

BIOLOGY ACADEMY

CHAPTER: 8 – MICROBES IN HUMAN WELFARE.

CHAPTER: 9 – APPLICATIONS OF BIOTECHNOLOGY.

CHAPTER: 10 – ORGANISMS AND POPULATIONS.

CHAPTER: 11 – BIODIVERSITY AND ITS CONSERVATION.

CHAPTER: 12 – ENVIRONMENTAL ISSUES.

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Untouchability is Inhuman and a Crime



8

CHAPTER

UNIT - III

Microbes in Human Welfare



BOOK BACK QUESTIONS

TWO AND THREE MARK QUESTIONS:

- 1. How is milk converted into curd? Explain the process of curd formation.**

 - The LAB bacteria grow in milk and convert it into curd, thereby digesting the milk protein casein.
 - A small amount of curd added to fresh milk as a starter or inoculum contains millions of Lactobacilli.
 - Under suitable temperature ($\leq 40^{\circ}\text{C}$) the bacteria multiply and convert milk into curd.
 - 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.**

 - Lipases - used in detergent formulations and are used for removing oily stains from the laundry.
 - Pectinase, protease and cellulose – used in clarify the Bottled juices.
 - Rennet - used to separate milk into solid curds for cheese making.
- 3. Define the following terms: a) Antibiotics b) Zymology c) Superbug**

 - **Antibiotics:** The chemical substances that are produced by microorganisms which can kill or retard the growth of other disease causing microbes even in low concentration. Antibiotic means “against life”.
 - **Zymology:** It is an applied science which deals with the biochemical process of fermentation and its practical uses.
 - **"Superbug":** These are the strains of bacteria that are resistant to the majority of antibiotics commonly used today.
- 4. Write short notes on the following. a) Brewer's yeast b) Ideonella sakaiensis c) Microbial fuel cells.**

 - **Saccharomyces cerevisiae** commonly called brewer's yeast is used for fermenting malted cereals and fruit juices to produce various alcoholic beverages.
 - **Ideonella sakaiensis** bacteria are currently tried for recycling of PET plastics. These bacteria use PETase and MHETase enzymes to breakdown PET plastic into terephthalic acid and ethylene glycol.
 - **A microbial fuel cell** is a bio-electrochemical system that drives an electric current by using bacteria and mimicking bacterial interaction found in nature. Microbial fuel cells work by allowing bacteria to oxidize and reduce organic molecules.
- 5. List the advantages of biogas plants in rural areas.**

 - The slurry from the biogas plant is drained through another outlet and is used as manure.
 - Biogas is used for cooking and lighting.
 - 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).

Five marks:**1. When does antibiotic resistance develop?**

- 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.
- **Reasons:** Misuse and over use of antibiotics, as well as poor infection prevention control.
- Antibiotics should be used only when prescribed by a certified health professional.
- When the bacteria become resistant, antibiotics cannot fight against them and the bacteria multiply.
- Narrow spectrum antibiotics are preferred over broad spectrum antibiotics. They effectively and accurately target specific pathogenic organisms and are less likely to cause resistance.

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

- *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.
- Bacteria such as *Zymomonas mobilis* and *Sarcina ventriculi* are also involved in ethanol production.

The principal substrates:

- Molasses or corn, potatoes and wood wastes.

The process of ethanol production:

- Milling a feed stock
- Addition of dilute or fungal amylase (enzyme) from *Aspergillus* to break down the starch into fermentable sugars.
- Yeast is then added to convert the sugars to ethanol.
- Then distilled off to obtain ethanol which is upto 96 percent in concentration.
- The two most common type of biofuels in use today are ethanol and biodiesel, both of them represent the first generation of biofuel technology.
- Ethanol is often used as a fuel, mainly as a biofuel additive for gasoline.

3. What is bioremediation? Mention its types.

- The use of naturally occurring or genetically engineered microorganisms to reduce or degrade pollutants is called bioremediation.
- Bioremediation is less expensive and more sustainable than other remediations available.

Types:

- In situ bioremediation (treatment of contaminated soil or water in the site).
- Ex situ bioremediation (treatment of contaminated soil or water that is removed from the site and treated).

Intext questions:**Two and three mark questions:****1. Name two microbes used in making household products.**

- In everyday life, microbes and their products are used in the preparation of idli, dosa, cheese, curd, yogurt, dough, bread, vinegar, etc.,
- Bacteria like *Lactobacillus acidophilus*, *L. lactis* and *Streptococcus lactis* commonly called **lactic acid bacteria** (LAB) are probiotics which check the growth of pathogenic microbes in the stomach and other parts of the digestive tract.

2. How are lactic acid bacteria helpful to us?

- The LAB bacteria grow in milk and convert it into curd, thereby digesting the milk protein casein.
- 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.
- Curd is more nutritious than milk as it contains a number of organic acids and vitamins.

3. What are prebiotics / probiotics?

- **Prebiotics** are compounds in food (fibers) that induce the growth or activity of beneficial microorganisms.
- **Probiotics** are live microorganisms intended to provide health benefits when consumed, generally by improving or restoring the gut flora.

4. How is yogurt prepared?

- Yogurt is produced by bacterial fermentation of milk, and lactic acid is produced as a byproduct.
- *Streptococcus thermophilus* and *Lactobacillus bulgaricus* coagulate the milk protein and convert the lactose in the milk to lactic acid.
- The flavour in yogurt is due to acetaldehyde.

5. How is cheese prepared?

- Cheese is a dairy product produced in a wide range of flavours, textures and is formed by coagulation of the milk protein, casein.
- During cheese production, milk is usually acidified and the enzyme rennet is added to cause coagulation.
- The solids are separated and pressed to form cheese.
- Most cheese are made with a starter bacterium, *Lactococcus*, *Lactobacillus* or *Streptococcus*.

6. How is cottage cheese prepared?

- Paneer (cottage cheese) is fresh cheese common in South Asia, especially in India.
- It is made by curdling milk with lemon juice, vinegar and other edible acids.
- Large holes in Swiss cheese are due to the production of large amount of carbon-di-oxide by the bacterium *Propionibacterium shermanii*.

7. How does Fermentation help in making the bread porous and soft?

- Fermentation of glucose mainly forms ethyl alcohol and carbon-di -oxide, which is responsible for leavening of dough.
- When leavened dough is baked, both carbon-di-oxide and ethyl alcohol evaporate making the bread porous and soft.

8. What are single cell proteins?

- Single cell protein refers to edible unicellular microorganisms like *Spirulina*.
- Protein extracts from pure or mixed cultures of algae, yeasts, fungi or bacteria may be used as ingredient or as a substitute for protein rich foods
- It is suitable for human consumption or as animal feed.

9. Name some industrial products that are produced with the help of microbes.

- Products like beverages, antibiotics, organic acids, amino acids, vitamins, biofuels, single cell protein, enzymes, steroids, vaccines, pharmaceutical drugs, etc., are produced in industries, with the help of microbes.

10. Name some diseases that are cured by antibiotics. For the first time, who used the term antibiotics?

- Antibiotics are used to treat diseases such as plague, meningitis, diphtheria, syphilis, leprosy, tuberculosis etc.,
- **Selman Waksman** discovered Streptomycin and was the first to use the term “antibiotic” in 1943.

11. What you know about a fermentor (bio reactors)?

- Fermentors (bioreactor) is a closed vessel with adequate arrangement for aeration, agitation, temperature, pH control and drain or overflow vent to remove the waste biomass of cultured microorganisms along-with their products.

12. Define: Zymology and Oenology.

- **Zymology** is an applied science which deals with the biochemical process of fermentation and its practical uses.
- **Oenology** is the science and study of **wine** and wine making.

13. Write the process of preparation of alcoholic beverages like wine, whisky, brandy and rum.

- Alcoholic beverages - *Saccharomyces cerevisiae* - fermenting malted cereals and fruit juices.
- Wine and beer are produced without distillation,
- Whisky, brandy and rum are obtained by fermentation and distillation.

14. Why is ethanol referred to as industrial alcohol?

- *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**.

15. Name the microbes useful in the preparation of organic acid.

- *Aspergillus niger* - **citric acid**.
- *Acetobacter aceti* - **acetic acid**.
- *Rhizopus oryzae* - **fumaric acid**.
- *Clostridium butyricum* - **butyric acid**.
- *Lactobacillus* - **lactic acid**.

16. Name the organisms that help in the commercial production of enzymes.

- Yeast (*Saccharomyces cerevisiae*) and bacteria are used for the commercial production of enzymes.

17. What is a clot buster?

- Streptokinase produced by the bacterium *Streptococcus* and genetically engineered *Streptococci* are used as "**clot buster**".
- It helps in removing clots from the blood vessels of myocardial infarction patients.

18. State the importance of cyclosporin A.

- **Cyclosporin A**, an immunosuppressant used in organ transplantation is produced from the fungus *Trichoderma polysporum*.
- It is also used for its anti-inflammatory, anti-fungal and anti-parasitic properties.

19. State the importance of statins.

- **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.

20. Name the microbes used for Recombinant human insulin.

- Recombinant **human insulin** has been produced predominantly using *E. coli* and *Saccharomyces cerevisiae*

21. Why should we treat sewage before disposal?

- Sewage is the waste generated every day in cities and towns containing human excreta.
- It contains large amounts of organic matter and microbes, which are pathogenic to humans and are bio-degradable pollutants.
- Sewage should not be discharged directly into natural water bodies like rivers and streams.
- Before disposal, sewage should be treated in sewage treatment plants to make it less polluting.

22. Name the constituents of Bio-gas.

- Biogas primarily consists of methane (63%), along with CO₂ and hydrogen.

23. What is gobar? Name the constituents of Gobar gas.

- The excreta of cattle called dung is commonly called “Gobar”.
- Gobar gas is generated by the anaerobic decomposition of cattle dung.
- It consists of methane, CO₂ with some hydrogen, nitrogen and other gases in trace amounts.

24. Name the institutions that developed the technology for biogas plants in India.

- Indian Agricultural Research Institute (IARI) and
- Khadi and Village Industries Commission (KVIC).

25. State the importance of *Pseudomonas putida*.

- *Pseudomonas putida* is a genetically engineered microorganism (GEM).
- Ananda Mohan Chakrabarty obtained patent for this recombinant bacterial strain.
- It is multi-plasmid hydrocarbon-degrading bacterium which can digest the hydrocarbons in the oil spills.

THREE MARK QUESTIONS:**1. How is paneer prepared?**

- Paneer (cottage cheese) is fresh cheese common in South Asia, especially in India.
- It is made by curdling milk with lemon juice, vinegar and other edible acids.
- Large holes in Swiss cheese is due to the production of large amount of carbon-di-oxide by the bacterium *Propionibacterium shermanii*.

2. What is referred to as “Queen of Drugs”? Why is it called so?

- Penicillin is produced by the fungi *Penicillium notatum* and *Penicillium chrysogenum*.
- It is bactericidal (antibiotics that kill bacteria) in action and inhibits the synthesis of the bacterial cell wall.
- Penicillin is also referred to as the “queen of drugs”
- Its full potential as an effective antibiotic was established much later by **Ernest Chain** and **Howard Florey** when they treated the wounded soldiers in World War II with penicillin.
- **Fleming, Chain** and **Florey** were awarded the **Nobel Prize** in 1945 for the discovery of penicillin.

3. Define: Antibiosis. Compare Broad spectrum antibiotics and narrow spectrum antibiotics.

- **Antibiosis** is the property of antibiotics to kill microorganisms.
- **Broad-spectrum antibiotics** act against a wide range of disease-causing bacteria.
- **Narrow-spectrum antibiotics** are active against a selected group of bacterial types.

4. State the importance of Tetracycline, Chlortetracycline and streptomycin.

- **Tetracycline** is a broad spectrum bacteriostatic antibiotic (antibiotics that limit the growth of bacteria) that inhibits microbial protein synthesis.
- **Chlortetracycline** is the first antibiotic of this group, isolated from the cultures of *Streptomyces aureofaciens*.
- **Streptomycin** is a broad spectrum antibiotic isolated from the actinomycetes, *Streptomyces griseus*. It is bactericidal against both gram positive and gram negative bacteria, especially against *Mycobacterium tuberculosis*.

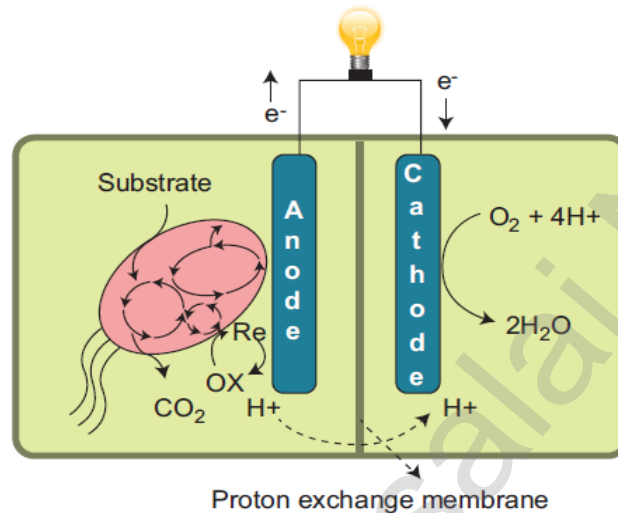
5. How are microbes useful in the preparation of enzymes?

- Yeast (*Saccharomyces cerevisiae*) and bacteria are used for commercial production of enzymes.
- Lipases are used in detergent formulations and are used for removing oily stains from the laundry.
- Bottled juices are clarified by the use of **pectinase, protease** and **cellulase**.

Five marks:

1. Explain the working of a microbial fuel cell.

- A microbial fuel cell is a bio-electrochemical system that drives an electric current by using bacteria and mimicking bacterial interaction found in nature.
- Microbial fuel cells work by allowing bacteria to oxidize and reduce organic molecules.
- Bacterial respiration is basically one big redox reaction in which electrons are being moved around.
- A MFC consists of an anode and a cathode separated by a proton exchange membrane.
- 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 external circuit to generate current.

2. Write the economic importance of *Nitrosomonas europaea*, *Ideonella sakaiensis*, *Dechloromonas aromatic*, *Phanerochaete chrysosporium*, *Dehalococcoides* and *Pestalotiopsis microspora*.

- ***Nitrosomonas europaea*** - Degrading benzene and a variety of halogenated organic compounds including trichloroethylene and vinyl chloride.
- ***Ideonella sakaiensis*** - Currently tried for recycling of PET plastics. These bacteria use PETase and MHETase enzymes to breakdown PET plastic into terephthalic acid and ethylene glycol.
- ***Dechloromonas aromatica*** - Degrade benzene anaerobically and to oxidize toluene and xylene.
- ***Phanerochaete chrysosporium*** - An anaerobic fungus that exhibits strong potential for bioremediation of pesticides, polyaromatic hydrocarbons, dyes, trinitrotoluene, cyanides, carbon tetrachloride,
- ***Dehalococcoides*** - An anaerobic bioremediation of toxic trichloroethene to non-toxic ethane.
- ***Pestalotiopsis microspora*** - A species of endophytic fungus capable of breaking down and digesting polyurethane.

3. What is bioremediation? Explain the role of microbes in bioremediation.

<ul style="list-style-type: none"> ➤ The use of naturally occurring or genetically engineered microorganisms to reduce or degrade pollutants is called bioremediation. ➤ Bioremediation is less expensive and more sustainable than other remediations available. <p>Types:</p> <ul style="list-style-type: none"> ➤ In situ bioremediation (treatment of contaminated soil or water in the site). ➤ Ex situ bioremediation (treatment of contaminated soil or water that is removed from the site and treated). 		
(Aerobic fungus)		
1	<i>Pseudomonas putida</i> (GEM).	<ul style="list-style-type: none"> • It is multi-plasmid hydrocarbon-degrading bacterium which can digest the hydrocarbons in the oil spills.
2	<i>Nitrosomonas europaea</i>	<ul style="list-style-type: none"> • Degrading benzene and a variety of halogenated organic compounds including trichloroethylene and vinyl chloride.
4	<i>Ideonella sakaiensis</i>	<ul style="list-style-type: none"> • Currently tried for recycling of PET plastics.
(Anaerobic fungus)		
5	<i>Phanerochaete chrysosporium</i>	<ul style="list-style-type: none"> • Exhibits strong potential for bioremediation of pesticides, polyaromatic hydrocarbons, dyes, trinitrotoluene, cyanides, carbon tetrachloride.
	<i>Dechloromonas aromatica</i>	<ul style="list-style-type: none"> • Ability to degrade benzene anaerobically and to oxidize toluene and xylene.
6	<i>Dehalococcoides.</i>	<ul style="list-style-type: none"> • Responsible for anaerobic bioremediation of toxic trichloroethene to non-toxic ethane.
7	<i>Pestalotiopsis microspore</i> (Endophytic fungus)	<ul style="list-style-type: none"> • Capable of breaking down and digesting polyurethane. • This makes the fungus potential candidates for bio – remediation projects involving large quantity of plastics.

4. Explain the role of microbes in production of chemicals, Enzymes and other bio active molecules.

Name of the microbes	Product	Uses
<i>Lactobacillus</i>	Lactic acid.	
<i>Aspergillus niger,</i>	citric acid,	
<i>Acetobacter aceti</i>	acetic acid,	
<i>Rhizopus oryzae ,</i>	fumaric acid,	
<i>Clostridium butyricum</i>	butyric acid	
<i>Streptococcus</i> and genetically engineered <i>Streptococci.</i>	Streptokinase bacterium	<ul style="list-style-type: none"> • Used as “clot buster” for removing clots from the blood vessels of patients, who have undergone myocardial infarction.
<i>Trichoderma polysporum.</i>	Cyclosporin A,	<ul style="list-style-type: none"> • An immunosuppressant used in organ transplantation
Monascus purpureus	Statins produced by the yeast <i>Monascus purpureus</i> have been used to lower blood cholesterol levels.	<ul style="list-style-type: none"> • It acts by competitively inhibiting the enzyme responsible for the synthesis of cholesterol.
<i>E. coli</i> and <i>Saccharomyces cerevisiae</i>	Human insulin	<ul style="list-style-type: none"> • Human insulin has been produced predominantly using <i>E. coli</i> and <i>Saccharomyces cerevisiae</i> for therapeutic use in human.

5. Explain the role of microbes in industrial products (Antibiotic production)

II. MICROBES IN INDUSTRIAL PRODUCTS. - Antibiotic production		
Name of the Microbes	Uses	Other notes
<i>Penicillium notatum</i> <i>Penicillium chrysogenum</i> . (fungus)	Penicillin production First Antibiotics.	<ul style="list-style-type: none"> ➤ Penicillin is also referred as the “queen of drugs” ➤ Selman Waksman discovered Streptomycin and was the first to use the term “antibiotic” in 1943.
Broad spectrum bacteriostatic antibiotic	Tetracycline	<ul style="list-style-type: none"> ➤ It is a broad spectrum bacteriostatic antibiotic (antibiotics that limit the growth of bacteria) that inhibits microbial protein synthesis
	Chlortetracycline	<ul style="list-style-type: none"> ➤ It is the first antibiotic of this group, isolated from the cultures of <i>Streptomyces aureofaciens</i>.
	Streptomycin	<ul style="list-style-type: none"> ➤ It is a broad spectrum antibiotic isolated from the actinomycetes, <i>Streptomyces griseus</i>
"Superbug"		<ul style="list-style-type: none"> ➤ strains of bacteria that are resistant to the majority of antibiotics commonly used today.



9

CHAPTER

UNIT - IV

Applications of Biotechnology



BOOK BACK QUESTIONS:

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.

- For each cycle of PCR two primers are required.

Role of primers in PCR:

- Primers are the small fragments of single stranded DNA or RNA.
- It serves as template DNA polymerization.

Role of polymerase in PCR:

- Synthesizes DNA molecules.

The organism of the DNA polymerase used in PCR:

- Taq polymerase.
- It is isolated from *Thermus aquaticus* bacteria.

2. How is the amplification of a gene sample of interest carried out using PCR?

- PCR is an invitro amplification of DNA.
- The technique was developed by Kary Mullis.

Steps in PCR:

Denaturation:

- The double stranded DNA is separate into two individual strands by high temperature.
- The mixture is heated to 95° C for a short time

Renaturation (Primer annealing):

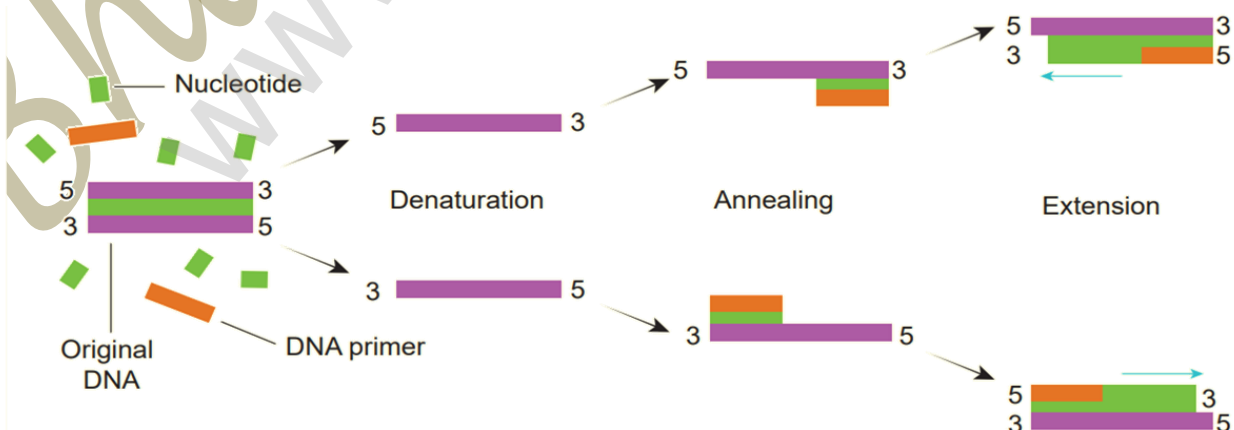
- Each strand is allowed to hybridize with a primer.
- Annealing is done by cooling of the mixture.

Synthesis (Primer extension):

- Synthesize DNA by using Taq – DNA polymerase.
- the mixture is increased to 75° C for a sufficient period of time.

Amplification:

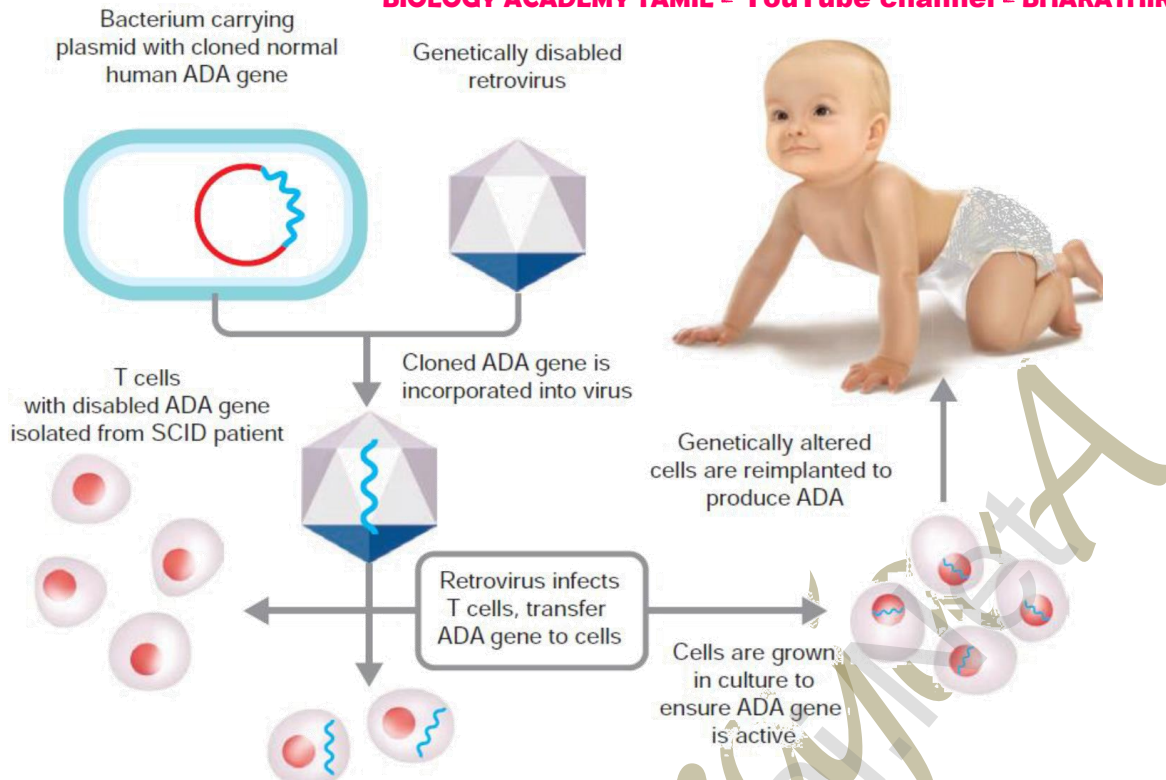
- At the end of incubation both single template strands will be made as double stranded.
- These steps are repeated again and again to generate multiple forms of the desired DNA.
- This process is also called DNA amplification.



3. What is genetically engineered Insulin?

- The insulin synthesized by recombinant DNA technology is called genetically engineered Insulin.
- It was the first pharmaceutical product of DNA technology.
- In 1986, human insulin was marketed as Humulin.

- 4. Explain how “Rosie” is different from a normal cow.**
- Rosie was the first transgenic cow.
 - It produced protein - enriched milk,
 - This milk contained the human alpha-lactalbumin (2.4 gm / litre).
 - This milk was a nutritionally balanced food for infants than the normal milk of cows.
- 5. How was Insulin obtained before the advent of rDNA technology? What were the problems encountered?**
- Conventionally, Insulin was isolated from the pancreas of pigs and cows.
 - Due to minor structural changes, the animal insulin,
 - It caused allergic reaction in few 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?**
- ELISA is a test based on the principles of antigen and antibody interaction.
 - To perform ELISA, either antibody or antigen should be present in the sample.
 - Antibodies are not produced in the case of phenylketonuria.
 - Therefore, ELISA cannot be used for the diagnosis of phenylketonuria.
- 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.**
- Both gene therapy and Enzyme replacement therapy helps to restore the genetic defects.
 - But the gene therapy is much better than Enzyme replacement therapy.
 - Because, in Gene therapy, the defective gene is repaired using normal gene.
 - So, the affected individual gains complete recovery.
 - Whereas, in Enzyme replacement therapy, the respective enzyme has to be provided periodically.
 - Moreover, when compared to Gene therapy, Enzyme replacement therapy is highly expensive.
- 8. What are transgenic animals? Give examples.**
- The animals that are produced by DNA manipulations are called transgenic animals or genetically engineered or genetically modified organisms.
 - **Example: Mice, Cow.**
- 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?**
- Yes, ELISA can be used to detect HIV in the blood.
 - ELISA is to detect the presence of specific antibodies or antigens in a sample of serum urine etc.
 - It is a very important diagnostic tool to determine if a person is positive or negative.
- 10. Explain how ADA deficiency can be corrected?**
- Other than the gene therapy methods:**
- Bone marrow transplantation,
 - Defective immune cells could be replaced with healthy immune cells from a donor.
 - Enzyme replacement therapy.
- Gene therapy method:**
- The lymphocytes from the blood of the patient are removed.
 - Grown in a nutrient culture medium.
 - A functional ADA gene is introduced into the lymphocytes using a retrovirus.
 - The genetically engineered lymphocytes are returned to the patient.
 - This disease could be cured permanently by introducing ADA gene in early embryonic stages.



11. What are DNA vaccines?

- The immune response of the body is stimulated by a DNA molecule.
- A DNA vaccine consists of a gene encoding an antigenic protein, inserted onto a plasmid, and then incorporated into the cells in a target animal.
- DNA instructs the cells to make antigenic molecules which are displayed on cell surfaces.
- This would evoke an antibody response to the free-floating antigen secreted by the cells
- The DNA vaccine cannot cause the disease as it contains only copies of a few of its genes.

Advantages of DNA vaccines:

- Easy and inexpensive to design and produce.
- Producing target proteins,
- Long lasting immunity and
- Trigger immune response only against specific pathogens.
- Less toxic effects.

12. Differentiate between Somatic cell gene therapy and Germ line gene therapy.

	Somatic Cell Gene Therapy:	Germ Line Gene Therapy:
1	Therapeutic genes transferred into the somatic cells.	Therapeutic genes transferred into the germ cells.
2	Ex: Bone marrow cells, blood cells, skin cells etc.	Ex: Eggs and Sperms.
3	Will not be inherited in next generations.	Heritable to next generations.

13. What are stem cells? Explain its role in the field of medicine. (Explain in detail about stem cell therapy.)

- Stem cells are undifferentiated cells found in most of the multi cellular animals.
- These cells maintain their undifferentiated state even after numerous mitotic divisions.

Characteristic features of stem cells:

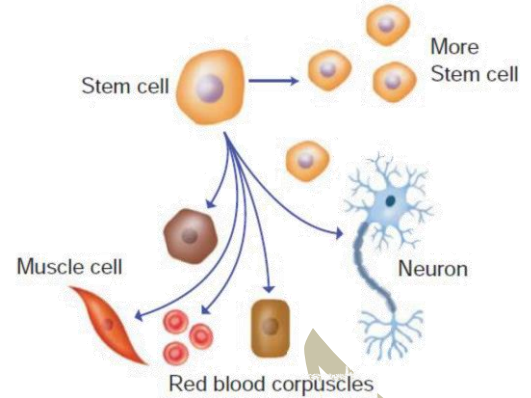
- Stem cells are capable of self-renewal.
- Stem cells can differentiate into all types of cells. (Ectoderm, endoderm and mesoderm).

Two types of stem cells in mammals:

1. Embryonic Stem cells (ES cells)
2. Adult Stem cells.

Embryonic Stem cells (ES cells).

- ES cells are isolated from the inner cell mass of a blastocyst.
- ES cells are pluripotent.
- They can produce the three primary germ layers ectoderm, mesoderm and endoderm.
- Embryonic stem cells are multipotent.
- That can differentiate into a number of types of cells.

**Adult stem cells:**

- The red bone marrow is a rich source of adult stem cells.
- They are found in various tissues of children as well as adults.
- An adult stem cell or somatic stem cell can divide and create another cell similar to it.
- Most of the adult stem cells are multipotent.
- They can act as a repair system of the body, replenishing adult tissues.

Important and potential application of human stem cells.

- 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?**

- This process involves the transfer of a normal gene into a person's cells that carries one or more mutant alleles.

ii) Name the hereditary disease for which the first clinical gene therapy was used.

- Adenosine deaminase (ADA) deficiency.

iii) Mention the steps involved in gene therapy to treat this disease.

- The lymphocytes from the blood of the patient are removed.
- Grown in a nutrient culture medium.
- A functional ADA gene is introduced into the lymphocytes using a retrovirus.
- The genetically engineered lymphocytes are returned to the patient.
- This disease could be cured permanently by introducing ADA gene in early embryonic stages.

15. PCR is a useful tool for early diagnosis of Infectious disease. Elaborate.

- PCR is useful for the diagnosis of inherited disorders (genetic diseases), viral diseases, bacterial diseases, etc.
- Identifying a particular pathogen is essential for the best treatment.
- **Traditional methods:** Culturing microorganisms from clinical specimens, Metabolic and other tests.
- **The concept of PCR:** if the pathogen is present in a clinical specimen its DNA will be present.
- Its DNA can be detected by PCR, from the clinical specimen. (Blood, stool, spinal fluid, or sputum) in the PCR mixture.

Clinical uses of PCR.

- PCR is used in diagnosis of inherited diseases by using chorionic villi samples or amniocentesis.
- Diseases like sickle cell anemia, β -thalassemia and phenylketonuria can be detected by PCR.
- Used for diagnosis of retroviral infections.
- Used for diagnosis of tuberculosis by Mycobacterium tuberculosis.
- Cervical cancer caused by Papilloma virus can be detected by PCR.
- Sex of human beings can be determined by PCR.
- PCR technique is also used to detect sex-linked disorders in fertilized embryos.

16. What are recombinant vaccines? Explain the types. Recombinant DNA technology has been used to produce new generation vaccines.

- The recombinant vaccines are generally of uniform quality and produce less side effects as compared to the vaccines produced by conventional methods.

Different types of recombinant vaccines.

i) Subunit recombinant vaccines:

- Components of a pathogenic organism used as Vaccines.
- It includes components like proteins, peptides and DNAs of pathogenic organisms.
- **Advantages:** Purity in preparation, stability and safe use.

ii) Attenuated recombinant vaccines:

- This includes genetically modified pathogenic organisms (bacteria or viruses) that are made nonpathogenic and are used as vaccines.
- Use them as live vaccines - Attenuated recombinant vaccines.

iii) DNA Vaccines:

- The immune response of the body is stimulated by a DNA molecule.
- A DNA vaccine consists of a gene encoding an antigenic protein, inserted onto a plasmid, and then incorporated into the cells in a target animal.
- DNA instructs the cells to make antibody response to the antigen secreted by the cell.
- The DNA vaccine cannot cause the disease as it contains only copies of a few of its genes.

Advantages of DNA vaccines:

- Easy and inexpensive to design and produce.
- Producing target proteins.
- Long lasting immunity.
- Trigger immune response against specific pathogens.
- Less toxic effects.

17. Mention the advantages and disadvantages of cloning.

Advantages of cloning:

- Helps in clinical trials and medical research.
- Helps in the production of proteins and drugs in the field of medicine.
- Helps in stem cell research.
- Animal cloning could help to save endangered species.

Disadvantages of cloning:

- The process is tedious and very expensive.
- It can cause animals to suffer.
- Reports show that animal surrogates were manifesting adverse outcomes and cloned animals were affected with disease and have high mortality rate.
- It might compromise human health through consumption of cloned animal meat.
- Cloned animals age faster than normal animals.
- Animal has less healthy than the parent organism as discovered in Dolly.
- Cloning can lead to occurrence of genetic disorders in animals.
- More than 90% of cloning attempts fail to produce a viable offspring.

18. Explain how recombinant Insulin can be produced.

Structure of insulin:

- The Human insulin is synthesized by the β cells of pancreas.
- It is formed of 51 aminoacids with two polypeptide chains, A and B.
- The polypeptide chain A has 21 amino acids and B has 30 amino acids.
- Both A and B chains are attached together by disulphide bonds.

Uses of insulin:

- Insulin controls the levels of glucose in blood.
- It facilitates the cellular uptake and utilization of glucose for the release of energy.

Deficiency of insulin:

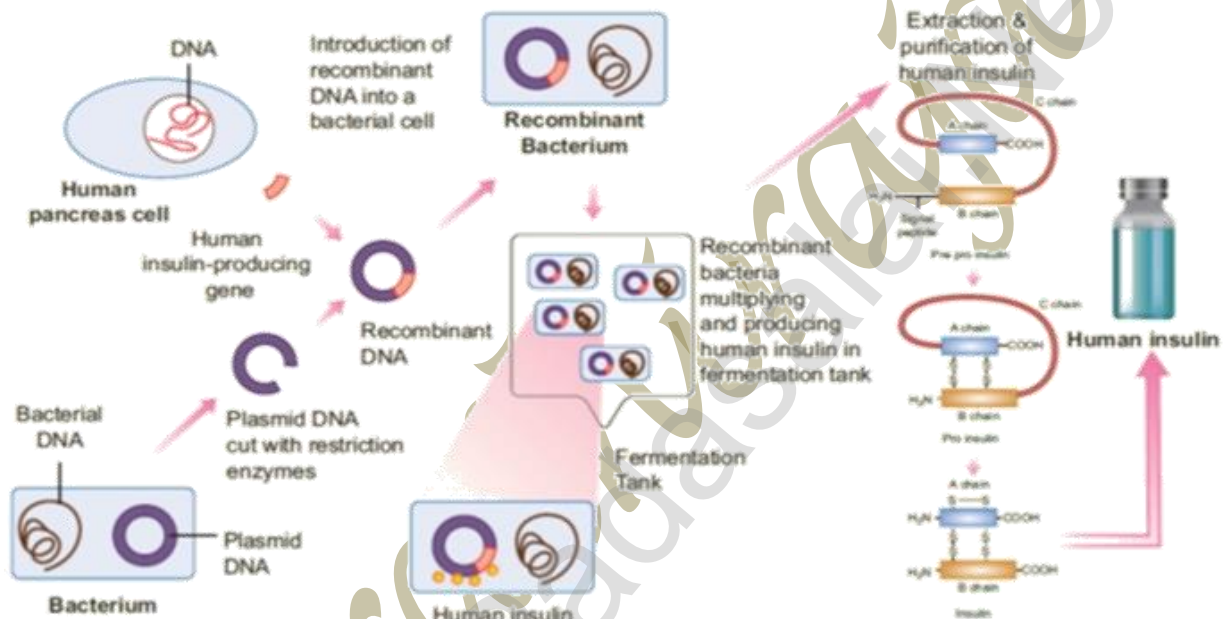
- Deficiency of insulin leads to diabetes mellitus.
- It is characterized by increased blood glucose concentration.
- It may lead to death, if untreated.

Treatment of diabetes:

- In the early years, insulin isolated and purified from the pancreas of pigs and cows.
- Due to minor differences in the structure of the animal insulin, occurrence of allergic reactions in some diabetic patients.

Production of insulin recombinant by DNA technology:

- Production of insulin by recombinant DNA technology started in the late 1970s.
- This technique involved the insertion of human insulin gene on the plasmids of *E. coli*.
- The polypeptide chains are synthesized as a precursor called pre-pro insulin.
- Pro – insulin contains A and B segments and (C) segments.
- leader sequence is removed after translation.

**INTEXT TWO AND THREE MARKS****1. Define: DNA recombinant technology.**

- Recombinant DNA technology involves extracting a gene from one organism and transferring it to the DNA of another organism, of the same or another species.
- The DNA produced in this way is referred to as recombinant DNA (rDNA).
- This technique as recombinant DNA technology.

2. What is Humulin?

- Human insulin.
- Insulin was the first ever pharmaceutical product of recombinant DNA technology.
- The approval to use recombinant insulin was given in 1982.
- In 1986 human insulin was marketed under the trade name Humulin.

3. What are Interferons?

- Interferons are proteinaceous, antiviral, species specific substances produced by mammalian cells when infected with viruses.
- **Types:** α , β and γ interferons.
- Interferons stimulate the cellular DNA to produce antiviral enzymes.
- And inhibit viral replication and protect the cells.

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4. *Saccharomyces cerevisiae*, acts as a best host than *Encherichia coli* for the production of recombinant interferons. Yes or No? Support your answer.
- **YES.** The yeast *Saccharomyces cerevisiae* is more suitable for production of recombinant interferons than *E.coli*,
 - Because, *E.coli* does not possess the machinery for glycosylation of proteins.
5. **What are the two strategies involved in gene therapy?**
- **Gene augmentation:** Insertion of DNA into the genome to replace the missing gene product.
 - **Gene inhibition:** insertion of the anti-sense gene which inhibits the expression of the dominant gene.
6. **Comment on SCID.**
- SCID (Severe combined immunodeficiency).
 - It is an autosomal recessive metabolic disorder.
 - It is caused by the deletion or dysfunction of the ADA gene.
7. **What are Stem Cells?**
- Stem cells are undifferentiated cells found in most of the multi cellular animals.
 - These cells maintain their undifferentiated state.
8. **Compare Embryonic stem cells and adult stem cells.**

Embryonic stem cells	Adult stem cells
Source: Inner cell mass of a blastocyst	Source: Bone marrow
They are pluripotent	adult stem cells are multipotent
can produce the three primary germ layers ectoderm, mesoderm and endoderm.	act as a repair system of the body
Found in epiblast tissue of the inner cell mass of a blastocyst.	found in various tissues of children as well as adults

9. **Compare: Totipotency, pluripotency, multipotency.**
- **Totipotency (Toti-total):** The ability of a single cell to divide and produce all of the differentiated cells in an organism.
 - **Pluripotency (Pluri-several):** A stem cell that can differentiate into any of the three germ layers-ectoderm, endoderm and mesoderm.
 - **Multipotency (multi-Many):** A stem cells that can differentiate into various types of cells that are related.
 - For example, blood stem cells can differentiate into lymphocytes, monocytes, neutrophils etc.
10. **What are Amniotic cell bank?**
- Stem cells derived from amniotic fluid for future use.
 - Stem cells are stored in banks specifically for an individual.
 - For stem cells banking costs are paid.
11. **What is cord blood banking?**
- The extraction of stem cells from the umbilical cord during childbirth.
 - While the umbilical cord and cord blood.
 - The most popular sources of stem cells, the placenta, amniotic sac and amniotic fluid.
12. **What are the conventional diagnostic methods?**
- Microscopic examinations, serum analysis and urine analysis.
 - These laboratory techniques are indirect and not always specific.
13. **Name the techniques that are reliable and help in early diagnosis.**
- Recombinant DNA technology,
 - Polymerase Chain Reactions (PCR) and Enzyme Linked Immunosorbent Assay (ELISA).

14. What are the advantages of early diagnosis technique?

- Presence of pathogens like virus, bacteria, etc., is detected only when the pathogen produces symptoms in the patient.
- By the time the symptoms appear concentration of pathogen becomes very high in the body.
- However very low concentration of a bacteria or a virus, even when the symptoms of the disease does not appear, can be detected by amplification of their nucleic acid.

15. What is ELISA? What is its importance?

- ELISA (Enzyme Linked Immuno Sorbent Assay) is a biochemical procedure.
- discovered by **Eva Engvall** and **Peter Perlmanin (1971)**.
- It is used to detect the presence of specific antibodies or antigens in a sample of serum, urine, etc.,
- It is a very important diagnostic tool to determine if a person is HIV positive or negative.

16. What are the types of ELISA?

- Direct ELISA,
- Indirect ELISA,
- Sandwich ELISA and
- Competitive ELISA.

17. Write the advantages of ELISA.

- ELISA is a highly sensitive.
- Not requiring radioisotopes or a radiation counting apparatus.

18. What is PCR (Polymerase Chain Reaction)?

- The polymerase chain reaction (PCR) is an *invitro* amplification technique.
- Used for synthesising multiple identical copies (billions) of DNA.
- The technique was developed by **Kary Mullis** (Nobel laureate, 1993) in the year 1983.

19. List the applications of PCR.

- The differences in the genomes of two different organisms can be studied.
- PCR is very important in the study of evolutions, more specifically phylogenetics.
- As a technique which can amplify even minute quantities of DNA from any source, like hair, mummified tissues, bones or any fossilized materials.
- PCR technique can also be used in the field of forensic medicine.
- PCR is also used in amplification of specific DNA segment to be used in gene therapy.

20. Name the steps involved in the process Of PCR technique.

- Denaturation
- Renaturation or primer annealing
- Synthesis or primer extension.

21. How does PCR help in the field of forensic medicine?

- PCR technique can also be used in the field of forensic medicine.
- A single molecule of DNA from blood stains, hair, and semen of an individual is adequate for amplification by PCR.
- The amplified DNA is used to develop DNA fingerprint which is used in forensic science.
- Thus, PCR is very useful for identification of criminals.

22. Whether PCR is applicable for RNA molecules? Explain.

- The PCR technique can also be used for amplifications of RNA. (Reverse transcription PCR-RT-PCR).
- 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.

23. What is basis of PCR in clinical diagnosis?**The concept behind PCR:**

- If the pathogen is present in a clinical specimen, its DNA will be present.
- Its DNA can be detected by PCR, from the clinical specimen (for example, blood, stool, spinal fluid, or sputum) in the PCR mixture.
- PCR is also employed in the prenatal diagnosis of inherited diseases by using chorionic villi samples or cells from amniocentesis.

24. What is Transgenesis?

- **Transgenesis** is the process of introduction of extra (foreign/ exogenous) DNA into the genome of the animals to create and maintain stable heritable characters.

25. What are called transgenic animals?

- The foreign DNA is introduced (transgene) and the animals that are produced by DNA manipulations are called **transgenic animals** or the **genetically engineered** or genetically modified organisms.

26. What are Biological products?

- A biological product is a substance derived from a living organism.
- And used for the prevention or treatment of disease.
- These products include antitoxins, bacterial and viral vaccines, blood products and hormone extracts.

27. What is animal cloning?

- Cloning is the process of producing genetically identical individuals of an organism either naturally or artificially.
- In nature many organisms produce clones through asexual reproduction.

INTEXT FIVE MARK QUESTIONS:**1. List the various steps involved in the production of transgenic organisms.**

- Identification and separation of desired gene.
- Selection of a vector (generally a virus) or direct transmission.
- Combining the desired gene with the vector.
- Introduction of transferred vector into cells, tissues, embryo or mature individual.
- Demonstration of integration and expression of foreign gene in transgenic tissue or animals. Transgenic animals such as mice, rat, rabbit, pig, cow, goat, sheep and fish have been produced.

2. Write the uses of Transgenesis.

- Study gene expression and developmental processes in higher organisms.
- Transgenesis helps in the improvement of genetic characters in animals.
- Transgenic animals serve as good models for understanding human diseases which help in the investigation of new treatments for diseases.
- Transgenic models exist for many human diseases such as cancer, Alzheimer's, cystic fibrosis, rheumatoid arthritis and sickle cell anemia.
- Transgenic animals are used to produce proteins which are important for medical and pharmaceutical applications.
- Transgenic mice are used for testing the safety of vaccines.
- Transgenic animals are used for testing toxicity in animals.
- Testing drug resistance.
- Transgenesis is important for improving the quality and quantity of milk, meat, eggs and wool production.

3. List the Ethical Issues in biotechnology.

- Biotechnology has given to the society cheap drugs, better fruits and vegetables, pest resistant crops, indigenous cure to diseases and lot of controversy.
- People fear that these genetic manipulations may lead to unknown consequences.
- The major apprehension of recombinant DNA technology is that unique microorganisms either inadvertently or deliberately for the purpose of war may be developed that could cause epidemics or environmental catastrophies.
- Although many are concerned about the possible risk of genetic engineering, the risks are in fact slight and the potential benefits are substantial.

4. What is the advantage of PCR and ELISA over conventional diagnostic methods?

- Early diagnosis of infectious diseases or inherent genetic defects is essential for appropriate treatment.
- Early detection of the disease is not possible using conventional diagnostic methods like microscopic examinations, serum analysis and urine analysis.
- These laboratory techniques are indirect and not always specific.
- Presence of pathogens like virus, bacteria is detected only when the pathogen produces symptoms in the patient.
- By the time the symptoms appear concentration of pathogen becomes very high in the body.
- However very low concentration of a bacteria or a virus, even when the symptoms of the disease do not appear, can be detected by amplification of their nucleic acid.

5. What is ELISA? How is it used for detecting HIV? Explain the methodology of ELISA test.

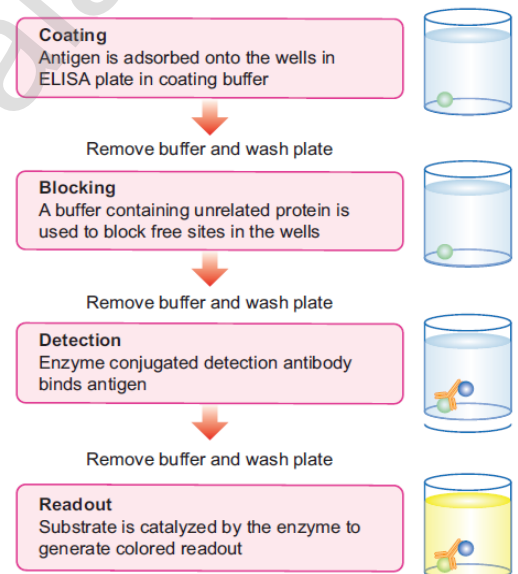
- ELISA [Enzyme Linked Immunosorbent Assay].
- ELISA is a biochemical procedure.
- Discovered by Eva Engvall and Peter Perlmanin (1971).

Uses of ELISA:

- It is used to detect the presence of specific antibodies or antigens in a sample of serum, urine, etc.,
- It is a important diagnostic tool to determine if a person is HIV positive or negative.
- ELISA is a tool for determining serum antibody concentrations.
- Used for detecting the presence of specific antigens and human chorionic gonadotropic hormone.

Methodology of ELISA:

- During diagnosis the antigen is immobilized on the surface of an ELISA plate.
- The antibody specific to this antigen is added and allowed to react with the immobilized antigen.
- The anti - antibody is linked to an appropriate enzyme like peroxidase.
- The unreacted anti- antibody is washed away.
- The substrate of the enzyme (hydrogen peroxidase) is added with 4 - chloronaphthol.
- The activity of the enzyme yields a coloured product indicating the presence of the antigen.
- The intensity of the colour is directly proportional to the amount of the antigen.
- ELISA is highly sensitive and can detect antigens in the range of a nanogram.



Key





-  Analyte/ Antigen
-  Enzyme
-  Directly conjugated primary antibody
- Conjugated secondary antibody
-  Capture antibody

Fig. 9.5 Enzyme Linked Immuno Sorbent Assay

6. Explain the mechanism of cloning?

Mechanism of cloning:

- Dolly was the first mammal (Sheep) clone developed by Ian Wilmut and Campbell in 1997.
- Dolly was developed by the nuclear transfer technique and the phenomenon of totipotency.
- The mammary gland udder cells (somatic cells) from a donor sheep (ewe) were isolated and subjected to starvation for 5 days.
- An ovum (egg cell) was taken from another sheep (ewe) and its nucleus was removed to form an enucleated ovum.
- The dormant mammary gland cell / udder cell and the enucleated ovum were fused.
- The outer membrane of the mammary cell was ruptured allowing the ovum to envelope the nucleus.
- The fused cell was implanted into surrogate mother.
- Five months later dolly was born.
- Dolly was the first animal formed without fertilization.

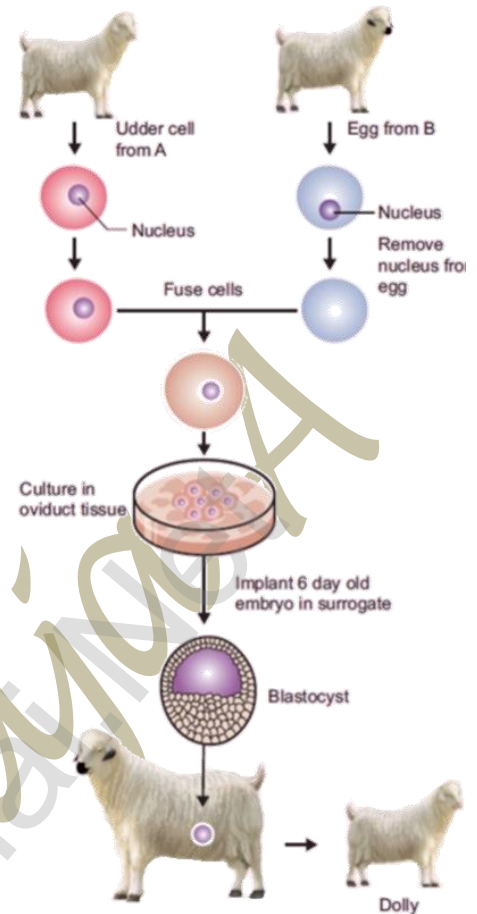


Fig. 9. 8 Cloning of dolly

7. List out the uses of biological product.

- Animals used as bioreactor to produce desirable protein.
- Antibiotic can be produced using transgenic animals.
- Monoclonal antibodies can be produced this technique.

Advantages of monoclonal antibodies:

- Treat the cancer, heart diseases, and immune transplantation.
- Production of protein adhesive.

Advantages of protein adhesive:

- No toxic.
- Biodegradable.
- Rarely trigger the immune response.
- Used to re attaché tendons and tissue.
- Used in fill cavities in teeth.
- Repair broken bone.



10

CHAPTER

UNIT - V

Organisms and Populations



BOOK BACK QUESTIONS

1. What is a Habitat?

- Habitat refers to the place where an organism or a community of organisms live.
- Including all biotic and abiotic factors or
- Conditions of the surrounding environment.

2. Define: Ecological niche.

- The ecological niche is the physical space occupied by an organism.
- Its functional role in the community.
- It is the functional states of an organism in its community.
- It is the total position and function of an individual in its environment.

3. What is Acclimatisation?

- Animals are known to modify their response to environmental changes in a short time.
- This is known as Acclimatization.
- This is observed when people who have moved from the plains to higher altitudes.
- It shows enhanced RBC count in their new habitat.
- This helps them cope with lower atmospheric oxygen and higher oxygen demand.

4. What is Pedogenesis?

- The process of formation of soil from the rocks by weathering process.
- The soil zone of the earth is known as Pedosphere.
- Soil is formed from rocks.
- Rocks are the parent materials of soil and embryonic soil (Pedogenesis).

5. What is soil permeability?

- The characteristic of soil that determines the movement of water through pore spaces is known as soil permeability.
- Soil permeability is directly dependent on the pore size.
- Water holding capacity of the soil is inversely dependent on soil porosity.

6. Differentiate between Eurytherms and Stenotherms.

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

7. Explain hibernation and aestivation with examples.

- If the organisms are unable to migrate, it may avoid the stress by becoming inactive.
- Hibernation during winter (winter sleep) **Ex: Polar bears.**
- Aestivation (summer sleep) to avoid summer problems like heat and desiccation.
- **Ex: Some snails and fish.**

8. Give the diagnostic characters features of a Biome?

- Location, Geographical position (Latitude, Longitude).
- Climate and physiochemical environment.
- Predominant plant and animal life.
- 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:

- Freshwater biome - Lakes, ponds, rivers.
- Brackish water biome - Estuaries / Wetlands.
- Marine biome - Coral reefs, pelagic zones and abyssal zones.

Five marks:

1. Write short notes on: Population density, Natality and Mortality.

Population density:

- The density of a population refers to its size in relation to unit of space and time.
- Population density is the total number of that species within a natural habitat.

Measurement of population:

- **Including abundance:** absolute number in population.
- **Numerical density:** number of individuals per unit area (or) volume
- **Biomass density:** biomass per unit area (or) volume.
- When the size of individuals in the population is relatively uniform then density is expressed in terms of number of individuals (numerical density).

Natality (Population increase):

- Birth rate
- Populations increase because of natality.
- The production of new individuals in the population by birth, hatching, germination (or) fission.
- The two main aspects of reproduction, namely fertility and fecundity play a significant role in a population.
- Birth rate number of organisms born per female per unit time.

$$\text{Birth rate (b)} = \frac{\text{number of birth per unit time}}{\text{average population}}$$

Mortality (Population decrease):

- Death rate.
- Population decline factor and is opposite to natality.
- Mortality can be expressed as a loss of individuals in unit time or death rate.

Specific mortality:

- The number of members of an original population dying after the lapse of a given time.

$$\text{Death rate (d)} = \frac{\text{number of deaths per unit time}}{\text{average population}}$$

- Mortality is high at high density because of the hazards of overcrowding, increased predation and spread of disease.

Factors influenced on mortality rate:

- Destruction of nests, eggs or young by storms, wind, floods, predators, accidents and desertion by parents.

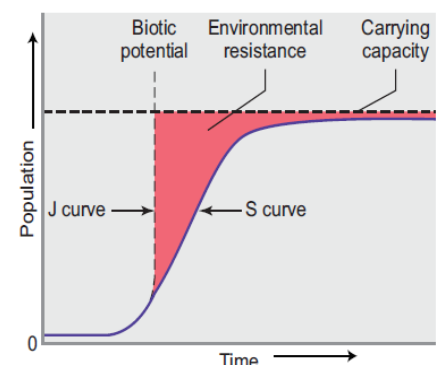
2. Differentiate J and S shaped curve:

J - Shaped curve:

- When a 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.

S - Shaped curve:

- Some populations, as in a 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.



3. What are the ways by which organisms respond to abiotic factors?

➤ The types of responses are:

Regulate:

- Some organisms are able to maintain homeostasis.
- They ensure constant body temperature, ionic / osmotic balance.
- **Examples:** Birds, mammals and a few lower vertebrate and invertebrate.

Conform:

- Most animals cannot maintain a constant internal environment.
- Their body temperature changes with the ambient temperature.
- **Examples:** In aquatic animals like fishes, the osmotic concentration of the body fluids changes with that of the ambient water osmotic concentration.
- In case of extreme condition, the inhabitants relocate themselves as in migration.

Migrate:

- Organisms tend to move away temporarily from a stressful habitat to a new, hospitable area and return when the stressful period is over.
- **Examples:** Birds migrate from Siberia to Vedanthangal in Tamilnadu.

Suspend:

- In certain conditions, if the organisms are unable to migrate, it may avoid the stress by becoming inactive.
- **Examples:** hibernation during winter – Polar bears.
- Aestivation to avoid summer related problems like heat and desiccation - Some snails and fish.

Diapause:

- Some lower animals suspend a certain phase of their life cycle.

4. Give an account of population regulation:

- The inherent tendency of all animal populations is to increase in number. But it does not increase indefinitely.
- Once the carrying capacity of the environment is reached, population numbers remain static or fluctuate depending on environmental conditions.

This is regulated by many factors which are

- 1. Density independent – Extrinsic factors - include availability of space, shelter, weather, food, etc.
- 2. Density dependent - Intrinsic factors - competition, predation, emigration, immigration and diseases.

5. Give an account of the properties of soil:

Texture of soil:

- 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.

Porosity:

- The space present between soil particles in a given volume of soil are called pore spaces.
- The percentage of soil volume occupied by pore space or by the interstitial spaces is called porosity of the soil.

Permeability of soil:

- The characteristic of soil that determines the movement of water through pore spaces is known as soil permeability.
- Soil permeability is directly dependent on the pore size.
- Water holding capacity of the soil is inversely dependent on soil porosity.

Soil Temperature:

- Soil gets its heat energy from solar radiation, decomposing organic matter, and heat from the interior of earth.
- Soil temperature effects the germination of seeds, growth of roots and biological activity of soil-inhabiting micro-and macro-organisms.

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.

6. Differentiate between Tundra and Taiga Biomes:

Tundra	Taiga
Place:	
➤ Treeless plain parts, Northern parts of Asia, Europe and North America	➤ 1300 – 1450 km wide zone south of the Tundra
➤ Long winter (little day light) short summer (long lay light)	➤ This area has long and cold winters
➤ Precipitation is less than 250 mm / year. It is a zone of permafrost < 0 ⁰ C	➤ Precipitation ranges about 380 – 1000mm / year
Fauna:	Fauna:
➤ Reindeer, arctic hare, musk ox, Lemmings – (Herbivores)	➤ Herbivores – moose, elk, deer, and reindeer.
➤ Artic fox, Artic wolf, bobcat, and snowy owl (carnivores). Polar bears.	➤ Predators: timber wolf, grizzly bear, black bear, bobcat and wolverines
Flora:	Flora:
➤ Dwarf willows, birches, mosses, grasses, sedges	➤ Coniferous tress, spruce, fir and pine.
➤ Because of the serve winters, many animals are migratory.	➤ Moose reindeer migrate to the Taiga for winter and to Tundra for summer
➤ Shore birds, ducks and geese, nest during summer (Tundra) migrate south for winter.	

7. List the adaptations seen in terrestrial animals:

- **Earthworms, land Planarians:** Mucus coating to maintain a moist situation for burrowing, coiling, respiration, etc.,
- **Arthropods:** external covering over the body surfaces and well - developed tracheal systems for respiration.
- **Vertebrate:** Skin with many cellular layers. The well protected respiratory surfaces that help in preventing loss of water.
- **Some animals:** Obtain their water requirement from food as partial replacement of water lost through excretion.
- **Birds:** Make nests and breed before the rainy season as there is availability of abundant food. But during drought birds rarely reproduce.
- **Camels:** They 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.

8. Describe Population Age Distribution:

- The proportion of the age groups (pre- reproductive, reproductive and post reproductive) in a population is its age distribution attribute.
- This determines the reproductive status of the population at the given time and is an indicator of the future population size.
- Usually, a rapidly growing population will have larger proportion of young individuals.
- A stable population will have an even distribution of various age classes.
- A declining population tends to have a larger proportion of older individuals

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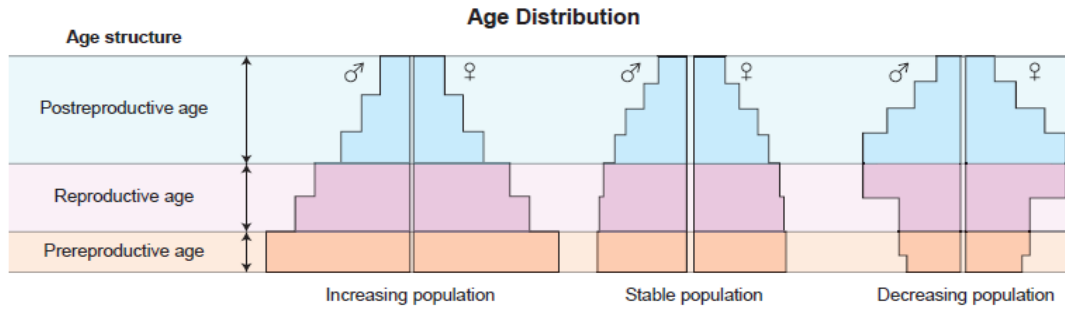


Fig. 10.13 Age distribution pyramids

9. Explain parasitism with an example.

- PARASITISM (+, --): It is a kind of harmful interaction between two species, wherein one species is the 'parasite' and the other its 'host'.
- The parasite benefits at the expense of the host.
- A parasite derives shelter, food and protection from the host. Parasites exhibit adaptations to exploit their hosts.
- The parasites may be viral parasites (plant / animal viruses), microbial parasites (e.g., bacteria / protozoa / fungi), phytoparasites (plant parasites) and zooparasites (animal parasites such as Platyhelminthes, nematodes, arthropods).
- Parasites may inhabit or attach to the surface of the host (Ectoparasites - Head lice, Leech) or live within the body of the host (endoparasites – ascaris, tapeworm).
- **Endoparasites:** usually live in the alimentary tract, body cavities, various organs or blood or other tissues of the host.
- Parasites may be permanent or temporary.
- **Temporary parasites:** these parasites spend only a part of their life cycle as parasites.
- **Example:** Glochidium larva of Anadonia (fresh water mussel) attaches itself to the body of fish.
- **Permanent parasites:** these parasites spend their life completely dependent on their host organism.
- **Examples:** Plasmodium, Entamoeba, Round worms, Pin worms, Tape worms, etc.,

10. Tabulate and analysis of two species population interaction.

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	Elephant 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

Intext questions:**TWO MARKS**

1. **Define: population/Biotic community/Ecology/Ecosystem.**
 - **Population:** A groups of individuals of any one kind of organism.
 - **Community:** includes all the populations occupying a given area.
 - **The word 'ecology':** Greek term '*oikos*', meaning 'house' and *logos*, meaning 'study'. Thus, the study of the environmental 'house'.
 - **Ecological system (or) Ecosystem:** The community (Biotic) and the non-living environment (Abiotic) function together.
2. **State Bergmann's rule / Allen's rule / Jordon's rule.**
 - **Bergmann's rule** - Birds and mammals attain greater body size in colder regions than warmer regions.
 - **Allen's rule** - Warm blooded animals, living in colder climates, tend to have shorter limbs, ears and other appendages when compared to the members of the same species in warmer climates.
 - **Jordon's rule** - In some aquatic environments, an inverse relationship between water temperature and fish meristic characters is observed - lower the temperature, more the vertebrae.
3. **What are the different types of water available in nature?**
 - Fresh water (rivers, lakes, ponds)
 - Salt water (seas and oceans).
 - Based on the dissolved salts, water can be hard water (sulphates/nitrates of Calcium/Magnesium) or soft water.
 - If hardness can be removed by boiling, it is temporary hard water, and if boiling does not help, it is permanent hard water.
4. **List the major functions of soil.**
 - Medium for plant growth.
 - Means for water storage and purification.
 - Modifier of earth's atmosphere.
 - Habitat for many organisms, which in turn modify the soil.
5. **Compare Absolute humidity and Relative humidity?**
 - **Absolute humidity:** The total mass of water vapour present in a given volume or mass of air.
 - It does not take temperature into consideration.
 - **Relative humidity:** The amount of water vapour present in air and is expressed as a percentage of the amount needed for saturation at the same temperature.
 - Relative humidity is expressed as a percentage.
6. **Define: Biome.**
 - Biomes are large regions of earth that have similar or common vegetation and climatic conditions.
 - They play a crucial role in sustaining life on Earth.
 - They are defined by their soil, climate, flora and fauna.
7. **What are Regulators in an environment? Give an example.**
 - Some organisms are able to maintain homeostasis.
 - They ensure constant body temperature, ionic / osmotic balance.
 - **Ex:** Birds, mammals and a few lower vertebrate and invertebrate species.
8. **What are conformers in an environment? Give an example.**
 - **Conform:** Most animals cannot maintain a constant internal environment.
 - Their body temperature changes with the ambient temperature.

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- **Ex:** Fishes, - The osmotic concentration of the body fluids changes with that of the ambient water osmotic concentration.

9. Define: Diapause. Give an example.

- In certain conditions, if the organisms are unable to migrate, these may avoid the stress by becoming inactive.
- **Diapause:** Some lower animals suspend a certain phase of their life cycle.

10. With the examples explain camouflage / mimicry – example?

- Certain reptiles and insects such as chameleons and stick insects show **camouflage** type of adaptation, which helps in prey capture or to evade from predators.

11. Compare: anadromous migration and catadromous migration.

- **Anadromous migration:** Fishes are known to migrate from sea to fresh. **E.g. Salmon fish.**
- **Catadromous migration:** Fishes are known to migrate from fresh water to sea. **E.g. Eel.**

12. Differentiate: Crude density and ecological density.

S.No	Crude density	Ecological density
1	It is the size of a population in relation to the numbers per unit of total space. Eg.1000 fish in a pond.	It is the size of a population in relation to the numbers per unit of habitat space. (Available area or volume that can be colonized by a population). E.g. 1000 fish in the volume of water in the pond.

13. Why do organisms migrate?

- Migration is a peculiar and unique kind of mass population movement from one place to another and back.
- To avoid the severe winter cold, Siberian cranes migrate from Siberia to Vedanthangal in Tamil Nadu and return back in spring.

14. Differentiate: Inter specific and Intra specific interaction of population.

- Intra specific - interaction within the members of same species
- Inter specific - interaction among organisms of different species.

15. Name the extrinsic and intrinsic factors that affect population in a place.

- Density independent – Extrinsic factors - it includes availability of space, shelter, weather and food.
- Density dependent - Intrinsic factors - it includes competition, predation, emigration, immigration and diseases.

THREE MARKS**1. What is a habitat? State the adaptations of a camel to a xerophytic habitat.**

- Habitat refers to the place where an organism or a community of organisms live,
- Including all biotic and abiotic factors or conditions of the surrounding environment.
- In a xerophytic habitat, the camel is able to use water efficiently and effectively for evaporative cooling through their skin and respiratory system.
- They excrete highly concentrated urine and can also withstand dehydration upto 25% of the body weight.
- The hoofs and hump are also suitable adaptations for survival in this dry sandy environment.

2. How are aquatic animals adapted to their habitat?

- In an aquatic media, maintaining homeostasis and osmotic balance is a challenge.
- So, marine animals have appropriate adaptations to prevent cell shrinkage.
- While freshwater organisms have suitable adaptations to withstand bursting of their cells.
- Apart from this, organisms such as fish have a wide range of adaptations like fins (locomotion), streamlined body (aerodynamic), lateral line system (sensory), gills (respiration), air sacs (floatation) and kidneys (excretion).

3. How does Altitude affect organisms?

- **Altitude** (elevation or gradient) affects temperature and precipitation in an ecosystem or biome.
- As altitude increases, temperature and density of oxygen decreases.
- Higher altitudes usually receive snow instead of rain because of low temperature.
- Animals are known to modify their response to environmental changes (stress) in reasonably short time spans. This is known as **Acclimatization**.
- **Ex:** When people who have moved from the plains to higher altitudes show enhanced RBC count within a few days in their new habitat.
- This helps them cope with lower atmospheric oxygen and higher oxygen demand.

4. Write short notes on crypsis.

- Some of the most attractive adaptations in nature occur for reasons of crypsis (e.g. camouflage) and mimicry.
- Cryptic animals are those which **camouflage perfectly** with their environment and are almost impossible to detect.
- Certain reptiles and insects such as chameleons and stick insects show this type of adaptation, which helps in prey capture or to evade from predators.

5. Compare: emigration and immigration.**Emigration:**

- Under natural conditions, emigration usually occurs when there is overcrowding.
- This is regarded as an adaptive behavior that regulates the population in a particular site and prevents over exploitation of the habitat.
- Further, it leads to occupation of new areas elsewhere.

Immigration:

- It leads to a rise in population levels.
- If the population increases beyond the carrying capacity, it can result in increased mortality among the immigrants or decreased reproductive capacity of the individuals.

FIVE MARKS:**1. List the essential properties of water:**

- Water is one of the main agents in Pedogenesis (soil formation).
- It is the medium for several different ecosystems.
- It is present as moisture in the atmosphere and the outer layers of the lithosphere and is uneven in distribution on the earth.
- Water is heavier than air and imparts greater buoyancy to the aquatic medium. This enables organism to float at variable levels.
- Water has high heat capacity and latent heat, due to which it can withhold large amounts of heat.
- Water is physically unique because it is less dense as a solid (ice) than as a liquid.
- Water is considered as the Universal solvent. It is the main medium by which chemical constituents are transported from abiotic components to the living components of an ecosystem.
- Water has high surface tension. This allows pollen, dust, and even water striders to remain at the surface of a water body even though they are denser than the water.

2. List the Adaptations of aquatic animals:

- The pectoral fins and dorsal fins act as stabilizers or balancers and the caudal fin help in changing the direction as a rudder.
- Arrangement of body muscles in the form of bundles (myotomes) help in locomotion.
- Stream lined structure helps in the swift movement of the animals in water.

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- Respiration by gills making use of gases dissolved in water.
- Presence of air-bladders filled with air for buoyancy.
- Presence of lateral-line system. They function as rheoreceptors which is helpful in echolocating objects in water.
- Integuments rich in mucous glands are protected by scales.
- Maintain water and ionic balance in its body with excretory structures.

3. Many animals share the same general habitat. But their niches are well defined – justify your answer with an example.

- The life style of an individual population in the habitat is known as its niche.
- For example, crickets and grasshoppers are closely related insects that live in the same habitat, yet they occupy different ecological niches.
- The grasshopper is very active during daylight. It can usually be found on a plant, feeding on the plant parts.
- During the day, the cricket hides under leaves or plant debris and is usually inactive. It is active at night time (nocturnal).
- The cricket and the grasshopper do not interfere with each other's activities in the same habitat.
- Thus, niche of an organism can be defined as the total position and function of an individual in its environment.

4. Define: Adaptations. What are the different adaptive traits that are present animals?

- In biology, **adaptation** is a dynamic evolutionary process that fits organisms to their environment and enhancing their evolutionary fitness.

The adaptive traits in animals:

- Structural adaptation.
- Behavioural adaptation.
- Physiological adaptation.

a) Structural adaptations:

- The external and internal structures of animals can help them to **adapt better to their environment**.

Examples:

- Mammals growing thicker fur to survive freezing climates.

Crypsis (E.g: Camouflage) and mimicry.

- Cryptic animals are **camouflage perfectly** with their environment and are almost impossible to detect.
- **Ex:** Certain reptiles and insects such as chameleons and stick insects.
- **Crypsis** helps in prey capture or to evade from predators.

Horse:

- In horse legs are suitable for fast running and adapted for grasslands and similar terrestrial environments.

b) Behavioural adaptations:

- Action and behaviour of animals are instinctive or learned.
- Animals develop certain behavioural traits or adaptations for survival.

Examples:

- Fleeing from a predator.
- Hiding during sleep.
- Seeking refuge from climate change.
- Moving to find different food sources.
- Most nocturnal animals remain underground or inactive during daytime. This is a modification of their feeding and activity pattern or habit or behaviour.
- The two most characteristic forms of behavioral adaptations are **migration and courtship**.
- **Migration:** it allows the animals to find better resources or evade threat.

- **Courtship:** it is a set of behavioral patterns to find a mate to reproduce.

c) Physiological adaptations

- These are adaptations of organisms that help them to live and survive in their environment with unique niches.

Examples:

- Lions have sharp canines to hunt and tear meat and a digestive system suitable for digesting raw meat.
- The two most well-known physiological adaptations are **hibernation and aestivation**.
- These are two different types of inactivity where the metabolic rate slows down so much that the animal can survive without eating or drinking.
- Aquatic medium and terrestrial habitats have their own respective environmental conditions.
- Hence organisms have to evolve appropriate adaptations to select suitable habitats and niches.

5. Differentiate r selected and k selected species.

S.NO	r selected species	k selected species
1	Smaller sized organisms	Larger sized organisms
2	Produce many offspring	Produce few offspring
3	Mature early	Late maturity with extended parental care
4	Short life expectancy	Long life expectancy
5	Each individual reproduces only once or few times in their life time	Can reproduce more than once in lifetime
6	Only few reaches adulthood	Most individuals reach maximum life span
7	Unstable environment, density independent	Stable environment, density dependent

6. Explain the types of population dispersion observed in animals.

- Populations have a tendency to disperse or spread out in all directions, until some barriers are reached.
- This is observed by the migration of individuals into (Immigration) or out (Emigration) of the population area.

Migration:

- Migration is a peculiar and unique kind of mass population movement from one place to another and back.
- **EX:** To avoid the severe winter cold, Siberian cranes migrate from Siberia to Vedanthangal in Tamil Nadu and return back in spring.
- **Anadromous migration:** Fishes are known to migrate from sea to fresh water (Salmon)
- **Catadromous migration:** Fishes are known to migrate from fresh water to sea (Eel).

Emigration

- Under natural conditions, emigration usually occurs when there is overcrowding.
- This is an adaptive behavior that regulates the population in a particular site and prevents over exploitation of the habitat.
- Further, it leads to occupation of new areas.

Immigration:

- It leads to a rise in population levels.
- If the population increases beyond the carrying capacity, it can result in increased mortality or decreased reproductive capacity of the individuals.
- Both emigration and immigration are initiated by weather and other abiotic and biotic factors.



BOOK BACK QUESTIONS

1. Define endemism and species richness:

Endemism:

- A phenomenon in which the organisms are exclusively restricted to a given area.
- Endemism is a crucial indicator of richness. **E.g:** Nilgiri thar.

Species richness:

- The number of species per unit area at a specific time is called species richness.
- It denotes the measure of species diversity.

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

- **Himalayas:** The entire Indian Himalayan region.
- **Western Ghats.**
- **Indo - Burma:** includes entire North - eastern India, except Assam and Andaman group of Islands.
- **Sundalands:** Includes Nicobar group of Islands.

3. What are the three levels of biodiversity?

- Biodiversity is used to describe diversity at all levels of biological organization from populations to biomes.
- There are three levels of biodiversity
 - ✓ Genetic diversity.
 - ✓ Species diversity.
 - ✓ Community / Ecosystem diversity.

4. Name the active chemical found in the medicinal plant *Rauwolfia vomitoria*. What type of diversity it belongs?

- *Rauwolfia vomitoria*, is a medicinal plant growing in different ranges of the Himalayas.
- Active ingredient is reserpine.
- *Rauwolfia vomitoria* belongs to genetic diversity.

5. "Amazon forest is considered to be the lungs of the planet"-Justify this statement:

- The Amazon rainforest, a vast area, harboring millions of species, also called "Lungs of the planet".
- More than 20 % of the world oxygen is produced in the amazon rain forest.
- A great proportion of CO₂ released due to anthropogenic activities are uptake by amazon rain forest.
- So the Amazon forest is considered to be the lungs of the planet.

6. What are endangered species? Explain with examples.

- A species that has been categorized as 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).
- In 1998 there were 1102 animal and 1197 plant species in the IUCN Red List.
- In 2012, the list features 3079 animal and 2655 plant species as endangered (EN) worldwide.

7. “Red data book” - What do you know about it?

- Red Data Book or Red list is a catalogue of taxa facing the risk of extinction.
- IUCN – International Union of Conservation of Nature and Natural Resources.
- It is renamed as WCU – World Conservation Union. (Morges Switzerland). It maintains the Red Databook.
- The concept of Red list was mooted in 1963.

The purpose of preparation of Red List is:

- To create awareness about threats to biodiversity.
- Identification and documentation of species at high risk of extinction.
- Provide global index on declining biodiversity.
- Preparing conservation priorities and help in conservation of action.

Eight categories of species in red list:

- Extinct, Extinct in wild, Critically Endangered, Endangered, Vulnerable, Lower risk, Data deficiency and not evaluated

8. Why do we find a decrease in biodiversity distribution, if we move from the tropics towards the poles? (OR) latitude increases the species diversity - birds – justify by giving reasons

- The most important pattern of biodiversity is latitudinal gradient in diversity.
- There is an increasing diversity from the poles to equator.
- Thus, tropics harbour (Tropic of Cancer to the Tropic of Capricorn) more biodiversity than temperate or polar regions, especially between the latitudes of 23.5° N and 23.5° S.
- Harsh conditions exist in temperate areas during the cold seasons.
- While very harsh conditions prevail for most of the year in polar regions.
- The number of species per unit area declines as we move from tropics towards the poles.

Examples:

- The Tundra and Taiga of northern Canada, Alaska, northern Europe and Russia possess less than 12 species of trees.
- Columbia located near the equator (0°) has nearly 1400 species of birds.
- New York at 41° N has 105 species
- Greenland at 71° N has 56 species.
- Decrease in species diversity occurs as one ascends to the polar region.
- India, with much of its land area in the tropical latitudes, is home for more than 1200 species of birds.
- Thus, it is evident that the latitude increases the species diversity.
- Decrease in species diversity occurs as one ascends a high mountain due to drop in temperature. **(temperature decreases @ 6.5°C per Km above mean sea level)**

9. 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.
- Over population, urbanization, industrialization and agricultural advancements require additional land, water and raw materials every year.

Example of habitat loss:

- 14 % of the earth’s land surface once covered by these tropical forests, is not more than 6% now.
- Kodaikanal and Nilgiri hills of Tamil Nadu have been destroyed for human occupancy.
- Loss of habitat results in annihilation of plants and microorganisms and forcing out animals from their habitats.

10. Mention the major threats to biodiversity caused by human activities.

- Apart from natural causes, human activities, both directly and indirectly causes habitat loss and biodiversity loss.
- Fragmentation and degradation due to agricultural practices.
- Extraction - Mining, fishing, logging, harvesting.
- Development - Settlements, industrial and associated infrastructures lead to habitat loss.
- Fragmentation leads to formation of isolated, small and scattered populations and as endangered species.

11. 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:**

- Destruction of large number of species/ population of organisms.
- The earth has experienced with 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.

Steps to taken for the Preventive measure.

- Identify and protect all threatened species.
- Identify and conserve in protected areas and the economically important organisms.
- Identify and protect critical habitats for feeding, breeding, nursing, resting of each species.
- Resting, feeding and breeding places of the organisms should be identified and protected.
- Air, water and soil should be conserved on priority basis.
- Wildlife Protection Act should be implemented

12. Alien species invasion is a threat to endemic species – Substantiate this statement. (OR) Organisms introduced unintentionally or deliberately for commercial purpose, as biological control agents and other uses can cause for biodiversity loss – explain.

- 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.
- It is considered as the second major cause for extinction of species.
- Exotic species have proved harmful to both aquatic and terrestrial ecosystems.

Examples:

- **Tilapia fish (Jilabi kendai) (*Oreochromis mosambicus*):** it was introduced from east coast of South Africa in 1952 for its high productivity into Kerala's inland waters.
- It led the native species such as *Puntius dubius* and *Labeo kontius* face local extinction.
- **Amazon sailfin catfish:** Destroying the fish population in the wetlands of Kolkata.
- **Nile Perch: (A predatory fish):** introduced into Lake Victoria in East Africa led to the extinction of more than 200 nature species of cichlid fish in the lake.

13. Write a note on: i) Protected areas. ii) Wildlife sanctuaries.**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 centre has recognized 37,000 protected areas world-wide.
- India has about 771 protected areas covering 162099 Km².
- National Parks (104).
- Wild Life Sanctuaries (544).
- biosphere reserves (18) and
- Several sacred groves.

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National Parks in Tamil Nadu	Year of establishment	District(s)
Guindy NP	1976	Chennai
Gulf of Mannar Marine NP	1980	Ramanathpuram and Tuticorin
Indira Gandhi (Annamalai) NP	1989	Coimbatore
Mudumalai NP	1990	Nilgiris
Mukurthi NP	1990	Nilgiris

ii) Wildlife sanctuaries:

- Any area other than the area comprised with any reserve forest or the territorial waters can be notified by the State Government.
- This constitutes as a sanctuary with adequate ecological, faunal, floral, geomorphological, natural or zoological significance.
- This is for the purpose of protecting, endangered factual species.
- Ecotourism is permitted, as long as animal life is undisturbed.
- Wild life sanctuaries in India 544.
- Wild life sanctuaries in India covering an area of 118,918 km².
- It is 3.62 % of the geographical area of the country (National Wildlife Database, 2017).
- Sanctuaries are tracts of land where wild animals and fauna can take refuge without being hunted or poached.
- Collection of forest products, harvesting of timber and private ownership of land also permitted.

Prominent WLS in Tamil Nadu	Year of establishment	Districts
Vedanthangal Lake Birds WLS	1936	Chengalpet
Mudumalai WLS	1942	Nilgiris
Point Calimere WLS	1967	Nagapattinam
Indira Gandhi (Annamalai) WLS	1976	Coimbatore
Mundanthurai WLS	1977	Tirunelveli

14. In north eastern states, the jhum culture is a major threat to biodiversity – substantiate.

- This system is practiced in north - eastern regions of India.
- Plots of natural tree vegetation are burnt away and the cleared patches are farmed for 2 - 3 seasons.
- After their fertility reduces, crop production is no longer profitable.
- The farmer then abandons this patch and cuts down a new forest for crop production.
- When vast areas are cleared and burnt, it results in loss of forest cover, pollution and discharge of CO₂.
- This in turn attributes to loss of habitat and climate change.
- It is impact on the faunal diversity of that region.

15. Differentiate *insitu conservation* from *Exsitu Conservation*.

<i>Insitu Conservation</i>	<i>Exsitu Conservation</i>
<ul style="list-style-type: none"> ➤ It is the on - site conservation. ➤ The conservation of genetic resources in natural populations of plant or animal species. 	<ul style="list-style-type: none"> ➤ This is a conservation which involves placing of threatened animals and plants in special care locations for their protection.
<ul style="list-style-type: none"> ➤ It is the process of protecting an endangered plant or animal species in its natural habitat. ➤ by protecting or restoring the habitat itself, or by defending the species from predators. 	<ul style="list-style-type: none"> ➤ It helps in recovering populations or preventing their extinction under simulated conditions. ➤ It closely resembles their natural habitats.
<ul style="list-style-type: none"> ➤ Ex: National Parks, Biosphere Reserve, Wild Life Sanctuaries. 	<ul style="list-style-type: none"> ➤ Ex: Zoological parks and Botanical gardens.

16. 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, Industrialization, Urbanization, infrastructure development, Transport – Road and Shipping activity, communication towers, dam construction, unregulated tourism.
- Co-extinction.

Intext questions:**TWO AND THREE MARKS:****1. Define: Bio – diversity.**

- The 1992 UN Earth Summit: **Biodiversity** as the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems.
- The term biodiversity was introduced by Walter Rosen (1986).
- Biodiversity is the assemblage of different life forms.

2. Why is biodiversity important?

- It helps to maintain ecological processes, create soil, recycle nutrients, influence climate, degrade waste and control diseases.
- It provides an index of health of an ecosystem.
- The survival of human race depends on the existence and wellbeing of all life forms (plants and animals) in the biosphere.

3. Explain genetic diversity.

- **Genetic diversity** refers to the differences in genetic make-up (number and types of genes).
- Genetic variation between species and to the within a single species.
- Also covers genetic variation between distinct populations of the same species.
- Genetic diversity can be measured using a variety of molecular techniques.
- India has more than 50,000 genetic variants of Paddy and 1000 variants of Mango.
- It results in the formation of varieties and Subspecies.

4. What is Species diversity? Explain with an example.

- **Species diversity** refers to the variety in number and richness of the species in any habitat.
- The number of species per unit area at a specific time is called species richness.
- **Example:** 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.

5. What are the three types of species diversity? Explain.

- **Alpha diversity:** It is measured by counting the number of taxa (usually species) within a particular area, community or ecosystem.
- **Beta diversity:** It is species diversity between two adjacent ecosystems and is obtained by comparing the number of species unique to each of the ecosystem.
- **Gamma diversity:** it refers to the diversity of the habitats over the total landscape or geographical area.

6. What is ecosystem diversity?

- **Community / Ecosystem diversity** is the variety of habitats, biotic communities, and ecological processes in the biosphere.
- 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.
- India with its alpine meadows, rain forests, mangroves, coral reefs, grass lands and deserts has one of the greatest ecosystem diversity on earth.

7. How the habitat conditions determined by their Latitudinal and altitudinal gradients?

- Temperature, precipitation, distance from the equator (latitudinal gradient), altitude from sea level (altitudinal gradient) are some of the factors that determine biodiversity distribution patterns.
- There is an increasing diversity from the poles to equator.
- Diversity increases as one moves towards the temperate zones and reaches the maximum at the tropics.

8. Name any three major functional attributes of biodiversity.

- Continuity of nutrient cycles or biogeochemical cycles (N₂, C, H₂O, P, S cycles)
- Soil formation, conditioning or maintenance of soil health (fertility) by soil microbial diversity along with the different trophic members.
- Increases ecosystem productivity and provides food resources.
- Climate stability (forests are essential for rainfall, temperature regulation, CO₂ absorption, which in turn regulate the density and type of vegetation)

9. State the importance of Himalayas as Bio geographical region.

- Himalayas are, the entire mountain chain running from north-western to north - eastern India.
- It covers 7.2% of the country's landmass.
- **Fauna of the Himalayan ranges:** Wild sheep, mountain goats, shrew, snow leopard and panda, many of which are endangered.

10. State the importance of Western Ghats as a Bio geographical region.

- Western Ghats are mountain ranges along the west coast of India.
- extending over almost 1,500 km from Sat Pena in south Gujarat to the southernmost tip of Kerala.
- The annual rainfall is about 2000 mm.
- This zone has large populations of *Nilgiri tahr* (State animal of Tamil Nadu), *Nilgiri Langur*, tiger, leopard, and Indian elephant.
- The grizzled squirrel and lion tailed macaque are endemic to this region.

11. Excessive exploitation of a species reduces the size of its population to such a level that it becomes vulnerable to extinction – explain with an example.

- Excessive exploitation of a species reduces its size of population and become extinction.
- **Ex:** Dodo, passenger pigeon and *Steller's sea cow* have become extinct in the last 200 - 300 years due to over exploitation by humans.
- Overfishing leads to declining of many marine fishes around the world.

12. What is Intensive agriculture? How can it cause loss of biodiversity?

- Spread of agriculture is sometimes at the cost of wetlands, grasslands and forests.
- Intensive agriculture is based on a few high yielding varieties.
- As a result, there is reduction in the genetic diversity.
- It also increases vulnerability of the crop plants to sudden attack by pathogens and pests.
- There are only few varieties of traditional paddy strains today due to use to hybrid varieties in Tamil Nadu.

- 13. What are the direct and indirect human activities that have a detrimental effect on biodiversity?**
- **Direct human activities:** 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:** Demographic, economic, technological, cultural and religious factors.
- 14. Name the Natural threats to Biodiversity.**
- Spontaneous jungle fires.
 - Tree fall.
 - Land slide.
 - Defoliation by insects or locust attack.
- 15. List the biodiversity hotspots in India.**
- India is home to four biodiversity hotspots (as per ENVIS).
 - **Himalaya:** The entire Indian Himalayan region.
 - **Western Ghats.**
 - **Indo-Burma:** includes entire North-eastern India, except Assam and Andaman group of Islands (and Myanmar, Thailand, Vietnam, Laos, Cambodia and Southern China)
 - **Sundalands:** includes Nicobar group of Islands (and Indonesia, Malaysia, Singapore, Brunei, Philippines)
- 16. Compare: extinct / extinct in the wild / globally extinct / locally extinct.**
- **Extinct:** None of members of species are alive anywhere in the world.
 - **Extinct in the wild:** If individuals of a species remain alive only in captivity or other human controlled conditions and not in the wild.
 - In both the case of extinct and extinct in the wild these situations, the species would be considered globally extinct.
 - **Locally extinct:** a species is no longer found in an area it once inhabited but is still found elsewhere in the wild.
- 17. What are the three types of Extinctions?**
- Natural extinction:**
- It is a slow process of replacement of existing species with better adapted species due to changes in environmental conditions, evolutionary changes, predators and diseases.
 - A small population can get extinct sooner than the large population due to inbreeding depression (less adaptivity and variation).
- 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.
- Anthropogenic extinctions:**
- These are abetted by human activities like hunting, habitat destruction, over exploitation, urbanization and industrialization.
 - **Examples: Dodo of Mauritius and Steller's Sea cow** of Russia.
 - Amphibians seem to be at higher risk of extinction because of habitat destruction.
- 18. What is IUCN? Mention its role in the conservation of biodiversity.**
- The International Union for Conservation of Nature (IUCN) is an organization working in the field of nature conservation and sustainable use of natural resources.
 - It was established in 1948 and located at Gland VD, Switzerland.
 - It is involved in data gathering and analysis research, field projects and education on conservation, sustainable development and biodiversity.
 - **IUCN's mission:** To influence, encourage and assist societies throughout the world to conserve nature
 - To ensure that any use of natural resources is equitable and ecologically sustainable.

19. What are the General strategies taken for the conservation of biodiversity?

- Identify and protect all threatened species.
- Identify and conserve in protected areas and all the economically important organisms.
- Identify and protect critical habitats for feeding, breeding, nursing, resting of each species.
- Resting, feeding and breeding places of the organisms should be identified and protected.
- Air, water and soil should be conserved on priority basis.
- Wildlife Protection Act should be implemented.

20. What is a National Park (NP)?

- A National Park is an area which is strictly reserved for the betterment of wildlife and biodiversity.
- Activities like development, forestry poaching, hunting, grazing and cultivation are not permitted.
- Kaziranga National Park – Assam. One Horned Rhinoceros.

21. What are wild life sanctuaries?

- Sanctuaries are tracts of land where wild animals and fauna can take refuge without being hunted or poached.
- Other activities like collection of forest products, regulated harvesting of timber and private ownership of land are permitted.
- Periyar wild life sanctuary – Kerala - Tiger and Asiatic Elephant.

22. Define: Biosphere Reserve (BR).

- Biosphere Reserve (BR) is an international designation by UNESCO for representative parts of natural and cultural landscapes extending over large area of terrestrial or coastal / marine ecosystems or a combination thereof.
- BRs are designated to deal with the conservation of biodiversity, economic and social development and maintenance of associated cultural values.

23. What are sacred groves?

- A sacred grove or sacred woods are any grove of trees that are of special religious importance to a particular culture.
- Sacred groves feature in various cultures throughout the world.

Five marks:**1. What are the reasons for the richness of biodiversity in the Tropics?**

- Warm tropical regions between the tropic of Cancer and Capricorn on either side of equator possess congenial habitats for living organisms.
- Environmental conditions of the tropics are favourable not only for speciation but also for supporting both variety and number of organisms.
- The temperatures vary between 25°C to 35°C, a range in which most metabolic activities of living organisms occur with ease and efficiency.
- The average rainfall is often more than 200 mm per year.
- Climate, seasons, temperature, humidity, photoperiods are more or less stable and encourage both variety and numbers.
- Rich resource and nutrient availability.

2. Extinction of one species may automatically cause extinction of the other species - Justify your answer with an example.

- Loss of a species as a consequence of the extinction of another.
- **Examples:** Orchid bees and forest trees by cross pollination.
- The connection between *Calvaria* tree and the extinct bird of Mauritius Island, the Dodo.
- The *Calvaria* tree is dependent on the Dodo bird for completion of its life cycle.

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- The mutualistic association is that the tough horny endocarp of the seeds of *Calvaria* tree are made permeable by the actions of the large stones in birds gizzard and digestive juices thereby facilitating easier germination.
- The extinction of the Dodo bird led to the imminent danger of the *Calvaria* tree coextinction.

3. Industrialization is a major contributor to climate change and a major threat to biodiversity – explain.

- Industrialization is a major contributor to climate change and a major threat to biodiversity.
- Energy drives our industries, which is provided by burning of fossil fuels. This increases the emission of CO₂, a GHG, leading to climate change.
- Due to large scale deforestation, the emitted CO₂ cannot be absorbed fully, and its concentration in the air increases.
- Climate change increases land and ocean temperature, changes precipitation patterns and raises the sea level.
- This inturn results in melting of glaciers, water inundation, less predictability of weather patterns, extreme weather conditions, outbreak of squalor diseases, migration of animals and loss of trees in forest.
- Thus, climate change is an imminent danger to the existing biodiversity.

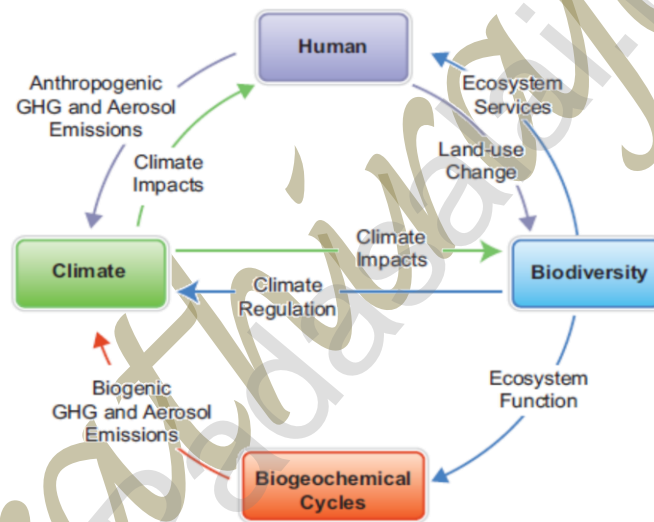


Fig. 11.4 Links between biodiversity, climate change and human well - being

4. Pollutants and pollution are a major cause for biodiversity loss – explain with an example.

- Excessive uses of fertilizers, pesticides and heavy metals have polluted the land, ground and surface water bodies.
- There is a tendency of pesticide bio - magnification which results in high concentrations at higher trophic levels which has resulted in drastic decline in the population of fish eating birds and falcons.
- Run off from fertilizer rich fields causes nutrient enrichment of water bodies leading to eutrophication.
- Mercury, arsenic, cadmium, chromium poisoning has led to depletion of biotic resources in vulnerable ecosystems.
- Death of vulture population is attributed to the veterinary medicine Diclofenac, which is responsible for the thinning of the egg shells.

- 5. Loss of habitat results in annihilation of plants, microorganisms and forcing out animals from their habitats – Explain.**
- The tropical rainforests 14% of the earth's land surface once covered by these tropical forests is not more than 6% now.
 - 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.
 - 90% of New Zealand's wetlands have been destroyed and cleared for cultivating soya beans and raising grass for beef cattle.
 - Kodaikanal and Nilgiri hills of Tamil Nadu have been destroyed rapidly for human occupancy.
 - Loss of habitat results in annihilation of plants, microorganisms and forcing out animals from their habitats.
- 6. How is habitat fragmentation causes biodiversity loss? Explain.**
- Habitat fragmentation is the process where a large, continuous area of habitat is reduced in area and divided into two or more fragments.
 - Fragmentation of habitats like forest land into crop lands, orchard lands, plantations, urban areas, industrial estates, transport and transit systems has resulted in the destruction of complex interactions amongst species, (food chain and webs).
 - Destruction of species in the cleared regions, annihilation of species restricted to these habitats (endemic) and decreased biodiversity in the habitat fragments.
 - Animals requiring large territories such as mammals and birds are severely affected.
 - The elephant corridors and migratory routes are highly vulnerable.
 - The dwindling of many well-known birds (sparrows) and animals can be attributed to this.
- 7. Mention the role of Gene Banks in biodiversity conservation.**
- Gene banks are a type of biorepository which preserve genetic materials.
 - Seeds of different genetic strains of commercially important plants can be stored in long periods in seed banks, gametes of threatened species can be preserved in viable and fertile condition for long periods using cryopreservation techniques.
 - However, it is not economically feasible to conserve all biological wealth and all the ecosystems.
 - The number of species required to be saved from extinction far exceeds the conservation efforts.



BOOK BACK QUESTIONS

1. Expand:

- i) CFC - Chlorofluorocarbons.
- ii) AQI - Air Quality Index
- iii) PAN – Proxy Acetyl Nitrate

2. What is SMOG and how it is harmful for us?

- Smog is a type of air pollution caused by tiny particles in the air.
- It is a mixture of the smoke and fog.

Harmful effects:

- Smog can make breathing difficult, especially for people with asthma.
- Affects plants and animals.
- It damages crops, health problems in pets, farm animals and human beings.
- Cause corrosive damage to buildings and vehicles.

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?

- **Home:** Food wastes, plastics, paper, glass, leather, cardboard, metals, yard wastes, ashes, tires, batteries, old mattresses.
- **School:** Wood, paper, metals, cardboard materials, electronics.
- **During trip:** Plastic water bottle, carry bags, Aluminum foils.
- For example, using jute / cloth bags instead of plastic bags, using the plastic drum as flower pots, etc.
- **Yes**, we can reduce the generation of daily wastes in our life.
- E - Wastes and plastic wastes are generally difficult to biodegrade.

4. Write notes on the following:

Eutrophication:

- When water run-off from land, containing nutrients reaches water bodies like lakes, it results in dense growth of plant life. This phenomenon is called Eutrophication.

Algal Bloom:

- Growth of algae in an aquatic system due to the pollution.
- It affects the Quality of water bodies.
- Red tides can be lethal to the aquatic animal.

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

- When water run-off from land containing nutrients' reaches water bodies like lakes results in a dense growth of plant life.
- This phenomenon is called Eutrophication.

6. How can we control eutrophication?

- Reducing the use of chemical fertilizers and pesticides in agricultural lands.
- Checking the runoff water from agriculture fields.
- Planting vegetation along the stream beds there by the nutrients will be uptake by plants.
- Waste water like sewage should be discharge into water bodies only after proper treatment.
- Waste water should be treated by scientific method.
- Setting up of sewage treatment plant and effluent treatment plant.

7. Discuss the role of an individual to reduce environmental pollution.**Role of an individual to reduce Air Pollution:**

- Forests act as carbon sinks and lungs of the planet, so plant and grow as many trees as possible.
- Use Catalytic converters in vehicles which help to reduce polluting gases drastically.
- Promoting Swachh Bharat Abhiyan.
- **Reducing carbon emissions:** Using public transport is contributing to less air pollution.
- **Recycle and Reuse:** The concept of recycle also helps in reducing pollution emissions.
- The use of paper bags instead of plastic bags as they decompose easily and are recyclable.
- **Use of fans instead of Air Conditioner:** Increase in the concentrations of greenhouse gases such as CO₂, methane, nitrous oxide, CFCs, and ozone causes greenhouse effect, warming of the earth.

Role of an individual to reduce water Pollution.

- Regulate or control of pollutant(s) discharge at the point of generation.
- Wastewater can be pretreated by scientific methods before discharge to municipal treatment sources.
- Setting up of Sewage Treatment Plants (STP) and Effluent Treatment Plants (ETP) in factories
- Avoid use of synthetic fertilizers and pesticides.

Role of an individual to reduce Noise Pollution:

- Planting more trees in and around noise sources.
- Plants are known to absorb noise and bring down sound levels.
- Lubrication of machinery and regular servicing minimizes noise levels.
- Avoid usage of loudspeakers in crowded areas and public places.

8. How does recycling help reduce pollution?

- Recycling is the process of converting a used material in to a new material.
- Recycling prevents the emissions waste materials and pollutants.
- Using recovered material generates less solid waste.
- Recycling helps to reduce the pollution caused by the extraction and processing of virgin materials

9. Discuss briefly the following:**a) Catalytic converter:**

- Catalytic converters in vehicles help to reduce polluting gases drastically.
- Diesel exhaust filters in automobiles cuts particulates.

b) Ecosan:

- About 150 litres of wastewater at an average is generated by an Indian individual daily, and a large amount of it is generated from toilets.
- Ecological sanitation (EcoSan) is a sustainable system for handling human excreta by using dry composting toilets.
- EcoSan toilets not only reduce wastewater generation but also generate the natural fertilizer from recycled human excreta.
- It forms an excellent substitute for chemical fertilizers.
- This method is based on the principle of recovery and recycling of nutrients from excreta.
- 'EcoSan' toilets are being used in several parts of India and Sri Lanka.

10. What are some solutions to toxic dumping in our oceans?

- Ships and tankers that carry oil can be supervised earlier and ensured that they are not damaged in any way and through this oil will not be spilt in the ocean water.
- Toxic dumping should not be thrown into the sea. These should be collected in the ship and bring the land for proper disposal.
- Management and minimizing of waste dumping in port.
- Industrial wastewater should be treated by scientific methods before discharge to ocean.

11. Define: BOD

- The amount of the oxygen that would be consumed by bacteria, if all the organic matter were oxidized in one litre of water.
- The greater the BOD of the waste water more is its polluting potential.

12. What is referred as bio-magnification?

- When non - degradable substances enter the food chain, they do not get metabolized or broken down or expelled.
- They get transferred up the tropic levels of the food chain.
- During this process, they show an increase in concentration which is referred to as **biomagnification**.
- This results in increased toxicity and may even be lethal.
- Ex: Biomagnification of DDT in aquatic food chain.

13. What are the effects of Noise Pollution?

- According to the USEPA there are direct links between noise and health.
- Heart diseases, high blood pressure, stress related illness, sleep disruption, hearing loss (deafness), etc.
- Increased stress and tension, nervousness, irritability, anxiety, depression and panic attacks.
- Peptic ulcer, severe head ache, memory loss.
- Marine animals are affected by noise pollution from offshore activities and port activities.
- Fire crackers frighten animals.
- Birds are often affected by increased air traffic.

Intext questions:**TWO AND THREE MARKS****1. Define: Pollution.**

- Pollution is any undesirable change in the physical, chemical and biological characteristics of the environment due to natural causes and human activities.
- The agents which cause pollution are called pollutants.
- **Types:** Air pollution, water pollution and soil pollution.

2. Give the importance of the atmosphere.

- Earth is surrounded by a gaseous envelope which is called atmosphere.
- The gaseous blanket of the atmosphere acts as a thermal insulator.
- And regulates the temperature of the earth by selectively absorbing the UV rays of solar radiation.

3. Define: Air pollution.

- The alterations or changes in the composition of the earth's atmosphere by natural or human activities (anthropogenic factors) are referred as **Air Pollution**.
- Pollutants include of solid, liquid or gaseous substances produced by human or natural activity.

4. How does air pollution affect O₂ transport in human body?

- CO in the atmosphere interferes with O₂ transport since haemoglobin has greater affinity for carbon monoxide.
- At low concentration it causes headache and blurred vision.
- In higher concentration, it can lead to coma and death.

5. Peroxy acetyl nitrate is a type of air pollutant - justify. Write short notes on PAN.

- **Peroxyacetyl nitrate (PAN)** is a secondary pollutant present in photochemical smog.
- It is thermally unstable and decomposes into peroxyethanol radicals and nitrogen dioxide gas.
- Effect: Causing eye irritation.

- 6. Why are outdoor exercisers advised to walk or jog in the mornings in places with ample tree cover?**
- People who exercise outdoors can sometimes be susceptible to adverse effects of air pollution because it involves deeper and faster breathing.
 - Hence it is advisable to walk or jog in the mornings in places with ample tree cover.
- 7. How does air pollution affect cardiovascular system?**
- The Frequent exposure to polluted air increases the risk of cardiovascular diseases.
 - Breathing air that is filled with fine particulate matter can induce hardening of the arteries, triggering cardiac arrhythmia or even a heart attack.
- 8. How is Global warming caused? What effect it causes in sea?**
- **Global warming:** Increase in the concentrations of greenhouse gases such as CO₂, methane, nitrous oxide, CFCs, and ozone causes greenhouse effect,
 - Warming of the earth, resulting in sea level rise, submerging of islands and sea shores of various parts of the world.
- 9. What is Ozone depletion? What is the significance of ozone?**
- Ozone depletion:**
- Thinning of the stratospheric ozone layer.
 - Such depletion causes the 'ozone hole'.
 - Resulting in poor screening of the harmful UV rays and increase in incidences of skin cancer.
 - The agents that deplete ozone are CFCs.
- 10. Write short notes on: Acid rain.**
- Acid rain is a form of precipitation that contains acidic components, such as sulfuric acid or nitric acid.
 - It damages trees, crops and harms marine animals (coral reefs) and induces corrosion
- 11. What is air quality index?**
- **Air Quality Index (AQI)** is a number used by government agencies to communicate to the public how polluted the air is at a given time.
- | AQI | Air pollution level |
|-----------|--------------------------------|
| 0 – 50 | Good |
| 51 – 100 | Moderate |
| 101 – 150 | Unhealthy for sensitive groups |
| 151 – 200 | Unhealthy |
| 201 – 300 | very unhealthy |
| 301 + | Hazardous |
- 12. How is water quality determined?**
- Water quality is commonly defined by its physical, chemical, biological and aesthetic (appearance and smell) characteristics.
 - A healthy environment is one in which the water quality supports a rich and varied community of organisms and protects public health.
- 13. State the effect of water pollution on ecosystems.**
- Ecosystems, especially aquatic systems, can be severely affected or destroyed by water pollution.
 - Water pollutants affect existing niches and habitats and the survival of organisms.
 - Soil fertility is affected and the system becomes uninhabitable.
- 14. What is "4 R"?**
- '4R'- Refuse, Reduce, Reuse and Recycle mantra.
 - It is the best available remedy for plastic waste pollution.

- 15. How does water pollution disrupt the natural food chains as well as food webs in an aquatic ecosystem?**
- Water pollution disrupts the natural food chains as well as food webs.
 - Pollutants such as lead and cadmium are taken up by primary consumers and that can be lethal.
 - When the primary consumers are consumed by secondary consumers, the food chain can get disrupted at any trophic level.
 - Result in enhanced concentration of these pollutants (biomagnification).
 - Hot water from industries when released into the water bodies affects aquatic density and diversity.
- 16. How can we prevent water pollution?**
- Regulate or control of pollutant(s) discharge at the point of generation.
 - Wastewater can be pretreated by scientific methods before discharge to municipal treatment sources.
 - Setting up of Sewage Treatment Plants (**STP**) and Effluent Treatment Plants (**ETP**).
 - Regulate or restrict the use of synthetic fertilisers and pesticides.
 - Public awareness and people's involvement is essential.
- 17. What is noise pollution? How is its intensity measured?**
- Unwanted and undesirable sound that can disrupt one's quality of life is called noise.
 - When there is lot of 'noise' in the environment, it is termed as noise Pollution.
 - The intensity of noise is measured in **decibels** (dB).
- 18. Name the sources of noise pollution.**
- Vehicle engines, air horns, audio video systems, trains, low flying aircrafts, factory machines, sirens, motors, drillers and crushers, compressor machines, crackers, explosives, modern supersonic transports are the common sources of noise pollution.
- 19. What are agrochemicals or agrichemicals?**
- Chemicals which are used in agriculture for growth of plants and pest control are called agrochemicals or agrichemicals.
- 20. What is Eutrophication?**
- When water run - off from land containing nutrients reaches water bodies like lakes, it results in dense growth of plant life. This phenomenon is called **Eutrophication**.
- 21. What is known as Cultural or Accelerated Eutrophication?**
- Pollutants from anthropogenic activities like effluents from the industries and homes can radically accelerate the aging process.
 - This phenomenon is known as **Cultural or Accelerated Eutrophication**.
- 22. Write short notes on organic farming and its implementation.**
- It is a method of farming system.
 - Cultivating the land and raising crops by use of organic wastes (crop, animal and farm wastes, aquatic wastes) and biological materials along with beneficial microbes (biofertilizers).
 - Organic wastes release nutrients to the crops for increased sustainable production in eco - friendly pollution free environment.
 - It keeps the soil alive and in good health.
- 23. What are radioactive wastes?**
- Radioactive wastes are generated during various operations of the nuclear power plant.
 - Radioactive waste can be in gas, liquid or solid form, and its level of radioactivity can vary.
 - These wastes can remain radioactive for a certain time.

Three marks:

1. **Based on the time taken to breakdown into their ingredients, how are the degradable pollutants are classified?**

Rapidly degradable or non-persistent pollutants:

 - Waste that can be broken down by natural processes.
 - **Ex:** Domestic sewage and vegetable waste.

Slowly degradable or persistent pollutants:

 - These pollutants that remain in the environment for many years in an unchanged condition.
 - It takes decades or longer to degrade.
 - **Ex:** DDT

Non-degradable pollutants:

 - These cannot be degraded by natural processes.
 - Once they are released into the environment, they are difficult to be eliminated and continue to accumulate (biomagnification).
 - **Ex:** Lead, Mercury, Cadmium, Chromium and Nickel.
2. **Name the sources of air pollution.**
 - **Transport sources** – cars, buses, airplanes, trucks, train
 - **Stationary sources** – power plants, incinerators, oil refineries, industrial facilities, and factories
 - **Area sources** – agricultural - wood / stubble burning, fireplaces
 - **Natural sources** – wind-blown dust, wildfires, volcanoes.
3. **How can we control air pollution?**
 - Trees are the best remedy for urban particulate and gaseous pollution.
 - Forests act as carbon sinks and lungs of the planet.
 - Catalytic converters in vehicles help to reduce polluting gases drastically.
 - Diesel exhaust filters in automobiles cuts particulates.
 - Electrostatic precipitators reduce release of industrial pollutants.
 - Cost effective air pollution treatment systems like indoor plants and high performance biofilters can improve indoor air quality.
4. **What are point and non-point sources of water?**

Point sources:

 - Discharge of pollutants at specific locations through pipelines or sewers into the water body.
 - **Ex:** Factory effluents, sewage, underground mines, oil wells, oil tankers and agriculture.

Non-point sources:

 - Sources that cannot be traced to a single site of discharge.
 - **Ex:** Acid rain, dumping of the plastics in water bodies, agriculture chemical run off.
5. **How can we prevent noise pollution?**
 - Planting trees in and around noise sources.
 - plants are known to absorb noise and bring down sound levels.
 - Regular servicing and tuning of automobile engines can reduce noise pollution by vehicles and machinery.
 - Workers should be provided with ear plugs and earmuffs at work sites that generate high noise levels.
 - Lubrication of machinery and regular servicing minimizes noise levels.
 - Usage of loudspeakers in crowded areas and public places should be avoided.

6. Give an account of Legal protection on Noise pollution.

- Article 48-A and Article 51-A of the Constitution of India, Noise Pollution (Regulation and Control) Rules 2000.
- Tamil Nadu State Environment Policy 2017 is some of the legal relief from noise pollution.
- According to Noise Pollution (Regulation and Control) Rules, 2000, the permissible limit of noise in areas categorized as commercial is 65 decibels (dB) during day and 55 dB during night.

7. Compare oligotrophic and stage mesotrophic stage in Eutrophication.

- **Oligotrophic stage:** Natural aging of lakes also leads to nutrient enrichment of its water. In a lake, the water is cold and clear (**oligotrophic stage**), supporting little life.
- **Mesotrophic stage:** streams draining into the lake introduce nutrients such as nitrates and phosphates, which encourage the growth of aquatic organisms. Aquatic plants and animal life grow rapidly, and organic remains begin to be deposited on the lake bottom.

8. Enumerate the steps taken by the central government in controlling air pollution.

- Prevention and Control of Pollution **Act** was enacted in 1981 and amended in 1987 for the prevention, control and abatement of Air pollution in India.
- Traffic Emissions Standards: The Government has decided to enforce Bharat Stage VI norms from 2020.
- The Green Bench and the National Green Tribunal (NGT) give judicial safeguard to environmental protection.

Five marks:**1. Enumerate the steps taken by the state governments in controlling air pollution.**

- Road traffic rationing, encourage public transport, carpooling.
- Increase green cover alongside roads (planting avenue trees).
- Promoting Swachh Bharat Abhiyan.
- Enactment and Enforcement of stricter environmental laws.
- Maintenance of air standards by proper enforcement and monitoring.
- Reducing carbon emissions.
- Encourage use of renewable energy
- Limiting the sale of firecrackers and developing eco-friendly crackers.
- Make Environmental Impact Assessment mandatory.

2. Explain the effects of water pollution on organisms.

- Water pollution can be lethal to aquatic organisms and others that depend on these water bodies.
- Accidental oil spills from tanker ships can cause substantial environmental damage.
- Oil spreads on the water surface, prevents the entry of light and oxygen into the water.
- This increases BOD and COD, resulting in mass death of organisms and degradation of water quality.
- It also clogs fish gills and the feathers of aquatic birds.
- Humans and other organisms can get affected by diseases such as hepatitis and typhoid by consuming contaminated water and food.
- Excess of fluoride in drinking water causes fluorosis.
- In many poor nations, outbreak of water borne diseases and epidemics are a result of contaminated water and poor or absence of water treatment processes.
- Water pollution can cause eutrophication due to nutrient enrichment.
- This causes algal blooms which affect the quality of water bodies.
- Red tides, if occur, can be lethal to aquatic organisms.

3. Describe the preventive measures taken for water pollution.

- Right to clean water is a fundamental right under the Indian Constitution.
- Water (Prevention and Control of Pollution) Act, 1974, sections 17 to 40 prohibit the pollution of a stream or well by disposal of polluting matter.
- The Central / State Pollution Control Boards have the power to advise the central/state government on various matters concerned with the prevention and control of pollution of water.
- The Ministry of Environment, Forest and Climate Change (MoEFCC) is the nodal agency of the Central Government for the planning, promotion, co-ordination and for overseeing the implementation of India's environmental and forestry policies and programmes.

4. State the harmful effects of overuse of Agrochemicals.

- Overuse of agrochemicals have been observed to generate residues that cause nutrient imbalance, and May kill beneficial bacteria and soil organisms.
- Can cause eutrophication in water bodies.
- Affect aquatic animals and their productivity.
- Pesticide containing water, even in trace quantities is unfit for human consumption.
- Particles (aerosols) and residues of these chemicals cause air pollution.
- Inhalation of contaminated air can cause respiratory problems.
- Consumption can lead to poisoning, side effects and after effects.
- Chemicals can cause skin rashes and irritation of eyes.
- Many of these chemicals are reported to be carcinogenic.
- They can trigger hormonal disorders and neurotoxicity.
- Beneficial insects and animals can be affected.

5. Explain the Methods of disposal of radioactive wastes.**Limit generation:**

- Limiting the generation of waste is the first and most important consideration in managing radioactive wastes.

Dilute and disperse:

- For wastes having low radioactivity, dilution and dispersion are adopted.

Delay and decay:

- Delay and decay is frequently an important strategy because much of the radioactivity in nuclear reactors and accelerators is very short lived.

Concentrate and confine process:

- Concentrating and containing is the objective of treatment activities for longer-lived radioactivity.
- The waste is contained in corrosion resistant containers and transported to disposal sites.
- Leaching of heavy metals and radionuclides from these sites is a problem of growing concern.

6. Explain the control and management of radioactive wastes.**Three ways are employed to manage nuclear wastes:****Spent Fuel Pools:**

- The spent fuel discharged from the reactors is temporarily stored in the reactor pool.
- The Spent fuel rods are used in stored cooling ponds.
- They protect the surroundings from radiation and absorb the heat generated during radioactive decay.

Vitrification method:

- This prevents reaction or degradation of nuclear waste for extended periods of time and encased in dry cement caskets.

Geological Repositories:

- A deep geological repository is a nuclear waste repository excavated deep within a stable geologic environment.

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- It is suited to provide a high level of long-term isolation and containment without future maintenance.
- In India at Tarapur and Kalpakkam, a wet storage facility of Spent Fuel is the main mode of storage.

7. List the major sources of solid waste.

Waste category	Source
Residential	Food wastes, plastics, paper, glass, leather, cardboard, metals, yard wastes, ashes, tires, batteries, old mattresses
Industrial	Packaging wastes, ashes, chemicals, cans, plastics, metal parts
Commercial	Thin and thick plastics, food wastes, metals, paper, glass, wood, cardboard materials
Institutional	Wood, paper, metals, cardboard materials, electronics
Construction and Demolition	Steel materials, concrete, wood, plastics, rubber, copper wires, dirt and glass.
Agriculture	Agricultural wastes, spoiled food, pesticide containers
Biomedical	Syringes, bandages, used gloves, catheter, urine bags, drugs, paper, plastics, food wastes, sanitary napkins and diapers, chemicals.
E-waste	Electronic items like used TVs, transistors, tape recorders, computer cabinets, mother boards, CDs, cassettes, mouse, wires, cords, switches., chargers.

8. What is electronic waste or e-waste? List the major components of e – waste.

- Electronic waste or e-waste: Discarded electrical electronic devices, any refuse created by discarded electronic devices and components and substances involved in their manufacture or use.
- Their disposal is a growing problem because electronic equipment frequently contains hazardous substances.
- Personal computer - Lead (Pb) in the cathode ray tube (CRT) soldering compound,
- Mercury (Hg) in switches and housing,
- Cobalt (Co) in steel components, among other equally toxic substances.
- E-wastes are basically PCB (Polychlorinated biphenyl) based, which are non-degradable.

9. What are Plastic Wastes? What are the Solutions and Remedies for disposal of plastic waste?

- Plastics are low molecular weight organic polymers that are non-degradable in the natural environment.
- They are used in several items, including cars, bulletproof vests, toys, hospital equipment, carry bags and food containers.
- Packaging materials used in supermarkets, retail outlets, manufacturing industries, households, hotels, hospitals, restaurants and transport companies are major contributors to plastic waste generation.
- Plastic waste constitutes a major part of municipal solid waste.
- **Remedies:** '4R'- Refuse, Reduce, Reuse and Recycle mantra is the best available remedy for plastic waste pollution.

10. What is eutrophication? Explain the different types.

- When run-off from land containing nutrients reaches water bodies like lakes, it results in dense growth of plant life is called Eutrophication.

Oligotrophic stage:

- Natural aging of lakes also leads to nutrient enrichment of its water.
- In a lake, the water is cold and clear supporting little life.

Mesotrophic stage:

- The streams draining into the lake introduce nutrients such as nitrates and phosphates, which encourage the growth of aquatic organisms.
- Aquatic plants and animal life grow rapidly,
- And organic remains begin to be deposited on the lake bottom.

Cultural or Accelerated Eutrophication.

- Pollutants from anthropogenic activities like effluents from the industries.
- And homes can radically accelerate the aging process.

Effects of eutrophication:

- Nutrients stimulate the growth of algae, water hyacinth and can cause clogging of canals, rivers and lakes as well as, displacing native plants.
- It causes unsightly foam and unpleasant odours, and deprives the water of dissolved oxygen.

11. Explain wastewater treatment**The main objective of a wastewater treatment:**

- To reduce organic and inorganic components in wastewater.
- No longer supports microbial growth.
- Eliminate other potentially toxic materials.
- Microorganisms in treatment of sewage to make it harmless: Bacteria and some protozoa.
- Bacteria in sewage water destroyed and prevent the spread of diseases.

Three stages Sewage treatment.**Primary treatment: (filtration and sedimentation):**

- It involves the physical removal of solid and particulate organic and inorganic materials from the sewage.
- Floating debris is removed by sequential filtration.
- Then the grit (soil and small pebbles) are removed by sedimentation.
- All solids that settle form the primary sludge and the supernatant forms the effluent.
- The effluent from the primary settling tank is taken for secondary treatment.

Secondary treatment or biological treatment: (Aerobic)

- The primary effluent is passed into large aeration tanks.
- Then it is constantly agitated mechanically and air is pumped into it.
- This allows vigorous growth of useful aerobic microbes into floc (masses of bacteria associated with fungal filaments to form mesh like structures).
- While growing, these microbes consume the major part of the organic matter in the effluent.
- This significantly reduces the BOD (Biochemical oxygen demand or Biological oxygen demand).

BOD:

- BOD refers to the amount of the oxygen that would be consumed by bacteria, if all the organic matter were oxidized in one litre of water.
- The sewage water is treated till the BOD is reduced.
- The greater the BOD of the waste water more is its polluting potential.

Secondary treatment or biological treatment: (Anaerobic)

- Once the BOD of sewage water is reduced significantly, the effluent is then passed into a settling tank where the bacterial “flocs” are allowed to sediment.
- This sediment is called activated sludge.
- A small part of activated sludge is pumped back into the aeration tank to serve as the inoculum.

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- The remaining major part of the sludge is pumped into anaerobic sludge digesters.
- Here, the bacteria grow anaerobically, digest the bacteria and the fungi in the sludge.
- During this digestion, bacteria produce a mixture of gases such as methane, hydrogen sulphide and CO₂.
- These gases form biogas and can be used as a source of energy.

Tertiary treatment:

- Tertiary treatment is the final process.
- It improves the quality of the waste water before it is reused, released into natural water bodies.
- This treatment removes the remaining inorganic compounds and substances, such as nitrogen and phosphorus.

UV treatment:

- UV is an ideal disinfectant for wastewater since it does not alter the water quality.
- Inactivating microorganisms.
- UV is a chemical free process that can completely replace the existing chlorination system.
- Inactivates chlorine-resistant microorganisms like *Cryptosporidium* and *Giardia*.

12. What medical waste? Describe management and disposal of biomedical waste.

- Waste that contains infectious material and generated by hospitals, laboratories, medical research centers, pharmaceutical companies and Veterinary clinics.
- Medical wastes contain body fluids like blood, urine, body parts and other contaminants, culture dishes, glassware, bandages, gloves, discarded needles, scalpels, swabs and tissues.

Management:

- The safe and sustainable management of biomedical waste is the social and legal responsibilities of people working in healthcare centers.

Waste disposal:

- Involved by incineration, chemical disinfection, autoclaving, encapsulation, microwave irradiation are methods of waste disposals.
- Final disposal includes landfill and burying as per norms inside premises.

13. Explain the other notable effects of Air Pollution.**Smog:**

- It is a type of air pollution caused by tiny particles in the air.
- It is mixture of the words smoke and fog
- Smog can make breathing more difficult, especially for people with asthma.
- Smog also affects plants and animals.
- Smog has also been known to cause corrosive damage to buildings and vehicles.

Peroxyacetyl nitrate (PAN):

- It is a secondary pollutant present in photochemical smog.
- It is thermally unstable and decomposes into peroxyethanol radicals and nitrogen dioxide gas causing eye irritation.

Global warming:

- Increase in the concentrations of greenhouse gases such as CO₂, methane, nitrous oxide, CFCs, and ozone.
- It causes greenhouse effect and warming of the earth resulting in sea level rise, submerging of islands and various parts of the world.

Ozone depletion:

- Thinning of the stratospheric ozone layer.
- Resulting in poor screening of the harmful UV rays and increase in skin cancer.
- Some of the common agents that deplete ozone are CFCs.

Acid rain:

- Acid rain: it is a form of precipitation that contains sulphuric acid or nitric acid.
- It damages trees, crops and harms marine animals (coral reefs) and induces corrosion.