days.
2. Menstrual flow is due to **the breakdown of endometrial lining of the uterus**, and its blood vessels due to decline in the level of **progesterone** and **oestrogen**.

2. Follicular or proliferative phase:

1. The follicular phase extends from the **5th day** of the cycle until the time of ovulation.
2. During this phase, the **primary follicle in the ovary grows to become a fully mature Graafian follicle** and simultaneously, the **endometrium regenerates** through proliferation.
3. These changes in the ovary and the uterus are induced by the secretion of **gonadotropins** like **FSH** and **LH**, which increase gradually during the follicular phase.
4. It stimulates follicular development and secretion of **oestrogen** by the follicle cells.

3. Ovulatory phase:

1. Both **LH** and **FSH** attain peak level in the middle of the cycle (about the **14th** day)
2. Maximum secretion of **LH** during the mid cycle called **LH surge** induces the rupture of the **Graafian follicle** and the release of the **ovum (secondary oocyte)** from the ovary wall into the peritoneal cavity. This process is called as **ovulation**.

4. Luteal or secretory phase:

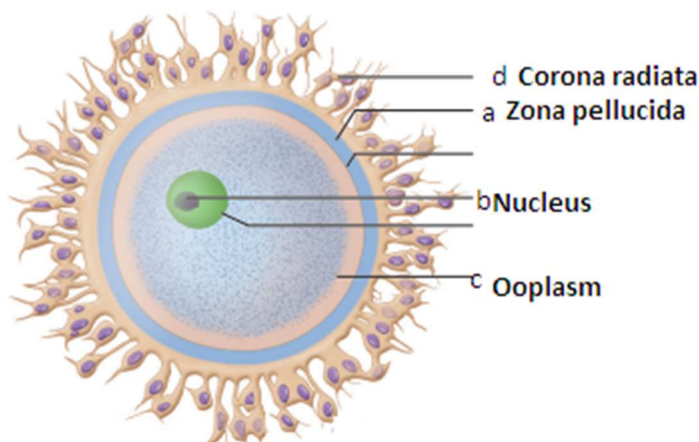
1. During luteal phases, the remaining part of the **Graafian follicle** is transformed into a transitory endocrine gland called corpus luteum.
2. The **corpus luteum secretes large amount of progesterone** which is essential for the maintenance of the endometrium.
3. If Fertilization takes place, it paves way for the implantation of the fertilized ovum.
4. The uterine wall secretes nutritious fluid in the uterus for the foetus. So, this phase is also called as **Secretory phase**.

32. Explain the role of oxytocin and relaxin in parturition and lactation. (2019-2020)

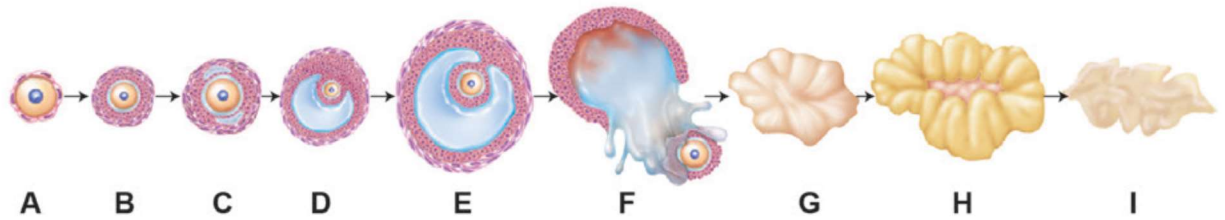
Role of Oxytocin:

1. Oxytocin brings about the **powerful contraction** of the uterine muscles and leads to the expulsion of the baby through the birth canal.
2. Oxytocin causes the **Let-Down reflex** the actual **ejection of milk from the alveoli** of the mammary glands.
3. During lactation, oxytocin stimulates the recently emptied uterus to contract, helping it to return to **pre-pregnancy size**.

33. Identify the given image and label its parts marked as a, b, c and d.



34. The following is the illustration of the sequence of ovarian events (a-i) in a human female.



a) Identify the figure that illustrates ovulation and mention the stage of oogenesis it represents.

A-D- The stages of follicular development.

E- Single mature follicle

F- Ovulation

G and H- Corpus luteum

I- Corpus albicans.

It represents the maturation state of Oogenesis.

b) Name the ovarian hormone and the pituitary hormone that have caused the above mentioned events.

Ovarian hormones:

1. Oestrogen
2. Progesterone.

Pituitary hormone:

1. Follicle Stimulating Hormone (FSH)
2. Lutenizing hormone (LH)

c) Explain the change that occurs in the uterus simultaneously in anticipation.

1. The uterus wall becomes thick and spongy so as to receive the eggs and nourish it.
2. The wall surrounds with extensive network of blood.

d) Write the difference between C and H.

C- Developing stage of follicle.

H- Developed corpus luteum

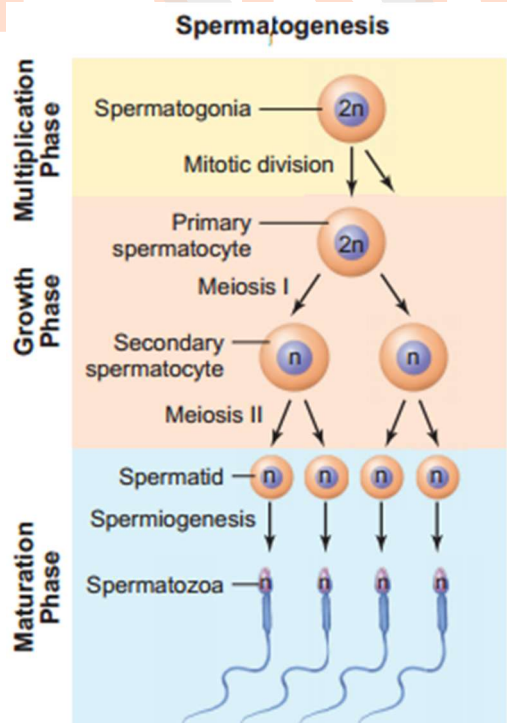
SL. No	C- Developing stage of follicle	H- Developing corpus luteum
1	Primary follicles in the ovary grow to become a mature follicle (Graafian follicle)	A corpus luteum is a mass of cells that forms in an ovary and is responsible for the production of the hormone progesterone during early pregnancy.
2	It extends for about 10-12 days in a 28 day cycle.	Secretion Of hormone: It act as a temporary endocrine gland. Secretes large quantities of Progesterone and small quantities of Oestrogens.
3	Changes in follicular phase are due To high level of FSH, LH and Oestrogen	Maintenance of pregnancy.

❖ Other important 2 and 3 mark question and answers:

1. Scrotum acts as a thermo regulator for spermatogenesis why? (PTA-2019-2020)

The viable sperms cannot be produced at normal body temperature, the scrotum is placed outside the abdominal cavity to provide a temperature 2-3°C lower than the normal internal body temperature. Thus the scrotum acts as a thermoregulator for spermatogenesis.

2. Draw the diagrammatic representation of spermatogenesis. (PTA-2019-2020)



3. Explain the penetration mechanism of a sperm into an egg. (PTA-2019-2020)

1. A sperm can enter the egg it must penetrate the multiple layers of granulosa cells which are around the ovum forming the corona radiata.
2. The follicular cells are held together by an adhesive cementing substance called hyaluronic acid.
3. The acrosomal membrane disintegrates releasing the proteolytic enzyme hyaluronidase during sperm entry through the corona radiata and zona pellucida. This is called acrosomal reaction.
4. Once fertilization is accomplished, cortical granules from the cytoplasm of the ovum form a barrier called the fertilisation membrane around the ovum preventing further penetration of other sperms. Thus polyspermy is prevented.

4. What is known as "Let-Down" reflex? (2019-2020)

Oxytocin causes the "Let-Down" reflex the actual ejection of milk from the alveoli of the mammary glands.

5. What is ovulation? In which day of menstrual cycle it takes place? (2019-2020)

1. Rupture of the graafian follicle and the release of the ovum (secondary oocyte) from the ovary.
2. About the 14th day.

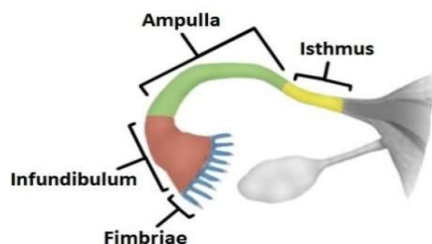
❖ Creative questions and answers:

1. Name two reproductive hormones secreted by pituitary gland.

- i) Follicle Stimulating Hormone (FSH)
- ii) Luteinizing Hormone (LH)

2. What is fimbriae?

1. The edges of the infundibulum of fallopian tube have many finger like projections.
2. It helps in collection of the ovum after ovulation.



This picture is only for your understanding

3. Define organogenesis.

Organogenesis is formation of specific tissues, organs and organ systems from three germ layers takes place.

4. What is tubulus rectus?

The seminiferous tubules of each lobule converge to form a tubulus rectus that conveys the sperms into the rete testis.

5. What are sertoli cells? Explain its function.

1. Sertoli cells are one of the two types of cells of the seminiferous tubule.
2. It provides nourishment to the sperm till maturation.
3. It also secretes a hormone namely inhibin, which is involved in the negative feedback control of sperm production.

6. What is epididymis?

1. Epididymis is single highly coiled tube.
2. It is temporarily stores the spermatozoa where they undergo physiological maturation.
3. Acquire increased motility and fertilizing capacity.

7. Leyding cells are endocrine in nature. Justify.

Leyding cells are endocrine in nature, because they secrete hormone, androgens namely the testosterone, which initiates the process of spermatogenesis.

8. What is rete testis?

It is a tubular network on the posterior side of the testis

9. Name the accessory ducts associated with the male reproductive system.

- i) Rete testis.
- ii) Vasa efferentia.
- iii) Epididymis.
- iv) Vas deferens.

10. Differentiate between vasa efferentia and vasa deferentia?

SL.NO	Vasa efferentia	Vasa deferentia
1	They arise from the rete testes.	They arise from the epididymis.
2	Fine and convoluted ductules.	Thick and coiled ductules.
3	Carry spermatozoa from rete testes to epididymis.	Carry spermatozoa from epididymis to ejaculatory ducts.

11. Explain the function of seminal vesicle.

1. Seminal vesicle secretes an alkaline fluid, containing fructose sugar, ascorbic acid, prostoglandins.
2. It also secretes a coagulating enzyme called vesiculase, which helps in sperm motility.

12. Mention the female accessory reproductive organs.

- i) Fallopian tube.
- ii) Uterus.
- iii) Vagina

13. What is the function of the sperm tail?

It helps in the movement of sperm in the female genital tract for fertilization.

14. What are the functions of centrioles in the sperm?

- 1. The proximal centriole lies towards the nucleus and plays a role in the first division of the zygote.
- 2. Distal centriole gives rise to axial filament of the sperm.

15. What is the function of middle piece of sperm?

It contains mitochondria and produces energy in the form of ATP molecules for the movement of sperm.

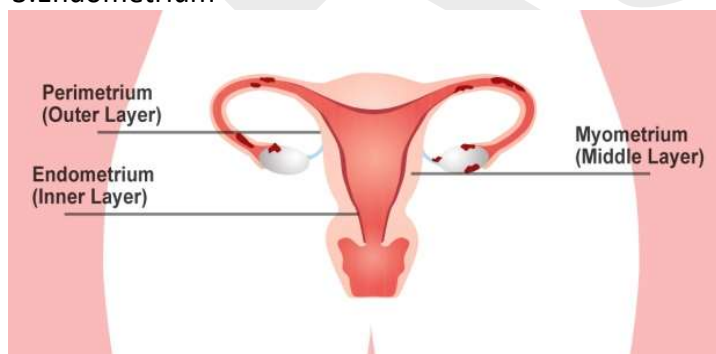
16. What is acrosome? Mention its role during fertilization.

- 1. It is a small cap like pointed structure present at the tip of the nucleus in the sperm.
- 2. It is formed from the Golgi body of the spermatid.
- 3. It contains **hyaluronidase** or sperm lysine a **proteolytic enzyme** which helps to penetrate the ovum during fertilization.

17. What are the three layers of uterus wall?

The wall of the uterus has three layers of tissue namely

- 1. Perimetrium
- 2. Myometrium
- 3. Endometrium



This picture is only for your understanding

18. What is spermiation?

The process that the sperms are released into the cavity of seminiferous tubules.

19. What is azospermia?

Azospermia refers to the failure spermatogenesis. It is seen in males.

20. What is orchidectomy?

Castration or surgical removal of testis is known as orchidectomy.

21. Explain the functions of skene's gland.

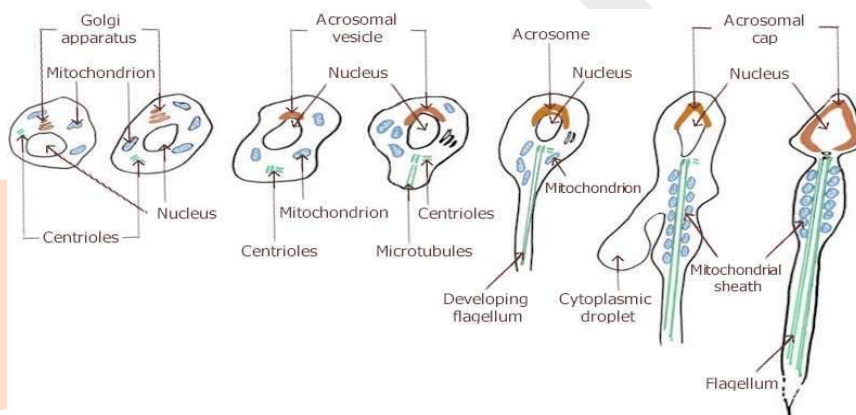
The skene's glands are present on the anterior wall of the vagina, surrounding the lower end of the urethra. These glands secrete a lubricating fluid.

22. What is ovulation?

The rupture of the Graafian follicle and the release of the ovum (secondary oocyte) from the ovary wall into the peritoneal cavity.

23. Define spermiogenesis.

Spermiogenesis is a process in which a spermatid is transformed into a spermatozoa or sperms.



This picture is only for your understanding.

24. What are the phases of menstrual cycle?

- i) Menstrual phase
- ii) Follicular phase
- iii) Ovulatory phase
- iv) Luteal or secretory phase

25. What is polymenorrhoea?

It denotes a menstrual cycle that is shorter than 21 days which may be due to hyperactivity of anterior pituitary gland, psychological disturbances, malnutrition, sexually transmitted disease.

26. What is menorrhagia?

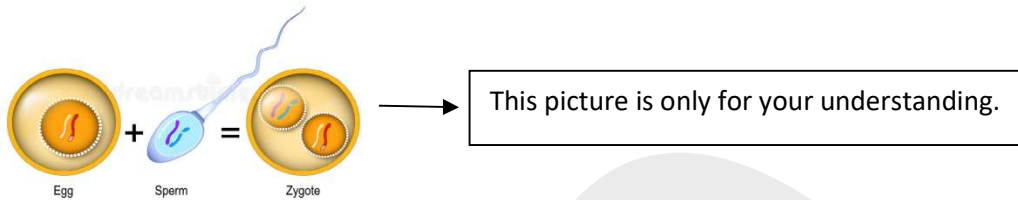
1. Heavy and prolonged menstrual period that disrupts a woman's normal activities is referred to as menorrhagia.
2. Menorrhagia may be due to hormonal imbalance, ovarian dysfunction, uterine fibroids and may also be due to cancer of the ovary, uterus or cervix.

27. What is the function of seminal fluid?

The seminal fluid acts as a transport medium, provides nutrients, contains chemicals that protect and activate the sperms and also facilitate their movement.

28. Define fertilization.

Fusion of male and female gametes to form zygote is called fertilization.

**29. Define cleavage.**

Cleavage refers to the rapid mitotic divisions of the zygote which convert the single celled zygote into a multicellular structure called blastocyst.

**30. List the different parts of human oviduct through which the ovum travels till it meets the sperm for fertilization.**

Fimbriae → Infundibulum → Ampulla → Isthmus.

31. Define morula stage.

The morula stage of human embryo in which loose collection of cells into a berry shaped cluster of 16 or more cell is formed after 72 hours of fertilization.

**32. Define monozygotic twins.**

When a single fertilized egg splits into two during first cleavage each daughter egg develop into each individual forming identical twins.

33. Mention the pathway of the sperms in the male reproductive system?

Seminiferous tubule → Rete testis → Vas deferens → Epididymis → Vasa efferentia → Ejaculatory duct → Urethra → Urethral meatus.

34. Define parturition.

Parturition is the completion stage of pregnancy and child birth.

35. What is hymen?

The external opening of the vagina is partially closed by a thin ring of tissue.

36. Expand the following abbreviations:

- i) **WABA- World Alliance for Breast feeding Action.**
- ii) **WHO- World Health Organisation.**

37. Why is luteal phase otherwise known as secretory phase?

- 1. During luteal phase if fertilisation takes place, corpus luteum paves way for the implantation of the fertilized ovum.
- 2. The uterine wall secretes nutritious fluid for the foetus. So, this phase is called as secretory phase.

38. Mention the hormones and their role in stimulating lactation.

- 1. Increased level of **oestrogens, progesterone** and **human Placental Lactogen (hPL)** towards the end of pregnancy stimulate the hypothalamus towards prolactin-releasing factors.
- 2. The anterior pituitary secretes **Prolactin** which plays a **major role in lactogenesis.**

39. What is abdominal delivery or caesarean section?

When normal vaginal delivery is not possible due to factors like position the baby and nature of the placenta, the baby is delivered through a surgical incision in the woman's abdomen and uterus.

40. What is the role of cervix in the female reproductive system?

- 1. It helps in regulating the passage of sperms into female uterus.
- 2. The cervical canal along with vagina forms the birth canal.

41. What is Foetal ejection reflex or Ferguson reflex?

- 1. As the pregnancy progresses, increase in the oestrogen concentration promotes uterine contractions.
- 2. It facilitates moulding and downward movement of the foetus.
- 3. This causes dilation of cervix of the uterus and vaginal canal resulting in a neuro humoral reflex called Foetal ejection reflex or Ferguson reflex.

42. What is Braxter-Hicks contraction?

- 1. Throughout pregnancy the uterus undergoes periodic episodes of weak and a strong contraction is called Braxter-Hicks contraction.
- 2. It leads to false labour.

43. What is labour?

The series of events that expels the infant from the uterus.

44. What is gestation period?

1. Human pregnancy lasts for about 280 days or 40 weeks.
2. It is called the gestation period.

45. What are the roles of endometrium and myometrium?

1. The endometrium undergoes cyclic changes during the menstrual cycle.
2. The myometrium exhibits strong contractions during parturition.

46. Cervix contains the largest and the strongest sphincter in its wall. Give reason.

Cervix can hold about 7 kg of foetus and fluid in the uterus against the pull of gravity for several days during pregnancy. Thus, it contains the largest and strongest sphincter.

47. The hymen is often torn during the first coitus (physical union). How would not the hymen be considered as an indicator of a woman's virginity?

1. The hymen is often torn during the first coitus (physical union). In some women it remains intact.
2. It can be stretched or torn due to a sudden fall or jolt and also during cycling, horseback riding.

48. Write the physiological reasons, why a woman generally cannot conceive a child after 50 years of age?

1. Stoppage of menstrual cycle, menopause occurs around 50 years of age.
2. Since no ovulation occurs the woman cannot conceive after this age.

49. What is Nebenkern?

1. The middle piece of sperm possesses mitochondria spirally twisted around the axial filament called mitochondrial spiral or nebenkern.
2. It produces ATP molecules for the movement of sperms.

50. How many eggs do you think were released by the ovary of a female dog, which gave birth to six puppies?

The ovaries of a female dog must have released 6 eggs, each of which was fertilized. So, six zygotes were formed, that developed into six puppies.

51. A woman passes out hCG in the urine during the pregnancy. Why?

1. The presence of human Chorionic Gonadotropin (hCG) is the basis of pregnancy test.
2. Placenta forms during pregnancy releases hCG, which comes in urine of pregnant woman.

52. Mention the name and functions of the extra embryonic membranes?

- i) Amnion.
- ii) Yolk sac.
- iii) Allantois.
- IV) Chorion.

They protect the embryo from dessication, mechanical shock and help in the absorption of nutrients and exchange of gases.

53. What is the function of amnion?

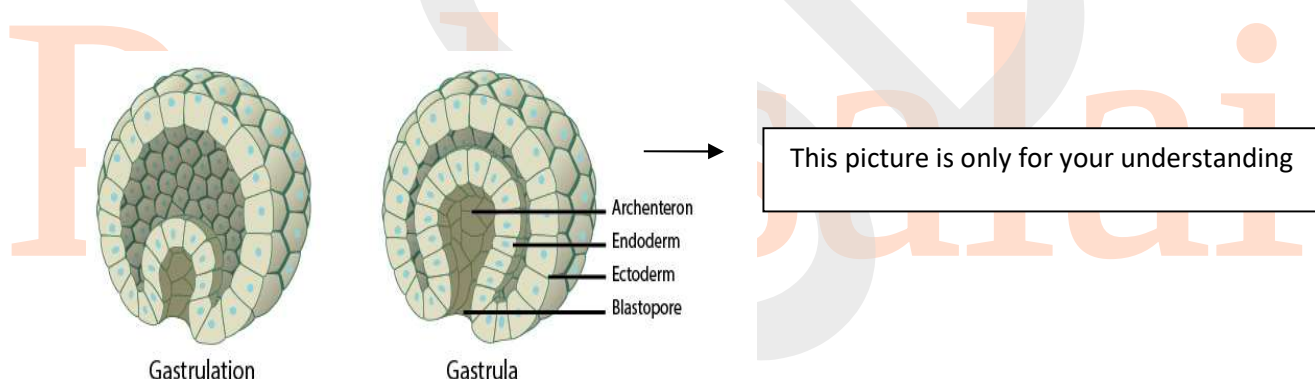
1. The amnion is a double layered translucent membrane filled with the amniotic fluid.
2. It provides a buoyant environment to protect the developing embryo from injury.
3. Regulates the temperature of the foetus and provides a medium in which the foetus can move.

54. What is the significance of allantois?

1. The allantois is an extra embryonic membrane which forms a small out pocketing of embryonic tissue at the caudal end of the yolk sac.
2. It is the structural base for the umbilical cord that links the embryo to the placenta and ultimately it becomes part of the urinary bladder.

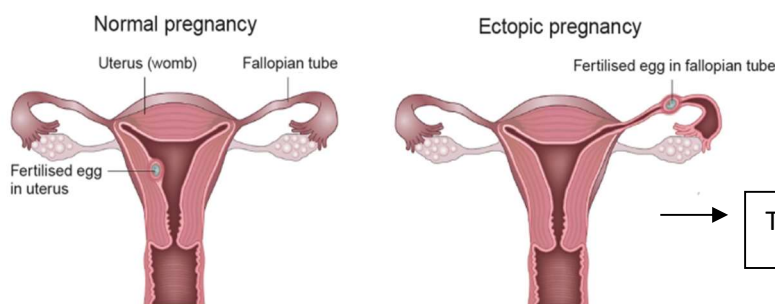
55. What is Gastrulation?

The transformation of the blastocyst into a gastrula with the primary germ layers by the movement of the blastomeres.



56. What is Ectopic pregnancy?

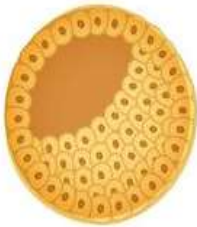
1. If the fertilized ovum is implanted outside the uterus it is called ectopic pregnancy.
2. It occurs in the fallopian tube.
3. The growth of the embryo causes internal bleeding, infection and even death due to rupture of the fallopian tube.



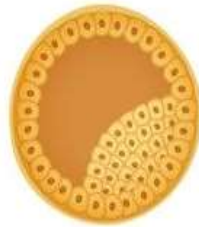
57. What is Blastocyst?

After implanted in the uterine wall the embryo consists of a fluid filled hollow ball of about 100 cells.

Early blastocyst



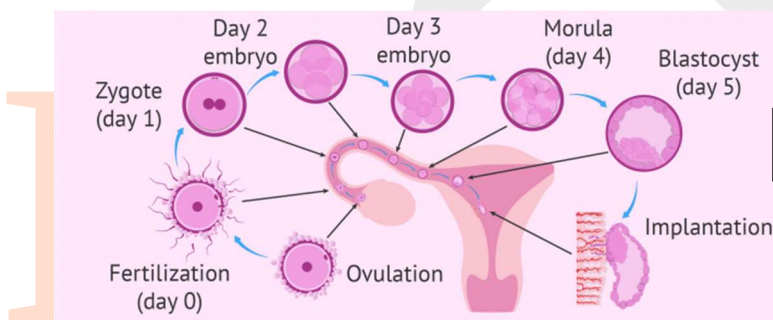
Late blastocyst



This picture is only for your understanding

58. What is Implantation?

Implantation is the process of the inner cell mass of the blastocyst develops into the embryo and becomes embedded in the endometrium of the uterus. It results in pregnancy.



This picture is only for your understanding

59. Define menstrual cycle.

1. The cycle of events starting from one menstrual period till the next one.
2. The cyclic changes occurs once in every 28/29 days from menarche (puberty) to menopause except during pregnancy.

60. What are the effects of menstrual hygiene?

1. It is vital for good health well-being dignity empowerment and productivity of women.
2. It helps in enhancing the quality of life of women during this period.
3. The impact of poor menstrual hygiene on girl's **increases stress levels, fear and embarrassment** during menstruation.
4. This can keep girls inactive during such periods leading to **absenteeism from school**.

61. What are the materials's used to manage menstruation? How should it be disposed?

1. Clean and safe absorbable clothing materials, sanitary napkins, pads, tampons and menstrual cups have been used to manage menstruation.
2. Changing sanitary material 4-5 hours provides comfort, cleanliness and protection from infection. It helps in enhancing the quality of life of women during this period.

3. Used sanitary napkins should be wrapped in paper and disposed.
4. It should not be thrown in open areas or drain pipe of toilets.
5. Flushing of sanitary napkins in the drain pipes causes choking of the drainage line leading to water pollution.

62. How is placenta formed? Mention its function?

1. The trophoblast cells in the blastocyst send out several finger like projections called chorionic villi .
→
2. The chorionic villi carrying foetal blood and are surrounded by sinuses that contain maternal blood (mother blood).
3. The chorionic villi and the uterine tissues form the disc-shaped placenta.

Functions:

1. It connects the foetus to the uterine wall through the umbilical cord.
2. It is the organ of nutritive, respiratory and excretory functions.
3. The blood circulates through the umbilical cord and placenta.

63. Mention the organs developed from the germ layers?

1. The Ectoderm:

The central nervous system (brain and spinal cord), Peripheral nervous system, epidermis and it's derivatives and mammary glands.

2. The mesoderm:

The connective tissue, cartilage and bone, muscle, organs of urinogenital system (kidney, ureter and gonads) arise from the mesoderm.

3. The endoderm:

Epithelium of gastrointestinal and respiratory tract, liver, pancreas, thyroid and parathyroid's.

64. What are twins? Mention their types.

Twins are two off springs produced in the same pregnancy.

1. Mnozygotic twins:

The monozygotic (**Identical**) twins are produced when **single fertilized egg** splits into two during the **first cleavage**. They are of the same **sex**, **look alike** and **share the same genes**.

2. Dizygotic twins:

The dizygotic (**fraternal**) twins are produced when **two separate eggs** are fertilized by **two separate sperms**. The twins may be of the **same sex** or **different sex** and are **non-identical**.

3. Siamese:

The Siamese (**united**) twins are the **conjoined twins** who are **joined during birth**.

65. Mention the major features of embryonic development at three trimesters of three months?

1. First trimester:

It is the period of organogenesis, the body organs namely the heart, limbs, lungs, liver and external genital organs are well developed.

2. Second trimester:

The face is well formed with feature, eyelids and eyelashes, eyes blink, body is covered with fine hair, muscle tissue develops and bones become harder.

3. Third trimester:

The foetus is fully developed and is ready for delivery by the end of nine months.

66. What is menopause?

1. It is the phase in a women's life when ovulation and menstruation stops.
2. The average age of menopause is 45-50 years.
3. It indicates the permanent cessation of the functions of the ovaries.

67. What is corpus luteum?

1. After ovulation the remaining part of the Graafian follicle is transformed into a transitory endocrine gland called corpus luteum.
2. It secretes progesterone, essential for the maintenance of the endometrium.

68. What is corpus albican?

1. In the absence of fertilization, the corpus luteum degenerates completely and leaves a scar tissue.
2. It initiates the disintegration of the endometrium leading to menstruation marking the next cycle.

69. What is Relaxin?

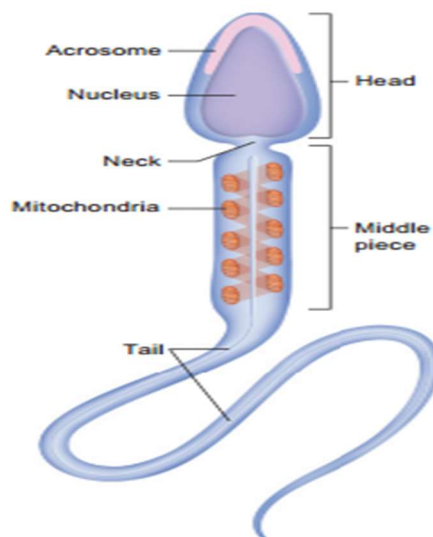
1. Relaxin is a hormone secreted by the placenta and also found in the corpus luteum.
2. It promotes parturition by relaxing the pelvic joints and by dilatation of the cervix with continued powerful contractions.

Five mark questions:

1. Describe the structure of a sperm.

1. The human sperm is a microscopic, flagellated and motile gamete.
2. The whole body of the sperm is enveloped by plasma membrane and is composed of head, neck, and a tail.
3. The head comprises of two parts namely acrosome and nucleus.
4. Acrosome is a small cap like pointed structure present at the tip of the nucleus and is formed mainly from the Golgi body of the spermatid.
5. It contains hyaluronidase, a proteolytic enzyme, popularly known as sperm lysine which helps to penetrate the ovum during fertilization.

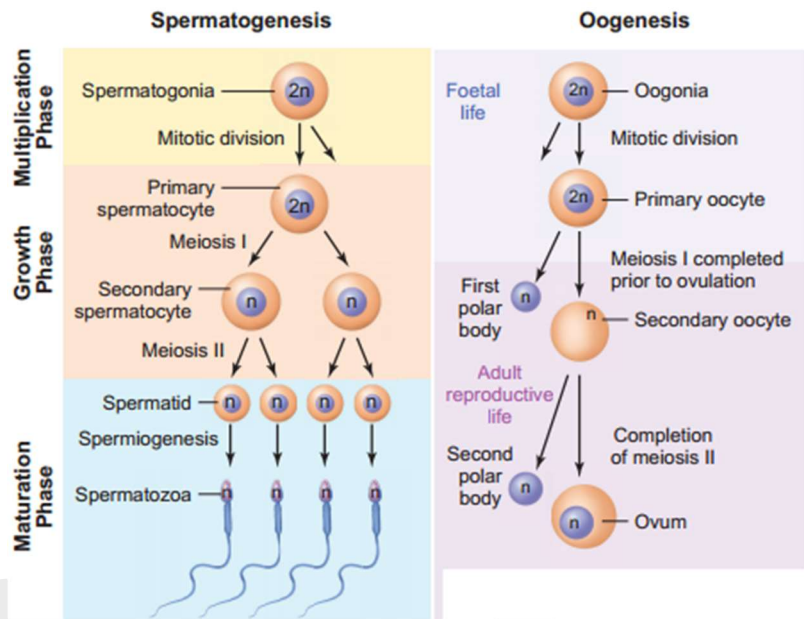
6. The nucleus is flat and oval.
7. The neck is very short and is present between the head and the middle piece.



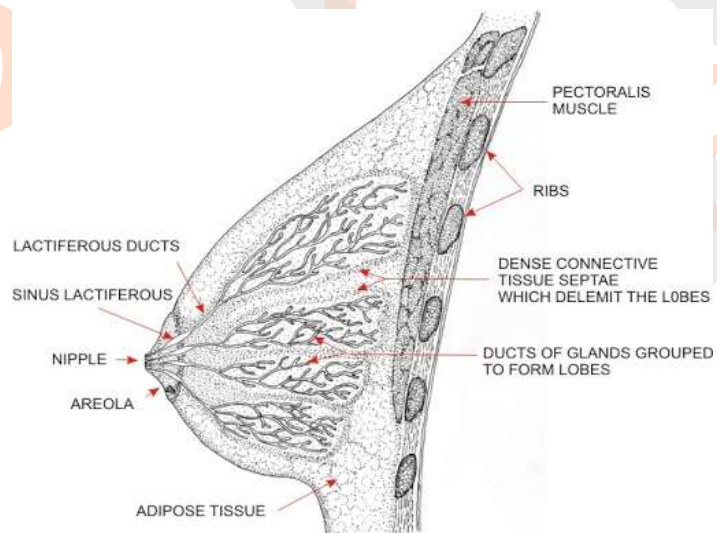
8. The middle piece possesses mitochondria spirally twisted around the axial filament called mitochondrial spiral or nebenkern.
9. It produces energy in the form of ATP molecules for the movement of sperms.
10. The lashing movements of the tail push the sperm forward.

2. Differentiate spermatogenesis and oogenesis.

	Spermatogenesis	Oogenesis
Location	Testis	Ovary
Number of gametes produced	Life long production (Millions)	Fixed amount (only- mature)
Gametes per germ cell	Four	One
Beginning of process	Begins at puberty	Begins during fetal development
Timing of gamete formation	Continuous (any time)	Once a month (menstrual cycle)
End of process	Fertility is life long but reduces	Fertility stops at menopause
Timing of gamete release	Any time	Monthly cycle
Meiotic divisions	Uninterrupted	Arrested
Germ line epithelium	Involved in gamete production	Not involved in gamete production



3. Give an account of mammary glands.



1. Mammary glands are modified sweat glands present in both sexes.
2. It is functional in females and rudimentary in males.
3. In human a pair of mammary glands is placed in the thoracic region.
4. The glandular tissues and variable quantities of fat are present in mammary gland along with a median nipple.
5. The nipple is surrounded by a pigmented area called areola.
6. The areolar glands modified sebaceous glands are present on the surface.
7. They help in reducing the cracking of the skin of the nipple.

8. Each mammary gland consists of 2-25 lobes. They are separated by fat and connective tissues.
9. They are separated by fat and connective tissues. Each lobe contains many lobules, which contain acini or alveoli lined by epithelial cells.
10. Milk is secreted by the cells of alveoli which opens into mammary tubules.
11. Mammary ampulla is formed by joining several mammary ducts.
12. The mammary duct is connected to lactiferous duct in the nipple. The lactiferous sinus is the expansion of lactiferous duct under the nipple and was a reservoir of milk.
13. On the surface of the nipple, each lactiferous duct opens by a minute pore.

4. Write about the accessory glands of male reproductive system.

The accessory glands associated with male reproductive system include the following:

- i) A paired seminal vesicles.
- ii) Bulbourethral glands or cowper's glands.
- iii) A single prostate gland

Seminal vesicles:

Seminal vesicles are located on either side of the prostate gland and secrete an alkaline fluid called seminal plasma, which contains fructose sugar ascorbic acid, prostaglandins and a coagulating enzyme called vesiculases, which helps sperm motility.

The Bulbourethral glands:

These glands are located inferior to the prostate gland and they secrete a lubricating fluid, which helps to lubricate the penis.

The prostate glands:

The single prostate gland is placed just below the urinary bladder, encircling the urethra. It secretes slightly acidic fluid, which contains citrate several enzymes and prostate specific antigens.

The secretions of the three glands along with sperm is called semen or seminal fluid

5. Explain the sequence of events in the fertilization process in human.

1. The sperm migrates through the coat of follicle cells and binds to receptor molecules in the zona pellucida of the egg.
2. This binding induces the acrosome reaction in which the sperm releases hyaluronidase into the zona pellucida.
3. Breakdown of the zona pellucida by these enzymes allows the sperm to reach the plasma membrane of the egg.
4. The nucleus and other components of the sperm enter the egg.
5. Cortical granules from a barrier called fertilization membrane which now functions as a block to polyspermy.

6. Write a note on extra embryonic membranes.

The extra embryonic membranes namely the amnion, yolk sac, allantois and chorion protect the embryo from desiccation, mechanical shock and help in the absorption of nutrients and exchange of gases.

Amnion:

1. The amnion is a double layered translucent membrane filled with the amniotic fluid.
2. It provides a buoyant environment to protect the developing embryo from injury, regulates the temperature of the foetus and provides a medium in which the foetus can move.

Yolk sac:

1. The yolk sac forms a part of the gut and is the source of the earliest blood cells and blood vessels.

Allantois:

1. The allantois is an extra embryonic membrane which forms a small out pocketing of embryonic tissue at the caudal end of the yolk sac.
2. It is the structural base for the umbilical cord that links the embryo to the placenta and ultimately it becomes part of the urinary bladder.

Chorion:

The chorion is the outermost membrane which encloses the embryo and all other membranes and also helps in the formation of the placenta.

Chorionic villi:

1. The trophoblast cells in the blastocyst send out several finger like projections called chorionic villi.
2. The chorionic villi carrying foetal blood and are surrounded by sinuses that contain maternal blood.
3. The chorionic villi and the uterine tissues form the disc shaped placenta.

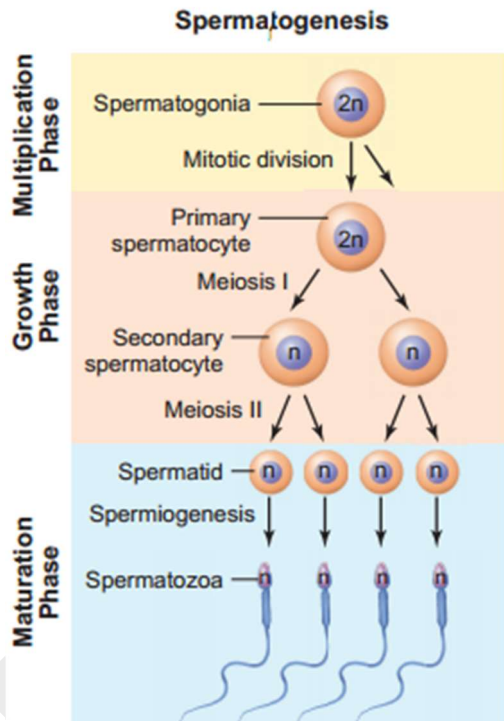
Placenta:

1. Placenta is a temporary endocrine organ formed during pregnancy and it connects the foetus to the uterine wall through the umbilical cord.
2. It is the organ by which the nutritive, respiratory and excretory functions are fulfilled.

7. Explain process of spermatogenesis.

1. Spermatogenesis is the sequence of events in the seminiferous tubules of the testes that produce the male gametes, the sperms.
2. The first stage of spermatogenesis, the spermatogonia migrate among sertoli cells towards the central lumen of the seminiferous tubule and become modified and enlarged to form primary spermatocytes which are diploid with 23 pairs, 46 chromosomes.
3. The primary spermatocytes undergo first meiotic division to form two secondary spermatocytes which are haploid with 23 chromosomes each.

4. The secondary spermatocytes undergo second meiotic division to produce four haploid spermatids.
5. The spermatids are transformed into mature spermatozoa (sperms) by the process called spermiogenesis.

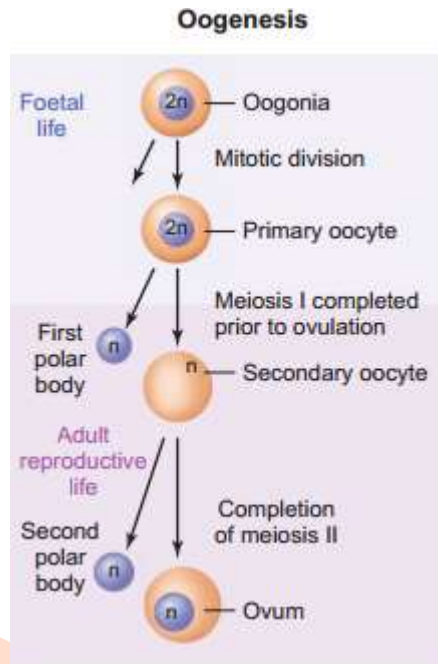


6. Sperms are finally released into the cavity of seminiferous tubules by a process called spermiation.
7. The whole process of spermatogenesis about about 64 days.
8. Spermatogenesis starts at the age of puberty and is initiated due to the increase in the release of Gonadotropin Releasing Hormone by the hypothalamus.
9. FSH stimulates testicular growth and enhances the production of Androgen Binding Protein by the sertoli cells and helps in the process of spermiogenesis.
10. LH acts on the Leyding cells and stimulates the synthesis of testosterone which in turn stimulates the process of spermatogenesis.

8. Explain process of Oogenesis.

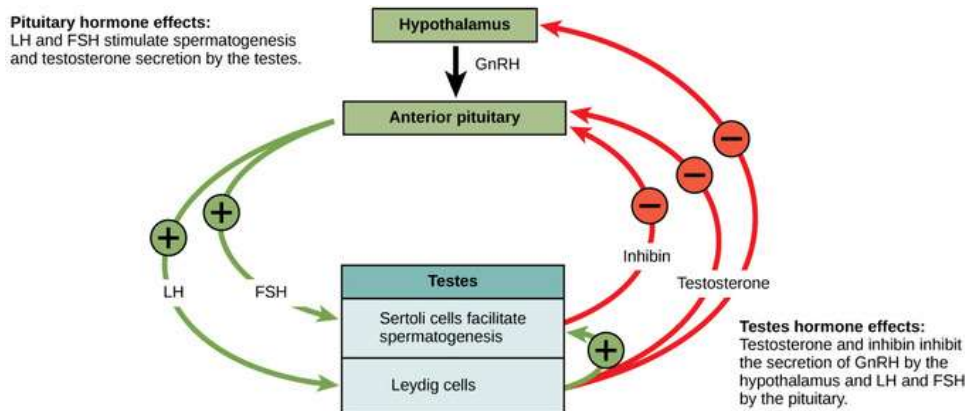
1. Oogenesis is the process of development of the female gamete or ovum or egg in the ovaries.
2. The germinal epithelium of the foetal ovary divide by mitosis and produce millions of egg mother cells or oognia.
3. The oogonial cells start dividing and enter into prophase I of meiotic division I to form the primary oocytes which are temporarily arrested at this stage.

4. The primary oocytes then get surrounded by single layer of granulose cells to form the primordial or primary follicles.
5. A large number of follicles degenerate during the period from birth to puberty.



6. The primary follicle gets surrounded by many layers of granulose cells and a new theca layer to form the secondary follicle.
7. A fluid filled space, the antrum develops in the follicle and gets transformed into a tertiary follicle.
8. The theca layer gets organized into an inner theca interna and an outer theca externa.
9. The primary oocyte within the tertiary follicle grows in size and completes its first meiotic division and forms the secondary oocyte.
10. It is an unequal division resulting in the formation of a large haploid secondary oocyte and a first polar body. The first polar body disintegrates.
11. During fertilization, the secondary oocyte undergoes second meiotic division and produces a large cell, the ovum and a second polar body. The second polar body also degenerates.
12. The tertiary follicle eventually becomes a mature follicle or Graafian follicle.
13. The end of gametogenesis in females, each primary oocyte gives rise to only one haploid ovum.

9.Explain the role of hormones in the maintenance of human male fertility (PTA-2019 to-2020)



1. Spermatogenesis starts at the age of puberty and is initiated due to the increase in the release of Gonadotropin Releasing Hormone (GnRH) by the hypothalamus.
2. GnRH acts on the anterior pituitary gland and stimulates the secretion of two gonadotropins namely Follicle Stimulating Hormone (FSH) and Lutenizing Hormone (LH).
3. FSh stimulates testicular growth and enhances the production of Androgen Binding Protein (ABP) by the sertoli cells and helps in the process of spermiogenesis.
4. LH acts on the Leyding cells and stimulates the synthesis of testosterone which in turn stimulates the process of spermatogenesis.

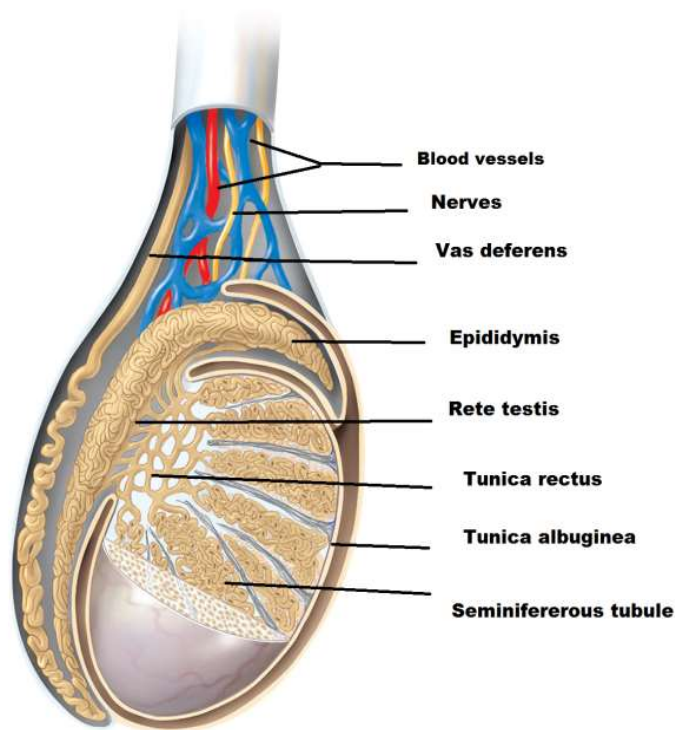
10.Explain the role of placenta during pregnancy.(PTA-2019-2020)

1. Placenta is a temporary endocrine organ.
2. Its formed during pregnancy and it connects the foetus to the uterine wall through the umbilical cord.
3. It is the organ by which the nutritive, respiratory and excretory functions are fulfilled.
4. The embryo's heart develops during the fourth week of pregnancy and circulates blood through the umbilical cord and placenta as well as through is won tissues.

11. Explain the anatomy of testis with the help of a diagram. (PTA-2019-2020)

1. The male reproductive system include rete testis, vasa efferentia, epididymis and vas deferens.
2. The seminiferous tubulus of each lobule converge to form a tubulus rectus that conveys the sperms into the rete testis.
3. The rete testis is a tubular netwoek on the posterior side of the testis.
4. The sperms leave the rete testis and enter the epididyis through the vasa efferentia.

5. The epididymis is a single highly coiled that temporarily stores the spermatozoa and they undergo physiological maturation and acquire increased motility and fertilizing capacity.

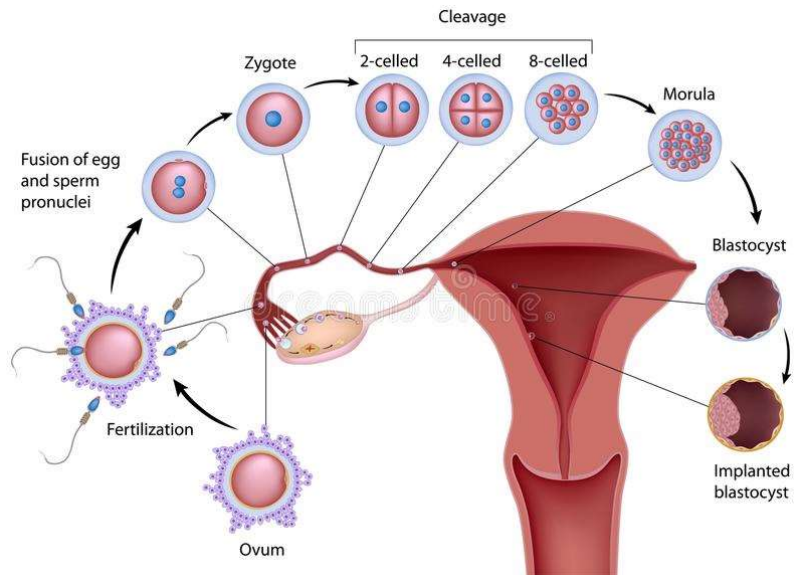


6. The epididymis leads to the vas deferens and joins the duct of the seminal vesicle to form the ejaculatory duct which passes through the prostate and opens into the urethra.
7. The urethra is the terminal portion of the male reproductive system and is used to convey both urine and semen at different times.
8. It originates from the urinary bladder and extends through the penis by an external opening called urethral meatus.

12. Briefly explain the mechanism of fertilization and implantation in human beings. (PTA-2019-2020)

Fertilisation:

Fertilisation occurs when a haploid sperm fuses with a haploid ovum to form a fertilized egg or diploid zygote.



Implantation:

1. The first cleavage produces two identical cells called blastomeres. These produce 4 cells then 8 cells.
2. After 72 hours of fertilization, a loose collection of cells forms a berry shaped cluster of 16 or more cells called the morula.
3. Under the influence of progesterone, smooth muscles of the fallopian tube relax and the dividing embryo takes 4-5 days to move through the fallopian tube into the uterine cavity and finally gets implanted in the uterine wall.
4. At this point the embryo consists of a fluid filled hollow ball of about 100 cells called the blastocyst.
5. The blastocyst is composed of a single layer of large flattened cells called trophoblast and a small cluster of 20-30 rounded cells called the inner cell mass.
6. The inner cell mass of the blastocyst develops into the embryo and becomes embedded in the endometrium of the uterus this process is called implantation and it results in pregnancy.

Rana sakthi durga
Puducherry

Bio-Zoology

Unit-I

Chapter: 3 Reproductive Health

Textbook questions and answers:

- Which of the following is correct regarding HIV, hepatitis B, gonorrhea and trichomoniasis?
HIV is a pathogen whereas others are diseases.
- Which one of the following groups includes sexually transmitted diseases caused by bacteria only? **Syphilis, Chlamydiasis and gonorrhea**
- Identify the correct statements from the following
 - Chlamydiasis is a viral disease.
 - Gonorrhoea is caused by a spirochaete bacterium, *Treponema palladium*.
 - The incubation period for syphilis is 2 to 14 days in males and 7 to 21 days in females.
 - Both syphilis and gonorrhea are easily cured with antibiotics.**
- A contraceptive pill prevents ovulation by
 - Blocking fallopian tube
 - Inhibiting release of FSH and LH**
 - Stimulating release of FSH and LH
 - Causing immediate degeneration of released ovum
- The approach which does not give the defined action of contraceptive is**

a	Hormonal contraceptive	Prevents entry of sperms, prevent ovulation and fertilization.
b	Vasectomy	Prevents spermatogenesis
c	Barrier method	Prevents fertilization
d	Intra uterine device	Increases phagocytosis of sperms, suppresses sperm motility and fertilizing capacity of sperms.

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

Statement 1: Diaphragms, cervical caps and vaults are made of rubber and are inserted into the female reproductive tract to cover the cervix before coitus.

Statement 2: They are chemical barriers of conception and are reusable.

Answer: Statement 1 is correct but statement 2 is incorrect.

7. Match column I with column II and select the correct option from the codes given below.

Answer:

Column I	Column II
A. Copper releasing IUD	Multiload-3759 (iv)
B. Hormone releasing	LNG-20 (i)
C. Non medicated IUD	Lippes loop IUD (ii)
D. Mini pills	Saheli (iii)

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

8. Select the incorrect action of hormonal contraceptive pills from the following

a) Inhibition of spermatogenesis.

b) Inhibition of ovulation

c) Changes in cervical mucus impairing its ability to allow passage and transport of sperms.

d) Alteration in uterine endometrium to make it unsuitable for implantation.

9. What is amniocentesis? Why a statutory ban is imposed on this technique?

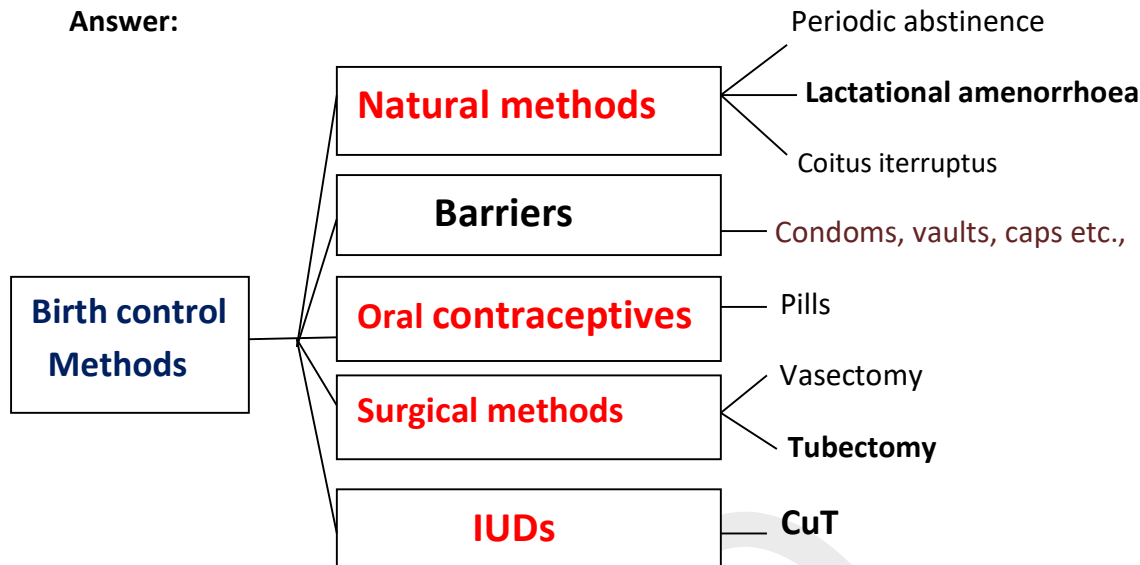
1. Amniocentesis is a prenatal technique used to detect any chromosomal abnormalities in the foetus and it is being often misused to determine the sex of the foetus.

2. Once the sex of the foetus is known, there may be a chance of female foeticide.

3. In order to prevent female foeticide and infanticide, Government of India has taken various steps like **PCPNDT Act** enacted to ban the identification of sex and to prevent the use of prenatal diagnostic techniques for selective abortion.

10. Select the correct term from the bracket and complete the given branching tree

Answer:



11. Correct the following statements:

Answer:

- Transfer of an ovum collected from donor into the fallopian tube is called **GIFT**.
- Transferring of an embryo with more than 8 blastomeres into uterus is called **IUT**.
- Multiload 375 is a **copper** releasing **IUD**.

12. Which method do you suggest the couple to have a baby, if the male partner fails to inseminate the female or due to very low sperm count in the ejaculate?

The method suggested is the micro-testicular sperm extraction, in which a small amount of testicular tissue in areas of active sperm production are removed and improved for sperm yield and used for fertilization of ovum. Intra- cytoplasmic sperm injection can also be done.

13. Expand the following:

- ZIFT**- Zygote Intra- Fallopian Transfer.
- ICSI**- Intra - Cytoplasmic Sperm Injection.

14. What are the strategies to be implemented in India to attain total reproductive health?

- Creating awareness and providing medical assistance to build a healthy society.
- Introducing sex education in schools to provide information about adolescence and adolescence related changes.

3. Educating couples and those in the marriageable age groups about the available birth control methods and family planning norms.
4. Creating awareness about care for pregnant women, post-natal care of mother and child and the importance of breast feeding.
5. Encouraging and supporting governmental and non-governmental agencies to identify new methods and to improve upon the existing methods of birth control.

15. Differentiate foeticide and infanticide.

foeticide	Infanticide
Foeticide refers to aborting the foetus in the mother's womb .	Infanticide is killing the female child after her birth .

16. Describe the major STDs and their symptoms.

❖ **Gonorrhoea:**

- **Causative agent:** *Neisseria gonorrhoeae*

➤ **Symptoms:**

- i) Affects the urethra, rectum and throat and in females the cervix also get affected.
- ii) Pain and pus discharge in the genital tract and burning sensation during urination.

❖ **Syphilis:**

- **Causative agent:** *Treponema pallidum*

➤ **Symptoms:**

1. Primary stage:

Formation of painless ulcer on the external genitalia.

2. Secondary stage:

Skin lesions, rashes, swollen joints and fever and hair loss.

3. Tertiary stage:

1. Appearance of chronic ulcers on nose, lower legs and palate.
2. Loss of movement.
3. Mental disorder.
4. Visual impairment.
5. Heart problems.
6. Gummas (soft non-cancerous growths)

❖ **Chlamydiasis:**

- **Causative agent:** *Chlamydia trachomatis*

➤ **Symptoms:**

Trachoma, affects the cells of the columnar epithelium in the urinogenital tract, respiratory tract and conjunctiva.

❖ **Lymphogranuloma venereum:**

- **Causative agent:** *Chlamydia trachomatis*

➤ **Symptoms:**

1. Cutaneous or mucosal genital damage, urithritis and endocervicitis.
2. Locally harmful ulcerations and genital elephantiasis.

❖ **Genital herpes:**

- **Causative agent:** Herpes simplex virus

➤ **Symptoms:**

1. Sores in and around the vulva, vagina, urethra in female or sores on or around the penis in male.
2. Pain during urination, bleeding between periods.
3. Swelling in the groin nodes.

❖ **Genital warts:**

- **Causative agents:** Human papilloma virus (HPV)

➤ **Symptoms:**

Hard outgrowths (Tumour) on the external genitalia, cervix and perianal region.

❖ **Hepatitis-B:**

- **Causative agents:** Hepatitis B virus (HBV)

➤ **Symptoms:**

1. Fatigue, jaundice, fever, rashes and stomach pain.
2. Liver cirrhosis and liver failure occur in the later stage.

❖ **AIDS:**

- **Causative agents:** Human Immunodeficiency Virus (HIV)

➤ **Symptoms:**

Enlarged lymph nodes, prolonged fever, prolonged diarrhoea, weight reduction, night sweating.

17. How are STDs transmitted?

1. Normally STI are transmitted from person to person during intimate sexual contact with an infected partner.
2. Infections like **Hepatitis-B** and **HIV** are transmitted sexually as well as by sharing of infusion needles, surgical instruments with infected people.
3. Infected mother to foetus.

18. Write the preventive measures of STDs.

1. Avoid sex with unknown partner/ multiple partners.
2. Use condoms.
3. In case of doubt, consult a doctor for diagnosis and get complete treatment.

19. The procedure of GIFT involves the transfer of female gametes into the fallopian tube, can gametes be transferred to the uterus to achieve the same result?

1. Gametes cannot be transferred to the uterus because the uterine environment is not congenial for the survival of the gamete.
2. If directly transferred to the uterus they will undergo degeneration or could be phagocytosis and hence viable zygote would not be formed.

20. Amniocentesis, the foetal sex determination test, is banned in our country, is it necessary? Comment.

1. Amniocentesis is misused to determine the sex of the foetus.
2. When the sex of the foetus is known, there may be chance of female foeticide due to family norms and skewed choice for a male child.
3. Hence, a statutory ban on amniocentesis is necessary in our country.

21. Open book assessment:

“Healthy reproduction, legally checked birth control measures and proper family planning programmes are essential for the survival of mankind” justify.

- ❖ Healthy reproduction involves safe and protected reproduction, through which STDs may not be transmitted from one person to another.
- ❖ A healthy society without such diseases can be developed. This in turn will develop a healthy nation.
- ❖ The population explosion is the main cause of under development of a society and or a nation.
- ❖ To overcome the problem of population explosion, birth control is the only available solution.
- ❖ The voluntary use of contraceptive procedures to prevent fertilization or prevent implantation of a fertilized egg in the uterus is called as birth control.
- ❖ **The proper family planning programme includes:**
 - Planning for one or two children.
 - Preventing child birth through the use of contraceptive devices.
 - Creating awareness among people about the importance of family planning.
 - Implementing Government policies on family planning programme.

Therefore, healthy reproduction, legally checked birth control measures and proper family planning programmes are essential for the survival of mankind.

❖ **Other important questions and answer:**

1. Write a note on "Amniocentesis". (2019-2020) (Or) How do Amniocentesis? (PTA-2019-2020)

1. Amniocentesis involves taking a small sample of the amniotic fluid that surrounds the foetus to diagnose for chromosomal abnormalities.
2. Amniocentesis is generally performed in a pregnant woman between the 15th and 20th weeks of pregnancy by inserting a long thin needle through the abdomen into the amniotic sac to withdraw a small sample of amniotic fluid.
3. The amniotic fluid contains cells shed from the foetus.

2. Describe any three of the viral STI and mention their symptoms. (2019-2020)

i) Genital herpes symptoms:

1. Sores in and around the vulva, vagina, urethra in female or sores on or around the penis in male.
2. Pain during urination, bleeding between periods.
3. Swelling in the groin nodes.

ii) Genital warts symptoms:

Hard outgrowths on the external genitalia, cervix and perianal region.

iii) Hepatitis-B symptoms:

1. Fatigue, jaundice, fever, rash and stomach pain.
2. Liver cirrhosis and liver failure occur in the later stage.

iv) AIDS symptoms:

Enlarged lymph nodes, prolonged fever, prolonged diarrhea, weight reduction, night sweating.

3. Define infertility. Write its causes. (2019-2020)

Infertility:

1. Inability to conceive or produce children even after unprotected sexual cohabitation is called infertility.
2. That is, the inability of a man to produce sufficient numbers or quality of sperm to impregnate a woman or inability of a woman to become pregnant or maintain a pregnancy.
3. The causes for infertility are tumours' formed in the pituitary or reproductive organs, inherited mutations of genes responsible for the biosynthesis of sex hormones, malformation of the cervix or fallopian tubes and inadequate nutrition before adulthood.
4. Long-term stress damages many aspects of health especially the menstrual cycle.

5. Ingestion of toxins (heavy metal cadmium), heavy use of alcohol, tobacco and marijuana, injuries to the gonads and aging also cause infertility.

Causes of infertility:

1. Pelvic inflammatory disease (PID), uterine fibroids and endometriosis are the most common causes of infertility in women.
2. Low body fat or anorexia in women. A psychiatric eating disorder characterized by the fear of gaining weight.
3. Undescended testes and swollen veins (varicocoele) is scrotum.
4. Tight clothing in men may raise the temperature in the scrotum and affect sperm production.
5. Under developed ovaries or testes.
6. Female may develop antibodies against her partner's sperm.
7. Males may develop an autoimmune response to their own sperm.

4. Write the symptoms of Hepatitis-B. (PTA-2019-2020)

1. Fatigue, jaundice, fever, rash and stomach pain.
2. Liver cirrhosis and liver failure occur in the later stage.

5. Differentiate ZIFT and GIFT. (PTA-2019-2020)

ZIFT	GIFT
1. As in IVF, the zygote upto 8 blastomere stage is transferred to the fallopian tube by laparoscopy. 2. The zygote continues its natural divisions and migrates towards the uterus where it gets implanted.	1. Transfer of an ovum collected from a donor into the fallopian tube. In this the eggs are collected from the ovaries and placed with the sperms in one of the fallopian tubes. 2. The zygote travels toward the uterus and gets implanted in the inner lining of the uterus.

6. Enumerate the causes for male infertility. (PTA-2019-2020)

1. Undescended testes and swollen veins (varicocoele) in scrotum.
2. Tight clothing in men may raise the temperature in the scrotum and affect sperm production.
3. Under developed testes.
4. Male may develop an autoimmune response to their own sperm.

7. Write the tertiary stage symptoms of syphilis.

1. Appearance of chronic ulcers on nose, lower legs and palate.
2. Loss of movement, mental disorder, visual impairment, heart problems, gummas (soft non-cancerous growths)

❖ **Creative questions and answers:**

1. What does the term “Reproductive health” refer to?

Reproductive health represents a society with people having physically and functionally normal reproductive organs.

2. Health is a community issue-Justify.

Healthy people have healthier babies and are able to care for their family, and contribute more to the society and community.

3. Define birth control.

Birth control is the voluntary use of contraceptive methods to prevent child birth, by prevent child birth, by preventing fertilization of egg or by preventing the implantation of egg or by preventing the implantation of embryo in the uterus.

4. Distinguish tubectomy and vasectomy.

Tubectomy	Vasectomy
1. It is the surgical sterilization in women.	1. It is the surgical procedure for male sterilization.
2. A small portion of both fallopian tubes are cut and tied up through a small incision in the abdomen or through vagina.	2. Both vas deferens are cut and tied through a small incision on the scrotum to prevent the entry of sperm into the urethra.
3. This prevents fertilization as well as the entry of the egg into the uterus.	3. It prevents sperm from heading off to penis as the discharge has no sperms in it.

5. Define sex ratio. How is it in India? Give reasons for this condition.

1. It is the ratio of males to the females in a population.
2. In India, the child sex ratio has decreased from 927 to 919 female for every 1000 males.
3. Female foeticide and infanticide is the manifestation of gender discrimination in our society.

6. Mention the solutions taken in our country to overcome the population explosion.

1. Birth control is the only available solution. People should be motivated to have smaller families by using various contraceptive devices.

2. Advertisements by the Government in the media, posters/bills, with a slogan “*Naam iruvar namakku iruvar*” (We two, ours two) and “*Naam iruvar namakku oruvar*” (we tw, ours one) have motivated to control population growth.
3. Statutory rising of marriageable age of the female to 18 years and that of males to 21 years and incentives given to couples with small families have taken to control population growth.

7. Explain intra fallopian transfer GIFT.

1. In this technology, the ovum collected from a donor is transferred into the fallopian tube of recipient.
2. The transferred eggs are placed with the sperms in the fallopian tube for fertilization. The fertilized egg moves towards the uterus and gets implanted in the inner lining of the uterus.

8. Expand the abbreviation POCSO and PCPNDT.

- i) POCSO- Prevention of Children from Sexual Offences.
- ii) PCPNDT- Preconception and Prenatal Diagnostic Technique

9. How should be an ideal contraceptive method?

1. It should be user friendly.
2. Easily available.
3. Least side effects.
4. it should not interfere with sexual drive.

10. What is natural contraceptive method?

The natural contraceptive method is the procedure to prevent meeting of sperm with ovum in order to prevent fertilization.

11. Mention any two chemical barriers used in contraceptive method.

- i) Foaming tablets
- ii) Melting suppositories

12. Explain briefly about hormonal barrier in contraceptive device.

Hormonal barrier is a contraceptive method, in which the hormonal imbalance prevents the ovaries from releasing ova and thickens the cervical fluid. This keeps the sperm away from the ovum.

13. What are Non-medicated IUDS?

Non-medicated IUDS are the intrauterine devices made of plastic or stainless steel.

Example: Lippes loop is a double S-shaped plastic device.

14. Name any two copper releasing IUDs.

- i) NOVaT ii) Multiload 375.

15. Name any two bacterial sexually transmitted diseases.

- i) Chlamydia ii) Syphilis

16. What is lactational amenorrhoea?

The reappearance of normal ovarian cycles may be delayed for six months during breastfeeding. This delay in ovarian cycles is called lactational amenorrhoea.

17. How does lactational amenorrhoea serve as a contraceptive method?

1. Suckling by the baby during breast feeding stimulates the pituitary to secrete increased prolactin hormone in order to increase milk production.
2. This high prolactin prevents menstrual cycle by suppressing the release of GnRH (Gonadotropin Releasing Hormone) from hypothalamus and gonadotropin from the pituitary.

18. What are the risk factors for cervical cancer?

- i) Having sex with multiple unknown partners.
- ii) Prolonged use of contraceptive pills.

19. Define Mayer-Rokitansky syndrome.

Mayer-Rokitansky syndrome is a condition in which the women do not have a functional uterus.

20. What is embryo transfer technique?

The embryo transfer technique is the method of transferring an embryo with cells more than blastomere stage into uterus.

21. Define Azoospermia.

Azoospermia is defined as the absence of spermatozoa in the ejaculate semen on at least two occasions.

22. What is a foetoscope?

Foetoscope is an instrument used to monitor the heart rate of foetus and other functions during late pregnancy and labour.

23. List the health care programmes taken up by Government of India.

- i) Massive child immunization
- ii) Supply of nutritional food to the pregnant women.
- iii) Implementation of Janani Suraksha Yojana, Janani Shishu suraksha Karuakram, RMNCH+ A approach (An integrated approach for reproductive, maternal, new born, child and adolescent health), Pradhan Mantri Surakshit Matruva Abhiyan.

24. How are IUDs the ideal contraceptives for females who want to delay pregnancy?

1. IUDs are inserted by medical experts in the uterus through the vagina.
2. They are available as copper releasing IUDs, hormone releasing IUDs and non-medicated IUDs.
3. IUDs increase phagocytosis of sperm within the uterus.
4. IUDs are the popular method of contraception in India and have a success rate of 95 to 99%.

25. Copper releasing IUDs are more efficient contraceptives in human females. How?

1. Copper releasing IUDs differ from each other by the amount of copper.
2. Copper IUDs such as CuT-380A, Nova T, Cu7, CuT380 Ag, Multiload 375, etc. Release free copper and copper salts into the uterus and suppress sperm motility.
3. They can remain in the uterus for five to ten years.

26. Write briefly about oral contraceptives.

1. Oral contraceptives are taken orally in the form of pills, used to prevent ovulation in females.
2. They inhibit the secretion of FSH and LH hormones. Most commonly used birth control pills are combined pills, which contain synthetic progesterone and oestrogen hormones.
3. Central Drug Research Institute (CDRI) in Lucknow, India developed a non-steroidal contraceptive pill, called saheeli.

27. Early medical termination is safe. But abortions during the second trimester are more risky.**Give reason.**

1. Early medical termination is extremely safe upto 12 weeks (the first trimester) of pregnancy and has no impact on a woman's fertility.
2. Abortion during the second trimester is more risky as the foetus becomes intimately associated with the maternal tissue.

28. Mention the types of IUDs.**1. Copper IUDs:**

Copper IUDs release free copper and copper salts into the uterus and suppress sperm motility and can remain in the uterus for five to ten years.

Example: Cu T-380 A, Nova T, Cu 7, CuT380Ag, Multiload 375,ect.

2. Hormone-releasing IUDs:

The Hormone releasing IUDs increase the viscosity of the cervical mucus and prevent sperms from entering the cervix.

Example: Progestasert and LNG-20

3.Non-medicated IUDs:

Non-medicated IUDs are made of plastic or stainless steel. Lippes loop is a double S-shaped plastic device.

29. What is medical termination of pregnancy?

It is a voluntary or intentional termination of pregnancy in a non-surgical or non invasive way.

30. Mention the other names of sexually transmitted infection.

Sexually transmitted diseases (STD) or Venereal diseases (VD) or Reproductive Tract Infections (RTI).

31. What is Azoospermia? How is it treated?

It is defined as the absence of spermatozoa in the ejaculate semen on at least two occasions.

32. Expand and Explain CVS.

1. CVS- Chorionic Villus Sampling.
2. It is a prenatal test that involves taking a sample of the placental tissue to test for chromosomal abnormalities.

33. How is the foetal heart known during pregnancy?

1. Foetoscope is used to monitor the foetal heart rate and other functions during late pregnancy and labour.
2. The average foetal heart rate is 120-160 beats per minute. An abnormal foetal heart rate means that the foetus is not getting enough oxygen and it indicates other problems.

34. Strict conditions as to be followed in medical Termination of pregnancy procedure. Give reasons.

1. Sex discrimination and illegal female foeticides to avoid its misuse.
2. MTP performed illegally by unqualified quacks in unsafe and could be fatal.
3. MTP of the first conception may have serious psychological consequences.

35. What are the symptoms of AIDS.

1. Enlarged lymph nodes.
2. Prolonged fever.
3. Prolonged diarrhea.
4. Weight reduction and night sweating.

36. Mention the causes the symptoms and risk factors of cervical cancer.**Causes:**

1. By a sexually transmitted virus called Human Papilloma Virus (HPV).
2. Abnormal growth of cervical cells or cervical dysplasia.

Symptoms:

1. Pelvic pain.
2. Increased vaginal discharge.
3. Abnormal vaginal bleeding.

The risk factors:

1. Having multiple sexual partners.
2. Prolonged use of contraceptive pills.

37. Mention the techniques to diagnose the cervical cancer.

1. Papanicolaou smear (PAP smear) combined with an HPV test.
2. X-Ray
3. CT scan.
4. MRI.
5. PET scan.

38. What is called Infertility?

1. Inability to conceive or produce children even after unprotected sexual cohabitation.
2. The inability of a man to produce sufficient numbers or quality of sperm to impregnate a woman or inability of a woman to become pregnant or maintain a pregnancy.

39. What is Assisted Reproductive Technology?

1. Assisted Reproductive Technology collection of procedure, which includes the handling of gametes and or embryo outside the body to achieve a pregnancy.
2. It increases the chance of pregnancy in infertile couples.

40. How is surrogacy helpful in case of an infertile woman?

1. It is a method of assisted reproduction or agreement.

2. A woman agrees to carry a pregnancy for another person, who will become the newborn child's parent after birth.

41. Mention two sexually transmitted diseases caused by virus.

1. AIDS.
2. Genital Herpes.

42. All reproductive tract infections (RTIs) are STDs, but all STDs are not RTIs. Justify with example.

1. Among the common STDs, hepatitis-B and AIDS are not infections of the reproductive organs through their mode of transmission could be through sexual contact also. So, AIDS and hepatitis are STDs but not RTIs.
2. All other diseases like gonorrhea, syphilis, genital herpes, are transmitted through sexual contract and are also infections of the reproductive tract, so these are RTIs as well as STDs.

43. Removal of gonads cannot be considered as a contraceptive option. Why?

1. Removal of gonads cannot be considered as a contraceptive option because it not only stops the production of gametes, but also stops the secretion of many other hormones required for normal body function.
2. Also this is an irreversible method. It means once removed, gonads cannot be replaced and the person will remain infertile for while life.

44. What does MTP stand for?

1. MTP stands for medical termination of pregnancy.
2. Medical method of abortion is a voluntary or intentional termination of pregnancy in a non-surgical or non-invasive way.

45. What is saheli?

1. Saheli is a contraceptive pill devised by Central Drug Research Institute (CDRI) in Lucknow, India.
2. It contains a non-steroidal preparation called centchroman.

46. Mention two sexually transmitted disease caused by bacteria.

1. Syphilis.
2. Gonorrhoea.

47. What is cryopreservation?

1. Cryopreservation (freezing) of embryos is often used when there are more embryos than needed for a single IVF transfer.

2. Embryo cryopreservation can provide an additional opportunity for pregnancy through a Frozen embryo transfer (FET) without undergoing another ovarian stimulation and retrieval.

48. What is IUT?

IUT- Intra Uterine Transfer

1. Embryo with more than 8 blastomeres is inserted into uterus to complete its further development.
2. It is a method to achieve pregnancy by Assisted Reproductive Technology.

49. What is micro- testicular sperm extraction (TESE)?

Microsurgical sperm retrieval retrieval from the testicle involves a dilation of the microscope, the seminiferous tubules under the microscope and small amount of testicular tissue in areas of active sperm production are removed. This is improved for sperm yield compare to traditional biopsy techniques.

50. What is surrogacy? Explain it briefly.

Surrogacy is a method of assisted reproduction or an agreement whereby a woman agrees to carry a pregnancy for another person who will become the parent of the new born child after birth. The embryos are produced through in vitro fertilization in the lab and are transferred into the uterus of surrogate mother.

51. Name any three procedures followed under assisted reproductive technology.

1. Intra Uterine Insemination (IUI)
2. In Vitro Fertilization (IVF)
3. Embryo Transfer (ET)

Five mark questions and answers:**1. Describe the different natural methods of birth control.****Natural method:**

Natural method is used to prevent meeting of sperm with ovum. Rhythm method, coitus interruptus, continuous abstinence and lactational amenorrhoea.

i) Periodic abstinence/ rhythm method:

1. Ovulation occurs at about the 14th day of the menstrual cycle.
2. Ovum survives for about two days and sperm remains alive for about 72 hours in the female reproductive tract.
3. Coitus is to be avoided during this time.

ii) Continuous abstinence:

It is the simplest and most reliable way to avoid pregnancy is not to have coitus for a defined period that facilitates conception.

iii) Coitus interruptus:

It is the oldest family planning method. The male partner withdraws his penis before ejaculation, thereby preventing deposition of semen into the vagina.

iv) Lactational amenorrhoea:

1. It is menstrual cycles resume as early as 6 to 8 weeks from parturition.
2. However the reappearance of normal ovarian cycle may be delayed for six months during breast feeding.
3. This delay in ovarian cycles is called lactational amenorrhoea.
4. It serves as a natural but an unreliable form of birth control.

2. Describe the different barrier methods of birth control.

In these methods the ovum and sperm are prevented from meeting so that fertilization does not occur.

i) Chemical barrier:

1. Foaming tablets.
2. Melting suppositories.
3. Jellies.
4. Creams.

They are used as chemical agents that inactivate the sperms in the vagina.

ii) Mechanical barrier:

1. Condoms are a thin sheath used to cover the penis in male whereas in female it is used to cover vagina and cervix just before coitus so as to prevent the entry of ejaculated semen into the female reproductive tract.
2. This can prevent conception.
3. Condoms should be discarded after a single uses.
4. Condoms are made of polyurethane, latex and lambskin.
5. Diaphragms, cervical caps and vaults are made of rubber and are inserted into the female reproductive tract to cover the cervix before coitus in order to prevent the sperms from entering the uterus.

iii) Hormonal barrier:

1. It prevents the ovaries from releasing the ova and thickens the cervical fluid which keeps the sperm away from ovum.
2. **Oral contraceptive** pills are used to prevent ovulation by inhibiting the secretion of FSH and LH hormones.

3. A combined pill is the most commonly used birth control pill. It contains synthetic progesterone and estrogen hormones.
4. Saheli, contraceptive pill by Central Drug Research Institute in Lucknow, India contains a non-steroidal preparation called centchroman.

iv) Intrauterine Devices (IUDs):

1. Intrauterine devices are inserted by medical experts in the uterus through the vagina.
2. These devices are available as copper releasing IUDs, hormone releasing IUDs and non-medicated IUDs.
3. IUDs increase phagocytosis of sperm within the uterus.
4. IUDs are the ideal contraceptives for females who want to delay pregnancy.
5. It is one of the popular methods of contraception in India and has a success rate of 95 to 99%.

3. Explain intrauterine devices (IUDs).

1. Intrauterine devices are inserted by medical experts in the uterus through the vagina.
2. These devices are available as copper releasing IUDs, hormone releasing IUDs and non-medicated IUDs.
3. IUDs increase phagocytosis of sperm within the uterus.
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5. It is one of the popular methods of contraception in India and has a success rate of 95 to 99%.

Copper releasing IUDs:

1. It differs from each other by the amount of copper.
2. Copper IUDs such as Cu T-380 A, Nova T, Cu 7, Cu T 380 Ag, Multiload 375, etc.
3. Release free copper and copper salts in the uterus and suppress sperm motility.
4. They can remain in the uterus for five to ten years.

Hormone-releasing IUDs:

1. It such as progestasert and LNG-20 are often called as intrauterine systems (IUS).
2. They increase the viscosity of the cervical mucus and thereby prevent sperms from entering the cervix.

Non-medicated IUDs:

1. They are made of plastic or stainless steel, Lippes loop is a double S-shaped plastic device.

4. Describe the method of surgical sterilization.

1. The surgical sterilization methods are the permanent contraception methods advised for male and female partners to prevent any more pregnancies.
2. It blocks the transport of the gametes and prevents conception.

Tubectomy:

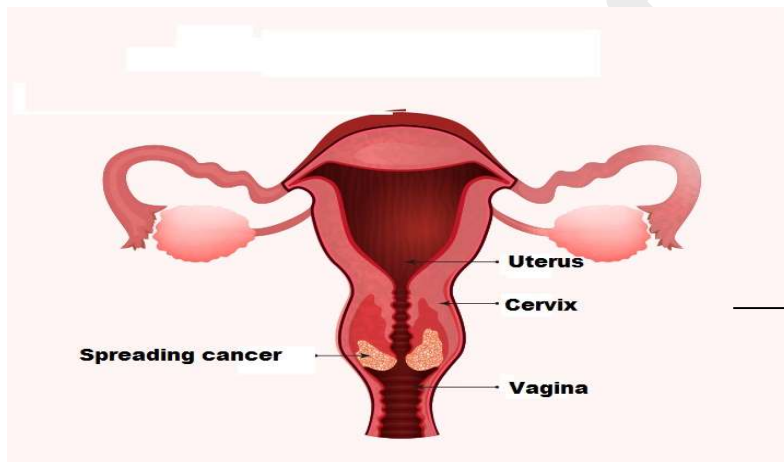
1. Tubectomy is the surgical sterilization in women.
2. In this procedure a small portion of both fallopian tubes are cut and tied up through a small incision in the abdomen or through vagina.
3. This prevents fertilization as well as the entry of the egg into the uterus.

Vasectomy:

1. Vasectomy is the surgical procedure for male sterilization.
2. In this procedure both vas deferens are cut and tied through a small incision on the scrotum to prevent the entry of sperm into the urethra.
3. Vasectomy prevents sperm from heading off to penis as the discharge has no sperms in it.

5. What is cervical cancer? Explain its causes, symptoms, diagnoses, treatment and preventions.

Cervical cancer starts in the cells lining the cervix the lower part of the uterus. The cervix connects the body of the uterus to the vagina. Cancer starts when cells in the body begin to grow out of control.



This picture is only for your understanding

Causes:

1. Cervical cancer is caused by a sexually transmitted virus called Human Papilloma Virus (HPV).
2. HPV may cause abnormal growth of cervical cells or cervical dysplasia.

The risk factors for cervical cancer include:

1. Having multiple sexual partners.
2. Prolonged use of contraceptive pills.

The most common symptoms:

1. Pelvic pain.
2. Increased vaginal discharge.
3. Abnormal vaginal bleeding.

Diagnoses:

1. The cervical cancer can be diagnosed by a papanicolaou smear (PAP smear) combined with an HPV test.
2. X-ray, CT scan, MRI and a PET scan may also be used to determine the stage of cancer.

Treatment:

1. Radiation therapy.
2. Surgery.
3. Chemotherapy.

Prevention:

1. Modern screening techniques can detect precancerous changes in the cervix. Therefore screening is recommended for women above 30 years once in a year.
2. Cervical cancer can be prevented with vaccination.
3. Primary prevention begins with HPV vaccination of girls aged 9-13 years, before they become sexually active.
4. Modification in lifestyle can also help in preventing cervical cancer.
5. Healthy marriages, practicing monogamy and regular exercise minimize the risk of cervical cancer.

6. Describe the method of In Vitro Fertilization (IVF). Or Test tube baby.

1. In this technique, sperm and eggs are allowed to unite outside the body in a laboratory.
2. One or more fertilized eggs may be transferred into the woman's uterus, where they may implant in the uterine lining and develop.
3. Excess embryos may be cryopreserved for future use.
4. Initially IVF was used to treat women with blocked, damaged, or absent fallopian tubes. Today IVF is used to treat many causes of infertility.
5. The basic steps in an IVF treatment cycle are ovarian stimulation, egg retrieval, fertilization, embryo culture and embryo transfer.
6. Egg retrieval is done by minor surgery under general anesthesia, using ultrasound guide after 34 to 37 hours of hCG (human Chorionic Gonadotropin) injection.
7. The eggs are prepared and stripped from the surrounding cells.
8. At the same time, sperm preparation is done using a special media.
9. After preparing the sperms the eggs are brought together. 10,000-1,00,000 motile sperms are needed for each egg.
10. Then the zygote is allowed to divide to form 8 celled blastomere and then transferred into the uterus for a successful pregnancy.
11. The transfer of an embryo of an embryo with more than 8 blastomere stage into uterus is called Embryo transfer technique.

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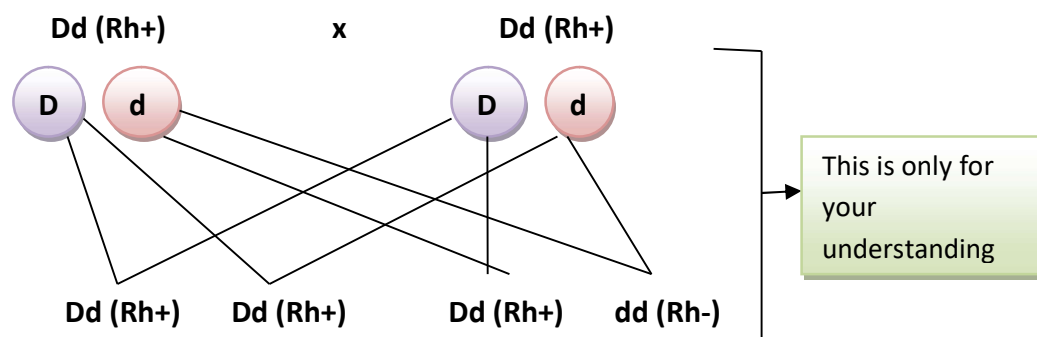
Bio-Zoology

Unit-II

Chapter: 4 Principles of Inheritance and Variation

Textbook questions and answers:

1. Hemophilia is more common in males because it is a **Recessive trait carried by x-chromosome**.
2. ABO blood group in man is controlled by **Multiple alleles**.
3. Three children of a family have blood groups A, AB and B. What could be the genotypes of their parents? **$I^A I^O$ and $I^B I^O$**
4. Which of the following is not correct?
 - a) Three or more alleles of a trait in the population are called multiple alleles.
 - b) A normal gene undergoes mutations to form many alleles.
 - c) **Multiple alleles map at different loci of a chromosome.**
 - d) A diploid organism has only two alleles out of many in the population.
5. Which of the following phenotypes in the progeny are possible from the parental combination A x B? **A, B, AB, and O**
6. Which of the following phenotypes is not possible in the progeny of the parental genotypic combination $I^A I^O \times I^B I^O$? **"O" phenotype is not possible**
7. Which of the following is true about Rh factor in the offspring of a parental combination Dd x Dd (both Rh positive)? **(Heterozygous) (Heterozygous)**



Answer: About one fourth will be Rh negative.

8. What can be the blood group of offspring when both parents have AB blood group? **A,B and AB**
9. If the child's blood group is 'O' and fathers blood group is 'A' and mother's blood group is 'B' the genotype of the parents will be **$I^A I^O$ and $I^B I^O$**
10. XO type of sex determination and XY type of sex determination are examples of **Male heterogamety**
11. In an accident there is great loss of blood and there is no time to analyse the blood group which blood can be safely transferred? **O and Rh negative**
12. Father of a child is colorblind and mother is carrier for colorblindness, the probability of the child being colorblind is **50%**
13. A marriage between a colorblind man and a normal woman produces **All carrier daughters and normal sons**
14. Mangolism is a genetic disorder which is caused by the presence of an extra chromosome number **21**
15. Klinefelter's syndrome is characterized by a karyotype of **XXY**
16. Females with Turner's syndrome have **ALL of these**
17. Patau syndrome is also referred to as **13-Trisomy**
18. "Universal Donor" and "Universal Recipients" blood group are **O** and **AB** respectively.
19. ZW-ZZ system of sex determination occurs in **Gypsy moth, fishes, reptiles and birds.**

Answer: (All of these)

20. Co-dominant blood group is **AB.**
21. Which of the following is incorrect regarding ZW-ZZ type of sex determination?

Females are homogametic and males are heterogametic.

22. What is haplodiploidy?

1. The males have half the number of chromosomes (haploid)
2. The females have double the number (diploid)
3. The name haplodiploidy for this system of sex determination.

Example: Honeybees, ants and wasps a mechanism of sex determination called haplodiploidy mechanism of sex determination is common.

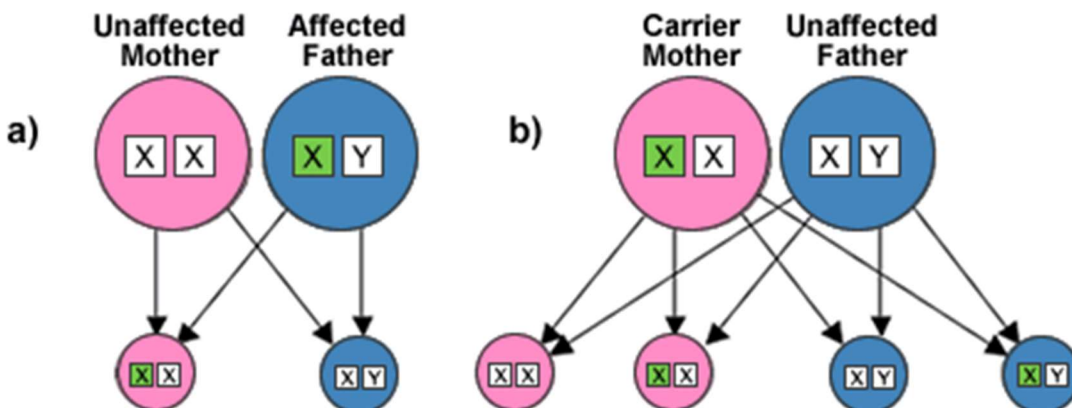
23. Distinguish between heterogametic and homogametic sex determination systems.

Heterogametic	Homogametic
1. Heterogametic individuals (dissimilar sex chromosomes) 2. Produce two types of gametes, so they are called heterogamete. Example: In human males produce two kinds of sperms. Some with X chromosome and some with Y chromosome.	1. Homogametic individuals (similar chromosomes) 2. Produce only one type of gamete so they are called homogametic. Example: In human the female are homogametic. They produce only one kind of egg with X chromosome.

24. What is Lyonisation?

1. Lyonisation is commonly known as X-inactivation in mammals.
2. Male receives one copy (X) of the X chromosome.
3. Female receives two copies (XX) of the X chromosome.
4. One of the two X chromosomes in every cell in a female is randomly inactivated early in embryonic development named after geneticist Mary Lyon.

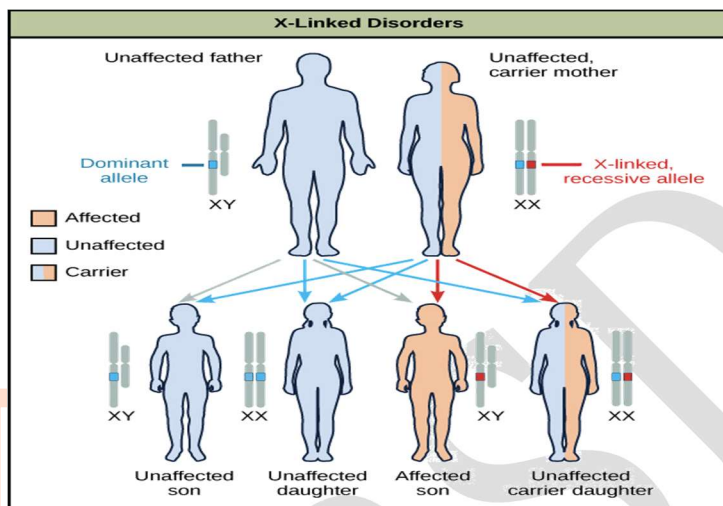
25. What is criss-cross inheritance



1. Criss-cross inheritance is the transmission of a gene from mother to son or father to daughter.
2. Those patterns of inheritance are called criss-cross inheritance or skip generation inheritance.
3. In which a character is inherited to the second generation through the carrier of first generation.

Example: X-chromosome linkage haemophilia.

26. Why are sex linked recessive characters more common in the male human beings?



This picture is only for you understanding

Answer:

1. A male with a mutation in a gene on the X chromosome is typically affected with the condition. Because females have (XX) two copies of the X chromosome and males have (XY) only one X chromosome.
2. So X linked recessive diseases are more common among males than females.

Example: Haemophilia.

27. What are holandric genes?

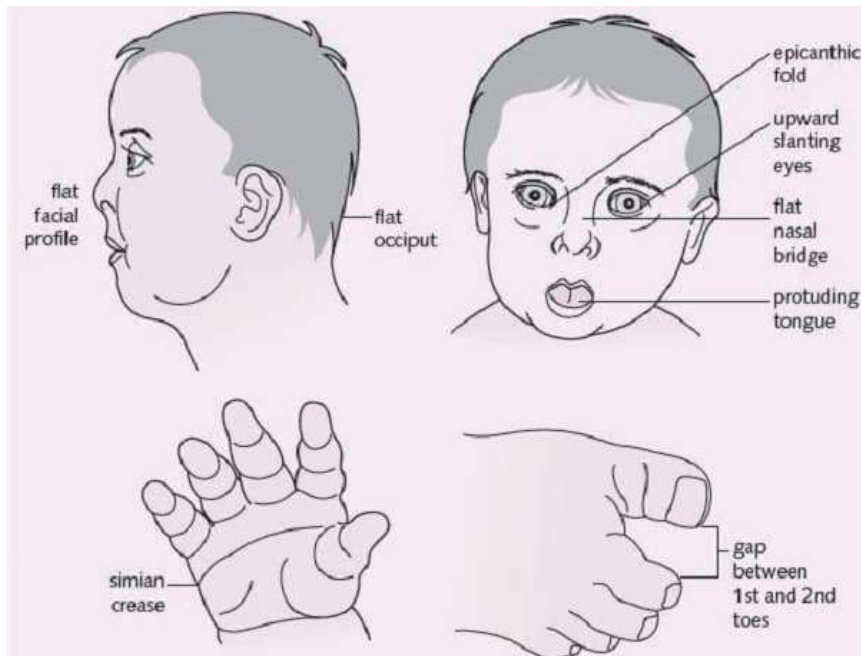
1. Holandric gene is Y linked genes that are found on the Y chromosome.
2. Therefore this gene is only found in males. An example of a trait for this gene is facial hair growth.
3. "Holandric" means basically a gene on the Y chromosome (in mammal) that does not have a homolog on the X chromosome.

Example: A father may carry the gene for hairy ears on his Y chromosome his daughter will not inherit this gene but his son would.

28. Mention the symptoms of phenylketonuria.

1. Severe mental retardation.
2. Light pigmentation of skin and hair.
3. Phenylpyruvic acid is excreted in the urine.

29. Mention the symptoms of Down's syndrome.



This picture is only for your understanding.

1. Severe mental retardation.
2. Defective development of the central nervous system.
3. Increased separation between the eyes.
4. Flattened nose.
5. Ears are malformed.
6. Mouth is constantly open
7. Tongue protrudes.

30. Explain the genetic basis of ABO blood grouping in man.

1. **Karl Landsteiner** discovered two kinds of antigens called **antigen A** and **antigen B** on the surface of RBCs of human blood.
2. Based on the presence or absence of these antigens three kinds of blood group **type "A"**, **type "B"** and **type "O"** (universal donor).
3. The fourth and the rarest blood group **"AB"** (Universal recipient) was **discovered in 1902** by two of Landsteiner's students **Von De Castelle and Struli**.
4. **Bernstein in 1925 discovered** that the inheritance of different blood groups in human beings is determined by a number of **multiple allelic series**.
5. The **three autosomal alleles located on chromosome 9** are concerned with the **determination of blood group** in any person.
6. The **gene controlling** blood type has been labeled as **"I"** (Iso agglutination).

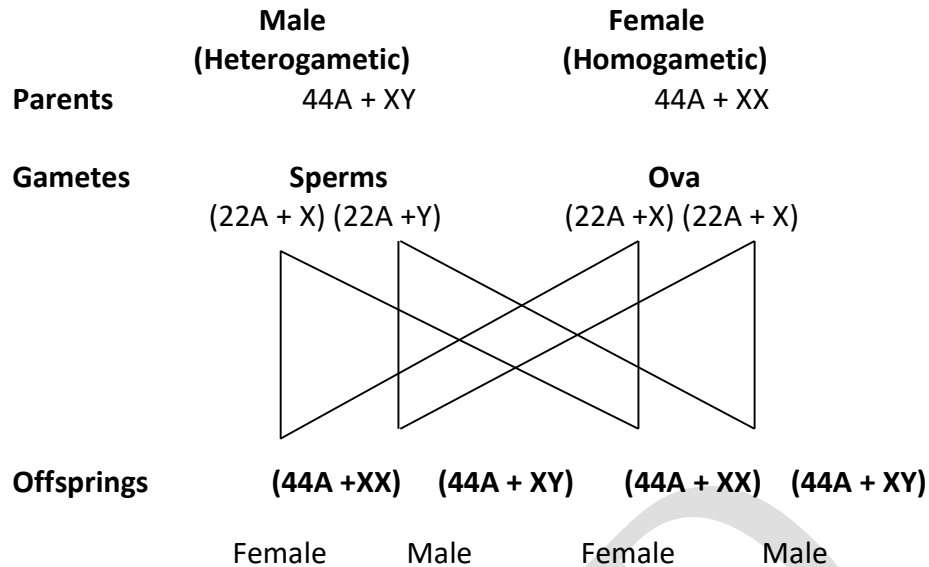
Genotype	ABO blood group phenotype	Antigens present on red blood cell	Antibodies present in blood plasma
I^AI^A	Type A	A	Anti-B
I^AI^O	Type A	A	Anti-B
I^BI^B	Type B	B	Anti-A
I^BI^O	Type B	B	Anti-A
I^AI^B	Type AB	AB	Neither Anti-A nor Anti-B
I^OI^O	Type O	Neither A nor B	Anti-A and Anti-B

- The **I** gene exists in three allelic forms **I^A, I^B** and **I^O**.
- I^A** specifies **A** antigen, **I^B** allele determines **B** antigen and **I^O** allele specifies **no antigen**.
- Each allele (**I^A** and **I^B**) produce transferase enzyme.
- I^A** allele produces **N- acetyl galactose transferase** and can add **N-acetyl galactosamine (NAG)**.
- I^B** allele encodes for the enzyme **galactose transferase** that **adds galactose** to the precursor.
- I^O/I^O** allele no terminal transferase enzyme is produced and therefore called null allele and hence **cannot add NAG or galactose** to the precursor.

31. How is sex determined in human beings?

- Genes determining sex in human beings are located on two sex chromosomes, called **allosomes**.
- Mamma's **sex determination** is associated with chromosomal differences between the two sexes typically **XX females and XY males**.
- 23 pairs of human chromosomes include **22 pairs of autosomes (44A)** and **one pair of sex chromosome (XX or XY)**.
- Females** are **homogametic** producing **only one type of gamete** (egg) each containing **one X** chromosome.

5. The **males** are **heterogametic** producing **two types of sperms** with **X** and **Y** chromosomes.



32. What is male heterogamety?

1. In this method of sex determination the males are heterogametic producing dissimilar gametes while females are homogametic producing similar gametes.
2. It is of two kinds XX-Xo type

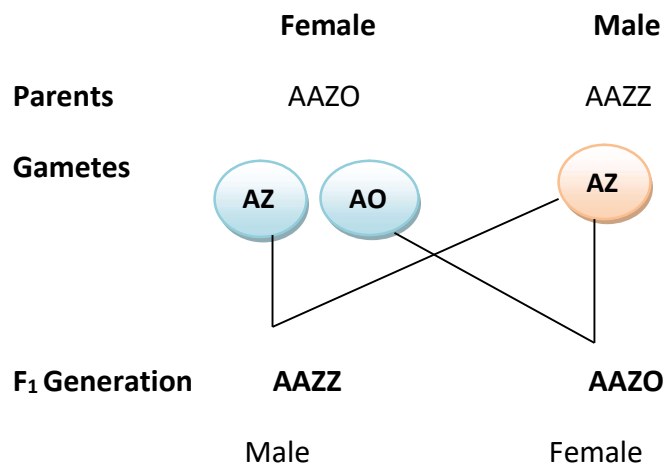
Example: Bugs, cockroaches and grasshoppers. And XX-Xy type (Human beings and Drosophila)

33. Brief about female heterogamety.

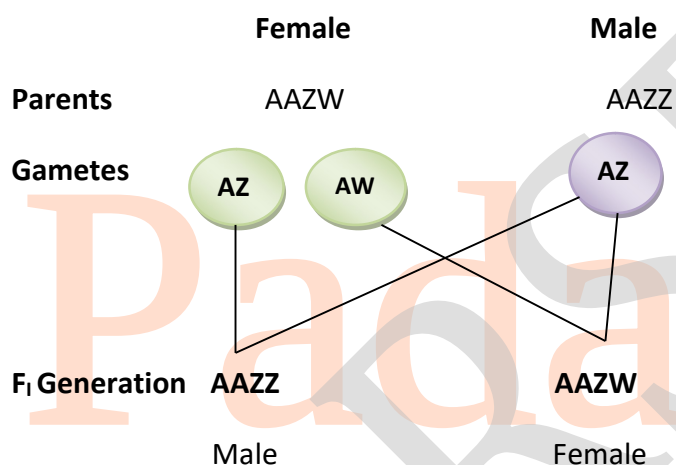
1. In this method of sex determination the females are heterogametic producing dissimilar gametes while males are homogametic producing similar gametes.
2. Sex determination the alphabets Z and W are used here instead of X and Y respectively.

ZO-ZZ Type:

1. This method of sex determination is seen in certain moths, butterflies and domestic chickens.
2. In this type the female possesses single Z chromosome in its body cells and is heterogametic (ZO) producing two kinds of eggs some with Z chromosome and some without Z chromosome.
2. The male possesses two Z chromosomes and is homogametic.



ZW-ZZ type:

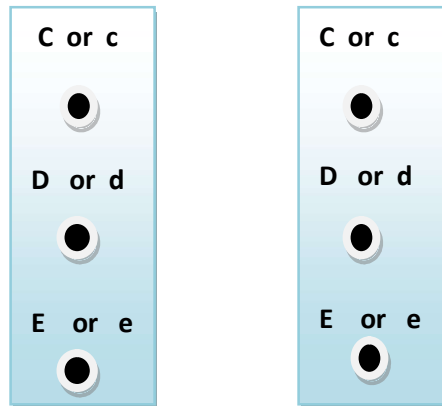


1. This method of sex determination occurs in certain insects (gypsy moth) and in vertebrates such as fishes, reptiles and birds.
2. In this method the female has one Z and one W chromosome (ZW) producing two types of egg
3. The male sex has two Z chromosomes and is homogametic (ZZ) producing a single type of sperm.

34. Give an account of genetic control Rh factor.

Fisher and Race hypothesis:

1. Rh factor involves three different pairs of alleles located on three different closely linked loci on the chromosome pair.
2. Three pairs of Rh alleles (Cc, Dd and Ee) occur at 3 different loci on homologous chromosome pair.



4. The possible genotypes will be one C or c, one D or d, one E or e from each chromosome.
5. All genotypes carrying a dominant 'D' allele will produce Rh positive phenotype and double recessive genotype 'dd' will give rise to Rh negative phenotype.

Wiener hypothesis:

1. Wiener proposed the existence of eight alleles ($R^1, R^2, R^0, R^Z, r, r^1, r^{11}, r^Y$) at a single Rh locus.
2. All genotypes carrying a dominant R allele (R^1, R^2, R^0, R^Z) will produce Rh positive phenotype and
3. Double recessive genotypes ($rr, r^1r^1, r^{11}r^{11}, r^Yr^Y$) will give rise to Rh negative phenotype.

35. Explain the mode of sex determination honeybees.

1. The sex of offspring is determined by the number of sets of chromosomes it receives.
2. Fertilized eggs develop into females (Queen or Worker) and unfertilized eggs develop into males (drones) by parthenogenesis.
3. The male have half the number of chromosomes (haplod) and the females have double the number (diploid)
4. Sex determination facilitates the evolution of sociality in which only one diploid female becomes a queen and lays the eggs for the colony.
5. All other females which are diploid having developed from fertilized eggs help to raise the queen's eggs and so contribute to the queen's reproductive success and indirectly to their own, a phenomenon known as kin selection.
6. The queen constructs their social environment by releasing a hormone that suppresses fertility of the workers.

36. What are the applications of Karyotyping?

1. It helps in gender identification.
2. It is used to detect the chromosomal aberrations like deletion, duplication, translocation, nondisjunction of chromosomes.
3. It helps to identify the abnormalities of chromosomes like aneuploidy.
4. It is also used in predicting the evolutionary relationships between species.
5. Genetic diseases in human beings can be detected by this technique.

37. Explain the inheritance of sex linked characters in human being.

Red-green color blindness or daltonism, haemophilia are example of X-linked gene inheritance in human.

1. Haemophilia:

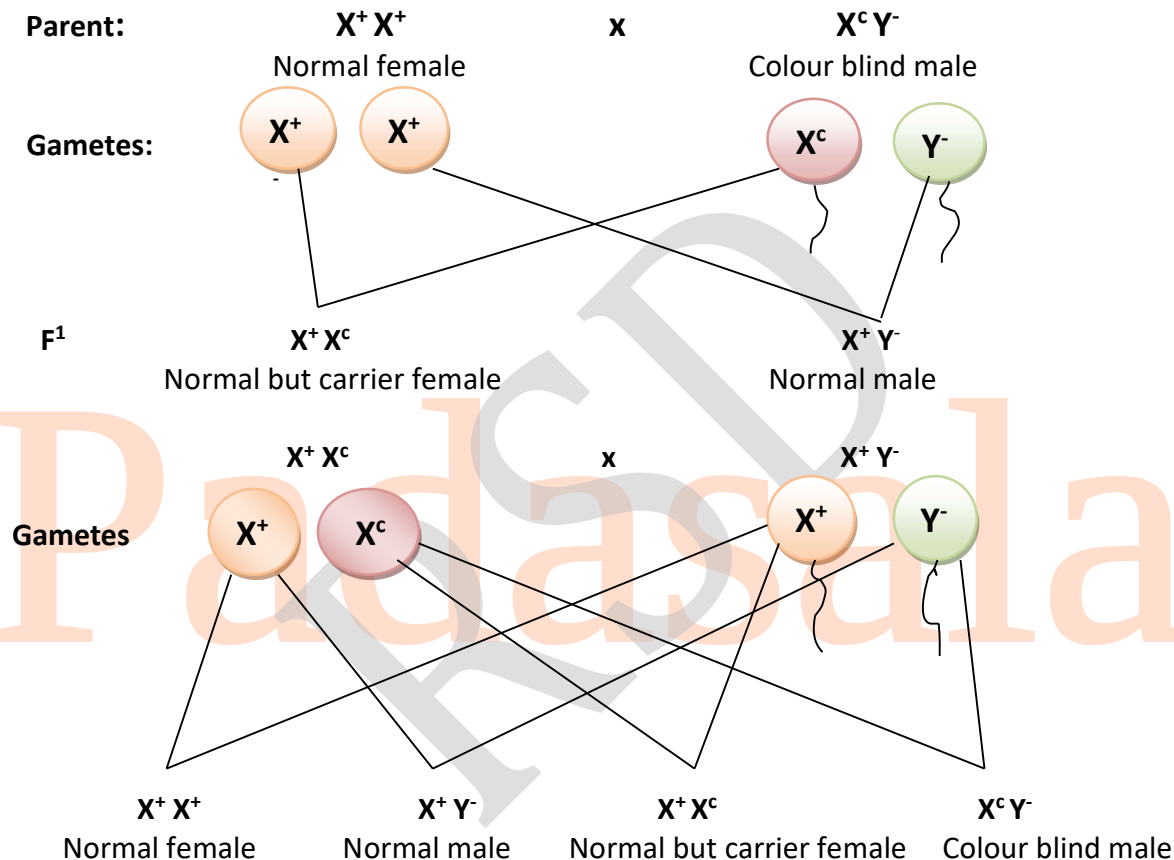
1. Haemophilia is commonly known as bleeders disease, which is more common men than women.
2. This hereditary disease was first reported by John Cotto in 1803.
3. Haemophilia is caused by a recessive X-linked gene.
3. A person with recessive gene haemophilia lacks a normal clotting substance (thromboplastin) in blood, hence minor injuries cause continuous bleeding, leading to death.
4. The female are carriers of the disease and would transmit the disease to 50% of their sons even if the male parent is normal Haemophilia follows the characteristic criss- cross pattern of inheritances.

2. Colour blindness:

1. In human beings a dominant X-linked gene is necessary for the formation of colour sensitive cells, the cone.
2. The recessive form of this gene is incapable of producing colour sensitive cone cells.
3. Homozygous recessive females (X_cX_c) and hemizygous recessive males (X_cY) are unable to distinguish red and green colour.

Other importance questions:**1. Write the cause of Down's syndrome. (2019-2020)**

1. Trisomic condition of chromosome-21 results in down's syndrome.
2. It is characterized by severe mental retardation, defective development of the central nervous system.

2. A character present in grandfather goes to grandson through. Draw flow chart for this pattern of inheritance. (2019-2020)**3. Give an account of allosomal abnormalities in human beings. 2019-2020)**

1. Huntington's chorea is inherited as an autosomal dominant lethal gene in man.
2. It is characterized by involuntary jerking of the body and progressive degeneration of the nervous system, accompanied by gradual mental and physical deterioration.
3. The patients with this disease usually die between the age of 35 and 40.

4. A thalassemia baby is born to a normal non thalassemic parents. Explain the possible for the occurrence of thalassemia. (PTA_2019-2020)

1. Thalassemia is an autosomal recessive disorder.
2. It is caused by gene mutation resulting in excessive destruction of RBC's due to the formation of abnormal haemoglobin molecules.

3. Normally haemoglobin is composed of four polypeptide chains, two alpha and two beta globin chains.
4. Thalassaemia patients have defects in either the alpha or beta globin chain causing the production of abnormal haemoglobin molecules resulting in anaemia.

5. Sex linked inheritable diseases mostly affects men. Explain it with an example. (PTA-2019-2020)

1. Hemophilia lacking the normal factor VIII are said to have Hemophilia-A or (Factor VIII deficiency), the most common from.
2. Hemophilia is a genetic disease, passed down through family.
3. It is linked to the X- chromosome, so it mostly affects males.

6. Write the wiener hypothesis for Rh+ phenotype. (2019-2020)

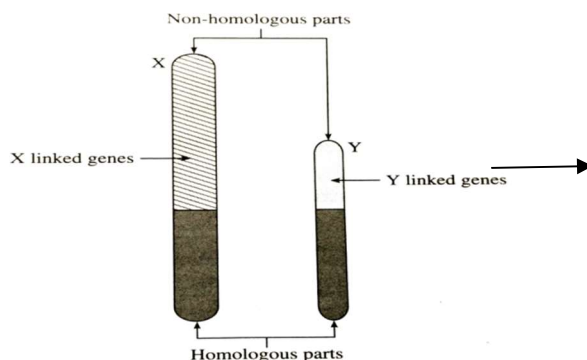
1. Wiener proposed the existence of eight alleles ($R^1, R^2, R^0, R^Z, r, r^1, r^{11}, r^Y$) at a single Rh locus.
2. All genotypes carrying a dominant R allele (R^1, R^2, R^0, R^Z) will produce Rh positive phenotype.
3. Double recessive genotypes ($rr, r^1r^1, r^{11}r^{11}, r^Yr^Y$) will give rise to Rh negative phenotype.

7. Is phenylketonuria related to albinism? Give reason for your answer. (PTA-2019-2020)

1. Phenylketonuria is an autosomal recessive metabolic genetic disorder characterized by a mutation in the gene for the hepatic enzyme phenylalanine hydroxylase.
2. The disease may present clinically with seizures, albinism (excessively fair hair and skin) and a "musty odor" to the baby's sweat and urine.

8. Y- linked genes are non homologous why? (PTA-2019-2020)

1. Over time, the Y chromosome changed in such a way as to inhibit the areas around the sex determining genes from recombining at all with the X chromosome.
2. As a result of this process, 95% of the human Y chromosome is unable to recombine. Only the tips of the Y and X chromosomes recombine.



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Creative questions and answers:**1. Define ideogram.**

Ideogram is the technique of diagrammatic representation of chromosomes.

2. State a difference between a gene and an allele.

Gene	Alleles
It is the inherited factor that determines the biological character of an organism	The two alternative forms of a gene. Example: Tall versus dwarf (T and t)

3. What are multiple alleles?

When three or more alleles of a gene that control a particular trait occupy the same locus on the homologous chromosome of an organism, they are called multiple alleles and their inheritance.

4. Who discovered ABO blood groups?

Karl Landsteiner discovered A, B and O blood groups.

Von De Castelle and **Struli** discovered AB blood group.

5. What is RH⁺ and Rh⁻?

An individual having D antigen are Rh D positive (Rh⁺) and those without D antigen are Rh D negative (Rh⁻).

6. With the help of one example, explain the phenomenon of co dominance and multiple allelism in human population.

Inheritance pattern of ABO blood group in human population.

i) Co dominance:

I^A and I^B both are co dominant as both of them express themselves independently in blood group AB (I^AI^B).

ii) Multiple allelism:

A phenomenon in which genes exist in more than two allelic forms or combinations for example, the gene for blood group exists as three allelic forms I^A, I^B and I^O.

7. What is Erythroblastosis foetalis?

1. Rh⁺ ve children carried by the Rh⁻ ve mother, is exposed to antibodies produced by the mother.
2. Rh antibodies are carried across the placenta into the foetal blood circulation.
3. This causes haemolysis of foetal RBCs resulting in haemolytic jaundice and anaemia.
4. This condition is known as Erythroblastosis foetalis or Haemolytic disease of the new born (HDN).

8. How can Erythroblastosis foetalis be prevented?

1. If the mother is Rh negative and foetus is Rh positive, anti D antibodies should be administered to the mother at 28th and 34th week of gestation as a prophylactic measure.
2. If the Rh negative mother delivers Rh positive child then anti D antibodies should be administered to the mother soon after delivery.
3. This develops passive immunity and prevents the formation of anti D antibodies in the mother's blood by destroying the Rh foetal RBC before the others immune system is sensitized.
4. This has to be done whenever the woman attains pregnancy.

9. What is Barr body? How many Barr bodies are seen in male and female?

1. In 1949, Barr and Bertram first observed a condensed body in the nerve cells of female cat which was absent in the male.
2. This condensed body was called sex chromatin by them and was later referred as Barr body.
3. Barr bodies are inactive X chromosome, in females, in the form of condensed tightly coiled and visible chromatin.
4. The number of Barr bodies observed in cell is one less than the number of X chromosome. XX female has one Barr body. XO females have no Barr body. XXY males have one Barr body.
5. In mammals the necessary dosage compensation is accomplished by the inactivation of one of the X chromosome in females so that both males and females have only one functional X chromosome per cell.

10. In the XX-XY type, males have one X chromosome and female has two. How does the organism compensate for this dosage differences between the sexes?

In mammals the dosage compensation is accomplished by the inactivation of one of the X chromosome in females so that both males and females have only one functional X chromosome per cell.

11. What is kin selection?

1. In honey bees only one diploid female becomes a queen and lays the eggs for the colony.
2. All other diploid female developed from fertilized eggs help to raise the queen's eggs and so contribute to the queen's reproductive success and indirectly to their own, This is known as kin selection.

12. What are called X- linked genes? Give example.

The genes present in the “X” chromosome are called X linked genes. They have no alleles in the Y chromosome.

Example: Haemophilia, colour blindness, Duchenne’s muscular dystrophy.

13. Write short notes on Haemophilia.

1. Haemophilia is commonly known as bleeder’s disease, which is more common in men than women.
2. This hereditary disease was first reported by John Cotto in 1803.
3. Haemophilia is caused by a recessive X- linked gene.
4. A person with a recessive gene for haemophilia lacks a normal clotting substance (thromboplastin) in blood, hence minor injuries cause continuous bleeding, leading to death.
5. The female are carriers of the disease and would transmit the disease to 50% of their sons even if the male parent is normal.
6. Haemophilia follows the characteristic criss- cross pattern of inheritance.

14. Write the genetic reason colour blindness.

1. In human beings a dominant X- linked gene is necessary for the formation of colour sensitive cells, the cones.
2. The recessive females, (X^cX^c) and hemizygous recessive males (X^cY) are unable to distinguish red and green colour.

15. Write about the inheritance of Y- linked genes with example.

1. Genes in the Y- chromosome are inherited directly from male to male.
Example: Hypertrichosis (excessive development of hairs on pinna of the ear) are transmitted directly from father to son, because males inherit the Y chromosome from the father.
2. Female inherits only X chromosome from the father and are not affected.

16. Define the terms karyotyping and ideogram.**1. Karyotyping:**

It is a technique through which a complete set of chromosomes is separated from a cell and the chromosomes are arranged in pairs.

2. Idiogram:

It refers to a diagrammatic representation of chromosomes.

17. What is pedigree?

It is a “family tree” drawn with standard genetic symbols, showing the inheritance pathway for specific phenotypic characters.

18. How is karyotype prepared?

1. Tjio and levan (1960) described a simple method of culturing lymphocytes from the human blood.
2. Mitosis is induced, followed by addition of colchicines to arrest cell division at metaphase stage and the suitable spread of chromosomes is photographed.
3. The individual chromosomes are cut from the photograph and are arranged in an orderly fashion in homologous pairs. This arrangement is called karyotype.

19. What is pedigree analysis?

Pedigree analysis is the study of traits as they have appeared in a given family line for several past generations.

20. What is genetic disorder?

A genetic disorder is a disease or syndrome that is caused by an abnormality in an individual DNA. The Genetic disorders are of two types namely, Mendelian disorders and chromosomal disorders.

21. What is thalassemia?

1. Thalassemia is an autosomal recessive disorder.
2. It is caused by gene mutation resulting in excessive destruction of RBC's due to the formation of abnormal haemoglobin molecules.
3. Thalassemia is classified into alpha and beta based on which chain of haemoglobin molecule is affected. It is controlled by two closely linked genes HBA1 and HBA2 on chromosome 16.

21. How does a chromosomal disorder differ from a mendelian disorder?

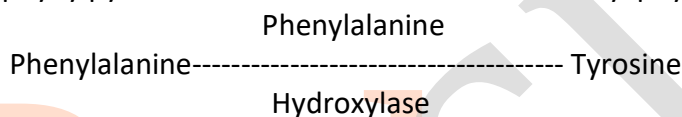
Chromosomal disorder	Mendelian disorders
1. Chromosomal disorders are caused by errors in the number or structure of chromosomes.	1. Alteration or mutation in a single gene causes mendelian disorders.
2. Chromosomal anomalies usually occur when there is an error in cell division.	2. These disorders are transmitted to the offsprings on the same line as the mendelian pattern of inheritance.
3. Group of signs and symptoms that occur together and characterize a particular abnormality is called a syndrome. In humans, Down's syndrome, Turner's syndrome, Klinefelter's syndrome, Patau's syndrome are some of the example of chromosomal disorders.	3. Some examples for Mendelian disorders are Thalassemia, albinism, phenylketonuria, sickle cell anaemia, Huntington's chorea, These disorders may be dominant or recessive and autosomal or sex linked.

22. How does alpha Thalassemia differ from Beta Thalassemia?

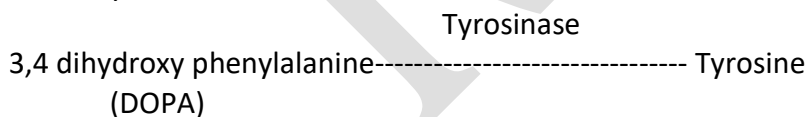
Alpha Thalassemia	Beta Thalassemia
1. Production of alpha globin is affected by mutation or deletion of alpha gene alleles.	1. Production of beta globin chain is affected.
2. It is controlled by two closely linked genes HBA 1 and HBA 2 on chromosome 16.	2. It is controlled by a single gene (HBB) on chromosome 11. It is known as cooley's anaemia

23. Mention the causes of phenylketonuria.

1. It is caused due to a pair of autosomal recessive genes it is PAH (phenylalanine hydroxylase gene). It is located on chromosome 12. This gene is responsible for the hepatic enzyme "Phenylalanine hydroxylase".
2. This enzyme is essential for the conversion of phenylalanine to tyrosine.
3. Affected individual lacks this enzyme, so phenylalanine accumulates and gets converted to phenylpyruvic acid and other derivatives. Phenyl pyruvic acid is excreted in the urine.

**24. What are the causes and symptoms of Albinism?**

1. It is an inborn error of metabolism, caused due to an autosomal recessive gene.
2. Melanin pigment is responsible for skin colour. Absence of melanin results in albinism.
3. A person with the recessive allele lacks the tyrosinase enzyme system, which is required for the conversion of dihydroxyphenyl alanine (DOPA) into melanin pigment inside the melanocytes.

**25. Which is an autosomal dominant lethal gene disorder? Mention its symptoms.**

Huntington's disease: Is an autosomal dominant lethal gene in man.

Symptoms: Involuntary jerking of the body and progressive degeneration of the nervous system, Gradual mental and physical deterioration. The patients will die between the age of 35 and 40.

26. During a medical investigation, an infant was found to possess an extra chromosome 21.

Describe the symptoms the child is likely to develop later in the life.

Trisomic condition of chromosome-21 results in Down's syndrome.

Symptoms: Severe mental retardation, defective development of the central nervous system, increased separation between the eyes, flattened nose, ears are malformed, mouth is constantly open and the tongue protrudes.

27. Name the disorder by Trisomy- 13. Mention its symptoms.

Trisomy-13 result in patau's syndrome. Meiotic non disjunction is the cause for this chromosomal abnormality.

Symptoms: Multiple and severe body malformations profound mental deficiency. Small head with small eyes, cleft palate, malformation of the brain and internal organs.

28. Name the disorder by the absence of one X-chromosome in a human female. Mention its symptoms.

Turner's syndrome: This is due to the loss of a X chromosome resulting in a karyotype of 45, X. (44 autosomes and one X chromosome) (44AA+XO) and are sterile females.

Symptoms: Low stature, webbed neck, under developed breast, rudimentary gonads lack of menstrual cycle during puberty.

29. How is the child affected, if it has grown from the Zygote formed by an XX- egg fertilized by a Y- carrying sperm? What do you call this abnormality? Mention its symptoms.

1. The affected child shows the abnormality of Klinefelters syndrome (XXYmales).
2. This genetic disorder is due to the presence of an additional X chromosome resulting in a karyotype of 47, XXY. (44AA+XXY).

Symptoms:

Sterile males, tall, obese, with long limbs, high pitched voice, under developed genitalia feeble breast (gynaecomastia) development.

30. What is a syndrome?

1. Group of signs and symptoms that occur together and characterize a particular abnormality is called a syndrome.
2. In humans, Down's syndrome, Turner's syndrome, Klinefelter's syndrome, Patau's syndrome are some of the examples of chromosomal disorders.

31. What is Lyon's hypothesis?

1. Mary Lyon suggested that Barr bodies represented an inactive chromosome, which in females becomes tightly coiled into a heterochromatin, a condensed and visible form of chromatin.
2. The number of Barr bodies observed in cell was one less than the number of X-Chromosome.
3. XO females have no Barr body, whereas XXY males have one Barr body.

32. What are Gynandromorphy?

1. These individuals have parts of their body expressing male characters and other parts of the body expressing female characters.
2. The organism is made up of tissues of male and female genotype and represents a mosaic pattern.

33. How does hemophilia affect an individual?

1. A person with a recessive gene for haemophilia lacks a normal clotting substance

(thromboplastin) in blood, hence minor injuries cause continuous bleeding, leading to death.

34. What is SRY?

1. SRY stands for sex determining region Y. It is a gene found in the euchromatin regions of the Non-combining region of Y chromosome.
2. It codes for testes determining factor (TDF) present in testes of Males. This gene does not occur in X chromosome.

35. What are kappa particles.

1. They are cytoplasmic symbionts occurring in some strains of the ciliated paramecium which have their own DNA.
2. It liberates a toxin paramycin and strains which possess these particles are called killer paramecia.
3. Inheritance of killer trait is by extra chromosomal inheritance.

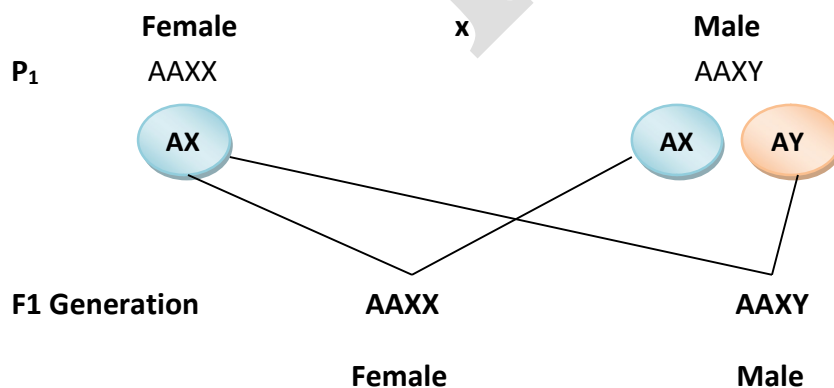
36. What is euphenics?

1. The symptomatic treatment of genetic disease of man is called Euphenics or Medical engineering.
2. In 1960, Joshua Lederberg coined the term euphenics. It means normal appearing.
3. It deals with the control of several inherited human diseases especially the inborn errors of metabolism.

Example: Phenylketonuria (PKU)

Five marks:

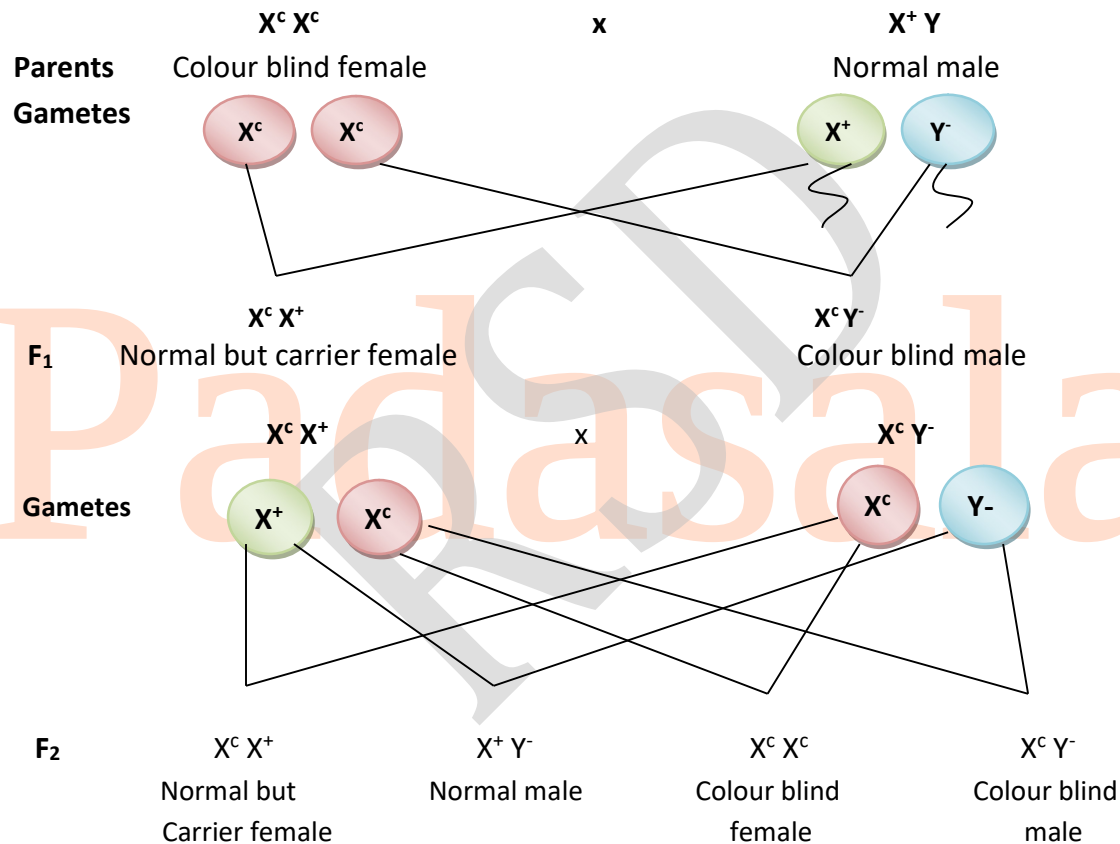
1. Describe the Lygaeus type of sex determination in *Drosophila*.



1. This method of sex determination is seen in human beings and in *Drosophila*.
2. The females are homogametic with XX chromosome, while the males are heterogametic with X and Y chromosome.

- Homogametic female produce only one kind of egg, each with one X chromosome, while the heterogametic males produce two kinds of sperms some with X chromosome and some with Y chromosome.
- The sex of the embryo depends on the fertilizing sperm.
- An egg fertilized by an X bearing sperm produces a female if fertilized by a Y bearing sperm a male is produced.

2. Explain the inheritance of colour blindness in a marriage of colour blind woman with normal man.



- When a colour blind woman with two recessive genes ($X^c X^c$) marries a normal man ($X^+ Y$) among the progenies, all the sons are colour blind and all the daughters are normal, but carries of this gene in F_1 generation.
- If marriage between this F_1 female with a colour blind man takes place among progenies, normal vision carrier daughters and colour blind daughters and males of colour blindness and normal vision will be expected in the F_2 generation.

3. Write a note on thalassemia.

1. Thalassemia is an autosomal recessive disorder.
2. It is caused by gene mutation resulting in excessive destruction of RBC's due to the formation of abnormal haemoglobin molecules.
3. Normally haemoglobin is composed of four polypeptide chains, two alpha and two beta globin chains.
4. Thalassemia patients have defects in either the alpha or beta globin chain causing the production of abnormal haemoglobin molecules resulting in anaemia.
5. Thalassemia is classified into alpha and beta based on which chain of haemoglobin molecule is affected.
6. It is controlled by two closely linked genes HBA1 and HBA2 on chromosome 16.
7. Mutation or deletion of one or more of the four alpha gene alleles causes Alpha Thalassemia.
8. In Beta Thalassemia production of beta globin chain is affected.
9. It is controlled by a single gene (HBB) on chromosome 11.
10. It is the most common type of Thalassemia and is also known as Cooley's anaemia. In this disorder the alpha chain production is increased and damages the membranes of RBC.

4. Write a note on allosomal chromosomal abnormalities.

Mitotic or meiotic non- disjunction of sex chromosomes causes allosomal abnormalities.

Several sex chromosomal abnormalities have been detected. **Example:** Klinefelter's syndrome and Turner's syndrome.

i) Klinefelter's Syndrome (XXY males)

1. This genetic disorder is due to the presence of an additional copy of the X chromosome resulting in a karyotype of 47, XXY.
2. Persons with this syndrome have 47 chromosomes (44AA+XXY).
3. They are usually sterile males, tall, obese, with long limbs, high pitched voice, under developed genitalia and have feeble breast (gynaecomastia) development.

ii) Turner's Syndrome (XO Females)

1. This genetic disorder is due to the loss of a X chromosome resulting in a karyotype of 45,X.
2. Persons with this syndrome have 45 chromosomes (44 autosomes and one X chromosome) (44AA+ XO) and are sterile females.
3. Low stature, webbed neck, under developed breast, rudimentary gonads lack of menstrual cycle during puberty, are the main symptoms of this syndrome.

5. Write a note on any two mendelian disorders occurring in human beings.

1. Alteration or mutation in a single gene causes Mendelian disorders.
2. These disorders are transmitted to the offsprings on the same line as the Mendelian pattern of inheritance.
3. Some examples for Mendelian disorders are

- a) Thalassemia.
- b) Albinism.
- c) Phenylketonuria.
- d) Sickle cell anaemia.
- c) Huntington's chorea.

1. Phenylketonuria:

1. It is an inborn error of Phenylalanine metabolism caused due to a pair of autosomal recessive genes.
2. It is caused due to mutation in the gene PAH (phenylalanine hydroxylase gene) located on chromosome 12 for the hepatic enzyme "phenylalanine hydroxylase" this enzyme is essential for the conversion of phenylalanine to tyrosine.
3. Affected individual lacks this enzyme, so phenylalanine accumulates and gets converted to phenylpyruvic acid and other derivative.
4. It is characterized by severe mental retardation, light pigmentation of skin and hair. Phenylpyruvic acid is excreted in the urine.

Phenylalanine hydroxylase

Phenylalanine ----- Tyrosine

2. Huntington's chorea:

1. It is inherited as an autosomal dominant lethal gene in man.
2. It is characterized by involuntary jerking of the body and progressive degeneration of the nervous system, accompanied by gradual mental and physical deterioration.
3. The patients with this disease usually die between the age of 35 and 40.

6. Write notes on chromosomal abnormalities in human beings. Or what is aneuploidy? Explain it.

1. Each human diploid ($2n$) body cell has 46 chromosomes (23 pairs). Chromosomal disorders are caused by errors in the number or structure of chromosomes.
2. Chromosomal anomalies usually occur when there is an error in cell division.
3. Failure of chromatids to segregate during cell division resulting in the gain or loss of one or more chromosomes is called aneuploidy. It is caused by non-disjunction of chromosomes.

a. Autosomal aneuploidy in human beings.

Several autosomal aneuploidies have been reported in human beings.

Example: Down's syndrome (21-Trisomy), Patau's syndrome (13-Trisomy)

1. Down's syndrome/ Trisomy-21:

1. Trisomic condition of chromosome-21 results in Down's syndrome.
2. It is characterized by severe mental retardation, defective development of the central nervous system, increased separation between the eyes, flattened nose, ears are malformed, mouth is constantly open and the tongue protrudes.

2. Patau's syndrome/ Trisomy-13

1. Trisomic condition of chromosome 13 result in patau's syndrome.
2. Meiotic non disjunction is thought to be the cause for this chromosomal abnormality.

3. It is characterized by multiple and severe body malformations as well as profound mental deficiency.
4. Small head with small eyes, cleft palate, malformation of the brain and internal organs are some of the symptoms of this syndrome.

b. Allosomal abnormalities in human beings.

1. Mitotic or meiotic non-disjunction of sex chromosomes causes allosomal abnormalities.
2. Several sex chromosomal abnormalities have been detected.

Example: Klinefelter's syndrome and Truner's syndrome.

1. Klinefelter's syndrome (XXY Males)

1. This genetic disorder is due to the presence of an additional copy of the X chromosome resulting in a karyotype of 47,XXY.
2. Persons with this syndrome have 47 chromosomes (44AA+XXY)
3. They are usually sterile males, tall, obese, with long limbs, high pitched voice, Under developed genitalia and have feeble breast (gynaecomastia) development.

2. Turner's syndrome (XO Female)

1. This genetic disorder is due to the loss of a X chromosome resulting in a karyotype of 45, X.
2. Persons with this syndrome have 45 chromosomes (44 autosomes and one X chromosome) (44AA+XO) and are sterile females.
3. Low stature, webbed neck, under developed breast, rudimentary gonads lack of menstrual cycle during puberty, are the main symptoms of this syndrome.

Rana Sakthi Durga
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Bio-Zoology

Unit-II

Chapter-5 Molecular Genetics

❖ Textual questions and answers:

1. Hershey and chase experiment with bacteriophage showed that

b) DNA is the genetic material

2. DNA and RNA are similar with respect to

c) Nucleotide containing sugars, nitrogen bases and phosphates.

3. A mRNA molecule is produced by **Transcription**.

4. The total number of nitrogenous bases in human genome is estimated to be about **3.1 billion**.

5. E. coli cell grown on ^{15}N medium are transferred to ^{14}N medium and allowed to grow for two generations. DNA extracted from these cells is ultracentrifuged in a cesium chloride density gradient. What density distribution of DNA would you expect in this experiment?

d) One low and one intermediate density band.

6. What is the basis for the difference in the synthesis of the leading and lagging strand of DNA molecules?

c) DNA polymerase can join new nucleotides only to the 3' end of the growing stand.

7. Which of the following is the correct sequence of event with reference to the central dogma?

d) Replication, Transcription, Translation.

8. Which of the following statements about DNA replication is not correct?

b) Replication occurs as each base is paired with another exactly like it.

9. Which of the following statements is not true about DNA replication in eukaryotes?

d) There are numerous different bacterial chromosomes, with replication occurring in each at the same time.

10. The first codon to be deciphered was **UUU** which codes for **Phenylalanine**.

11. Meselson and stahl's experiment proved

d) semi-conservative nature of DNA replication.

12. Ribosomes are composed of two subunits the smaller subunit of a ribosome has a binding site for **mRNA** and the larger subunit has two binding sites for two **tRNA**.

13. An operon is a **Cluster of structural genes with related function**.

14. When lactose is present in the culture medium:

a) Transcription of lac y, lac z, lac a genes occurs.

b) Repressor is unable to bind to the operator.

c) Repressor is able to bind to the operator.

d) Both (a) and (b) are correct.

15. Give reasons: Genetic code is 'universal'.

The genetic code is universal. It means that all known living systems use nucleic acids and the same three base codons (triplet codon) direct the synthesis of protein from amino acids.

Example: The mRNA (UUU) codon codes for phenylalanine in all cells of all organisms. Some exceptions are reported in prokaryotic, mitochondrial and chloroplast genome. However similarities are more common than differences.

16. Name the parts marked 'A' and 'B' in the given transcription unit.

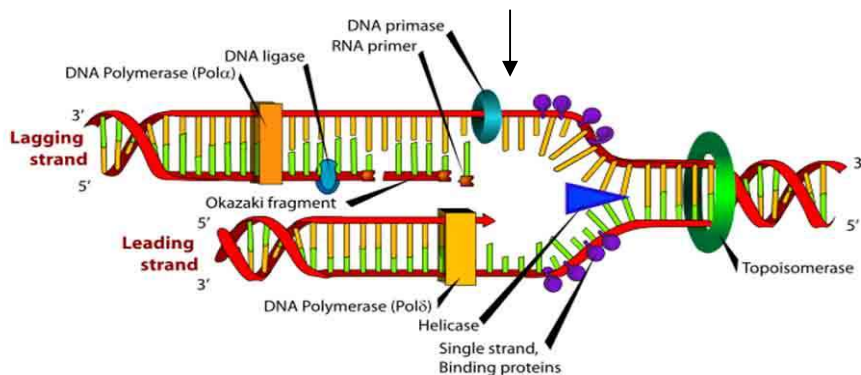
A=Promoter, B=Template strand.

17. Differentiate- Leading strand and lagging strand.

Leading strand	Lagging strand
1. It is a replicated strand of DNA which grows continuously without any gap.	1. Lagging strand is a replicated strand of DNA which is formed in short segments called okazaki fragment. Its growth is discontinuous.
2. It does not require DNA ligase for its growth.	2. DNA- ligase is required for joining okazaki fragments.
3. The polarity of this strand is 3'-----5'	3. The polarity of this strand is 5'-----3'

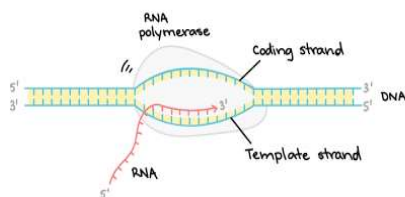
4. Only a single RNA Primer is required	4. Starting of each okazaki fragment requires a new RNA.
5. Formation of leading strand is quite rapid.	5. Formation of lagging strand is slower.
6. Formation of leading strand begins immediately at the beginning of replication.	6. Formation of lagging strand begins a bit later than that of leading strand.

Leading strand and Lagging strand this picture is only for your understanding

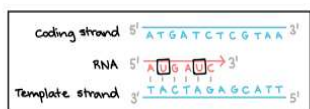


18. Differentiate- Template strand and coding strand.

Template strand	Coding strand
1. It is a DNA strand with 3'-----5'	1. DNA strand with 5'-----3' polarity.
2. Act as template for transcription and codes for RNA.	2. Does not code for any region of RNA during transcription.
3. DNA dependent RNA polymerase catalyses the polymerization in only one direction in this strand.	3. It has a sequence same as RNA (except thymine instead of uracil) and is displaced during transcription.



This picture is only for your understanding



19. Mention any two ways in which single nucleotide polymorphism (SNPs) identified in human genome can bring revolutionary change in biological and medical science.

1. Scientists have identified about 1.4 million locations where single base DNA differences (**BSNPs- Single nucleotide polymorphism**-pronounce as 'snips') occur in humans.
2. Identifications of '**SNIPS**' is helpful in finding chromosomal locations for disease associated sequences and tracing human history.

20. State any three goals of the human genome project.

The main goals of Human Genome Project are as follows:

1. Identify all the genes (approximately 30000) in human DNA.
2. Determine the sequence of the three billion chemical base pairs that makeup the human DNA.
3. To store this information in databases.
4. Improve tools for data analysis.
5. Transfer related technologies to other sectors, such as industries.
6. Address the ethical, legal and social issues (ELSI) that may arise from the project.

21. In E.coli, three enzymes β - galactosidase, permease and transacetylase are produced in the presence of lactose. Explain why the enzymes are not synthesized in the absence of lactose.

1. In the absence of lactose the 'I' gene transcribes a repressor mRNA and after translation a repressor protein is produced.
2. The repressor protein binds to the operator of the operon and prevents RNA polymerase from transcribing the operon.
3. It prevents translation as a result β - galactosidase is not produced.
4. In the presence of lactose, the repressor is inactivated by interaction with the inducer.
5. This allows RNA polymerase to bind to the promoter site and transcribe the operon to produce lac mRNA.
6. It enables the formation of all the required enzymes needed for lactose metabolism.

22. Distinguish between structural gene, regulatory gene and operator gene.

Structural Gene	Regulatory gene
1. Structural gene represents an enormous variety of protein structures and functions, including structural proteins, enzymes and regulatory proteins.	1. The interaction can regulate a target gene in a manner either positive (the interaction turns the gene on) or negative (the interaction turns the gene off).

23. A low level of expression of lac operon occurs at all the time. Justify the statement.

1. A low level of lac operon occurs due to the absence of formation of permeases.
2. Due to the failure of transport of lactose into the cell, it will not act as inducer.

24. HGP is the windows for treatment of various genetic disorders. Justify the statement.

1. The Human Genome Project has made it easier to genetically map and clone mutant genes which predispose to a great many human diseases.
2. Once a gene or genes associated with disease has been cloned, it is possible to design DNA- based diagnostics to detect altered forms of the gene which predispose to disease.

25. Why the human genome project is called a mega project?

The human genome project (HGP) is called as a mega project because of the following reasons:

1. It took 13 years to complete.
2. It is the first vertebrate genome to be completed.
3. Human genome is about 25 times larger than the genome of any other organism sequenced so far.
4. Human genome is said to have approximately 3×10^9 bp.

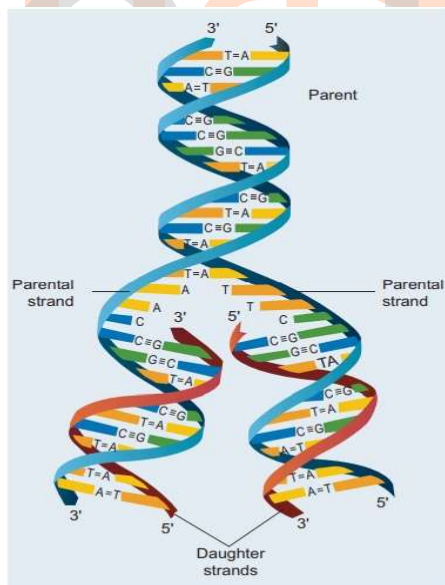
26. From their examination of the structure of DNA, What did Watson and Crick infer about the probable mechanism of DNA replication, coding capability and mutation?

Fig. 5.4 Semiconservative DNA replication

1. Watson and Crick in 1953 proposed semi-conservative mechanism of DNA model.
2. They were on the opinion that the two polynucleotide strands of DNA molecule unwind and start separating at one end.
3. The covalent hydrogen bonds are broken during this process.

4. The separated single strand DNA acts as a template for the synthesis of new strand.
5. Therefore each double helix daughter DNA carries one polynucleotide strand from the parent DNA, which acts as a template and other polynucleotide strand is newly synthesized and complementary to the parent strand.
6. Watson and Crick inferred that the DNA strands have the capacity to pass on genetic information to the RNA.
7. DNA replication → (transcription) RNA → (Translation) Protein.
8. They also inferred that nucleic acids are able to undergo sudden changes in structure, which is termed as mutation.

27. Why tRNA is called an adapter molecule? (PTA-2019-2020)

tRNA is called an adaptor molecule because of the following reasons:

1. The molecule of tRNA acts as vehicle to pick up amino acids scattered in the cytoplasm.
2. It reads specific codes of mRNA molecules.

28. What are the three structural differences between RNA and DNA?

DNA	RNA
1. Double stranded with exception of some viruses.	1. Single stranded.
2. The sugar molecule is deoxy ribose.	2. The sugar molecule is ribose.
3. Presence of thymine instead of uracil.	3. Presence of uracil instead of thymine.
4. DNA structure is more stable.	4. RNA is unstable when compared to DNA

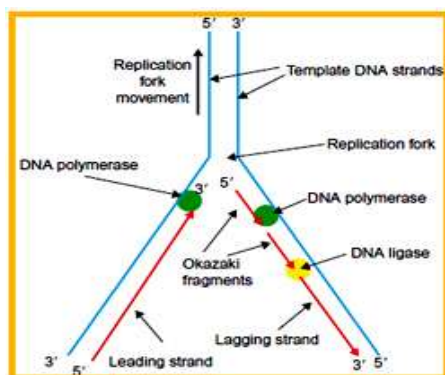
29. Name the anticodon required to recognize the following codons: AAU, CGA, UAU, and GCA.

Codon	Anticodon
1. AAU	1. UUA
2. CGA	2. GCU
3. UAU	3. AUA
4. GCA	4. CGU

30. a) Identify the figure given below:

Mechanism of DNA replication showing a replication forck.

b) Redraw the structure as a replicating fork and label the parts.



c) Write the source of energy for this replication and name the enzyme involved in this process.

Source of energy:

Deoxy nucleotide triphosphate acts as a substrate and provides energy.

Enzymes involved:

1. DNA polymerase I, II and III.
2. DNA helicase for unwinding of DNA.
3. DNA ligase to join the broken DNA fragments.

d) Mention the differences in the synthesis of protein, based on the polarity of the two template strands.

1. The mRNA base sequence is complementary to the template strand only.
2. mRNA brings the information for the formation of protein.
3. Thus the synthesis of protein is based on the sequence of the template, strand of DNA with polarity $3' \rightarrow 5'$

31. If the coding sequence in a transcription unit is written as follows:

5' TGCATGCATGCATGCATGCATGC 3' Write down the sequence of mRNA.

3' ACGUACGUACGUACGUACGUACG 5'

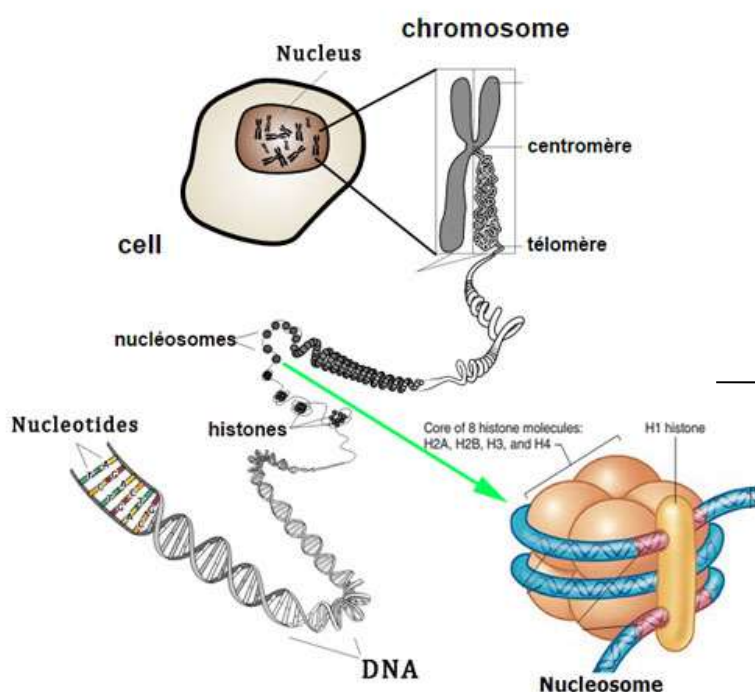
32. How is the two stage process of protein synthesis advantageous?

1. The process of copying genetic information from one strand of DNA into RNA is transcription.
2. Translation in the process of polymerization of amino acids to form polypeptide chain.
3. Protein synthesis occurs when the mRNA is translated by the ribosomes.
4. Each mRNA may encode the information for more than one protein.
5. It is done by many ribosomes binding to a single mRNA to form polysomes. Thus it can rapidly synthesize many copies of the peptide.

33. Why did Hershey and chase radioactively labeled phosphorous and sulphur only? Would they have got the same result if they use radiolabelled carbon and nitrogen?

1. Hershey and Chase Wanted to observe whether it was DNA or protein that entered the bacteria through phage T₂.
2. They designed their experiments with radioactive isotopes of sulphur (³⁵S) and phosphorous (³²P), in order to keep track of viral proteins and nucleus acids during infection process.
3. The culture medium with isotope ³⁵S or ³²P was used to culture virus and bacteria to infect.
4. When the bacteriophages were grown in the presence of isotopes (³⁵S) in the culture medium, the proteins will be labeled with ³⁵S.
5. The bacteriophage grown in presence ³²P had labeled DNA.
6. This differential labeling thus enabled them to identify DNA and proteins of the phage.
7. Hershey and Chase proved that it was DNA not the protein which carries the genetic information from virus to bacteria.
8. If they use radioactive isotopes of ¹⁴C and ¹⁵N.
9. They may not be incorporated separately in proteins and DNA of the bacteriophage and hence the purpose of their experiments may not be solved, if they would have used radioactive carbon and nitrogen instead isotopes of phosphorous and sulphur.

34. Explain the formation of a nucleosome.



1. Nucleosome is a structural unit of a eukaryotic chromosome, consisting of a length of DNA coiled around a core of histones.
2. In eukaryotes, the formation of nuceosome is much more complex.

3. Chromatin is formed by a series of repeating units of nucleosomes.
4. Kornberg proposed a model for the nucleosome.
5. Histone octamere is an unit of two molecules of the four histone proteins, H2A, H2B, H3 and H4.
6. The negatively charged DNA is wrapped around positively charged histone octamere to form a structure known as nucleosome.

35. It is established that RNA is the first genetic material. Justify giving reasons. (PTA2019-2020)

The reasons to establish that RNA is the first genetic material, are as follows:

1. A typical cell contains about ten times as much RNA as DNA.
2. The high RNA content is mainly due to the variety of roles played by RNA in the cell.
3. Fraemkel-Conrat and Singer (1957) first demonstrated to RNA is the genetic material in RNA containing viruses like TMV (Tobacco Mosaic Virus) and they separated RNA from the protein of TMV viruses.
4. Three molecular biologists in the early 1980's (Leslie Orgel, Francis Brick and Carl Woese) independently proposed the 'RNA World' as the first stage in the evolution of life, a stage when RNS catalysed all molecules necessary for survival and replication.
5. The term 'RNA World' first used by Walter Gilbert in 1986, hypothesizes RNA as the first genetic material on earth.
6. There is now enough evidence to suggest that essential life processes (Such as metabolism, Translation, splicing ect.) evolved around RNA.
7. RNA has the ability to act as both genetic material and catalyst.

❖ **Other important questions and answers:**

1. Write the main goals of Human Genome Project. (2019-2020)

1. Identify all the genes (approximately 30000) in human DNA.
2. Determine the sequence of the three billion chemical base pairs that makeup the human DNA.
3. To store this information in databases.
4. Improve tools for data analysis.
5. Transfer related technologies to other sectors, such as industries.
6. Address the ethical, legal and social issues (ELSI) that may arise from the project.

2. List out the salient features of genetic code.(2019-2020)

1. The genetic codon is a triplet code and 61 codons code for amino acids and 3 codons do not code for any amino acid and function as stop codon (Termination).
2. The genetic code is universal. It means that all known living systems use nucleic acids and the same three base codons (triplet codon) direct the synthesis of protein form amino acids.

3. For example, the mRNA (UUU) codon codes for phenylalanine in all cells of all organisms. Some exceptions are reported in prokaryotic, mitochondrial and chloroplast genomes.
4. However similarities are more common than differences.
5. A non-overlapping codon means that the same letter is not used for two different codons. For instance, the nucleotide sequence GUU GUC represents only two codons.
6. It is comma less, which means that the message would be read directly from one end to the other i.e., no punctuation are needed between two codes.
7. A degenerate code means that more than one triplet codon could code for a specific amino acid. For example: codons GUU, GUC, GUA and GUG code for valine.
8. Non-ambiguous code means that one codon will code for one amino acid.
9. The code is always read in a fixed direction from 5' → 3' direction called polarity.
10. AUG has dual functions. It acts as a initiator codon and also codes for the amino acid methionine.
11. UAA, UAG (tyrosine) and UGA (tryptophan) codons are designated as termination (stop) codons and also are known as "non_sense" codons.

3. Explain the process of transcription in eukaryotes. (2019-2020)

1. In Eukaryotes, there are at least three RNA polymerases in the nucleus (in addition to RNA polymerase found in the organelles).
2. There is a clear division of labour. The RNA polymerase I transcribes rRNAs (28s, 18s and 5.8s), whereas the RNA polymerase III is responsible for transcription of tRNA, 5s rRNA and snRNA.
3. The RNA polymerase II transcribes precursor of mRNA, the hnRNA (heterogeneous nuclear RNA).
4. In eukaryotes, the monocistronic structural genes have interrupted coding sequences known as exons (expressed sequences) and non-coding sequences called introns (intervening sequences). The introns are removed by a process called splicing.
5. hnRNA undergoes additional processing called as capping and tailing. In capping an unusual nucleotide, methyl guanosine triphosphate is added at the 5' end, whereas adenylate residues (200-300) (poly A) are added at the 3' end in tailing.
6. Thereafter, this processed hnRNA, now called mRNA is transported out of the nucleus for translation.

4. What are Operons? How many operon groups are present in E.coli? (2019-2020)

1. The cluster of gene with related functions are called operons.
2. 75 different operons.

5. Write about the methodologies of HGP. (2019-2020)

Identifying all the genes that are:

1. Expressed as RNA or expressed sequence tags ETS
2. Sequence annotation.
3. Sequence coding and non- coding sequence.
4. Sequence with functions.
5. DNA- small fragments.
6. Amplification of DNA by vector.
7. BAC (Bacterial Artificial Chromosomes), YAC (Yeast Artificial Chromosome)
8. Fragments Sequence- automated DNA sequences.
9. Genetic and physical maps on genome restriction endonucleaus microsatellites.
10. Sequencing longer fragments by shotgun sequencing.

6. Explain the transformation experiment of Avery et.al., (PTA-2019-2020)

1. Later, Oswald Avery, Colin Macleod and Maclyn McCarty in 1944 repeated Griffith's experiments in an 'in vitro' system in order to identify the nature of the transforming substance responsible for concerting a non-virulent strain into virulent strain.
2. They observed that the DNA, RNA and proteins isolated from the heat-killed S-strain when added to R-strain changed their surface character from rough to smooth and also made them pathogenic.
3. But when the extract was treated with **DNase** (an enzyme which destroys DNA) the transforming ability was lost.
4. **RNase** (an enzyme which destroys RNA) and **Proteases** (an enzyme which destroys protein) did not affect the transformation.
5. Digestion with DNase inhibited transformation suggesting that the DNA caused the transformation.
6. These experiments suggested that DNA and not proteins is the genetic material.
7. The phenomenon, by which DNA isolated from one type of cell (R-strain), when introduced into another type (S-strain), is able to retain some of the properties of the R-strain is referred to as transformation.

7. Statellite DNA forms the basis of DNA finger printing. Explain? (PTA-2019-2020)

1. DNA finger printing involves identifying differences in some specific regions in DNA sequence called repetitive DNA, because in these sequences, a small stretch of DNA is repeated many times.
2. These repetitive DNA as different peaks during density gradient centrifugation.
3. The bulk DNA forms a major peak and the other small peaks are referred to as satellite DNA.

4. Depending on base composition (A:T rich or G:C rich), length of segment and number of repetitive units, the satellite DNA is classified into many sub categories such as micro-satellites, mini-satellites, etc.,
5. These sequences do not code for any proteins, but they form a large portion of human genome.
6. These sequence show high degree of polymorphism and form the basis of DNA Fingerprinting.
7. DNA isolated from blood, hair, skin cell, or other genetic evidences left at the scene of a crime can be compared through VNTR patterns, with the DNA of a criminal suspect to determine guilt or innocence.
8. VNTR patterns are also useful in establishing the identify of a homicide victim, either from DNA founds as evidence or from the body itself.

8. What is known as ribozyme? What is its significance. (PTA-2019-2020)

1. There are several biochemical reactions in living systems that are catalysed by RNA. This catalytic RNA is known as ribozyme.
2. The ribozyme catalyses specific reactions in a similar way to that of protein enzymes.
3. Also called catalytic RNA, ribozymes are found in the ribosome where they join amino acids together to form protein chains.

9. What is known as RNA world? (PTA-2019-2020)

1. The term 'RNA World' first used by Walter Gilbert in 1986, hypothesize RNA as the first genetic material on earth.
2. There is now enough evidence to suggest that essential life processes (such as metabolism, translation, splicing etc.,) evolved around RNA.
3. RNA has the ability to act as both genetic material and catalyst.

10. HGP is useful in tracing human history. How? (PTA2019-2020)

1. The mapping of human chromosomes is possible to examine a person's DNA and to identify genetic abnormalities.
2. This is extremely useful in diagnosing diseases and to provide genetic counseling to those planning to have children.
3. This kind of information would also create possibilities for new gene therapies.
4. Besides providing clues to understand human biology, learning about non-human organisms, DNA sequences can lead to an understanding of their natural capabilities that can be applied towards solving challenges in healthcare, agriculture, energy production and environmental remediation.

5. A new era of molecular medicine, characterized by looking into the most fundamental causes of disease than treating the symptoms will be an important advantage.

11. Explain gene switch on and off mechanism in E.coli. (PTA-2019-2020)

1. Jacob and monod proposed the classical model of lac operon to explain gene expression and regulation in E.coli.
2. In lac operon, a polycistronic structural gene is regulated by a common promoter and regulatory gene.
3. When the cell is using its normal energy source as glucose, the 'i' gene transcribes a repressor mRNA and after its translation, a repressor protein is produced.
4. It binds to the operator region of the operon and prevents translation, as a result, β -galactosidase is not produced.
5. In the absence of preferred carbon source such as glucose, if lactose is available as an energy source for the bacteria then lactose enters the cell as a result of permease enzyme.
6. Lactose acts as an inducer and interacts with the repressor to inactivate it.
7. The repressor protein binds to the operator of the operon and prevents RNA polymerase from transcribing the operon.
8. In the presence of inducer, such as lactose or allolactose, the repressor is inactivated by interaction with the inducer.
9. This allows RNA polymerase to bind to the promoter site and transcribe the operon to produce lac mRNA which enables formation of all the require enzymes needed for lactose metabolism.
10. This regulation of lac operon by the repressor is an example of negative control of transcription initiation.
11. Lac operon is also under the control of positive regulation as well.

12. There are no tRNAs for stop codons why? (PTA-2019-2020)

1. During initiation, the small ribosomal subunit binds to the start of the mRNA sequence.
2. Lastly, termination occurs when the ribosome reaches a stop codon (UAA, UAG, and UGA).
3. Since there are no tRNA molecules that can recognize these codons, the ribosome recognize that translation is complete.

13. 5'-----3' direction of a nucleic acid. Write the meaning of 5' and 3' in the above statement. (PTA-2019-2020)

1. The symbol 5' refers to carbon in the sugar to which a phosphate (PO_4) functional group is attached.

2. The symbol 3' refers to carbon in the sugar to which hydroxyl (OH) functional group is attached.
3. Understanding the 5'-----3' direction of a nucleic acid is critical for understanding the aspects of replication and transcription.

14. 'RNA world' –Discuss. (PTA-2019-2020)

1. Fraenkel-Conrat and Singer (1957) first demonstrated that RNA is the genetic material in RNA containing viruses like TMV (Tobacco Mosaic Virus) and they separated RNA from the protein of TMV viruses.
2. Three molecular biologists in the early 1980's (Leslie Orgel, Francis Crick and Carl Woese) independently proposed the 'RNA World' as the first stage in the evolution of life, a stage when RNA catalysed all molecules necessary for survival and replication.
3. The term 'RNA World' first used by Walter Gilbert in 1986, hypothesizes RNA as the first genetic material on earth.
4. There is now enough evidence to suggest that essential life processes (such as metabolism, translation, splicing etc.,) evolved around RNA.
5. RNA has the ability to act as both genetic material and catalyst.
6. There are several biochemical reactions in living systems that are catalysed by RNA.
7. This catalytic RNA is known as ribozyme. But RNA being a catalyst was reactive and hence unstable.
8. This led to evolution of a more stable form of DNA, with certain chemical modifications.
9. Since DNA is a double stranded molecule having complementary stranded molecule having complementary strand, it has resisted changes by evolving a process of repair.
10. Some RNA molecules function as gene regulators by binding to DNA and affect gene expression.
11. Some viruses use RNA as the genetic material.

15. Write about the applications and future challenges of HGP. (PTA-2019-2020)

1. The mapping of human chromosomes is possible to examine a person's DNA and to identify genetic abnormalities.
2. This is extremely useful in diagnosing diseases and to provide genetic counseling to those planning to have children.
3. This kind of information would also create possibilities for new gene therapies.
4. Besides providing clues to understand human biology, learning about non-human organisms, DNA sequences can lead to an understanding of their natural capabilities that can be applied towards solving challenges in healthcare, agriculture, energy production and environmental remediation.

5. A new era of molecular medicine, characterized by looking into the most fundamental causes of disease than treating the symptoms will be an important advantage.

16. Discuss the properties of genetic material. (PTA-2019-2020)

Self Replication:

1. It should be able to replicate.
2. According to the rule of base pairing and complementarily, both nucleic acids (DNA and RNA) have the ability to direct duplications.
3. Proteins fail to fulfill this criteria.

Stability:

1. It should be stable structurally and chemically.
2. The genetic material should be stable enough not to change with different stages of life cycle, age or with change in physiology of the organisms.
3. Stability as one of property of genetic material was clearly evident in Griffith's transforming principle.
4. Heat which killed the bacteria did not destroy some of the properties of genetic material.
5. In DNA the two strands being complementary, if separated (denatured) by heating can come together (renaturation) when appropriate condition is provided.
6. Further 2' OH group present at every nucleotide in RNA is a reactive group that makes RNA liable and easily degradable.
7. RNA is also known to be catalytic and reactive.
8. Hence, DNA is chemically more stable and chemically less reactive when compared to RNA.
9. Presence of thymine instead of uracil in DNA confers additional stability to DNA.

Information storage:

1. It should be able to express itself in the form of 'Mendelian characters'.
2. RNA can directly code for protein synthesis and can easily express the characters.
3. DNA, however depends on RNA for synthesis of proteins.
4. Both DNA and RNA can act as a genetic material, but DNA being more stable store the genetic information and RNA transfers the genetic information.

Variation through mutation:

1. It should be able to mutate.
2. Both DNA and RNA are able to mutate.
3. RNA being unstable mutates at a faster rate. Thus viruses having RNA genome with shorter life span can mutate and evolve faster.
4. The above discussion indicates that both RNA and DNA can function as a genetic material.

5. DNA is more stable, and is preferred for storage of genetic information.

17. State one gene-one enzyme hypothesis. (PTA-2019-2020)

1. The experiments of George Beadle and Edward Tatum in the early 1940's on *Neurospora crassa* (the red bread mould) led them to propose one gene one enzyme hypothesis, which states that one gene controls the production of one enzyme.

18. Write about the third phase of translation in protein synthesis. (PTA-2019-2020)

1. Translation is a process by which the genetic code contained within a messenger RNA (mRNA) molecule is decoded to produce a specific sequence of amino acids in a polypeptide chain.
2. It occurs in the cytoplasm following transcription and, like transcription, has **three stages**: Initiation, elongation and termination.

19. Fingerprinting technique is inevitable in the detection of criminal in human beings. (PTA-2019-2020)

1. DNA finger printing involves identifying differences in some specific regions in DNA sequence called repetitive DNA, because in these sequences, a small stretch of DNA is repeated many times.
2. These repetitive DNA as different peaks during density gradient centrifugation.
3. The bulk DNA forms a major peak and the other small peaks are referred to as satellite DNA.
4. Depending on base composition (A:T rich or G:C rich), length of segment and number of repetitive units, the satellite DNA is classified into many sub categories such categories such as micro- satellites, mini-satellites, etc.,
5. These sequences do not code for any proteins, but they form a large portion of human genome.
6. These sequence show high degree of polymorphism and form the basis of DNA Fingerprinting.
7. DNA isolated from blood, hair, skin cell, or other genetic evidences left at the scene of a crime can be compared through VNTR patterns, with the DNA of a criminal suspect to determine guilt or innocence.
8. VNTR patterns are also useful in establishing the identify of a homicide victim, either from DNA founds as evidence or from the body itself.

❖ **Creative questions and answers:**

❖ **Two marks and three marks:**

1. Define gene.

A gene is defined as a basic physical and functional unit of heredity. And it is discrete particles that follow Mendelian rules of inheritance, occupy a definite locus in the chromosome and are responsible for the expression of specific phenotypic character.

2. Write the properties of genes.

1. Number of genes in each organism is more than the number of chromosomes. Hence several genes are located on the same chromosome.
2. The genes are arranged in a single linear order like beads on a string.
3. Each gene is arranged in a single linear order like beads on a string.
4. Gene may exist in several alternate forms called alleles.
5. Genes may undergo sudden change in positions and composition called mutations.
6. Genes are capable of self-duplication producing their own copies.

2. What is the main aim of Hershey and Chase experiment on T₂ bacteriophage?

The main objective of Hershey and Chase experiment on T₂ bacteriophage is to prove whether it was DNA or protein that acts as genetic material.

3. How is the information in DNA used?

1. DNA directs the construction of proteins.
2. Proteins determine the shapes of cells and the rate of chemical reactions, during metabolism and photosynthesis.
3. The hereditary nature of every living organism is defined by its genome that provide information to construct organism.

4. What is base pair rule?

1. Erwin Chargaff changes observed that in DNA, Adenine pairs with Thymine (A=T) with two hydrogen bonds and Guanine pairs with Cytosine (G≡C) with three hydrogen bonds.
2. The ratios between Adenine with Thymine and Guanine with Cytosine are constant and equal.
3. This base pairing gives a unique property to DNA.

5. State one gene one enzyme hypothesis.

1. The experiments of George Beadle and Edward Tatum in the early 1940's on *Neurospora crassa* (the red bread mould) led them to propose one gene-one enzyme hypothesis.

2. Which states that one gene controls the production of one enzyme. This is called one gene one enzyme hypothesis.

6. What is reverse transcription?

1. In some retroviruses that contain RNA as the genetic material (e.g. HIV), the flow of information is reversed.
2. RNA synthesizes DNA by reverse transcription, then transcribed into mRNA by transcription and then into proteins by translation. This is called reverse transcription.

7. What is open reading frame?

1. One of the alternative ways of dividing up a sequence of bases in DNA or RNA into codon is called reading frame.
2. Any sequence of DNA or RNA, beginning with a start codon and which can be translated into a protein is known as an open reading frame (ORF).

8. What is S-D sequence?

1. The 5' end of the mRNA of prokaryotes has a special sequence which precedes the initial AUG start codon of mRNA.
2. This ribosome binding site is called the shine-Dalgarno sequence or S-D sequence.

9. Distinguish replication and transcription.

Replication	Transcription
1. Replication is a process by which a DNA molecule makes as a copy of itself	1. The process of copying genetic information from one strand of DNA into RNA is called transcription.
2. It takes place during 'S' phase of cell cycle.	2. It takes place during protein synthesis.
3. It requires DNA and enzymes like DNA polymerases and Ligases.	3. It requires DNA and enzymes like RNA polymerases.

10. What are the components of a nucleotide?

Each nucleotide consists of three components namely nitrogenous base, a pentose sugar and a phosphate group.

11. Define genophore.

Genophore is defined as the DNA of prokaryotes, which is almost circular and lacks chromatin organization.

12. Explain histone octamer.

In nucleosome, 8 molecules of four histone proteins H2A, H2B, H3 and H4 are organized to form a unit of eight molecules called histone octamer.

13. Name any two enzymes involved in DNA replication.

1. DNA polymerase
2. DNA ligase.

14. Define transcription.

Transcription is a process through which copying of genetic information from one strand of DNA into RNA takes place.

15. What is a promoter unit?

The promoter region is located towards the 5' end. It is a DNA sequence in which RNA polymerase binds.

16. Define genetic code.

The genetic code is the sequence relationship nucleotide in genes (mRNA) and the amino acids in protein, they encode.

17. Define 'Non-sense' codon.

'Non-sense' codons are defined as the codons designated as termination (stop) codons.

18. Define translation.

Translation is a process in which polymerisation of amino acids to form polypeptide chain takes place.

19. What is meant by reading frame?

Reading frame is a codon which is formed by dividing up sequence of bases in DNA or RNA.

20. Mention any two enzymes involved in the metabolism of lactose in E.Coli.

1. β -galactosidase.
2. Transacetylase.

21. What is pharmacogenomics?

Pharmacogenomics is the study of genes, affecting a person's response to drugs.

22. Mention any three properties of mendelian rules of inheritance.

1. Genes are arranged in a single linear order on chromosomes.
2. A specific position called locus, where the genes occupy on the chromosome.
3. Gene may exist in several alternate forms called alleles.

23. What are genes present in lac operon? Mention their function.

The genes present in lac operon and their function include the following:

1. One inhibitor gene (i) present between promoter site (p) and operator site (o).
2. Three structural genes namely lac z, y and lac a gene are present.
3. Lac z gene codes for β galactosidase enzyme.
4. Lac y gene codes for permease enzyme.
5. Lac a gene codes for transacetylase enzyme.

24. Explain negative control of transcription initiation.

1. The repressor protein binds to the operator of the operon, preventing RNA polymerase from transcribing the operon.
2. When an inducer such as lactose is present, the repressor protein is inactivated by the interaction with inducer.
3. This allows RNA polymerase to bind to the promoter site and transcribe the operon to produce lac mRNA.
4. This enables the formation of all required enzymes for lactate metabolism.

25. Distinguish between Nucleoside and nucleotide.

Nucleoside	Nucleotide
Nucleoside is formed by a chemical linkage of nitrogenous base with one molecule of sugar at one carbon atom.	Nucleotide is formed by attaching a phosphate group to the 5' carbon of same sugar. Nucleotides are polymerized to form polynucleotides.

26. Differentiate monocistronic mRNA from polycistronic mRNA

Monocistronic mRNA	Polycistronic mRNA
1. Each mRNA carries only a single gene.	1. Cluster of related genes form operon.
2. Each mRNA encodes information for the synthesis of only a single protein.	2. They transcribed together to give a single mRNA.
3. It is present in eukaryotes.	3. They are present in prokaryotes.

27. Distinguish between promoters and operators.

Promoters	Operators
Promoters are the single sequences of DNA that initiate RNA synthesis.	Operators are present between promoters and structural genes.

28. What is transformation?

The phenomenon, by which DNA isolate from one type of cell (R-strain), when introduced into another type (S- strain), is able to retain some of the properties of the R-strain.

29. Who discovered DNA as genetic material? How did they get their final conclusion?

1. Hershey and Chase proved that DNA as genetic material. They mixed the labeled phages with unlabeled E. coli and allowed bacteriophages to attack and inject their genetic material.
2. It was observed that only ^{32}P was found associated with bacterial cells and ^{35}S was in the surrounding medium and not in the bacterial cells.
3. When phage progeny was studied it was found that it carried only ^{32}P and not ^{35}S .
4. These results indicate that only DNA and not protein coat entered the bacterial cells.
5. Hershey and Chase thus conclusively proved that it was DNA, not protein, which carries that hereditary information from virus to bacteria.

30. What are the two types of nucleic acids?

1. Deoxyribose Nucleic Acid (DNA).
2. Ribonucleic Acid (RNA).

31. What are the two kinds of nitrogenous bases.

1. **Purines:** Adenine (A) and Guanine (G).
2. **Pyrimidines:** Thymine (T), Cytosine (C) and Uracil (U). Thymine is unique for DNA, while Uracil is unique for RNA.

32. What are the significance of phosphate group in DNA and RNA?

1. It is derived from phosphoric acid (H_3PO_4), has three active OH- groups of which two are involved in strand formation.
2. The phosphate functional group (PO_4) gives DNA and RNA the property of an acid, hence the name nucleic acid.
3. The bonds that are formed from phosphates are esters.
4. The oxygen atom of the phosphate group is negatively charged after the formation of the phosphodiester bonds.
5. This ensures the retention of nucleic acid within the cell or nuclear membrane.

33. How are nucleoside and nucleotide formed?

1. The nitrogenous base is chemically linked to one molecule of sugar (at the 1-carbon of the sugar) forming a nucleoside.
2. When a phosphate group is attached to the nucleoside at 5' carbon of the same sugar, it will become a nucleotide.

34. How are the nucleotides joined in a polynucleotide chain and what is the bond formed between them?

1. The nucleotides are joined (polymerized) by condensation reaction to form a polynucleotide chain.
2. The hydroxyl group on the 3' carbon of a sugar of one nucleotide forms an ester with the phosphate of another nucleotide.
3. The chemical bonds that link the sugar components are called phosphodiester bond.

35. How is the polarity of the strand (5'-----3') maintained in DNA and RNA?

1. The ends of the DNA or RNA are designated by the symbols 5' and 3'.
2. The symbol 5' refers to carbon in the sugar to which a phosphate (PO_4) functional group is attached.
3. The symbol 3' refers to carbon in the sugar to which hydroxyl (OH) functional group is attached.

36. Mention the base pairing between the strands of the polynucleotide chain. Or State Erwin Chargaff's law.

1. Adenine pairs with Thymine ($\text{A}=\text{T}$) with two hydrogen bonds and Guanine pairs with Cytosine ($\text{G}\equiv\text{C}$) with three hydrogen bonds.
2. The ratios between Adenine with thymine and Guanine with cytosine are constant and equal.

37. What are the functions of RNA?

1. RNA is the genetic material in RNA viruses like TMV (Tobacco Mosaic Virus).
2. RNA has the ability to act as both genetic material and catalyst.
3. Some RNA molecules function as gene regulators by binding to DNA and affect gene expression.
4. RNA is an active ingredient in the chemistry of life.

38. DNA is chemically more stable and chemically less reactive when compared to RNA- Discuss.

1. In DNA the two strands being complementary, if separated (denatured) by heating can come together (renaturation) when appropriate condition is provided.
2. Presence of thymine instead of uracil in DNA confers additional stability to DNA.
3. 2' OH group present at every nucleotide in RNA is a reactive group that makes RNA liable and easily degradable.
4. RNA is also known to be catalytic and reactive.

39. How is the length of DNA double helix calculated?

The total length of the double helical DNA = total number of base pairs x distance between two consecutive base pairs.

40. If the length of E.Coli DNA is 1.36 mm calculate the number of base pairs in E.Coli.

If the length of E.Coli DNA is 1.36 mm, the number of base pairs in E.coli is 4×10^6 m ($1.36 \times 10^3 \text{ m} / 0.34 \times 10^{-9}$)

41. What is genophore?

It is the DNA of prokaryotes which is almost circular and lacks chromatin organization.

42. Write the structure of the nucleosome.

1. In a typical nucleus, some regions of chromatin are loosely packed and are referred to as euchromatin.
2. The Chromatin that is tightly packed is called heterochromatin.
3. Euchromatin is transcriptionally active and heterochromatin is transcriptionally inactive.
4. The negatively charged DNA is wrapped around the positively charged histone octamer to form a structure called nucleosome.

43. Name the three hypotheses of DNA replication.

1. Conservation replication,
2. Dispersive replication.
3. Semi-conservative replication.

44. Distinguish conservative replication and dispersive replication.

Conservative replication	Dispersive replication
1. The original double helix serves as a template.	1. The original molecule is broken into fragments and each fragment serves as a template for the synthesis of complementary fragments.
2. It is preserved intact and an entirely new double stranded molecule is synthesized.	2. Finally two new molecules are formed which consist of both old and new fragments.

45. What are okazaki fragments?

1. The discontinuously synthesized fragments of the lagging strand.
2. They are joined by the enzymes DNA ligase.

46. Mention the enzymes and their functions involved in DNA replication.

Enzymes	Functions
1. DNA helicase	Unwinding of the DNA strand.
2. Topoisomerase	Pull apart the strands forming a replication fork.
3. DNA polymerase	Add nucleotides to the new strand in 5'-----3' direction.
4. DNA ligase	Gaps are sealed.

47. What is called Messenger RNA (mRNA)?

The RNA that carries genetic information encoding a protein from genes into the cell.

48. What are called TATA box and pribnow box?

In eukaryotes the promoter has AT rich regions called TATA box (Goldberg Hogness box) and in prokaryotes this region is called pribnow box.

49. List out the three regions of a transcriptional unit. Write the role of them.

Promoter: It is located towards the 5' end. It is a DNA sequence that provides binding site for RNA polymerase.

Structural gene: It defines the template and coding strands.

The terminator region: Located towards the 3' causes the RNA polymerase to stop transcribing.

50. Distinguish between monocistronic and poly cistronic gene.

Monocistronic mRNA	Polycistronic mRNA
In eukaryotes, each mRNA carries only a single gene and encodes information for only a single protein.	In prokaryotes clusters of related genes, are transcribed together to give a single mRNA.

51. What are the two major components of RNA polymerase? Mention their functions?

The core enzymes and the sigma subunit.

1. **The core enzyme:** (β_1 , β , and α) is responsible for RNA synthesis.
2. **Sigma subunit** is responsible for recognition of the promoter.

52. Mention the main role of the three types of RNA's?

mRNA, tRNA, and rRNA. They are needed to synthesize a protein in a cell.

1. The mRNA provides the template,
2. tRNA brings amino acids and reads the genetic code.
3. rRNAs play structural and catalytic role during translation.

53. How are the RNA polymerases able to catalyse the three steps initiation, elongation and termination.

1. The RNA polymerase is only capable of catalyzing the process of elongation.
2. It associates transiently with initiation factor sigma (σ) and termination factor rho (ρ) to initiate and terminate the transcription, respectively.

53. In bacteria the translation can begin much before the mRNA is fully transcribed- Discuss.

This is because the genetic material is not separated from other cell organelles by a nuclear membrane.

Transcription and translation can be coupled in bacteria.

54. What are the functions of three RNA polymerases in the nucleus?

1. The RNA polymerase I transcribes rRNA s (28s, 18s and 5.8s).
2. The RNA polymerase II transcribes precursor of mRNA, the hnRNA (heterogenous nuclear RNA).
3. The RNA polymerase III is responsible for transcription of tRNA, 5srRNA and snRNAs.

55. What are Exons and Introns?

Exons: The coding sequences of structural genes (expressed sequences).

Introns: The non-coding sequences of gene (intervening sequences).

56. What is happened in capping and tailing in hnRNA?

In capping an unusual nucleotide, methyl guanosine triphosphate, is added at the 5' end, whereas adenylate residue (200-300) (Poly A) are added at the 3' end in tailing this processed hnRNA is, now called mRNA and transported out of the nucleus for translation.

57. What is the role of HGT in evolution of life on earth?**Horizontal Gene Transfer:**

1. Introns are mobile DNA sequences that can splice themselves out of, as well as into, specific target sites acting like mobile transposon like elements that mediate transfer of genes between organisms.
2. HGT occurs between lineages of prokaryotic cells or from prokaryotic.
3. Thus it played a major role in the evolution of life on earth.

58. What is non- overlapping codon?

1. It means that the same letter is not used for two different codons.
2. For instance, the nucleotide sequence GUU GUC represents only two codons.

59. What is base substitution mutation? Give example.

A change in nucleotide that substitutes one base for another.

Example:

Sickle cell anemia it is due to abnormal haemoglobin.

1. This abnormality is due to a single base substitution at the sixth codon of the beta globin gene from GAG to GTG.
2. It results in a change of amino acid glutamic acid to valine at the 6th position of the β -chain.
3. The mutant haemoglobin undergoes changes in the shape of the RBC from biconcave to a sickle shaped structure.

58. What is Open Reading Frame (ORF)?

Any sequence of DNA or RNA, beginning with a start codon can be translated into a protein.

59. Which is called cellular factory of protein synthesis? Write its structure.

The cellular factory responsible for synthesizing protein is the ribosome.

1. It consists of structural RNAs and about 80 different proteins.
2. In inactive state, it exists as two subunits large subunit and small subunit.

60. Differentiate between mRNA and tRNA.

mRNA	tRNA
1. It is called messenger RNA and carries the codes for amino acid sequence.	1. It is called transfer RNA as it carries amino acids to the site of protein synthesis.
2. It is a long chain of bases with large molecular weight (25- 200000 Dalton)	2. It is clover- leaf like structure with small molecular weight (25000 Dalton)
3. It is synthesized by RNA polymerase-II	3. Synthesized by RNA polymerase-III

61. Differentiate 70s and 80s ribosome.

70s ribosome	80s ribosome
1. Prokaryotic ribosome.	1. Eukaryotic ribosome.
2. It consists of larger subunit (50s) and smaller subunit (30s)	2. It consists of 60s and 40 s sub units.
3. The 30s subunit consist of 16sr RNA and 50s subunit contains 5s RNA molecules and 23s RNA and 31 ribosomal proteins.	3. The 40s subunit consists of 18s RNA component and 33 proteins. The 60s, subunit consist of a 23s RNA and 5s RNA molecule and 31 ribosomal proteins.

61. Which is called the start codon? Write its role in initiation.

1. AUG is the start codon.
2. It begins the coding sequence and is read by a special tRNA that carries methionine (met).
3. The initiator tRNA charged with methionine binds to the AUG start codon.
4. In prokaryotes, N-formyl methionine (f^{met}) is attached to the initiator tRNA.

62. What are untranslated Regions (UTR)?

Some additional sequences of mRNA that are not translated.

63. What is called shine-Dalgarno sequence or S-D sequence?

1. In prokaryotes the 5' end of the mRNA has a special sequence which precedes the initial AUG start codon of mRNA.
2. This sequences base- pairs with a region of the 16s RNA of the small ribosomal subunit facilitating initiation.
3. This ribosome binding site is called the shine Dalgarno sequence or S-D sequence.

64. What is the role of peptidyl transferase?

Once the charged tRNA molecule is positioned at the A site, the enzyme peptidyl transferase catalyses the formation of peptide bonds that link the two amino acids together.

65. How does termination of translation occur?

1. Termination occurs when one of the three stop codons (UAA, UAG, UGA) appears in the 'A' site of the ribosome.
2. The terminal codon signals the action of GTP-dependent release factor, It cleaves the polypeptide chain from the terminal tRNA.
3. The translational complex is released from it.
4. The tRNA is then released from the ribosome then tRNA dissociates into its subunits.

66. Define operon.

It is a unit of gene expression and regulation it consists of one or more structural genes and an adjacent operator gene that control transcriptional activity of the structural gene.

67. Mention the functions of the three enzymes involved in Metabolism of lactose in E.coli.

1. The enzyme permease is needed for entry of lactose into the cell.
2. β -galactosidase brings about hydrolysis of lactose to glucose and galactose.
3. Transacetylase transfers acetyl group from acetyl CoA to β -galactosidase.

68. What are the components of the lac operon?

1. It consists of one regulator gene ('i' gene refers to inhibitor) promoter sites (p), operator site (o) and three structural genes namely lac z, y and lac a.
2. The lac 'z' gene codes for β -galactosidase, lac 'y' gene codes for permease and 'a' gene codes for transacetylase.

69. What is satellite DNA? Mention the types of it.

1. It is a region that consists of short DNA sequences repeated many times.
2. The variation between individuals in the lengths of their DNA satellites forms the basis of DNA fingerprinting.
3. They are two types
 - i) Micro satellites.
 - ii) Mini satellites.

70. What is the role of satellite DNA?

1. These sequences do not code for any proteins, but they form a large portion of human genome.
2. These sequences show high degree of polymorphism and form the basis of DNA fingerprinting.

71. List the two methodologies which are involved in HGP. Mention how they are used?

Expressed sequence tags (ESTs):

Identifying all the genes that are expressed as RNA.

Sequence annotation:

1. Sequencing the whole set of genome that contains all the coding and non- coding sequences.
2. Assigning different regions in the sequence with functions.

Five marks:

1. Write the applications of DNA finger printing.**1. Forensic analysis:**

It can be used in the identification of a person involved in criminal activities, for settling paternity or maternity disputes, and in determining relationships for immigration purposes.

2. Pedigree analysis:

Inheritance pattern of genes through generations and for detecting inherited diseases.

3. Conservation of wild life:

Protection of endangered species. By maintaining DNA records for identification of tissues of the dead endangered organisms.

4. Anthropological studies:

It is useful in determining the origin and migration of human populations and genetic diversities.

2. List the salient features of classical concept of gene.

According to the classical concept of gene introduced by Sutton in 1902, genes have been defined as discrete particles that follow Mendelian rules of inheritance, occupy a definite locus in the chromosome and are responsible for the expression of specific phenotypic character.

They show the following properties:

1. Number of genes in each organism is more than the number of chromosome: hence several genes are located on the same chromosome.
2. The genes are arranged in a single linear order like beads on a string.
3. Each gene occupies a specific position called locus.
4. Genes may exist in several alternate forms called alleles.
5. Genes may undergo sudden change in positions and composition called mutations.
6. Genes are capable of self-duplication producing their own copies.

3. List the salient features of genetic code.

1. The genetic codon is a triplet code and 61 codons code for amino acids and 3 codons do not code for any amino acid and function as stop codon (Termination).
2. The genetic code is universal. It means that all known living systems use nucleic acids and the same three base codons (triplet codon) direct the synthesis of protein from amino acids. Some exceptions are reported in prokaryotic, mitochondrial and chloroplast genomes. However similarities are more common than differences.
3. A non- overlapping codon means that the same latter is not used for two different codons. For instance, the nucleotide sequence GUU GUC represents only two codons.
4. It is comma less, which means that the message would be read directly from one end to the other i.e., no punctuation are needed between two codes.
5. A degenerate code means that more than one triplet codon could code for a specific amino acid. For example: codons GUU, GUC, GUA and GUG code for valine.
6. Non- ambiguous code means that one codon will code for one amino acid.
7. The code is always read in a fixed direction i.e. from 5'→3' direction called polarity.
8. AUG has dual function. It acts as initiator codon and also codes for the amino acid methionine.

4. Describe the structure of tRNA with a diagram.

1. The transfer RNA, (tRNA) molecule of a cell acts as a vehicle that picks up the amino acids scattered through the cytoplasm and also reads specific codes of mRNA molecules. Hence it is called an adapter molecule. This term was postulated by Francis Crick.
2. The two dimensional clover leaf model of tRNA was proposed by Robert Holley.
3. The secondary structure of tRNA depicted in looks like a clover leaf.
4. In actual structure, the tRNA is a compact molecule which looks like an inverted L.
5. The clover leaf model of tRNA shows the presence of three arms namely DHU arm, middle arm and T ψ C arm.
6. These arms have loops such as amino acyl binding loop, anticodon loop and ribosomal binding loop at their ends.
7. In addition it also shows a small lump called variable loop or extra arm.
8. The amino acid is attaché to one end (amino acid acceptor end) and the other end consists of three anticodon nucleotides.

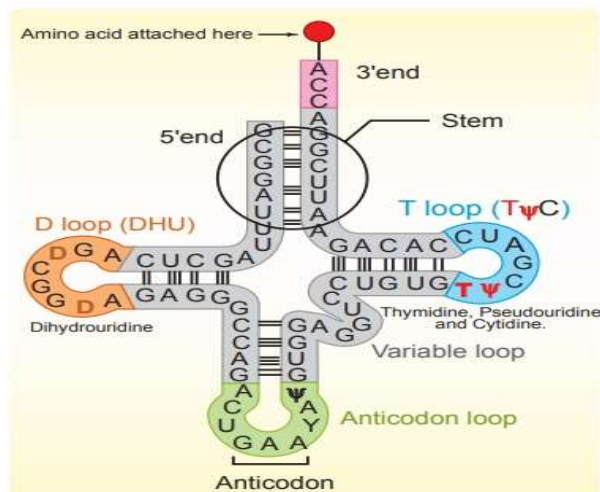


Fig. 5.11 Holley's two-dimensional clover leaf model of transfer RNA

9. The anticodon pairs with a codon in mRNA ensuring that the correct amino acid is incorporated into the growing polypeptide chain.
10. Four different regions of double-stranded RNA are formed during the folding process. Modified bases are especially common in tRNA.
11. Wobbling between anticodon and codon allows some tRNA molecule to read more than one codon.

5. Describe the steps involved in DNA fingerprinting.

1. Extraction of DNA:

The process of DNA fingerprinting starts with obtaining a sample of DNA from blood, semen, vaginal fluids, hair roots, teeth, bones, etc.,

2. Polymerase chain reaction (PCR):

In many situations, there is only a small amount of DNA available for DNA fingerprinting. If needed many copies of the DNA can be produced by PCR (DNA amplification).

3. Fragmenting DNA:

DNA is treated with restriction enzymes which cut the DNA into smaller fragments at specific sites.

4. Separation of DNA by electrophoresis:

During electrophoresis in an agarose gel, the DNA fragments are separated into bands of different sizes. The bands of separated DNA are sieved out of the gel using a nylon membrane (treated with chemicals that allow for it to break the hydrogen bonds of DNA so there are single strands).

5. Denaturing DNA:

The DNA on gels is denatured by using alkaline chemicals or by heating.

6. Blotting:

The DNA band pattern in the gel is transferred to a thin nylon membrane placed over the 'size fractionated DNA strand' by southern blotting.

7. Using probes to identify specific DNA:

A radioactive probe (DNA labeled with a radioactive substance) is added to the DNA bands. The probe attaches by base pairing to those restriction fragments that are complementary to its sequence. The probes can also be prepared by using either 'fluorescent substance' or 'radioactive isotopes'.

8. Hybridization with probe:

After the probe hybridizes and the excess probe washed off, a photographic film is placed on the membrane containing 'DNA hybrids'.

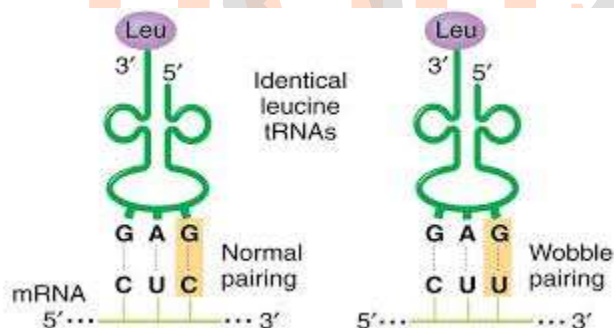
9. Exposure on film to make a generic/ DNA Fingerprint:

The radioactive label exposes the film to form an image (image of bands) corresponding to specific DNA bands. The thick and thin dark bands from a pattern of bars which constitutes a genetic fingerprint.

6. Explain wobble hypothesis with an example.

Crick in 1966 proposed this hypothesis, which states:

1. tRNA anticodon has the ability to wobble at its 5' and by pairing with even non-complementary base of mRNA codon.
2. In anticodon pairing the third base may not be complementary.

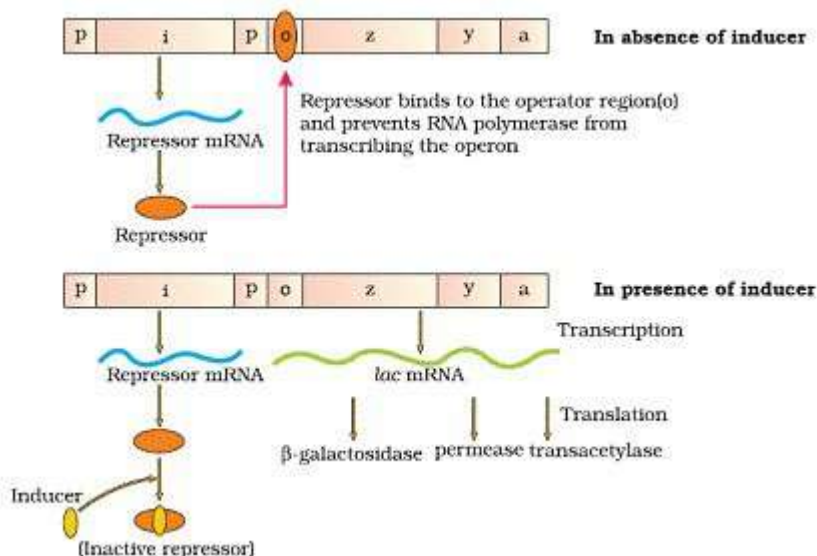


3. The third base of the codon is called wobble base and the position is known as wobble position.
4. At the first two position actual base pairing occurs.
5. According to this hypothesis, it reduces the number of tRNAs required for the synthesis of polypeptide.
6. It also overcomes effect of code degeneracy.

Example:

In this example, the codons and anticodons do not match perfectly. Yet, the required amino acid is produced perfectly. This helps the economy of tRNA GUU, GUC, GUA and GUG code for valine amino acid.

7. Explain the structure of Lac operon.



1. Jacob and Monod proposed the classical model of lac operon to explain gene expression and regulation in *E. coli*.
2. The metabolism of lactose in *E. coli* requires three enzymes permease, β -galactosidase (β -gal) and transacetylase.
3. The enzyme permease is needed for entry of lactose into the cell, β -galactosidase brings about hydrolysis of lactose to glucose and galactose, while transacetylase transfers acetyl group from acetyl CoA to β -galactosidase.
4. The lac operon consists of one regulator gene ('i' gene refers to inhibitor) promoter sites (P), and operator site (o).
5. Besides these, it has three structural genes namely lac z, y and lac a. the lac 'z' gene codes for β -galactosidase, lac 'y' gene codes for permease and 'a' gene codes for transacetylase.

8. Mention any five salient features of human genome project.

1. The human genome contains 3 billion nucleotide bases.
2. An average gene consists of 3000 bases, the largest known human gene being dystrophin with 2.4 million bases.
3. Genes are distributed over 24 chromosomes. Chromosome 13 and Y chromosome have lowest gene densities.
4. The chromosomal organization of human genes shows diversity.
5. There may be 35000-40000 genes in the genome and almost 99.9 nucleotide bases are exactly the same in all people.
6. Functions for over 50 percent of the discovered genes are unknown.
7. Less than 2 percent of the genome codes for proteins.

8. Repeated sequences make up very large portion of the human genome. Repetitive sequences have no direct coding functions but they shed light on chromosome structure, dynamics and evolution (genetic diversity).
9. Chromosome 1 has 2968 genes whereas chromosome 'Y' has 231 genes.
10. Scientists have identified about 1.4 million locations where single base DNA differences (SNPs- Single nucleotide polymorphism- pronounce as 'snips') occur in humans. Identification of 'SNIPS' is helpful in finding chromosomal locations for disease associated sequences and tracing human history.

Padasalai

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Bio-Zoology

Unit-II

Chapter: 6 Evolution

❖ Textbook questions and answers:

1. The first life on earth originated in **water**.
2. Who published the book "Origin of species by Natural Selection" in 1859? **Charles Darwin**.
3. Which of the following was the contribution of Hugo de vries? **Theory of mutation**.
4. The wings of birds and butterflies example of **convergent evolution**.
5. The phenomenon of "Industrial Melanism" demonstrates **Natural selection**.
6. Darwin's finches are an excellent example of **adaptive radiation**.
7. Who proposed the Germplasm theory? **August Weismann**.
8. The age of fossils can be determined by carbon **dating**.
9. Fossils are generally found in **sedimentary rocks**.
10. Evolutionary history of an organism is called **Sedimentary rocks**.
11. The golden age of reptiles was **Mesozoic era**.
12. Which period was called 'Age of fishes'? **Devonian**.
13. Modern man belongs to which period? **Quaternary**.
14. The Neanderthal man had the brain capacity of **1400cc**.
15. According to Darwin, the organic evolution is due to **interspecific competition**.
16. A population will not exist in Hardy Weinberg equilibrium if **individuals mate selectively**.
17. **List out the major gases seems to be found in the primitive earth.**
 - 1) The primitive earth had no proper atmosphere, but consisted of ammonia, methane, hydrogen and water vapour.
 - 2) Hydrogen and oxygen were formed by splitting of water molecules by UV rays.
 - 3) Ammonia and Methane in the atmosphere combined with oxygen to form carbon dioxide and other gases.

18. Explain the three major categories in which fossilization occur?

Fossilization is the process by which plant and animal remains are preserved in sedimentary Rocks. They fall under three main categories.

Actual remains:



→ This picture is only for your understating

- 1) The original hard parts such as bones, teeth or shells are preserved as such in the earth's atmosphere. This is the most common method of fossilization.

- 2) When marine animals die, their hard parts such as bone, shells, etc., are covered with sediments and are protected from further deterioration.
- 3) They get preserved as such as they are preserved in vast ocean; the salinity in them prevents decay.
- 4) The sediments become hardened to form definite layers or strata. For example: Woolly mammoth that lived 22 thousand years ago were preserved in the frozen coast of Siberia.
- 5) Several human beings and animal living in the ancient city of Pompeii were preserved intact by volcanic ash which gushed out from mount Vesuvius.

Petrifaction:



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- 1) When animals died the original portion of their body may be replaced molecule for molecule by minerals and the original substance beings lost through disintegration. This method of fossilization is called petrification.
- 2) The principle minerals involved in this type fossilization are iron pyrites, silica, calcium carbonate and bicarbonates of calcium and magnesium.

Natural moulds and casts:



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- 1) Even after disintegration, the body of an animal might leave indelible impression on the soft mud which later becomes hardened into stones. Such impressions are called moulds.
- 2) The cavities of the moulds may get filled up by hard minerals and get fossilized, which are called casts.

- 3) Hardened faecal matter termed as coprolites occur as tiny pellets. Analysis of the coprolites enables us to understand the nature of diet the pre-historic animals thrived on.

19. Differentiate between divergent evolution and convergent evolution with one example for each. (2019-2020)

SL.NO	Divergent evolution	Convergent evolution
1	Structures which are similar in origin but perform different functions are called homologous structure. Example: For limbs of terrestrial vertebrates bird, bat, whale, horse and human	Organism having different structural patterns but similar function is termed as analogous structure. Example: Wings of bird and insects (Butterfly, dragonfly).
2	The forelimbs of these organisms perform different functions and have similar anatomical structures such as humerus, radius, ulna, carpals, metacarpals and phalanges.	The structures of these animals are not anatomically similar though they perform similar functions.
3	In these animals same structures develop along different directions due to adaptations to different needs. This is referred to as divergent evolution.	The analogous structures are developed due to convergent evolution different structures evolving for the same function.

20. How does Hardy- Weinberg's expression ($p^2+2pq+q^2$) explain that genetic equilibrium is maintained in a population? List any four factors that can disturb the genetic equilibrium.

- 1) Hardy of UK and Weinberg of Germany stated that the allele frequencies in a population are stable and are constant from generation to generation in the absence of gene flow, genetic drift, mutation, recombination and natural selection.
- 2) If a population is in a state of Hardy Weinberg equilibrium, the frequencies of alleles and genotypes or sets of alleles in that population will remain same over generation.
- 3) Evolution is a change in the allele frequencies in a population over time. Hence population in Hardy Weinberg is not evolving.
- 4) Suppose we have a large population of beetles, (infinitely large) and appear in two colours dark grey (black) and light grey, and their colour is determined by 'A' gene.
- 5) 'AA' and 'Aa' beetles are dark grey and 'aa' beetles are light grey.
- 6) In a population let's say that 'A' allele has frequency (p) of 0.3 and 'a' allele has a frequency (q) of 0.7. Then $p+q=1$.
- 7) If a population is in Hardy Weinberg equilibrium, the genotype frequency can be estimated by Hardy Weinberg equation.

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

P^2 = frequency of AA

$2pq$ = frequency of Aa

q^2 = frequency of aa
 $p = 0.3$, $q = 0.7$ then,
 $p^2 = (0.3)^2 = 0.09 = 9\% AA$
 $2pq = 2(0.3)(0.7) = 0.42 = 42\% Aa$
 $q^2 = (0.7)^2 = 0.49 = 49\% aa$.

- 8) Hence the beetle population appears to be in Hardy Weinberg equilibrium reproduces, the allele and genotype frequency in the next generation would be: Let's assume that the frequency of 'A' and 'a' allele in the pool of gametes that makes the next generation would be the same, than there would be no variation in the progeny.
- 9) The genotype frequencies of the parent appear in the next generation. (9%AA, 42%Aa and 49%aa)
- 10) If we assume that the beetles mate randomly (selection of male gamete and female gamete in the pool of gametes), the probability of getting the offspring genotype depends on the genotype of the combining parental gametes.

21. Explain how mutations, natural selection and genetic drift affect Hardy Weinberg equilibrium.

- 1) Hardy Weinberg equilibrium in a population is stable from generation to generation in the absence of mutation, genetic drift, recombination and natural selection.
- 2) Mutation is an important factor to alter Hardy- Weinberg equilibrium because new alleles are generated by mutation in a population due to duplication or deletion of chromosomes.
- 3) Genetic drift can also alter the equilibrium because of gene flow from the population due to movement of individuals from the population.
- 4) Natural selection does not produce any genetic variation, such variations if occur in a population, it favors some genetic changes while rejecting other. The may alter the Hardy-Weinberg equilibrium.

22. How did Darwin explain fitness of organisms?

Charles Darwin proved that fittest organisms can survive and leave more progenies than the unfit ones through natural selection. Darwin's theory was based on several facts, observations and influences.

Over production (or) prodigality of production:

All living organisms increase their population in larger number.

Example: Salmon fish produces about 28 million eggs during breeding season and if all of them hatch.



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Struggle for existence:

Organisms struggle for food, space and mate. As these become a limiting factor, competition exists among the members of the population.

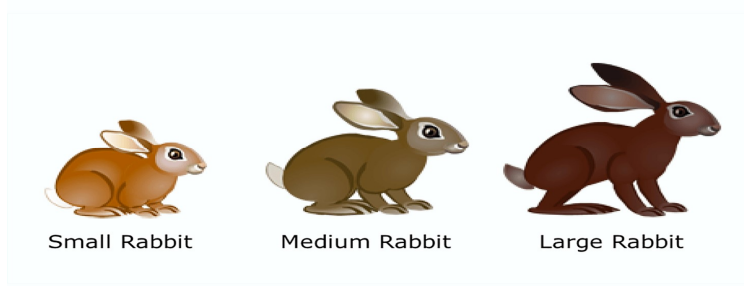


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Darwin denoted struggle for existence in three ways:

- 1) Intra specific struggle between the same species for food, space and mate.
- 2) Inter specific struggle with different species for food and space.
- 3) Struggle with the environment to cope with the climatic variations, flood, earthquakes, drought, etc.,

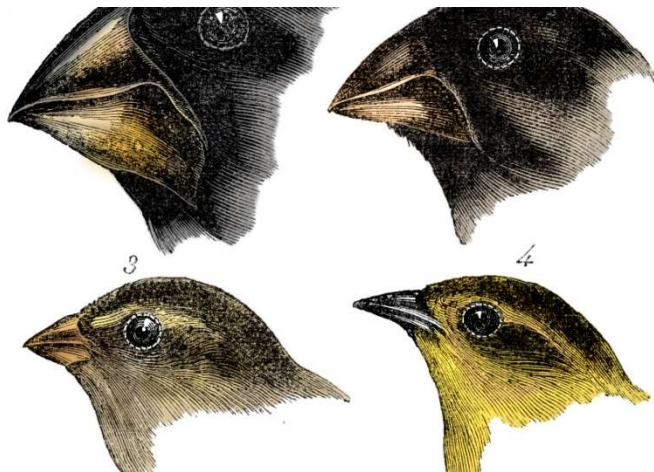
Universal occurrence of variations:



This picture is your understanding

No two individuals are alike. There are variations even in identical twins. Even the children born of the same parents differ in colour, height, behavior, etc., The useful variations found in an organism help them to overcome struggle and such variations are passed on to the next generation.

Origin of species by Natural Selection:



→ This is only for your understanding

According to Darwin, nature is the most powerful selective force. He compared origin of species by natural selection to a small isolated group. Darwin believed that the struggle for existence resulted in the survival of the fittest. Such organisms become better adapted to the changed environment.

23. Mention the main objections to Darwinism.

1. Darwin failed to explain the mechanism of variation.
2. Darwinism explains the survival of the fittest but not the arrival of the fittest.
3. He focused on small fluctuating variations that are mostly non- heritable.
4. He did not distinguish between somatic and germinal variations.
5. He could not explain the occurrence of vestigial organs, over specialization of some organs like large tusks in extinct mammoths, oversized antlers in the extinct Irish deer, etc.,

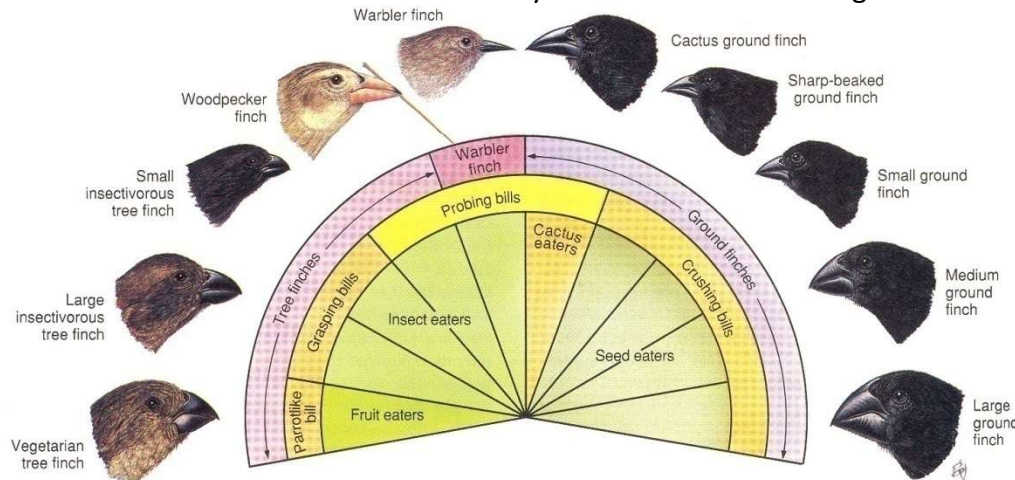
24. Taking the example of peppered moth, explain the action of natural selection. What do you call the above phenomenon? (PTA-2019-2020)

1. Natural selection can be explained clearly through industrial melanism is a classical case of Natural selection exhibited by the peppered moth, *Biston betularia*.
2. These were available in two colours, white and black. Before industrialization peppered moth both white and black coloured were common in England.
3. Pre-industrialization witnessed white coloured background of the wall of the buildings hence the white coloured moths escaped from their predators.
4. Post industrialization, the tree trunks became dark due to smoke and soot let out from the industries.
5. The black moths camouflaged on the dark bark of the trees and the white moths were easily identified by their predators.
6. Hence the dark coloured moth population was selected and their number increase when compared to the white moths.
7. Nature offered positive selection pressure to the black coloured moths.

8. The above proof shows that in a population, organisms that can adapt will survive and produce more progenies resulting in increase in population through natural selection.

25. Darwin's finches and Australian marsupials are suitable example of adaptive radiation justify the statement.

Darwin's finches and Australian marsupials are best examples for adaptive radiation. When more than one adaptive radiation occurs in an isolated geographical area, having the same structural and functional similarity is referred to as convergent evolution.



1. Their common ancestor arrived on the Galapagos about 2 million years ago. During that time, Darwin's finches have evolved into 14 recognized species differing in body size, beak shape and feeding behavior.
2. Changes in the size and form of the beak have enabled different species to utilize different food resources such as insects, seeds, nectar from cactus flowers and blood from iguanas, all driven by Natural selection represents some of the finches observed by Darwin.
3. Genetic variation in the ALX1 gene in the DNA of Darwin finches is associated with variation in the beak shape.
4. Mild mutation in the ALX1 gene leads to phenotypic change in the shape of the beak of the Darwin finches

26. Who disproved Lamarck's Theory of acquired characters? How?

The theory of inheritance of acquired character:

1. Characters that are developed during the life time of an organism are called acquired characters and these are than inherited.
2. Lamarck's "Theory of Acquired characters" was disproved by August Weismann who conducted experiments on mice for twenty generations by cutting their tails and breeding them.

3. All mice born were with tail. Weismann proved his germplasm theory that change in the somatoplasm will not be transferred to the next generation but changes in the germplasm will be inherited.

27. How does mutation theory of De Vries differ from Lamarck and Darwin's view in the origin of new species?

1. According to de Vries, sudden and large variations were responsible for the origin of new species whereas Lamarck and Darwin believed in gradual accumulation of all variations as the causative factors in the origin of new species.
2. Hugo de Vries believed that Mutations are random and directionless, but Darwinian variations are small and directional.

28. Explain stabilizing, directional and disruptive selection with examples.

1. Stabilising Selection (centripetal selection):

- 1) This type of selection operated in a stable environment.
- 2) The organisms with average phenotypes survive whereas the extreme individuals from both the ends are eliminated.
- 3) There is no speciation but the phenotypic stability is maintained within the population over generation.

Example:

Measurements of sparrows that survived the storm clustered around the mean, and the sparrows that failed to survive the storm clustered around the extremes of the variation showing stabilizing selection.

2. Directional selection:

- 1) The environment which undergoes gradual change is subjected to directional selection.
- 2) This type of selection removes the individuals from one end towards the other end of phenotypic distribution.

Example:

Size differences between male and female sparrows. Both male and female look alike externally but differ in body weight. Female show directional selection in relation to body weight.

3. Disruptive Selection (centrifugal selection):

- 1) When homogenous environment changes into heterogenous environment this type of selection is operational.
- 2) The organisms of both the extreme phenotypes are selected whereas individuals with average phenotype are eliminated. This results in splitting of the population into sub population/ species.
- 3) This is a rare form of selection but leads to formation of two or more different species. It is also called adaptive radiation.

Example:

Darwin's finches beak size in relation to seed size inhabiting Galapagos islands.

29. Rearrange the descent in human evolution.

Australopithecus → *Homo erectus* → *Homo sapiens* → *Ramapithecus* → *Homo habilis*.

Answer:

Ramapithecus → *Australopithecus* → *Homo habilis* → *Homo erectus* → *Homo sapiens*.

30. How does Neanderthal man differ from the modern man in appearance?

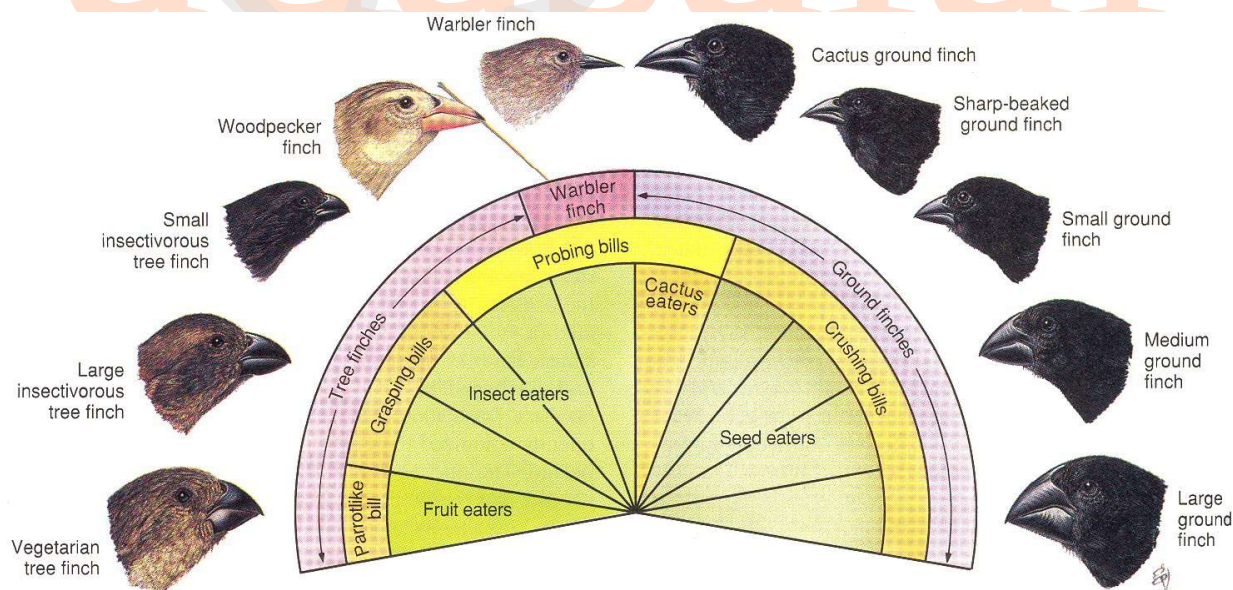
They differ from the modern human in having semierect posture, flat cranium, sloping forehead, thin large orbits, heavy brow ridges, protruding jaws and no chin. They used animal hides to protect their bodies, knew the use of fire and buried their dead. They did not practice agriculture and animal domestication.

Other importance question and answer:

1. Darwin's finches and Australian marsupials are suitable examples of adaptive radiation- Justify this statement. (2019-2020)

The evolutionary process which produces new species diverged from a single ancestral form becomes adapted to newly invaded habitats is called adaptive radiation. Adaptive radiations are best exemplified in closely related groups that have evolved in relatively short time. Darwin's finches and Australian marsupials are best examples for adaptive radiation.

Darwin's finches:



- 1) Their common ancestor arrived on the Galapagos about 2 million years ago. During that time, Darwin's finches have evolved into 14 recognized species differing in body size, beak shape and feeding behavior.

- 2) Changes in the size and form of the beak have enabled different species to utilize different food resources such as insects, seeds, nectar from cactus flowers and blood from iguanas, all driven by Natural selection represents some of the finches observed by Darwin.
- 3) Genetic variation in the ALX1 gene in the DNA of Darwin finches is associated with variation in the beak shape.
- 4) Mild mutation in the ALX1 gene leads to phenotypic change in the shape of the beak of the Darwin finches
- 5) Australian Marsupials:
- 6) Marsupials in Australia and placental mammals in North America are two subclasses of mammals they have adapted in similar way to a particular food resource, locomotory skill or climate.
- 7) They were separated from the common ancestor more than 100 millions year ago and each lineage continued to evolve independently.
- 8) Despite temporal and geographical separation, marsupials in Australia and placental mammals in North America have produced varieties of species living in similar habitats with similar ways of life.
- 9) Their overall resemblance in shape, locomotory mode, feeding and foraging are superimposed upon different modes of reproduction.
- 10) This feature reflects their distinctive evolutionary relationships.
- 11) The marsupials have undergone adaptive radiation to occupy the diverse habitats in Australia, just as the placental mammals have radiated across North America.

2. Explain the evolutionary path of man. (2019-2020)

1. 210 million years ago- mammals evolved.
2. Hominids evolution occurred in Asia and Africa.
3. 14 mya ago-Dryopithecus 1) Ramapithecus 2) Sivapithecus.
4. 5mya ago- Australopithecus- Australian ape man.
5. 2mya ago- Homohabilis.
6. 1.7 mya ago- human in looks- Homo erectus.
7. Homo ergaster and Homo erectus- first leave to Africa.
8. 34,000-1,00,000 years ago – Neanderthal human.
9. Cro-Magnon- ancestor of modern Europeans adapted various environmental condition cave paintings.
10. 25000 years ago- Homo sapiens cultivating crops and domesticating animals.

3. State the theory of chemical evolution. (PTA-2019-2020)

A third theory of life's origin is known as chemical evolution. In this idea, pre biological changes slowly transform simple atoms and molecules into the more complex chemicals needed to produce life. This modern theory then suggests that life originated on Earth by means of a rather slow evolution of nonliving matter.

4. What is the evolutionary significance of Archaeopteryx? (PTA-2019-2020)

- 1) Archaeopteryx (Archea: old, pteris: feather/ wing) is considered as the common ancestors of all birds.
- 2) This organism existed about 150 million years ago and its fossils are the proof that Aves have originated from Reptiles.
- 3) It forms an important link between two classes in the phylum chordate.

5. Differentiate relative dating from absolute dating. (PTA-2019-2020)

Relative dating	Absolute dating
Relative dating is used to determine a fossil by comparing it to similar rocks and fossils of known age.	Absolute dating is used to determine the precise age of a fossil by using radiometric dating to measure the decay of isotopes.

6. What is the role of connecting links in evolution? (PTA-2019-2020)

Connecting link provide the evidence for the path of evolution and lie midway between the two groups that is they have features of both the groups of organisms. These confirm evolution of amphibians from fishes, Mammals from reptiles, Arthropods and mollusks from the annelids.

7. Gene flow can be a strong agent of evolution Explain how? (PTA-2019-2020)

- 1) Movement of genes through gametes or movement of individuals in (immigration) and out (emigration) of a population is referred to as gene flow.
- 2) Organisms and gametes that enter the population may have new alleles or may bring in existing alleles but in different proportions than those already in the population. Gene flow can be a strong agent of evolution.

8. Explain the modern synthetic theory of natural selection. (PTA-2019-2020)

Sewell Wright, Fisher, Mayer, Huxley, Dobzhansky, Simpson and Haeckel explained Natural Selection in the light of Post- Darwinian discoveries. According to this theory gene mutations, chromosomal mutations, genetic recombination's, natural selection and reproductive isolation are the five basic factors involved in the process of organic evolution.

Gene mutations:

Gene mutation refers to the changes in the structure of the gene. It is also called gene/ point mutation. It alters the phenotype of an organism and produces variations in their offspring.

Chromosomal mutation:

Chromosomal mutation refers to the changes in the structure of chromosomes due to deletion, addition, duplication, inversion or translocation. This too alters the phenotype of an organism and produces variations in their offspring.

Genetic recombination:

Genetic recombination is due to crossing over of genes during meiosis. This brings about genetic variations in the individuals of the same species and leads to heritable variations.

Natural selection:

Natural selection does not produce any genetic variations but once such variations occur it favours some genetic changes while rejecting others (driving force of evolution).

Reproductive isolation:

Reproductive isolation helps in preventing interbreeding between related organisms.

Creative questions and answers (2 and 3 marks):**1. When was earth formed? What was it's conditions at that time?**

- 1) An estimated age for earth was around 4.4-4.6 billion years.
- 2) The new born earth was inhospitable at first it was too hot. This is because the collisions of the planetesimals released much heat to melt the entire planet.
- 3) The outer surface of the earth cooled and solidified to form a crust. Water vapor released from the planet's interior cooled and condensed to form oceans.
- 4) Hence origin of life can be reconstructed, using indirect evidences.

2. Explain briefly about the theory of special creation.

The theory of special creation is the process of origin of life in which all the component of universe namely plants and animals are created by a supernatural power, referred as God.

3. What is Big bang theory?

It explains the origin of universe as a singular huge explosion in physical terms.

4. Define biogenesis.

Biogenesis is defined as a process, through which life arose from pre- existing life. Hendry Bastaian coined this word "biogenesis".

5. Explain the view of oparin- Haldane on the origin of life.

Oparin and Haldane independently proposed prebiotic soup with wide range of organic compounds formed with energy as lightening or UV light, leading to origin of life.

6. Define mutation theory of evolution.

Mutation theory is defined as process sudden and large variations due to mutation which is responsible for the origin of new species. This is proposed by Hugo De Vries.

7. Defined artificial selection.

Artificial selection is defined as a process in which human exploitations of forests, oceans and fisheries or use of pesticide, herbicides or drugs can occur.

8. Give examples for adaptive radiation.

- i) Darwin's finches.
- ii) Marsupials in Australia.

9. Define microevolution.

Microevolution is a process which refers to the changes in allelic frequencies within a population.

10. What is Sewall Wright effect?

Sewall Wright effect is otherwise known as genetic drift and is a mechanism of evolution, in which allelic frequencies of a population change over generation due to chance.

11. State Hardy-Weinberg law.

The law states that if the population is in equilibrium state, the frequencies of alleles and genotypes or sets of alleles in a population will remain the same over generations.

12. Explain the characteristics of Homo erectus.

- 1. They are the first human-like being lived in around 1.7 mya.
- 2. The skull was flatter and thicker than the modern man.
- 3. They had large brain capacity of around 900 cc.
- 4. They ate meat.

13. State Hardy-Weinberg principle.

The allele frequencies in a population are stable and are constant from generation to generation in the absence of gene flow, genetic drift, mutation, recombination and natural selection.

14. Mention the salient features of mutation theory.

- 1. Mutations or discontinuous variation are transmitted to other generations.
- 2. In naturally breeding populations, mutations occur from time to time.
- 3. There are no intermediate forms, as they are fully fledged.
- 4. They are strictly subjected to natural selection.

15. State the theory of Germplasm.

Change in the somatoplasm will not be transferred to the next generation but changes in the germplasm will be inherited.

16. What is molecular evolution?

It is the process of change in the sequence and composition of molecules such as DNA, RNA and proteins across generations.

17. What are coprolites?

Coprolites is hardened faecal matter occurred as tiny pellets. Analysis of the coprolites help us to understand the nature of diet of, the pre-historic animals thrived.

18. How are moulds and casts formed?**1. Moulds:**

Even after disintegration the body of an animal might leave indelible impression on the soft mud which later becomes hardened into stones.

2. Casts:

The cavities of the moulds filled up by hard minerals and fossilized.

19. What are called connecting links? Give example.**Connecting links:**

The organisms which possess the characters of two different groups (transitional stage).

Example:

Peripatus- Connecting link between Annelida and Arthropoda.

Archeopteryx- Connecting link between Reptiles and Aves.

20. What is paleontology?

Paleontology is the study of prehistoric life through fossils.

21. What are called protobionts?

- 1) Abiotically produced molecules can spontaneously self assemble into droplets.
- 2) These enclose a watery solution and maintain a chemical environment different from their surroundings. These spheres are called as 'protobionts'.

22. How can the age of fossils be determined?

It can be determined using two methods relative dating and absolute dating.

Relative dating:

Relative dating is used to determine a fossil by comparing it to similar rocks and fossils of known age.

Absolute dating:

Absolute dating is used to determine the precise age of a fossil by using radiometric dating to measure the decay of isotopes.

23. Which is called golden age of reptiles? What are the three periods of it?

Mesozoic era is called the Golden age of reptiles, It is divided into three periods namely.

- i) **Triassic**-Origin of eggs laying mammals.
- ii) **Jurassic**- Dinosaurs, fossil bird Archaeopteryx.
- iii) **Cretaceous**-Extinction of toothed birds and dinosaurs, emergence of modern birds.

24. Explain briefly about Mesozoic era.

Mesozoic era is otherwise known as golden age of reptiles. This era is divided into three periods as follows:

- i) **Triassic:** Origin of egg laying mammals.
- ii) **Jurassic:** Dinosaurs were dominant and the fossil bird- Archaeopterys was present on earth.
- iii) **Cretaceous:** Extinction of toothed birds and dinosaurs, emergence of modern birds occur.

25. Explain the principles of Lamarck's theory.

Lamarck's proposed two principles in his theory and they are:

1. The theory of use and disuse:

The organs increase in size, when they are used often and the organs, that are not used will degenerate.

Example:

Neck in giraffe is an example of constant use and the absence of limbs in snakes is the example of disuse theory.

- ### 2. The theory of inheritance of acquired characters:
- The characters developed by an organism during its life time are the acquired characters. Lamarck postulated that these acquired characters are then inherited to next generation.

26. List the three ways of struggle for existence denoted by Darwin.

1. Intraspecific struggle between individuals of the same species for food, space and mate.
2. Interspecific struggle between different species for food and space.
3. Struggle with the environment to cope with climatic variations like flood, earth quakes, drought ect.

27. What is gene flow? Explain it briefly.

1. Gene flow is referred as the movement of genes through gametes or movement of individual organisms in and out of a population.
2. Immigration in which the gametes and the organisms enter the population may have new alleles or may bring in existing alleles.
3. These existing alleles in deferent proportions due to incoming alleles may alter allelic frequency of the original population. Therefore gene flow can act as a strong agent of evolution.

28. Distinguish between Homo habilis and Homo erectus.

Homo habilis	Homo erectus
Homo habilis lived about 2 mya.	Homo erectus lived around 1.7 mya.
Their brain capacity was between 650-800 cc.	They are the first human like being. They had brain capacity of 900cc.
They are probably vegetarian.	They are probably meat eaters.
They have bipedal locomotion. They used chipped stones as tools.	They are much closer to human, but skull was flatter and thicker than modern man.

29. Name the types of natural selection.

- i) Stabilizing selection.
- ii) Directional selection.
- iii) Disruptive selection.

31. What is founder's effect?

Genetic drift can have major effects, when the population is reduced in size. When a small group of population splits from the main population to form a new colony. It is called founder's effect.

32. Define isolation.

Isolation is the separation of the members of a single population into sub populations so that genetic integrity of the subpopulation can be maintained.

Five mark question and answer:**1. Give an account of theory of chemical evolution.**

1. According to the theory of chemical evolution primitive organisms in the primordial environment of the earth evolved spontaneously from inorganic substances and physical forces such, as lightning, UV radiations, volcanic activities, etc.,
2. Oparin (1924) suggested the organic compounds could have undergone a series of reactions leading to more complex molecules.
3. He proposed that the molecules formed colloidal aggregates or 'coacervates' in an aqueous environment.
4. The coacervates were able to absorb and assimilate organic compounds from the environment.
5. Haldane (1929) proposed that the primordial sea served as a vast chemical laboratory powered by solar energy.
6. The atmosphere was oxygen free and the combination of CO_2 , NH_3 and UV radiations gave rise to organic compounds.
7. The sea n becomes a 'hot' dilute soup containing large populations of organic monomers and polymers.
8. They envisaged that groups of monomers and polymers acquired lipid membranes and further developed into the first living cell.
9. Haldane coined the term prebiotic soup and this became the powerful symbol of the Oparin- Haldane view of the origin of life (1924-1929).
10. Oparin and Haldane independently suggested that if the primitive atmosphere was reducing and if there was appropriate supply of energy such as lightning or UV light then a wide range of organic compounds can be synthesized.

2. Explain Urey and Miller experiment.

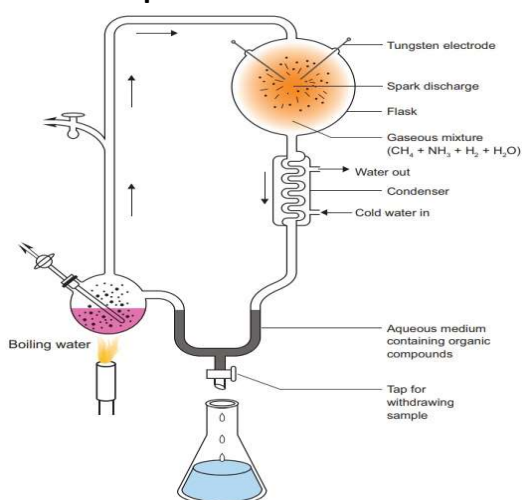


Fig. 6.1 Diagrammatic representation of Urey-Miller's experiment

1. Urey and Miller (1953), paved way for understanding the possible synthesis of organic compounds that led to the appearance of living organisms.
2. In their experiment, a mixture of gases was allowed to circulate over electric discharge from an tungsten electrode.
3. A small flask was kept boiling and the steam emanating from it was made to mix with the mixture of gases (ammonia, methane and hydrogen) in the large chamber that was connected to the boiling water.
4. The steam condensed to form water which ran down the 'U' tube. Experiment was conducted continuously for a week and the liquid was analyzed. Glycine, alanine, beta alanine and aspartic acid were identified.
5. Thus Miller's experiments had an insight as to the possibility of abiogenetic synthesis of large amount of variety of organic compounds in nature from a mixture of sample gases in which the only source of carbon was methane.
6. Later in similar experiments, formation of all types of amino acids and nitrogen bases were noticed.

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Bio-Zoology

Unit-III

Chapter: 7 Human Health and Diseases

Textbook question and answer:

1. A 30 year old woman has bloody diarrhoea for the past 14 hours, which one of the following organisms is likely to cause this illness? **Shigella dysenteriae.**
2. Exo- erythrocytic schizogony of plasmodium takes place in **Liver.**
3. The sporozoites of plasmodium vivax are formed from **Oocysts.**
4. Amphetamines are stimulants of the CNS, whereas barbiturates are **CNS depressants.**
5. Choose the correctly match pair.
 - a) **Amphetamines- Stimulant**
 - b) LSD- narcotic
 - c) Heroin- Psychotropic
 - d) Benzodiazepine- Pain killer
6. The Athlete's foot disease in human is caused by **Fungi.**
7. Cirrhosis of liver is caused by chronic intake of **Alcohol.**
8. The sporozoite of the malarial parasite is present in **Saliva of infected female anopheles mosquito.**
9. Where do the following events in the life cycle of plasmodium takes place?
 - a) Fertilization-**Gut of mosquito**
 - b) Development of gametocytes- **Human RBC's**
 - c) Release of sporozoites- **From Mosquito to the human blood**
 - d) Schizogony- **Human liver cells**
10. Paratope is an **Antigen binding site n variable regions.**
11. Allergy involves **IgE.**
12. Spread of cancerous cells to distant sites is termed as **Metastasis.**
13. AIDS virus has **Single stranded RNA.**
14. B cells that produce and release large amount of antibody are called **Plasma cells.**
15. Give below are some human organs. Identify one primary and one secondary lymphoid organ. Explain its role. Liver, thymus, stomach, thyroid, tonsils.
 - i) **Primary lymphatic organ:**
Thymus is a primary lymphoid organ.
Function:
i) One of its main secretions is the hormone thymosin.

ii) It stimulates the T cell to become mature and immunocompetent. By the early teens, the thymus begins to atrophy and is replaced by adipose tissue.

ii) Secondary lymphatic organ:

Tonsils is a secondary lymphoid organ.

Function:

- i) The tonsils are part of the lymphatic system, which help to fight infections.
- ii) They stop invading germs including bacteria and viruses.

16. Name and explain the type of barriers which involve macrophages.

- i) The type of barriers that involve the macrophages is phagocytic barriers.
- ii) They are specialized cells like monocytes, neutrophils and tissue macrophages.
- iii) These cells phagocytose and digest whole microorganisms.

17. What are interferons? Mentions their role.

- i) Interferons are proteins produced by animal's body in response to viral infection.
- ii) They are named as such because they interfere with the proliferation of viruses.
- iii) They play an important role in protecting the organism from viral infection and also bacterial and parasitic pathogens.

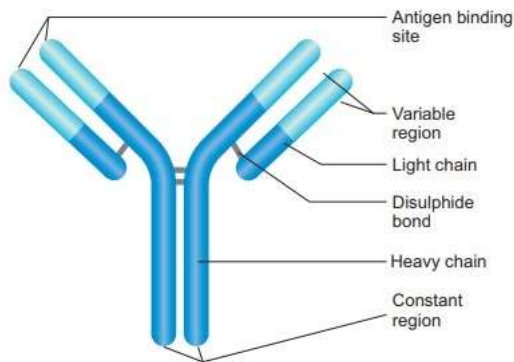
18. List out chemical alarm signals produced during inflammation.

- i) Inflammatory barriers is a type of innate immunity.
- ii) Tissues damage and infection induce leakage of vascular fluid, containing chemotactic signals like serotonin, histamine and prostaglandins.
- iii) They influx the phagocytic cells into the affected area. This phenomenon is called diapedesis.

19. Explain the process of replication of retrovirus after it gains entry into the human body.

1. After getting into the body of the person, the virus enter into macrophages where RNA genome of the virus replicates to form viral DNA with the help of the enzyme reverse transcriptase.
2. This viral DNA gets incorporated into the DNA of host cells and directs the infected cells to produce viral particles.
3. The macrophages continue to produce virus and in this way act like a HIV factory.
4. Simultaneously HIV enters into helper T-lymphocytes, replicates and produces progeny viruses. The progeny viruses released in the blood attack other helper T-lymphocytes.
5. This is repeated, leading to a progressive decrease in the number of helper T lymphocytes in the body of the infected person.
6. During this period, the person suffers from bouts of fever, diarrhea and weight loss. Due to decrease in the number of helper T lymphocytes, the person starts suffering from infections and becomes immune deficient and unable to protect against any infection.

20. Explain the structure of immunoglobulin with suitable diagram.



21. What are the cells involved innate immune system?

Natural killer cells, mast cells, Eosinophils, basophils and the phagocytic cells include macrophages, neutrophils, dendritic cells and function within the immune system by identifying and eliminating pathogens that might cause infection.

22. What is vaccine? What are its types?

- A Vaccine is a biological preparation that provides active acquired immunity to a particular disease and resembles a disease- causing microorganism and is often made from weakened or attenuated or killed forms of the microbes, their toxins, or one of its surface proteins.
- Vaccines teach our body how to defend itself when viruses or bacteria, invade it. Vaccines deliver only very little amounts of inactivated or weakened viruses or bacteria or parts of them. This allows the immune system to recognize the organism without actually experiencing the disease

❖ **First generation vaccine:**

First generation vaccine is further subdivided into live attenuated vaccine, killed vaccine and toxoids.

Example: MMR vaccine, Salk's polio vaccine, DPT vaccine.

❖ **Second generation vaccine:**

Second generation vaccine contains the pure surface antigen of the pathogen.

Example: Hepatitis-B

❖ **Third generation vaccine:**

Third generation vaccine contains the purest and the highest potency vaccines which are synthetic generation.

Example: DNA vaccine or recombinant vaccine.

23. A person is infected by HIV. How will you diagnose for AIDS?

1. Preliminary test:

ELISA- (Enzyme Linked Immuno Sorbent Assay) detects the presence of HIV antibodies.

2. Confirmatory test:

Western blot test is more reliable and a confirmatory test. It detects the viral core proteins. If both tests detect the presence of the antibodies, the person is considered to be HIV positive.

24. Autoimmunity is a misdirected immune response. Justify.

1. Autoimmunity is due to an abnormal immune response in which the immune system fails to properly distinguish between self and non-self and attacks its own body.
2. Our body produces antibodies and cytotoxic T cells that destroy our own tissues.
3. If a disease- state results, it is referred to as auto-immune disease. Thus, autoimmunity is a misdirected immune response.
4. Autoimmunity is evidenced by the presence of auto antibodies and T cells that are reactive with host antigens.

25. List the causative agent, mode of transmission and symptoms for Diphtheria and Typhoid.

Diseases	Causative agent	Transmission	Symptoms
Diphtheria	<i>Corynebacterium diphtheria</i>	Droplet infection	Fever, sore throat, hoarseness and difficulty in breathing.
Typhoid (Enteric fever)	<i>Salmonella typhi</i>	Through contaminated food and water	Headache, abdominal discomfort, fever and diarrhea.

26. A patient was hospitalized with fever and chills. Merozoites were observed in her blood.

What is your diagnosis?

Occurrence of Merozoites in the blood indicates that the person is suffering from malaria, shivering, chills are the other symptoms of the disease.

27. i) Write the scientific name of the filarial worm that causes filariasis.

Scientific name of Filarial Worm that causes filariasis is “ *Wuchereria bancrofti*”

ii) Write the symptoms of fillariasis.

The accumulation of the worms in lymph glands block the lymphatic system resulting in inflammation of the lymph nodes. In some cases, the obstruction of lymph vessels causes elephantiasis or filariasis of the limbs, scrotum and mammary glands.

iii) How is this disease transmitted?

The disease is transmitted by female *culex mosquito*, when the mosquito bites an infected person and then bites a healthy person.

28. List the common withdrawal symptoms of drugs and alcohol abuse.

Mild tremors to convulsions, severe agitation and fits, depressed mood, anxiety, nervousness, restlessness, irritability, insomnia, dryness of throat etc. depending on the type of drug abuse.

29. Why do you think it is not possible to produce vaccine against common cold?

It is difficult to make, a vaccine to prevent the common cold primarily because there are more than 200 different varieties of viruses that can cause colds.

❖ **Other important question and answers:**

30. Explain the role of immunity in prevention of cancer. (PTA-2019-2020)

1. Immunotherapy also called biological therapy uses substances made by the body or in a laboratory to improve or to resist the immune system function.
2. Different approaches have been attempted in the immunotherapy of cancer. Immunotherapy appears to be important in getting rid of the residual malignant cells after the gross tumor has been removed.
3. The best results in the treatment of cancer are to follow an integrated approach to therapy, combining surgery, radiotherapy, chemotherapy and immunotherapy.

31. Suggest methods of maintenance of personal and public hygiene. (PTA-2019-2020)

1. Hygiene is a set of practices performed to conserve good health. According to the World Health Organization (WHO), hygiene refers to conditions and practices that help to maintain health and prevent the spread of diseases.
2. Personal hygiene refers to maintaining one's body clean by bathing, washing hands, trimming fingernails, wearing clean clothes and also includes attention to keeping surfaces in the home and workplace, including toilets, bathroom facilities, clean and pathogen-free.

32. AIDS is not a disease but it facilitates the attack by other organisms. Explain why? (PTA-2019-2020)

1. Immunodeficiency results from the failure of one or more components of the immune system. Primary immune deficiencies are caused by genetic developmental defects.
2. Secondary immune deficiencies arise due to various reasons like radiation, use of cytolytic and immunosuppressive drugs and infections.
3. AIDS is an acronym for Acquired Immuno Deficiency Syndrome. It is the deficiency of immune system, acquired during the life time of an individual indicating that it is not a congenital disease.
4. AIDS is caused by Human Immuno Deficiency Virus (HIV). It selectively infects helper T cells. The infected helper T cells will not stimulate antibody production by B-cell resulting in loss of natural defense against viral infection.

33. A 10 year old child is suffering from chicken pox. Is this infection good or bad? Give reason for your answer. (PTA-2019-2020)

Most commonly, children get chickenpox before the age of 10 years. The immune system makes proteins called antibodies during the infection. These fight the virus and then

provide lifelong protection against it (immunity). Therefore, it is uncommon to have more than one bout of chickenpox in your lifetime.

34. Why is typhoid called as enteric fever? (PTA-2019-2020)

Typhoid is an infection caused by a bacteria called as *salmonella typhi*. It leads to fever and is also known as Enteric fever. Typhoid spreads through contamination of food and water and ingesting these contaminated foods.

35. Define metastasis. (PTA-2019-2020)

A tumour or neoplasm is a group of cells whose growth has gone unchecked. When a tumour continues to grow and invades healthy tissue it is called cancer. They spread to other parts of the body from the tumour and give rise to secondary tumour. This is known as metastasis.

36. Mention the four types of malaria and their causative agents. (PTA_2019-2020)

S.No	Types of malaria	Causative agent
1	Tertian, benign tertian or vivax malaria	<i>Plasmodium vivax</i>
2	Quartan malaria	<i>Plasmodium malariae</i>
3	Mild tertian malaria	<i>Plasmodium ovale</i>
4	Malignant tertian or quotidian malaria	<i>Plasmodium falciparum</i>

37. How does a chemical mediator act as physiological barriers? (2019-2020)

1. Lysozyme acts as antibacterial agent and cleaves the bacterial cell wall. Interferons induce antiviral state in the uninfected cells.
2. Complementary substances produced from leucocytes lyse the pathogenic microbes or facilitate phagocytosis.

38. Imagine, if atrophy of thymus occurs in a child, what would be the serious consequences the child would face? Explain briefly. (2019-2020)

1. The hormone thymosin is not secreted.
2. T cells do not become mature and immunocompetent.

39. Discuss the various types of innate immunity and their functioning mechanisms. (PTA-2019-2020)

S.No	Type of innate immunity	Mechanisms
1	Anatomical barriers	
	Skin	Prevents the entry of microbes. Its acidic environment (pH 3-5) retards the growth of microbes.
	Mucus membrane	Mucus entraps foreign micro organisms and competes with microbes for attachment.
2	Physiological barriers	

	Temperature	Normal body temperature inhibits the growth of pathogens.
	Low P ^H	Acidity of gastric secretions (HCL) kills most ingested microbes.
	Chemical mediators	Lysozyme acts as antibacterial agent and cleaves the bacterial cell wall. Interferons induce antiviral state in the uninfected cells. Complementary substances produced from leucocytes lyse the pathogenic microbes or facilitate phagocytosis.
3	Phagocytic barriers	Specialized cells (Monocytes, neutrophils, tissue macrophages phagocytose and digest whole microorganisms.
4	Inflammatory barriers	Tissue damage and infection induce leakage of vascular fluid, containing chemotactic signals like serotonin, histamine and prostaglandins. They influx the phagocytic cells into the affected area. This phenomenon is called diapedesis

40. Compare and contrast bacillary dysentery and amoebic dysentery. (2019-2020)

S.No		Bacillary Dysentery	Amoebic Dysentery
1	Causative agent	<i>Shigella species</i> (Bacteria)	<i>Entamoeba histolytica</i> (Protozoan)
2	Site of infection	Intestine	Intestine (colon) and secretes histolytic enzymes causing ulceration.
3	Mode of transmission	Food and water contaminated by faeces/ faecal oral route	Faecal oral route (food and water contaminated with faeces.
4	Symptoms	Abdominal pain, dehydration, blood and mucus in the stools. Frequency of stools is less and not frequent as in amoebiasis.	Bleeding abdominal pain and stools with excess mucus. Foul smelling stools symptoms can range from diarrhea to dysentery.

41. What are the two most prevalent helminthic diseases in human beings? Explain them. (2019-2020)

Helminthes are mostly endoparasitic in the gut and blood of human beings and cause diseases called helminthiasis. The two most prevalent helminthic diseases are Ascariasis and Filariasis.

Ascariasis:

1. Ascaris is a monogenic parasite and exhibits sexual dimorphism.
2. Ascariasis is a disease caused by the intestinal endoparasite *Ascaris lumbricoides* commonly called the round worms.
3. It is transmitted through ingestion of embryonated eggs though contaminated food and water.
4. Children playing in contaminated soils are also prone to have a chance of transfer of eggs from hand to mouth.

Symptoms:

Abdominal pain, vomiting, headache, anaemia, irritability and diarrhoea. A heavy infection can cause nutritional deficiency and severe abdominal pain and causes stunted growth in children. It may also cause enteritis, hepatitis and bronchitis.

Filariasis:

1. Filariasis is caused by *Wuchereria bancrofti*, commonly called filarial worm.
2. It is found in the lymph vessels and lymph nodes of man.
3. *Wuchereria bancrofti* is sexually dimorphic, viviparous and digenic.
4. The life cycle is completed in two hosts, man and the female *Culex* mosquito the female filarial worm gives rise to juveniles called microfilariae larve. In the lymph glands the juveniles develop into adults.

Symptoms:

The worms block the lymphatic system resulting in inflammation of the lymph nodes. In some cases, the obstruction of lymph vessels causes elephantiasis or filariasis of the limbs, scrotum and mammary glands.

42. Write any two differences between active and passive immunity. (2019-2020)

S.No	Active immunity	Passive immunity
1	Active immunity is produced actively by host's immune system.	Passive immunity is received passively and there is no active host participation.
2	It is produced due to contact with pathogen or by its antigen.	It is produced due to antibodies obtained from outside.
3	It is durable and effective in protection.	It is transient and less effective.
4	Immunological memory is present.	No memory.
5	Booster effect on subsequent dose is possible.	Subsequent dose is less effective.
6	Immunity is effective only after a short period.	Immunity develops immediately.

43. Name the hormone secreted by thymus gland and mention two functions of that hormone.

Hormone: Thymosin.

Function:

- i) Stimulates the T cell to become mature.
- ii) Mature and immune component.
- iii) Most active during the neonatal and pre-adolescent periods.

❖ **2 and 3 marks creative questions and answers:**

44. What is the primary function of the thymus?

The thymus produces progenitor cells, which mature into T-cells (Thymus- derived cells). The body uses T-cells help destroy infected or cancerous cells. T-cells created by the thymus also help other organs in the immune system grow properly.

45. What is anaphylaxis?

Anaphylaxis is the classical immediate hypersensitivity reaction. It is a sudden, systematic, severe and immediate hypersensitivity reaction occurring as a result of rapid generalized mast-cell degranulation.

46. What does the term antibiotic refer to?

Antibiotics are medicines that treat infections by killing bacteria. They don't work on viruses, like the flu. B-lymphocytes produce an army of proteins called antibodies to fight with them. Thus they are secreted in response to an antigen (Ag) by the effects of B cells called plasma cells.

47. Write any three unique features of specific immunity.

The unique features of specific immunity are antigenic specificity, diversity, recognition of self and non-self and immunological memory.

48. What are the main functions of free antibodies?

- i) Agglutination.
- ii) Precipitation.
- iii) Opsonisation.
- iv) Neutralization.

49. Enumerate the methods of diagnosis of AIDS.**Preliminary test:**

ELISA- (Enzyme Linked Immuno Sorbent Assay) detects the presence of HIV antibodies.

Confirmatory test:

Western blot test is more reliable and a confirmatory test. It detects the viral core proteins. If both tests detect the presence of the antibodies, the person is considered to be HIV positive.

50. Name the secondary lymphoid organs.

1. Lymph nodes.
2. Appendix.
3. Peyer's patches of gastrointestinal tract.
4. Tonsils.
5. Adenoids.
6. Spleen.
7. Mucosa Associated Lymphoid Tissue-MALT
8. Gut Associated Lymphoid Tissue-GALT
9. Bronchial Tracheal Associated Lymphoid Tissue-BALT

51. Distinguish between paratope and epitope.

Paratope	Epitope
A paratope is the antigen binding site and is a part of an antibody which recognizes and binds to an antigen	Epitope is an antigenic determinate and is the active part of an antigen.

52. What are haptens?

Haptens are substances that are non-immunogenic but can react with the products of a specific immune response.

53. What is phagocytosis?

Phagocytosis is the process by which a cell uses its plasma membrane to engulf a large particle, giving rise to an internal compartment called the phagosome. It is one type of endocytosis. In a multicellular organism immune system, phagocytosis is major mechanism used to remove pathogen and cell debris.

54. What is signet ring stage?

1. Inside the RBC the merozoite of plasmodium develops in to unicellular trophozoites.
2. It grows in size and a central vacuole develops pushing nucleus to one side of cytoplasm. It is called signet ring stage.

55. What is immunity?

The overall ability of body to fight against the disease causing pathogen.

56. What is immunology?

It is the study of immune system. It refers to all the mechanism used by the body for protection from environmental agents that are foreign to the body.

57. What is called antigen?

Any substance capable of eliciting immune response is called antigen. (ANTibody GENerator).

58. Distinguish infectious and non infectious diseases.

S.No	Infection	Non infections
1	They are transmitted from one person to another.	They are not transmitted from an infected person to a healthy person.
2	They are transmitted through air, water, food, physical contact and vectors by virus, bacteria, fungi, protozoan parasites, helminthic parasites.	In origin they may be genetic, nutritional and degenerative.
3	Most of the bacterial diseases are curable but all viral diseases are not Example: AIDS may be fatal.	They are not curable. Example: Cancer.

59. Bacteria have developed resistance to antibiotics justify. How can it be avoided?**Bacterial resistance:**

If an antibiotic is used too often to light a specific bacterial infection, the bacteria may become resistant to the specific antibiotic. The specific antibiotic can no longer be used. Therefore, infections are difficult to be cured.

Prevention:

1. Avoid using antibiotics to treat minor infections that can be taken care by our immune system.
2. Do not use an antibiotic to treat viral infections such as common cold or flu.
3. Always follow the prescription. Skipping doses or failing to complete the prescription may allow antibiotic resistance to develop.

60. Mention the symptoms of malaria.

Early symptoms: Headache, nausea and muscular pain.

Classic symptoms:

1. By release of haemozoin toxin and erythrocyte debris resulting in –Shivering chills, high fever sweating.
2. Fever and chills are caused by malarial toxins that induce macrophages to release tumour necrosis factor (TNF- α) and interleukin.

61. Write the preventive methods of malaria.

1. Oil can be sprayed over the water surface, to prevent mosquito larvae and pupae to breathe.
2. Ponds, drainage and ditches can be stocked with fishes such as Gambusia.

3. Bacillus thuringiensis can be sprayed to kill the mosquito larvae can be sprayed to kill the mosquito larvae.
4. People are advised to use mosquito nets, wire gauging of windows and doors.

62. List the fungi causing dermatomycosis?

1. Tricjophyton
2. Microsporum
3. Epidermophyton

63. Write short notes on ring worm.

It is a fungal disease in humans.

Symptoms:

1. Appearance of dry, scaly lesions on the skin nails and scalp.
2. Heat and moisture help these fungi to grow in the groin or between the toes.

Athlete's foot:

1. Ringworm of the feet is caused by Tinea pedis.
2. They are acquired from soil or by using clothes, towels and comb used by infected persons.

64. What is Diapedesis?

1. Tissue damage and infection induce leakage of vascular fluid, containing chemo tactic signals like serotonin, histamine and prostaglandins.
2. They influx the phagocytic cells into the affected are. This phenomenon is called diapedesis.

65. What are the unique features of acquired immunity?

Antigenic specificity, diversity, recognition of self and non-self and immunological memory.

66. Mention the two components of acquired immunity.

1. Cell mediated immunity (CMI).
2. Antibody Mediated Immunity or Humoral immunity.

67. What is active immunity?

1. The immunological resistance developed by the organisms through the production of antibodies in their body is called active immunity.
2. Active immunity is acquire through the use of a person's immune responses, which lead to the development of memory cells Active immunity results from an infection or an immunization.

68. What is passive immunity?

1. Passive immunity does not require the body to produce antibodies to antigens.
2. The antibodies are introduced from outside into the organism.
3. Thus passive immunity is acquired without the activation of a person's immune response, and therefore there is no memory.

69. What are two types of acquired immunity?

1. Active immunity
2. Passive immunity

70. Primary immune response is the first step of immunity against pathogens-justify.

1. The primary immune response occurs when a pathogen comes in contact with the immune system for the first time.
2. During this the immune system has to learn to recognize the antigen, produce antibody against it and eventually produce memory lymphocytes.
3. The primary immune response slow and short lived.

71. Why secondary immune response is called booster response?

1. The secondary immune response occurs when a person is exposed to the same antigen again.
2. During this time, immunological memory has been established and the immune system can start producing antibodies immediately.
3. Within hours after recognition of the antigen, a new army of plasma cells are generated.
4. Within 2 to 3 days the antibody concentration in the blood rises steeply to reach much higher level than primary response. This is also called as booster response.

72. How do you maintain personal hygiene?

Maintaining one's body clean by bathing, washing hands, trimming fingernails, wearing clean clothes and also includes attention to keeping surfaces in the home and workplace, toilets, bathroom facilities, clean and pathogen-free.

73. What are lymphoid organs? Classify them with examples.

The organs involved in the origin, maturation and proliferation of lymphocytes are called lymphoid organs. Based on their functions they are classified into primary or central lymphoid organs and secondary or peripheral lymphoid organs.

Primary lymphoid organs:

Primary lymphoid organs provide appropriate environment for lymphocytic maturation.

Secondary lymphoid organs:

The secondary lymphoid organs trap antigens and make it available for mature lymphocytes, which can effectively fight against these antigens.

74. What is the reason for the visible swelling of lymph nodes?

1. Sometimes visible swelling of lymph nodes occurs due to active immune response and increase concentration of lymphocytes.
2. It indicates the signal of an infection.
3. The most frequently enlarged lymph nodes are found in the neck, under the chin, in the armpits and in the groin.

75. What is MALT?

1. The Mucosa Associated Lymphoid Tissue (MALT) is a diffuse system of small concentrations of lymphoid tissue in the alimentary, respiratory and urogenital tracts.
2. MALT is populated by lymphocytes such as T and B cells, as well as plasma cells and macrophages, each of which is well situated to encounter antigens passing through the mucosal epithelium.
3. It also possesses IgA antibodies.

76. What is GALT?

Gut Associated Lymphoid Tissue (GALT) is a component of the mucosa associated lymphoid tissue (MALT) which works in the immune system to protect the body from invasion in the gut.

77. What is BALT?

Bronchus Associated Lymphoid Tissues (BALT) also a component of MALT is made of lymphoid tissue (tonsils, lymph nodes, lymph follicles) is found in the respiratory mucosae from the nasal cavities to the lungs.

78. Why are dendritic cells called so? List their types.

1. Dendritic cells are called so because they are covered with long thin membrane extensions that resemble dendrites of nerve cells.
2. These cells present the antigen to T-helper cells.
3. Four types of dendritic cells are known. They are langerhans, interstitial cells, myeloid and lymphoid cells.

79. Differentiate antigens on the basis of origin.**Exogenous antigens:**

The antigens which enter the host from the outside.

Example: Microorganisms, pollens.

Endogenous antigens:

The antigens which are formed within the individual.

Example: Blood group antigens.

80. What are the functional differences between B and T cells?

S.No	B-lymphocytes	T-lymphocytes
1	They form humoral or antibody mediated immune system (AMIS)	They form cell mediated immune system (CMIS).
2	They defend against viruses and bacteria that enter the blood and lymph.	They defend against pathogens including protists and fungi that enter the cells.
3	They form plasma cells and memory cells by the division.	They form killer, helper and suppressor cells by the division of lymphoblasts.

81. Discuss the three stages of the reaction between antigen and antibody.**First stage:**

The reaction involves the formation of antigen antibody complex.

Second stage:

It leads to visible events like precipitation, agglutination etc.,

Final stage:

The final stage includes destruction of antigen or its neutralization.

82. Define the terms allergy and allergens.**Allergy:**

1. Some of the individuals are very sensitive to some particles present in the environment.
2. The exaggerated response of the immune system to certain antigens present in the environment is called allergy. (allo-altered, erg-reaction)

Allergens:

1. The substances to which such an immune response is produced are called allergens. An allergen is an antigen that causes an allergic reaction.
2. Allergic reactions begin within few seconds after the contact with the allergen and last about half an hour.

83. What is precipitin reaction?

1. The reaction between soluble antigen and antibody leads to visible precipitate formation, which is called precipitin reaction.
2. Antibodies that bring about precipitate formation on reacting with antigens are called as precipitins.

84. What is agglutination reaction?

1. A particulate antigen interacts with its antibody it would result in clumping or agglutination of the particulate antigen, which is called agglutination reaction.
2. The antibody involved in bringing about agglutination reaction is called agglutinin.

85. What is opsonisation or enhanced attachment?

1. Opsonisation or enhanced attachment is the process by which a pathogen is marked for ingestion and destruction by a phagocyte.
2. Opsonisation involves the binding of an opsonin antibody to a receptor on the pathogen's cell membrane.
3. After opsonin binds to the membrane, phagocytes are attracted to the pathogen. So, opsonisation is a process in which pathogens are coated with a substance called an opsonin marking the pathogen out for destruction by the immune system. This results in a much more efficient phagocytosis.

86. What is neutralization?

1. The neutralization reactions are the reactions of antigen-antibody that involve the elimination of harmful effects of bacterial exotoxins or a virus by specific antibodies.
2. These neutralizing substances antibodies are known as antitoxins.
3. This specific antibody is produced by a host cell in response to a bacterial exotoxin or corresponding toxoid (inactivated toxin).

87. Differences between normal cell and cancer cell?

S.No	Normal cell	Cancer cells
1	Small, uniformly shaped nuclei relatively large cytoplasmic volume	Large, variable shaped nuclei relatively small cytoplasmic volume
2	Conformity in cell size and shape cells arranged into discrete tissues	Variation in cell size and shape disorganized arrangement of cells.
3	May possess differentiated cell structure Normal presentation of cell surface markers.	Loss of normal specialized features elevated expression of certain cell markers.
4	Lower levels of dividing cells cell tissues clearly demarcated	Large number of dividing cells poorly defined tumor boundaries.

88. What is vaccination?

Vaccination is the process of administering a vaccine into the body or the act of introducing a vaccine into the body to produce immunity to a specific disease.

89. What is Immunization?

1. Immunization is the process of the body building up immunity to a particular disease.
2. Immunization describes the actual changes in the body after receiving a vaccine.
3. Vaccines work by fighting the pathogen and then recoding it in their memory system to ensure that the next time this pathogen enters the body, it is eliminated far quickly.
4. Once the body is able to fight against the disease, it is believed to have built the immunity for it also known as the body being immunized against the disease.

90. Write the symptoms of hypersensitivity?

1. Allergic reactions include sneezing, watery eyes, running nose and difficulty in breathing.
2. Allergy is a form of over active immune response mediated by IgE and mast cells.
3. It can also be due to the release of chemical like histamine and serotonin from the mast cells.

91. Mention the prevention methods of spreading of AIDS.

Advocating safe sex and promoting regular check-up, safe blood for transfusion, use of disposable needles, use of condoms during sexual contact, prevention of drug abuse, AIDS awareness programme by **NACO** (National AIDS Control Organisation). **NGOs** (Non-Governmental Organisations) and **WHO** are to prevent the spreading of AIDS.

92. What are auto antibodies and auto antigens?**Auto antibodies:**

Our body produces antibodies (auto antibodies) and cytotoxic T cells that destroy our own tissues.

Auto antigens:

The cells act as antigens in the same body they are called auto antigens.

93. Differentiate between benign tumour and malignant tumour.

S.No	Benign tumour	Malignant tumour
1	It is a non-cancerous tumour.	It is a cancerous tumour.
2	Limited adherence occurs amongst cells of benign tumour	There is no adherence amongst cells. They tend to slip past one another.

3	It does not show metastasis and is non-invasive.	It shows metastasis and thus invades other body parts.
4	It stops growth after reaching a certain size.	It shows indefinite growth.
5	It is less fatal to the body.	It is more fatal to the body.

94. What is called drug abuse?

The intake of certain drugs for a purpose other than their normal clinical use in an amount and frequency that impair one's physical, physiological and psychological functions is called drug abuse.

95. Name the drugs obtained from hemp plant *cannabis sativa*. Mention their effects on human body.

1. Natural cannabinoids are the main source of marijuana, ganja, hashish and charas.
2. It interferes in the transport of the neurotransmitter, dopamine and has a potent stimulating action on the CNS, producing increased energy and a sense of euphoria.

96. Name some drugs which are commonly abused.

1. Opioids.
2. Cannabinoids.
3. Coca-alkaloids.
4. Barbiturates.
5. Amphetamines.
6. LSD

97. Mention the effects of morphine and Heroin on the human body.

1. Heroin is obtained by acetylation of morphine, which is extracted from flowers of the poppy plant.
2. Morphine is one of the strongest pain killers and is used during surgery. It is the most widely abused narcotic drug which acts as a depressant and slows down body function.

98. Name the drug obtained from the leaves of coca plant. Mention their effects on human body.

1. Cocaine is a white powder that is obtained from the leaves of the coca plant, *Erythroxylum coca*.
2. Cocaine causes serious physical and psychological problems including hallucinations and paranoia.

99. Mention the drugs that are medically useful, but are often abused.

Drugs like methamphetamine, amphetamines, barbiturates, tranquilizers, Lysergic acid diethylamide (LSD) are normally used as medicine to treat patients with mental illness like depression and insomnia and are often abused.

100. Explain why using tobacco in any form is injurious to health.

1. Tobacco is smoked, chewed and used as snuff. It increases the carbon monoxide content of blood and reduces the concentration hemoglobin bound oxygen, thus causing oxygen deficiency in the body.
2. Tobacco contains nicotine, Carbon monoxide and tars, which cause problems in the heart, lung and nervous system.
3. Adrenal glands are stimulated by nicotine to release adrenaline and nor adrenaline which increases blood pressure and heart beat.

101. How do repeated uses of drugs affect the addicted person?

1. Repeated use of drugs and alcohol may affect the tolerance level of the receptors present in the body.
2. These receptors then respond only to highest doses of drugs and alcohol leading to greater intake and addiction.
3. Excessive use of drug and alcohol leads to physical and psychological dependence. When psychological dependence develops the drug user gets mentally hooked on to the drug.
4. The drug user constantly thinks only about the drug and has continuous uncontrollable craving for it. This state called “**euphoria**” is characterized by mental and emotional preoccupation with the drug.

102. State some short term-effects of drugs and alcohol.

Euphoria, pain, dullness of sense, alteration in behavior, blood pressure, narcosis(deep sleep), nausea and vomiting.

103. Mention the long-term of alcohol.

1. Alcohol interferes with the ability of the liver to break down fat. Over time fat accumulation and high levels of alcohol destroy the liver cells and a scar tissue grows in the place of dead cells. This scarring of the liver is called “**Liver cirrhosis**”.
2. Alcohol irritates the stomach lining due to the production of excess acid leading to ulcers.

3. Excessive alcohol use weakens the heart muscle, causing scar tissue to build up in the cardiac muscle fibers. As a result heavy drinkers have an increased risk of high blood pressure, stroke, coronary artery disease and heart attack.
4. Korsakoff syndrome a chronic memory disorder is most commonly caused by alcohol misuses.

104. Mention the symptoms of mental depression.

1. Loss of self confidence and self esteem.
2. Anxiety
3. Not being able to enjoy things that are usually pleasurable or interesting.

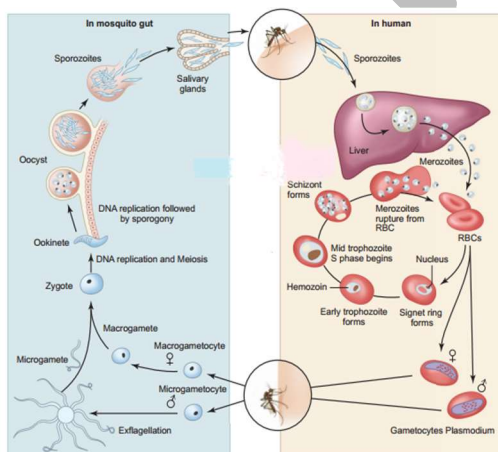
105. Write the ways that can help to be relieved from depression.

1. Lifestyle changes like exercise, meditation, yoga and healthy food habits can help to be relieved from depression.
2. Exercise stimulates the body to produce serotonin and endorphins, which are neurotransmitters that suppress depression. Practicing exercise in daily life creates a positive attitude.
3. Participating in an exercise programme can:
 - Increase self-esteem.
 - Boost self-confidence.
 - Create a sense of empowerment.
 - Enhance social connections and relationships.

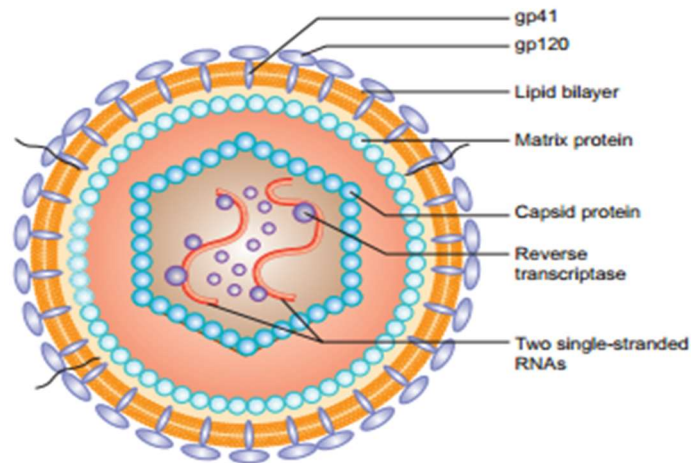
❖ **5 marks creative questions and answers:**

106. Explain the events in life cycle of plasmodium in the secondary host/Man.

1. *Plasmodium vivax* is a digenic parasite, involving two hosts, man as the secondary host and female *anopheles* mosquito as the primary host.

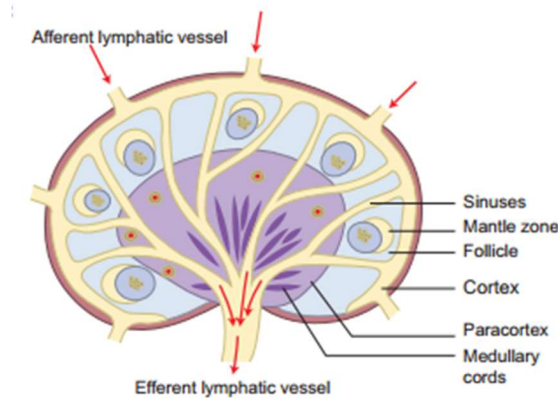


2. The life cycle of plasmodium involves three phases namely schizogony, gamogony and sporogony.
3. The parasite first enters the human blood stream through the bite of an infected female anopheles mosquito. As it feeds, the mosquito injects the saliva containing the sporozoites.
4. The sporozoite within the blood stream immediately enters the hepatic cells of the liver. Further in the liver they undergo multiple asexual fission (schizogony) and produce merozoites.
5. After being released from liver cells, the merozoites penetrate the RBC's. Inside the RBC, the merozoite begins to develop as unicellular trophozoites.
6. The trophozoite grows in size and a central vacuole develops pushing them to one side of cytoplasm and becomes the signet ring stage.
7. The trophozoite nucleus then divides asexually to produce the schizont. The large schizont shows yellowish-brown pigmented granules called schuffner's granules.
8. The schizont divides and produces mononucleated merozoites. Eventually the erythrocyte lyses, releasing the merozoites and haemozoin toxin into the blood stream to infect other erythrocytes. Lysis of red blood cells results in cycles of fever and other symptoms.
9. This erythrocytic stage is cyclic and repeats itself approximately every 48 to 72 hours or longer depending on the species of plasmodium involved.
10. The sudden release of merozoites triggers an attack on the RBCs. Occasionally, merozoites differentiate into macrogametocytes and microgametocytes.
11. When these are ingested by a mosquito, they develop into male and female gametes respectively.
12. In the mosquito's gut, the infected erythrocytes lyse and male and female gametes fertilize to form a diploid zygote called ookinete.
13. The ookinete migrates to the mosquito's gut wall and develop into an oocyte. The oocyte undergoes meiosis by a process called sporogony to form sporozoites. These sporozoites migrate to the salivary glands of the mosquito.
14. The cycle is now completed and when the mosquito bites another human host, the sporozoites are injected and the cycle begins anew.

107. Describe the structure of HIV.

1. The human immunodeficiency virus belongs to the genus lentivirus.
2. When observed under the electron microscope, HIV is seen as a spherical virus, 100-120 nm in diameter, containing a dense core surrounded by a lipoprotein envelope.
3. The envelope has glycoprotein (gp) spikes termed gp 41 and gp 120. At the core, there are two large single stranded RNA. Attached to the RNA are molecules of reverse transcriptase.
4. It also contains enzymes like protease and ribonuclease. The core is covered by a capsid made of proteins.
5. HIV can survive for 1.5 days inside a cell but only about 6 hours outside a cell.

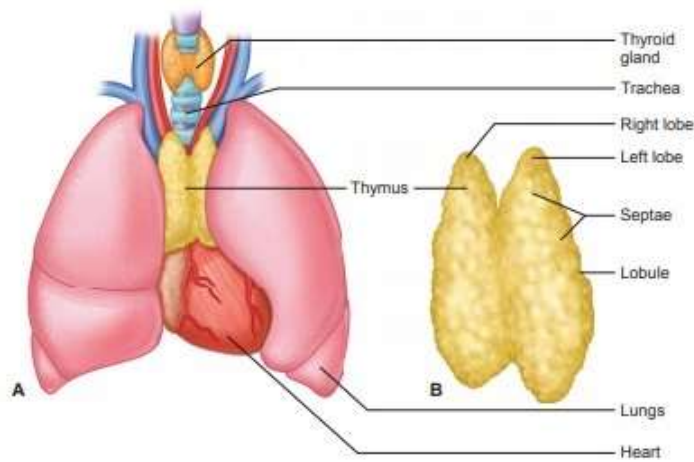
108. Explain the structure of peripheral lymphoid organ lymph node with suitable diagram.



1. Lymph node is a small bean shaped structure and is part of the body's immune system. It is the first one to encounter the antigen that enters the tissue spaces.
2. Lymph nodes filter and trap substances that travel through the lymphatic fluid. They are packed tightly with white blood cells, namely lymphocytes and macrophages.
3. There are hundreds of lymph nodes found throughout the body. They are connected to one another by lymph vessels.
4. Lymph is a clear, transparent, colorless, mobile and extracellular fluid connective tissue. As the lymph percolates through the lymph node, the particulate antigen brought in by the lymph will be trapped by the phagocytic cells, follicular and interdigitating dendritic cells.
5. Lymph node has three zones they are the cortex, paracortex and medulla. The outer most layer of the lymph node is called cortex, which consists of B-lymphocytes, macrophages. And follicular dendritic cells.
6. The paracortex zone is beneath the cortex, which is richly populated by T lymphocytes and interdigitating dendritic cell.
7. The inner most zone is called the medulla which is sparsely populated by lymphocytes, but many of them are plasma cells, which actively secrete antibody molecules.
8. As the lymph enters, it slowly percolates through the cortex, paracortex and medulla, giving sufficient chance for the phagocytic cells and dendritic cells to trap the antigen brought by the lymph.
9. The lymph leaving a node carries enriched antibodies secreted by the medullary plasma cells against the antigens that enter the lymph node.
10. Sometimes visible swelling of lymph nodes occurs due to active immune response and increase concentration of lymphocytes.
11. Thus swollen lymph nodes may signal an infection. There are several groups of lymph nodes. The most frequently enlarged lymph nodes are found in the neck, under the chin, in the armpits and in the groin.

109. Explain the structure of primary lymphoid organ thymus and Bone marrow with suitable diagram.

Thymus:



1. The thymus is a flat and bilobed organ located behind the sternum, above the heart.
2. Each lobe of the thymus contains numerous lobules, separated from each other by connective tissue called septa.
3. Each lobule is differentiated into two compartments, the outer compartment or outer cortex, is densely packed with immature T cells called thymocytes, whereas the inner compartment or medulla is sparsely populated with mature thymocytes.
4. One of its main secretions is the hormone thymosin. It stimulates the T cell to become mature and immune competent.
5. By the early teens, the thymus begins to atrophy and is replaced by adipose tissue thus thymus is most active during the neonatal and pre adolescent periods.

Bone marrow:

1. Bone marrow is a lymphoid tissue found within the spongy portion of the bone.
2. Bone marrow contains stem cells known as hematopoietic cells.
3. These cells have the potential to multiply through cell division and either remain as stem cells or differentiate and mature into different kinds of blood cells.

110. List any five bacterial diseases causative agents, mode of transmission of syndrome.

S.No	Diseases	Causative agent	Site of infection	Mode of transmission	Symptoms
1	Shigellosis (Bacillary dysentery)	<i>Shigella sp.</i>	Intestine	Food and water contaminated by faeces/ faecal oral route	Abdominal pain, dehydration, blood and mucus in the stools.
2	Bubonic plague (Black death)	<i>Yersinia pestis</i>	Lymph nodes	Rat flea vector <i>Xenopsylla cheopis</i>	Fever, headache, and swollen lymph nodes.
3	Diphtheria	<i>Corynebacterium</i>	Larynx, skin, nasal and genital passage	Droplet infection	Fever, sore throat, hoarseness and difficulty in breathing
4	Cholera	<i>Vibrio cholera</i>	Intestine	contaminated food and water/ faecal oral route	Severe diarrhea and dehydration
5	Tetanus (Lock jaw)	<i>Clostridium tetani</i>	Spasm of muscles	Through wound infection	Rigidity of jaw muscle, increase heart beat rate and spasm of the muscles of the jaw and face
6	Typhoid (Enteric fever)	<i>Salmonella typhi</i>	Intestine	Through contaminated food and water	Headache abdominal discomfort, fever and diarrhea.
7	Pneumonia	<i>Streptococcus pneumonia</i>	Lungs	Droplet infection	Fever, cough, painful breathing and brown sputum
8	Tuberculosis	<i>Tuberculosis</i>	lungs	Droplet infection	Thick mucopurulent nasal discharge

111. List any five viral diseases, their causative agents, site of infection, mode of transmission and symptoms.

S.No	Diseases	Causative agent	Site of infection	Mode of transmission	Symptoms
1	Common cold	<i>Rhino viruses</i>	Respiratory tract	Droplet infection	Nasal congestion and discharge, sore throat, cough and headache
2	Mumps	<i>Mumps virus (RNA virus), Paramyxo virus</i>	Salivary glands	Saliva and droplet infection	Enlargement of the parotids glands
3	Measles	<i>Rubella virus (RNA virus), paramyxo virus</i>	Skin and respiratory tract	Droplet infection	Sore throat, running nose, cough and fever, reddish rashes on the skin, neck and ears.
4	Viral hepatitis	<i>Hepatitis-B virus</i>	Liver	Parenteral route, blood transfusion	Liver damage, jaundice, nausea, yellowish eyes, fever and pain in the abdomen
5	Chicken pox	<i>Varicella zoster virus (DNA virus)</i>	Respiratory track, skin and nervous system	Droplet infection and direct contact	Mild fever with itchy skin, rash and blisters
6	Poliomyelitis	<i>Polio virus (RNA virus)</i>	Intestine, brain, spinal cord	Droplet infection through faecal oral route	Fever, muscular stiffness and weakness, paralysis and respiratory failure
7	Dengue fever (Break bone fever)	<i>Dengue virus or flavi virus (DENV1-4 virus)</i>	Skin and blood	Mosquito vector <i>Aedes aegypti</i>	Severe flu like illness with a sudden onset of fever and painful headache, muscle and joint pain

112. List out the classification of drugs.

Group	Drugs	Effects
Stimulants	Amphetamines, cocaine, nicotine and tobacco	Accelerates the activity of the brain
Depressants	Alcohol, barbiturates, tranquilizers	Slow down the activity of the brain
Narcotic/ Analgesics	Opium, morphine	Act as depressants on the Central Nervous System.
Hallucinogens	Lysergic acid diethylamide (LSD), phenylclidine	Distorts the way one sees, hears and feels
Stimulants, Depressants, Hallucinogens	Bhang (Marijuana), Ganja, Charas	Stimulating action on the CNS and affects the cardiovascular system

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Bio-Zoology

Unit-III

Chapter: 8 Microbes in Human Welfare

Textbook questions and answers:

1. Which of the following microorganism is used for production of citric acid industries
***Aspergillus niger*.**
2. Which of the following pair is correctly matched for the product produced by them?
 - a) Asetobacter aceti- Antibiotics
 - b) Methanobacterium-Lactic acid
 - c) Penicilium notatum- Acetic acid
 - d) ***Saccharomyces cerevisiae*- Ethanol**
3. The most common substrate used in distilleries for the production of ethanol is
Molasses.
4. Cyclosporin- A is an immunosuppressive drug produced from ***Trichoderma polysporum*.**
5. CO₂ is not released during **Lactate fermentation.**
6. The purpose of biological treatment of waste water is to **Reduce BOD.**
7. The gases produced in anaerobic sludge digesters are **Methane, hydrogen sulphide and CO₂.**
8. **How is milk converted into curd? Explain the process of curd formation.**
 1. The LAB bacteria grows in milk and convert it into curd, thereby digesting the milk protein casein.
 2. A small amount of curd added to fresh milk as a starter or inoculums contains millions of lactobacilli which under suitable temperature ($\leq 40^{\circ}\text{C}$) multiply and convert milk into curd.
 3. Curd is more nutritious than milk as it contains a number of organic acids and vitamins.

9. Give any two bioactive molecules produced by microbes and state their uses.

1. **Lipases** are used in detergent formulations and are used for removing oily stains from the laundry.
2. **Rennet** can also be used to separate milk into solid curds for cheese making.
3. Bottled juices are clarified by the use of **pectinase, protease** and **cellulose**.
4. Streptococcus and genetically engineered streptococci are used as “**Clot buster**” for removing clots from the blood vessels of patients who have undergone myocardial infarction.
5. **Cyclosporin A** an immunosuppressant used in organ transplantation is produced from the fungus.
6. **Statins** produced by the yeast *monascus purpureus* have been used to lower blood cholesterol levels. It acts by competitively inhibiting the enzyme responsible for the synthesis of cholesterol.

10. Define the following terms.

a) Antibiotics:

1. **Selman Waksman** discovered streptomycin and was the first to use the term “**Antibiotic**” in 1943.
2. Antibiotics are chemical substances produced by microorganism which can kill or retard the growth of other disease causing microbes even in low concentration. Antibiotic means “**against life**”.
3. Antibiotics are used to treat diseases such as plague, meningitis, syphilis, leprosy, tuberculosis etc.,

b) Zymology:

The zymology is an applied science which deals with the biochemical process of fermentation and its practical uses.

c) Superbug:

“Superbug” is a term used to describe strains of bacteria that are resistant to the majority of antibiotics commonly used today.

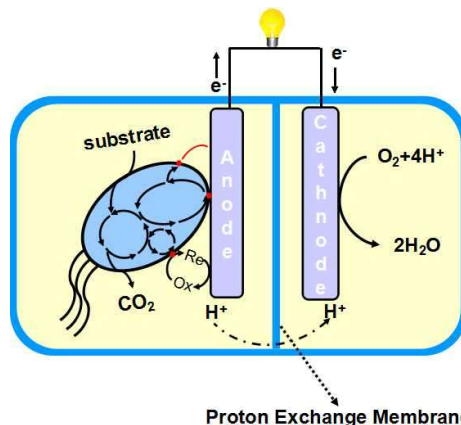
11. Write short notes on the following.

a) Brewer's yeast:

1. *Saccharomyces cerevisiae* commonly called brewer's yeast is used for fermenting malted cereals and fruit juices to produce various alcoholic beverages.
2. Wine and beer are produced without distillation, whereas whisky, brandy and rum are obtained by fermentation and distillation.

b) *Ideonella sakaiensis*:

1. *Ideonella sakaiensis* is currently tried for recycling of PET plastics.
2. These bacteria use PTEase and MHETase enzymes to breakdown PET plastic into *terephthalic acid* and ethylene glycol.

c) Microbial fuel cells:

1. A microbial fuel cell is a bio-electrochemical system that drives an electric current by using bacteria and mimicking bacterial interaction found in nature.
2. Microbial fuel cells work by allowing bacteria to oxidize and reduce organic molecules.
3. Bacterial respiration is basically one big redox reaction in which electrons are being moved around.
4. A MFC consists of an anode and a cathode separated by a proton exchange membrane.
5. Microbes at the anode oxidize the organic fuel generating protons which pass through the membrane to the cathode and the electrons pass through the anode to the cathode and the electrons pass through the anode to the external circuit to generate current.

12. List the advantages of biogas plants in rural areas.

1. The slurry is drained through another outlet and is used as fertilizer.
2. Biogas is used for cooking and lighting.
3. The technology of biogas production was developed in India mainly due to the efforts of Indian Agricultural Research Institute (IARI) and Khadi and Village Industries Commission (KVIC).

13. When does antibiotic resistance develop?

1. Antibiotic resistance occurs when bacteria develop the ability to defeat the drug designed to kill or inhibit their growth. It is one of the most acute threats to public health.
2. Antibiotic resistance is accelerated by the misuse and over use of antibiotics, as well as poor infection prevention control.
3. Antibiotics should be used only when prescribed by a certified health professional.
4. When the bacteria become resistant, antibiotics cannot fight against them and the bacteria multiply.
5. Narrow spectrum antibiotics are preferred over broad spectrum antibiotics. They effectively and accurately target specific pathogenic organisms and are less likely to cause resistance.
6. "Superbug" is a term used to describe strains of bacteria that are resistant to the majority of antibiotics commonly used today.

14. What is referred to as industrial alcohol? Briefly describe its preparation.

1. *Saccharomyces cerevisiae* is the major producer of ethanol (C_2H_5OH). It is used for industrial, laboratory and fuel purposes. So ethanol is referred to as **industrial alcohol**.
2. Bacteria such as *Zymomonas mobilis* and *Sarcina ventriculi* are also involved in ethanol production.
3. The principal substrates for the commercial production of industrial alcohol include molasses or corn, potatoes and wood wastes.
4. The process of ethanol production starts by milling a feed stock followed by the addition of dilute or fungal amylase (enzyme) from *Aspergillus* to break down the starch into fermentable sugars.
5. Yeast is then added to convert the sugars to ethanol which is then distilled off to obtain ethanol which is upto 96% in concentration.
6. The two most common type of biofuels in use today are ethanol and biodiesel, both of them represent the first generation of biofuel technology.
7. Ethanol is often used as a fuel, mainly as a biofuel additive for gasoline.

15. What is bioremediation?

1. The use of naturally occurring or genetically engineered microorganisms to reduce or degrade pollutants is called bioremediation.
2. Bioremediation is less expensive and more sustainable than other remediation's available.

3. It is grouped into **in situ** bioremediation (treatment of contaminated soil or water in the site) and **ex situ** bioremediation (treatment of contaminated soil or water that is removed from the site and treated).

Other important questions and answers:

16. Which is referred to as industrial alcohol? Why? (2019-2020)

1. Ethanol is referred to as industrial alcohol.
2. It is used for industrial, laboratory and fuel purposes.

17. What are the uses of methanobacterium? (PTA 2019-2020)

1. Methanobacteria can be used in biomass conversion as well as energy production through anaerobic digestion process.
2. Microbial community is used in anaerobic digestion to convert organic wastes into clean energy by reducing chemical and biological oxygen demand in the wastes.

18. Why do we call some strains of bacteria super bug? (PTA-2019-2020)

They effectively and accurately target specific pathogenic organisms and are less likely to cause resistance. "Superbug" is a term used to describe strains of bacteria that are resistant to the majority of antibiotics commonly used today.

19. PET plastics are no more environmental hazardous substances. Why? (PTA 2019-2020)

Because *Ideonella sakaiensis* is currently tried for recycling of PET plastics. These bacteria use PETase and MHETase enzymes to breakdown PET plastic into terephthalic acid and ethylene glycol.

2 and 3 marks Creative questions and answers:

20. What are prebiotics?

Prebiotics are compounds in food (fibers) that induce the growth or activity of beneficial microorganisms.

21. What are probiotics?

Probiotics are live microorganism intended to provide health benefits when consumed, generally by improving or restoring the gut flora.

22. Why is curd more nutritious than milk?

Curd is more nutritious than milk since it contains a number of organic acids and vitamins.

23. How is yoghurt produced?

1. Yoghurt is produced by bacterial fermentation of milk, and lactic acid is produced as a byproduct.
2. Microorganisms such as *Streptococcus thermophilus* and *Lactobacillus bulgaricus* coagulate the milk protein and convert the lactose in the milk to lactic acid.

3. The flavour in yogurt is due to acetaldehyde.

24. How is cheese produced?

1. Cheese is a dairy product produced in a wide range of flavours, textures and is formed by coagulation of the milk protein, casein.
2. During cheese production, milk usually acidified and the enzyme rennet is added to cause coagulation.
3. The solids are separated and pressed to form cheese. Most cheese are made with a starter bacteria, *lactococcus*, *lactobacillus* or *Streptococcus*.

25. How is paneer produced?

1. Paneer (cottage cheese) is fresh cheese common in South Asia, especially in India.
2. It is made by curdling milk with lemon juice, vinegar and other edible acids.
3. Large holes in Swiss cheese is due to the production of large amount of carbon-di-oxide by the bacterium *propionibacterium shermanii*.

26. How is bread prepared by microbial action?

1. Dough used in bread making is fermented by *saccharomyces cerevisiae* (Baker's Yeast).
2. Fermentation of glucose mainly forms ethyl alcohol and carbon-di-oxide, which is responsible for leavening of dough.
3. When leavened dough is baked, both carbon-di-oxide and ethyl alcohol evaporated making the bread porous and soft.

27. What is SCP?

Single cell protein refers to edible unicellular microorganisms like *spirulina*. Protein extracts from pure or mixed cultures of algae, yeasts, fungi or bacteria may be used as ingredient or as a substitute for protein rich foods and is suitable for human consumption or as animal feed.

28. What is penicillin?

1. Penicillin is produced by the fungi *penicillium notatum* and *penicillium chrysogenum*.
2. It is bactericidal (antibiotics that kill bacteria) in action and inhibits the synthesis of the bacterial cell wall.
3. Penicillin is also referred as the "Queen of drugs".

29. What is antibiosis?

The antibiosis is the property of antibiotics to kill microorganisms.

30. Define tetracycline.

Tetracycline is a broad spectrum bacteriostatic antibiotic (antibiotics that limit the growth of bacteria) that inhibits microbial protein synthesis.

31. Define streptomycin.

1. Streptomycin is a broad spectrum antibiotic isolated from the *actinomycetes*, *streptomyces griseus*.
2. It is bactericidal against both gram positive and gram negative bacteria, especially against *mycobacterium tuberculosis*.

32. Name some antibiotics isolated as microbial products.

1. Erythromycin.
2. Chloromycetin.
3. Griseofulvin.
4. Neomycin.
5. Kenamycin.
6. Bacitracin.

33. Why were Chain and Florey awarded Nobel Prize?

1. The first antibiotic (penicillin) discovered by Alexander Fleming in 1926.
2. Penicillin is also referred as the “queen of drugs” and its full potential as an effective antibiotic was established much later by Earnest Chain and Howard Florey when they treated the wounded soldiers in World War II with penicillin.
3. Fleming, chain and Florey were awarded the nobel prize in 1945 for the discovery of penicillin.

34. Give example of two antibiotics and their mode of action.

1. Penicillin is a bactericidal (antibiotics that kill bacteria) in action and inhibits the synthesis of the bacterial cell wall.
2. Tetracycline is a broad spectrum bacteriostatic antibiotic (antibiotics that limit the growth of bacteria) that inhibits microbial protein synthesis.

35. What is Oenology?

Oenology is the science and study of wine and wine making. Wine is made from the fermentation of grape juice.

36. Name the substrates used for production of industrial alcohol.

The principal substrates for the commercial production of industrial alcohol include molasses or corn, potatoes and wood wastes.

37. How is wine made? What are the two types of wine?

1. Wine is made from the fermentation of grape juice. Grape juice is fermented by various strains of *saccharomyces cerevisiae* into alcohol.
2. Grape wine is of two types, red wine and white wine.

Red wine:

Black grapes are used including skins and sometimes the stems also are used.

White wine:

White wine is produced only from the juice of either white or red grapes without their skin and stems.

38. What is toddy? How is vinegar produced?

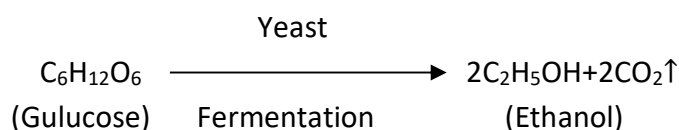
1. When pathaneer is left undisturbed for few hours it gets fermented to form toddy with the help of naturally occurring yeast, to form a beverage that contains 4% alcohol.
2. After 24 hours toddy becomes unpalatable and is used for the production of vinegar.

39. How are palm trees used for obtaining alcoholic beverages?

Pathaneer a traditional drink is got from fermenting sap of palm and coconut trees. When pathaneer is left undisturbed for few hours it gets fermented to form toddy with the help of naturally occurring yeast, to form a beverage that contains 4% alcohol.

40. Write the scientific name of the microbes used for fermenting the following and mention their products.

S.No	Microbes	Plant	Product
1	<i>Saccharomyces carlsbergensis</i> or <i>Saccharomyces cerevisiae</i> .	Barley Malt grain	Beer
2	<i>Saccharomyces cerevisiae</i>	Fermented sugarcane or molasses or directly from sugarcane juice.	Rum
3	<i>Saccharomyces cerevisiae</i>	Fermented grain mash	Whisky

41. Write the equation for fermentation of glucose.**42. What is the significance of world biofuel day?**

1. World bio-fuel day is observed every year on 10th August to create awareness about the importance of renewable bio-fuels as an alternative to conventional non-renewable fossil fuels.
2. This day also highlights the various efforts taken by the government in the bio-fuel sector.

43. Give four examples of acids produced from microbes.

1. *Aspergillus niger* for **citric acid**.
2. *Acetobacter aceti* for **acetic acid**.
3. *Rhizopus oryzae* for **fumaric acid**.
4. *Clostridium butyricum* for **butyric acid**.
5. *Lactobacillus* for **lactic acid**.

44. What is GEM? Give an example.

1. *Pseudomonas putida* is a genetically engineered microorganism (GEM). Ananda Mohan Chakrabarty obtained patent for this recombinant bacterial strain.
2. It is multi plasmid hydrocarbon degrading bacterium which can digest the hydrocarbons in the oil spills.

45. Mention the commercial enzymes and their importance.

1. **Lipases** are used in detergent formulations and are used for removing oily stains from the laundry.
2. Bottled juices are clarified by the use of **pectinase**, **protease** and **cellulose**.
3. **Rennet** can also be used to separate milk into solid curds for cheese making.

46. Name the enzyme produced by streptococcus bacterium. Explain its importance in medical sciences.

Streptokinase produced by the bacterium streptokinase produced by the bacterium *streptococcus* and genetically engineered *streptococci* are used as clot buster for removing clots from the blood vessels of patients who have undergone myocardial infarction.

47. What is biogas? How is it produced? List the components of it?

1. Biogas is a mixture of different gases produced by the breakdown of organic matter in the absence of oxygen.
2. Biogas can be produced from raw materials such as agricultural wastes, manure, municipal wastes, plant material, sewage, food waste etc.,
3. Biogas is produced under anaerobic condition, when the organic materials are converted through microbiological reactions into gas and organic fertilizer.
4. Biogas primarily consists of methane 63%, along with CO₂ and hydrogen.

48. How biogas is generated form a biogas plant?

1. Ina biogas plant, anaerobic digestion is carried out in an air tight cylindrical tank known as digester. It is made up of concrete brick and cement or steel.
2. Bio-wastes are collected and slurry of dung is fed into this digester. It has a side opening into which organic materials for digestion are incorporated for microbial activity.
3. Anaerobic digestion is accomplished in three stages: **solubilisation**, **acidogenesis** and **methanogenesis**.
4. The outlet is connected to a pipe to supply biogas. The slurry is drained through another outlet and is used as fertilizer.

49. How is Gobar gas produced?

1. The excreta of cattle called dung is commonly called "Gobar".
2. Gobar gas is generated by the anaerobic decomposition of cattle dung.
3. It consists of methane, CO₂ with some hydrogen, nitrogen and other gases in trace amounts.

50. Explain Bio remediation by aerobic microbes with examples.

1. Aerobic microbes degrade the pollutants in the presence of oxygen. They mainly degrade pesticides and hydrocarbons.
2. *Pseudomonas putida* is a genetically engineered microorganism (GEM). Ananda Mohan Chakrabarty obtained patent for this recombinant bacterial strain.
3. It is multi plasmid hydrocarbon degrading bacterium which can digest the hydrocarbons in the oil spills.
4. *Nitrosomonas europaea* is also capable of degrading benzene and a variety of halogenated organic compounds including trichloroethylene and vinyl chloride.
5. *Ideonella sakaiensis* is currently tried for recycling of PET plastics. These bacteria use PETase and MHETase enzymes to breakdown PET plastic into terephthalic acid and ethylene glycol.

51. Explain Bio remediation by anaerobic microbes with examples.

1. Anaerobic microbes degrade the pollutants in the absence of oxygen. *Dechloromonas aromatica* has the ability to degrade benzene anaerobically and to oxidize toluene and xylene.
2. *Phanerochaete chrysosporium* an anaerobic fungus exhibits strong potential for bioremediation of pesticides, polyaromatic hydrocarbons, dyes, trinitrotoluene, cyanides, carbon tetrachloride etc.,

3. *Dehalococcoides* species of are responsible for anaerobic bioremediation of toxic trichloroethene to non-toxic ethane.
4. *Pestalotiopsis microspora* is a species of endophytic fungus capable of breaking down and digesting polyurethane. This makes the fungus a potential candidate for bioremediation projects involving large quantities of plastics.

5 marks creative questions and answers:

52. Explain the working of a biogas plant.

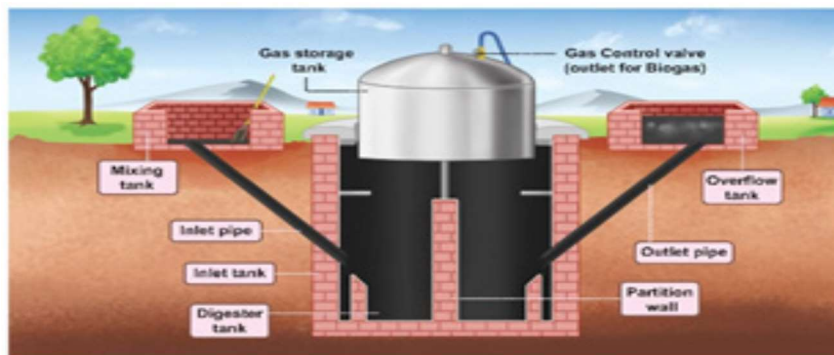


Fig. 8.4 Biogas unit

1. Biogas is a mixture of different gases produced by the breakdown of organic matter in the absence of oxygen.
2. Biogas can be produced from raw materials such as agricultural wastes, manure, municipal wastes, plant material, sewage, food waste etc.,
3. Biogas is produced under anaerobic condition, when the organic materials are converted through microbiological reactions into gas and organic fertilizer.
4. Biogas primarily consists of methane 63%, along with CO₂ and hydrogen.
5. Methane producing bacteria are called methanogens and one such common bacterium is *methanobacterium*. Biogas is devoid of smell and burns with a blue flame without smoke.
6. The methanogens are also present in anaerobic sludge and rumen of cattle. In rumen, these bacteria help in the breakdown of cellulose.
7. The excreta of cattle called dung is commonly called "Gobar". Gobar gas is generated by the anaerobic decomposition of cattle dung.
8. It consists of methane, CO₂ with some hydrogen, nitrogen and other gases in trace amounts.
9. In a biogas plant, anaerobic digestion is carried out in an air tight cylindrical tank known as digester. It is made up of concrete brick and cement or steel.
10. Bio-wastes are collected and slurry of dung is fed into this digester. It has a side opening into which organic materials for digestion are incorporated for microbial activity.

11. Anaerobic digestion is accomplished in three stages: **solubilisation**, **acidogenesis** and **methanogenesis**.
12. The outlet is connected to a pipe to supply biogas. The slurry is drained through another outlet and is used as fertilizer.
13. The slurry is drained through another outlet and is used as fertilizer. Biogas is used for cooking and lighting.
14. The technology of biogas production was developed in India mainly due to the efforts of Indian Agricultural Research Institute (IARI) and Khadi and Village Industries Commission (KVIC).

53. Explain how microorganisms involved in bioremediation?

Aerobic microbes:

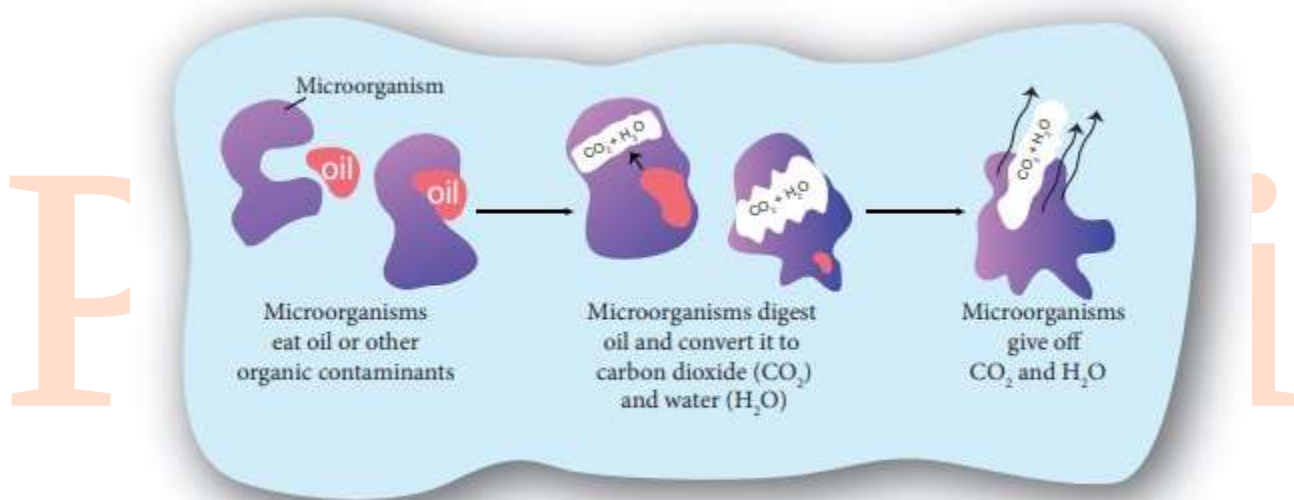
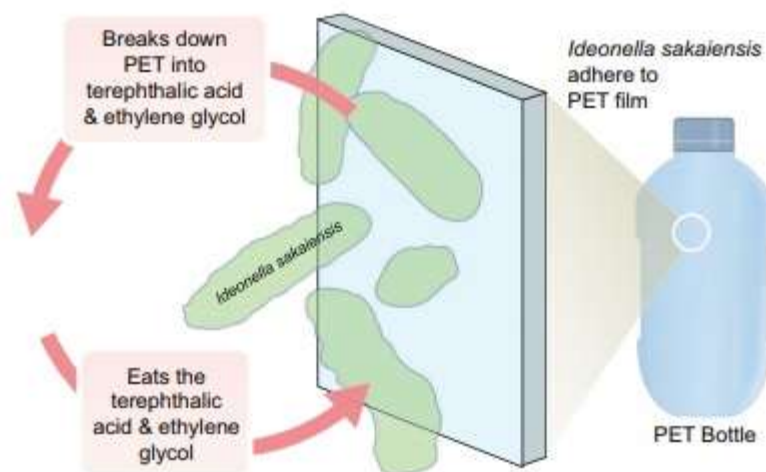


Fig. 9.6 The process of bioremediation

1. Aerobic microbes degrade the pollutants in the presence of oxygen. They mainly degrade pesticides and hydrocarbons.
2. *Pseudomonas putida* is a genetically engineered microorganism (GEM). Ananda Mohan Chakrabarty obtained patent for this recombinant bacterial strain.
3. It is multi plasmid hydrocarbon degrading bacterium which can digest the hydrocarbons in the oil spills.
4. *Nitrosomonas europaea* is also capable of degrading benzene and a variety of halogenated organic compounds including trichloroethylene and vinyl chloride.
5. *Ideonella sakaiensis* is currently tried for recycling of PET plastics. These bacteria use PETase and MHETase enzymes to breakdown PET plastic into terephthalic acid and ethylene glycol.

Anaerobic microbes:**Fig. 9.7 Actions of *Ideonella sakaiensis***

1. Anaerobic microbes degrade the pollutants in the absence of oxygen. *Dechloromonas aromatica* has the ability to degrade benzene anaerobically and to oxidize toluene and xylene.
2. *Phanerochaete chrysosporium* an anaerobic fungus exhibits strong potential for bioremediation of pesticides, polyaromatic hydrocarbons, dyes, trinitrotoluene, cyanides, carbon tetrachloride etc.,
3. *Dehalococcoides* species of are responsible for anaerobic bioremediation of toxic trichloroethene to non-toxic ethane.
4. *Pestalotiopsis microspora* is a species of endophytic fungus capable of breaking down and digesting polyurethane. This makes the fungus a potential candidate for bioremediation projects involving large quantities of plastics.

54. List any three useful microbes in household products.**Yogurt:**

1. Yogurt is produced by bacterial fermentation of milk, and lactic acid is produced as a byproduct.
2. Microorganisms such as *Streptococcus thermophilus* and *Lactobacillus bulgaricus* coagulate the milk protein and convert the lactose in the milk to lactic acid.
3. The flavour in yogurt is due to acetaldehyde.

Cheese:

1. Cheese is a dairy product produced in a wide range of flavours, textures and is formed by coagulation of the milk protein, casein.

2. During cheese production, milk usually acidified and the enzyme rennet is added to cause coagulation.
3. The solids are separated and pressed to form cheese. Most cheese are made with a starter bacteria, *lactococcus*, *lactobacillus* or *Streptococcus*.

Paneer:

1. Paneer (cottage cheese) is fresh cheese common in South Asia, especially in India.
2. It is made by curdling milk with lemon juice, vinegar and other edible acids.
3. Large holes in Swiss cheese is due to the production of large amount of carbon-di-oxide by the bacterium *propionibacterium shermanii*.

Dough:

1. Dough used in bread making is fermented by *saccharomyces cerevisiae* (Baker's Yeast).
2. Fermentation of glucose mainly forms ethyl alcohol and carbon-di-oxide, which is responsible for leavening of dough.
3. When leavened dough is baked, both carbon-di-oxide and ethyl alcohol evaporated making the bread porous and soft.

55. Define fermentation. Explain any three fermented beverages.

Saccharomyces cerevisiae commonly called brewer's yeast is used for fermenting malted cereal and fruit juices to produce various alcoholic beverages. Wine and beer are produced without distillation, whereas whisky, brandy and rum are obtained by fermentation and distillation.

Beer:

Beer is produced from germinated barley malt grain by *saccharomyces carlsbergensis* or *saccharomyces cerevisiae*.

Rum:

Rum is made from fermented sugarcane or molasses or directly from sugarcane juice by *saccharomyces cerevisiae*.

Whisky:

Whisky is a type of distilled alcoholic beverage made from fermented grain mash by *saccharomyces cerevisiae*.

Wine:

Grape juice is fermented by various strains of *saccharomyces cerevisiae* into alcohol.

Grape wine is of two types, red wine and white wine.

Red wine:

Black grapes are used including skins and sometimes the stems also are used.

White wine:

White wine is produced only from the juice of either white or red grapes without their skin and stems.

Rana Sakthi Durga
Puducherry

Bio-Zoology

Unit-IV

Chapter: 9 Applications of Biotechnology

Textbook questions and answers:

1. The first clinical gene therapy was done for the treatment of **SCID**.
2. Dolly the sheep was obtained by a technique known as **cloning by nuclear transfer**.
3. The genetic defect adenosine deaminase deficiency may be cured permanently by **Introducing bone marrow cells producing ADA into embryo at an early stage of development**.
4. **Chain A has 21 and chain B has 30 amino acids** are arranged in the two chains of insulin.
5. PCR proceeds in three distinct steps governed by temperature, they are in order of **Denaturation, Annealing and Synthesis**.
6. Which one of the following statements is true regarding DNA polymerase used in PCR?
 - a) It is used to ligate introduced DNA in recipient cells.
 - b) It serves as a selectable marker.
 - c) It is isolated from a virus.
 - d) **It remains active at a high temperature.**
7. ELISA is mainly used for **Detection of pathogens**.
8. Transgenic animals are those which have **foreign DNA in all their cells**.
9. Vaccines that use components of a pathogenic organism rather than the whole organism are called **subunit recombinant vaccines**.

10. Mention the number of primers required in each cycle of PCR. Write the role of primers and DNA polymerase in PCR. Name the source organism of the DNA polymerase used in PCR.

Two sets of primers and the enzyme DNA polymerase are required in each cycle of polymerase chain reaction.

Role of primers and DNS polymerase:

1. Primers are necessary to start the functioning of DNA polymerase.
2. DNA polymerase extends the primers using the nucleotides provided in the reaction and the genomic DNA as the template.
3. The segment of DNA can be amplified to approximately billion times.

Source organism of the DNA polymerase used in PCR:

DNA polymerase used in PCR reaction is known as Taq polymerase, which is obtained from a bacterium *Thermus aquaticus*. It remains active during the high-temperature induced denaturation of double stranded DNA.

11. How is the amplification of a gene sample of interest carried out using PCR? (2019-2020)

1. The polymerase chain reaction (PCR) is an *invitro* amplification technique used for synthesising multiple identical copies (billions) of DNA of interest. The technique was developed by Kary Mullis (Nobel laureate, 1993) in the year 1983.
2. Denaturation, maturation or primer annealing and synthesis or primer extension, are the three steps involved in PCR.
3. The double stranded DNA of interests denatured to separate into two individual strands by high temperature. This is called denaturation.
4. Each strand is allowed to hybridize with a primer (renaturation or primer annealing). The primer template is used to synthesize DNA by using Taq-DNA polymerase.
5. During denaturation the reaction mixture is heated to 95° C for a short time to denature the target DNA into single strands that will act as a template for DNA synthesis.
6. Annealing is done by rapid cooling of the mixture, allowing the primers to bind to the sequences on each of the two strands flanking the target DNA.
7. During primer extension or synthesis the temperature of the mixture is increased to 75° C for a sufficient period of time to allow taq DNA polymerase to extend each primer by copying the single stranded template.
8. At the end of incubation both single template strands will be made partially double stranded.
9. The new strand of each double stranded DNA extends to a variable distance downstream. These steps are repeated again and again to generate multiple forms of the desired DNA. This process is also called DNA amplification.
10. The PCR technique can also be used for amplifications of RNA in which case it is referred to as reverse transcription PCR.

11. In this process the RNA molecules (mRNA) must be converted to complementary DNA by the enzyme reverse transcriptase. The cDNA then serves as the template for PCR.

12. What is genetically engineered Insulin?

1. Production of insulin by recombinant DNA technology started in the late 1970s.
2. This technique involved the insertion of human insulin gene on the plasmids of *E.coli*.
3. Insulin produced by recombination DNA technology to treat diabetic patients is called genetic engineered insulin. It is otherwise known as humulin.

13. Explain how “Rosie” is different from a normal cow?

1. Rosie is the first transgenic cow produced human protein enriched milk.
2. Which contained the human alpha lactalbumin.
3. The protein rich milk (2.4 gm/litre) was a nutritionally balanced food for new born babies than the normal milk produced by the cows.

14. How was Insulin obtained before the advent of rDNA technology? What were the problems encountered?

1. In the early years insulin isolated and purified from the pancreas of pigs and cows was used to treat diabetic patients.
2. Due to minor differences in the structure of the animal insulin as compare to human insulin it resulted in the occurrence of allergic reactions in some diabetic patients.

15. ELISA is a technique based on the principles of antigen antibody reactions. Can this technique be used in the molecular diagnosis of a genetic disorder such as Phenylketonuria?

1. Yes one can use antibody against the enzyme (that is responsible for the metabolism of phenylalanine) to develop ELISA based diagnostic technique.
2. The patient in which the enzyme protein is absent would give negative result in ELISA when compared to the normal individual.

16. Gene therapy is an attempt to correct a genetic defect by providing a normal gene into the individual. By this the function can be restored. An alternate method would be to provide gene product known as enzyme replacement therapy, which would also restore the function. Which in your opinion is a better option? Give reasons for your answer.

1. Gene therapy is the best option to correct a genetic defect. Because the disease could be cured permanently if the gene for that defect is introduced to the affected person.
2. In case of enzyme replacement therapy it will only be a temporary solution and involves injection of the enzyme to the patient which has to be done periodically.

17. What are transgenic animals? Give examples.

1. The foreign DNA that is introduced is called the transgenic and the animals that are produced by DNA manipulations are called transgenic animals or the genetically engineered or genetically modified organisms.
2. Transgenic animals such as **Mice, rat, rabbit, pig, cow, goat, sheep** and **fish** have been produced.

18. If a person thinks he is infected with HIV due to unprotected sex and goes for a blood test. Do you think a test such as ELISA will help? If so why? If not, why?

1. ELISA is a biochemical procedure to detect the presence of specific antibodies or antigens in a sample of serum, urine, etc.,
2. It is a very important diagnostic tool to determine if a person is HIV positive or negative.
3. ELISA is a tool for determining serum antibody concentrations (such as the antibodies produced in a person infected by pathogens such as HIV).
4. ELISA is highly sensitive and can detect antigens in the range of a nanogram.
5. ELISA will help to detect the presence of HIV antigens in the blood to show if the person is infected with HIV or not since it is only based on determination of antigens or antibodies in the sample being tested serum, urine etc.,

19. Explain how ADA deficiency can be corrected?

1. ADA deficiency could be cured by bone marrow transplantation, where defective immune cells could be replaced with healthy immune cells from a donor.
2. In some patients it can be treated by enzyme replacement therapy, in which functional ADA is injected into the patient.
3. During gene therapy the lymphocyte from the blood of the patient are removed and grown in a nutrient culture medium.
4. A healthy and functional human gene, ADA cDNA encoding this enzyme is introduced into the lymphocytes using a retrovirus.
5. The genetically engineered lymphocytes are subsequently returned to the patient. Since these cells are not immortal, the patient requires periodic infusion of such genetically engineered lymphocytes.
6. The disease could be cured permanently if the gene for ADA isolated from bone marrow cells are introduced into the cells of the early embryonic stages.

20. What are DNA vaccines?

1. A DNA vaccine consists of a gene encoding an antigenic protein, inserted onto a plasmid, and then incorporated into the cells in target animal.
2. DNA instructs the cells to make antigenic molecules which are displayed on its surfaces.
3. The DNA vaccine cannot cause the disease as it contains only copies of a few of its genes. DNA vaccines are relatively easy and inexpensive to design and produce.

21. Differentiate between somatic cell gene therapy and germ line gene therapy.

S.No	Somatic cell gene therapy	Germ line gene therapy
1	Therapeutic genes transferred into the somatic cells.	Therapeutic genes transferred into the germ cells.
2	Introduction of genes into bone marrow cells, blood cells, skin cells etc.,	Genes introduced into eggs and sperms.
3	Will not be inherited in later generations.	Heritable and passed on to later generation.

22. What are stem cells? Explain its role in the field of medicine.

1. Stem cells are undifferentiated cells found in most of the multi cellular animals. These cells maintain their undifferentiated state even after undergoing numerous mitotic divisions.
2. Most of the adult stem cells are multipotent and can act as a repair system of the body, replenishing adult tissues.
3. The red bone marrow is a rich source of adult stem cells.
4. The most important and potential application of human stem cells is the generation of cells and tissues that could be used for cell based therapies. Human stem cells could be used to test new drugs.

23. One of the applications of biotechnology is “gene therapy” to treat a person born with a hereditary disease.**i) What does “gene therapy” mean?**

1. The transfer of a normal gene into a person's cells that carries one or more mutant alleles.
2. Expression of normal gene in the person results in a functional gene product whose action produces a normal phenotype.

ii) Name the hereditary disease for which the first clinical gene therapy was used.

The first clinical gene therapy was given in 1990 by French Anderson to a four year old girl with adenosine deaminase (ADA) deficiency.

iii) Mention the steps involved in gene therapy to treat this disease.

1. Gene therapy the lymphocytes from the blood of the patient are removed and grown in a nutrient culture medium.
2. A healthy and functional human gene, ADA cDNA encoding this enzyme is introduced into the lymphocytes using a retrovirus.
3. The genetically engineered lymphocytes are subsequently returned to the patient. Since these cells are not immortal, the patient requires periodic infusion of such genetically engineered lymphocytes.
4. The disease could be cured permanently if the gene for ADA isolated from bone marrow cells are introduced into the cells of the early embryonic stages.

24. PCR is a useful tool for early diagnosis of an infectious disease. Elaborate. (PTA-2019-2020)

1. The specificity and sensitivity of PCR is useful for the diagnosis of inherited disorders (genetic diseases), viral diseases, bacterial diseases, etc.,
 2. The diagnosis and treatment of a particular disease often requires identifying a particular pathogen.
 3. DNA has unique sequences that can be detected by PCR, often using the clinical specimen (for example, blood, stool, spinal fluid, or sputum) in the PCR mixture.
 4. PCR is also employed in the prenatal diagnosis of inherited diseases by using chorionic villi samples or cells from amniocentesis.
 5. cDNA from PCR is a valuable tools for diagnosis and monitoring retroviral infections.
- Examples: Tuberculosis by *Mycobacterium tuberculosis*.**
6. Sex of human beings and live stocks, embryos fertilized *invitro* can be determined by PCR by using primers and DNA probes specific for sex chromosomes.
 7. PCR technique is also used to detect sex-linked disorders in fertilized embryos.

25. What are recombinant vaccines? Explain the types.

1. The recombinant vaccines are generally of uniform quality and produce less side effects as compared to the vaccines produced by conventional methods.
2. Different types of recombinant vaccines include subunit recombinant vaccines, attenuated recombinant vaccines and DNA vaccines.

Subunit recombinant vaccines:

1. Vaccines that use components of a pathogenic organism rather than the whole organism are called Subunit vaccines.
2. It includes components like proteins, peptides and DNAs of pathogenic organisms.

Attenuated recombinant vaccines:

1. This includes genetically modified pathogenic organisms (bacteria or viruses) that are made nonpathogenic and are used as vaccines.
2. It is now possible to genetically engineer the organisms (bacteria or viruses) and use them as live vaccines and such vaccines are referred to as attenuated recombinant vaccines.

DNA vaccines:

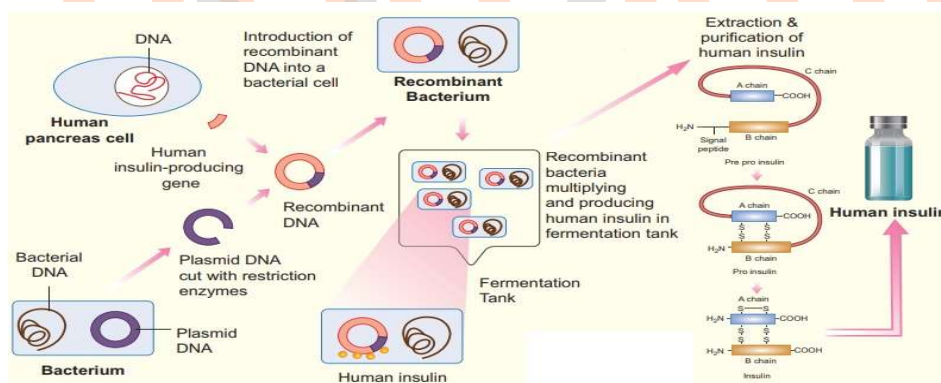
1. A DNA vaccine consists of a gene encoding an antigenic protein, inserted into a plasmid, and then incorporated into the cells in a target animal.
2. DNA instructs the cells to make antigenic molecules which are displayed on its surfaces.
3. The DNA vaccine cannot cause the disease as it contains only copies of a few of its gene. DNA vaccines are relatively easy and inexpensive to design and produce.

26. Explain why cloning of Dolly, the sheep was such a major scientific breakthrough?

1. Dolly was the first animal to be clone from a differentiated somatic cell taken from an adult animal without the process of fertilization.
2. This study offers benefits of clinical trials and medical researchers.
3. It is a breakthrough in receiving endangered species through this technique.

27. Mention the advantages and disadvantages of cloning.

1. Offers benefits for clinical trials and medical research. It can help in the production of proteins and drugs in the field of medicine.
2. Aids stem cell research.
3. Animal cloning could help to save endangered species.
4. Animal and human activists see it as a threat to biodiversity saying that this alters evolution which will have an impact on populations and the ecosystem.
5. The process is tedious and very expensive.
6. It can cause animals to suffer.
7. Reports show that animal surrogates were manifesting adverse outcomes and cloned animals were affected with disease and have high mortality rate.
8. It might compromise human health through consumption of cloned animal meat.
9. Cloned animals age faster than normal animals and are less healthy than the parent organism as discovered in Dolly.
10. Cloning can lead to occurrence of genetic disorders in animals.
11. More than 90% of cloning attempts fail to produce a viable offspring.

28. Explain how recombinant Insulin can be produced.**Fig. 10.1 Human Insulin Production**

1. The production of insulin by recombinant DNA technology started in the late 1970s.
2. This technique involved the insertion of human insulin gene on the plasmids of *E.coli*.
3. The polypeptide chains are synthesized as a precursor called pre-pro insulin, which contains A and B segments linked by a third chain (C) and preceded by a leader sequence.

4. The leader sequence is removed after translation and the C chain is excised, leaving the A and B polypeptide chains.
5. The approval to use recombinant insulin for diabetes mellitus was given in 1982. In 1986 human insulin was marketed under the trade name Humulin.

Other important questions and answers:

29. What is the most important application of human stem cells? (2019-2020)

1. Generation of cells and tissues used for cell based therapies.
2. Could be used to test new drugs.

30. Deliberate release of GMOs (Genetically Modified Organisms) into the environment could have negative ecological effects. Write the possible risks of GMOs. (2019-2020)

1. Creating new or more vigorous pests and pathogens. Worsening the effects of existing pest through hybridization with related transgenic organisms.
2. Harming non-target species such as soil organisms, non-pest insects, birds and other animals.
3. Disrupting biotic communities including agro ecosystems.
4. Irreparable loss or changes in species diversity or genetic diversity within species.

31. Stem cell therapy will increase the longevity of human life. Explain it logically.(PTA-2019-2020)

Stem cells regenerate many adult tissues and contribute to the development of cancer by accumulating mutations age-related changes in stem cells likely contribute to age-related morbidity. However, mechanisms that influence longevity also modulate age-related morbidity, partly through effects on stem cells.

32. A diabetic patient wants to have a single time treatment and permanent care for diabetes possible? If so explain. (PTA-2019-2020)

1. Production of insulin by recombinant DNA technology started in the late 1970s. This technique involved the insertion of human insulin gene on the plasmids of E.coli.
2. Insulin was the first ever pharmaceutical product of recombinant DNA technology administered to humans.
3. The approval to use recombinant insulin for diabetes mellitus was given in 1982. In 1986 human insulin was marketed under the trade name Humulin.

33. Differentiate oligopotency from unipotency? (PTA-2019-2020)

Oligopotency	Unipotency
Oligopotency refers to stem cells that can differentiate into few cell types. Example: Lymphoid or myeloid stem cells can differentiate into B and T cells but not RBC.	Unipotency refers to the ability of the stem cells to differentiate into only one cell type.

34. How can we utilize PCR technique in the field of forensic medicine?(PTA-2019-2020)

PCR can be used as a tool in genetic fingerprinting. This technology can identify any one person from millions of others.

2 and 3 marks creative questions:**35. What is genetic engineering?**

1. Genetic engineering involves the manipulation of DNA and naturally occurring processes such as protein synthesis for a wide range of applications including the production of therapeutically important proteins. This also involves extracting a gene from one organism and transferring it to the DNA of another organism of the same or another species.

36. Define Biotechnology?

Biotechnology which can be defined as the applications of scientific and engineering principles to the processing of material by biological agents to provide goods and services.

37. Mention the functions of Insulin?

1. Insulin controls the levels of glucose in blood.
2. It facilitates the cellular uptake and utilization of glucose for the release of energy.

38. What is prepro insulin?

The polypeptide chains are synthesized as a precursor called pre-pro insulin, which contains A and B segments linked by a third chain (C) and preceded by a leader sequence.

39. Write the structure of human insulin?

1. Human insulin is formed of 51 amino acids which are arranged in two polypeptide chains A and B.
2. The polypeptide chain A has 21 amino acids while the polypeptide chain B has 30 amino acids.
3. Both A and B chains are attached together by disulphide bonds.

40. What are interferons? Write their function.

1. Interferons were discovered by Alick Isaacs and Jean Lindemann in 1957.
2. Interferons are proteinaceous, antiviral, species specific substances produced by mammalian cells when infected with viruses.

41. State the uses of Interferons.

1. Interferons are used for the treatment of various diseases like cancer, AIDS, multiple sclerosis, hepatitis C and herpes zoster.
2. In spite of the therapeutic applications interferons are not within the reach of the common man due to high cost for its production.

42. Which is suitable for the production of recombinant interferons than E.Coli? why?

The yeast *Saccharomyces cerevisiae* is more suitable for production of recombinant interferons than *E.coli*, since *E.coli* does not possess the machinery for glycosylation of proteins.

43. Name the diseases cured by interferons.

1. Cancer.
2. AIDS.
3. Multiple sclerosis.
4. Hepatitis C.
5. Herpes zoster.

44. Difference between subunit recombinant vaccines and Attenuated recombinant vaccines.

S.No	Subunit recombinant vaccines	Attenuated recombinant vaccines
1	Vaccines that use components of a pathogenic organism rather than the whole organism are called subunit vaccines. Recombinant DNA technology is very suited for developing new subunit vaccines.	This includes genetically modified pathogenic organism (bacteria or viruses) that are made nonpathogenic and are used as vaccines.
2	It includes components like proteins, peptides and DNAs of pathogenic organisms. The advantages of these vaccines include their purity in preparation, stability and safe use.	It is now possible to genetically engineer the organisms (Bacteria or viruses) and use them as live vaccines and such vaccines are referred to as attenuated recombinant vaccines.

45. Write short notes on edible vaccines?

1. Edible vaccines are prepared by molecular pharming using the science of genetic engineering.
2. Selected genes are introduced into plants and the transgenic plants are induced to manufacture the encoded protein.
3. Edible vaccines are mucosal targeted vaccines which cause stimulation of both systemic and mucosal immune response.
4. At present edible vaccines are produced for human and animal diseases like measles, cholera, foot and mouth disease and hepatitis.

46. What are the two types of stem cells? Write the characteristic features of these cells.

In mammals there are two main types of stem cells.

i) Embryonic stem cells (ES cells):

1. ES cells are pluripotent and can produce the three primary germ layers ectoderm, mesoderm and endoderm.
2. Embryonic stem cells are multipotent stem cells that can differentiate into a number of types of cells.
3. ES cells are isolated from the epiblast tissue of the inner cell mass of a blastocyst.
4. When stimulated ES can develop into more than 200 cells types of the adult body.
4. ES cells are immortal they can proliferate in a sterile culture medium and maintain their undifferentiated state.

ii) Adult stem cells:

1. Adult stem cells are found in various tissues of children as well as adults.
2. An adult stem cell or somatic stem cell can divide and created another cell similar to it.
3. Most of the adult stem cells are multipotent and can act as a repair system of the body, replenishing adult tissues.
4. The red bone marrow is a rich source of adult stem cells.

47. What is stem cell banking? Mention the sources of stem cells.**Stem cell banking:**

Stem cell banking is the extraction, processing and storage of stem cells, so that they may be used for treatment in the future, when required.

Sources of stem cells:

The umbilical cord and cord blood are the most popular sources of stem cells, the placenta, amniotic sac and amniotic fluid are also rich sources in terms of both quantity and quality.

48. Write the techniques involved in ELISA test.

1. Diagnosis the sample suspected to contain the antigen is immobilized on the surface of an ELISA plate.
2. The antibody specific to this antigen is added and allowed to react with the Immobilized antigen.
3. The anti-antibody is linked to an appropriate enzyme like peroxidase.
4. The unreacted anti-antibody is washed away and the substrate of the enzyme (hydrogen peroxidase) is added with certain reagents such as 4-chloronaphthol.
5. The activity of the enzyme yields a coloured product indicating the presence of the antigen.
6. The intensity of the colour is directly proportional to the amount of the antigen. ELISA is highly sensitive and can detect antigens in the range of a nanogram.

49. What are the four types of ELISA? Write the advantages of ELISA.

1. Direct ELISA.
2. Indirect ELISA.
3. Sandwich ELISA.

4. Competitive ELISA.

Advantages:

1. It is a highly sensitive and specific method used for diagnosis.
2. ELISA possesses the added advantages of not requiring radioisotopes or a radiation counting apparatus.

50. How is PCR used in the forensic medicine?

1. PCR technique can also be used in the field of forensic medicine. A single molecule of DNA from blood stains, hair, semen of an individual is adequate for amplification by PCR.
2. The amplified DNA is used to develop DNA fingerprint which is used as an important tool in forensic science.
3. Thus, PCR is very useful for identification of criminals.
4. PCR is also used in amplification of specific DNA segment to be used in gene therapy.

51. What is Transgenesis?

Transgenesis is the process of introduction of extra (Foreign/ exogenous) DNA into the genome of the animals to create and maintain stable heritable characters.

52. Define the term cloning. Name the first mammal developed by cloning.

1. Cloning is the process of producing genetically identical individuals of an organism either naturally or artificially.
2. In nature many organisms produce clones through asexual reproduction.
3. Cloning is biotechnology refers to the process of creating copies of organisms or copies of cells or DNA fragments (molecular cloning).
4. Dolly was the first mammal (Sheep) clone developed by Ian Wilmut and Campbell in 1997.

53. Difference between Totipotency and Pluripotency?

Totipotency	Pluripotency
Totipotency is the ability of a single cell to divide and produce all of the differentiated cells in an organism.	Pluripotency refers to a stem cell that has the potential to differentiate into any of the three germ layers ectoderm, endoderm, and mesoderm.

54. Define Unipotency?

Unipotency refers to the ability of the stem cells to differentiate into only one cell type.

55. What is bioethics?

Bioethics is the study of the ethical issues emerging from the advances in biology and medicine. It is also a moral discernment as it relates to the medical policy and practice.

5 Mark creative questions and answers:**56. Write the applications of PCR.**

1. The differences in the genomes of two different organisms can be studied by PCR.
2. PCR is very important in the study of evolutions, more specifically phylogenetics.
3. As a technique which can amplify even minute quantities of DNA from any source, like hair, mummified tissues, bones or any fossilized materials.
4. PCR technique can also be used in the field of forensic medicine.
5. A single molecule of DNA from blood stains, hair, semen of an individual is adequate for amplification by PCR.
6. The amplified DNA is used to develop DNA fingerprint which is used as an important tool in forensic science.
7. Thus, PCR is very useful for identifications of criminals.
8. PCR is also used in amplification of specific DNA segment to be used in gene therapy.

57. Mention the steps involved in the production of transgenic organisms.

1. Identification and separation of desired gene.
2. Selection of a vector (generally a virus) or direct transmission.
3. Combining the desired gene with the vector.
4. Introduction of transferred vector into cells, tissues, embryo or mature individual.
5. Demonstration of integration and expression of foreign gene in transgenic tissue or animals.
6. Transgenic animals such as mice, rat, rabbit, pig, cow, goat, sheep and fish have been produced.

58. List the uses of transgenesis.

1. Transgenesis is a powerful tool to study gene expression and developmental processes in higher organisms.
2. Transgenesis help in improvement of genetic characters in animals. Transgenic animals serve as good models for understanding human diseases which help in the investigation of new treatments for diseases.
3. Transgenic models exist for many human diseases such as cancer, Alzheimer's cystic fibrosis, rheumatoid arthritis and sickle cell anemia.
4. Transgenic animals are used to produce proteins which are important for medical and pharmaceutical applications.
5. Transgenic mice are used for testing the safety of vaccines.
6. Transgenic animals are used for testing toxicity in animals that carry genes which make them sensitive to toxic substances than non-transgenic animals exposed to toxic substances and their effects are studied.
7. Transgenesis is important for improving the quantity of milk, meat, eggs and wool production in addition to testing drug resistance.

59. Explain the creation of Dolly.

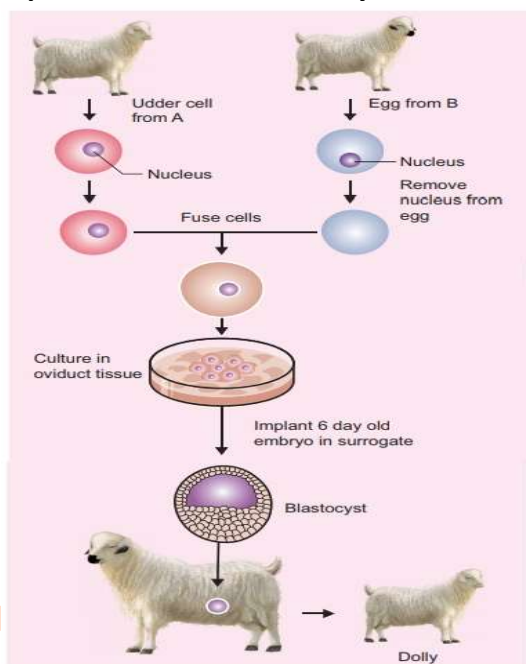


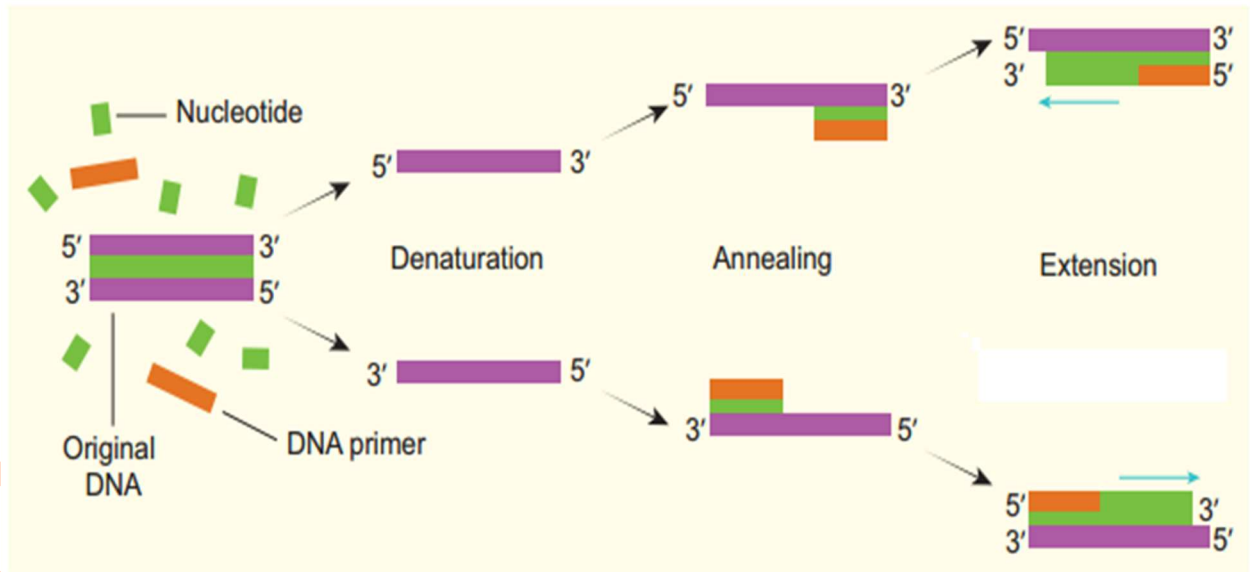
Fig. 10. 10 Cloning of dolly

1. Dolly was the first mammal (Sheep) clone developed by Ian Wilmut and Campbell in 1997.
2. Dolly, the transgenic clone was developed by the nuclear transfer technique and the phenomenon of totipotency.
3. Totipotency refers to the potential of a cell to develop different cells, tissues, organs and finally an organism.
4. The mammary gland under cells (Somatic cells) from a donor sheep (ewe) were isolated and subjected to starvation for 5 days.
5. The udder cells could not undergo normal growth cycle entered a dormant stage and became totipotent.
6. An ovum (egg cell) was taken from another sheep (ewe) and its nucleus was removed to form an enucleated ovum.
7. The dormant mammary gland cell/udder cell and the enucleated ovum were fused.
8. The outer membrane of the mammary cell was ruptured allowing the ovum to envelope the nucleus.
9. The fused cell was implanted into another ewe which served as a surrogate mother. Five months later dolly was born.

10. Dolly was the first animal to be cloned from a differentiated somatic cell taken from an adult animal without the process of fertilization.

60. What are steps involved in polymerase chain reactions?

The polymerase chain reaction is used to reproduce selected sections of DNS or RNA for analysis. Previously, amplification of DNA involved cloning the segments of interest into vectors for expression in bacteria.



Steps involved in PCR

The three steps are used for amplification:

1. Denaturing:

When the double stranded template DNA is heated to separate it into two single strands.

2. Annealing:

When the temperature is lowered to enable the DNA primers to attach to the template DNA.

3. Extension:

Polymerisation of nucleotide chain by the enzyme. Taq polymerase using the nucleotides provided in the medium.

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Bio-Zoology

Unit-V

Chapter: 10 Organisms and populations

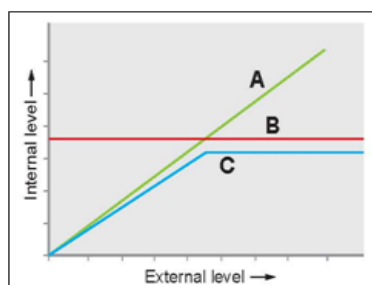
Textbook questions and answers:

1. All populations in a given physical area are defined as **Biome**.
2. Organisms which can survive a wide range of temperature are called **Eurytherms**.
3. The interaction in nature, where one gets benefit on the expense of other is **Commensalism**.
4. Predation and parasitism are **(+,-)** type of interactions.
5. Competition between species leads to **Extinction**.
6. **Insects** are an r-species.
7. Match the following and choose the correct combination from the options given below.

S.No	Column I	S.No	Column II
A	Mutualism	1	Lion and deer
B	Commensalism	2	Round worm and man
C	Parasitism	3	Birds compete with squirrels for nuts
D	Competition	4	Sea anemone on hermit crab
E	Predation	5	Barnacles attached to whales.

Answer: a) A-4, B-5, C-2, D-3, E-1.

8. The figure given below is a diagrammatic representation of response of organisms to abiotic factors. What do A, B and C represent respectively.



S.No	A	B	C
A	Conformer	Regulator	Partial Regulator
B	Regulator	Partial Regulator	Conformer
c	Partial Regulator	Regulator	Conformer
D	Regulator	Conformer	Partial Regulator

9. The relationship between sucker fish and shark is **commensalism**.

10. Which of the following is correct for r-selected species?

- a) **Large number of progeny with small size.**
- b) Large number of progeny with large size.
- c) Small number of progeny with small size.
- d) Small number of progeny with large size.

11. Animals that can move from fresh water to sea called as **Catadromous**.

12. Some organisms by physical means **Regulate**.

13. **What is Habitat?**

Habitat refers to the place where an organism or a community of organism live, including all biotic and abiotic factors or conditions of the surrounding environment.

Examples:

- 1. Xerophytic habitat.
- 2. Aquatic media.

14. **Define ecological niche.**

- 1. As every organism has its unique habitat, so also it has an ecological niche which includes the physical space occupied by an organism and its functional role in the community.
- 2. The ecological niche of an organism not only depends on where it lives but also includes the sum total of its environmental requirements.

15. **What is Acclimatisation?**

Animals are known to modify their response to environmental changes (Stress) in reasonably short time spans. This is known as Acclimatization.

Example:

People who have moved from the plains to higher altitudes show enhanced RBC count within a few days of settling in their new habitat. This helps them cope with lower atmospheric oxygen and higher oxygen demand.

16. **What is pedogenesis?**

Soil is formed from rocks which are the parent materials of soil, by weathering and is called embryonic soil (pedogenesis).

17. What is soil permeability?

1. The characteristic of soil that determines the movement of water through pore spaces is known as soil permeability.
2. Soil permeability is directly dependent on the pore size.
3. Water holding capacity of the soil is inversely dependent on soil porosity.

18. Differentiate between Eurytherms and Stenotherms.

Eurytherms	Stenotherms
Organisms which can survive a wide range of temperature are referred to as Eurytherms. Examples: Cat, dog, tiger, human.	Those organisms which can tolerate only a narrow range of temperature are stenotherms. Examples: Fish, Frogs, Lizards and Snakes.

19. Explain hibernation and aestivation with example.

Hibernation	Aestivation
Hibernation is a state of reduced activity in some organism to escape cold winter conditions. Bear and squirrels inhabiting cold regions are examples of animals that hibernate during winters.	Aestivation is a state of reduced activity in some organisms to escape desiccation due to heat in summers. Fishes and snails are examples of organisms aestivating during summers.

20. Give the diagnostic characters features of a Biome?

1. Location, Geographical position (Latitude, Longitude)
2. Climate and physiochemical environment.
3. Predominant plant and animal life.
4. Boundaries between biomes are not always sharply defined. Transition or transient zones are seen as in case of grassland and forest biomes.

21. Classify the aquatic biomes of Earth.

1. Freshwater (Lakes, ponds, rivers)
2. Brackish water (Estuaries/Wetlands)
3. Marine (Coral reefs, Pelagic zones and abyssal zones)

22. What are the ways by which organisms respond to abiotic factors? (PTA-2019-2020) and (2019-2020)**Regulation:**

1. Some organisms are able to maintain homeostasis by physiological means which ensures constant body temperature, ionic/ osmotic balance.

2. Birds, mammals and a few lower vertebrate and invertebrate species are capable of such regulation.

Conform:

1. Most animals cannot maintain a constant internal environment. Their body temperature changes with the ambient temperature.
2. In aquatic animals like fishes, the osmotic concentration of the body fluids changes with that of the ambient water osmotic concentration. Such animals are called conformers.
3. In case of extreme conditions, the inhabitants relocate themselves as in migration.

Migrate:

1. Organisms tend to move away temporarily from a stressful habitat to a new, hospitable area and return when the stressful period is over.
2. Birds migrate from Siberia to Vedanthangal in Tamilnadu to escape from the severe winter periods.

Suspend:

1. In certain conditions if the organism's is unable to migrate it may avoid the stress by becoming inactive. This is seen commonly in bears going into hibernation during winter.
2. Some snails and fish go into aestivation to avoid summer related problems like heat and desiccation.
3. Some lower animals suspend a certain phase of their life cycle, which is referred to as diapauses.

23. Classify the adaptive traits found in organisms.

1. Adaptation is a dynamic evolutionary process that fits organisms to their environment and enhancing their evolutionary fitness.
2. Adaptations can be a phenotypic or adaptive trait with a functional role in each individual organism that is maintained and has been evolved by natural selection.
3. The adaptive traits may be structural adaptation, behavioural adaptation and physiological adaptation.

a) Structural adaptations:

The external and internal structures of animals can help them to adapt better to their environment some of the most common examples are mammals growing thicker fur to survive freezing climates.

Example:

Likewise, horse legs are suitable for fast running and adapted for grasslands and similar terrestrial environments.

b) Behavioural adaptations:

Action and behavior of animals are instinctive or learned. Animals develop certain behavioural traits or adaptations for survival.

Example:

1. The two most characteristic forms of behavioural adaptation are migration and courtship. Migration allows the animals to find better resources or evade threat. Courtship is a set of behavioural patterns to find a mate to reproduce.
2. Fleeing from a predator, hiding during sleep, seeking refuge from climate change or moving to find different food sources are all behavioural adaptations.

c) Physiological adaptations:

These are adaptations of organism that help them to live and survive in their environment with unique niches.

Examples:

1. Lions have sharp canines to hunt and tear meat and a digestive system suitable for digesting raw meat.
2. The two most well-known physiological adaptations are hibernation and aestivation.

24. Differentiate Natality and Mortality. (2019-2020)

Natality	Mortality
The production of new individuals in the population by birth, hatching, germination or fission.	Loss of individuals in unit time or death rate.
Birth rate number of organism born per female per unit time.	The number of members of an original population dying after the lapse of a given time.
Birth rate (b) = $\frac{\text{number of birth per unit time}}{\text{Average population}}$	Death Rate = $\frac{\text{number of deaths per unit time}}{\text{Average population}}$

25. Differentiate J and S shaped curve.

J-shaped curve	S-Shaped curve
Increases rapidly in an exponential fashion and then stops abruptly due to environmental resistance or due to sudden appearance of a limiting factor, they are said to exhibit J-shaped growth form.	Increase slowly at first then more rapidly and gradually slow down as environmental resistance increases whereby equilibrium is reached and maintained. Their growth is represented by S shaped growth curve.

26. Give an account of population regulation.

1. The inherent tendency of all animal populations is to increase in number. But it does not increase indefinitely.
2. Once the carrying capacity of the environment is reached population numbers remain static or fluctuate depending on environmental conditions. This is regulated by many factors which are

Density independent- Extrinsic factors:

Extrinsic factors include availability of space, shelter, weather, food etc.

Density dependent- Intrinsic factors:

Intrinsic factors include competition, predation, emigration, immigration and diseases.

27. Give an account of the properties of soil. (PTA 2019-2020)**1. Texture of soil:**

1. The texture of soil is determined by the size of the soil particles.
The types of soil include sand, silt and clay on the basis of their size differences.

2. Porosity:

1. The space present between soil particles in a given volume of soil are called pore spaces.
2. The percentage of soil volume occupied by pore space or by the interstitial spaces is called porosity of the soil.

3. Permeability of soil:

1. The characteristic of soil that determines the movement of water through pore spaces is known as soil permeability.
2. Soil permeability is directly dependent on the pore size.
3. Water holding capacity of the soil is inversely dependent on soil porosity.

4. Soil temperature:

1. Soil gets its heat energy from solar radiation, decomposing organic matter, and heat from the interior of earth.
2. Soil temperature affects the germination of seeds, growth of roots and biological activity of soil- inhabiting micro and macro organisms.

5. Soil water:

In soil, water is not only important as a solvent and transporting agent, but also maintains soil texture, arrangement and compactness of soil particles, making soil habitable for plants and animals.

28. Differentiate between Tundra and Taiga Biomes.

S.No	Tundra Biome	Taiga Biome
1	This is the almost treeless plain in the northern parts of Asia, Europe and North America.	The Taiga is 1300-1450 km wide zone south of the Tundra.
2	Winters are long with little daylight, Summers are short, with long daylight hours.	This area has long and cold winters. Summer temperature ranges from 10°C to 21°C.
3	Precipitation is less than 250 mm per year. It is a zone of permafrost.	Precipitation ranges about 380-1000 mm annually.
4	Dwarf willows, birches, mosses, grasses, sedges are the flora here.	The taiga is a forest of coniferous trees such as spruce, fir and pine. This is a major source for the logging industry.
5	Reindeer, arctic hare, musk ox, lemmings are important Tundra herbivores. Some important carnivores are the arctic fox, arctic wolf, bobcat and snowy owl. Polar bears live along coastal areas.	Important migratory herbivores include moose, elk, deer and reindeer. Moose and reindeer migrate to the Taiga for winter and to the Tundra for summers. The common smaller mammals are herbivorous squirrels, snowshoe hare and predatory pine martens. Important predators include the timber wolf, grizzly bear, black bear, bobcat and wolverines.

29. List the adaptations seen in terrestrial animals.

1. Earthworms, land planarians secrete a mucus coating to maintain a moist situation for burrowing, coiling, respiration, etc.,
2. Arthropods have an external covering over the respiratory surfaces and well developed tracheal system.
3. Invertebrate skin, there are many cellular layers besides the well protected respiratory surfaces that help in preventing loss of water.
4. Some animals obtain their water requirement from food as partial replacement of water lost through excretion.
5. Birds make nests and breed before the rainy season as there is availability of abundant food. But during drought birds rarely reproduce.
6. Camels are able to regulate water effectively for evaporative cooling through the skin and respiratory system and excrete highly concentrated urine and can also withstand dehydration up to 25% of their body weight.

30. Describe population Age Distribution.

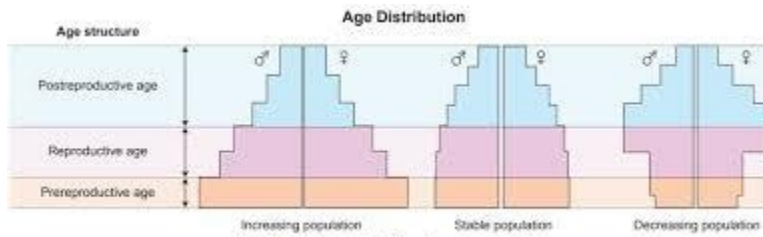
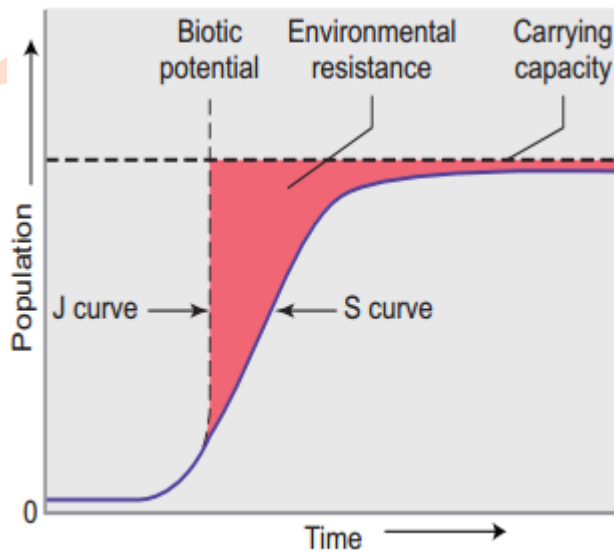


Fig. 11.13 Age distribution pyramids

1. The proportion of the age groups (pre-reproductive, reproductive and post reproductive) in a population is its age distribution attribute.
2. This determines the reproductive status of the population at the given time and is an indicator of the future population size.
3. Usually a rapidly growing population will have larger proportion of young individuals.
4. A stable population will have an even distribution of various age classes.
5. A declining population tends to have a larger proportion of older individuals.

31. Describe Growth Models/Curves.

Populations show characteristic growth patterns or forms. These patterns can be plotted and termed as J-shaped growth form and S-shaped growth form (sigmoid form).



shaped and S shaped growth curves

J shaped growth form:

1. Population increases rapidly in an exponential fashion and then stops abruptly due to environmental resistance or due to sudden appearance of a limiting factor, they are said to exhibit J-shaped growth form.
2. Many insects show explosive increase in number during the rainy season followed by their disappearance at the end of the season.

S-Shaped grow form (sigmoid growth):

1. Population of small mammals, increase slowly at first then more rapidly and gradually slow down as environmental resistance increases whereby equilibrium is reached and maintained. Their growth is represented by S shaped growth curve.

32. Tabulate and analysis of two species population interaction. (PTA 2019-2020)

S.No	Types of interaction	Species 1	Species 2	General nature of interaction	Examples
1	Amensalism	-	0	The most powerful animal or large organisms inhibits the growth of other lower organisms.	Cat and Rat
2	Mutualism	+	+	Interaction favorable to both and obligatory.	Between crocodile and bird.
3	Commensalism	+	0	Population 1, the commensal benefits, while 2 the host is not affected.	Sucker fish on shark.
4	Competition	-	-	Direct inhibition of each species by the other.	Birds compete with squirrels for nuts and seeds.
5	Parasitism	+	-	Population 1, the parasite, generally smaller than 2, the host.	<i>Ascaris</i> and tapeworm in human digestive tract.
6	Predation	+	-	Population 1, the predator, generally larger than 2, the prey.	Lion predatory on deer.

33. Explain parasitism with an example.

Parasitism is a (+/-) symbiotic relationship. In parasitism, one organism (the parasite) benefits, while the other (the host) is harmed. Parasites often live exclusively on or in their host organism.

Example:

1. Parasites may inhabit or attach to the surface of the host(Head lice).
2. Endo parasites which live within the body of the host (*Ascaris* and tapeworm in human digestive tract)

34. Differentiate between predator and prey.

S.No	Predator	Prey
1	The animal which kills another animal for its food is called a predator.	The animal which gets killed by the predator is called Prey.
2	A predator is larger than the pray.	The prey is smaller than the predator.
3	Predator finds means to catch their prey. Example: Lion is a predator	Prey finds means to escape from their predators and develop adaptations for the same. Example: Deer is a prey for Lions and Tigers.

Other important questions and answers:

35. Write short notes on: (2019-2020)

a) Population Density

The density of a population refers to its size in relation to unit of space and time or population density is the total number of that species within a natural habitat.

b) Natality (Population increase):

- i) Production of new individuals in the population by birth, hatching, germination or fission.
- ii) Birth rate number of organisms born per female per unit time.
- iii) Birth rate (Y)= $\frac{\text{number of birth per unit time}}{\text{Average population}}$

Mortality (Population decrease):

- i) Mortality- loss of individuals in unit of time or death rate.
- ii) Number of members of an original population dying after the lapse of a given time.
- iii) Death rate (d)= $\frac{\text{number of deaths per unit time}}{\text{Average population}}$

36. What is commensalism? Explain with an example. (2019-2020)

1. This defines the interaction in which two or more species are mutually associated in activities centering on food and one species at least, derives benefit from the association while the other associated are neither benefited no harmed.

2. The concept of commensalism has been broadened in recent years to apply to coactions other than those centering on food such as cover, support production and locomotion.
3. **Examples:** Barnacle attached to whales travel thousands of miles collecting and filtering food from the moving water. The whales are not affected by the barnacles.

37. What is called positive phototaxis? (PTA 2019-2020)

The movement of organism in response to light, either towards the source of light as in Moths (positive phototaxis).

38. Differentiate mutualism from commensalism. (PTA 2019-2020)

S.No	Mutualism	Commensalism
1	Mutualism is a type of symbiotic relationship among two or more different species where both species benefit.	Commensalism is a type of symbiotic relationship where only one species benefits and the other are unaffected.
2	Both species receive benefits.	Only one species receive benefits
3	Example: Crocodile and bird	Example: Sucker fish on shark

39. How are the different fish communities living in a pond ecosystem? (PTA-2019-2020)

1. In a pond ecosystem, where Catla, Rohu and Mrigal are present, the ecological niche of the Catla is a surface feeder, Rohu is a column feeder and Mrigal is a bottom feeder.
2. Their mouths are designed to suit their niche and hence have different positions and functions in their habitat.

40. What is known as photokinesis? (PTA-2019-2020)

A change in the speed of locomotion in a motile organism or cell which is made in response to a change in light intensity is called photokinesis. It involves undirected random movement in response to light.

41. Draw the diagram showing thermal zones in cold water bodies. (PTA-2019-2020)

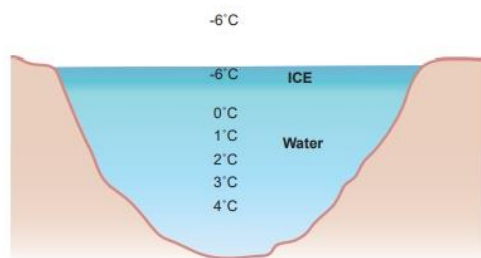


Fig. 11.3 Thermal zones in cold water bodies

2 and 3 Marks creative questions and answers

42. What are ecological equivalents?

Species that occupy the same niche in different geographical regions are termed ecological equivalents.

43. What is Biome?

A large regional or sub continental system characterized by a major vegetation type.

44. Name the various Abiotic components?

1. Light
2. Temperature
3. Soil
4. Wind
5. Humidity
6. Altitude

45. State Bergmann's rule.

1. In certain environments the size and colouration of animals are influenced by temperature.
2. Birds and mammals attain greater body size in colder regions than warmer region.

46. State Allen's rule.

Warm blooded animals living in colder climates, tend to have shorter limbs, ears and other appendages when compared to the members of the same species in warmer climates.

47. State Jordon's rule.

In some aquatic environments an inverse relationship between water temperature and fish meristic characters is observed lower the temperature, more the vertebrae.

48. Define carrying capacity.

The maximum number of organisms that a region can support without environmental degradation is called carrying capacity.

49. Define Environmental resistance.

Is the sum total of the environmental limiting factors both biotic and abiotic, which together act to prevent the biotic potential of an organism from being realized.

50. What is Ethology?

Ethology is the scientific study of animal behavior, under natural conditions.

51. How is the camel able to with stand desert conditions?

1. Camels are able to regulate water effectively for evaporative cooling through the skin and respiratory system.
2. Excrete highly concentrated urine, and can also withstand dehydration up to 25% of their body weight.
3. The hoofs and hump are suitable for survival in dry sandy environment.

52. What is the significance of lateral line system in fishes?

They function as rheoreceptors which is helpful in echo locating objects in water.

53. Define population.

It is defined as "Any group of organisms of the same species which can interbreed among themselves and occupy a particular space and function as part of a biotic community.

54. List out the various properties of population?

1. Population density
2. Age distribution
3. Natality
4. Mortality
5. Biotic potential
6. Dispersion
7. 'r', 'K' selected growth forms.

55. What is meant by population Dispersion?

1. Populations have a tendency to disperse or spread out in all direactions, until some barriers are reached.
2. This is observed by the migration of individuals into (Immigration) or out (Emigration) of the population area.

56. Why marine animals and fresh water organisms need adaptation?

1. Marine animals have adaptations to prevent cell shrinkage.
2. Fresh water organisms have adaptations to withstand bursting of their cells.

57. Eurythermy is advantageous to the animal.

1. Adaptations to cold temperatures (cold- eurythermy) are seen as essential for the survival of species during ice ages.
2. The ability to survive in a wide range of temperatures increases a species ability to inhabit other areas, an advantage for natural selection.
3. Eurytherm is an aspect of thermoregulation in organisms.

58. List some adaptations seen in animals to overcome extreme winters and summers.

The adaptations seen in animals to overcome extreme winters and summers are:

1. Formation of heat resistant spores.
2. Formation of cysts (Entamoeba)
3. Presence of antifreeze proteins (Arctic fishes)
4. Hibernation (Winter sleep)
5. Aestivation (Summer sleep)
6. Migration

59. Mention the adaptations of fish in aquatic media?

1. Slippery scales on their bodies that protect the fish and also help in easy movement through water.
2. Flat fins and tails that help them to change directions and keep their body balance in water.
3. Gills to help them use oxygen dissolved in water.
4. Lateral line system to help them sensory.

60. State. Van't Hoff's rule. Mention the value of living system.

1. Van't Hoff proposed that, with the increase of every 10°C, the rate of metabolic activity doubles or the reaction rate is halved with the decrease of 10°C. This rule is referred as the van't Hoff's rule.
2. The effect of temperature on the rate of reaction is expressed in terms of temperature coefficient or Q_{10} value.
3. The Q_{10} values are estimated taking the ratio between the rate of reaction at $X^\circ\text{C}$ and rate of reaction at $(X-10^\circ\text{C})$.
4. In the living system the Q_{10} value is about 2.0 it means 10°C increase and the rate of metabolism doubles.

61. Differentiate absolute humidity and relative humidity.

S.No	Absolute Humidity	Relative Humidity
1	Absolute humidity is the total mass of water vapor present in a given volume or mass of air	Relative humidity is the amount of water vapor present in air and is expressed as a percentage of the amount needed for saturation at the same temperature relative humidity is expressed as a percentage.
2	It does not take temperature into consideration	A high percentage means that the air-water mixture is more humid at a given temperature.

62. Light is an important and essential abiotic factor- Justify your Answer

1. Light influences growth, pigmentation, migration and reproduction.
2. The intensity and frequency of light influences metabolic activity, induce gene mutations (UV, X-rays).
3. Light is essential for vision. It influences Diapause.
4. Gonads of birds become more active with increasing light in summer. It influences the locomotion and movement of lower animals.

63. Where does soil get heat energy? Mention the effects of soil temperature.

1. Soil gets its heat energy from solar radiation, decomposing organic matter, and heat from the interior of earth.
2. Soil temperature effects the germination of seeds, growth of roots and biological activity of soil-inhabiting micro and macro organisms.

64. What is Coriolis effect?

Wind is the natural movement of air of any velocity from a particular direction. The two main causes are differential heating between the equator and the poles and the rotation of planet.

65. How does altitude affect the environment?

1. This factor is mainly the elevation or gradient and it affects temperature and precipitation in an ecosystem or biome.
2. As altitude increase, temperature and density of oxygen decreases.
3. Higher altitudes usually receive snow instead of rain because of low temperature.

66. Why do people living in high altitude have more haemoglobin and high RBC count?

1. When people who have moved from the plains to higher altitudes show enhanced RBC count within a few days of settling in their new habitat.
2. This helps them cope with lower atmospheric oxygen and higher oxygen demand.

67. What is the use of wind in the environment?

Wind helps to transport pollen grains, seeds, and even flight of birds. While it is the source of wind energy, it also causes erosion.

68. What is adaptation?

1. Adaptation is a dynamic evolutionary process that fits organisms to their environment and enhancing their evolutionary fitness.
2. The adaptive traits may be structural adaptation, behavioural adaptation and physiological adaptation.

69. What are the advantages of Emigration?

This is regarded as an adaptive behavior that regulates the population in a particular site and prevents over exploitation of the habitat. It leads to occupation of new areas elsewhere.

70. Differentiate anadromous migration and catadromous migration.

Anadromous migration	Catadromous migration
Migration of fishes from sea to fresh water.	Migration of fishes from fresh water to sea.
Example: Salmon fishes	Example: Eel

71. How do animals overcome their stressful conditions casting for short duration?

1. IN certain conditions, if the organism is unable to migrate, it may avoid the stress by becoming inactive.
2. This is seen commonly in bears going into hibernation during winter.
3. Some snails and fish go into aestivation to avoid summer related problems like heat and desiccation.
4. Some lower animals suspend a certain phase of their life cycle, which is referred to as diapauses.

72. Differentiate migration and court ship.

Migration	Court Ship
It allows the animals to find better	It is a set of behavioral patterns to find a

resources or evade threat	mate to reproduce
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73. What is the disadvantages immigration?

1. It leads to a rise in population levels.
2. If the population increases beyond the carrying capacity, it can result in increased mortality among the immigrants or decreased reproductive capacity of the individuals.

74. What is meant by cold deserts?

Cold deserts are referred by places where cold with snowfall and high overall rainfall throughout the winter and occasionally during summer.

75. What is meant by relative abundance?

Relative abundance is a time related index, which can show the changes in number in a population with respect to time.

Example: Number of birds of a particular species spotted in an unit area over a period of time.

76. List out the adaptations of desert animals.

The desert animals possess special adaptations to cope up with desert environment. They are:

1. The animals living in desert are capable of tapping available water and strong sufficiently to withstand the heat.
2. Small nocturnal carnivores are predominate animals in the desert.
3. They are burrowers having cursorial, fossorial and saltatoreial adaptation.

5 mark creative questions and answers:**77. List the adaptation of aquatic animals.**

1. The pectoral fins and dorsal fins act as stabilizers or balancers and the caudal fin helps in changing the direction as a rudder.
2. Arrangement of body muscles in the form of bundles (myotomes) help in locomotion.
3. Stream lined structure helps in the swift movement of the animals in water.
4. Respiration by gills making use of gases dissolved in water.
5. Presence of air-bladders filled with air for buoyancy.
6. Presence of lateral line system. They function as rheoreceptors which is helpful in echo locating objects in water.
7. Integuments rich in mucous glands are protected by scales.
8. Maintain water and ionic balance in its body with excretory structures.

78. List the differences between R selected and K selected species.

S.No	r selected species (r-Reproductive capacity)	K selected species (K-Carrying capacity)
1	Smaller sized organisms	Larger sized organisms
2	Produce many offspring	Produce few offspring
3	Mature early	Late maturity with extended parental care
4	Short life expectancy	Long life expectancy
5	Each individual reproduces only once or few times in their life time	Can reproduce more than once in life time
6	Only few reach adulthood	Most individuals reach maximum life span
7	Unstable environment, density independent.	Stable environment density dependent

79. Write about the essential properties of water.

1. Water is one of the main agent in pedogenesis (soil formation)
2. It is the medium for several different ecosystems.
3. It is present as moisture in the atmosphere and the outer layers of the lithosphere and is uneven in distribution on the earth.
4. Water is heavier than air and imparts greater buoyancy to the aquatic medium. This enables organism to float at variable levels.
5. Water has high heat capacity and latent heat, due to which it can withhold large amounts of heat. Thus, oceans and lakes tend to maintain a relatively constant temperature, and the biosphere is relatively thermostable.
6. Water is physically unique because it is less dense as a solid than as a liquid.
7. When water freezes (0°C), it contracts. The maximum density of liquid water occurs at 4°C. below that, it expands markedly. This enables ice to float on the top of water bodies. Hence, only the surface of water bodies will freeze, while below the surface, water will be in liquid form, sustaining life.
8. Water is considered as the Universal solvent. It is the main medium by which chemical constituents are transported from abiotic components to the living components of an ecosystem.
9. Water has high surface tension. This allows pollen, dust and even water striders to remain at the surface of a water body even though they are denser than the water.

80. Write a note on grassland biome.

1. Grasslands occur in temperate and in the tropical regions.

2. They have hot summers, cold winters and irregular rainfall.
3. Often they are characterized by high winds.
4. The low irregular rainfall is the factor which makes the difference between a temperate deciduous forest and temperate grassland.
5. Herbivores like antelope, bison, wild horse, jack rabbit, ground squirrel and prairie dog are abundant.
6. Predators include coyotes, foxes, hawks and snakes.
7. In India, fauna of grasslands includes Elephant, Gaur, Rhino, Antelope.
8. Flora of grasslands includes purple needle grass, wild oats, foxtail, ryegrass and buffalo grass.

81. Write a note on Alpine biome.

1. The alpine zone (zone between timber line and snow zone) includes in the descending order, a sub-snow zone immediately below the snow zone, a meadow zone in the centre and a shrub zone which gradually merges into the timber zone.
2. The snow zone of Himalayas lies over 5100m above mean sea level and alpine zone exists at a height of 3600m.
3. From an ecological view point, the zone above the limits of tree growth (timber line) exhibits extreme environmental conditions which greatly influence the biota of this region.
4. Alpine zone of Himalayas is characterized by sparseness of animal groups.
5. Many invertebrates of alpine zone are predatory and occur in lakes, streams and ponds. Among fishes, amphibians and vertebrates are totally lacking and reptilian fauna is greatly impoverished.
6. Flora of alpine includes alpine phacelia, bear grass, bristlecone pine, moss campion, polyepis forest, pygmy bitterroot, and wild potato.

82. Write a note on Tropical forest.

1. They occur near the equator (between latitudes 23.5° at north and 23.5° at south).
2. The major characteristic of tropical forests is their distinct seasons. Only two seasons are present (rainy and dry). Winter is absent.
3. The length of daylight is about 12 hours and varies little.
4. The average annual temperature ranges between 20°C and 25°C.
5. Precipitation is evenly distributed throughout the year with annual rainfall exceeding 2000 mm.
6. Soil is nutrient-poor and acidic. Decomposition is rapid and soils are subject to heavy leaching.
7. Three canopy is multilayered and continuous, allowing little light penetration.

8. Flora is highly diverse: One square kilometer may contain as many as 100 different tree species.
9. Trees are 25-35m tall, with buttressed trunks and shallow roots, mostly evergreen with large dark green leaves. Common vegetation are orchids, bromeliads, vines (lianas), ferns, mosses, and palms.
10. They are characterized by the greatest diversity of fauna which includes birds, bats, small mammals and insects.

83. Write a note on temperate forest.

1. These forests occur in eastern North America, northeastern Asia and western and central Europe.
2. Have well- defined seasons with a distinct winter. Moderate climate and a growing season of 140-200 days during 4-6 frost free months distinguish temperate forests.
3. Annual temperature varies from -30°C to 30°.
4. Precipitation (750-1500mm) is distributed evenly throughout the year.
5. Soil is fertile, enriched with decaying litter.
6. Canopy is moderately dense and allows light to penetrate, resulting in well developed and richly diversified under storey vegetation and stratification of animals.
7. Flora is characterized by 3-4 tree species per km². Trees have broad leaves that are lost annually such as oak, hickory, beech, hemlock, maple, basswood, cottonwood, elm, willow, and spring flowering herbs.
8. Fauna consists of squirrel, rabbits, skunks, birds, deer, mountain lion, bobcat, timber wolf, fox, and black bear.

84. Write a note on Desert biomes.

1. Deserts cover about one fifth of the earth's surface and occur where rainfall is >500 mm/year.
2. Rainfall is usually very low and or concentrated in short bursts between long rainless periods. Evaporation rates regularly exceed rainfall rates.
3. Soils are coarse textured, shallow, rocky or gravely with good drainage and have no sub surface water.
4. The finer dust and sand particles are blown elsewhere, leaving heavier pieces behind. Sand dunes are common.
5. Mean annual temperatures range from 20-25°C. The extreme maximum ranges from 43.5-49°C.
6. Minimum temperatures sometimes drop to -18°C. Based on the temperature range, deserts can be Hot deserts and Cold deserts

85. Write short note on Hot desert and Cold desert.**Hot deserts:**

1. Hot deserts such as the Sahara of North Africa and the deserts of the southwestern U.S., Mexico, Australia and India (Thar desert) occur at low latitudes.
2. Hot deserts have a considerable amount of specialized vegetation (xerophytes), aloe, agave, opuntia species, Euphorbia royleana as well as specialized vertebrate and invertebrate animals.
3. The dominant animals of warm deserts are reptiles and small mammals. The Indian spiny-tailed lizard, the blackbuck, the white-footed fox are the common fauna of the Thar deserts. There are also insects, arachnids and birds.

Cold deserts:

1. Cold deserts occur in Antarctica, Greenland and the Nearctic realm, parts of USA and in parts of western Asia and the Ladakh region in India.
2. Widely distributed animals are jack rabbits, kangaroo rats, kangaroo mice, pocket mice, grasshopper mice, antelope and ground squirrels.

Padasalai

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Bio-Zoology

Unit-V

Chapter: 11 Biodiversity and its Conservation

Textbook questions and answers:

1. **Tropical forest** region has maximum biodiversity.
2. Conservation of biodiversity within their natural habitat is **Insitu conservation**.
3. **Zoological Park** is not coming under insitu conservation.
4. **Western ghats and Eastern Himalayas** is considered a hotspot of biodiversity in India.

Answer: d) A and C

5. The organization published the **IUCN** red list of species.
6. **Water Rosen** introduced the term biodiversity.
7. **Amazon rain forest** is known as the lungs of the planet earth.
8. **Amphibians** are at high risk extinction due to habitat destruction.
9. **Assertion:** The environmental conditions of the tropics are favorable for speciation and diversity of organisms.

Reason: The climate seasons, temperature, humidity and photoperiod are more or less stable and congenial.

a) Both Assertion and Reason are true and Reason explains Assertion correctly.

10. Define endemism.

The phenomenon in which the organisms are exclusively restricted to a given area.

11. How many hotspots are there in India? Name them.

India is home to four biodiversity hotspots. They are

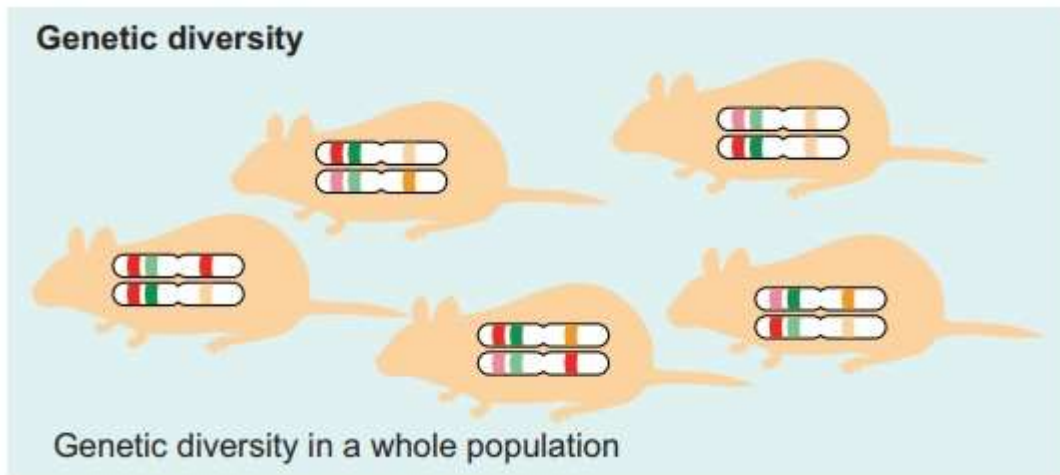
- i) Himalaya (the entire Indian Himalayan region)
- ii) Western Ghats.

- iii) Indo-Burma: includes entire North- eastern India, except Assam and Andaman group of Islands (and Myanmar, Thailand, Vietnam, Laos, Cambodia and Southern China)
- iv) Sundalands: includes Nicobar group of Islands (and Indonesia, Malaysia, Singapore, Brunei, Philippines)

12. What are the three levels of biodiversity?

There are three levels of biodiversity Genetic diversity, Species diversity and Community/ Ecosystem diversity.

Genetic diversity:



1. Genetic diversity refers to the differences in genetic makeup (number and types of genes) between distinct species and to the genetic variation within a single species also covers genetic variation between distinct populations of the same species.
2. Genetic diversity can be measured using a variety of molecular techniques.
3. India has more than 50,000 genetic variants of paddy and 1000 variants of mango.
4. Variation of genes of a species increases with diversity in size and habitat. It result in the formation of different races, varieties and subspecies.
5. *Rouwolfia vomitaria* a medicinal plant growing in different ranges of the Himalayas shows differences in the potency and concentration of the active ingredient reserpine due to genetic diversity.
6. Genetic diversity helps in developing adaptations to changing environmental conditions.

Species diversity:

1. Species diversity refers to the variety in number and richness of the species in any habitat.
2. The number of species per unit area at a specific time is called species richness, which denotes the measure of species diversity.
3. The Western Ghats have greater amphibian species diversity than the Eastern Ghats. The more the number of species in an area the more is the species richness.
4. The three indices of diversity are Alpha, Beta and Gamma diversity.

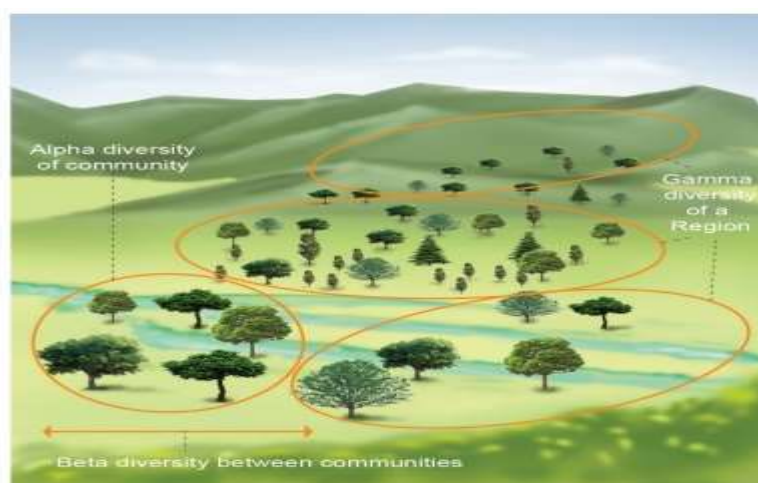


Fig. 12.1a Species biodiversity

a) Alpha diversity:

It is measured by counting the number of taxa (usually species) within a particular area, community or ecosystem.

b) Beta diversity:

It is species diversity between two adjacent ecosystem and is obtained by comparing the number of species unique to each of the ecosystem

c) Gamma diversity:

Gamma diversity refers to the diversity of the habitats over the total landscape or geographical area.

Community/Ecosystem diversity:

1. Community /Ecosystem diversity is the variety of habitats, biotic communities, and ecological processes in the biosphere.
2. It is the diversity at ecosystem level due to diversity of niches, trophic levels and ecological processes like nutrient cycles, food webs, energy flow and several biotic interactions.
3. India with its alpine meadows, rain forests, mangroves, coral reefs, grass lands and deserts has one of the greatest ecosystem diversity on earth.

13. Name the active chemical found in the medicinal plant *Rauwolfia vomitoria*. What type of diversity does it belong to?

1. **Genetic diversity** is the diversity at the genetic level. It enables a population to adapt to its environment.
2. Genetic variation in the medicinal plant *Rauwolfia vomitoria* growing in different Himalayan ranges might be in terms of the potency and concentration of the **active chemical (reserpine)** that the plant produces.

14. “Amazon forest is considered to be the lungs of the planet”-Justify this statement.

The Amazon rainforest, a vast area, harbouring millions of species also called Lungs of the planet is destroyed and being replaced for agriculture and human settlements.

15. ‘Red data book’- What do you know about it? (PTA-2019-2020)

Red Data book or Red list is a catalogue of taxa facing risk of extinction. IUCN International Union of Conservation of Nature and Natural Resources, which is renamed as WCU- World Conservation Union (Morges Switzerland) maintains the Red Data book. The concept of Red list was mooted in 1963.

The purpose of preparation of Red List are:

1. To create awareness on the degree of threat to biodiversity.
2. Identification and documentation of species at high risk of extinction.
3. Provide global index on declining biodiversity.
4. Preparing conservation priorities and help in conservation of action.
5. Information on international agreements on conservation of biological diversity.

Red list has eight categories of species

- i) Extinct
- ii) Extinct in wild
- iii) Critically Endangered
- iv) Endangered
- v) Vulnerable
- vi) Lower risk
- vii) Data deficiency
- viii) Not evaluated.

16. Compare and Contrast the insitu and exsitu conservation.

S.No	Insitu Conservation	Exsitu Conservation
1	It is the on-site conservation or the conservation of genetic resources in natural populations of plant or animal species.	This is a conservation strategy which involves placing of threatened animals and plants in special care locations for their protection.
2	It is the process of protecting an endangered plant or animal species in its natural habitat, either by protecting or restoring the habitat itself or by defending the species from predators.	It helps in recovering populations or preventing their extinction under simulated conditions that closely resemble their natural habitats.
3	National Parks, Biosphere Reserve, Wild Life Sanctuaries form insitu conservation strategies.	Zoological parks and Botanical gardens are common exsitu conservation programs

17. What are called endangered species? Explain with examples.

1. A species that has been categorized as very likely to become extinct is an endangered species.
2. Endangered (EN) as categorized by the International Union for Conservation of Nature (IUCN) Red List is the second most severe conservation status for wild populations in the IUCN's scheme after Critically Endangered (CR).

Example: George the tree snail (*Achatinella apexfulva*)

18. Why do we find a decrease in biodiversity distribution, if we move from the tropics towards the poles?

1. Temperature, precipitation, distance from the equator (latitudinal gradient), altitude from sea level (altitudinal gradient) are some of the factors that determine biodiversity distribution patterns.
2. The most important pattern of biodiversity is latitudinal gradient in diversity. This means that there is an increasing diversity from the poles to equator.

19. What are the factors that drive habitat loss?

1. Development of human society is inevitable. Natural habitats are destroyed for the purpose of settlement, agriculture, mining, industries and construction of highways.
2. As a result species are forced to adapt to the changes in the environment or move to other places.
3. If not they become victim to predation, starvation, disease and eventually die or results in human animal conflict.

20. Alien species invasion is a threat to endemic species- substantiate this statement.

1. Exotic species (Non-native; alien) are organisms often introduced unintentionally or deliberately for commercial purpose, as biological control agents and other uses.
2. They often become invasive and drive away the local species and is considered as the second major cause for extinction of species.
3. Exotic species have proved harmful to both aquatic and terrestrial ecosystems.
4. Tilapia fish (Jilabi kendai) (*Oreochromis mosambicus*) introduced from east coast of South Africa in 1952 for its high productivity into kerala's inland waters, became invasive, due to which the native species such as *puntius dubius* and *labeo kontius* face local extinction.
5. The introduction of the Nile Perch, a predatory fish into Lake Victoria in East Africa led to the extinction of an ecologically unique assemblage of more than 200 nature species of cichlid fish in the lake.

6. Papaya Mealy Bug (*Paracoccus marginatus*) is native of Mexico and Central America, is believed to have destroyed huge crops of papaya in Assam, West Bengal and Tamil Nadu.

21. Mention the major threats to biodiversity caused by human activities. Explain.

1. Human activities greatly contribute to the loss of biodiversity. Natural resources such as land, water and organisms are indiscriminately exploited by human beings.
2. According to the convention of Biological Diversity, direct and indirect human activities have a detrimental effect on biodiversity.
3. Direct human activities like change in local land use, species introduction or removal, harvesting, pollution and climate change contribute a greater pressure on loss of biodiversity.
4. Indirect human drivers include demographic, economic, technological, cultural and religious factors.
5. Monsoon failure, global warming, depletion in ozone layer, landslides in hilly states, pollution are a few indirect effects of human activities which results in the loss biodiversity.
6. This loss of biodiversity has a immense impact on plant animal and human life. The negative effects include dramatic influence on the food web.
7. Even reduction in one species can adversely affect the entire food chain which further leads to an overall reduction in biodiversity. Reduced biodiversity leads to immediate danger for food security by reducing ecosystem services.

22. What is mass extinction? Will you encounter one such extinction in the near future? Enumerate the steps to be taken to prevent it.

Mass extinction:

1. The earth has experienced quite a few mass extinctions due to environmental catastrophes.
2. A mass extinction occurred about 225 million years ago during the Permian, where 90% of shallow water marine invertebrates disappeared.

The steps to be taken to prevent:

1. Identify and protect all threatened species.
2. Identify and conserve in protected areas the wild relatives of all the economically important organisms.
3. Identify and protect critical habitats for feeding, breeding, nursing, resting of each species.
4. Resting, feeding and breeding places of the organisms should be identified and protected.
5. Air, water and soil should be conserved on priority basis.
6. Wildlife protection Act should be implemented.

23. In north eastern states, the jhum cultivation is a major threat to biodiversity substantiates the statement.

1. In shifting cultivation, plots of natural tree vegetation are burnt away and the cleared patches are farmed for 2-3 seasons, after which their fertility reduces to a points where crop production is no longer profitable.
2. The farmer then abandons this patch and cuts down a new patch of forest tress elsewhere for crop production.
3. This system is practiced in north- eastern regions of India. When vast areas are cleared and burnt, it results in loss of forest cover, pollution and discharge of CO₂ which in turn attributes to loss of habitat and climate change which has an impact on the faunal diversity of that region.

24. List out the various causes for biodiversity losses.

1. Habitat loss, fragmentation and destruction (affects about 73% of all species)
2. Pollution and pollutants (Smog, pesticides, herbicides, oil slicks, GHGs)
3. Climate change.
4. Introduction of alien/ exotic species.
5. Over exploitation of resources (poaching, indiscriminate cutting of trees, over fishing, hunting, mining)
6. Intensive agriculture and aquaculture practices.
7. Hybridization between native and non-native species and loss of native species.
8. Natural disasters (Tsunami, forest fire, earth quake, volcanoes)
9. Industrialization, Urbanization infrastructure development, Transport Road and shipping activity, communication towers, dam construction, unregulated tourism and monoculture are common area of specific threats.
10. Co-extinction.

25. How can we contribute to promote biodiversity conservation?

1. Conservation of biodiversity is protection and scientific management of biodiversity so as to maintain it at its optimum level and derive sustainable benefits for the present as well as future generations.
2. It aims to protect species from extinction and their habitats and ecosystems form degradation.

General strategies in conservation:

1. Identify and protect all threatened species.
2. Identify and conserve in protected areas the wild relatives of all the economically important organisms.

3. Identify and protect critical habitats for feeding, breeding, nursing, resting of each species.
4. Resting, feeding and breeding places of the organisms should be identified and protected.
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26. Write a note on i) Protected areas, ii) Wild life sanctuaries, iii) WWF

i) Protected areas:

1. These are biogeographical areas where biological diversity along with natural and cultural resources is protected, maintained and managed through legal measures.
2. Protected areas include national parks, wild life sanctuaries community reserves and biosphere reserves.
3. World Conservation monitoring center has recognized 37,000 protected areas world- wide.
4. India has about 771 protected areas covering 162099 km² comprising of National Parks (104), Wild Life Sanctuaries (544). Biosphere reserves (18) and several sacred groves.

ii) Wild life sanctuaries:

1. Any area other than the area comprised with any reserve forest or the territorial waters can be notified by the State Government to constitute as a sanctuary if such area is of adequate ecological, faunal, and floral. geomorphological, natural or zoological significance.
2. This is for the purpose of protecting, endangered factual species.
3. Some restricted human activities are allowed inside the Sanctuary area.
4. Ecotourism is permitted as long as animal life is undisturbed.

iii) WWF:

1. World wild life fund is a mission to stop the degradation of our planet's natural environment and build a future in which humans live in harmony with nature.
2. In order to achieve this mission WWF focuses its efforts on broad areas of biodiversity and foot point.
3. The first is to ensure that the earth's biodiversity stays healthy and vibrant for generations to come.
4. The second is to reduce the negative impact of human activity on biodiversity.

Other important questions and answers:**27. What are the eight categories of species in Red List? (2019-2020)**

Red list has eight categories of species:

1. Extinct.
2. Extinct in wild.
3. Critically Endangered.
4. Endangered.
5. Vulnerable.
6. Lower risk.
7. Data deficiency.
8. Not evaluated.

28. Explain the exotic species invasion. (2019-2020)

1. Exotic species (Non-native; alien) are organisms often introduced unintentionally or deliberately for commercial purpose, as biological control agents and other uses.
2. They often become invasive and drive away the local species and is considered as the second major cause for extinction of species.
3. Exotic species have proved harmful to both aquatic and terrestrial ecosystems.
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6. Papaya Mealy Bug (*Paracoccus marginatus*) is native of Mexico and Central America, is believed to have destroyed huge crops of papaya in Assam, West Bengal and Tamil Nadu.

29. Intensive agriculture results in reduction of genetic diversity. How? (PTA-2019-2020)

1. Spread of agriculture is sometimes at the cost of wetlands, grasslands and forests. Intensive agriculture is based on a few high yielding varieties.
2. As a result there is reduction in the genetic diversity. It also increases vulnerability of the crop plants to sudden attack by pathogens and pests.
3. There are only few varieties of traditional paddy strains today due to use of hybrid varieties in Tamil Nadu.

30. List out the fauna of Trans Himalayan region. (PTA-2019-2020)

1. Richest wild sheep
2. Goat community in the world (renowned for its quality)
3. Chiru.
4. Black rock crane, etc.,

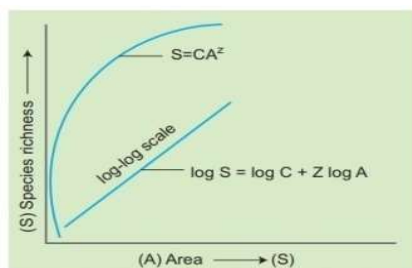
31. Describe species- area relationship on log scale. (PTA-2019-2020)

Fig. 12.2 Species - Area relationship on log scale

1. German Naturalist and Geographer Alexander von Humboldt explored the wilderness of South American jungles and found that within a region the species richness increased with increasing area but up to a certain limit.
2. The relationship between species richness and area for a wide variety of taxa (angiosperm plants, birds, bats, freshwater fishes) turned out to be the rectangular hyperbola
3. On a logarithmic scale, the relationship is a straight line described by the equation.

$$\log S = \log C + Z \log A$$

Where

S= Species richness

A= Area

Z= Slope of the line (regression coefficient)

C= Y- intercept

4. Regression coefficient Z generally has a value of 0.1-0.2 regardless of taxonomic group or region.
5. However, in case of the species area relationship in very large areas like entire continents the slope of the line appears to be much steeper (Z-value in the range of 0.6-1.2)
6. For example, in case of the fruit eating birds and mammals in the tropical forests of different continents, the slope is found to be a steeper line of 1.15

32. What is coextinction? Give an example. (PTA-2019-2020)

Co extinction of a species is the loss of a species as a consequence of the extinction of another.

Example: (Orchid bees and forest trees by cross pollination). Extinction of one will automatically cause extinction of the other.

Another example:



The Calvaria tree is dependent on the Dodo bird for completion of its life cycle. The mutualistic association is that the tough horny endocarp of the seeds of Calvaria tree are made permeable by the actions of the large stones in birds gizzard and digestive juices thereby facilitating easier germination. The extinction of the Dodo bird led to the imminent danger of the Calvaria tree coextinction.

33. Write about the three indices of species diversity. (PTA-2019-2020)**i) Alpha diversity:**

It is measured by counting the number of taxa (usually species) within a particular area, community or ecosystem.

ii) Beta diversity:

It is species diversity between two adjacent ecosystem and is obtained by comparing the number of species unique to each of the ecosystem.

iii) Gamma diversity:

Gamma diversity refers to the diversity of the habitats over the total landscape or geographical area.

2 and 3 Marks creative questions and answers**34. Define Biodiversity.**

1. The 1992 UN Earth Summit defined Biodiversity as the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part.
2. This includes diversity within species, between species and ecosystems of a region.

35. Write the most important functions of biodiversity.

1. It helps to maintain ecological processes, create soil, recycle nutrients, influence climate, degrade waste and control diseases.

2. It provides an index of health of an ecosystem.
3. The survival of human race depends on the existence and wellbeing of all life forms (plants and animals) in the biosphere.

36. What are alien species?

Alien species are organisms often introduced in a habitat unintentionally or deliberately for commercial purpose or a biological control agent and other uses.

37. Differentiate between species diversity and species richness.

Species diversity	Species richness
Species diversity refers to the variety in number and richness of the species in any habitat.	The number of species per unit area at a specific time is called species richness, which denotes the measure of species diversity.

38. What is main effect of climate change?

Climate change increases land and ocean temperature, changes precipitation pattern and raises the sea level.

39. What are the three indices of diversity?

1. Alpha diversity
2. Beta diversity
3. Gamma diversity

40. Name any two alien species introduced in India.

1. Tilapia fish (Jilabi kendain) (*Oreochromis mosambicus*)
2. Nile perch.
3. Papaya Mealy Bug (*Paracoccus marginatus*)

41. Write a short note on Deccan Peninsula.

1. It is known for deciduous forests, thorn forests and pockets of semi ever green forest.
2. Fauna found here are Chital, Sambhar, Nilgai, elephant, sloth bear, black buck and barking deer.
3. It is the catchment area of major Indian rivers like Godavari, Tapi, Narmada and Mahanadi.

42. What are anthropogenic extinctions?

Anthropogenic extinctions is human activities like hunting, habitat destruction, over exploitation, urbanization and industrialization.

43. What is community diversity?

1. It is the variety of habitats, biotic communities, and ecological processes in the biosphere.
2. It is the diversity at ecosystem level due to diversity of niches, trophic levels and ecological processes like nutrient cycles, food webs, energy flow and several biotic interactions.

Example: India with its alpine meadows, rain forests, mangroves, coral reefs, grass lands and deserts.

44. What are sacred groves?

1. Sacred groves or sacred woods are any assemblage of trees that are of special importance to a particular religion or culture.
2. Sacred groves are seen in various cultures throughout the world.
3. It is considered as one of means of insitu conservation of plants and its associated organisms.

45. What are the advantages of gene bank?

1. Gene banks are a type of biorepository which preserve genetic materials.
2. Seeds of different genetic strains of commercially important plants can be stored in long periods in seed banks.
3. Gametes of threatened species can be preserved in viable and fertile condition for long periods using cryopreservation techniques.

46. What are the factors that determine biodiversity distribution patterns?

1. Temperature.
2. Precipitation.
3. Distance from the equator (latitudinal gradient)
4. Altitude from sea level (altitudinal gradient)

47. List out any three important roles of IUCN.

1. It influences, assists and encourages societies in the world to conserve nature and to ensure that any use of natural resources is equitable and ecologically sustainable.
2. It influences Governments and industries through partnerships by providing information and advice.

3. It helps in the implementation of several international convention on nature conservation and biodiversity.

48. What are three types of Extinctions?

1. Natural Extinction
2. Mass Extinction
3. Anthropogenic Extinction

49. What is meant by habitat fragmentation?

1. Habitat fragmentation is the process where a large, continuous area of habitat is both reduced in area and divided into two or more fragments.
2. Fragmentation of habitats like forest land into crop lands, orchard lands, plantations, urban areas, industrial estates.

50. Name of Biosphere reserves in the Tamil Nadu.

1. Agasthyamalai (Karnataka –Tamil Nadu- Kerala)
2. Nilgiri (Tamil Nadu-Kerala)
3. Gulf of Mannar (Tamil Nadu)

5 Marks creative questions and answers

51. Pollutants and pollution are a major cause for biodiversity loss- justify.

1. The excessive uses of fertilizers, pesticides and heavy metals have polluted the land, ground and surface water bodies.
2. There is a decline in the population of fish eating birds and falcons due to pesticide bio magnification, which results in high concentrations of such pesticides in higher trophic levels like fishes.
3. Eutrophication of water bodies is resulted by the runoff from fertilizer rich fields.
4. Metal contamination like mercury, arsenic, cadmium and chromium has led to depletion of biotic resources in vulnerable ecosystems.
5. The veterinary medicine, Diclofenac used for the thinning of egg shells is said to be responsible for the death of vulture population.

52. How do habitat fragmentations affect biodiversity?

1. It results in the destruction of complex interactions amongst species, (food chain and webs).
2. Destruction of species in the cleared regions.
3. Annihilation of species restricted to these habitats (endemic).
4. Decreased biodiversity in the habitat fragments.

5. Animals requiring large territories such as mammals and birds are severely affected.
6. The elephant corridors and migratory routes are highly vulnerable.
7. The dwindling of many well-known birds (sparrows) and animals.

53. Write short notes on Biosphere Reserve.

1. Biosphere Reserve (BR) is an international designation by UNESCO for representative parts of natural and cultural landscapes extending over large areas of terrestrial or coastal/ marine ecosystems or a combination thereof.
2. BRs are designated to deal with the conservation of biodiversity, economic and social development and maintenance of associated cultural values.
3. Biosphere Reserves are thus special environments for both people and nature and are living examples of how human beings and nature can co-exist while respecting each other's needs.
4. The Biosphere Reserve Programme is guided by UNESCO's Man and Biosphere (MAB) programme, as India is a signatory to the landscape approach supported by MAB.
5. The scheme called Biosphere Reserve was implemented by the Government of India in 1986. There are 18 Biosphere Reserves in the country.

Agasthyamalai (Karnataka- Tamil Nadu- Kerala)

Nilgiri (Tamil Nadu- Kerala)

Gulf of Mannar (Tamil Nadu) are the BRs notified in Tamil Nadu.

54. List out the Role of organization which involved in conservation of biodiversity.

1. Continuity of nutrient cycles or biogeochemical cycles (N_2 , C, H_2O , P, S cycles)
2. Soil formation, conditioning or maintenance of soil health (fertility) by soil microbial diversity along with the different trophic members.
3. Increases ecosystem productivity and provide food resources.
4. Act as water traps, filters, water flow regulators and water purifiers (forest cover and vegetation)
5. Climate stability (forests are essential for rainfall, temperature regulation, CO_2 absorption, which in turn regulated the density and type of vegetation).
6. Forest resource management and sustainable development.
7. Maintaining balance between biotic components.
8. **Cleaning up of pollutants microbes** are the biggest degraders of molecules including many anthropogenic ones which are present in effluents, sewage, garbage and agro chemicals.
9. **Ecological stability** the varieties and richness of species contribute to ecological stability and survival of species. Biodiverse regions are reservoirs of biological

resources of biological resources like food resources, gene pool, genetic resource, medicinal resources, Bio-prospecting.

10. To provide unique aesthetic value and hot spots for ecotourism. Along with forest resources and wildlife it has commercial significance

11. An indicator of the health of the ecosystem. Endemism is a crucial indicator of richness.

55. Explain any five Biogeographical zones of India.

S.No	Biogeographical Zones	Biotic Provinces	Area%	Biota
1	Trans Himalaya	Comprises mountain areas of Ladakh (J&K), North Sikkim and Lahaul and Spiti of H.P	5.7%	Alpine steppe vegetation, richest wild sheep and goat community in the world (renowned for its quality wool), Chiru, black rock crane, etc.,
2	Himalayas	The entire mountain chain running from western to north eastern India	7.2%	Alpine forest, orchids, rhododendrons, wild sheep, mountain goats, shrew, snow leopard, panda etc.,
3	Indian Desert	The extremely arid area west of the Aravalli hill range comprising of the sand desert of Rajasthan (Thar) and the salt desert of Gujarat (Kutch)	6.9%	Thorn forest s, deciduous forest, wild ass (endemic), Indian bustard, camel, foxes, snakes etc.,
4	Semi-arid zones	The zones in between the desert and the Deccan plateau including the Aravalli hill range	15.6%	Thorn and deciduous forest, mangroves, Nilghai, black buck, four horned antelopes, sambar, chital, spotted deer, Asiatic lion, tiger, leopard, jackal etc.,
5	Western Ghats	Mountain ranges from Satpura in South Gujarat to the southern most tip of Kerala	4%	Evergreen to dry deciduous forests, Nilgiri langur, Indian elephant. Nilgiri tahr (state animal of Tamil Nadu) the grizzled

				squirrel and lion tailed macaque (endemic)
6	Deccan Peninsula	A large are comprising of raised land bound by the Sathpur range on the north, Western Ghats on the west and Eastern Ghats on the eastern Ghats on the east	43%	Deciduous forest, thorn forests and pockets of semi ever green forests, chital, sambar, sloth bear, barking deer, Nilghai, elephant, black buck etc.,
7	Gangetic plains	One of most fertile region of India which extends from eastern Rajasthan through Uttar Pradesh, Bihar and West Bengal	11%	Mangrove forest, dry deciduous forest, rhinoceros elephant, buffalo, tiger, crocodile, swamp deer, hog deer etc.,
8	North- East India	The plains and non Himalayan hill ranges of north eastern India. This region represents the transition zone between the Indian, Indo-Malayan and Indo- Chinese bio geographical regions. It is the meeting point of the Himalayan mountains and peninsular India	5.2%	Biogeographical Gateway for much of India's fauna and flora and also biodiversity hot spot. Semi ever green forest, monsoon forests, swamps and grassland, Indian rhinoceros, golden langur, leopard etc.,
9	Coastal Region	The coastline from Gujarat to Sunderbans with sandy beaches, mud flats, coral reefs and mangroves	2.5%	Mangroves, sponges, corals, crabs, turtles, tunas, ornamental fishes etc.,
10	Andaman and Nicobar Islands	Andaman and Nicobar Islands in the Bay of Bengal	0.3%	Evergreen forest, a wide diversity of corals, Narcondam hornbills, giant robber crab, turtle, wild boar, water monitor, south Andaman krait etc.,

56. List out and explain the types of extinction.

The extinction of species is mainly due to drastic environmental changes and population characteristics. There are three types of Extinctions.

i) Natural extinction:

1. The Natural extinction is a slow process of replacement of existing species with better adapted species due to changes in environmental conditions, evolutionary changes, predators and diseases.
2. A small population can get extinct sooner than the large population due to inbreeding depression (less adaptivity and variation)

ii) Mass extinction:

1. The earth has experienced quite a few mass extinctions due to environmental catastrophes.
2. A mass extinction occurred about 225 million years ago during the Permian, where 90% of shallow water marine invertebrates disappeared.

iii) Anthropogenic extinctions:

1. These are abetted by human activities like hunting, habitat destruction, over exploitation, urbanization and industrialization.
2. Some examples of extinctions are Dodo of Mauritius and steller's sea cow of Russia. Amphibians seem to be at higher risk of extinction because of habitat destruction.

57. List out the reasons for the richness of biodiversity in the tropics.

1. Warm tropical regions between the tropic of cancer and Capricorn on either side of equator possess congenial habitats for living organisms.
2. Environmental conditions of the tropics are favourable not only for speciation but also for supporting both variety and number of organisms.
3. The temperatures vary between 25°C to 35°C a range in which most metabolic activities of living organisms occur with ease and efficiency.
4. The average rainfall is often more than 200 mm per year.
5. Climate, seasons, temperature, humidity, photoperiods are more or less stable and encourage both variety and numbers.
6. Rich resource and nutrient availability.

Rana Sakthi Durga
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Bio-Zoology

Unit-V

Chapter: 12 Environmental Issues

❖ **Textbook questions and answers:**

1. Right to Clean Water is a fundamental right, under the Indian constitution.
b) Article 24.
2. With which of the following, the agenda 21 of Rio Summit, 1992 is related to?
b) Combating the consequences of population.
3. The thickness of Stratospheric Ozone layer is measured in/on:
b) Dobson units.
4. As per 2017 statistics, the highest per capita emitter of Carbon dioxide in the world is.....
b) China.
5. The use of microorganism metabolism to remove pollutants such as oil spills in the water bodies is known as
b) Bioremediation.
6. Which among the following always decreases in a food chain across trophic levels?
c) Energy.
7. In the E-waste generated by the mobile phones which among the following metal is most abundant?
a) Copper
8. The Hydro chlorofluorocarbons (HCFCs) are the compounds which have the following molecules:
b) Chlorine
9. SMOG is derived from:
c) Both A and B
10. Excess of fluoride in drinking water causes:
d) Fluorosis.

11. Expand i) CFC ii) AQI iii) PANi) **CFC**- Chloro Fluoro Carbons.ii) **AQI**- Air Quality Index.iii) **PAN**- Peroxy Acetyl Nitrate**12. What is SMOG and how it is harmful for us?**

1. Smog is a type of air pollution caused by tiny particles in the air. The word comes from a mixture of the words smoke and fog.
2. Smog generally refers to photochemical smog, which is created when sunlight reacts with nitrogen oxides and volatile organic compounds found in fossil fuel emissions from automobiles, factories and power plants.
3. These reactions create ground-level ozone and particulate matter, reducing visibility. Smog can make breathing more difficult, especially for people with asthma.
4. Smog also affects plants and animals. It damages crops as well as causes health problems in pets, farm animals and human beings.
5. Smog has also been known to cause corrosive damage to buildings and vehicles.

13. List all the wastes that you generate, at home, school or during your trips to other places. Could you very easily reduce the generation of these wastes? Which would be difficult or rather impossible to reduce?

S.No	Place	Waste generated	Mode of reduction
1	Home	1. Vegetable, Fruit, Food waste. 2. E-waste	1. They can be composted to form manure. 2. Reduce usage
2	School	Stationary waste/ paper waste	Segregate and sent to recycling unit.
3	Trips	Plastic cups/ Water bottles/ Plates	1. Avoid plastic usage. Use ecofriendly plates/ cups. Throw waste in garbage dry meant for the same in hotels/ trains/ public places.

14. Write notes on the following:**a) Eutrophication:**

When run-off from land containing nutrients reaches water bodies like lakes, it results in dense growth of plant life. This phenomenon is called Eutrophication.

b) Algal Bloom:

Algal Bloom is a rapid growth microscopic algae or cyanobacteria in water, due to nutrient enrichment, often enrichment, often resulting in a coloured scum on the surface.

15. What effect can fertilizer runoff have on an aquatic ecosystem?

Agrochemicals have been observed to generate residues that cause nutrient imbalance.

16. How can we control eutrophication? PTA (2019-2020)

1. Planting vegetation along streambeds to slow erosion and absorb nutrients.
2. Controlling application amount and timing of fertilizer.
3. Controlling runoff from feedlots.
4. The best, easiest and most efficient way to prevent eutrophication is by preventing excess nutrients from reaching water bodies.

17. Discuss the role of an individual to reduce environmental pollution.

1. Using public transports.
2. Turn off the lights when not in use.
3. Recycle and Reuse.
4. No to plastic bags.
5. Reduction of forest fires and smoking.
6. Use of fans instead of Air conditioner.
7. Use filters for chimneys.
8. Avoid usage of crackers.

18. How does recycling help reduce pollution?

1. Recycling prevents the emissions of many greenhouse gases and water pollutants and saves energy.
2. Using recovered material generates less solid waste.
3. Recycling helps to reduce the pollution caused by the extraction and processing of virgin materials.

19. Discuss briefly the following:**a) Catalytic converter**

Catalytic converter is an exhaust emission control device that reduces toxic gases and pollutants in exhaust gas from an internal combustion engine into less toxic pollutant by catalyzing a redox reaction.

b) Ecosan toilets.

1. 150 liters of waste water at an average is generated by an Indian individual daily, and a large amount of its is generated from toilets.
2. Ecological sanitation is a sustainable system for handling human excreta by using dry composting toilets.
3. Ecosan toilets not only reduce waste water generation but also generated the natural fertilizer from recycled human excreta, which forms an excellent substitute for chemical fertilizers.
4. This method is based on the principles of recovery and recycling of nutrients from excreta to create a valuable supply for agriculture. 'Ecosan' toilets are being used in several parts of India and Sri Lanka.

20. What are some solutions to toxic dumping in our oceans?

Toxic dumping involves depositing all the waste materials from factories and industries, tankers and ships and disposing sewage waste materials and ships and disposing sewage waste materials into the oceans and seas. Some of them may be toxic.

Ways to prevent ocean pollution are:

1. Avoid plastic usage. It is the single largest threat to oceans.
2. Avoid products containing microbeads.
3. Fat sustainable Reduce energy usage.
4. Practice proper disposal of hazardous materials.
5. Practice organic methods agriculture and less usage of chemical fertilizer/ pesticides etc.
6. Beach cleanup campaigns to be organized and make every individual to practice hygienic methods of waste disposal in beaches.

Other important questions and answers:**21. How would be the earth without greenhouse effect? (2019-2020)**

1. The naturally occurring greenhouse gases in the air, mainly carbon dioxide, methane and water vapour trap radiation from the sun and act like a thermal blanket around our planet earth.
2. Without the greenhouse gases, the earth would have an average temperature of -18°C and be covered in ice.
3. The greenhouse effect keeps the earth warm enough to sustain life.

22. Write about the effects of chemicals used in the field of Agriculture. (2019-2020)

1. May kill beneficial bacteria and soil organisms.
2. Can cause eutrophication in water bodies.
3. Affect aquatic animals and their productivity.
4. Pesticide containing water, even in trace quantities is unfit for human consumption.
5. Particles (aerosols) and residues of these chemicals cause air pollution.
6. Inhalation of contaminated air can cause respiratory problems.
7. Consumption can lead to poisoning, side effects and after effects.
8. Chemicals can cause skin rashes and irritation of eyes.
9. Many of these chemical are reported to be carcinogenic.
10. They can trigger hormonal disorders and neurotoxicity.
11. Beneficial insects and animals can be affected.

23. Write the biological effects of smog? PTA (2019-2020)

Smog can make breathing more difficult, especially for people with asthma.

24. Enumerate the controlling measures of noise pollution. PTA (2019-2020)

1. Planting trees in and around noise sources is an effective solution for noise pollution as plants are known to absorb noise and bring down sound levels.
2. Regular servicing and tuning of automobile engines can effectively reduce noise pollution by vehicles and machinery.

3. Workers should be provided with ear plugs and earmuffs at work sites that generate high noise levels.
4. Lubrication of machinery and regular servicing minimizes noise levels.
5. Regulation should be imposed to restrict the usage of loudspeakers in crowded areas and public places

25. Which is referred to as biomagnifications? PTA (2019-2020)

1. Non- degradable substances enter the food chain, they do not get metabolized or broken down or expelled and instead get transferred up the tropic levels of the food chain.
2. During this process they show an increase in concentration which is referred to as biomagnifications.

26. Ecosan toilets are an excellent substitute for chemical fertilizer. How? PTA (2019-2020)

1. The toilet is based on the principle of recovery and recycling of nutrients from excreta to create a valuable resource for agriculture.
2. When the pit of an Ecosan toilet fills up it is closed and sealed.
3. After about eight to nine months the faeces are completely composted to organic manure and can be used on farms.

2 and 3 Marks creative questions and answers

27. Define pollution.

Pollution is any undesirable change in the physical, chemical and biological characteristics of the environment due to natural causes and human activities.

28. Define pollution.

Pollution is any undesirable change in the physical, chemical and biological characteristics of the environment due to natural causes and human activities. The agents which cause pollution are called pollutants.

29. What are the different basic groups of pollutants?

1. Pollutants can be classified into two basic groups Non-degradable and degradable.
2. Based on the time taken to breakdown into their ingredients, degradable pollutants are classified as rapidly degradable (non-persistent) and slowly degradable (persistent).

30. Name the main sources of carbon monoxide pollution.

The main sources of carbon monoxide pollution include Automobile exhausts, fumes from factories and burning of fire wood.

31. Mention any two cost effective treatment of air pollution?

Cost effective air pollution treatment systems like indoor plants and high performance bio-filters can improve indoor air quality.

32. Explain Air Quality Index (AQI).

Air Quality Index is a number used by government agencies to communicate to the public how polluted the air is at a given time.

33. Define Noise pollution.

1. Sound that is unwanted and undesirable or can disrupts one's quality of life is called as Noise.
2. When there is lot of 'noise' in the environment it is termed as Noise pollution.
3. The intensity of noise is measured in decibels (dB)

34. Write the sources of Nitrogen oxides.

1. Fossil fuel combustion.
2. Automobiles exhausts.

35. Name the chemicals present in mosquito repellents.

DEET (n-n-diethylnetetolamide) and allethrin used in mosquito coils may cause itching, burning, tingling sensation or numbness.

36. List the methods of Medical waste disposal.

1. Incineration
2. Chemical disinfection
3. Autoclaving
4. Encapsulation
5. Landfill
6. Burying
7. Microwave irradiation

37. Which gas interferes with O₂ transport by affecting haemoglobin or Write the Adverse effects of carbon monoxide.

1. CO in the atmosphere interferes with O₂ transport since haemoglobin has greater affinity for carbon monoxide.
2. At low concentration it causes headache and blurred vision.
3. In higher concentration it can lead to coma and death.

38. What is '4R'?

"4R" means Refuse, Reduce, Reuse and Recycle mantra is the best available remedy for plastic waste pollution.

39. Recycling and disposal of e-waste involve significant risk-justify.

The recycling and disposal of e-waste may involve risk to the health of workers and communities in developed countries.

1. Great care must be taken to avoid unsafe exposure in recycling operation.
2. The leaching of materials like heavy metals from landfills and incinerator ashes may cause health problem to human and animals.

40. What is meant by Deforestation?

Deforestation is the destruction of forests in order to clear the land and make it available for other uses.

41. How does water pollution affect on ecosystem?**a) Destruction of ecosystems:**

1. Ecosystems, especially aquatic systems can be severely affected or destroyed by water pollution.
2. Water pollutants affect existing niches and habitats and the survival of organisms
3. Soil fertility is affected and the system becomes uninhabitable.

b) Disruption of food-chains:

1. Water pollution disrupts the natural food chains as well as food webs.
2. Pollutants such as lead and cadmium are taken up by primary consumers where they can be lethal or get stored.
3. Later, when these animals are consumed by secondary consumers, the food chain can get disrupted at any trophic level or result in enhanced concentration of these pollutants (biomagnifications).
4. Hot water from industries when release into the water bodies affects aquatic density and diversity.

42. What are three sources of water pollution?

1. Municipal wastes.
2. Industrial wastes.
3. Agricultural wastes.

43. Water pollution disrupts the nature of food chains as well as food webs-justify.

1. Pollutants such as lead and cadmium are taken up by primary consumers, where they can be lethal or get accumulated.

2. When these animals are consumed by secondary consumers, there pollutants are get enhanced by a process called biomagnifications.
3. The food chain may get disrupted at any trophic level due to the magnification and accumulation of these chemicals.

44. How do you control ozone layer depletion?

1. Phase down or ban the use of CFCs (CFC free refrigerants).
2. The usage of chemical such as halons and halo carbons ought to be minimized.
3. Creating awareness about ozone depleting agents.

45. Expand

STP- Sewage Treatment Plants.

ETP- Effluent Treatment Plants.

MOEFCC- Ministry Of Environment Forest and Climate Change.

RZWT- Root Zone Waste Water Treatment.

DEWATS- Decentralized Waste Water Treatment System.

GHG- Green House Gases.

46. What is PAN?

Peroxyacetyl nitrate (PAN) is a secondary pollutant present in photochemical smog.

It is thermally unstable and decomposes into peroxyethanol radicals and nitrogen dioxide gas causing eye irritation.

47. Define Global warming.

Increase in the concentrations of greenhouse gases such as CO₂, methane, nitrous oxide, CFCs, and ozone causes green house effect, warming of the earth, resulting in sea level rise, submerging of islands and sea shores of various parts of the world.

48. Define Ozone depletion.

1. Thinning of the stratospheric ozone layer is known as ozone depletion.
2. Depletion causes the Ozone hole resulting in poor screening of the harmful UV rays and increase in incidences of skin cancer.
3. Some of the common agents that deplete ozone are CFCs.

49. Define Acid rain.

1. Acid rain is a form of precipitation that contains acidic components, such as sulphuric acid or nitric acid.
2. It damages trees, crops and harms marine animals (coral reefs) and induces corrosion.

50. Define Agro or Agri chemicals.

Chemicals which are used in agriculture for growth of plants and pest control are called agrochemical or agrichemicals.

51. List three ways to Manage nuclear wastes.

1. Spent fuel pools.
2. Vitrification.
3. Geological Repositories.

Padasalai