CAREERS 360

PRACTICE Series

UP Board Class 12

Biology

Previous Year Questions with Detailed Solution

UP Board Class 12 Biology Question with Solution- 2024

1. Choose the correct option and write in your answer-book :
a) Which nitrogenous base is not present in D.N.A. ?
i) Thymine
ii) Uracil
iii) Adenine
iv) Guanine

Answer:

(ii) **Uracil**

b) How many contrasting characters are included by Mendel in his experiment?
i) 7
ii) 8
iii) 9
iv) 10

Answer:

(i) **7**

c) Sickle cell anaemia is an example of which mutation ?
i) Point mutation
ii) Euploidy
iii) Deletion
iv) Translocation

Answer:

(i) **Point mutation**

d) Pollen grains are formed in which organ of flower ?
i) Microsporangium
ii) Gynoecium
iii) Megasporangium
iv) Ovary

Answer:

(i) **Microsporangium**

2. a) Which organism is responsible for the spread of malaria discase ?

Answer:

The organism responsible is the **female Anopheles mosquito**.

b) Write down the full form of P.C.R.

Answer:

The full form of P.C.R. is **Polymerase Chain Reaction**.

c) Write down the name of any one transgenic animal.

Answer:

One example of a transgenic animal is the **"Dolly" sheep**.

d) Coloured attractive corolla of flower is suitable for which type pollination?

Answer:

Coloured and attractive corolla is suitable for **insect pollination (Entomophily)**.

e) What is the term used for green plants in ecosystem terminology ?

Answer:

Green plants are referred to as **producers** or **autotrophs** in ecosystem terminology.

3. a) Define decomposition.

Answer:

Decomposition is the process by which organic substances are broken down into simpler organic or inorganic matter, such as carbon dioxide, water, and nutrients. It is carried out by decomposers like bacteria, fungi, and other microorganisms that break down dead plants and animals, recycling nutrients back into the ecosystem.
b) Write down the names of any two fermented beverages.

Answer:

1. **Wine**
2. **Beer**

c) Write a note on test tube baby programme.

Answer:

The **test tube baby programme** refers to the process of **In Vitro Fertilization (IVF)**, where an egg is fertilized outside the woman's body in a laboratory. The fertilized egg (zygote) is then cultured for a few days and later implanted into the woman's uterus, where it can develop into a baby. This technique is used for couples who have difficulties conceiving naturally due to fertility issues.
d) Give two differences between homozygous and heterozygous.

Answer:

Homozygous	Heterozygous

Contains two identical alleles for a gene (e.g., AA or aa).	Contains two different alleles for a gene (e.g., Aa).
Exhibits the same trait, either dominant or recessive.	Exhibits the dominant trait if one allele is dominant.

e) Write two functions of Ribosomes.

Answer:

1. **Protein Synthesis:** Ribosomes are responsible for synthesizing proteins by translating messenger RNA (mRNA) into amino acid sequences.
2. **Polypeptide Chain Formation:** They facilitate the binding of transfer RNA (tRNA) and ensure the correct assembly of polypeptide chains, which later fold into functional proteins.

4 (Short Answer Type Queations-II)

a) Write a short note on polyembryony.

Answer:

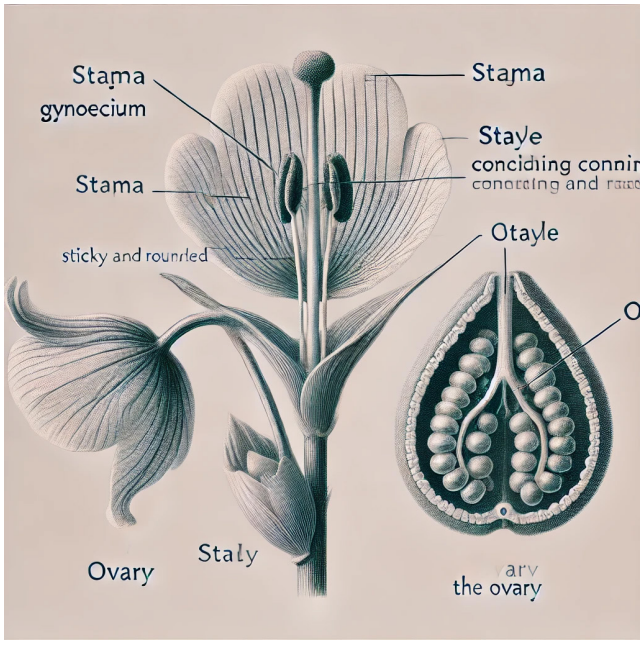
Polyembryony refers to the phenomenon where two or more embryos develop from a single fertilized egg (zygote). This process can occur naturally in certain animals (e.g., armadillos) and plants (e.g., citrus). In plants, polyembryony can lead to the production of multiple seedlings from a single seed, and in animals, it can result in identical offspring. It can be either **cleavage polyembryony** (splitting of the embryo) or **adventive polyembryony** (additional embryos arising from the nucellus or integuments of the seed).

b) Draw the three organs of Gynoecium with diagrams.

Answer:

The **gynoecium** is the female reproductive part of a flower, consisting of three main organs:

1. **Stigma:** The sticky top part that receives pollen grains.
2. **Style:** The slender stalk that connects the stigma to the ovary.
3. **Ovary:** The basal part that contains ovules, which develop into seeds after fertilization



c) Write down the names of three accessory glands of male sex organ.

Answer:

1. **Seminal Vesicles**
2. **Prostate Gland**
3. **Bulbourethral (Cowper's) Glands**

These glands secrete fluids that nourish and protect sperm, and they contribute to the formation of semen.

d) Differentiate between primary productivity and secondar productivity.

Answer:

Primary Productivity	Secondary Productivity
Refers to the rate at which plants (autotrophs) convert solar energy into chemical energy through photosynthesis.	Refers to the rate at which heterotrophs (consumers) convert the organic material they consume into their own biomass.
Involves the production of organic matter at the base of the food chain (producers).	Involves the generation of biomass at higher trophic levels (consumers).
Measured as Gross Primary Productivity (GPP) and Net Primary Productivity (NPP).	Only involves Net Secondary Productivity, which is the growth of consumers.

5. a) Explain natural selection with an example.

Answer:

Natural selection is the process by which organisms better adapted to their environment tend to survive and produce more offspring. This concept was introduced by Charles Darwin as a key mechanism of evolution. Over time, beneficial traits become more common in a population, while less advantageous traits may disappear.

Example:
The classic example of natural selection is the **peppered moth** during the Industrial Revolution in England. Before industrialization, the light-colored moths were more common because they could blend into the light-colored trees, avoiding predators. However, as industrial pollution darkened the trees, the darker moths had a survival advantage, leading to an increase in their population. This change in the population's color distribution was a result of natural selection.

b) Explain the functions of restriction enzyme.

Answer:

Restriction enzymes (also known as restriction endonucleases) are proteins that cut DNA at specific nucleotide sequences. These enzymes are naturally found in bacteria, where they serve as a defense mechanism against viral DNA by cutting it into nonfunctional pieces.

Functions of Restriction Enzymes:

1. **DNA Cutting:** They recognize specific palindromic sequences in DNA and make precise cuts, generating fragments with sticky or blunt ends.
2. **Genetic Engineering:** They are widely used in molecular biology for cutting DNA into fragments, which can be recombined to create recombinant DNA, such as inserting genes into plasmids.
3. **DNA Mapping:** Restriction enzymes help in genetic mapping by cutting DNA into manageable fragments for analysis in techniques like gel electrophoresis.

c) Write a note on adaptive radiation.

Answer:

Adaptive radiation is the process by which a single ancestral species rapidly diversifies into many different species, each adapted to a specific ecological niche. This occurs when organisms colonize new environments with diverse conditions or after an extinction event creates new opportunities for survival.

Example:
The **Darwin's finches** on the Galápagos Islands are a well-known example. From a common ancestor, the finches evolved into different species with varying beak shapes and sizes, each suited to different food sources like seeds, insects, or nectar.

d) Comment on Parthenocarpic fruits.

Answer:

Parthenocarpic fruits are fruits that develop without fertilization, meaning they do not contain seeds. This phenomenon can occur naturally or be induced artificially through the application of plant hormones like auxins.

Examples:
Common parthenocarpic fruits include **bananas**, **seedless grapes**, and **seedless watermelons**. These fruits are desirable in agriculture because they are easier to consume without seeds, and they

often have longer shelf lives.

Significance:
Parthenocarpy is beneficial for producing seedless varieties of fruits and ensures fruit production in conditions where pollination is inadequate or inconsistent.

6. a) Define the divergent evolution with example.

Answer:

Divergent evolution is the process by which two or more species evolve in different directions from a common ancestral species, leading to a diversity of traits. Over time, these species accumulate differences due to adaptation to different environments or ecological niches, resulting in distinct species.

Example:
A classic example of divergent evolution is the evolution of **Darwin's finches**. From a common ancestral species, different species of finches evolved on the Galápagos Islands with varying beak shapes and sizes, adapted to different food sources such as seeds, insects, and nectar.

b) Write a short note on t-RNA.

Answer:

t-RNA (transfer RNA) is a type of RNA molecule that plays a crucial role in the process of translation during protein synthesis. Its primary function is to carry amino acids to the ribosome, where they are assembled into proteins according to the sequence of codons in the messenger RNA (mRNA).

- **Structure:** t-RNA has a cloverleaf structure with three key regions:
1. The **anticodon loop** that recognizes and binds to the complementary codon on the mRNA.
2. The **amino acid attachment site** at the 3' end where the specific amino acid is attached.
- **Function:** It decodes the genetic information carried by mRNA and facilitates the addition of the correct amino acid to the growing polypeptide chain.

c) Define the opioid drugs with an example.

Answer:

Opioid drugs are a class of drugs that act on opioid receptors in the brain and body to produce pain relief, euphoria, and sedation. These drugs are derived from the opium poppy plant or synthesized chemically. Opioids are often prescribed for managing severe pain but can be addictive and prone to misuse.

Example:
Morphine is a commonly used opioid drug for pain relief, especially after surgery or for chronic pain conditions. Other examples include **heroin**, **codeine**, and **oxycodone**

d) Draw different trophic levels in an ecosystem with line diagram.

Answer:

Each level represents a stage in the food chain:

- **Producers:** Autotrophic organisms like plants and algae that produce energy through photosynthesis.
- **Primary Consumers:** Herbivores that eat producers.

- **Secondary Consumers:** Carnivores that eat herbivores.

7. Write an essay on the importance of Biotechnology in Agriculture.

Answer:

Introduction: Biotechnology in agriculture refers to the use of scientific techniques, including genetic engineering, to modify plants, animals, and microorganisms to enhance agricultural productivity, sustainability, and efficiency. This field has revolutionized modern farming, allowing for improved crop varieties, pest-resistant plants, and more efficient farming practices.

Key Importance of Biotechnology in Agriculture:

1. **Improved Crop Yield and Quality:** Biotechnology enables the development of genetically modified (GM) crops that produce higher yields and better-quality produce. These crops can withstand harsh environmental conditions like drought, salinity, and extreme temperatures, ensuring food security in regions facing climatic challenges.

2. **Pest and Disease Resistance:** Through genetic engineering, scientists have created crops resistant to pests and diseases. For example, **Bt cotton** and **Bt maize** are genetically modified to produce a toxin that repels or kills certain insects. This reduces the need for chemical pesticides, which benefits the environment and reduces production costs for farmers.

3. **Herbicide Tolerance:** Biotechnology has also led to the development of crops that can tolerate specific herbicides. Farmers can apply herbicides to eliminate weeds without harming the crops. **Roundup Ready** crops, for example, are engineered to tolerate glyphosate, a common herbicide.

4. **Nutritional Enhancement:** Biotechnology can enhance the nutritional content of crops, addressing malnutrition in developing countries. A famous example is **Golden Rice**, which has been engineered to contain higher levels of Vitamin A, potentially helping to combat vitamin A deficiency in regions where rice is a staple food.

5. **Environmental Sustainability:** By reducing the reliance on chemical fertilizers, pesticides, and herbicides, biotechnology promotes environmentally sustainable farming. Genetically engineered crops often require fewer inputs, thus reducing the environmental impact of agriculture.

6. **Faster Breeding Techniques:** Traditional plant breeding is time-consuming. Biotechnology accelerates the process by allowing scientists to introduce desired traits directly into the plant's genome. This helps in rapidly addressing food production challenges posed by population growth and climate change.

Challenges: Despite its many advantages, the use of biotechnology in agriculture has sparked ethical debates and concerns about the long-term environmental impact, potential allergenicity of GM foods, and the dominance of biotech companies in agriculture. However, with proper regulations and responsible use, biotechnology holds immense potential to meet the world's growing food demand.

Conclusion: Biotechnology in agriculture is a powerful tool for improving food security, reducing environmental impact, and enhancing the nutritional value of food. By continuing to develop and refine biotechnological methods, farmers and scientists can work together to build a more sustainable and productive agricultural system for the future.

8. What is cancer? Describe the causes and treatment of cancer in detail.

Answer:

Cancer is a disease characterized by the uncontrolled growth and spread of abnormal cells. If these cells are not controlled, they can invade surrounding tissues or spread to other parts of the body through the blood and lymph systems.

Causes of Cancer:

1. **Genetic Mutations:** Changes in the DNA of cells can lead to mutations that cause cancer. These mutations can be inherited or acquired due to exposure to carcinogens.

2. **Carcinogens:** Substances like tobacco smoke, asbestos, and certain chemicals can cause mutations that lead to cancer. Prolonged exposure to ultraviolet (UV) radiation and certain infections (e.g., human papillomavirus) can also lead to cancer.

3. **Lifestyle Factors:** Unhealthy habits such as smoking, excessive alcohol consumption, and poor diet can increase the risk of cancer. Obesity and lack of physical activity are also linked to higher cancer risk.

4. **Environmental Factors:** Exposure to pollutants, radiation, and toxic chemicals in the environment can contribute to the development of cancer.

Treatment of Cancer:

1. **Surgery:** Surgery involves the removal of cancerous tumors or tissues. It is most effective when the cancer has not spread to other parts of the body.

2. **Radiation Therapy:** This treatment uses high-energy radiation to kill cancer cells or shrink tumors. It can be used alone or in combination with other treatments like surgery and chemotherapy.

3. **Chemotherapy:** Chemotherapy involves the use of drugs to kill or inhibit the growth of cancer cells. It is often used to treat cancers that have spread throughout the body.

4. **Immunotherapy:** This treatment boosts the body's immune system to recognize and destroy cancer cells more effectively.

5. **Targeted Therapy:** Targeted therapy involves drugs or other substances that specifically target cancer cells without affecting normal cells. These therapies block the growth and spread of cancer by interfering with specific molecules involved in cancer growth.

6. **Hormone Therapy:** Hormone therapy is used to treat cancers that are sensitive to hormones, such as breast and prostate cancers. It involves blocking the body's ability to produce certain hormones or interfering with the action of hormones.

Conclusion: While cancer remains a leading cause of death worldwide, advances in early detection, treatment methods, and prevention strategies have significantly improved survival rates. Research continues to explore new treatments and ways to prevent cancer.

9. Write an essay on human evolution.

Answer:

Human evolution refers to the biological and cultural development of Homo sapiens, the species to which all modern human beings belong. It is a process that took millions of years, involving the gradual development of traits like bipedalism, larger brain size, and complex social structures.

Key Stages of Human Evolution:

1. **Australopithecus (4 to 2 million years ago):** Early human ancestors like **Australopithecus afarensis** (famously represented by "Lucy") were bipedal but had smaller brains. They lived primarily in Africa and represent the early stages of walking upright.

2. **Homo habilis (2.4 to 1.4 million years ago):** Homo habilis is known as the "handy man" because of its ability to make simple stone tools. This species had a slightly larger brain and marked the beginning of the genus Homo.

3. **Homo erectus (1.9 million years to 110,000 years ago):** Homo erectus was the first to use fire and create more advanced tools. They had a larger brain size and migrated out of Africa to Europe and Asia, marking a significant step in human evolution.

4. **Homo neanderthalensis (400,000 to 40,000 years ago):** Neanderthals were closely related to modern humans and adapted to colder climates. They had a robust build, used advanced tools, and exhibited signs of cultural behavior such as burying their dead.

5. **Homo sapiens (200,000 years ago to present):** Modern humans, **Homo sapiens**, first appeared in Africa and eventually spread across the globe. They have the largest brain size relative to body size and exhibit complex social structures, language, art, and technology.

Factors Contributing to Human Evolution:

- **Bipedalism:** Walking on two legs allowed early humans to free their hands for tool use and to travel efficiently.
- **Brain Size:** The increase in brain size over time enabled the development of language, problem-solving, and cultural practices.
- **Tool Use:** The ability to create and use tools for hunting and gathering allowed humans to survive in a variety of environments.
- **Social Structures:** The development of complex social structures

UP Board Class 12 Biology Question with Solution - 2023

(Multiple Choice Type Questions)

1. Choose the correct option and write in your answer-book :

a) In Vallisneria, the pollination occurs by means of

i) Water

ii) Air

iii) Insects

iv) Human beings.

Answer:

i) Water

b) Menstrual cycle in women typically occurs in

i) 10-11 days

ii) 28-29 days

iii) $25-26$ days

iv) 17 days.

Answer:

ii) 28-29 days

c) The process of protein synthesis with the help of m-RNA is called

i) Translation

ii) Transcription

ii) Reverse transcription

iv) Replication.

Answer:

i) Translation

d) Widal test is used for the diagnosis of which disease ?

i) Preumonia

ii) Typhoid

iii) Malaria

iv) Cholera.

Answer:

ii) Typhoid

(Definite Answer Type Questions)

2. a) Define the biodiversity hotspot.

Answer:

A biodiversity hotspot is a region that is rich in endemic species and has experienced significant habitat loss. These areas are critical for conservation efforts because they are home to a high number of species that are found nowhere else in the world but are also under threat from human activities.
b) Which vitamin is abundantly found in Golden rice?

Answer:

Golden rice is genetically engineered to be rich in **Vitamin A** (specifically, provitamin A or beta-carotene).
c) What is the function of Sertoli cells in human testis ?

Answer:

Sertoli cells, found within the seminiferous tubules of the testis, provide nourishment and support to developing sperm cells during spermatogenesis. They also create the blood-testis barrier and release inhibin, which regulates the production of sperm.
d) How many pairs of chromosomes are found in human beings ?

Answer:

Humans have **23 pairs** of chromosomes, for a total of 46 chromosomes.
e) Who discovered Penicillin ?

Answer:

Sir Alexander Fleming discovered Penicillin in 1928.

(Very Short Answer Type Questions)

3 a) What do you mean by medical termination of pregnancy (MTP)?

Answer:

Medical Termination of Pregnancy (MTP) refers to the intentional ending of a pregnancy through medical or surgical procedures. MTP is typically performed to safeguard the health of the mother, in cases of fetal abnormalities, or when pregnancy results from rape or contraceptive failure. MTP is legal in many countries under certain conditions and time frames.

b) If the sequence of Nitrogenous bases in one strand of DNA-helix is $5'$-ATGCATGCATGCATGCATGC-$3'$ then what will be the sequence of nitrogenous bases in complementary strand of that DNA helix in $3^t \rightarrow 5'$ direction ?

Answer:

Given strand:

$$5' - \text{ ATGCATGCATGCATGCATGC } - 3'$$

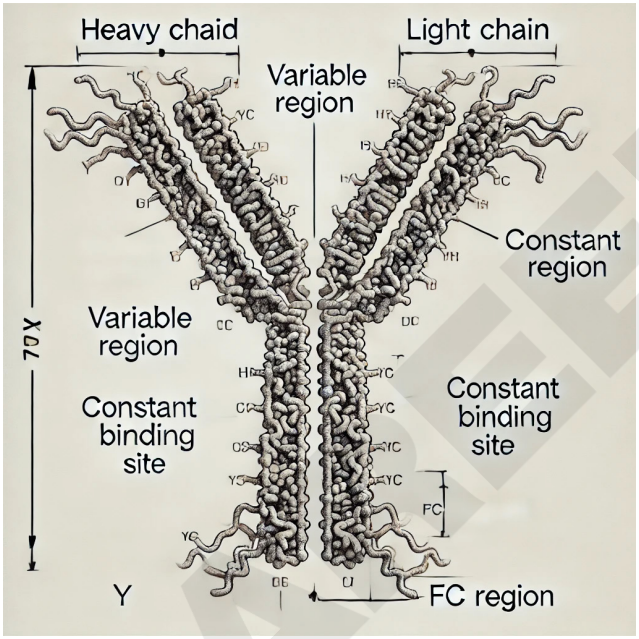
Complementary strand (in the $3'$ to $5'$ direction):

$$3' - \text{ TACGTACGTACGTACGTACG } - 5'$$

This shows the complementary base pairing between the two strands of DNA.

c) Draw only labelled dingram of a single antibody molecule.

Answer:



d) What is Heroin (Morphine) ? This is obtained from which plant?

Answer:

Heroin is a narcotic drug derived from morphine, which is an opioid. It is a potent, illegal drug with highly addictive properties and is used recreationally for its euphoric effects. Morphine is obtained from the **opium poppy plant** (*Papaver somniferum*).

c) What do you mean by central dogma of Molecular Biology ?

Answer:

The central dogma of molecular biology describes the flow of genetic information within a biological system. It explains that DNA is transcribed into RNA, and RNA is then translated into proteins. The process can be summarized as:

DNA → RNA → Protein.
This concept illustrates how genetic information encoded in DNA is used to synthesize functional proteins that perform various biological roles.

(Short Answer Type Questions)

4. a) Write short notes on Lichen and Mycorrhiza.

Answer:

- **Lichen:**
  Lichens are symbiotic associations between a fungus and a photosynthetic partner, usually algae or cyanobacteria. The fungus provides structural support, water, and mineral absorption, while the algae or cyanobacteria produce organic compounds through photosynthesis. Lichens are important bioindicators of environmental health and are often found in harsh environments, such as on rocks or tree bark.

- **Mycorrhiza:**
  Mycorrhiza refers to the symbiotic relationship between fungi and plant roots. In this mutualistic association, the fungus helps the plant absorb water and nutrients, particularly phosphorus, while the plant supplies the fungus with carbohydrates produced during photosynthesis. Mycorrhizae improve soil health and plant growth, and they are common in forests and grasslands.

b) What is codominance? Explain with example.

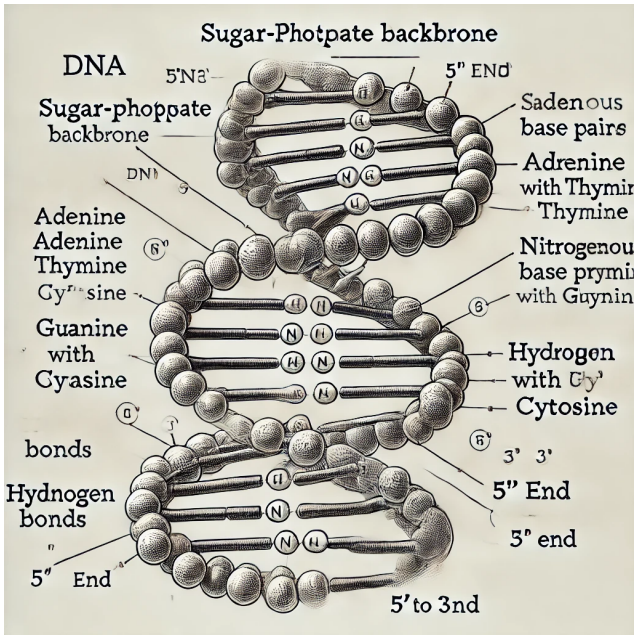
Answer:

Codominance is a form of inheritance in which both alleles of a gene in a heterozygous individual are fully expressed without blending. In codominance, the effects of both alleles are visible in the phenotype.

Example:
A classic example of codominance is seen in **ABO blood groups** in humans. Individuals with genotype **IAIB** have both A and B antigens expressed on the surface of their red blood cells, resulting in the AB blood type. Both A and B alleles are equally expressed, showing codominance

c) Draw only labelled diagram of a DNA doubble helix structure.

Answer:



d) What do you understand by transcription? Describe it.

Answer:

Transcription is the process by which the genetic information encoded in a DNA sequence is copied into a complementary RNA molecule. This is the first step in gene expression, where a segment of DNA serves as a template to synthesize messenger RNA (mRNA).

Steps of Transcription:

1. **Initiation:** RNA polymerase binds to the promoter region of the gene, unwinding a small portion of the DNA.

2. **Elongation:** RNA polymerase moves along the template strand of DNA, synthesizing mRNA by adding complementary RNA nucleotides (A pairs with U, G pairs with C).
3. **Termination:** When the RNA polymerase reaches a termination sequence, the mRNA strand is released, and the DNA double helix re-forms.
4. **Processing (in eukaryotes):** The pre-mRNA undergoes splicing to remove introns, and a 5' cap and poly-A tail are added to form mature mRNA, which can then be translated into a protein.

5. a) What is endosperm ? Describe the process of its development and functions.

Answer:

Endosperm is a tissue produced inside the seeds of most flowering plants after fertilization. It provides nutrition to the developing embryo in the form of starch, though it can also contain proteins and oils.

Process of Development: Endosperm development typically occurs after the fertilization of the egg and central cell in the ovule. The process can be divided into the following steps:

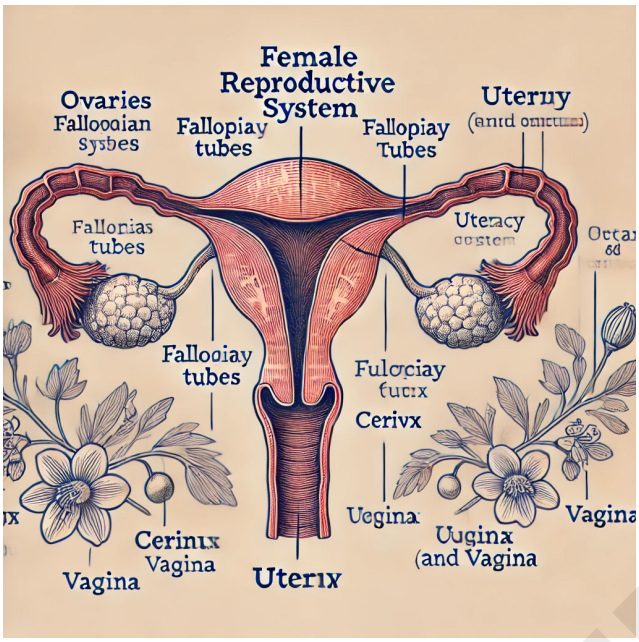
1. **Double Fertilization:** In flowering plants, one sperm fertilizes the egg cell to form a zygote (which becomes the embryo), and another sperm fertilizes the central cell (containing two polar nuclei) to form the triploid (3n) primary endosperm nucleus.
2. **Division of Endosperm:** The primary endosperm nucleus undergoes multiple divisions to form the endosperm tissue. There are three main types of endosperm development:
   - **Nuclear Type:** Free nuclei are formed first, followed by cell wall formation.
   - **Cellular Type:** Cell walls form immediately after the first division.
   - **Helobial Type:** An intermediate stage between nuclear and cellular types.

Functions of Endosperm:

- Provides nourishment to the developing embryo.
- Serves as a food reserve for the seedling after germination.
- Contains vital nutrients such as starch, oils, and proteins for plant growth.

b) Draw a labelled line diagram of women's reproductive system.

Answer:



c) Define sex linked inheritance. Explain it with haemophilia and colourblindness.

Answer:

Sex-linked inheritance refers to the pattern of inheritance for genes that are located on the sex chromosomes (X or Y). In humans, most sex-linked traits are associated with genes located on the X chromosome, as it contains more genes than the Y chromosome.

- **Haemophilia:**
  Haemophilia is a recessive X-linked disorder where the blood does not clot properly due to the lack of clotting factors. Males (XY) are more affected because they have only one X chromosome, so if that X chromosome carries the defective gene, they will have the disease. Females (XX) are usually carriers because they need two copies of the defective gene to show the disease.

- **Colourblindness:**
  Colourblindness, particularly red-green colourblindness, is another example of an X-linked recessive trait. Affected individuals cannot distinguish certain colours. As with haemophilia, males are more likely to be colourblind because they have only one X chromosome. Females are generally carriers unless they inherit two copies of the defective gene.

d) Comment upon PCR.

Answer:

Polymerase Chain Reaction (PCR) is a molecular biology technique used to amplify a specific segment of DNA, generating millions to billions of copies from a small initial sample. This allows scientists to study DNA in detail even from minute amounts. PCR is highly useful in various fields such

as genetics, forensic science, medical diagnostics, and biotechnology.

Steps of PCR:

1. **Denaturation:** The DNA sample is heated to around 94-96°C to separate the double-stranded DNA into single strands.
2. **Annealing:** The temperature is lowered to 50-65°C, allowing short DNA primers to bind (anneal) to the complementary sequences on the DNA strands.
3. **Extension:** The temperature is raised to 72°C, where a heat-stable DNA polymerase enzyme (Taq polymerase) synthesizes a new strand of DNA by adding nucleotides to the primer-bound DNA.

PCR is a highly efficient and sensitive technique that has revolutionized genetic research, diagnostics, and even crime scene investigations by enabling the rapid amplification of DNA samples.

6. a) Describe the Mendel's law of dominance.

Answer:

Mendel's **Law of Dominance** is one of the basic principles of inheritance discovered by Gregor Mendel. It states that in a heterozygous organism, where two different alleles (variants of a gene) are present for a specific trait, one allele is dominant and masks the expression of the other allele, which is recessive. The dominant allele determines the organism's phenotype (physical appearance).

For example, in pea plants, the allele for tall plants (T) is dominant over the allele for short plants (t). Therefore, a plant with the genotype (Tt) will be tall, as the dominant allele (T) masks the recessive allele (t).

b) What do you mean by polygenic inheritance ? Describe with suitable example.

Answer:

Polygenic inheritance refers to the phenomenon where multiple genes (polygenes) contribute to a single trait. Each of these genes has a small additive effect on the phenotype. Unlike Mendelian inheritance, where traits are determined by a single gene, polygenic traits exhibit a continuous range of variation rather than distinct categories.

Example:
Human skin color is an example of polygenic inheritance. It is influenced by several genes that control the production of melanin. The combination of multiple alleles from different genes results in the wide range of skin color seen in humans. Each gene adds to the pigmentation level, leading to continuous variation in skin color.

c) Describe the main characteristic features of Genetic Code.

Answer:

The **genetic code** is the set of rules by which the sequence of nucleotides in mRNA is translated into a sequence of amino acids during protein synthesis. The main features of the genetic code are:

1. **Triplet Code:** Each set of three nucleotides (codon) in mRNA corresponds to one amino acid.
2. **Universal:** The genetic code is nearly the same in all organisms, from bacteria to humans.

3. **Degenerate:** Most amino acids are encoded by more than one codon. For example, leucine is coded by six different codons.
4. **Non-overlapping:** Codons are read one after another in a linear sequence without overlapping.
5. **Unambiguous:** Each codon specifies only one amino acid.
6. **Start and Stop Codons:** AUG is the start codon, signaling the beginning of protein synthesis. There are also stop codons (UAA, UAG, UGA) that signal the end of translation.

d) What are the causal organisms of typhoid and pneumonia ? Give their symptoms.

Answer:

Causal Organism of Typhoid:
Typhoid is caused by the bacterium Salmonella typhi.
Symptoms of Typhoid:
- High fever (up to $104^{\circ}\mathrm{F}$)
- Weakness and fatigue
- Abdominal pain
- Headache
- Loss of appetite
- Constipation or diarrhea
- Rash (rose spots) on the abdomen in some cases

Causal Organism of Pneumonia:
Pneumonia can be caused by various organisms, but the most common bacterial cause is Streptococcus pneumoniae. Other organisms include viruses and fungi.

Symptoms of Pneumonia:
Cough with phlegm or pus
Chest pain
Difficulty breathing
High fever and chills

Fatigue
Rapid breathing
Confusion (especially in elderly individuals)

7. Write an essay on Biotechnology.

Answer:

Biotechnology is a broad field of science that combines biology with technology to develop innovative products and solutions that benefit society. It involves the use of living organisms, cells, and biomolecules to create new technologies, processes, and products for various sectors, including agriculture, medicine, environmental conservation, and industrial applications. Biotechnology has revolutionized many industries and has contributed to significant advancements in healthcare, food production, and environmental sustainability.

History and Evolution of Biotechnology:

The roots of biotechnology can be traced back thousands of years to when humans first used fermentation to produce food and beverages such as bread, cheese, and wine. However, modern biotechnology began to emerge in the 20th century with the discovery of DNA and the development of genetic engineering techniques.

One of the key milestones in the history of biotechnology was the discovery of the structure of DNA by James Watson and Francis Crick in 1953. This discovery paved the way for the development of recombinant DNA technology in the 1970s, which allows scientists to manipulate the genetic material of organisms. Since then, biotechnology has rapidly advanced, giving rise to genetic engineering, cloning, stem cell research, and various other breakthroughs.

Applications of Biotechnology:

1. **Medical Biotechnology:** Medical biotechnology focuses on the use of biotechnology to develop treatments, therapies, and diagnostic tools for human health. One of the most significant contributions of biotechnology in medicine is the development of **recombinant DNA** technology, which has enabled the production of important medical products such as **insulin, growth hormones, and vaccines**. Biotechnology has also played a key role in the development of gene therapy, which aims to treat genetic disorders by repairing or replacing defective genes.

   Stem cell research and **regenerative medicine** are other areas where biotechnology is making a profound impact. Stem cells have the potential to differentiate into various types of cells, offering hope for treating conditions such as Parkinson's disease, diabetes, and spinal cord injuries.

   Biotechnology has also facilitated the development of more accurate and rapid **diagnostic techniques**, such as polymerase chain reaction (PCR), which is used to detect infectious diseases like COVID-19.

2. **Agricultural Biotechnology:** Agricultural biotechnology focuses on improving crop yield, quality, and resistance to pests and diseases. One of the most notable advancements in this field is the development of **genetically modified organisms (GMOs)**. GMOs are crops that have been genetically engineered to exhibit desirable traits, such as resistance to pests, tolerance to herbicides, and improved nutritional content.

   For example, **Bt cotton** is a genetically modified crop that contains a gene from the bacterium *Bacillus thuringiensis*, which provides resistance to certain pests. **Golden rice** is another example of a GMO, engineered to produce beta-carotene, a precursor to vitamin A, to combat vitamin A deficiency in developing countries.

   Biotechnology has also enabled the development of **biofertilizers** and **biopesticides**, which reduce the reliance on chemical fertilizers and pesticides, thereby promoting sustainable agriculture.

3. **Environmental Biotechnology:** Environmental biotechnology focuses on using biological processes to address environmental challenges, such as pollution and waste management. One of the key applications of environmental biotechnology is **bioremediation**, which involves using microorganisms to degrade or remove harmful pollutants from soil, water, and air. For example, bacteria are used to clean up oil spills, and plants can be engineered to absorb heavy metals from contaminated soil.

   Biotechnology is also playing a role in the development of **biofuels**, which are renewable energy sources derived from biological materials. Biofuels, such as ethanol and biodiesel, offer an eco-friendly alternative to fossil fuels and help reduce greenhouse gas emissions.

4. **Industrial Biotechnology:** Industrial biotechnology, also known as white biotechnology, involves the use of enzymes, microorganisms, and other biological materials to create industrial products and processes. This includes the production of bio-based chemicals, biodegradable plastics, and enzymes used in detergents, textiles, and food processing.

One of the major advantages of industrial biotechnology is its potential to create more sustainable and environmentally friendly manufacturing processes by reducing energy consumption, waste generation, and reliance on non-renewable resources.

Ethical Considerations:

While biotechnology has brought about numerous benefits, it also raises ethical concerns. Issues such as the use of genetic modification, cloning, and stem cell research are often subjects of public debate. Some worry about the unintended consequences of genetically modifying organisms, such as the potential for creating "superweeds" or harming non-target species. Similarly, the use of stem cells from human embryos has raised moral and ethical questions.

In addition, concerns about the **patenting of genetically modified seeds** and **biopiracy**, where indigenous knowledge and resources are exploited without fair compensation, have been raised in relation to agricultural biotechnology. These issues require careful consideration and regulation to ensure that the benefits of biotechnology are maximized while minimizing potential risks.

Future of Biotechnology:

The future of biotechnology holds great promise, with ongoing research and innovation likely to lead to even more groundbreaking developments. The **CRISPR-Cas9** gene-editing technology, for example, has the potential to revolutionize genetic engineering by allowing scientists to make precise and targeted changes to DNA. This technology could lead to cures for genetic diseases, improved crop varieties, and new treatments for cancer.

In the field of medicine, advances in **personalized medicine** and **immunotherapy** are likely to continue improving patient outcomes. Personalized medicine uses genetic information to tailor treatments to individuals, while immunotherapy harnesses the body's immune system to fight diseases like cancer.

Conclusion:

Biotechnology is a rapidly evolving field that has transformed industries and improved the quality of life for people around the world. Its applications in medicine, agriculture, environmental sustainability, and industry are helping to solve some of the most pressing challenges faced by humanity today. However, it is essential to address the ethical and environmental concerns associated with biotechnology to ensure that its benefits are realized in a responsible and equitable manner. As scientific understanding and technological capabilities continue to grow, biotechnology will remain a key driver of innovation and progress in the 21st century.

8. What do you mean by Biodiversity ? Describe its different methods of conservation in detail.

Answer:

Biodiversity refers to the variety and variability of life on Earth. It encompasses all living organisms, including plants, animals, fungi, and microorganisms, and the ecosystems they form. Biodiversity is typically studied at three levels:

1. **Genetic Diversity:** The variety of genetic information within species, which allows populations to adapt to changing environments.
2. **Species Diversity:** The variety of different species within an ecosystem or the entire biosphere.
3. **Ecosystem Diversity:** The diversity of habitats, communities, and ecological processes within and between ecosystems.

Biodiversity is essential for the stability and resilience of ecosystems, providing vital ecosystem services such as pollination, nutrient cycling, soil formation, climate regulation, and water purification. It also supports food security, human health, and economic resources. However, biodiversity is under threat due to habitat loss, climate change, pollution, overexploitation, and invasive species.

Methods of Biodiversity Conservation:

Biodiversity conservation is essential to prevent the loss of species and the degradation of ecosystems. Conservation strategies are broadly classified into two categories: **in-situ** and **ex-situ** conservation. Both methods play vital roles in preserving biodiversity.

1. **In-Situ Conservation (On-Site Conservation):**

In-situ conservation refers to the preservation of ecosystems and natural habitats while maintaining and protecting species in their natural environments. This is considered the most effective way to conserve biodiversity as it allows species to evolve and adapt to their natural surroundings.

Methods of In-Situ Conservation:

- **Protected Areas:**
  Protected areas are regions designated for the preservation of biodiversity. They provide habitats for a wide range of species and help prevent habitat destruction. These include:

  - **National Parks:** Areas set aside to protect wildlife and ecosystems while allowing limited public access for educational and recreational purposes. For example, Yellowstone National Park in the U.S.
  - **Wildlife Sanctuaries:** Areas that provide protection to specific species, particularly endangered ones, while allowing limited human activities like grazing and tourism. Example: Kaziranga Wildlife Sanctuary in India, which protects the one-horned rhinoceros.
  - **Biosphere Reserves:** Large areas that include zones for strict protection, sustainable use, and research. Biosphere reserves aim to balance conservation with the needs of local communities. Example: Nilgiri Biosphere Reserve in India.
  - **Community Reserves:** Areas where local communities participate in conservation efforts, often protecting traditional lands and resources while conserving biodiversity.
- **Sacred Groves:**
  Sacred groves are patches of forest protected by local communities due to religious or cultural significance. These areas often serve as refuges for endangered species and are examples of traditional conservation practices.

- **Ecological Corridors (Wildlife Corridors):**
  Ecological corridors are stretches of natural habitat that connect isolated populations of species, allowing for gene flow and migration. These corridors help maintain the biodiversity of fragmented habitats.

- **Conservation of Hotspots:**
  Biodiversity hotspots are regions with high species richness and endemism that are under significant threat from human activities. Protecting these areas is a priority for global conservation efforts. Examples include the Western Ghats and the Amazon Rainforest.

- **Legislation and Regulations:**
  Governments enforce laws and policies to protect endangered species and habitats. International agreements like the Convention on Biological Diversity (CBD) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) play a significant role in in-situ conservation by regulating trade and protecting species globally.

2. **Ex-Situ Conservation (Off-Site Conservation):**

Ex-situ conservation involves conserving species outside their natural habitats. This approach is particularly important for species that are critically endangered or have lost their habitats. Ex-situ conservation helps preserve genetic material and can serve as a backup in case wild populations are lost.

Methods of Ex-Situ Conservation:

- **Botanical Gardens:**
  Botanical gardens play an important role in conserving plant species by growing and maintaining living collections of plants from around the world. These gardens often serve as centers for research, education, and the propagation of rare and endangered species.

- **Seed Banks:**
  Seed banks store seeds from a wide variety of plants, preserving genetic diversity for future use. Seeds are kept under controlled conditions to ensure long-term viability. These banks provide insurance against the extinction of plant species and help restore ecosystems. Example: The Svalbard Global Seed Vault in Norway.

- **Gene Banks:**
  Gene banks store genetic material, such as seeds, sperm, eggs, or embryos, from both plants and animals. They provide a repository of genetic diversity that can be used for breeding, research, and conservation. Gene banks are crucial for preserving the genetic resources of crops and endangered animal species.

- **Zoological Parks (Zoos):**
  Zoos conserve endangered species by maintaining live animals in captivity. Modern zoos focus on breeding programs, research, and education, with the goal of reintroducing species into the wild where possible. Zoos also help raise awareness about biodiversity conservation.

- **Aquaria:**
  Similar to zoos, aquaria play a role in the ex-situ conservation of aquatic species. Aquaria maintain and breed endangered aquatic species, while educating the public about marine biodiversity and conservation issues.

- **Cryopreservation:**
  Cryopreservation is a technique that involves freezing genetic material at very low temperatures to preserve it for future use. It is used to store seeds, embryos, sperm, and eggs for long periods, ensuring the genetic diversity of species is maintained.

- **Tissue Culture:**
  Tissue culture is a method of growing plants from small pieces of plant tissue under sterile conditions in a laboratory. This technique allows for the rapid multiplication of rare or endangered plant species and can be used to reintroduce them into the wild.

3. **Sustainable Use of Resources:**

Another essential aspect of biodiversity conservation is promoting the sustainable use of natural resources. This includes managing forests, fisheries, and agricultural systems in ways that maintain biodiversity while providing for human needs.

- **Agroforestry:**
  Integrating trees and shrubs into agricultural landscapes helps conserve biodiversity while improving soil health, water retention, and crop productivity.

- **Sustainable Fishing Practices:**
  Ensuring that fish populations are not overexploited and that marine ecosystems are protected can help conserve marine biodiversity. This includes the creation of marine protected areas and the regulation of fishing practices.

- **Sustainable Tourism:**
  Ecotourism promotes conservation while providing economic benefits to local communities. It encourages responsible travel that minimizes environmental impact and supports biodiversity conservation efforts.

Conclusion:

Biodiversity is critical for the health and stability of ecosystems, and its conservation is vital for the survival of all life on Earth. The threats to biodiversity, including habitat destruction, climate change, and pollution, require urgent action at both local and global levels. In-situ and ex-situ conservation strategies, along with sustainable resource management and education, are key methods of ensuring the preservation of biodiversity. With concerted efforts from governments, organizations, and individuals, we can protect the richness of life on our planet for future generations.

9. What do you mean by adaptations ? Describe various adaptations in living organisms, with suitable examples.

Answer:

Adaptations refer to the evolutionary process by which organisms develop specific traits or behaviors that increase their chances of survival and reproduction in a particular environment. These traits are inherited and can be structural, behavioral, or physiological, enabling the organism to cope with environmental challenges. Adaptations evolve over generations through the mechanism of natural selection, where individuals with favorable traits are more likely to survive and reproduce, passing on these traits to future generations.

Types of Adaptations

Adaptations can be broadly classified into three main categories:

1. **Structural Adaptations**
2. **Behavioral Adaptations**
3. **Physiological Adaptations**

1. **Structural Adaptations**

Structural adaptations are physical features of an organism that enhance its survival. These adaptations can affect an organism's shape, size, color, or specific body parts.

Examples of Structural Adaptations:

- **Camouflage:**
  Many animals have evolved body colors or patterns that allow them to blend in with their surroundings to avoid predators. For example, the **chameleon** changes its skin color to blend in with

its environment, making it difficult for predators to spot it. Another example is the **peppered moth** in the UK, which developed darker coloration during the Industrial Revolution to blend in with soot-covered trees.

- **Mimicry:**
  In mimicry, an organism resembles another organism or object to avoid predation. For example, the **viceroy butterfly** mimics the appearance of the toxic **monarch butterfly** to deter predators, even though the viceroy itself is not poisonous.

- **Body Shape and Size:**
  Different organisms develop unique body shapes and sizes to survive in specific environments. For instance, **cacti** in desert environments have thick, fleshy stems to store water, while their leaves are reduced to spines to minimize water loss and protect them from herbivores. Similarly, **polar bears** have thick fur and a layer of fat to insulate against the cold in the Arctic environment.

- **Beak Shape in Birds:**
  The shape of a bird's beak is a structural adaptation that enables it to feed efficiently in its environment. For example, **finches** on the Galápagos Islands have different beak shapes depending on their diet, such as sharp beaks for eating insects and large, strong beaks for cracking seeds.

2. **Behavioral Adaptations**

Behavioral adaptations are actions or activities that organisms develop to survive in their environment. These behaviors can be innate (instinctive) or learned and help the organism find food, shelter, avoid predators, or reproduce.

Examples of Behavioral Adaptations:

- **Migration:**
  Many animals migrate to survive seasonal changes. **Birds**, for example, migrate from colder regions to warmer ones during the winter to find food and breeding grounds. The **Arctic tern** is known for its long migratory journey from the Arctic to the Antarctic and back.

- **Hibernation:**
  Some animals go into hibernation during the winter to conserve energy when food is scarce. **Bears**, for example, hibernate in dens, slowing their metabolism to survive the cold months without food. **Frogs** and **bats** also exhibit hibernation behavior to survive harsh conditions.

- **Nocturnal Behavior:**
  Many animals, such as **owls** and **bats**, have adapted to be active at night (nocturnal) to avoid predators or extreme daytime temperatures. This behavior helps them conserve water in arid environments or avoid competition with diurnal animals.

- **Courtship Rituals:**
  Behavioral adaptations also include reproductive behaviors, such as courtship rituals that ensure successful mating. For example, **peacocks** display their vibrant tail feathers to attract mates, while **fireflies** use light signals to communicate during courtship.

3. **Physiological Adaptations**

Physiological adaptations involve internal processes and functions that enable an organism to survive in its environment. These adaptations often affect the metabolism, reproduction, or body chemistry of an organism.

Examples of Physiological Adaptations:

- **Temperature Regulation (Thermoregulation):**
  Endothermic animals (warm-blooded animals), such as mammals and birds, have developed physiological adaptations to maintain a stable body temperature regardless of external conditions. For example, humans sweat to cool down in hot weather, while **penguins** have a thick layer of fat and specialized blood flow to keep warm in the extreme cold.

- **Water Conservation:**
  Desert animals have physiological adaptations to conserve water. For example, the **kangaroo rat** can survive without drinking water for long periods by concentrating its urine and obtaining moisture from the food it eats. **Camels** store fat in their humps, which can be metabolized into water and energy when needed.

- **Toxin Resistance:**
  Some organisms have evolved resistance to toxins. For instance, **certain insects** have adapted to feed on toxic plants by developing enzymes that can detoxify the harmful chemicals in the plant. Another example is the **garter snake**, which has evolved resistance to the toxic skin secretions of its prey, the **rough-skinned newt**.

- **Photosynthesis in Plants:**
  In plants, the process of **photosynthesis** itself is a physiological adaptation. Some plants, especially in arid environments, have adapted specialized forms of photosynthesis (such as CAM photosynthesis) to conserve water. **Succulent plants** like cacti open their stomata at night to reduce water loss during photosynthesis.

Examples of Adaptations in Different Environments

1. **Aquatic Environment:**

- **Gills in Fish:**
  Fish have evolved **gills**, which are specialized structures that allow them to extract oxygen from water. This structural adaptation is essential for their survival in aquatic habitats.

- **Streamlined Bodies in Aquatic Animals:**
  Many aquatic animals, such as **dolphins**, **sharks**, and **fish**, have streamlined bodies that reduce resistance while swimming, allowing them to move efficiently through the water.

2. **Desert Environment:**

- **Thick Cuticles in Plants:**
  Desert plants, such as **cacti** and **aloe**, have developed thick cuticles (waxy coatings) on their leaves and stems to reduce water loss through evaporation.

- **Nocturnal Behavior in Animals:**
  Desert animals like **fennec foxes** and **desert snakes** are often nocturnal to avoid the heat of the day. They remain active during the cooler night to conserve water and energy.

3. **Cold Environment:**

- **Antifreeze Proteins in Polar Fish:**
  Some fish in polar regions, such as the **Antarctic toothfish**, produce **antifreeze proteins** that prevent their blood from freezing in subzero temperatures.

- **Blubber in Marine Mammals:**
  Marine mammals like **whales** and **seals** have a thick layer of **blubber** (fat) that insulates their bodies, helping them survive in cold ocean waters.

Conclusion:

Adaptations are crucial for the survival and success of living organisms in their respective environments. They allow organisms to respond to environmental challenges such as changes in temperature, availability of resources, and predation pressures. Through natural selection, organisms develop these adaptations over time, ensuring the continued survival of species in diverse and sometimes extreme conditions. Studying adaptations helps us understand the intricate relationship between organisms and their environments, showcasing the marvels of evolution and the incredible diversity of life on Earth.

UP Board Class 12 Biology Question with Solution- 2022

1. Choose the correct option and write in your answer-book :

(a) Which one of the following is not a false fruit?

(i) Apple

(ii) Strawberry

(iii) Walnut

(iv) Mango

Answer:

(iv) Mango

(b) For the initiation of protein synthesis, initiation codon is

(i) AUG

(ii) UAG

(iii) UGA

(iv) UAA

Answer:
(i) AUG

(c) Which one of the following pollutants is biodegradable?
(i) Plastic
(ii) Asbestos
(iii) Sewage
(iv) E-waste

Answer:

(iii) Sewage

(d) Crocodile Rehabilitation Centre Kukrail is located in
(i) Prayagraj
(ii) Lucknow
(iii) Varanasi
(iv) Lakhimpur Kheri

Answer:

(ii) Lucknow

2. (a) Where is tapetum located? What is its function?

Answer:

The **tapetum** is located in the **anther** of a flower, specifically within the **microsporangium**, which is part of the male reproductive structure. It forms the innermost layer of cells around the pollen sacs.

Function:
The tapetum provides nourishment to developing pollen grains. It also plays a crucial role in the synthesis of materials such as sporopollenin, which is essential for the formation of the tough outer wall (exine) of pollen grains.

(b) How many pairs of contrasting traits were studied by Mendel in pea plant?

Answer:

Mendel studied **seven pairs** of contrasting traits in pea plants (*Pisum sativum*).

(c) Which pathogen causes elephantiasis ? To which phylum does this pathogen belong ?

Answer:

The pathogen that causes **elephantiasis** is **Wuchereria bancrofti** (and sometimes **Brugia malayi**). These pathogens are **parasitic nematodes**.

Phylum:
They belong to the phylum **Nematoda**.

(d) What is ' r ' in rDNA ?

Answer:

In **rDNA**, the letter **'r'** stands for **recombinant**. Recombinant DNA (rDNA) refers to artificially created DNA molecules that combine genetic material from different organisms, used in genetic engineering and biotechnology.

(e) Define Niche.

Answer:

A **niche** refers to the specific role or function of an organism within its ecosystem, including how it interacts with its environment, its habitat, the resources it uses, and its relationships with other organisms. A niche encompasses an organism's behavior, diet, and how it contributes to energy flow and nutrient cycles in the ecosystem.

(Very Short Answer Type Questions)

3. (a) Mention the full forms of IVF and GIFT.

Answer:

- **IVF:** In Vitro Fertilization
- **GIFT:** Gamete Intrafallopian Transfer

(b) Comment upon Apomixis.

Answer:

Apomixis is a form of asexual reproduction in plants where seeds are formed without fertilization. In apomixis, the embryo develops from diploid cells without undergoing meiosis or fusion of gametes, resulting in offspring that are genetically identical to the parent plant.

(c) How many chromosomes are found in Turner and Klinefelter syndromes?

Answer:

- **Turner Syndrome:** Individuals have **45 chromosomes** (X0), missing one sex chromosome.
- **Klinefelter Syndrome:** Individuals have **47 chromosomes** (XXY), with an extra X chromosome.

(d) What are ill effects of alcohol abuse?

Answer:

Alcohol abuse can lead to:

- Liver damage (cirrhosis)
- Brain damage and memory loss
- Weakened immune system
- Cardiovascular diseases
- Increased risk of accidents and injuries
- Addiction and withdrawal symptoms
- Behavioral changes and social problems

(e) What does biodiversity hotspots mean?

Answer:

Biodiversity hotspots are regions that are exceptionally rich in endemic species but are also under significant threat from human activities. These areas are prioritized for conservation due to their high biodiversity and the risk of habitat destruction.

(Short Answer Type Questions)

4. (a) Describe the types of pollination.

Answer:

There are two main types of pollination:

Self-Pollination (Autogamy): Pollination occurs within the same flower or between flowers on the same plant. The pollen from the anther is transferred to the stigma of the same flower or plant. Example: Pea plants.

Cross-Pollination (Allogamy): Pollination occurs between different plants of the same species. The pollen from the anther of one flower is transferred to the stigma of another flower on a different plant. Cross-pollination can occur through:

- **Wind (Anemophily)**: Example: Maize
- **Water (Hydrophily)**: Example: Vallisneria
- **Insects (Entomophily)**: Example: Sunflower
- **Animals (Zoophily)**: Example: Birds, bats

(b) Comment on placenta in brief.

Answer:

The **placenta** is an organ that develops in the uterus during pregnancy in mammals. It connects the mother and fetus, facilitating the exchange of nutrients, oxygen, and waste products. The placenta also produces hormones that support pregnancy and provides a barrier against certain infections. It plays a crucial role in sustaining the fetus during development.

(c) Differentiate between incomplete dominance and co-dominance.

Answer:

- **Incomplete Dominance:** In incomplete dominance, the heterozygous phenotype is an intermediate between the two homozygous phenotypes. Neither allele is completely dominant.
  Example: In snapdragons, crossing a red-flowered plant with a white-flowered plant results in pink flowers.

- **Co-Dominance:** In co-dominance, both alleles are fully expressed in the heterozygous condition. Neither allele masks the other.
  Example: In human blood groups, individuals with genotype IAIB have both A and B antigens, resulting in the AB blood type.

(d) Explain the importance of biodiversity.

Answer:

Biodiversity is essential because it:

- Maintains ecosystem stability and resilience.
- Supports ecosystem services such as pollination, nutrient cycling, water purification, and climate regulation.
- Provides resources for food, medicine, and industrial products.
- Enhances genetic diversity, helping organisms adapt to environmental changes and resist diseases.
- Promotes recreational, cultural, and educational value for human societies.

5. (a) Describe the various methods of biodiversity conservation.

Answer:

There are two main approaches to biodiversity conservation:

In-Situ Conservation:
Conservation of species in their natural habitats. Examples include:

- **Protected Areas**: National parks, wildlife sanctuaries, and biosphere reserves.
- **Sacred Groves**: Traditionally protected forest areas.
- **Conservation Hotspots**: Areas with high biodiversity that are under threat.

Ex-Situ Conservation:
Conservation of species outside their natural habitats. Examples include:

- **Botanical Gardens**: Places where plants are cultivated for conservation.
- **Seed Banks**: Storage of seeds to preserve genetic diversity.
- **Zoos and Aquariums**: Maintenance of animal species in controlled environments.
- **Cryopreservation**: Freezing of genetic material for future use.

(b) Discuss the contribution of biotechnology in vaccine production, gene therapy and human insulin development.

Answer:

- **Vaccine Production:**
  Biotechnology enables the development of recombinant vaccines by inserting genes from pathogens into harmless organisms. These vaccines stimulate the immune system without causing disease.
  Example: **Hepatitis B** vaccine produced using recombinant DNA technology.

- **Gene Therapy:**
  Gene therapy involves introducing, removing, or altering genes within an individual's cells to treat genetic disorders. For example, it is used to treat diseases like cystic fibrosis, muscular dystrophy, and certain cancers.

- **Human Insulin Development:**
  Using recombinant DNA technology, the gene responsible for insulin production is inserted into bacteria, which then produce insulin. This method produces **human insulin** (r-insulin), which is used to treat diabetes, replacing animal-derived insulin

(c) Write down the names of four species of malarial parasite. Mention the type of malaria caused by them.

Answer:

1. **Plasmodium falciparum** – Causes the most severe form of malaria known as **malignant malaria** or **cerebral malaria**.
2. **Plasmodium vivax** – Causes **benign tertian malaria**.
3. **Plasmodium ovale** – Causes **tertian malaria** (less common).
4. **Plasmodium malariae** – Causes **quartan malaria** (a milder form of malaria).

(d) Describe the inheritance of ABO blood group in humans.

Answer:

The ABO blood group system in humans is an example of multiple alleles and co-dominance. The ABO blood group is determined by a single gene (I) with three alleles: IA, IB, and i .
- IA and IB are co-dominant, meaning that both can be expressed simultaneously.
- i is recessive to both IA and IB.

Possible Genotypes and Blood Types:
- IAIA or IAi $\rightarrow$ Blood type A
- IBIB or IBi $\rightarrow$ Blood type B
- IAIB $\rightarrow$ Blood type AB (co-dominance, both antigens A and B are expressed)
- ii $\rightarrow$ Blood type O (no antigens present)

6. (a) Comment upon the following :

(i) Embryo sac

Answer:

The **embryo sac** is the female gametophyte in flowering plants (angiosperms), where fertilization occurs and the embryo develops. It is formed by the process of **megasporogenesis** and contains several cells, including the **egg cell**, two **synergids**, three **antipodal cells**, and two **polar nuclei** that fuse to form the **endosperm** after fertilization. The embryo sac plays a critical role in sexual reproduction by facilitating fertilization and subsequent seed development.

(ii) Emasculation

Answer:

Emasculation is the removal of the anthers from a flower before they release pollen, a technique used in plant breeding to prevent self-pollination and ensure cross-pollination with pollen from a selected plant. This is commonly done in hybridization experiments to control the parentage of the offspring.

(b) What does the embryonic development in humans mean?

Answer:

Embryonic development in humans refers to the process by which a fertilized egg (zygote) undergoes a series of cellular divisions and differentiations to form a fully developed embryo. This process starts with fertilization and includes stages such as **cleavage**, **blastulation**, **gastrulation**, and **organogenesis**. The embryo develops through the formation of tissues, organs, and systems, eventually leading to a fetus, ready for birth.

(c) Comment upon sickle cell anaemia in short.

Answer:

Sickle cell anaemia is a genetic disorder caused by a mutation in the gene that codes for the **beta-globin** chain of hemoglobin. The mutation causes red blood cells to become rigid and shaped like a sickle, leading to reduced oxygen-carrying capacity and blocking blood flow in capillaries. It is inherited in an autosomal recessive manner, with individuals who inherit two mutated alleles developing the disease. Symptoms include anemia, pain episodes, and organ damage.

(d) Describe the role of microbes in biogas production.

Answer:

Microbes play a crucial role in **biogas production** through the process of **anaerobic digestion**, where organic materials like animal manure, plant waste, and sewage are broken down in the absence of oxygen. Specific bacteria, known as **methanogens**, convert organic matter into methane (CH_4), carbon dioxide (CO_2), and other gases. Methane is the primary component of biogas, which can be used as a renewable source of energy for cooking, electricity, and heating

(Long Answer Type Questions)

7. Describe the female reproductive system of humans.

OR

Explain the post-fertilization events in a flowering plant.

Answer:

The **female reproductive system** in humans consists of internal and external organs responsible for producing eggs (ova), facilitating fertilization, and supporting fetal development.

- **Ovaries:** These are the primary female reproductive organs that produce eggs and hormones (estrogen and progesterone). Each woman has two ovaries located on either side of the uterus.
- **Fallopian Tubes:** These tubes transport the egg from the ovary to the uterus. Fertilization typically occurs here.
- **Uterus (Womb):** The uterus is a muscular, pear-shaped organ where a fertilized egg implants and develops into a fetus. The uterine lining (endometrium) thickens each month to prepare for pregnancy.
- **Cervix:** The cervix is the lower part of the uterus that opens into the vagina. It allows the passage of menstrual blood, sperm, and a baby during childbirth.
- **Vagina:** The vagina is a muscular canal that connects the cervix to the outside of the body. It serves as the birth canal and also facilitates intercourse and the passage of menstrual flow.

OR

Explain the post-fertilization events in a flowering plant.

Post-fertilization events in flowering plants involve the development of the zygote into a seed and the transformation of the ovary into a fruit. These events include:

1. **Endosperm Formation:** After fertilization, one of the sperm cells fuses with two polar nuclei to form the **triploid endosperm**, which provides nourishment to the developing embryo.
2. **Embryo Development:** The fertilized egg (zygote) undergoes mitotic divisions to form the embryo, which will later develop into a new plant. The embryo has parts like the radicle (root), plumule (shoot), and cotyledons (seed leaves).
3. **Seed Formation:** The ovules develop into seeds, with the seed coat forming from the integuments of the ovule. Inside the seed, the embryo is protected and surrounded by nutrient-rich endosperm or cotyledons.
4. **Fruit Formation:** The ovary transforms into a fruit, enclosing the seeds. The fruit aids in the protection and dispersal of the seeds.

8. Describe the chromosomal theory of inheritance.

OR

Describe the roles of microbes in industrial products synthesis.

Answer:

The **Chromosomal Theory of Inheritance**, proposed by **Walter Sutton** and **Theodor Boveri** in the early 20th century, explains that genes are located on chromosomes, which are the vehicles of genetic inheritance. The theory draws parallels between the behavior of chromosomes during meiosis and

Mendel's laws of inheritance, showing that chromosomes segregate and assort independently during gamete formation.

Key Points of the Chromosomal Theory:

1. **Chromosomes occur in pairs**: Organisms inherit one chromosome from each parent.
2. **Chromosomes segregate independently**: During meiosis, homologous chromosomes separate, ensuring that each gamete receives only one chromosome from each pair.
3. **Genes are located on chromosomes**: Each chromosome carries many genes, and the position of a gene on a chromosome is called its locus.
4. **Linkage and recombination**: Genes located close to each other on the same chromosome tend to be inherited together (linkage), but crossing over can result in new combinations of genes (recombination).

This theory provided the foundation for understanding how genetic traits are passed from one generation to the next.

OR

Describe the roles of microbes in industrial products synthesis.

Microbes are essential in the production of various industrial products due to their ability to produce enzymes, chemicals, and pharmaceuticals.

1. **Fermentation Products**: Microbes such as yeast (*Saccharomyces cerevisiae*) are used in the production of alcohol, bread, and other fermented products. Yeast ferments sugars to produce ethanol in alcoholic beverages and carbon dioxide for bread leavening.

2. **Antibiotics**: Microorganisms like fungi (*Penicillium*) and bacteria (*Streptomyces*) are used to produce antibiotics such as **penicillin**, which is used to treat bacterial infections.

3. **Enzymes**: Microbes produce enzymes used in various industries. For example, **amylases** from *Aspergillus* are used in the starch industry, and **proteases** from *Bacillus* are used in detergents and food processing.

4. **Organic Acids**: Microorganisms like *Aspergillus niger* produce citric acid, which is widely used in food, beverages, and pharmaceuticals.

5. **Vitamins**: Bacteria such as *Propionibacterium* are used to produce vitamin B12, while *Acetobacter* is used for producing acetic acid (vinegar).

6. **Biogas Production**: Methanogenic bacteria break down organic matter in anaerobic conditions to produce methane, which is used as a renewable energy source.

9. Write an essay on rDNA technology.

OR

Define population. Describe its different interactions.

Answer:

Recombinant DNA (rDNA) technology is a genetic engineering technique used to modify the genetic material of an organism by introducing DNA from another organism. This allows scientists to create organisms with new traits or functions that would not naturally occur.

Key Steps in rDNA Technology:

1. **Isolation of DNA**: The DNA containing the gene of interest is isolated from the donor organism.
2. **Cutting DNA with Restriction Enzymes**: Specific enzymes, called **restriction endonucleases**, are used to cut the DNA at precise locations.
3. **Ligation of DNA**: The gene of interest is inserted into a plasmid or another vector using the enzyme **DNA ligase**.
4. **Transformation**: The recombinant DNA is introduced into a host organism, such as bacteria, through transformation. This host organism will then express the new gene.
5. **Selection and Screening**: Host cells that have successfully incorporated the recombinant DNA are identified and selected using antibiotic resistance markers or other techniques.

Applications of rDNA Technology:

- **Production of Insulin**: Recombinant bacteria are engineered to produce human insulin, which is used to treat diabetes.
- **Gene Therapy**: rDNA technology is used to correct defective genes in patients with genetic disorders.
- **GMOs**: Genetically modified crops such as Bt cotton and Golden rice are created to resist pests, improve yield, or enhance nutritional content.
- **Pharmaceuticals**: Recombinant vaccines, such as the Hepatitis B vaccine, are produced using rDNA technology.

OR

Define population. Describe its different interactions.

A **population** is a group of individuals of the same species living in a specific geographic area at a given time, capable of interbreeding and sharing the same gene pool. Population ecology studies how populations interact with their environment, including factors that influence population size, growth, and density.

Types of Population Interactions

1. **Competition**

Competition occurs when individuals of the same or different species compete for the same resources, such as food, water, space, or mates. Competition can be **intraspecific** (within the same species) or **interspecific** (between different species). This interaction can limit population growth and affect the distribution of species.

- **Example**: Trees in a dense forest compete for sunlight and nutrients. Animals such as lions and hyenas compete for prey in their shared habitat.

2. **Predation**

Predation is an interaction where one organism (the predator) hunts, kills, and feeds on another organism (the prey). This interaction helps regulate prey populations and can drive evolutionary adaptations in both predators and prey (e.g., camouflage, speed).

- **Example**: Lions preying on zebras in the savannah. Spiders catching insects in their webs.

3. **Parasitism**

In **parasitism**, one organism (the parasite) benefits at the expense of another organism (the host). The parasite lives on or inside the host, deriving nutrients and shelter, often harming the host in the process but typically not killing it.

- **Example**: Ticks feeding on the blood of mammals. The **Plasmodium** parasite causes malaria in humans.

4. **Mutualism**

Mutualism is a symbiotic interaction where both species benefit from the relationship. Mutualistic interactions are important for the survival and reproduction of the species involved.

- **Example**: Bees pollinating flowers while feeding on their nectar. The flower gets pollinated, and the bee gets food.

5. **Commensalism**

Commensalism is an interaction where one organism benefits while the other is neither helped nor harmed. The benefiting species takes advantage of the environment or resources provided by the other.

- **Example**: Barnacles attaching to the shell of a turtle. The barnacles get a surface to live on and access to moving water for feeding, while the turtle is unaffected.

6. **Amensalism**

Amensalism occurs when one organism is harmed while the other is unaffected. This usually happens when one organism produces substances that inhibit the growth or survival of another organism.

- **Example**: The release of toxins by certain fungi, such as **Penicillium**, which inhibits the growth of bacteria (the basis of antibiotic production).

7. **Neutralism**

Neutralism is an interaction in which two species coexist in the same environment but do not directly affect each other. True neutralism is rare because most organisms influence each other to some degree, even indirectly.

- **Example**: A deer grazing in a field and a bird flying in the sky above are typically considered to have a neutral relationship.