

XII – BIO-ZOOLOGY

Name :

Class : Sec:

School :

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Bio-Zoology

Unit-1

Chapter: 1 Reproduction in organisms

TEXTUAL: VERY SHORT ANSWERS:

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

Unicellular organisms like Amoeba, Bacteria, Paramecium and Vorticella.

2. 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.

3. 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.

TEXTUAL: SHORT ANSWERS:

4. 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.

5. 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).

6. 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.

7. 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.

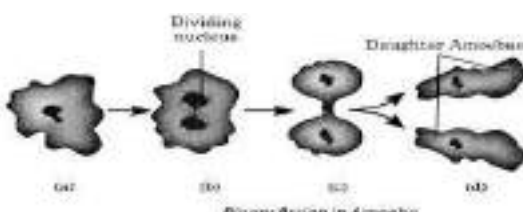
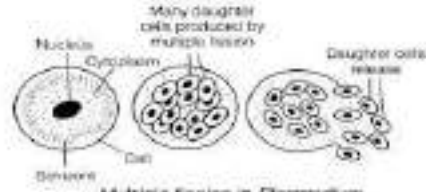
b) A male honey bee has 16 chromosomes where as its female has 32 chromosomes.

It 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.

TEXTUAL: LONG ANSWERS:

8. Differentiate between the following:

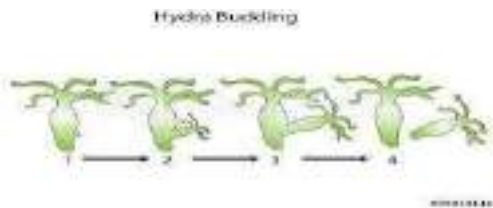
a) Binary fission in amoeba and multiple fission in plasmodium.

Binary fission in amoeba	Multiple fission in plasmodium
<ol style="list-style-type: none"> 1. Forms two daughter individuals. 2. Nucleus and cytoplasm divided only once. 3. Takes place in favorable conditions. <p>Example: Amoeba reproduces by binary fission.</p> 	<ol style="list-style-type: none"> 1. Forms many daughter individuals. 2. Nucleus and cytoplasm divided repeatedly. 3. Take place in favorable as well as unfavorable conditions. <p>Example: Plasmodium reproduces through multiple fission.</p> 

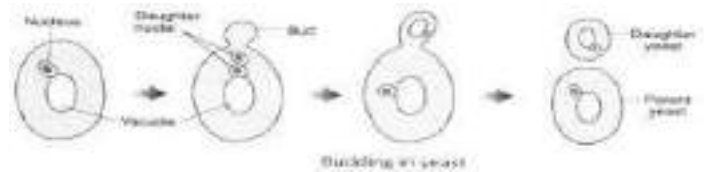
b) Budding in yeast and budding in Hydra.

Budding in Hydra	Budding in Yeast
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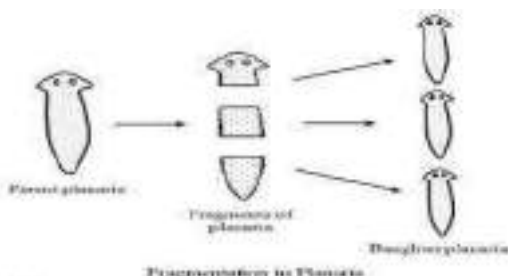
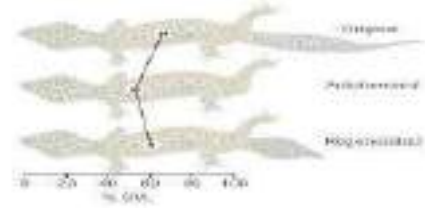
1. Hydra is a multicellular organism.
2. Budding starts on the parent organism and then offspring gets detached from the parent surviving as an independent organisms.
3. Multiple mitotic divisions are required for the formation of a bud.
4. Uses regenerative cells for reproduction.



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.



c) Regeneration in lizard and planaria.

Regeneration in planaria	Regeneration in lizard
<ol style="list-style-type: none"> Organisms that are fragmented result in each fragment into an individual organism. A new individual emerges from each fragment. Only a few organisms can fragment and form new individuals. This type of regeneration is observed in organisms such as Flatworms and Sponges.  <p>The diagram illustrates the process of regeneration in planaria. It starts with a single 'Parent planaria' on the left. An arrow points to the 'Fragmentation of planaria', where the parent is cut into three pieces. From these fragments, three arrows point to 'Daughter planaria', showing three separate, fully formed individuals.</p>	<ol style="list-style-type: none"> occur when an organism loses a limb or any other part of the body. No new organisms are formed. All organisms exhibit the ability to regenerate to some degree. Examples of regeneration include regrowing a lost limb, such as the tail of a lizard.  <p>The diagram shows a lizard's tail regrowing in three stages. The top lizard has a broken tail labeled 'Original'. The middle lizard has a tail labeled 'Re-growing'. The bottom lizard has a fully regrown tail labeled 'Regrown'. A scale bar at the bottom indicates time in days: 0, 25, 50, 75, 100.</p>

9. How is juvenile phase different from reproductive phase?

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

10. What is the difference between syngamy and fertilization?

Syngamy	Fertilization
<ol style="list-style-type: none">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.	<ol style="list-style-type: none">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.

Bio-Zoology

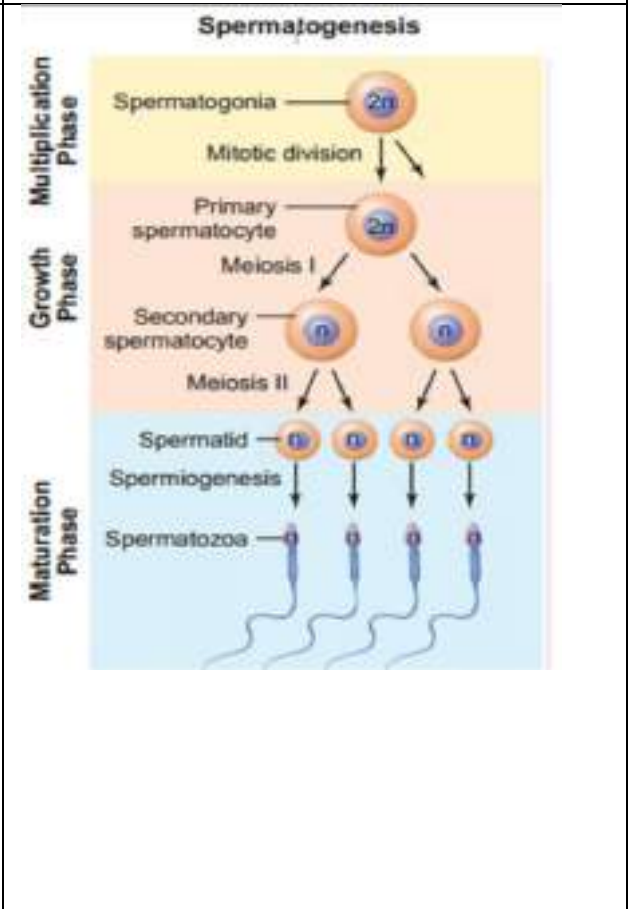
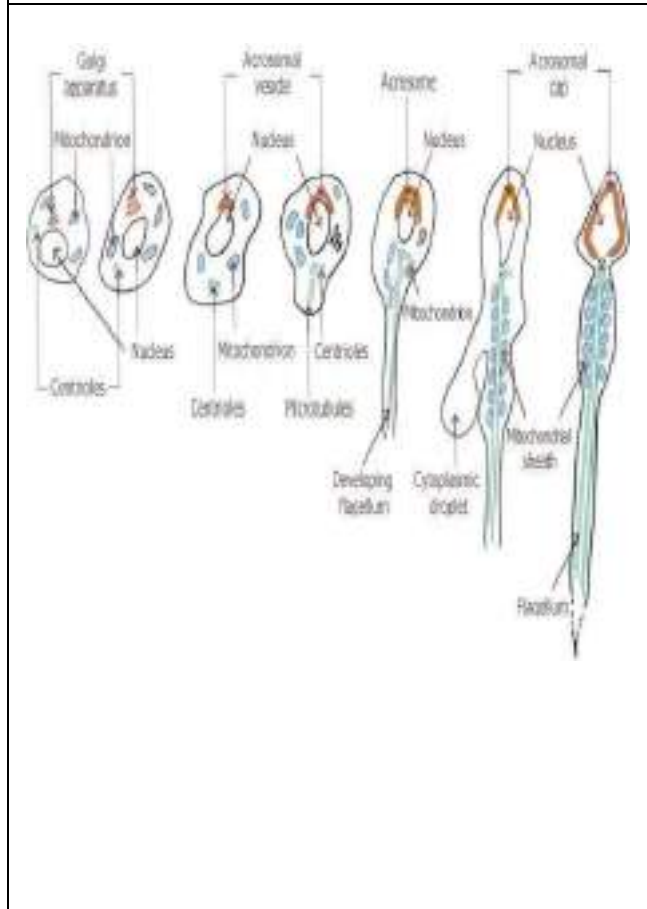
Unit-1

Chapter: 2 Human Reproduction

TEXTUAL: VERY SHORT ANSWERS:

1. 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



2. 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.

3. Expand the acronyms.

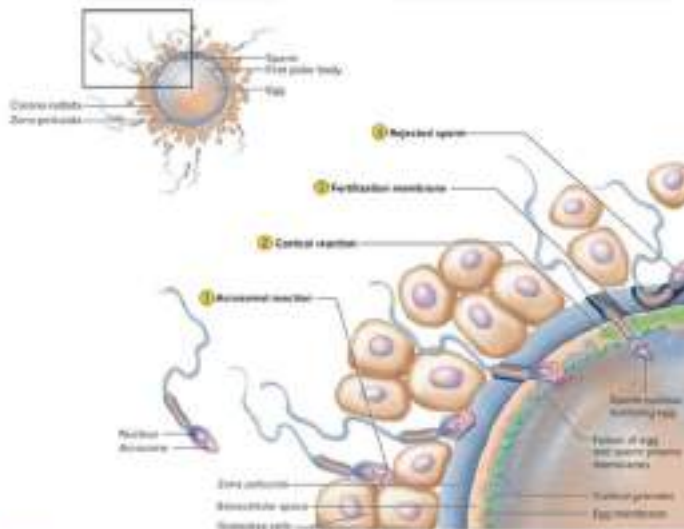
- a) **FSH- Follicle Stimulating Hormone.**
- b) **LH- Leutinising Hormone.**
- c) **hCG- human Chorionic Gonadotropin.**
- d) **hPL- human Placenta Lactogen.**

4. 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.



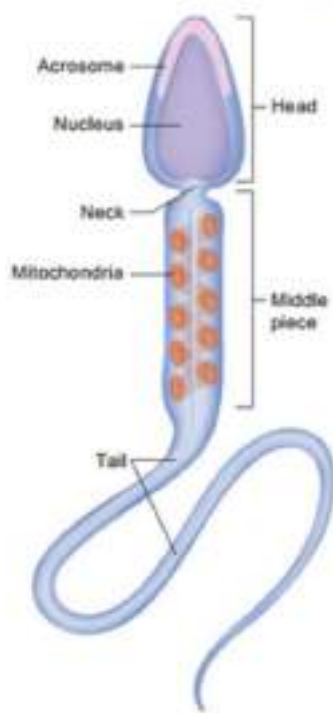
This picture is only for your understanding

TEXTUAL: SHORT ANSWERS:

5. 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.
6. **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.
7. **Draw a labeled sketch of a spermatozoan.**



8. **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.

9. 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

10. 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.

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

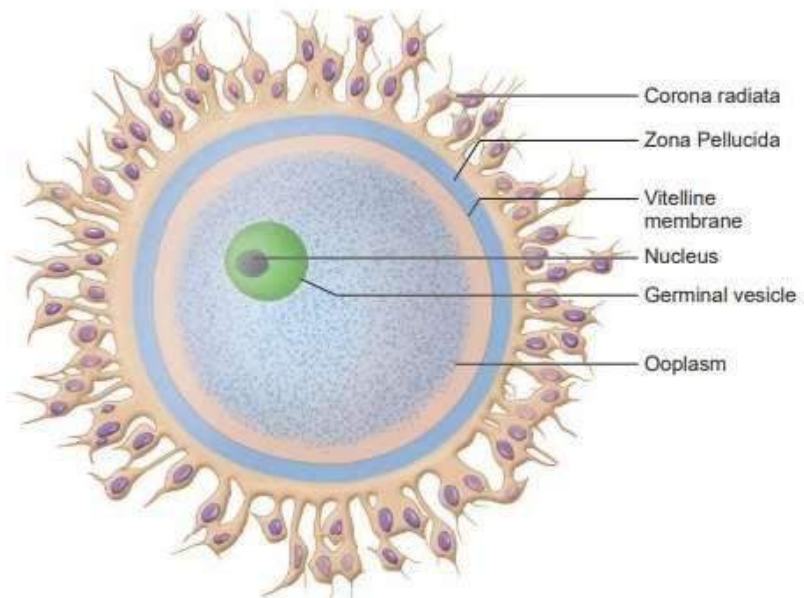
1. human Chorionic Gonadotropin (hCG)
2. human Chorionic Somatomammotropin (hCS)
3. human placental Lactogen (hPL)
4. Oestrogens
5. Progesterone
6. Relaxin:
 - i) Relaxin secreted during the later phase of pregnancy
 - ii) It help in relaxation of the pelvic ligaments at the time of parturition

12. 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.

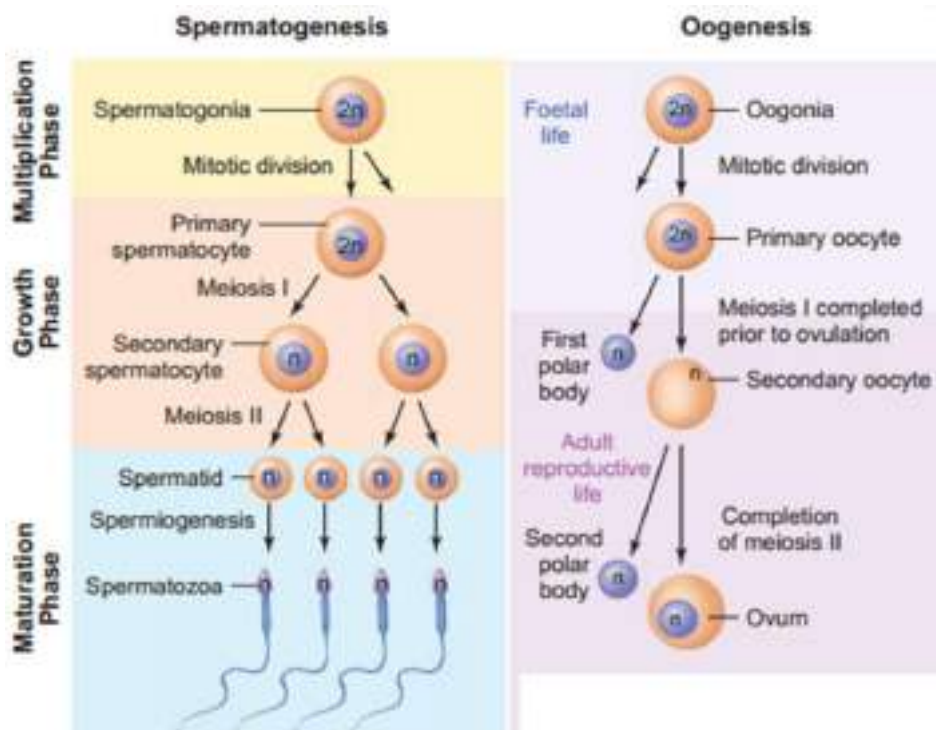
13. Describe the structure of the human ovum with a neat labeled diagram.

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 **zonapellucida** and outer thick coat of follicular cells called **corona radiate**.
4. The **vitelline** membrane and **zona pellucida** is a narrow perivitelline space.

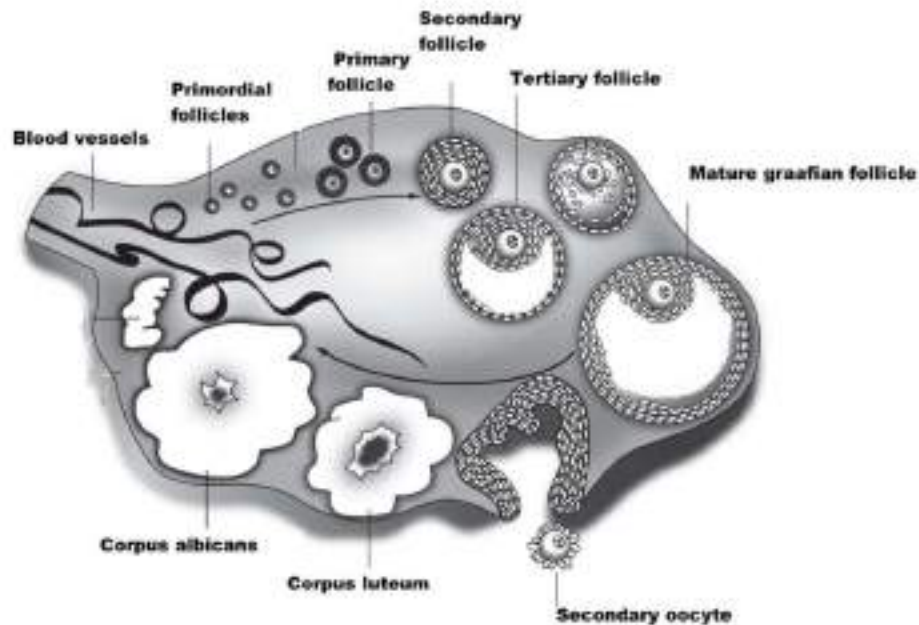


TEXTUAL: LONG ANSWERS:

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



15. 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:

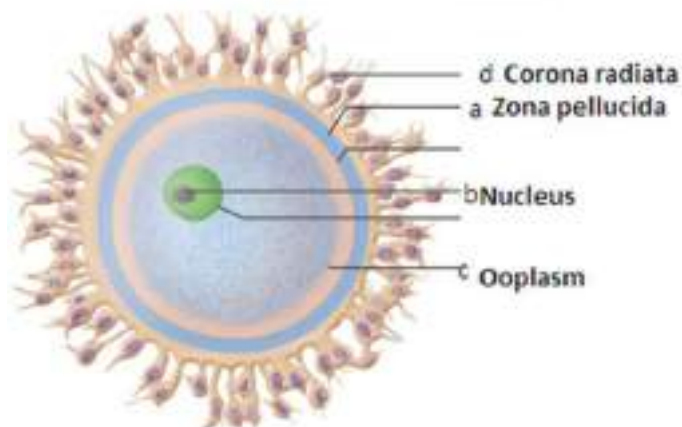
1. During luteal phases, the remaining part of the **Graafian follicle** is transformed into a transitory endocrine gland called corpus luteum.
2. The **corpus luteum secretes large amount of progesterone** which is essential for the maintenance of the endometrium.
3. If Fertilization takes place, it 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**.

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

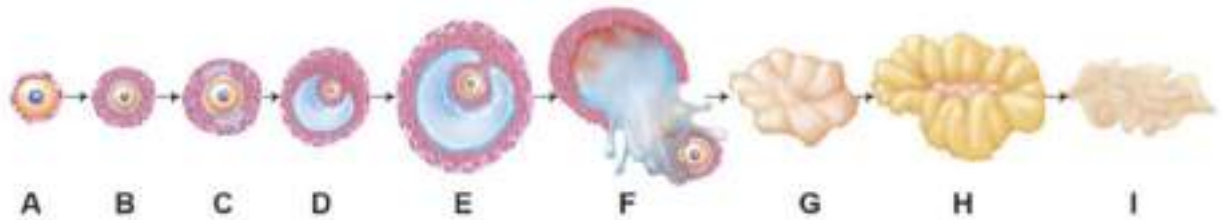
Role of Oxytocin:

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

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



18. 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.

Bio-Zoology

Unit-I

Chapter: 3 Reproductive Health

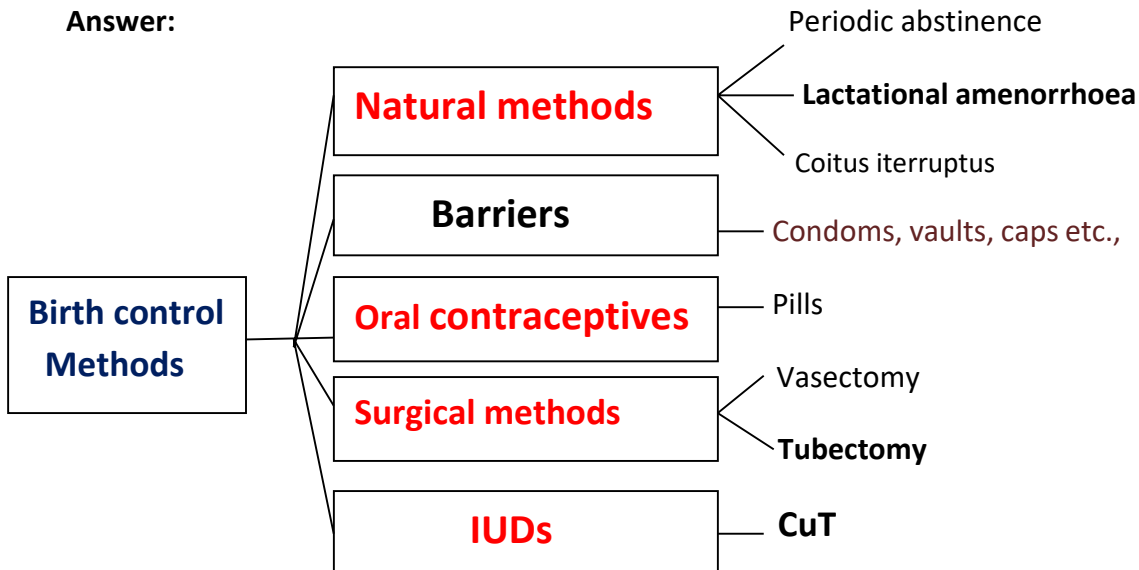
TEXTUAL: VERY SHORT ANSWERS:

1. 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.

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

Answer:



3. Correct the following statements:

Answer:

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

4. 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.

5. Expand the following:

- a) ZIFT- Zygote Intra- Fallopian Transfer.
- b) ICSI- Intra - Cytoplasmic Sperm Injection.

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

1. Creating awareness and providing medical assistance to build a healthy society.
2. 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.

7. 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 .

8. 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)

❖ **Chlamydia:**

- **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.

9. How are STDs transmitted?

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

10. 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.

11. 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.

12. 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.

13. 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.

Bio-Zoology

Unit-II

Chapter: 4 Principles of Inheritance and Variation

TEXTUAL: VERY SHORT ANSWERS:

1. 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.

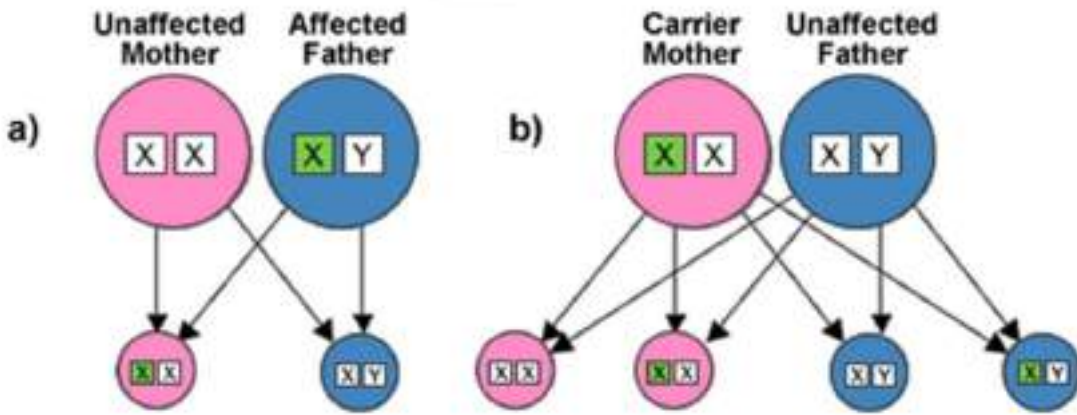
2. Distinguish between heterogametic and homogametic sex determination systems.

Heterogametic	Homogametic
<ol style="list-style-type: none">1. Heterogametic individuals (dissimilar sex chromosomes)2. Produce two types of gametes, so they are called heterogamete. <p>Example:In human males produce two kinds of sperms. Some with X chromosome and some with Y chromosome.</p>	<ol style="list-style-type: none">1. Homogametic individuals (similar chromosomes)2. Produce only one type of gamete so they are called homogametic. <p>Example:In human the female are homogametic. They are produce only one kind of egg with X chromosome.</p>

3. 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.

4.What is criss-cross inheritance



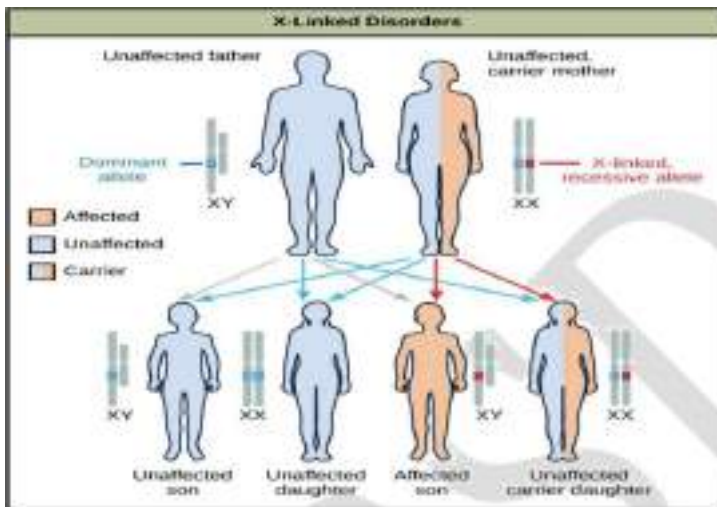
- Criss-cross inheritance is the transmission of a gene from mother to son or father to daughter.
- Those patterns of inheritance are called criss-cross inheritance or skip generation inheritance.
- In which a character is inherited to the second generation through the carrier of first generation.

Example: X-chromosome linkage haemophilia.

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

Answer:

- 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



This picture is only for your understanding

(XY) only one X chromosome.

- So X linked recessive diseases are more common among males than females.

Example: Haemophilia.

6. What are holandric genes?

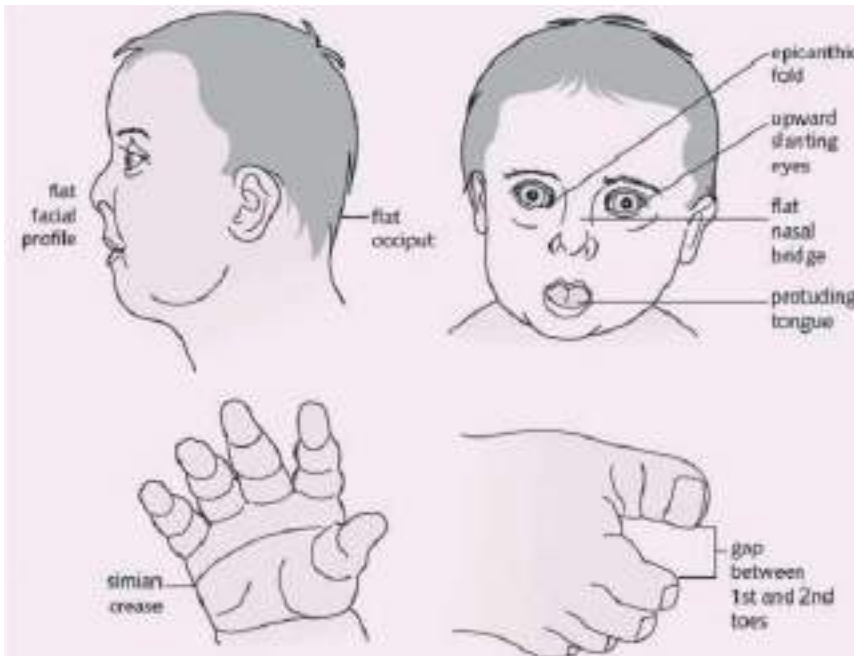
- Holandric gene is Y linked genes that are found on the Y chromosome.
- Therefore this gene is only found in males. An example of a trait for this gene is facial hair growth.
- “Holandric” means basically a gene on the Y chromosome (in mammal) that does not have a homolog on the X chromosome.

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.

7. Mention the symptoms of phenylketonuria.

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

8. Mention the symptoms of Down's syndrome.



This picture is only for your understanding.

- Severe mental retardation.
- Defective development of the central nervous system.
- Increased separation between the eyes.
- Flattened nose.
- Ears are malformed.
- Mouth is constantly open
- Tongue protrudes.

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

- Karl Landsteiner** discovered two kinds of antigens called **antigen A** and **antigen B** on the surface of RBCs of human blood.
- Based on the presence or absence of these antigens three kinds of blood group **type "A"**, **type "B"** and **type "O"** (universal donor).
- 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**.
- Bernstein in 1925 discovered** that the inheritance of different blood groups in human beings is determined by a number of **multiple allelic series**.
- The **three autosomal alleles located on chromosome 9** are concerned with the **determination of blood group** in any person.
- 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

g. The I gene exists in three allelic forms I^A, I^B and I^O.

h. I^A specifies **A** antigen, I^B allele determines **B** antigen and I^O allele specifies **no antigen**.

i. Each allele (I^A and I^B) produce transferase enzyme.

j. I^A allele produces **N- acetyl galactose transferase** and can add **N-acetyl galactosamine (NAG)**.

k. I^B allele encodes for the enzyme **galactose transferase** that **adds galactose** to the precursor.

l. 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.

10. How is sex determined in human beings?

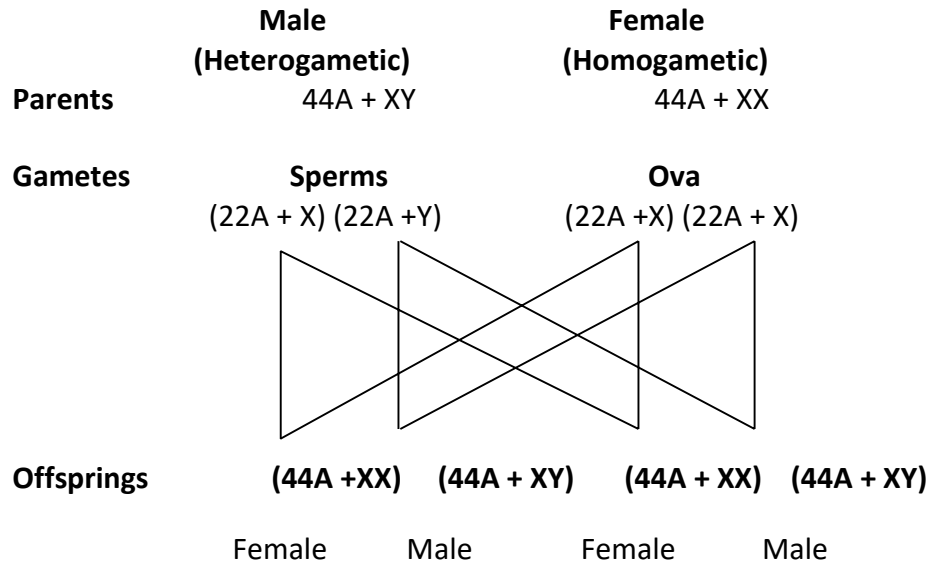
a. Genes determining sex in human beings are located on two sex chromosomes, called **allosomes**.

b. Mamma's **sex determination** is associated with chromosomal differences between the two sexes typically **XX females and XY males**.

c. 23 pairs of human chromosomes include **22 pairs of autosomes (44A)** and **one pair of sex chromosome (XX or XY)**.

d. **Females** are **homogametic** producing **only one type of gamete** (egg) each containing **one X** chromosome.

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



11. What is male heterogamety?

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

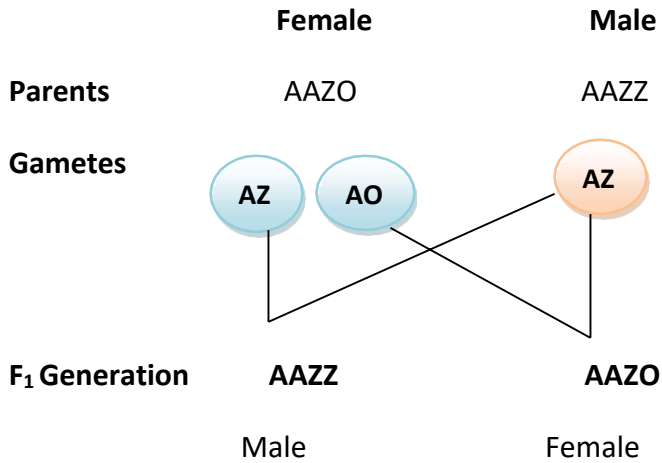
Example: Bugs, cockroaches and grasshoppers. And XX-Xy type (Human beings and Drosophila)

12. Brief about female heterogamety.

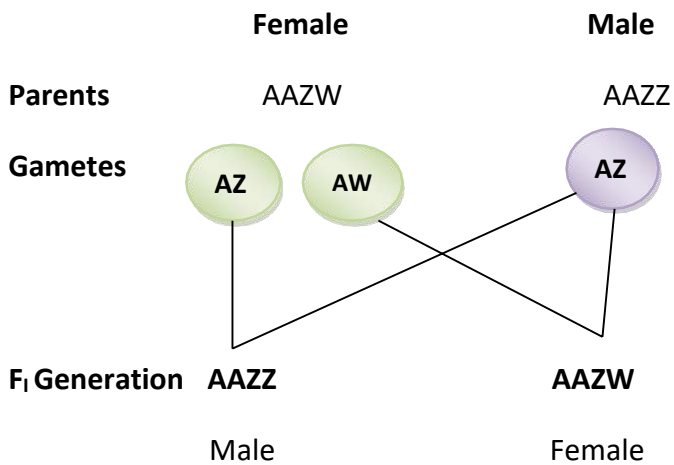
- a. In this method of sex determination the females are heterogametic producing dissimilar gametes while males are homogametic producing similar gametes.
- b. Sex determination the alphabets Z and W are used here instead of X and Y respectively.

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:

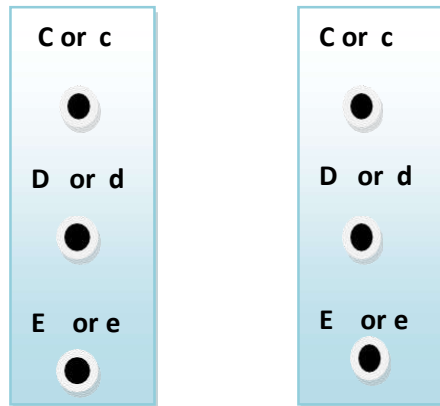


1. This method of sex determination occurs in certain insects (gypsy moth) and in vertebrates such as fishes, reptiles and birds.
2. In this method the female has one Z and one W chromosome (ZW) producing two types of egg
3. The male sex has two Z chromosomes and is homogametic (ZZ) producing a single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

13. Give an account of genetic control Rh factor.

Fisher and Race hypothesis:

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



- i. The possible genotypes will be one C or c, one D or d, one E or e from each chromosome.
- ii. 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.

14. Explain the mode of sex determination honeybees.

- a. The sex of offspring is determined by the number of sets of chromosomes it receives.
- b. Fertilized eggs develop into females (Queen or Worker) and unfertilized eggs develop into males (drones) by parthenogenesis.
- c. The male have half the number of chromosomes (haplod) and the females have double the number (diploid)
- d. Sex determination facilitates the evolution of sociality in which only one diploid female becomes a queen and lays the eggs for the colony.
- e. 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.
- f. The queen constructs their social environment by releasing a hormone that suppresses fertility of the workers.

15. What are the applications of Karyotyping?

- a. It helps in gender identification.
- b. It is used to detect the chromosomal aberrations like deletion, duplication, translocation, nondisjunction of chromosomes.
- c. It helps to identify the abnormalities of chromosomes like aneuploidy.
- d. It is also used in predicting the evolutionary relationships between species.
- e. Genetic diseases in human beings can be detected by this technique.

16. 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.

a. Haemophilia:

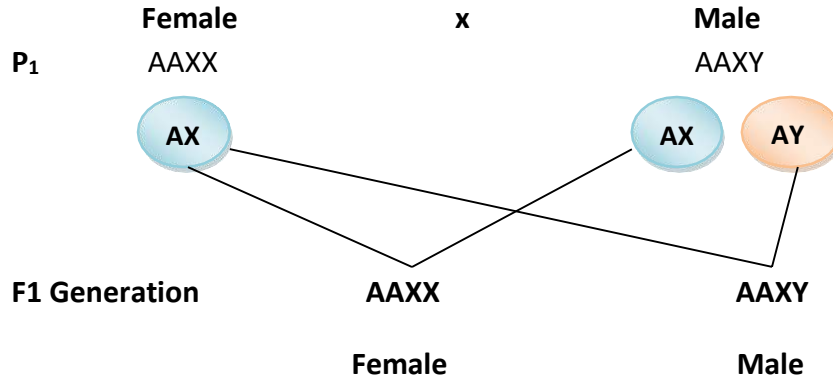
1. Haemophilia is commonly known as bleeders disease, which is more common men than women.
2. This hereditary disease was first reported by John Cotto in 1803.
3. Haemophilia is caused by a recessive X-linked gene.
3. A person with recessive gene haemophilia lacks a normal clotting substance (thromboplastin) 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.

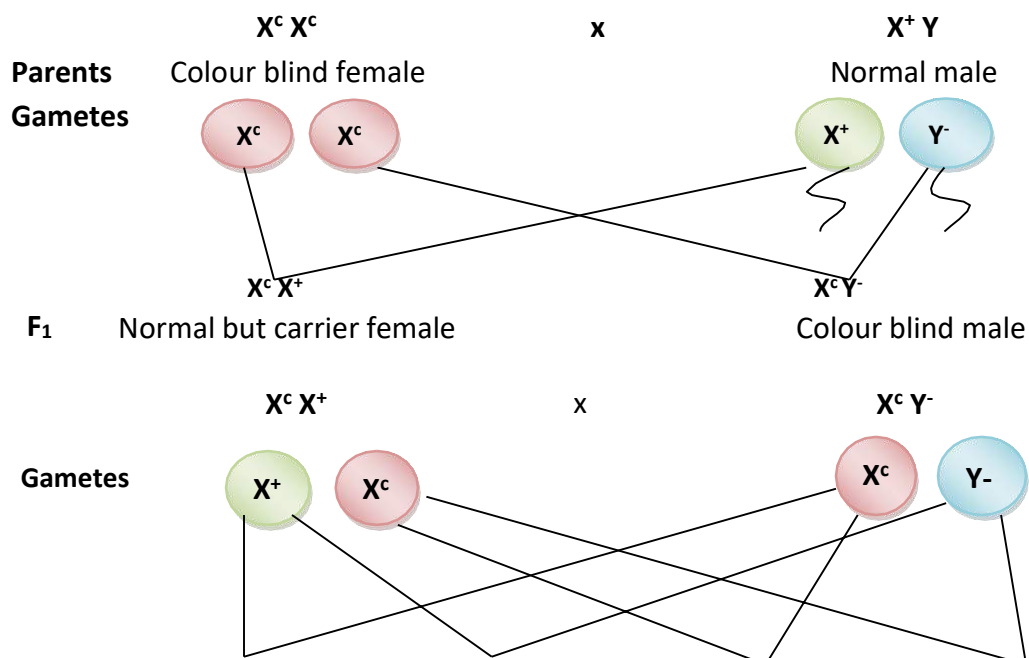
Five marks:

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.
3. 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.
4. The sex of the embryo depends on the fertilizing sperm.
5. 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.



F₂	$X^c X^+$	$X^+ Y^-$	$X^c X^c$	$X^c Y^-$
	Normal but Carrier female	Normal male	Colour blind female	Colour blind male

1. 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.
2. 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.

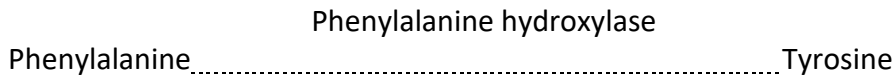
5. Write a note on any two mendelian disorders occurring in human beings.

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.



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 Turner'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.

Bio-Zoology

Unit-II

Chapter-5 Molecular Genetics

TEXTUAL: VERY SHORT ANSWERS

1. 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.

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

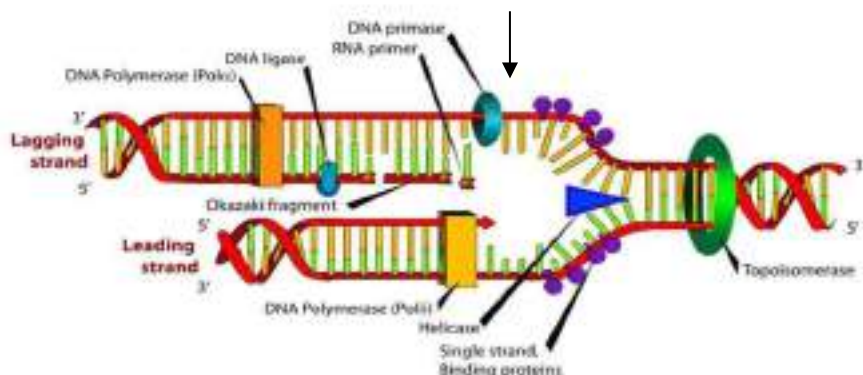
A=Promoter, B=Template strand.

3. 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'

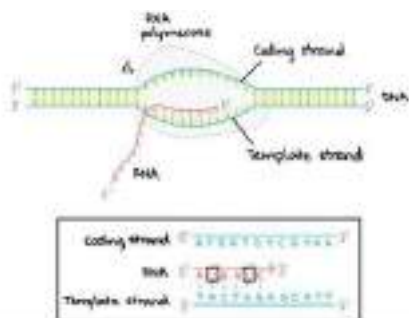
4. Only a single RNA Primer is required	4. Starting of each okazaki fragment requires a new RNA.
5. Formation of leading strand is quite rapid.	5. Formation of lagging strand is slower.
6. Formation of leading strand begins immediately at the beginning of replication.	6. Formation of lagging strand begins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

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



4. 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

5. 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.

TEXTUAL: LONG ANSWERS

6. 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.

7. 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.

8. 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).

9. 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.

10. 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.

11. 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.

12. 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?

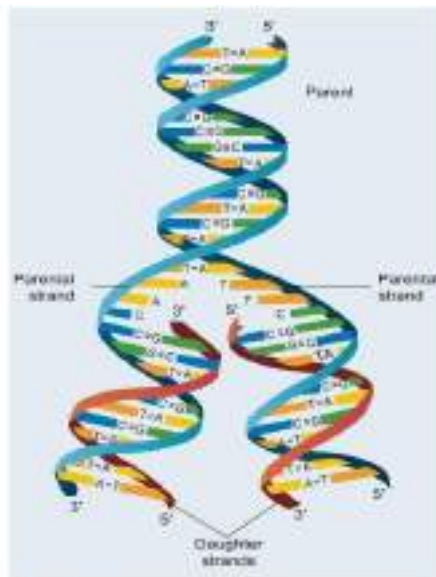


Fig. 5.4 Semiconservative DNA replication

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.

13. 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.

14. 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

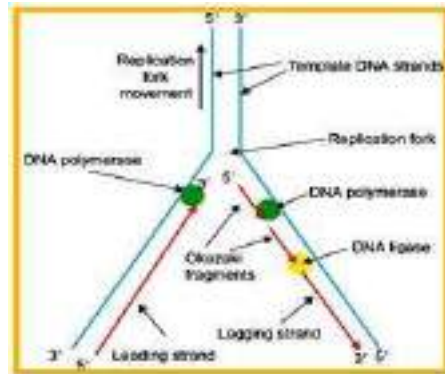
15. Name the anticodon required to recognize the following codons: AAU, CGA, UAU, and GCA.

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

16. 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 $3' \rightarrow 5'$

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

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

3' ACGUACGUACGUACGUACGUACGUACG 5'

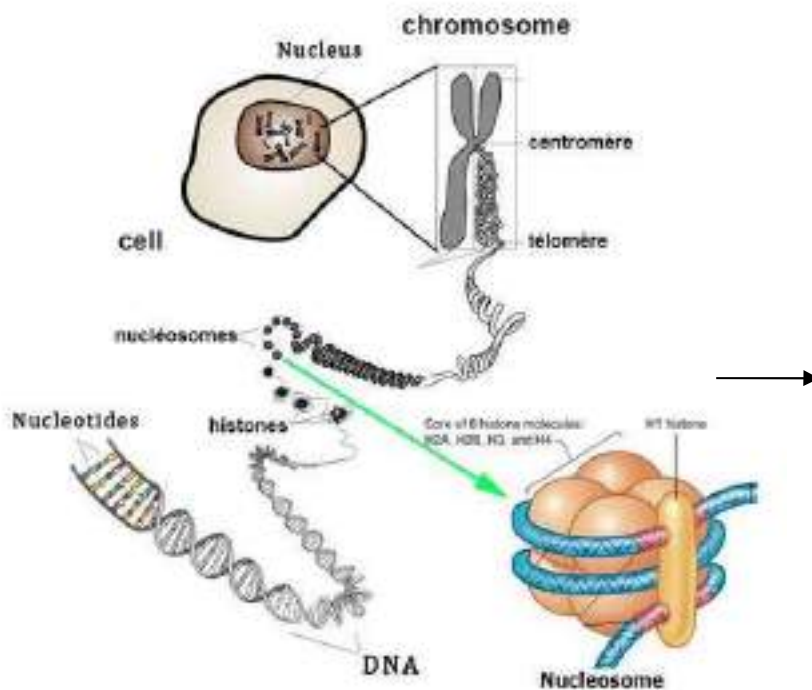
18. How is the two stage process of protein synthesis advantageous?

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.

19. Why did Hershey and Chase use 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.

20. 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 nucleosome 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.

21. 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.

Bio-Zoology
Unit-II
Chapter: 6 Evolution

TEXTUAL: VERY SHORT ANSWERS

1. 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.

2. 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:



→ This picture is only for your understanding

- 1) When animals died the original portion of their body may be replaced molecule by molecule by minerals and the original substance being 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:



→ This picture is only for your understanding

- 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.

3. 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.

TEXTUAL: SHORT ANSWERS

4. 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.

5. 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.

6. 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.



This picture is only for your understanding

Struggle for existence:

Organisms struggle for food, space and mate. As these become a limiting factor, competition exists among the members of the population.



This picture is only for your understanding

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.

TEXTUAL: LONG ANSWERS

7. 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.,

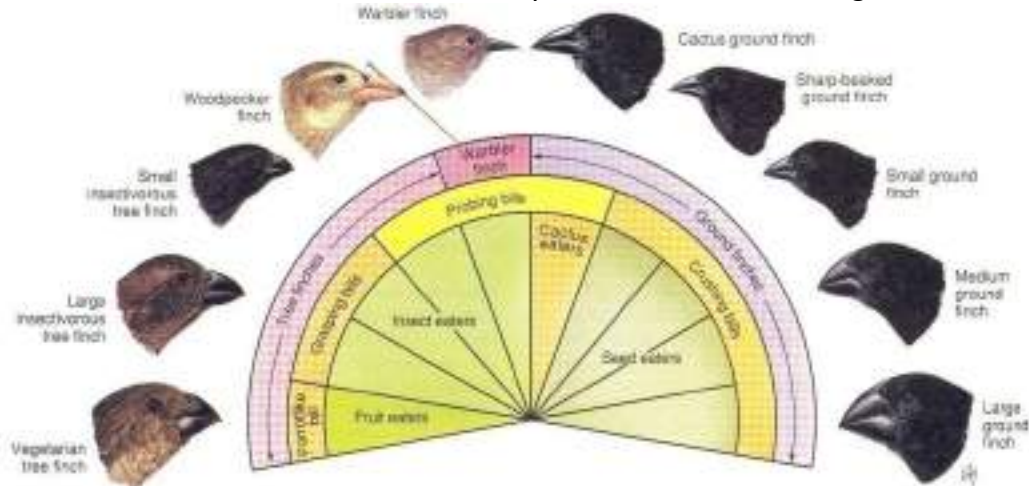
8. Taking the example of peppered moth, explain the action of natural selection. What do you call the above phenomenon? (PTA-2019-2020)

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.

- 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.

9. 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.



- 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.
- 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.
- Genetic variation in the ALX1 gene in the DNA of Darwin finches is associated with variation in the beak shape.
- Mild mutation in the ALX1 gene leads to phenotypic change in the shape of the beak of the Darwin finches

10. Who disproved Lamarck's Theory of acquired characters? How?

The theory of inheritance of acquired character:

- Characters that are developed during the life time of an organism are called acquired characters and these are than inherited.
- 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.

11. 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.

12. 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.

13. Rearrange the descent in human evolution.

Australopithecus → *Homo erectus* → *Homo sapiens* → *Ramapithecus* → *Homo habilis*.

Answer:

Ramapithecus → *Australopithecus* → *Homo habilis* → *Homo erectus* → *Homo sapiens*.

14. 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.

Bio-Zoology

Unit-III

Chapter: 7 Human Health and Diseases

TEXTUAL: VERY SHORT ANSWERS

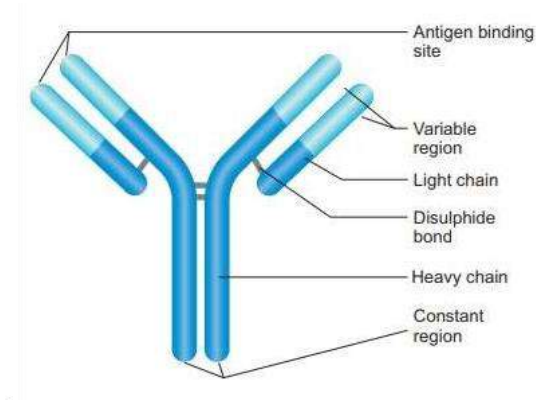
- 1. Name and explain the type of barriers which involve macrophages.**
 - i) The type of barriers that involve the macrophages is phagocytic barriers.
 - ii) They are specialized cells like monocytes, neutrophils and tissue macrophages.
 - iii) These cells phagocytose and digest whole microorganisms.

- 2. 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.

- 3. 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.

- 4. 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.

5. Explain the structure of immunoglobulin with suitable diagram.



6. 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.

TEXTUAL: SHORT ANSWERS

7. 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.

8. 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.

9. 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.

TEXTUAL: LONG ANSWERS

10. 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.

11. 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.

12. 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 filariasis.

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.

13. 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.

14. 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.

Bio-Zoology

Unit-III

Chapter: 8 Microbes in Human Welfare

TEXTUAL: VERY SHORT ANSWERS

1. 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 inoculum 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.

2. 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.

3. 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, diphtheria, 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.

TEXTUAL: SHORT ANSWERS

4. Write short notes on the following.

a) Brewer’s yeast:

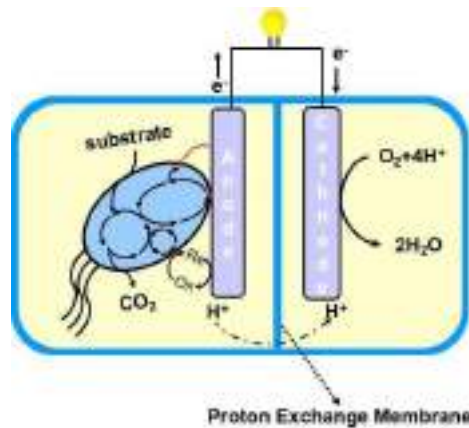
1. *Saccharomyces cerevisiae* commonly called brewer’s yeast is used for fermenting malted cereals and fruit juices to produce various alcoholic beverages.

b) Wine and beer are produced without distillation, whereas whisky, brandy and rum are obtained by fermentation and distillation.

c) 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.

d) 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.

5. 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).

6. 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.

TEXTUAL: LONG ANSWERS

7. What is referred to as industrial alcohol? Briefly describe its preparation.

1. *Saccharomyces cerevisiae* is the major producer of ethanol (C₂H₅OH). 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.

8. 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).

5 marks creative questions and answers:

9. Explain the working of a biogas plant.

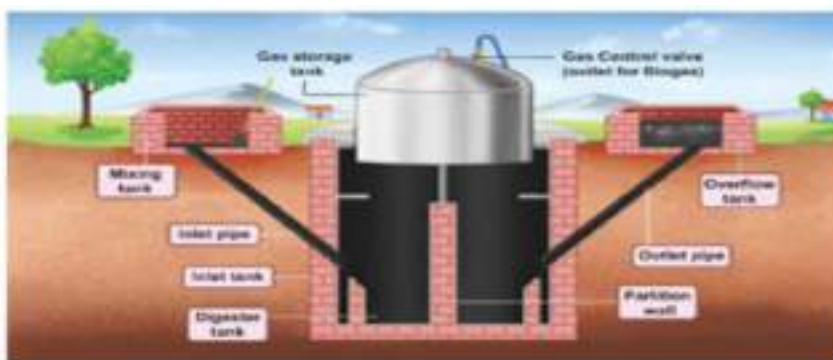


Fig. 8.4 Biogas unit

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 methanogenesns 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).

10. Explain how microorganisms involved in bioremediation?

Aerobic microbes:

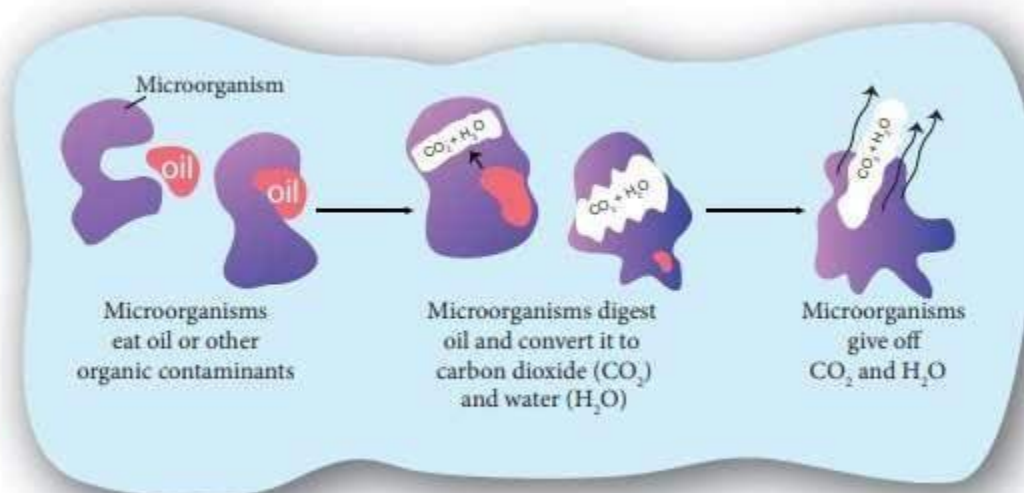


Fig. 9.6 The process of bioremediation

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:

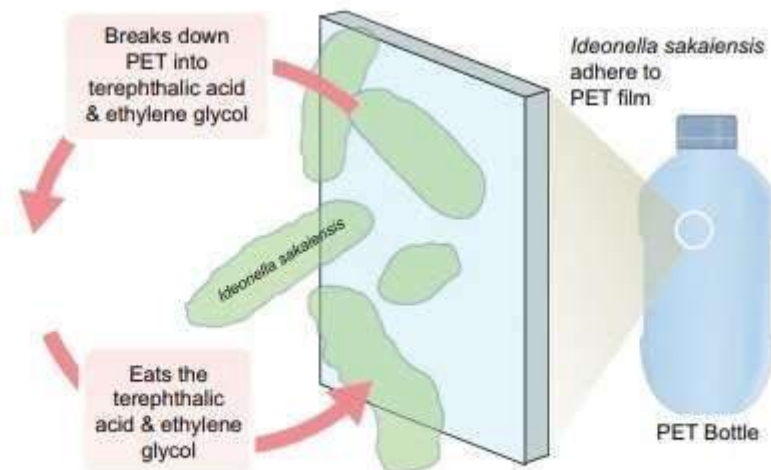


Fig. 9.7 Actions of *Ideonella sakaiensis*

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.

11. 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.

12. 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.

Bio-Zoology

Unit-IV

Chapter: 9 Applications of Biotechnology

TEXTUAL: VERY SHORT ANSWERS

1. **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 DNA 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.

TEXTUAL: LONG ANSWERS

2. **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.

3. What is genetically engineered Insulin?

- a. Production of insulin by recombinant DNA technology started in the late 1970s.
- b. This technique involved the insertion of human insulin gene on the plasmids of *E.coli*.
- c. Insulin produced by recombination DNA technology to treat diabetic patients is called genetic engineered insulin. It is otherwise known as humulin.

4. Explain how “Rosie” is different from a normal cow?

- a. Rosie is the first transgenic cow produced human protein enriched milk.
- b. Which contained the human alpha lactalbumin.
- c. 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.

5. How was Insulin obtained before the advent of rDNA technology? What were the problems encountered?

- a. In the early years insulin isolated and purified from the pancreas of pigs and cows was used to treat diabetic patients.
- b. 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.

6. 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?

- a. Yes one can use antibody against the enzyme (that is responsible for the metabolism of phenylalanine) to develop ELISA based diagnostic technique.
- b. The patient in which the enzyme protein is absent would give negative result in ELISA when compared to the normal individual.

7. 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.

- a. 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.
- b. 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.

8. What are transgenic animals? Give examples.

- a. 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.
- b. Transgenic animals such as **Mice, rat, rabbit, pig, cow, goat, sheep** and **fish** have been produced.

9. 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?

- a. ELISA is a biochemical procedure to detect the presence of specific antibodies or antigens in a sample of serum, urine, etc.,
- b. It is a very important diagnostic tool to determine if a person is HIV positive or negative.
- c. ELISA is a tool for determining serum antibody concentrations (such as the antibodies produced in a person infected by pathogens such as HIV).
- d. ELISA is highly sensitive and can detect antigens in the range of a nanogram.
- e. 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.,

10. Explain how ADA deficiency can be corrected?

- a. ADA deficiency could be cured by bone marrow transplantation, where defective immune cells could be replaced with healthy immune cells from a donor.
- b. In some patients it can be treated by enzyme replacement therapy, in which functional ADA is injected into the patient.
- c. During gene therapy the lymphocyte from the blood of the patient are removed and grown in a nutrient culture medium.
- d. A healthy and functional human gene, ADA cDNA encoding this enzyme is introduced into the lymphocytes using a retrovirus.
- e. 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.
- f. 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.

11. What are DNA vaccines?

- a. A DNA vaccine consists of a gene encoding an antigenic protein, inserted onto a plasmid, and then incorporated into the cells in target animal.
- b. DNA instructs the cells to make antigenic molecules which are displayed on its surfaces.
- c. 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.

12. 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.

13. What are stem cells? Explain its role in the field of medicine.

- a. 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.
- b. Most of the adult stem cells are multipotent and can act as a repair system of the body, replenishing adult tissues.
- c. The red bone marrow is a rich source of adult stem cells.
- d. 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.

14. 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.

15. PCR is a useful tool for early diagnosis of an infectious disease. Elaborate. (PTA-2019-2020)

- a. The specificity and sensitivity of PCR is useful for the diagnosis of inherited disorders (genetic diseases), viral diseases, bacterial diseases, etc.,
- b. The diagnosis and treatment of a particular disease often requires identifying a particular pathogen.
- c. 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.
- d. PCR is also employed in the prenatal diagnosis of inherited diseases by using chorionic villi samples or cells from amniocentesis.
- e. cDNA from PCR is a valuable tools for diagnosis and monitoring retroviral infections.
Examples: Tuberculosis by *Mycobacterium tuberculosis*.
- f. Sex of human beings and live stocks, embryos fertilized *in vitro* can be determined by PCR by using primers and DNA probes specific for sex chromosomes.
- g. PCR technique is also used to detect sex-linked disorders in fertilized embryos.

16. What are recombinant vaccines? Explain the types.

- a. The recombinant vaccines are generally of uniform quality and produce less side effects as compared to the vaccines produced by conventional methods.
- b. Different types of recombinant vaccines include subunit recombinant vaccines, attenuated recombinant vaccines and DNA vaccines.

Subunit recombinant vaccines:

- i. Vaccines that use components of a pathogenic organism rather than the whole organism are called Subunit vaccines.
- ii. 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.

17. Explain why cloning of Dolly, the sheep was such a major scientific breakthrough?

- a. Dolly was the first animal to be clone from a differentiated somatic cell taken from an adult animal without the process of fertilization.
- b. This study offers benefits of clinical trials and medical researchers.
- c. It is a breakthrough in receiving endangered species through this technique.

18. Mention the advantages and disadvantages of cloning.

- a. Offers benefits for clinical trials and medical research. It can help in the production of proteins and drugs in the field of medicine.
- b. Aids stem cell research.
- c. Animal cloning could help to save endangered species.
- d. 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.
- e. The process is tedious and very expensive.
- f. It can cause animals to suffer.
- g. Reports show that animal surrogates were manifesting adverse outcomes and cloned animals were affected with disease and have high mortality rate.
- h. It might compromise human health through consumption of cloned animal meat.
- i. Cloned animals age faster than normal animals and are less healthy than the parent organism as discovered in Dolly.
- j. Cloning can lead to occurrence of genetic disorders in animals.
- k. More than 90% of cloning attempts fail to produce a viable offspring.

19. Explain how recombinant Insulin can be produced.

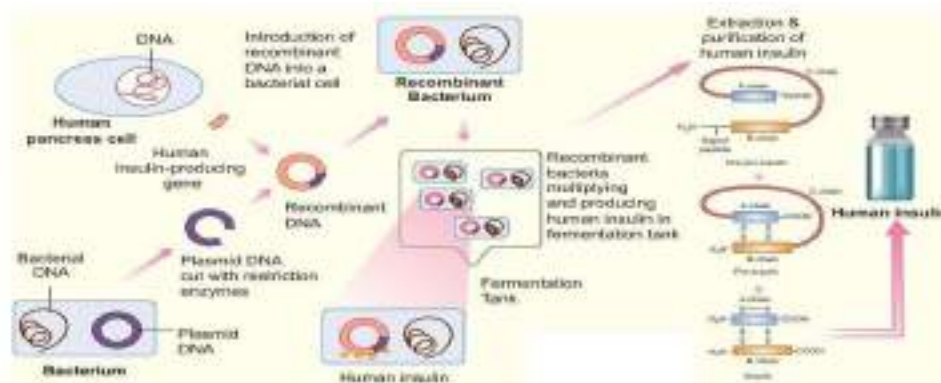


Fig. 10.1 Human Insulin Production

- a. The production of insulin by recombinant DNA technology started in the late 1970s.
- b. This technique involved the insertion of human insulin gene on the plasmids of *E.coli*.
- c. 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.

- d. The leader sequence is removed after translation and the C chain is excised, leaving the A and B polypeptide chains.
- e. The approval to use recombinant insulin for diabetes mellitus was given in 1982. In 1986 human insulin was marketed under the trade name Humulin.

20. Explain the creation of Dolly.

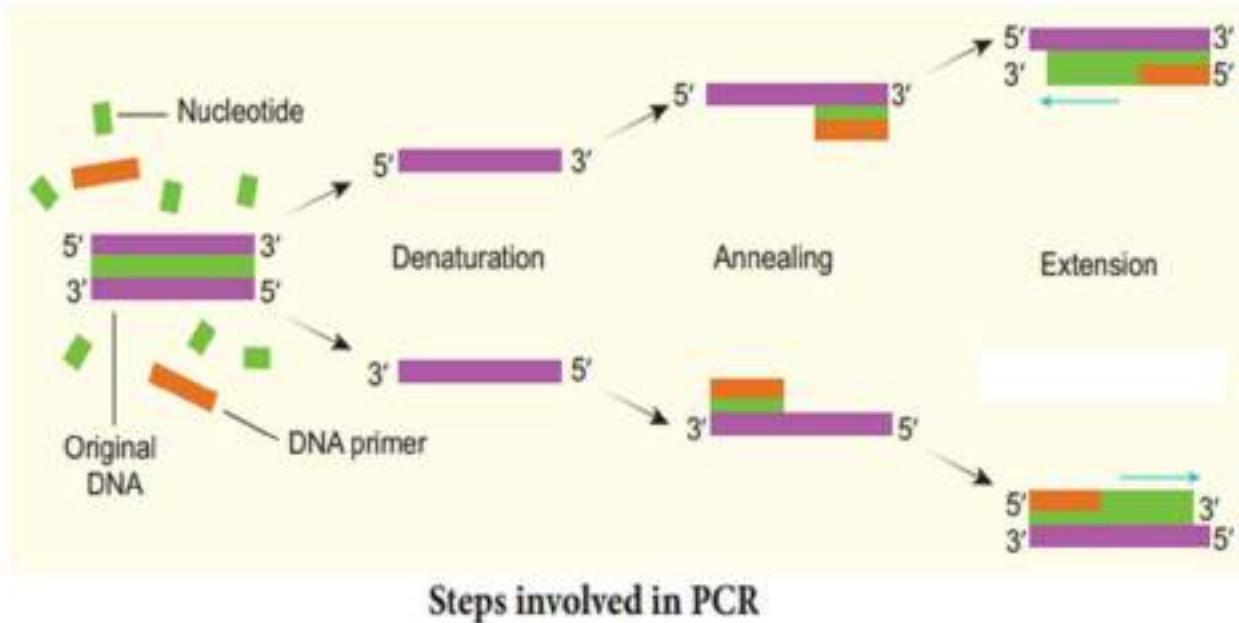


Fig. 10. 10 Cloning of dolly

- a. Dolly was the first mammal (Sheep) clone developed by Ian Wilmut and Campbell in 1997.
- b. Dolly, the transgenic clone was developed by the nuclear transfer technique and the phenomenon of totipotency.
- c. Totipotency refers to the potential of a cell to develop different cells, tissues, organs and finally an organism.
- d. The mammary gland under cells (Somatic cells) from a donor sheep (ewe) were isolated and subjected to starvation for 5 days.
- e. The udder cells could not undergo normal growth cycle entered a dormant stage and became totipotent.
- f. An ovum (egg cell) was taken from another sheep (ewe) and its nucleus was removed to form an enucleated ovum.
- g. The dormant mammary gland cell/udder cell and the enucleated ovum were fused.
- h. The outer membrane of the mammary cell was ruptured allowing the ovum to envelope the nucleus.
- i. The fused cell was implanted into another ewe which served as a surrogate mother. Five months later dolly was born.
- j. Dolly was the first animal to be cloned from a differentiated somatic cell taken from an adult animal without the process of fertilization.

21. What are steps involved in polymerase chain reactions?

The polymerase chain reaction is used to reproduce selected sections of DNA or RNA for analysis. Previously, amplification of DNA involved cloning the segments of interest into vectors for expression in bacteria.



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.

Bio-Zoology

Unit-V

Chapter: 10 Organisms and populations

TEXTUAL: VERY SHORT ANSWERS

1. 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.

2. 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.

3. 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.

4. What is pedogenesis?

Soil is formed from rocks which are the parent materials of soil, by weathering and is called embryonic soil (pedogenesis).

5. 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.

TEXTUAL: SHORT ANSWERS

6. Differentiate between Eurytherms and Stenotherms.

Eurytherms	Stenotherms
Organisms which can survive a wide range of temperature are referred to as Eurytherms.	Those organisms which can tolerate only a narrow range of temperature are stenotherms.
Examples: Cat, dog, tiger, human.	Examples: Fish, Frogs, Lizards and Snakes.

7. Explain hibernation and aestivation with example.

Hibernation	Aestivation
Hibernation is a state of reduced activity in some organism to escape cold winter conditions.	Aestivation is a state of reduced activity in some organisms to escape desiccation due to heat in summers.
Bear and squirrels inhabiting cold regions are examples of animals that hibernate during winters.	Fishes and snails are examples of organisms aestivating during summers.

8. 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.

9. 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)

TEXTUAL: LONG ANSWERS

10. 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. 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.

11. 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.

12. 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= $\frac{\text{number of deaths per unit time}}{\text{Average population}}$

13. 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 from.	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.

14. 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. One 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.

15. 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 effects 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.

16. 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 here and predatory pine martens. Important predators include the timber wolf, grizzly bear, black bear, bobcat and wolverines.

17. 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.

18. Describe population Age Distribution.

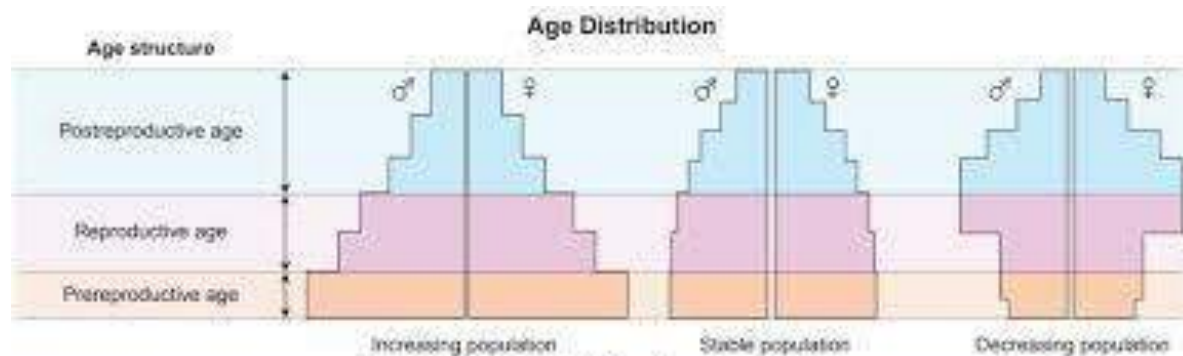
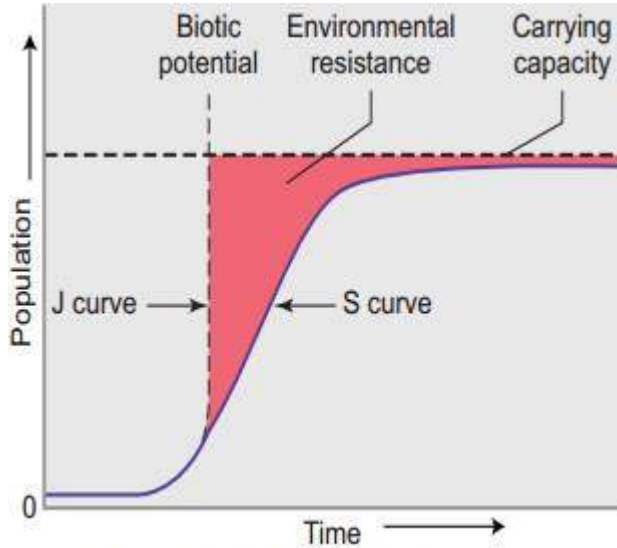


Fig. 11.13 Age distribution pyramids

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.

19. 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).



J 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.

20. Tabulate and analysis of two species population interation. (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.

21. 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)

22. 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.

Bio-Zoology

Unit-V

Chapter: 11 Biodiversity and its Conservation

TEXTUAL: VERY SHORT ANSWERS

1. Define endemism.

The phenomenon in which the organisms are exclusively restricted to a given area.

2. How many hotspots are there in India? Name them.

India is home to four biodiversity hotspots. They are

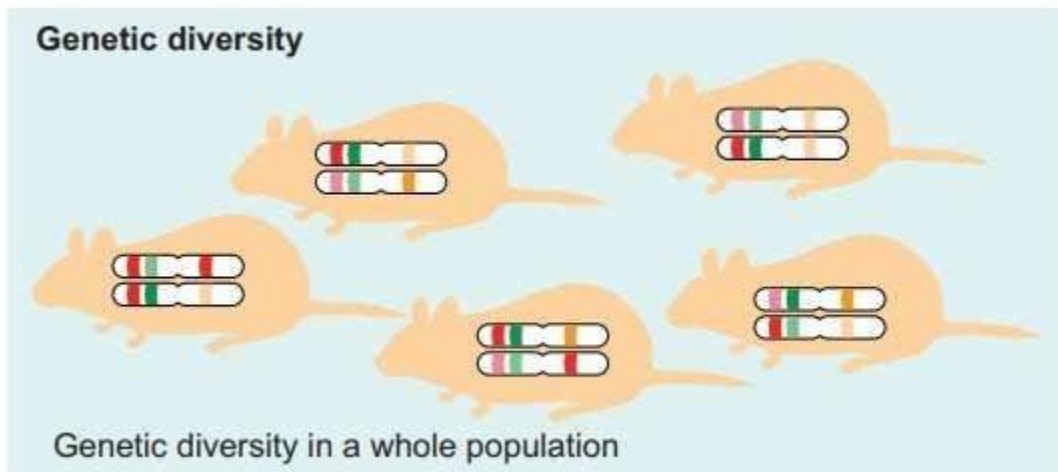
- i) Himalaya (the entire Indian Himalayan region)
- ii) Western Ghats.
- iii) Indo-Burma: includes entire North- eastern India, except Assam and Andaman group of Islands (and Myanmar, Thailand, Vietnam, Laos, Cambodia and Southern China)
- iv) Sundalands: includes Nicobar group of Islands (and Indonesia, Malaysia, Singapore, Brunei, Philippines)

TEXTUAL: SHORT ANSWERS

3. 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 unity 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.

4. Name the active chemical found in the medicinal plant *Rauwolfia vomitoria*. What type of divert it belongs 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 himalyan ranges might be in terms of the potency and concentration of the **active chemical (reserpine)** that the plant produces.

5. "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.

TEXTUAL: LONG ANSWERS

6. '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:

3. To create awareness on the degree of threat to biodiversity.
4. Identification and documentation of species at high risk of extinction.
5. Provide global index on declining biodiversity.
6. Preparing conservation priorities and help in conservation of action.
7. 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.

7. 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

8. What are called endangered species? Explain with examples.

- A species that has been categorized as very likely to become extinct is an endangered species.
- 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*)

9. Why do we find a decrease in biodiversity distribution, if we move from the tropic towards the poles?

- Temperature, precipitation, distance from the equator (latitudinal gradient), altitude from sea level (altitudinal gradient) are some of the factors that determine biodiversity distribution patterns.
- The most important pattern of biodiversity is latitudinal gradient in diversity. This means that there is an increasing diversity from the poles to equator.

10. What are the factors that drive habitat loss?

- Development of human society is inevitable. Natural habitats are destroyed for the purpose of settlement, agriculture, mining, industries and construction of highways.
- As a result species are forced to adapt to the changes in the environment or move to other places.
- If not they become victim to predation, starvation, disease and eventually die or results in human animal conflict.

11. Alien species invasion is a threat to endemic species- substantiate this statement.

- Exotic species (Non-native; alien) are organisms often introduced unintentionally or deliberately for commercial purpose, as biological control agents and other uses.
- They often become invasive and drive away the local species and is considered as the second major cause for extinction of species.

- Exotic species have proved harmful to both aquatic and terrestrial ecosystems.
- 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 kottius* face local extinction.
- 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 native species of cichlid fish in the lake.
- 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.

12. Mention the major threats to biodiversity caused by human activities. Explain.

- Human activities greatly contribute to the loss of biodiversity. Natural resources such as land, water and organisms are indiscriminately exploited by human beings.
- According to the convention of Biological Diversity, direct and indirect human activities have a detrimental effect on biodiversity.
- 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.
- Indirect human drivers include demographic, economic, technological, cultural and religious factors.
- Monsoon failure, global warming, depletion in ozone layer, landslides in hilly states, pollution are a few indirect effects of human activities which result in the loss of biodiversity.
- This loss of biodiversity has an immense impact on plant, animal and human life. The negative effects include dramatic influence on the food web.
- 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.

13. 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:

- The earth has experienced quite a few mass extinctions due to environmental catastrophes.
- 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.

14. In north eastern states, the jhum cultivation is a major threat to biodiversity substantiates the statement.

- 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 point where crop production is no longer profitable.
- The farmer then abandons this patch and cuts down a new patch of forest elsewhere for crop production.
- 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.

15. List out the various causes for biodiversity losses.

- Habitat loss, fragmentation and destruction (affects about 73% of all species)
- Pollution and pollutants (Smog, pesticides, herbicides, oil slicks, GHGs)
- Climate change.
- Introduction of alien/ exotic species.
- Over exploitation of resources (poaching, indiscriminate cutting of trees, over fishing, hunting, mining)
- Intensive agriculture and aquaculture practices.
- Hybridization between native and non-native species and loss of native species.
- Natural disasters (Tsunami, forest fire, earth quake, volcanoes)
- Industrialization, Urbanization infrastructure development, Transport Road and shipping activity, communication towers, dam construction, unregulated tourism and monoculture are common areas of specific threats.
- Co-extinction.

16. How can we contribute to promote biodiversity conservation?

- 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.
- It aims to protect species from extinction and their habitats and ecosystems from 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.
5. Air, water and soil should be conserved on priority basis.
6. Wildlife protection Act should be implemented

17. Write a note on i) Protected areas, ii) Wild life sanctuaries, iii) WWF

i) Protected areas:

- These are biogeographical areas where biological diversity along with natural and cultural resources is protected, maintained and managed through legal measures.
- Protected areas include national parks, wild life sanctuaries community reserves and biosphere reserves.
- World Conservation monitoring center has recognized 37,000 protected areas world- wide.
- 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 hot spot.
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.

Bio-Zoology

Unit-V

Chapter: 12 Environmental Issues

TEXTUAL: VERY SHORT ANSWERS:

1. Expand i) CFC ii) AQI iii) PAN
i) CFC- Chloro Fluoro Carbons.
ii) AQI- Air Quality Index.
iii) PAN- Peroxy Acetyl Nitrate

TEXTUAL: SHORT ANSWERS

2. 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.

TEXTUAL: LONG ANSWERS

3. 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.

4. 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.

5. What effect can fertilizer runoff have on an aquatic ecosystem?

Agrochemicals have been observed to generate residues that cause nutrient imbalance.

6. 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.

7. 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.

8. 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.