

UP Board Biology - 348 (KJ) - 2025 Question Paper with Solutions

Time Allowed :3 Hours	Maximum Marks :70	Total questions :35
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General Instructions

Instruction:

- i) *All* questions are compulsory. Marks allotted to each question are given in the margin.
- ii) In numerical questions, give all the steps of calculation.
- iii) Give relevant answers to the questions.
- iv) Give chemical equations, wherever necessary.

Q1(a). Exine layer of pollen grain is made up of

- (A) Cellulose
- (B) Pectin
- (C) Sporopollenin
- (D) Xanthophyll

Correct Answer: ((C) Sporopollenin

Solution:

Step 1: Recall the structure of pollen.

Exine is the outer layer of the pollen grain and is mainly composed of a highly resistant biopolymer.

Step 2: Identify the correct compound.

- Cellulose: Found in plant cell walls, but not in exine.
- Pectin: A structural polysaccharide but not the major component of exine.
- Sporopollenin: A tough, inert substance found in the exine layer. It is highly resistant to degradation.
- Xanthophyll: A pigment, not related to exine composition.

Step 3: Conclude.

Sporopollenin is the main component of the exine layer of pollen grain.

Final Answer:

Sporopollenin

Quick Tip

Sporopollenin is one of the most resistant organic compounds, making it ideal for the exine layer.

Q1(b). Which one of the following is not a stop terminator codon?

- (A) UAA

- (B) UAG
- (C) UGA
- (D) AUG

Correct Answer: ((D) AUG

Solution:

Step 1: Define stop codons.

Stop codons signal the end of protein synthesis. The three stop codons are UAA, UAG, and UGA.

Step 2: Identify the correct answer.

- UAA: A stop codon.
- UAG: A stop codon.
- UGA: A stop codon.
- AUG: A start codon, not a stop codon.

Step 3: Conclude.

AUG is the start codon, not a stop codon.

Final Answer:

AUG

Quick Tip

AUG is known as the "start codon," signaling the initiation of translation.

Q1(c). The exaggerated response of the immune system to certain antigens present in the environment is called

- (A) Allergy
- (B) Disease
- (C) Leukaemia
- (D) All of these

Correct Answer: ((A) Allergy

Solution:

Step 1: Define allergy.

An allergy is an exaggerated immune response to harmless substances (allergens), such as pollen, dust, or food.

Step 2: Differentiate between options.

- Allergy: Caused by hypersensitivity to specific antigens.
- Disease: General term for illness, not necessarily an immune reaction.
- Leukaemia: A type of cancer, not related to immune response.

Step 3: Conclude.

The correct term for an exaggerated immune response is "allergy."

Final Answer:

Allergy

Quick Tip

Allergies are often triggered by environmental factors like pollen, dust mites, and certain foods.

Q1(d). PCR stands for

- (A) Polymerase chain reaction
- (B) Polymerase chain reproduction
- (C) Polymerase chain recombinant
- (D) None of these

Correct Answer: ((A) Polymerase chain reaction

Solution:

Step 1: Define PCR.

PCR (Polymerase Chain Reaction) is a method used to amplify DNA sequences, making it easier to analyze.

Step 2: Identify the correct term.

- Polymerase chain reaction: Correct term for the DNA amplification process.
- Polymerase chain reproduction: Incorrect term.
- Polymerase chain recombinant: Not the correct term.

Step 3: Conclude.

The correct answer is Polymerase chain reaction.

Final Answer:

Polymerase chain reaction

Quick Tip

Quick Tip: PCR is widely used in genetic research, diagnostics, and forensics to replicate specific DNA segments.

Q2(a). What are the finger-like projections on the edges of the infundibulum called?

Solution:

Step 1: Define the structure.

The infundibulum is a part of the fallopian tube in mammals. It has finger-like projections that help in the movement of the egg.

Step 2: Identify the correct projection.

- Cilia: Small hair-like structures that help in moving the egg towards the uterus.
- Flagella: Tail-like structures used for locomotion in single-celled organisms.
- Villi: Tiny projections in the intestines that absorb nutrients.
- Pseudopodia: Temporary projections of the cytoplasm used for movement in amoeba.

Step 3: Conclude.

Cilia are the finger-like projections on the edges of the infundibulum.

Final Answer:

Cilia

Quick Tip

Cilia play a vital role in the movement of the egg and other substances in the female reproductive tract.

Q2(b). Name the flower which shows incomplete dominance.

Solution:

Step 1: Define incomplete dominance.

Incomplete dominance occurs when neither allele is completely dominant over the other, resulting in a blended phenotype.

Step 2: Identify the flower with incomplete dominance.

- Snapdragon: A classic example of incomplete dominance where red and white flowers produce pink offspring.
- Rose: Exhibits complete dominance.
- Poppy: Also shows complete dominance in color traits.
- Lily: Shows complete dominance.

Step 3: Conclude.

Snapdragon is the flower that exhibits incomplete dominance.

Final Answer:

Snapdragon

Quick Tip

Incomplete dominance results in a third phenotype, a blend of both parental traits.

Q2(c). What is double fertilization?

Solution:**Step 1: Define double fertilization.**

Double fertilization is a process unique to angiosperms where two fertilization events take place.

Step 2: Identify the process.

- One sperm fuses with the egg cell to form the zygote.
- The other sperm fuses with the two polar nuclei to form the triploid endosperm.

Step 3: Conclude.

Double fertilization involves two sperm cells, with one fertilizing the egg and the other forming the endosperm.

Final Answer:

Fertilization in angiosperms where one sperm fuses with the egg and the other with the two polar nuclei.

Quick Tip

Double fertilization is essential for the formation of the seed in angiosperms.

Q2(d). If the sequence of one strand of DNA is written as follows: 5' - ATGC ATGC ATGC ATGC ATGC - 3', write down the sequence of the complementary strand in 3' → 5' direction.

Solution:**Step 1: Recall complementary base pairing.**

Adenine (A) pairs with Thymine (T), and Guanine (G) pairs with Cytosine (C).

Step 2: Write the complementary strand.

- A pairs with T, T pairs with A, G pairs with C, and C pairs with G.

Step 3: Complete the strand.

The complementary strand will read: 3' - TACG TACG TACG TACG TACG - 5'.

Final Answer:

3' - TACGTACGTACGTACGTACG - 5'

Quick Tip

Remember the base pairing rule: A-T and G-C for DNA.

Q2(e). What does ELISA stand for?

Solution:

Step 1: Define ELISA.

ELISA is a test used to detect the presence of antibodies or antigens in a sample using an enzyme-linked antigen or antibody.

Step 2: Break down the acronym.

- Enzyme: A protein that catalyzes reactions. - Linked: The enzyme is linked to the antigen or antibody. - Immunosorbent: Refers to the binding of the antibody or antigen. - Assay: A test or analysis.

Step 3: Conclude.

ELISA stands for Enzyme-linked immunosorbent assay.

Final Answer:

Enzyme-linked immunosorbent assay

Quick Tip

ELISA is widely used in diagnostic labs to detect infections and diseases.

Q3(a). Write the difference between DNA and RNA.

Solution:

Step 1: Define DNA and RNA. - DNA (Deoxyribonucleic Acid) is a double-stranded molecule that carries genetic information. It is found in the nucleus of eukaryotic cells. - RNA (Ribonucleic Acid) is a single-stranded molecule that plays a role in protein synthesis and gene expression. It can be found in the nucleus and cytoplasm.

Step 2: Compare their structure. - DNA contains deoxyribose sugar, whereas RNA contains ribose sugar. - DNA has thymine (T) as one of its nitrogenous bases, while RNA has uracil (U) instead of thymine.

Step 3: Functions. - DNA stores and transmits genetic information. - RNA helps in protein synthesis and gene regulation.

Final Answer: The main difference between DNA and RNA lies in their structure and function. DNA is double-stranded, contains deoxyribose, and uses thymine, while RNA is single-stranded, contains ribose, and uses uracil.

Quick Tip

DNA is responsible for genetic storage, while RNA plays a crucial role in protein synthesis and gene expression.

Q3(b). Define population and community.

Solution:

Step 1: Define Population. - A population refers to a group of individuals of the same species living in a particular area or habitat. They interbreed and share a common gene pool.

Step 2: Define Community. - A community is an assemblage of different populations of species that live in the same area and interact with each other.

Final Answer: - A population is a group of individuals of the same species in a specific area, while a community consists of various species living and interacting in the same area.

Quick Tip

In ecology, a population refers to individuals of the same species, while a community includes all species interacting in a particular environment.

Q3(c). Write two useful functions of Lactic Acid Bacteria (LAB).

Solution:

Step 1: Function 1. - LAB are involved in the fermentation process, converting sugars into lactic acid. This helps preserve food and increase its shelf life.

Step 2: Function 2. - LAB also promote gut health by enhancing the balance of beneficial bacteria in the digestive system.

Final Answer: Lactic Acid Bacteria are useful in food preservation through fermentation and promoting digestive health by maintaining a healthy gut flora.

Quick Tip

LAB play a vital role in both food fermentation and supporting digestive health.

Q3(d). Draw a well-labelled diagram of DNA double helix model.

Solution:

Final Answer: The diagram represents the structure of DNA, showing the double-helix formation with complementary base pairs and sugar-phosphate backbones.

Quick Tip

DNA's double-helix structure is crucial for its stability and function in genetic information storage.

Q3(e). What do you mean by metastasis?

Solution:

Step 1: Definition. - Metastasis refers to the spread of cancer cells from their original site to other parts of the body through the bloodstream or lymphatic system.

Step 2: Process of Metastasis. - Cancer cells break away from the primary tumor, enter the bloodstream or lymphatic system, and form secondary tumors in distant organs.

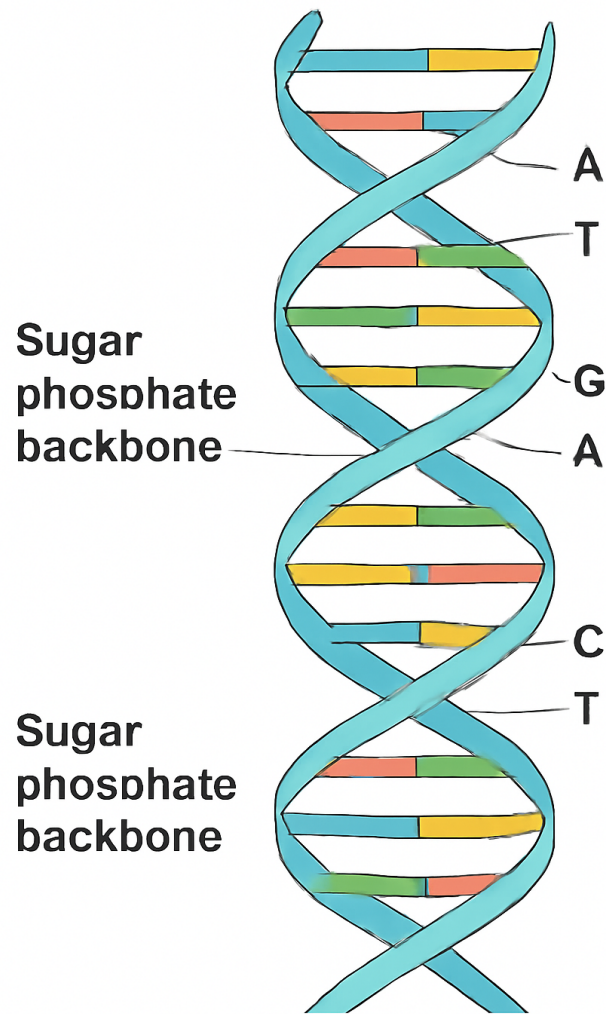


Figure 1: DNA Double Helix Model

Final Answer: Metastasis is the process by which cancer spreads from one part of the body to another, forming secondary tumors.

Quick Tip

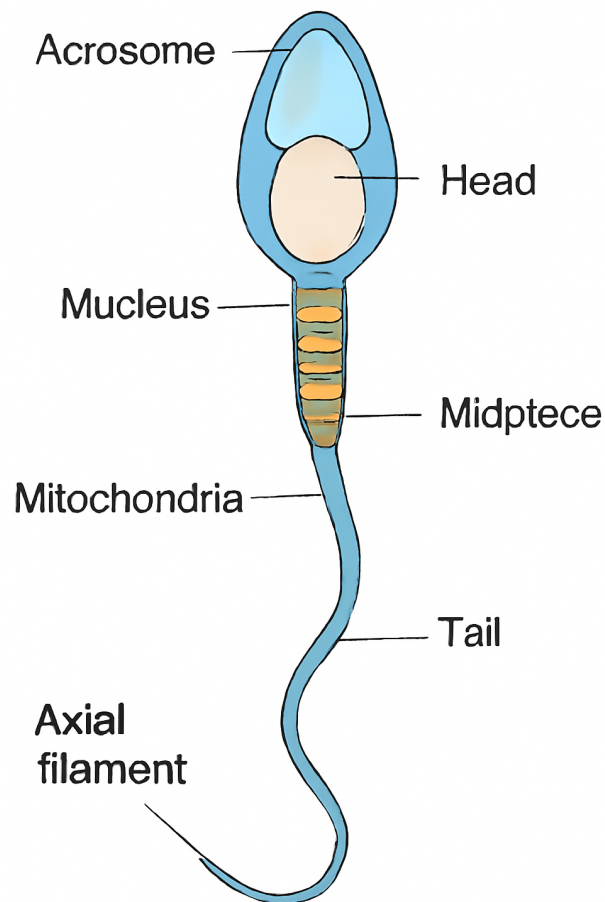
Metastasis is the key process that makes cancer dangerous, allowing it to spread to vital organs.

Q4(a). Describe the structure of human sperm with a well-labelled diagram.

Solution:

Step 1: Overview of the Sperm Structure. - The human sperm is a microscopic, motile cell with three main parts: head, middle piece, and tail.

Step 2: Describe Each Part. - ****Head****: Contains the nucleus with the genetic material (haploid DNA). It is covered by a cap-like structure called the acrosome, which contains enzymes to penetrate the egg during fertilization. - ****Middle Piece****: Contains mitochondria that provide energy for the sperm's movement. - ****Tail (Flagellum)****: A long whip-like structure that enables the sperm to swim towards the egg.



Final Answer: The human sperm consists of a head (with genetic material and acrosome), middle piece (with mitochondria), and a tail (for motility).

Quick Tip

The acrosome in the sperm head plays a critical role in fertilizing the egg by breaking through the egg's outer membrane.

Q4(b). Explain the causes of Klinefelter's syndrome. Also mention the symptoms of this syndrome.

Solution:

Step 1: Causes of Klinefelter's Syndrome. - Klinefelter's syndrome is caused by a genetic anomaly where a male is born with an extra X chromosome, resulting in a 47,XXY karyotype instead of the typical 46,XY. - This syndrome occurs due to non-disjunction during meiosis in one of the parents, leading to an extra X chromosome in the sperm or egg.

Step 2: Symptoms of Klinefelter's Syndrome. - Males with Klinefelter's syndrome often have reduced testosterone levels, leading to delayed puberty, infertility, and gynecomastia (development of breast tissue). - They may also experience learning difficulties, particularly with language and motor skills.

Final Answer: Klinefelter's syndrome occurs due to the presence of an extra X chromosome (47,XXY), and its symptoms include infertility, delayed puberty, gynecomastia, and learning difficulties.

Quick Tip

Klinefelter's syndrome is one of the most common chromosomal disorders but often goes undiagnosed due to mild symptoms.

Q4(c). Describe the important enzymes required for genetic engineering.

Solution:

Step 1: Introduction to Genetic Engineering. - Genetic engineering involves manipulating an organism's DNA, which requires the use of specific enzymes that can cut, join, and replicate DNA.

Step 2: List of Important Enzymes. - **Restriction Enzymes (Endonucleases)**: These enzymes cut DNA at specific sequences, allowing scientists to isolate and manipulate genes. - **Ligases**: These enzymes join DNA fragments by forming phosphodiester bonds, enabling the insertion of a gene into a vector. - **Polymerase (e.g., Taq polymerase)**: Used in PCR (Polymerase Chain Reaction) to replicate specific DNA sequences for analysis. - **Reverse Transcriptase**: Converts RNA into complementary DNA (cDNA), used for studying gene expression.

Final Answer: Key enzymes for genetic engineering include restriction enzymes (for cutting DNA), ligases (for joining DNA), polymerase (for amplifying DNA), and reverse transcriptase (for making cDNA).

Quick Tip

Restriction enzymes act as molecular scissors, cutting DNA at specific sequences, which is crucial for gene manipulation.

Q4(d). What are the major causes of the loss of biodiversity?

Solution:

Step 1: Overview of Biodiversity Loss. - Biodiversity loss refers to the reduction in the variety and variability of life on Earth, leading to ecosystem instability and environmental degradation.

Step 2: Major Causes of Biodiversity Loss. - **Habitat Destruction**: Deforestation, urbanization, and agriculture destroy natural habitats, reducing the space for wildlife. - **Climate Change**: Global warming alters ecosystems and disrupts species' ability to adapt or migrate. - **Pollution**: Chemical pollutants, plastic waste, and toxins can contaminate ecosystems, harming wildlife. - **Overexploitation**: Overfishing, hunting, and logging deplete natural resources faster than they can regenerate. - **Invasive**

Species:** Non-native species introduced to new environments can outcompete or prey on native species, disrupting ecosystems.

Final Answer: The major causes of biodiversity loss include habitat destruction, climate change, pollution, overexploitation, and the introduction of invasive species.

Quick Tip

Conserving biodiversity requires addressing both the causes of habitat destruction and the impacts of climate change and pollution.

Q5(a). What are cleistogamous flowers? Can cross-pollination occur in cleistogamous flowers? State the reasons.

Solution:

Step 1: Define Cleistogamous Flowers. - Cleistogamous flowers are a type of flower that remains closed throughout their life and do not open up for pollination. These flowers self-pollinate due to their closed nature.

Step 2: Cross-Pollination in Cleistogamous Flowers. - Cross-pollination cannot occur in cleistogamous flowers as their anthers and stigma are within the closed flower and do not interact with external pollinators. Therefore, pollination occurs within the same flower (self-pollination).

Step 3: Reasons for Non-Occurrence of Cross-Pollination. - The closed nature of cleistogamous flowers prevents the transfer of pollen from one flower to another, eliminating the possibility of cross-pollination.

Final Answer: Cleistogamous flowers are self-pollinating flowers that remain closed and do not permit cross-pollination.

Quick Tip

Cleistogamous flowers have evolved to ensure self-pollination, which guarantees reproduction in the absence of pollinators.

Q5(b). What is biofertilizer? A farmer is advised to add a culture of which bacterium before sowing? How is this bacterium useful to the crop?

Solution:

Step 1: Define Biofertilizer. - Biofertilizers are substances that contain living microorganisms, which promote plant growth by enhancing the availability of nutrients to the plant. These include bacteria, fungi, and algae.

Step 2: Bacterium Culture for Sowing. - A farmer is often advised to add a culture of **Rhizobium** bacteria before sowing.

Step 3: Role of Rhizobium in Crop Growth. - Rhizobium bacteria form a symbiotic relationship with leguminous plants, fixing atmospheric nitrogen into a usable form for the plant. This enhances the nitrogen content in the soil, reducing the need for synthetic fertilizers and promoting plant growth.

Final Answer: Biofertilizers are microbial cultures that aid plant growth. Rhizobium bacteria help in nitrogen fixation, providing essential nutrients to the crops.

Quick Tip

Rhizobium is a vital biofertilizer for leguminous crops, as it helps fix atmospheric nitrogen into the soil.

Q5(c). What is gene therapy? Illustrate this using the example of adenosine deaminase (ADA) deficiency.

Solution:

Step 1: Define Gene Therapy. - Gene therapy is a technique that involves altering or replacing defective genes in an individual's cells to treat or prevent disease.

Step 2: Example of ADA Deficiency. - **Adenosine deaminase (ADA) deficiency** is a genetic disorder caused by a mutation in the gene encoding the ADA enzyme, which is critical for breaking down toxic substances in the body.

Step 3: Application of Gene Therapy for ADA Deficiency. - In gene therapy for ADA deficiency, normal ADA genes are introduced into the patient's cells, typically through viral vectors. This helps the patient's immune system function normally by producing the missing enzyme.

Final Answer: Gene therapy for ADA deficiency involves replacing the defective ADA gene with a normal one, restoring the enzyme's function and improving the patient's immune system.

Quick Tip

Gene therapy holds promise for treating genetic disorders by directly correcting the defective genes responsible for diseases.

Q5(d). Define any two of the following: ((A) Commensalism ((B) Logistic growth ((C) Parasitism

Solution:

Step 1: Define Commensalism. - ****Commensalism**** is a type of symbiotic relationship where one organism benefits while the other is neither helped nor harmed. For example, barnacles on the skin of whales benefit from water currents, while the whale remains unaffected.

Step 2: Define Logistic Growth. - ****Logistic growth**** describes population growth that is initially exponential but slows as the population reaches the carrying capacity of its environment. It is represented by the sigmoid curve.

Final Answer: - Commensalism is a relationship where one organism benefits and the other is unaffected. - Logistic growth refers to population growth that slows as it reaches the environment's carrying capacity.

Quick Tip

In commensalism, one organism benefits without affecting the other, while logistic growth involves the slowing of growth as resources become limited.

Q6(a). Write the important goals of Human Genome Project (HGP).

Solution:

Step 1: Overview of HGP. - The Human Genome Project (HGP) was an international research initiative aimed at sequencing the entire human genome.

Step 2: Goals of HGP. - ****Identify all human genes****: The HGP aimed to identify all the approximately 20,000-25,000 genes in human DNA. - ****Determine the sequence of base pairs****: The project aimed to determine the sequence of the 3 billion base pairs in human DNA. - ****Map genetic diseases****: Identifying the genetic basis of diseases and understanding how genes influence disease susceptibility. - ****Improve diagnosis and treatment****: The project aimed to improve genetic testing, diagnosis, and personalized medicine.

Final Answer: The major goals of the HGP included identifying all human genes, sequencing the human genome, mapping genetic diseases, and improving medical treatments.

Quick Tip

The Human Genome Project laid the foundation for modern genetic research and personalized medicine.

Q6(b). How does the production of insulin take place in genetically modified organisms?

Solution:

Step 1: Genetic Modification of Organisms. - The production of insulin in genetically modified organisms (GMOs) involves inserting the human insulin gene into a host

organism's DNA, usually bacteria like *Escherichia coli* or yeast.

Step 2: Process of Insulin Production. - **Gene Isolation**: The human gene responsible for producing insulin (proinsulin) is isolated. - **Gene Insertion**: The gene is inserted into the DNA of a bacterial plasmid (a small, circular piece of DNA). - **Transformation**: The recombinant plasmid is introduced into bacterial cells. - **Protein Production**: The genetically modified bacteria are cultured, and they begin to produce insulin. - **Harvesting**: The insulin is then purified from the culture medium and used for medical purposes.

Final Answer: Insulin production in GMOs involves inserting the human insulin gene into bacteria or yeast, which then produce the protein, which is later harvested and purified.

Quick Tip

The use of genetically modified bacteria for insulin production revolutionized diabetes treatment by providing a reliable, cost-effective source of insulin.

Q6(c). Describe mutualism with the help of the wasp-fig relationship.

Solution:

Step 1: Define Mutualism. - Mutualism is a symbiotic relationship where both organisms involved benefit from the interaction.

Step 2: Wasp-Fig Mutualism. - In the **wasp-fig relationship**, the fig tree provides a home and food (figs) to the wasps. - The wasps, in turn, pollinate the fig tree by transferring pollen as they enter the fig's flowers to lay their eggs.

Step 3: Role of Each Organism. - **Fig Tree**: Provides shelter and food for the wasps' larvae. - **Wasp**: Pollinates the fig tree, allowing it to reproduce.

Final Answer: The wasp-fig relationship is an example of mutualism where both the fig tree and the wasp benefit—fig trees receive pollination, and wasps get food and a place to lay eggs.

Quick Tip

In mutualism, both species involved benefit from the relationship, as seen in the wasp-fig interaction.

Q6(d). Describe in brief the exponential growth curve with the help of a suitable example.

Solution:

Step 1: Define Exponential Growth. - Exponential growth occurs when the growth rate of a population is proportional to the current population size, leading to rapid increase over time. The population grows without any limitation (in ideal conditions).

Step 2: Characteristics of Exponential Growth. - Exponential growth is depicted as a J-shaped curve. It starts slow, but as the population increases, the growth accelerates exponentially. - Formula:

$$N(t) = N_0 e^{rt}$$

where $N(t)$ is the population size at time t , N_0 is the initial population size, r is the rate of growth, and t is the time.

Step 3: Example of Exponential Growth. - ****Bacteria in a culture****: In a controlled environment with unlimited resources, bacteria reproduce rapidly through binary fission, causing the population to grow exponentially.

Final Answer: Exponential growth occurs when a population grows at a constant rate, leading to rapid increases over time, as seen in bacterial cultures under ideal conditions.

Quick Tip

Exponential growth is characteristic of populations that have unlimited resources and no environmental constraints.

Q7. Explain the formation of Embryo sac with the help of a diagram.

Solution:

Step 1: Overview of Embryo Sac Formation. - The embryo sac is formed in the ovule of a flower during the process of female gametogenesis. It is produced through a series of stages starting from the megaspore mother cell.

Step 2: Stages of Embryo Sac Formation. 1. **Megaspore Mother Cell**: The diploid megaspore mother cell undergoes meiosis to form four haploid megaspores. 2.

Degeneration: Three of the four megaspores degenerate, leaving one functional megaspore. 3. **Mitotic Divisions**: The functional megaspore undergoes three successive mitotic divisions, resulting in eight nuclei. 4. **Formation of Embryo Sac**: These eight nuclei arrange themselves as follows: - One nucleus becomes the egg cell. - Two nuclei become the synergids. - One central nucleus becomes the central cell with two polar nuclei. - The remaining three nuclei become the antipodal cells.

Step 3: Diagram of Embryo Sac Formation.

Final Answer: The embryo sac is formed by meiosis and mitotic divisions of the megaspore mother cell, leading to the formation of eight haploid nuclei, which arrange into a mature embryo sac.

Quick Tip

The embryo sac is crucial for fertilization, as it houses the egg cell, which will fuse with the male gamete during fertilization.

OR

Q7. Write short notes on any two of the following:

((A) Red Data Book

Solution:

Step 1: Define Red Data Book. - The **Red Data Book** is a publication that contains information about the conservation status of plant and animal species. It categorizes species based on their risk of extinction.

Step 2: Categories in Red Data Book. - The Red Data Book classifies species into different categories such as: - **Extinct**: Species that no longer exist. - **Endangered**: Species

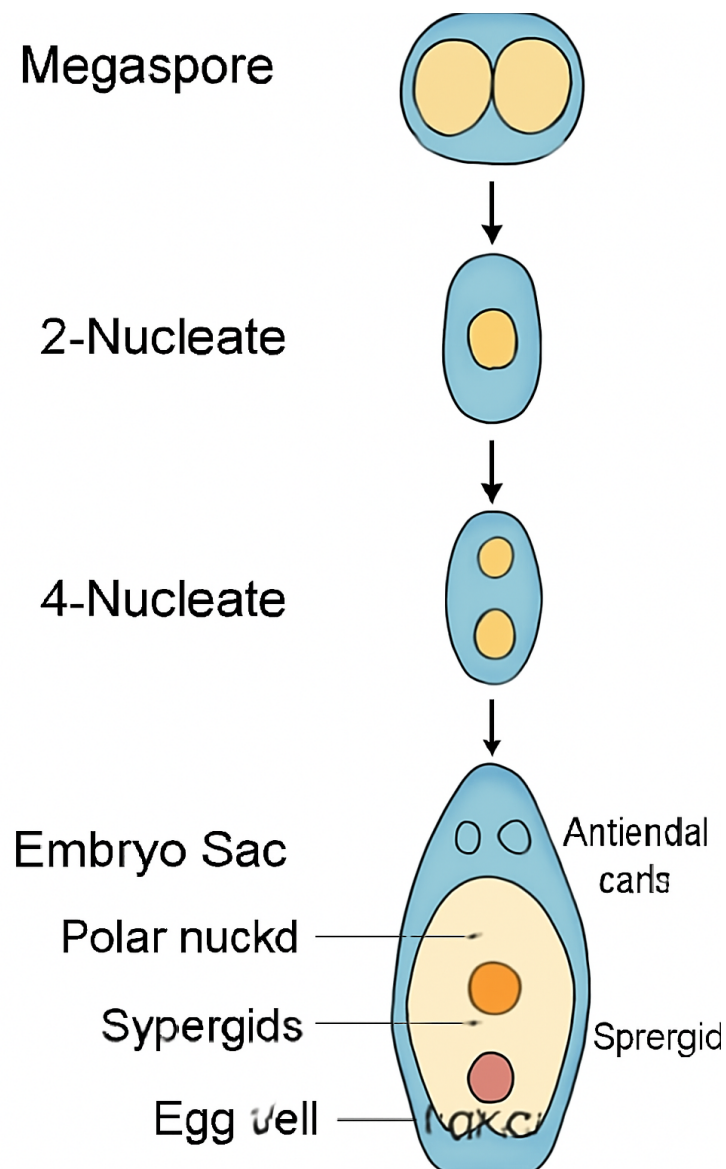


Figure 2: Formation of Embryo Sac

at risk of extinction in the near future. - ****Vulnerable****: Species that are likely to become endangered if not protected. - ****Rare****: Species with a very small population but not yet threatened with extinction.

Step 3: Importance of Red Data Book. - The Red Data Book helps in prioritizing conservation efforts and provides valuable data for protecting biodiversity.

Final Answer: The Red Data Book documents species at risk of extinction, helping guide conservation efforts for biodiversity preservation.

Quick Tip

The Red Data Book plays a crucial role in raising awareness about endangered species and informing conservation strategies.

((B) Pollen Grain

Solution:

Step 1: Define Pollen Grain. - A **pollen grain** is the male gametophyte in seed plants. It carries the male reproductive cells (sperm cells) and is involved in the fertilization process.

Step 2: Structure of Pollen Grain. - The pollen grain consists of two main parts: - **Outer Layer (Exine)**: A tough, protective outer covering made of sporopollenin. - **Inner Layer (Intine)**: A thinner inner layer that helps the pollen grain germinate.

Step 3: Function of Pollen Grain. - Pollen grains are transferred from one flower to another (pollination), where they germinate on the stigma to release sperm cells for fertilization.

Final Answer: Pollen grains are male gametophytes that contain sperm cells and are responsible for fertilizing the ovule during plant reproduction.

Quick Tip

Pollen grains are vital for cross-pollination, which increases genetic diversity in plant populations.

((C) Emasculation

Solution:

Step 1: Define Emasculation. - **Emasculation** is the process of removing the male reproductive organs (anthers) from a flower to prevent self-pollination.

Step 2: Purpose of Emasculation. - Emasculation is often performed in controlled breeding experiments to ensure that pollination occurs with pollen from another flower (cross-pollination).

Step 3: Method of Emasculation. - The anthers are carefully removed before they release pollen, ensuring that only controlled pollination can occur.

Final Answer: Emasculation is the removal of anthers from flowers to prevent self-pollination, ensuring cross-pollination in controlled breeding experiments.

Quick Tip

Emasculation is a key technique in plant breeding used to control the genetic outcome of cross-pollination.

Q8. Trace the events that would take place in flowers from the time of fall of pollen grain on stigma up to completion of fertilization with the help of diagram.

Solution:

Step 1: Pollen Grain Landing on Stigma. - The process of fertilization begins when a **pollen grain** lands on the **stigma** of a flower. The stigma is sticky, allowing the pollen to adhere.

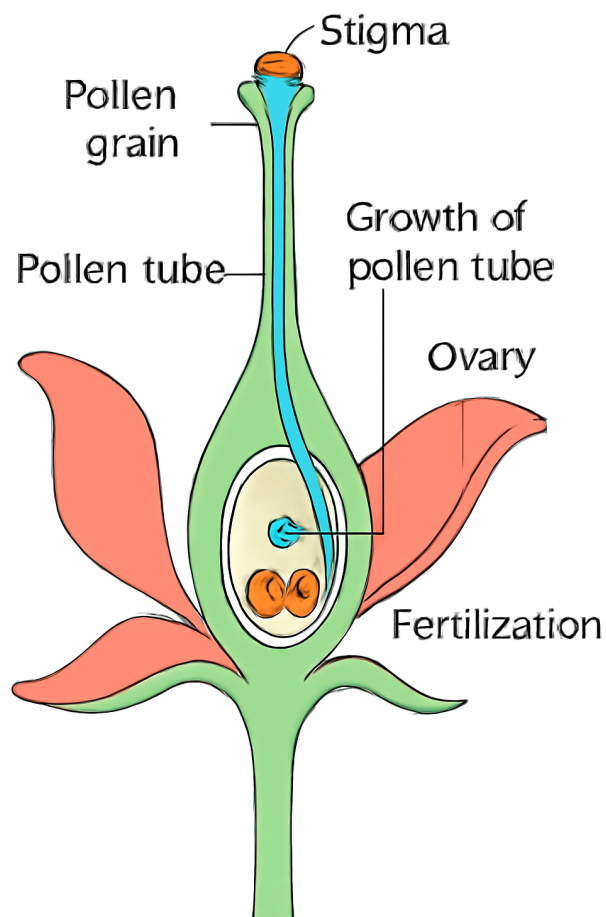
Step 2: Germination of Pollen Grain. - The pollen grain germinates on the stigma, forming a **pollen tube** that grows down the style toward the ovary.

Step 3: Growth of Pollen Tube. - The pollen tube grows through the style, carrying two sperm cells. It is guided by chemicals released from the ovule.

Step 4: Entry into Ovule. - The pollen tube enters the **micropyle** of the ovule. The tube releases two sperm cells into the ovule.

Step 5: Double Fertilization. - **Double fertilization** occurs: one sperm cell fuses with the **egg cell** to form a **zygote**, while the other sperm cell fuses with the **polar nuclei** to form the **triploid endosperm**.

Step 6: Fertilization Complete. - After fertilization, the **zygote** develops into an embryo, and the ovule develops into a seed. The fertilized ovary develops into a fruit.



Final Answer: Fertilization in plants involves pollen grain germination on the stigma, the growth of the pollen tube, double fertilization, and the development of seeds and fruits.

Quick Tip

Double fertilization in flowering plants results in the formation of both a zygote and a triploid endosperm.

OR

Q8. Describe the Hershey-Chase experiment with labelled diagram. Write the conclusion drawn by the scientists after this experiment.

Solution:

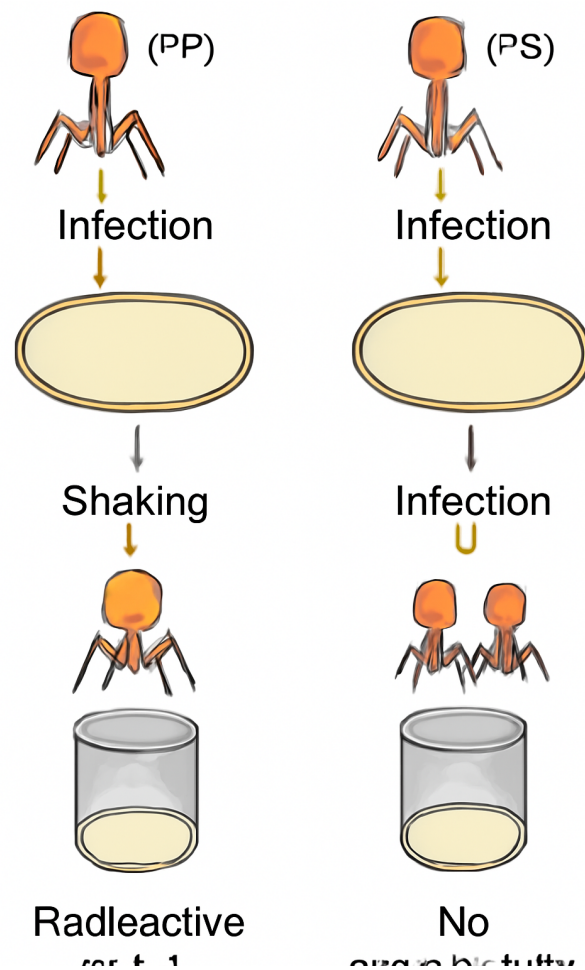
Step 1: Overview of Hershey-Chase Experiment. - The **Hershey-Chase experiment** (1952) was a landmark study that helped confirm that DNA, not protein, is the genetic material in living organisms.

Step 2: Experimental Procedure. - Hershey and Chase used **radioactive isotopes** to label DNA and protein in bacteriophages. - **Phosphorus-32 (P-32)** was used to label the DNA because DNA contains phosphorus but no sulfur. - **Sulfur-35 (S-35)** was used to label the protein coat because proteins contain sulfur but no phosphorus.

Step 3: Inoculation and Observation. - The labeled bacteriophages were allowed to infect **E. coli** bacteria. After infection, the bacteria were examined for the presence of radioactivity.

Step 4: Results. - It was observed that only the **DNA** entered the bacterial cell, while the protein coat remained outside. This indicated that DNA is the material that carries genetic information.

Step 5: Conclusion. - The Hershey-Chase experiment concluded that **DNA** is the genetic material responsible for inheritance in living organisms.



Final Answer: The Hershey-Chase experiment provided strong evidence that DNA, not protein, is the genetic material, as only labeled DNA entered bacterial cells during infection.

Quick Tip

The Hershey-Chase experiment was a critical turning point in molecular biology, establishing DNA as the genetic material.

Q9. What is Biogas? How is it produced? Name the microbe involved in biogas production.

Solution:

Step 1: Define Biogas. - **Biogas** is a renewable source of energy produced by the microbial degradation of organic matter in the absence of oxygen (anaerobic conditions). It primarily consists of **methane (CH₄)**, carbon dioxide (CO₂), and traces of other gases.

Step 2: Biogas Production Process. - Biogas is produced through the process of **anaerobic digestion** where organic waste (like plant materials, animal manure, and food waste) is broken down by microorganisms. - The process occurs in biogas digesters, where microbes decompose the organic matter and release methane gas.

Step 3: Microbe Involved in Biogas Production. - The key microorganisms involved in biogas production are **methanogens**, which are a group of archaeobacteria that produce methane during anaerobic respiration.

Final Answer: Biogas is a mixture of methane and carbon dioxide produced by anaerobic digestion of organic matter. Methanogens are the microbes responsible for biogas production.

Quick Tip

Biogas is a sustainable energy source that helps reduce greenhouse gas emissions by using waste material as fuel.

OR

Q9. Write a brief note on the role of lymphoid organs in the immune response. Elaborate the different types of lymphoid organs in the human body with examples.

Solution:

Step 1: Overview of Lymphoid Organs. - **Lymphoid organs** are specialized structures in the human body that play a crucial role in the immune response. They are involved in the production, maturation, and activation of lymphocytes, which are key components of the immune system.

Step 2: Role in Immune Response. - Lymphoid organs facilitate the recognition and elimination of pathogens by producing immune cells such as **T-cells** and **B-cells**, which are responsible for cell-mediated immunity and antibody production, respectively.

Step 3: Types of Lymphoid Organs. 1. **Primary Lymphoid Organs:** These are sites where lymphocytes are produced and mature. - **Bone Marrow:** Produces all blood cells,

including lymphocytes. B-cells mature here. - **Thymus**: T-cells mature here before migrating to secondary lymphoid organs.

2. **Secondary Lymphoid Organs**: These organs are sites where immune responses are initiated. - **Lymph Nodes**: Filter lymph fluid and provide a site for the activation of immune cells. - **Spleen**: Filters blood and helps remove old red blood cells. It also helps in activating immune responses to blood-borne pathogens. - **Mucosa-associated Lymphoid Tissue (MALT)**: Includes structures like the tonsils, Peyer's patches, and lymphoid tissue in the respiratory and digestive tracts.

Final Answer: Lymphoid organs are crucial in immune responses, with primary organs (bone marrow and thymus) producing and maturing lymphocytes, while secondary organs (lymph nodes, spleen, and MALT) activate immune responses.

Quick Tip

Primary lymphoid organs are essential for the development of immune cells, while secondary lymphoid organs activate the immune system in response to infection.