DIRECTORATE OF EDUCATION
Govt. of NCT, Delhi

SUPPORT MATERIAL
(2024-2025)

Class : XII

BIOLOGY

Under the Guidance of

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Secretary (Education)

Shri R.N. Sharma
Director (Education)

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ASHOK KUMAR
IAS

सत्यमेव जयते

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DE.5|228|Exam|Message/SM|2018|555
Dated:. 01/07/2024

MESSAGE

In the profound words of Dr. Sarvepalli Radhakrishnan, **"The true teachers are those who help us think for ourselves."**

Every year, our teams of subject experts shoulder the responsibility of updating the Support Material to synchronize it with the latest changes introduced by CBSE. This continuous effort is aimed at empowering students with innovative approaches and techniques, thereby fostering their problem-solving skills and critical thinking abilities.

I am confident that this year will be no exception, and the Support Material will greatly contribute to our students' academic success.

The development of the support material is a testament to the unwavering dedication of our team of subject experts. It has been designed with the firm belief that its thoughtful and intelligent utilization will undoubtedly elevate the standards of learning and continue to empower our students to excel in their examinations.

I wish to extend my heartfelt congratulations to the entire team for their invaluable contribution in creating this immensely helpful resource for our students.

Wishing all our students a promising and bright future brimming with success.

(ASHOK KUMAR)

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Dated: 04/07/2024

MESSAGE

It brings me great pleasure to present the support material specifically designed for students of classes IX to XII by our dedicated team of subject experts. The Directorate of Education remains resolute in its commitment to empower educators and students alike, extending these invaluable resources at no cost to students attending Government and Government-Aided schools in Delhi.

The support material epitomizes a commendable endeavour towards harmonizing content with the latest CBSE patterns, serving as a facilitative tool for comprehending, acquiring and honing essential skills and competencies stipulated within the curriculum.

Embedded within this initiative is a structured framework conducive to nurturing an analytical approach to learning and problem-solving. It is intended to prompt educators to reflect upon their pedagogical methodologies, forging an interactive conduit between students and academic content.

In the insightful words of Rabindranath Tagore, **"Don't limit a child to your own learning, for he was born in another time."**

Every child is unique, with their own interests, abilities and potential. By allowing children to learn beyond the scope of our own experiences, we support their individual growth and development, helping them to reach their full potential in their own right.

May every student embrace the joy of learning and be empowered with the tools and confidence to navigate and shape the future.

(R. N. SHARMA)

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D.O. No. DE.5/228/Exam/Message/SM/2018/570
Dated: 02/07/2024

MESSAGE

"Children are not things to be molded, but are people to be unfolded." - Jess Lair

In line with this insightful quote, the Directorate of Education, Delhi, has always made persistent efforts to nurture and unfold the inherent potential within each student. This support material is a testimony to this commitment.

The support material serves as a comprehensive tool to facilitate a deeper understanding of the curriculum. It is crafted to help students not only grasp essential concepts but also apply them effectively in their examinations. We believe that the thoughtful and intelligent utilization of these resources will significantly enhance the learning experience and academic performance of our students.

Our expert faculty members have dedicated themselves to the support material to reflect the latest CBSE guidelines and changes. This continuous effort aims to empower students with innovative approaches, fostering their problem-solving skills and critical thinking abilities.

I extend my heartfelt congratulations to the entire team for their invaluable contribution to creating a highly beneficial and practical support material. Their commitment to excellence ensures that our students are well-prepared to meet the challenges of the CBSE examinations and beyond.

Wishing you all success and fulfilment in your educational journey.

(Dr. Rita Sharma)

DIRECTORATE OF EDUCATION
Govt. of NCT, Delhi

SUPPORT MATERIAL

(2024-2025)

BIOLOGY

Class : XII

NOT FOR SALE

PUBLISHED BY : DELHI BUREAU OF TEXTBOOKS

भारत का संविधान

भाग 4क

नागरिकों के मूल कर्तव्य

अनुच्छेद 51 क

मूल कर्तव्य - भारत के प्रत्येक नागरिक का यह कर्तव्य होगा कि वह -

(क) संविधान का पालन करे और उसके आदर्शों, संस्थाओं, राष्ट्रध्वज और राष्ट्रगान का आदर करे;

(ख) स्वतंत्रता के लिए हमारे राष्ट्रीय आंदोलन को प्रेरित करने वाले उच्च आदर्शों को हृदय में संजोए रखे और उनका पालन करे;

(ग) भारत की संप्रभुता, एकता और अखंडता की रक्षा करे और उसे अक्षुण्ण बनाए रखे;

(घ) देश की रक्षा करे और आह्वान किए जाने पर राष्ट्र की सेवा करे;

(ङ) भारत के सभी लोगों में समरसता और समान भ्रातृत्व की भावना का निर्माण करे जो धर्म, भाषा और प्रदेश या वर्ग पर आधारित सभी भेदभावों से परे हो, ऐसी प्रथाओं का त्याग करे जो महिलाओं के सम्मान के विरुद्ध हों;

(च) हमारी सामासिक संस्कृति की गौरवशाली परंपरा का महत्त्व समझे और उसका परिरक्षण करे;

(छ) प्राकृतिक पर्यावरण की, जिसके अंतर्गत वन, झील, नदी और वन्य जीव हैं, रक्षा करे और उसका संवर्धन करे तथा प्राणिमात्र के प्रति दयाभाव रखे;

(ज) वैज्ञानिक दृष्टिकोण, मानववाद और ज्ञानार्जन तथा सुधार की भावना का विकास करे;

(झ) सार्वजनिक संपत्ति को सुरक्षित रखे और हिंसा से दूर रहे;

(ञ) व्यक्तिगत और सामूहिक गतिविधियों के सभी क्षेत्रों में उत्कर्ष की ओर बढ़ने का सतत् प्रयास करे, जिससे राष्ट्र निरंतर बढ़ते हुए प्रयत्न और उपलब्धि की नई ऊँचाइयों को छू सके; और

(ट) यदि माता-पिता या संरक्षक है, छह वर्ष से चौदह वर्ष तक की आयु वाले अपने, यथास्थिति, बालक या प्रतिपाल्य को शिक्षा के अवसर प्रदान करे।

Constitution of India

Part IV A (Article 51 A)

Fundamental Duties

It shall be the duty of every citizen of India —

(a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;

(b) to cherish and follow the noble ideals which inspired our national struggle for freedom;

(c) to uphold and protect the sovereignty, unity and integrity of India;

(d) to defend the country and render national service when called upon to do so;

(e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;

(f) to value and preserve the rich heritage of our composite culture;

(g) to protect and improve the natural environment including forests, lakes, rivers, wildlife and to have compassion for living creatures;

(h) to develop the scientific temper, humanism and the spirit of inquiry and reform;

(i) to safeguard public property and to abjure violence;

(j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement;

*(k) who is a parent or guardian, to provide opportunities for education to his child or, as the case may be, ward between the age of six and fourteen years.

Note: The Article 51A containing Fundamental Duties was inserted by the Constitution (42nd Amendment) Act, 1976 (with effect from 3 January 1977).

*(k) was inserted by the Constitution (86th Amendment) Act, 2002 (with effect from 1 April 2010).

भारत का संविधान

उद्देशिका

हम, भारत के लोग, भारत को एक [1][**संपूर्ण प्रभुत्व-संपन्न समाजवादी पंथनिरपेक्ष लोकतंत्रात्मक गणराज्य**] बनाने के लिए, तथा उसके समस्त नागरिकों को :

सामाजिक, आर्थिक और राजनैतिक **न्याय,**

विचार, अभिव्यक्ति, विश्वास, धर्म

और उपासना की **स्वतंत्रता,**

प्रतिष्ठा और अवसर की **समता**

प्राप्त कराने के लिए,

तथा उन **सब में**

व्यक्ति की गरिमा और [2][**राष्ट्र की एकता और अखंडता**] सुनिश्चित करने वाली **बंधुता**

बढ़ाने के लिए

दृढ़संकल्प होकर **अपनी इस संविधान सभा में** आज तारीख 26 नवंबर, 1949 ई. को **एतद्द्वारा इस संविधान को अंगीकृत, अधिनियमित और आत्मार्पित करते हैं।**

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1. संविधान (बयालीसवां संशोधन) अधिनियम, 1976 की धारा 2 द्वारा (3.1.1977 से) ''प्रभुत्व-संपन्न लोकतंत्रात्मक गणराज्य'' के स्थान पर प्रतिस्थापित।
2. संविधान (बयालीसवां संशोधन) अधिनियम, 1976 की धारा 2 द्वारा (3.1.1977 से) ''राष्ट्र की एकता'' के स्थान पर प्रतिस्थापित।

THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a [1]**[SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC]** and to secure to all its citizens :

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the [2][unity and integrity of the Nation];

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949 do **HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.**

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1. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Sovereign Democratic Republic" (w.e.f. 3.1.1977)
2. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Unity of the Nation" (w.e.f. 3.1.1977)

CLASS — XII
BIOLOGY

REVIEW COMMITTEE (2024-25)

S.No.	Name of the Official	Designation	School
1.	Mr. Pawan Kumar	Principal (Group Leader)	GCSSS MV ABLK Holambi Kalan, Delhi (1310399)
2.	Ms. Sushma Kumari	LECTURER BIOLOGY	School of Excellence Sec-17, Rohini, Delhi
3.	Mr. Jitender Sharma	LECTURER BIOLOGY	RPVV Civil Line Delhi
4.	MS. Sadab Fatima Merchant	LECTURER BIOLOGY	RPVV Sector-11 Rohini, Delhi

BIOLOGY
(Code No. 044)
Syllabus for Purpose of Examination 2024-25
CLASS – XII (2024-25)

The present curriculum provides the students with updated concepts along with an extended exposure to contemporary areas of the subject. The curriculum also aims at emphasizing the underlying principles that are common to animals, plants and microorganisms as well as highlighting the relationship of Biology with other areas of knowledge. The format of the curriculum allows a simple, clear, sequential flow of concepts. It relates the study of biology to real life through the use of technology. It links the discoveries and innovations in biology to everyday life such as environment, industry, health and agriculture. The updated curriculum focuses on understanding and application of scientific principles, while ensuring that ample opportunities and scope for learning and appreciating basic concepts continue to be available within its framework. The curriculum is expected to:

- promote understanding of basic principles of Biology
- encourage learning of emerging knowledge and its relevance to individual and society
- promote rational/scientific attitude towards issues related to population, environment and development
- enhance awareness about environmental issues, problems and their appropriate solutions
- create awareness amongst the learners about diversity in the living organisms and developing respect for other living beings
- appreciate that the most complex biological phenomena are built on essentially simple processes

It is expected that the students would get an exposure to various branches of Biology in the curriculum in a more contextual and systematic manner as they study its various units.

BIOLOGY (Code No. 044)
CLASS XII (2024 -25) (THEORY)
COURSE STRUCTURE
THEORY

Time: 03 Hours **Max. Marks: 70**

Units	Title	Marks
VI	Reproduction: Chapters - 1, 2 and 3	16
VII	Genetics and Evolution: Chapters – 4, 5, and 6	20
VIII	Biology and Human Welfare: Chapters – 7 and 8	12
IX	Biotechnology and its Applications: Chapters – 9 and 10	12
X	Ecology and Environment: Chapter – 11, 12 and 13	10
	Total	70

Unit-VI Reproduction

Chapter-2: Sexual Reproduction in Flowering Plants

Flower structure; development of male and female gametophytes; pollination - types, agencies and examples; outbreeding devices; pollen-pistil interaction; double fertilization; post fertilization events - development of endosperm and embryo, development of seed and formation of fruit; special modes- apomixis, parthenocarpy, polyembryony; Significance of seed dispersal and fruit formation.

Chapter-3: Human Reproduction

Male and female reproductive systems; microscopic anatomy of testis and ovary; gametogenesis - spermatogenesis and oogenesis; menstrual cycle; fertilisation, embryo development upto blastocyst formation, implantation; pregnancy and placenta formation (elementary idea); parturition (elementary idea); lactation (elementary idea).

Chapter-4: Reproductive Health

Need for reproductive health and prevention of Sexually Transmitted Diseases (STDs); birth control - need and methods, contraception and medical termination of pregnancy (MTP); amniocentesis; infertility and assisted reproductive technologies - IVF, ZIFT, GIFT (elementary idea for general awareness).

Unit-VII Genetics and Evolution

Chapter-5: Principles of Inheritance and Variation

Heredity and variation: Mendelian inheritance; deviations from Mendelism – incomplete dominance, co-dominance, multiple alleles and inheritance of blood groups, pleiotropy; elementary idea of polygenic inheritance; chromosome theory of inheritance; chromosomes and genes; Sex determination - in human being, birds and honey bee; linkage and crossing over; sex linked inheritance - haemophilia, colour blindness; Mendelian disorders in humans -thalassemia; chromosomal disorders in humans; Down's syndrome, Turner's and Klinefelter's syndromes.

Chapter-6: Molecular Basis of Inheritance

Search for genetic material and DNA as genetic material; Structure of DNA and RNA; DNA packaging; DNA replication; Central Dogma; transcription, genetic code, translation; gene expression and regulation - lac operon; Genome, Human and rice genome projects; DNA fingerprinting.

Chapter-7: Evolution

Origin of life; biological evolution and evidences for biological evolution (paleontology, comparative anatomy, embryology and molecular evidences); darwin's contribution, modern synthetic theory of evolution; mechanism of evolution - variation (mutation and recombination) and natural selection with examples, types of natural selection; Gene flow and genetic drift; Hardy-weinberg's principle; adaptive radiation; human evolution.

Unit-VIII Biology and Human Welfare

Chapter-8: Human Health and Diseases

Pathogens; parasites causing human diseases (malaria, dengue, chikungunya, filariasis, ascariasis, typhoid, pneumonia, common cold, amoebiasis, ring worm) and their control; Basic concepts of immunology - vaccines; cancer, HIV and AIDS; Adolescence - drug and alcohol abuse.

Chapter-10: Microbes in Human Welfare

Microbes in food processing, industrial production, sewage treatment, energy generation and microbes as bio-control agents and bio-fertilizers. Antibiotics; production and judicious use.

Unit-IX Biotechnology and its Applications

Chapter-11: Biotechnology - Principles and Processes

Genetic Engineering (Recombinant DNA Technology).

Chapter-12: Biotechnology and its Application

Application of biotechnology in health and agriculture: Human insulin and vaccine production, stem cell technology, gene therapy; genetically modified organisms - Bt crops; transgenic animals; biosafety issues, biopiracy and patents.

Unit-X Ecology and Environment

Chapter-13: Organisms and Populations

Population interactions - mutualism, competition, predation, parasitism; population attributes - growth, birth rate and death rate, age distribution. (Topics excluded: Organisms and its Major Aboitic factors, Responses to Abioitic factors, Adaptations)

Chapter-14: Ecosystem

Ecosystem: Patterns, components; productivity and decompostion; energy flow; pyramids of number, biomass, energy (Topics excluded: Ecological Succession and Nutrient cycles)

Chapter-15: Biodiversity and its Conservation

Biodiversity - Concept, patterns, importance; loss of biodiversity; biodiversity conservation; hotspots, endangered organisms, extinction, Red Data Book, Sacred Groves, biosphere reserves, national parks, wildlife, sanctuaries and Ramsar sites.

PRACTICALS

Time allowed: 3 Hours **Max. Marks: 30**

Evaluation Scheme		
One Major Experiment 5		**5**
One Major Experiment 2 & 3		**4**
Slide Preparation 1 & 4		**5**
Spotting		**7**
Practical Record + Viva Voce	(Credit to the students' work over the academic session may be given)	**4**
Investigatory Project and its Project Record + Viva Voce		**5**
Total		**30**

A. List of Experiments

1. Prepare a temporary mount to observe pollen germination.
2. Study the plant population density by quadrat method.
3 Study the plant population frequency by quadrat method.
4. Prepare a temporary mount of onion root tip to study mitosis.
5. Isolate DNA from available plant material such as spinach, green pea seeds, papaya, etc

B. Study/observation of the following (Spotting)

1. Flowers adapted to pollination by different agencies (wind, insects, birds).
2. Pollen germination on stigma through a permanent slide or scanning electron micrograph
3. Identification of stages of gamete development, i.e., T.S. of testis and T.S. of ovary through permanent slides (from grasshopper/mice).
4. Meiosis in onion bud cell or grasshopper testis through permanent slides.
5. T.S. of blastula through permanent slides (Mammalian).
6. Mendelian inheritance using seeds of different colour/sizes of any plant.
7. Prepared pedigree charts of any one of the genetic traits such as rolling of tongue, blood groups, ear lobes, widow's peak and colour blindness.
8. Controlled pollination - emasculation, tagging and bagging.

9. Common disease - causing organisms like Ascaris, Entamoeba, Plasmodium, any fungus causing ringworm through permanent slides, models or virtual images. Comment on symptoms of diseases that they cause.

10. Models specimen showing symbolic association in root modules of leguminous plants, cuscuta on host, lichens.

11. Flash cards models showing examples of homologous and analogous organs.

Practical Examination for Visually Impaired Students of Classes XI and XII

Evaluation Scheme

Time: 02 Hours **Max. Marks: 30**

Topic	MARKS
Identification/Familiarity with the apparatus	**5**
Written test (Based on given/prescribed practicals)	**10**
Practical Records	**5**
Viva	**10**
Total	**30**

General Guidelines

- The practical examination will be of one-hour duration.
- The written examination in practicals for these students will be conducted at the time of practical examination of all other students.
- The written test will be of 30 minutes duration.
- The question paper given to the students should be legibly typed. It should contain a total of 15 practical skill based very short answer type questions. A student would be required to answer any 10 questions.
- A writer may be allowed to such students as per CBSE examination rules.
- All questions included in the question paper should be related to the listed practicals. Every question should require about two minutes to be answered.

- These students are also required to maintain a practical file. A student is expected to record the listed experiments Term -wise as per the specific instructions for each subject. These practicals should be duly checked and signed by the internal examiner.
- The format of writing any experiment in the practical file should include aim, apparatus required, simple theory, procedure, related practical skills, precautions etc.
- Questions may be generated jointly by the external/internal examiners and used for assessment.
- The viva questions may include questions based on basic theory/principle/concept, apparatus/materials/chemicals required, procedure, precautions, sources of error etc.

Class XII

A. Items for Identification/ familiarity with the apparatus for assessment in practicals (All experiments)

- Beaker, flask, petriplates, Soil from different sites- sandy, clayey, loamy; Small potted plants, aluminium foil, paint brush, test tubes, Starch solution, iodine, ice cubes. bunsen, burner/spirit lamp/water bath.Large flowers, Maize inflorescence. Model of developmental stages morula and blastula of frog, beads/seeds of different shapes/size/texture Ascaris, Cactus/opuntia (model).

B. List of Practicals

1. Study of flowers adapted to pollination by different agencies (wind, insects).
2. Identification of T.S of morula or blastula of frog (model).
3 Study of the soil obtained from at least two different sites for their texture.
4. Preparation of pedigree charts of genetic traits such as rolling of tongue, colour blindness.
5. Study of emasculation, tagging and bagging by trying out an exercise on controlled pollination
6. Identify common disease-causing organisms like Ascaris (Model) and learn some common symptoms of the disease that they cause.
7. Comment upon the morphological adaptations of plants found in xerophytic conditions.

Note: The above practicals may be carried out in an experiential manner rather than recording observations.

Prescribed Books:

1. Biology, Class-XII, Published by NCERT
2. Other related books and manuals brought out by NCERT (including multimedia)
3. Biology Supplementary Material (Revised). Available on CBSE website.

Question Paper Design (Theory) 2023-24
Class XII
Biology (044)

Competencies	
Demonstrate Knowledge and Understanding	**50%**
Application of Knowledge / Concepts	**30%**
Analyse, Evaluate and Create	**20%**

Note:

- Typology of questions: VSA including MCQs, Assertion-Reasoning type question; SA; LA-I; LA-II; Source-based/Case-based/Passage-based/Intergrated assessment questions.
- Internal choice of approximately 33% would be provided.

Suggestive verbs for various competencies

- **Demonstrate, Knowledge and Understanding**

  State, name, list, identify, define, suggest, describe, outline, summarize, etc.

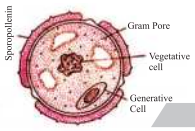
- **Application of Knowledge/Concepts**

  Calculate, illustrate, show, adapt, explain, distinguish, etc.

- **Analyze, Evaluate and Create**

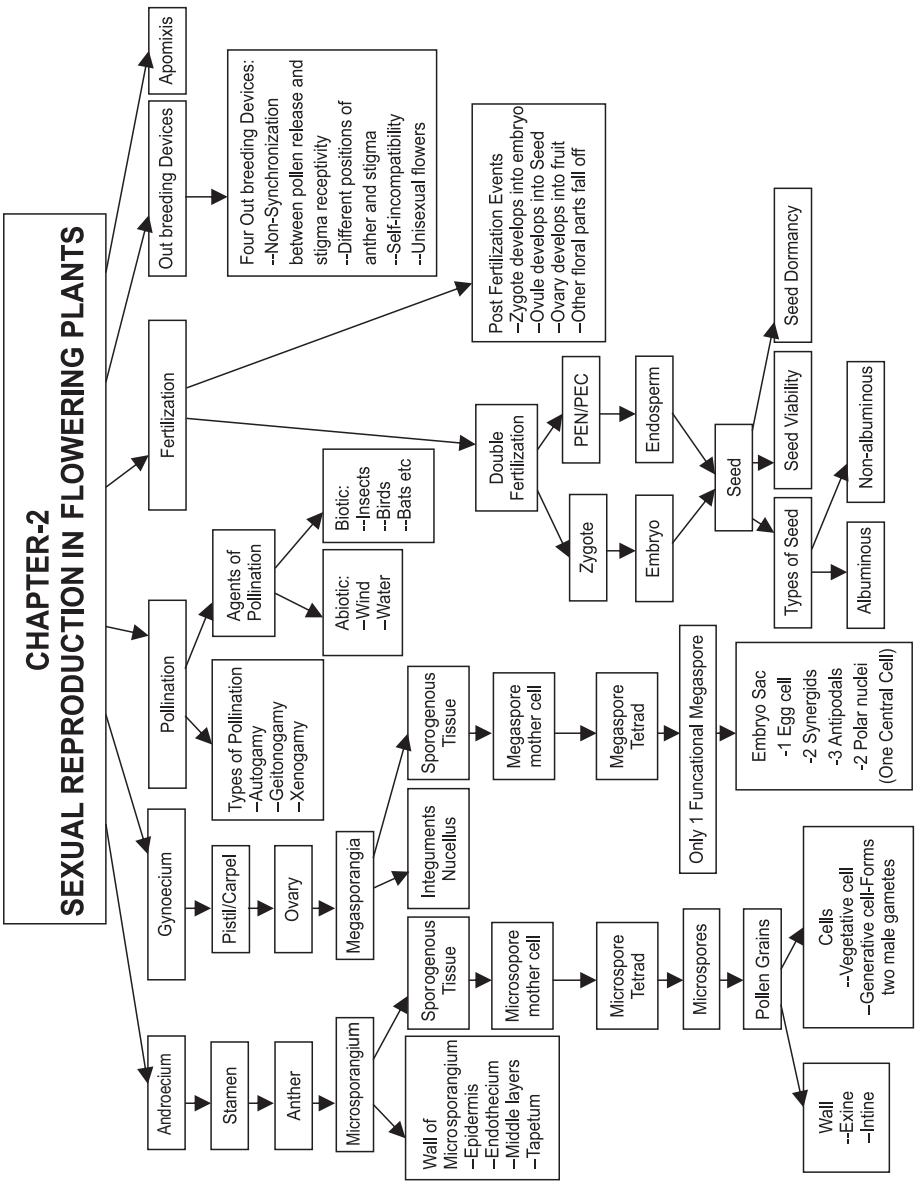
  Interpret, analyse, compare, contrast, examine, evaluate, discuss, construct, etc.

CONTENTS



Chapter - 1

Sexual Reproduction in Flowering Plants



Autogamy : When pollen grains of a flower are transferred from anther to stigma of the same flower.

Coleorhiza : A protective sheath of radicle in monocot seed.

Coleoptile : A protective sheath of plumule in monocot seed.

Perisperm : It is diploid persistent nucellus e.g. Black pepper, beet.

Nucellus : Multicellular tissue in the centre of ovule in which embryo sac is present.

Viability of Seed : Ability of seed to retain the power of germination.

Structure of Microsporangium (Pollen Sac)		
Sequence of layers	**Name of Layer**	**Function**
Outermost layers	Epidermis	Protection
Second layer	Endothecium	Protection
2-4 layers of Cells	Middle layer	Protection
Innermost layer	Tapetum multinucleate DENSE cytoplasm	Nourishment of developing microspores (pollen grains)

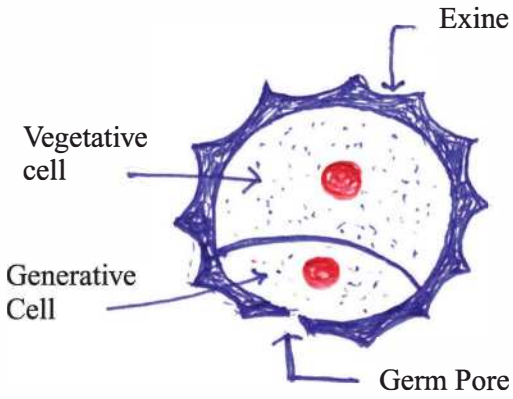
Microsporogenesis : Process of formation of microspores from a pollen mother cells.

Sporogenous tissue--> Microspore mother cell-MMC--> Microspore tetrad --> 4 Microspores --> 4 Pollen grains

[Diploid] [Diploid] [Haploid] [Haploid] [Haploid]

Pollen Grain (Male Gametophyte)		
Layers and Contents	**Name of Layers**	**Composition and Roles**
Outer wall	Exine	Thick, hard, made of sporopollenin Due to sporopollenin, pollen grains found preserved in fossils
Inner wall	Intine	Thin, made of cellulose and pectin. It emerges out as pollen tube.
Large cell	Vegetative cell	Forms a pollen tube to deliver male gametes to embryo sac
Smaller cell	Generative cell	Forms sperm cells or male gametes

Sporogenous Issue : Compactly arranged homogenous cells called as sporogenous tissue



Structure of Pollen Grain

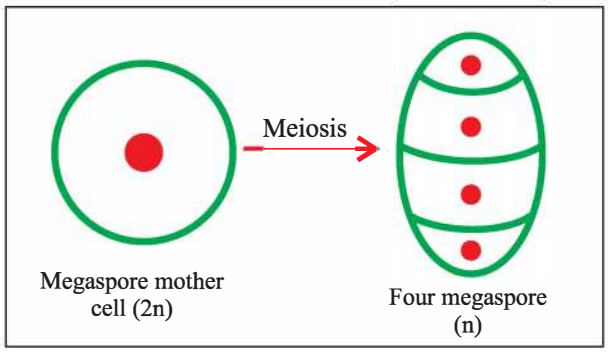
Sporopollenin is one of the most resistant organic substance. It is not affected by high temperature, strong acids or alkali. No enzyme can degrade it.

Pollen Products : Pollen grains are rich in carbohydrates, proteins and unsaturated fats. Their consumption is believed to increase performance of athlete and horses. They are used in the form of tablets and syrups.

Pollen Viability : Pollens of wheat and rice remain viable for 30 minutes. eg Pollen of some members of Rosaceae, Leguminoseae and solanaceae plant may remain viable for several months. Pollens can be cryopreserved in liquid Nitrogen (— 196°C) in pollen banks.

Pollen of carrot grass (*Parthenium*), *Chenopodium, Amaranthus* etc. may cause pollen allergy.

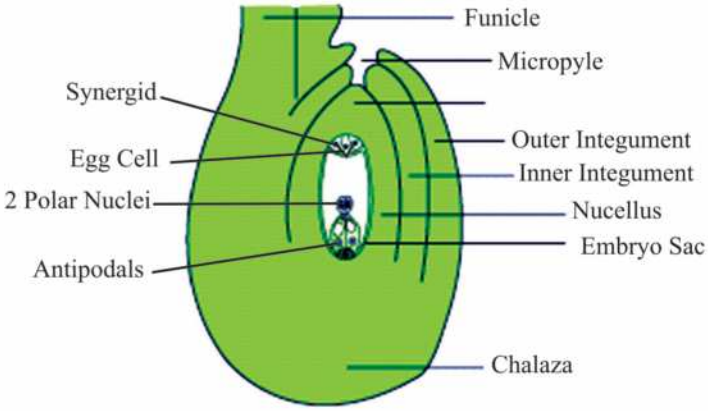
Megasporogensis : Process of formation of haploid megaspores from megaspore mother cells



Megasporangium (Ovule) :

- The ovule is a small structure which is attached to the placenta by means of a stalk called funicle.

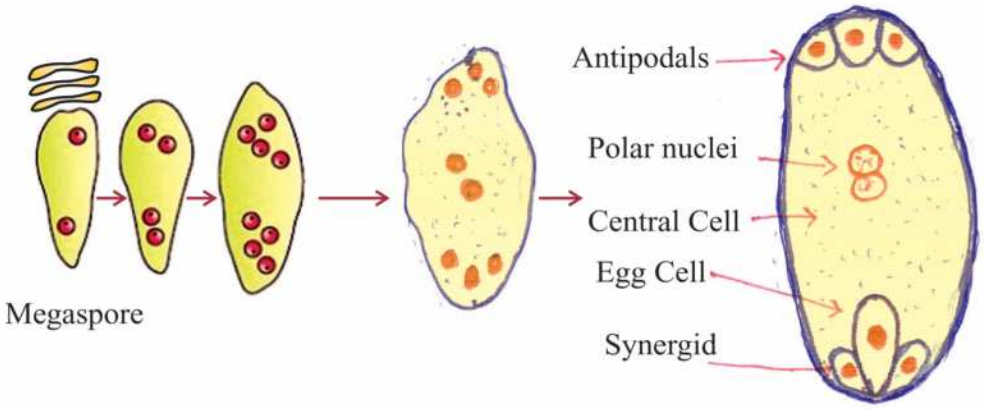
- The point of attachment of the body of the ovule to the funicle is known as hilum. The main body of the ovule is composed of parenchymatous cells known as nucellus.
- Each ovule has one or two protective integument, which encircle the ovule except at the tip having small opening called micropyle.
- Opposite to micropylar end is chalazal end
  Generally a single embryosac or female gametophyte located in nucellus.
- Cells of nucellus have abundant reserve food material and provide nourishment to the developing embryo.



Female gametophyte (embryo sac) : In a majority of flowering plant out of four megaspores one of the megaspore is functional while other three degenerate, (monosporic development)

- The functional megaspore develops in embryo sac.
- The nucleus of the functional megaspore (n) undergoes three successive mitotic cell division which results the formation of eight nucleated stage of embryo sac (free nuclear division).
- The cell wall formation starts at eight nucleated stages. Three cells are grouped together at micropylar end to form the egg apparatus (2 synergids + 1 egg cell).
- Three cells are grouped at chalazal end they are, called antipodal cells.
- The remaining 2 nuclei are polar nuclei move to the centre of embryo sac, called central cell.

  Thus, typical angiospermic embryo sac at maturity is 8 nucleate and 7 celled.



Development of Embryo Sac

TYPES OF POLLINATION		
Autogamy	**Definition**	**Special Feature**
	Transfer of pollen grain from the anther to the stigma of the same flower.	Self Pollination
Geitonogamy	Transfer of pollen grains from the anther to the stigma of another flower of the same plant.	It is functionally cross-pollination involving a pollination agent and genetically it is similar to autogamy since the pollen grains come from the same plant.
Xenogamy	Transfer of pollen grains from anther to the stigma of a different plant.	Cross Pollination

Agents of Pollination: Biotic and Abiotic agents help in pollination.

(a) Biotic Agents- Bees, flies, butterflies, wasps, moths, ants, birds, rodents, reptiles, and some primates.

(b) Abiotic Agents-Wind and water.

Types of Flowers : In some plants like Commelina, Oxalis and Viola have two types of flowers:

1. Chasmogamous Flower"

Flower remains open after maturity, both self pollination and cross pollination both can occur in the flower.

2. Cleistogamous Flower: Flower remain closed throughout their life, so, only self pollination (autogamy) occurs in such flowers.These flowers produce assured seed set even in the absence of pollinators

Out breeding Devices: Flowering plants have developed many devices called out breeding devices to discourage self pollination and to encourage cross-pollination. As continued, Self pollination leads to inbreeding depression . The types are:

(i) Non synchronization of pollen release and stigma receptivity
(ii) Position of anthers and stigma in such a way that pollen cannot come in contact of stigma of same flower.
(iii) Self-incompatibilty
(iv) Production of Unisexual flowers

Pollen—pistil interaction :

- The pistil has the ability to recognise the pollen grain, whether it is right type (Compatible) or of the wrong type (incompatible).
- If it is compatible then the pistil accepts the pollen grains.
- The pollen grains germinate on stigma to produce pollen tubes. The contents of the generative cell (or the two male gametes in those species whose pollen is liberated in the three celled stage), move into the pollen tube.
- Pollen tube grows through the tissue of stigma and style by secreting enzyme and enters the ovule, through micropyle via one of the synergid. Filiform apparatus guides the entry of pollen tube.

Double Fertilisation : The pollen tube releases two male gamete into the cytoplasm of synergid. One male gamete move towards egg cell and other male gamete towards the central cell.

- Syngamy : One male gamete + Egg cell → Zygote (2n)
- Triple Fusion : Second male gamete + 2 polar nuclei → PEN (3n)
- Since two types of fusion takes place in embryo sac, hence it is called as double fertilisation.

Post Fertilisation Events :

(i) Endosperm and embryo development

(ii) Maturation of ovule & ovary

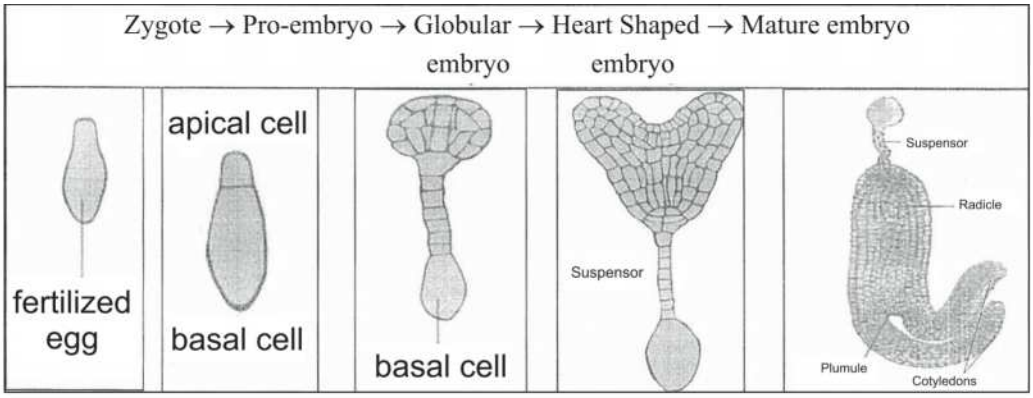
Fate of Floral Parts

Ovary (2n)	→	Fruit
Ovary Wall (2n)	→	Pericarp
Ovule (2n)	→	Seed
Outer Integument (2n)	→	Testa
Inner integument (2n)	→	Tegmen
Zygote (2n)	→	Embryo
Primary Endosperm Cell (3n)	→	Endosperm
Sepals (2n)	→	Fall down
Petals (2n)	→	Fall down
Stamens (2n)	→	Wither away
Stigma, style (2n)	→	Wither away
Nucellus	→	Consumed/may be present as Perisperm
Synergids (n)		Degenerate
Antipodal Cells (n)		Degenerate

Development of Endosperm: The primary endosperm cell (PEC) in embryo sac divide again and again, and form triploid endosperm. The cells of endosperm are filled with reserve food material which is used for nourishment of the embryo during its development and also for the young seedling at the time of germination.

PEN $\xrightarrow{\text{nuclear division}}$ Free Nuclear endosperm (e.g coconut water) $\xrightarrow{\text{Cellwall formation}}$ Cellular endosperm (e.g white kernel of coconut)

Development of Embryo: Embryo formation start after certain amount of endosperm is formed Following are the stages in development of a dicotyledonous embryo



Dicot Embryo : A typical dicot embryo consist of an embryonal axis and two cotyledons. The portion of embryonal axis above the level of cotyledons is the epicotyl and the portion below the level of cotyledons is hypocotyl.

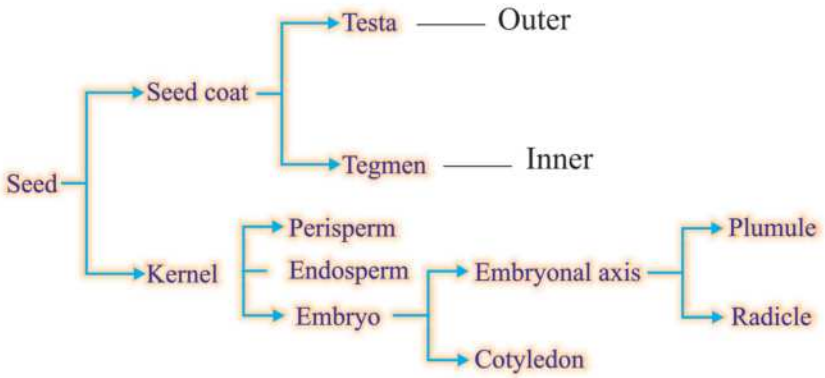
Monocot Embryo : Monocot (Rice, Maize etc.) has one cotyledon called Scutellum. The embryonal axis has the radicle and root cap enclosed by a sheath called Coleorrhiza.

The upper end (epicotyle) has plumule which is covered by hollow foliar structure called the coleoptile.

Polyembryony : Occurrence of more than one embryo in a seed, is known as polyembryony e.g. Orange, lemon, onion, mango, ground nut. It may be due to presence of more than one egg cell in the embryo sac or more than one embryo sac in the ovule.

Reasons of polyembryony : It is due to fertilisation of more than one egg cell in an ovule. The condition develop when an embryo sac contains more than one egg cell or ovule contain more than one embryo sac.

Seed : After fertilisation ovule mature into seed.



Non albuminous seed : Those seeds in which no residual endosperm is found because it is completely consumed during development of the embryo.
eg. pea, gram, ground nut.

Albuminous Seed : Those seeds, which retain a part of the endosperm because endosperm is not completely consumed by developing embryo.
eg. maize, wheat, sunflower, castor

Seed Dispersal : Seeds are dispersed to new habitat through agent like water, wind and animals.

Apomixis : Apomixis is a form of asexual reproduction that mimics sexual reproduction where seeds are formed without fertilisation.

Advantages of Apomictic Seed :

- No segregation of characters in hybrid progeny
- These seeds can be used to grow crop year after year
- These are economical as hybrid seed are not used to grow crops year after year.

Parthenocarpic fruits : The fruits which are formed (developed) without fertilisation are known as parthenocarpic fruit. Such fruits are seedless eg. Banana.

This phenomenon of development of fruit without fertilisation is known as parthenocarpy.

Questions

VSA **(1 Marks)**

1. Give the scientific name of a plant which came to India as a contaminant with imported wheat and causes pollen allergy.
2. Which characteristic of water pollinated species of pollen grains protect them from water?
3. Why are pollen grains produced in enormous quantity in maize ?
4. In some species of Asteraceae and grasses, seeds are formed without fusion of gametes. Mention the scientific term for such of reproduction.
5. If the diploid number of chromosomes in an angiospermic plant is 16. Mention number of chromosomes in the endosperm and antipodal cell.
6. Among the terms listed below, those that are not technically correct names for a floral whorl are:
   (i) Androecium (ii) Carpel (iii) Corolla (iv) Sepal
   (a) (i) and (iv)
   (b) (iii) and (iv)
   (c) (ii) and (iv)
   (d) (i) and (ii)
7. Embryo sac is to ovule as..... is to an anther
   (a) Stamen
   (b) Filament
   (c) Pollen grain
   (d) Androecium
8. In a typical complete, bisexual and hypogynous flower, the arrangement of floral whorls on the thalamus from the outermost to the innermost is
   (a) Calyx, corolla, androecium and gynoecium
   (b) Calyx, corolla, gynoecium and androecium
   (c) Gynoecium, androecium, corolla and calyx
   (d) Androecium, gynoecium, corolla and calyx

9. A dicotyledonous plant bears flowers but never produces fruits and seeds. The most probable cause for the above situation is
   (a) Plant is dioecious and bears only pistillate flowers
   (b) Plant is dioecious and bears both pistillate and staminate flowers
   (c) Plant is monoecious
   (d) Plant is dioecious and bears only staminate flowers
10. The outermost and innermost wall layers of microsporangium in an anther are respectively
   (a) Endothecium and tapetum
   (b) Epidermis and endodermis
   (c) Epidermis and middle layer
   (d) Epidermis and tapetum
11. **Assertion:** More than one embryo may also occur in a seed.
   Reason: It may be due to presence of more than one egg cell in the embryo sac or more than one sac in the ovule.
   (a) Both assertion and reason are true, and reason is the correct explanation of assertion.
   (b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
   (c) Assertion is true but reason is false.
   (d) Both assertion and reason are false.
12. **Assertion:** Apomixis is a form of asexual reproduction that mimics sexual reproduction where seeds are formed without fertilisation.
   Reason: Apomictic seeds cannot be used to grow crop year after year.
   (a) Both assertion and reason are true, and reason is the correct explanation of assertion.
   (b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
   (c) Assertion is true but reason is false
   (d) Both assertion and reason are false.

SA-I **(2 Marks)**

13. Fruits generally develops from ovary, but in few species thalamus contributes to fruit formation.
    Name the two categoris of fruits and give one example of each.
14. Among the animals, insects particularly bees are the domiant pollinating agents. List any four characteristic features of the insect pollinated flower.
15. Differentiate between geintonogamy and xenogamy.
16. In the given figure I of a dicot embryo, label the parts (A) and (B) and give their function.

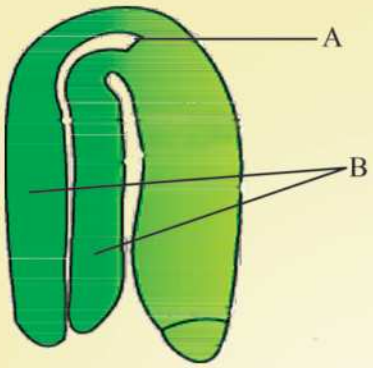


Figure 1

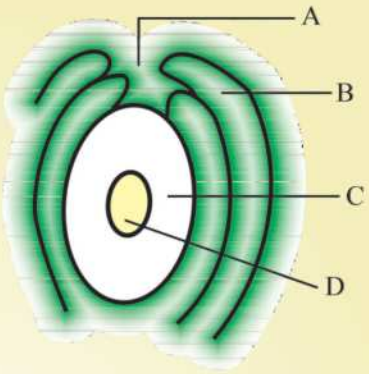
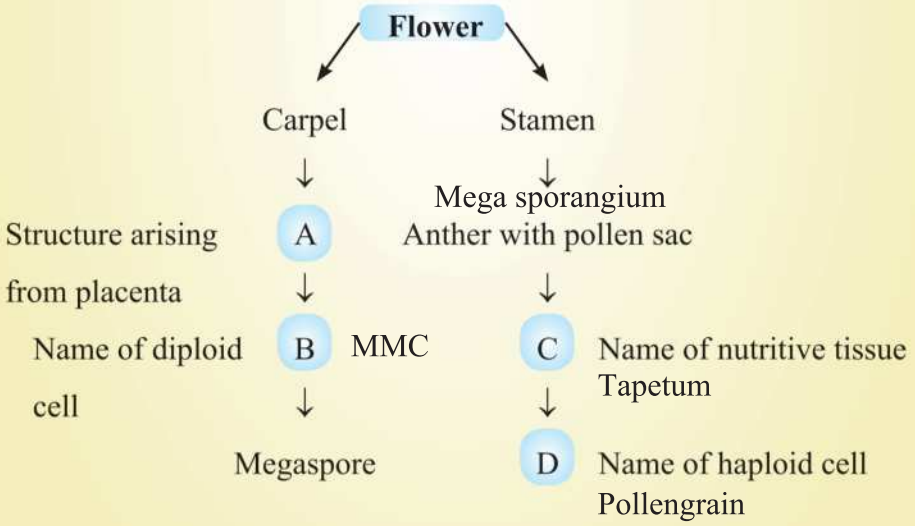


Figure 2

17. Name the parts A, B, C and D of the anatropous ovule (Figure 2) given above.

18. Given below is an incomplete flow chart showing formation of gamete in angiospermic plant. Observe the flow chart carefully and fill in the blank A, B, C and D.



19. Even though each pollen grain has two male gametes. Why are at least 10 pollen grains and not 5 pollen grains required to fertilise 10 ovules present in a particular carpel ?

SA-II **(3 Marks)**

20. Continued self pollination lead to inbreeding depression. List three devices, which flowering plant have developed to discourage self pollination ?

21. Differentiate between microsporogenesis and megasporogenesis. What type of cell division occurs during these events ? Name the structure formed at the end of these two events.

LA **(5 Marks)**

22. (a) Draw the embryo sac of a flowering plant and label the parts :

(i) Which guides the entry of pollen tube ?

(ii) Which develops into endosperm ?

(iii) Which fuses with male gamete to form zygote ?

(b) What will be the fate of antipodal cells after fertilisation ?

(c) Name the cell that develops into embryo Sac. How many embryo sacs are formed from one megaspore mother cell?

Case Based Questions

23. Observe the given fruit and answer the questions

(a) How the above fruit get formed? Write term used for such development.

(b) Write one advantage & one disadvantage of such fruits

(c) Weather the development of given fruit is natural? Explain.

(d) Give an example of a fruit develop in same manner naturally.

24. A flower of tomato plant following the process of sexual reproduction produces 120 seeds. Based on the above information answer the following questions:

(a) How many pollen grains and ovules involved?

(b) How many microspore mother cells & megaspore mother cells involved in formation of male & female gametophytes?

(c) How many meiotic divisions involved in formation of 120 seeds?

(d) How many male gametes participated in fertilization process?

25. Aman visited a nursery, where he observed many of the flowers of floweringplants were covered with butter paper as shown in picture. He asked for his queriesto his biology teacher. What answers you expect for the following questions:

(a) Name the process shown in the picture? Write its advantage.

(b) In bisexual flowers which additional process is required before covering flowes?

(c) How the above steps followed by the gardener are helpful in developing plants?

(d) In which plant the above steps were followed by Mendel to explain the inheritance?

Answers

VSA **(1 Mark)**

1. *Parthenium hysterophorus* (carrot grass)
2. Presence of mucilagenous covering
3. To ensure pollination because Maize is pollinated by wind.
4. Apomixis
5. 24 Chromosomes in endosperm and 8 chromosomes in antipodal cells.

Answer of Multiple-Choice Question :

6. (c) 7. (c) 8. (a) 9. (d) 10. (d) 11. (b) 12. (c)

Answer of Assertion-Reason Question :

11.(a) 12. (c)

SA-I (2 Marks)

6. Two categories of fruits are :
   (i) True fruits *e.g.*, Mango
   (ii) False fruit *e.g.*, Apple

7. (i) Flowers are large
   (ii) Colourful petals of flowers
   (iii) Presence of fragnance
   (iv) Rich in nectar

15.

Geitonogamy	Xenogamy
1. Transfer of pollen grains from the anther to stigma of another flower of the same plant.	Transfer of Pollen grains from anther to Stigma of different plant.
2. Does not provide opportunity for genetic recombination.	Provide opportunity for genetic recombinations

16. A = Plumule — To form shoot system
B = Cotyledons — Storage of food

17. A = Micropyle, B = Outer integument, C = Nucellus, D = Embryo sac

18. A = Ovule/megasporangium, C = Tapetum
B = Megaspore mother cell, D = Pollen grains

19. Because only one male gamete is involved is syngamy, *i.e.*, fusion of male gamete with egg cell.

SA-II (3 Marks)

20. (a) Release of pollen and stigma receptivity is not synchronised in some species
   (b) Anther and stigma are at different position/heights in some plants
   (c) Self-incompatibility (a genetic mechanism).

21. • Microsporogenesis–Process of formation of microspore from a Pollen mother cell.

- Megasporogenesis–Process of formation of megaspore from megaspore mother cell.
- Meiotic division in both.

Microsporogenesis results in the formation of pollen grain while megasporogenesis results in the formation of megaspore.

LA

22.(a) Refer to figure 2.8(c) page 26 NCERT book.

(i) Filliform apparatus (ii) Central cell (iii) Egg cell

(b) They degenerate after fertilization.

(c) Functional megaspore, one megaspore develops to form one embryo sac.

23. (a) Without fertilisation, parthenocarpy

(b) Advantage: seedless fruits easy to eat/no need of pollinators Disadvantage: no seeds available for dispersal/ new variations do not occur/induced parthenocarpy leaves the impact of chemicals

(c) No, it is induced by chemicals

(d) Banana.

24. (a) Pollen grains – 120, ovules – 120

(b) Microspore mother cells – 30, Megaspore mother cells – 120

(c) Meiotic divisions = $120 \times \frac{1}{4} + 120 = 150$ divisions

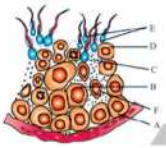
(d) Male gametes involved – $2 \times 120 = 240$.

25. (a) Bagging, prevent pollination with unwanted pollens

(b) Emasculation-removal of anthers/stamen at bud stage.

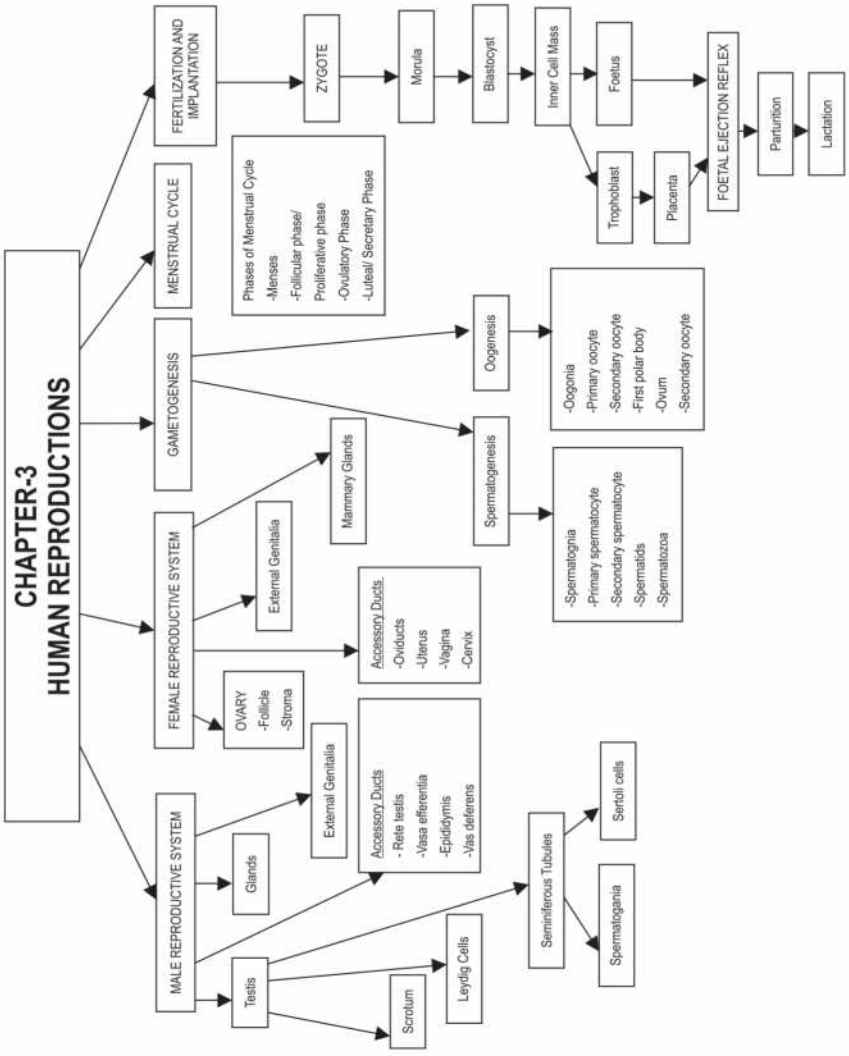
(c) Enable to develop plants with desirable characters/leads to controlled pollination.

(d) In sweet pea (*Pisum sativum*)



Chapter - 2

Human Reproduction



Blastula : A stage of embryogenesis which comes after morula and has a hollow fluid filled space called blastocoel.

Gestation Period : A period between fertilisation of ovum and the birth of a baby.

Implantation : Fixing of ernbryo/fertilised egg in uterus. It leads to pregnancy.

Menarche : The beginning of first menstruation in female on attaining puberty.

Menopause : Permanent cessation of menstrual cycle in female. It occurs between the age 45 to 50 years in human female.

Ovulation : Process of release of mature ovum (Secondary oocyte) from the ovary.

Parturition : Process of delivery of the foetus (Child birth), through birth canal.

Puberty : A stage at which immature reproductive system of boy or girl becomes mature. Period of puberty is 10-14 years in girls and 13-16 years in boys.

Spermiogenesis : Transformation of spermatids into sperms.

Spermiation : A process by which spermatozoa are released from the seminiferous tubules.

Spermatogenesis : Process of formation of sperm from male germ cell in the testes.

Colostrum : The fluid secreted by mammary glands soon after birth is called colostrum. It contains proteins, lactose and antibodies (e.g.IgA). This provides nutrition and help the new born baby to develop resistance for healthy development.

Ootid (Ovum) : A haploid cell formed by meiotic division of a secondary oocyte, especially the ovum, as distinct from the polar bodies.

Cleavage : The mitotic division in which the zygote undergoes to form morula and then blastocyst.

Insemination : The process in which the male transfers the sperms into the genital tract of the female.

Leydig Cells : (Interstitial Cells)—Present in connective tissue outside the seminiferous tubules. They are endocrine in nature and produce androgens e.g. testosterone.

Sertoli Cells : (nurse cells) : Present in the lumen of the seminiferous tubules. They provide nutrition and help in differentiation of cells undergoing spermatogenesis. They also secrete ABP (Androgen Binding Proteins) and inhibin.

Accessory Male Genital Glands :

- Seminal Vesicles—Produce seminal fluid which forms 60-70% of semen. The fluid activates the sperms and have fructose, citrate, inositol and proteins for nutrition of sperms.
- Prostate Gland : The gland secretes thin, milky and alkaline secretion which neutralises the acidic secretion in female vagina.
- Cowper's Gland : (Bulbourethral gland)—helps in secretion of mucus which provides lubrication of urinogenital tract.

Spermatogenesis : Process of formation of sperms in testis.

Germinal epithelium	46 (2n)
differentiation ↓ Mitosis	
Spermatogonia	46 (2n)
↓ Mitosis	
Primary spermatocyte	46 (2n)
Ist Meiotic division ↓	
Secondary spermatocyte	23 (n)
2nd meiotic division ↓	
Spermatid	23 (n)
Spermiogenesis ↓	
Spermatozoa/sperm	23 (n)

Oogenesis : Process of formation of ova in ovary.

Germinal epithelium — 46 (2n)

↓

Fetal life — Oogonia

↓ mitosis, (differentiation)

Primary oocyte — 46 (2n)

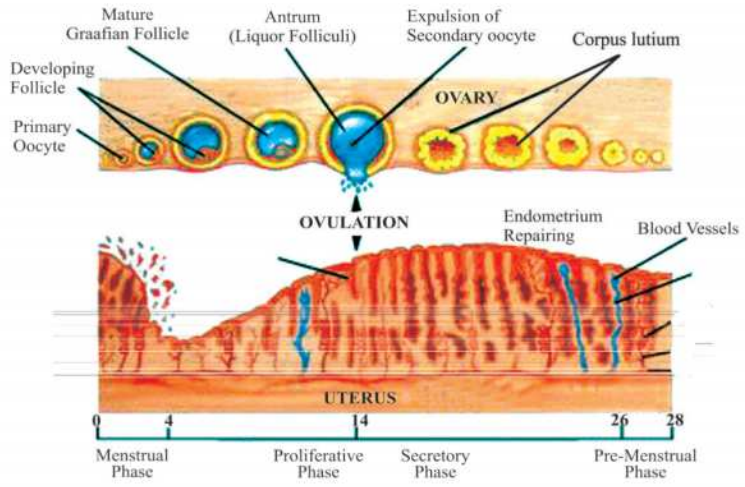
(At puberty) First polar body 23 (n) — Ist meiotic division completed prior to ovulation

Secondary oocyte — 23 (n)

Second polar body 23 (n)

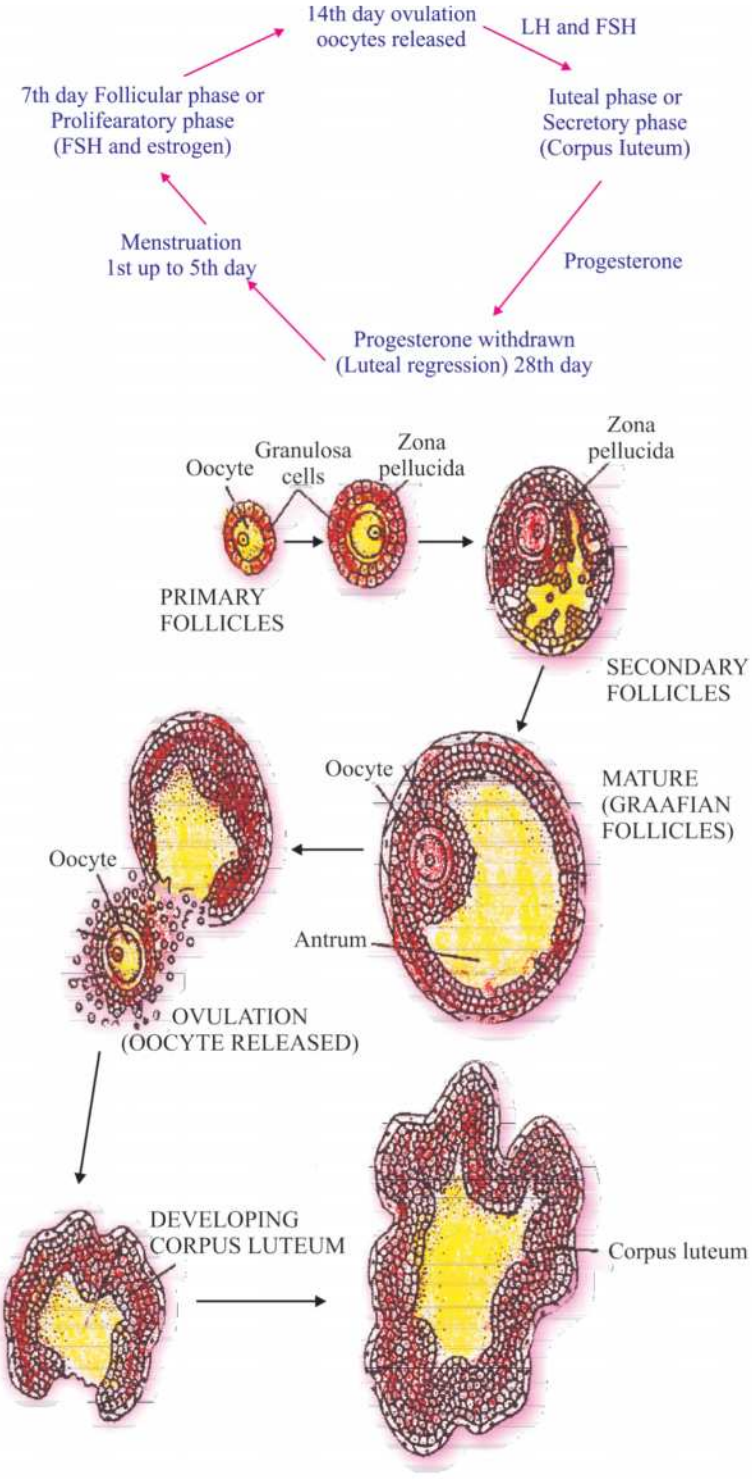
Ovum — 23 (n)

Phases of Menstrual Cycle : Menstrual phase, Follicular (Proliferative) Phase, ovulatory phase and Luteal (secretory) phase



Menstrual Cycle

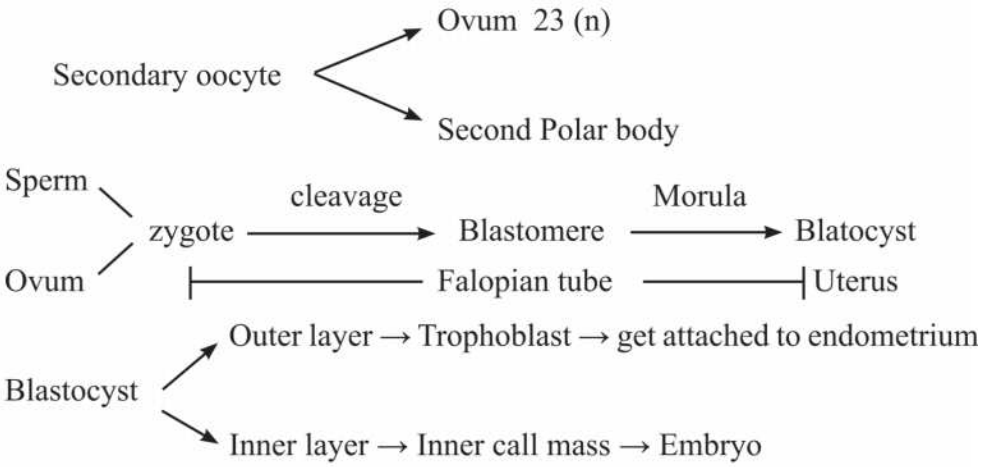
diag.- Menstrual Cycle



Fertilisation : Process of fusion of sperm with ovum

Site of fertilisation in human female : Ampullary region.

Secretion of acrosome helps the sperm entry into cytoplasm of ovum through zona pellucida and plasma membrane. Sperm entry induce the completion of the 2nd meiotic division of secondary oocyte.



Placenta : An intimate connection between foetus and uterine wall of the mother to exchange materials.

Function : Nutrition, Respiration, Excretion, as barrier, Endocrine function, shock absorber.

Placenta as Endocrine tissue : Placenta Produces several hormones such as Estrogen, hCG, hPL, Progesterone.

In late phase of pregnancy—relaxin hormone is released by ovary.

Progesterone is called 'Pregnancy hormone'.

Embryonic Development : (at various month of pregnancy) After 1 month = Heart, 2 months = Limbs and digits, 3 months = External genital organ, 5 months = First movement, 6 months = body covered with fine hairs, eye lid, eye lashes, 9 months = Fully developed and ready for delivery.

Questions

VSA **(I Mark)**

1. Failure of testes to descend into Scrotal sacs leads to sterility. Why ?
2. How many sperms will be produced from 10 primary spermatocytes and how many eggs will be produced from 10 primary occytes ?

3. In ovary which structure transforms as corpus luteum and name the hormone secreted by corpus luteum?

Chapter-3: Human Reproduction

Multiple-Choice Questions

4. Name the hormone that has no role in menstruation.
   a) LH
   b) FSH
   c) GH
   d) TSH
5. 2n=16 in a primary spermatocyte which is in metaphase of first meiotic division. What shall be the total number of chromatids in each of the secondary spermatocyte?
   a) 8
   b) 16
   c) 24
   d) 32
6. Some important events in the human female reproductive cycle are given below. Arrange the events in a proper sequence.
   A - Secretion of FSI-I, B - Growth of corpus luteum, C - Growth of the follicle and oogenesis, D - Ovulation, E - Sudden increase in the levels of LH
   a) A, C, E, D, B
   b) A, D, C, E, B
   c) B, A, C, D, E
   d) C, A, D, B, E
7. In the absence of acrosome, the sperm
   a) cannot get energy
   b) cannot penetrate the egg
   c) cannot swim
   d) cannot get food

8. In oocyte, secondary maturation division occurs in
   (a) Ovary
   (b) Abdominal cavity
   (c) Fallopian tube
   (d) Uterus

Assertion-Reason Questions

9. **Assertion:** Colostrum provides nutrition and helps the new born baby to develop resistance for healthy growth.
   Reason: Colostrum contains proteins, lactose and antibodies such as IgA.
   a) Both assertion and reason are true, and reason is the correct explanation of assertion.
   b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
   c) Assertion is true but reason is false.
   d) Both assertion and reason arc false.
10. **Assertion:** Sertoli cells provide nutrition and help in differentiation of cells undergoing spermatogenesis.
   Reason: Leydig cells are present in connective tissue outside the seminiferous tubule.
   a) Both assertion and reason are true, and reason is the correct explanation of assertion.
   b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
   c) Assertion is true but reason is false.
   d) Both assertion and reason are false.

Case-based Questions

11. Read the following and answer any four questions from (i) to (v) given below:
   The reproductive cycle in female primates is called the menstrual cycle. One ovum is released during the middle of each menstrual cycle. The cycle starts with the menstrual phase when menstrual flow occurs and it lasts for 3-5 days. The menstrual flow results due to the breakdown of the endometrial lining of the uterus and its blood vessels which form a liquid that comes out through the

vagina. The menstrual phase is followed by the follicular phase, the primary follicles in the ovary grow to become a fully mature Graafian follicle. Both LH and FSH attain a peak level in the middle of the cycle. The ovulatory phase is followed by the luteal phase during which the remaining parts of the Graafian follicle transform. During pregnancy, all events of the menstrual cycle stop and there is no menstruation.

(i) At what stage of life is oogenesis initiated in a human female?

a) At puberty

b) During menarche

c) During menopause

d) During embryonic development

(ii) Ovulation in the human female normally takes place during the menstrual cycle

a) at the middle of secretory phase

b) just before the end of the secretory phase

c) at the beginning of the proliferative phase

d) at the end of the proliferative phase

(iii) Immediately after ovulation, the mammalian egg is covered with a membrane known as

a) chorion

b) zona pellucida

c) corona radiate

d) vitelline membrane

(iv) Which one of the following events are correctly matched with the time period in a normal menstrual cycle?

a) Release of egg: 5th day

b) Endometrium regenerates: 5-10 days

c) Endometrium secretes nutrients for implantation: 11-18 days

d) Rise in progesterone level: 1-15 days

(v) Identify the correct sequence

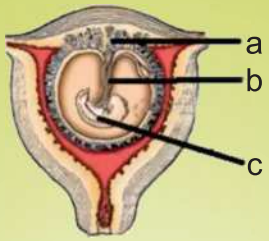
a) Primary follicle, ovum, corpus luteum, Graafian follicle

b) Corpus luteum, Graafian follicle, Primary follicle, ovum

c) Primary follicle, Graafian follicle, ovum, corpus luteum

d) Corpus luteum, Primary follicle, Graafian follicle, ovum

12. The following figure shows a foetus within the uterus. On the basis of the given figure, answer the questions that follow:



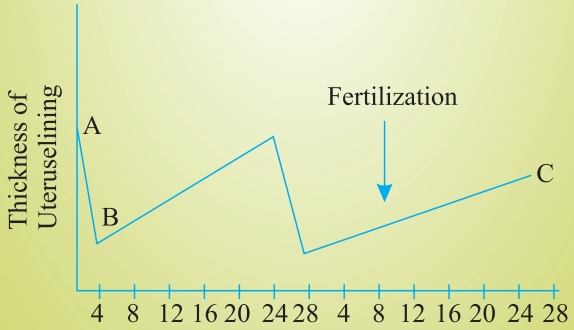
(a) In the above figure, label the parts a, b and c.

(b) In the above figure, choose and name the correct part (a, b or c) that act as a temporary endocrine gland and substantiate your answer.

(c) Mention the role of the 'b' in the development of the embyo.

(d) Name the fluid surrounding the developing embryo. How is it misused for sex determination?

13. The graph given below shows how the lining of the uterus in a female who has achieved puberty varies with time. Examine the graph and answer the following questions.



(a) What is happening between A and B?

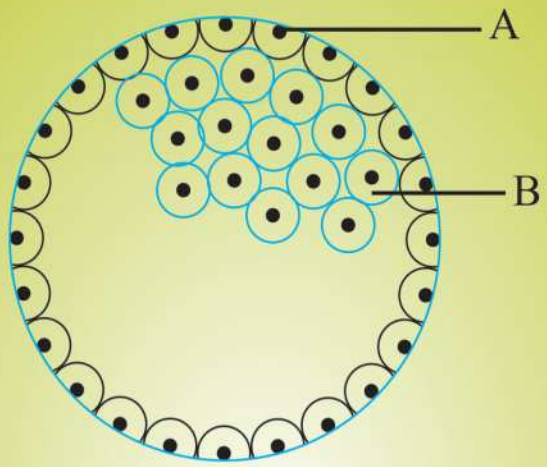
(b) When the ovulation will take place? Surge of which pituitary hormone is required for ovulation?

(c) Fertilisation occurs on the 16th day of the second menstrual cycle. How do you expect the graph to behave after points C? Will the pattern of the first and second months be followed?

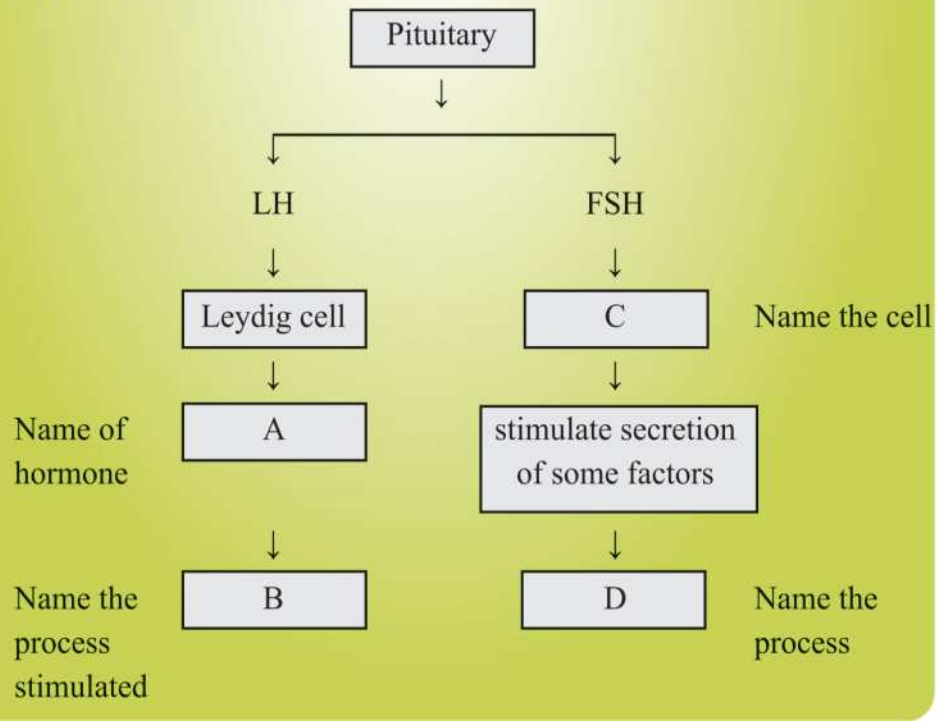
(d) Write the role of yolk sac.

SA - I **(2 Marks)**

14. In the given figure, give the name and functions of parts labelled A and B.



15. Given below is an incomplete flow chart showing influence of hormone on gametogenesis in male, observe the flow chart carefully and fill in the blank A, B, C and D.



16. Give reason for the following :

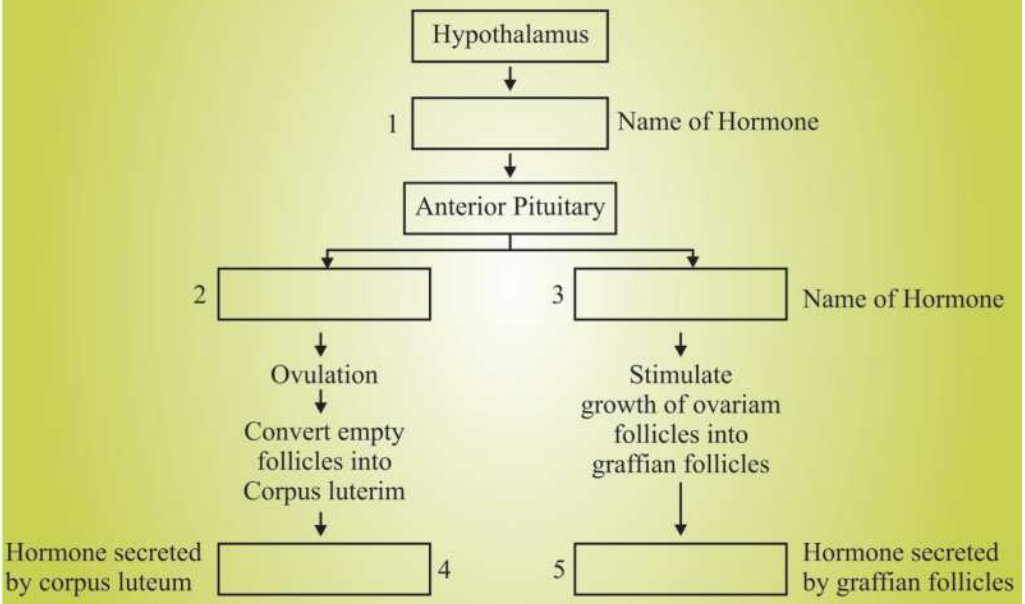
(a) The first half of the menstrual cycle is called follicular phase as well as proliferative phase.

(b) The second half of the menstrual cycle is called luteal phase as well as secretory phase.

17. What is meant by L.H. Surge ? Write the role of L.H.

SA-II **(3 Marks)**

18. Study the flow chart given below. Name the hormones involved at each stage and in human female.



19. Three of the steps of neuro-endocrine mechanism in respect of parturition are mentioned below.

Write the missing steps in proper sequence.

(a) Signals originate from fully developed foetus and placenta.

(b) ..... .

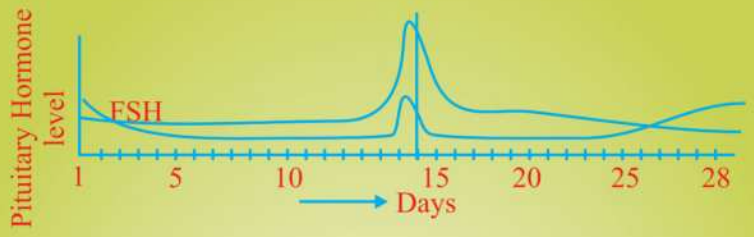
(c) ..... .

(d) Oxytocin causes strong uterine contraction

(e) Uterine contraction stimulates further secretion of oxytocin.

(f) ..... .

20.(a) Read the graph given below. Correlate the ovarian events that take place in the human female according to the level of the pituitary hormone during the following day.



(i) 10th – 14th days (ii) 14th – 15th days

(iii) 16th – 23th days (iv) 25th – 29th days

(If the ovum is not fertilised)

(b) What are the uterine events that follow beyond 29th day if the ovum is not fertilised.

21. T.S. of mammalian testis revealing seminiferous tubules show different types of cell.

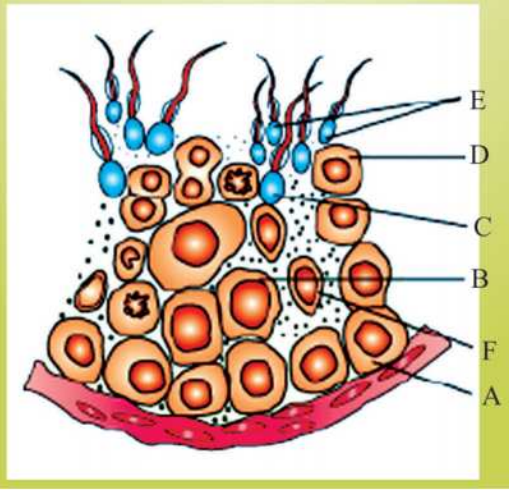
(i) Name the two types of cells of germinal epithelium.

(ii) Name of cells scattered in connective tissue and lying between seminiferous tubules.

Differentiate between them on the basis of their functions.

LA **(5 Marks)**

22.



Study the figure given :

(i) Pick out the name of cells that undergo spermiogenesis.

(ii) Name A, B, C and F.

(iii) Give ploidy of B and E.

(iv) Mention the function of 'F' cell.

Answers

VSA **(1 Mark)**

1. High temperature of abdomen kills the spermatogenic tissue of the testes, so no sperm are formed.
2. 40 sperms, 10 eggs.
3. • Follicular cells of empty Graafian follicle.
   • Progesterone.

Answer of Multiple-Choice Question :

4. (c) 5. (b) 6. (a) 7. (b) 8. (c)

Answer of Assertion-Reason Question :

9. (a) 10. (b) 11. (I) (d), (ii) (d), (iii) (d), (iv) b, (v) (c)

SA-I **(2 Marks)**

12. (a) a-Placental villi, b- umbilical cord, c - embryo

(b) Part 'a' is placenta which act as temporary endocrine tissue and producers several hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogens and progestogens.

(c) 'b' is the umbilical cord. It connects placenta to embryo and help in transportation of substances to and from the embryo.

(d) Amniotic fluid. Used to determine sex based on chromosomal pattern of cells of amniotic fluid and misused for female foeticide.

13. (a) It represents menstrual flow. During this phase the uterus lining is said along with the blood and moves out of the body in the form of bleeding.

(b) 14th day or in the mid of the cycle. LH surge (Luteinising Hormone increases)

(c) since fertilisation occurs on the day 16, the graph after point C will be straight lined. y if the ovum is It is because once fertilization occurs, the uterus lining is retained and no bleeding /menstrual flow occurs during that period.

(d) It provides nutrition and gas exchange between mother and developing embryo before the placenta forms.

14. A = Trophoblast – Gets attached to endometrium and draws nutritive material material secreted by uterine endometrium gland.

B = Inner cell mass – Differentiates as Embryo.

15. A = Testosterone; B = Spermatogenesis

C = Sertoli cells; D = Spermiogenesis

16. (a) During this phase, primary follicles transform into Graafian follicle under FSH stimulation. Graafian follicles secrete Estrogens with stimulate enlargement of Endometrium of uterus.

(b) During this phase, Corpus luteum is fully formed and secretes large quantity of Progestrone.

17. LH surge refers to maximum level of luteinising hormone middle of menstrual cycle. LH causes ovulation.

SA-II **(3 Marks)**

18. Hypothalamus → 1. GnRH → Anterior pituitary — 2. LH, 3. FSH

4. Progesterone 5. Estrogen

19. (b) Foetal ejection reflex

(c) The reflex triggers release of oxytocin

(f) Expulsion of the baby out through birth canal.

20. (a) (i) Gonadotropins and FSH increase

(ii) LH attains peak level but FSH decrease

(iii) LH and FSH level decrease

(iv) LH remains low and FSH increases.

(b) After 29th day there is a mentrual flow involving discharge of blood and cast off endometrium lining.

21. (i) Germinal epithelium have two types of cells. 1. Spermatogonium. 2. Sertoli cells

(ii) Leydig's cell or Interstitial cells.

Functions

Spermatogonium undergoes meiotic division leading to sperm formation.

Sertoli cell : Nourishes germ cells

Leydig cell : Synthesise and Secrete hormone androgen.

LA **(5 Marks)**

22. (i) D—Spermatids

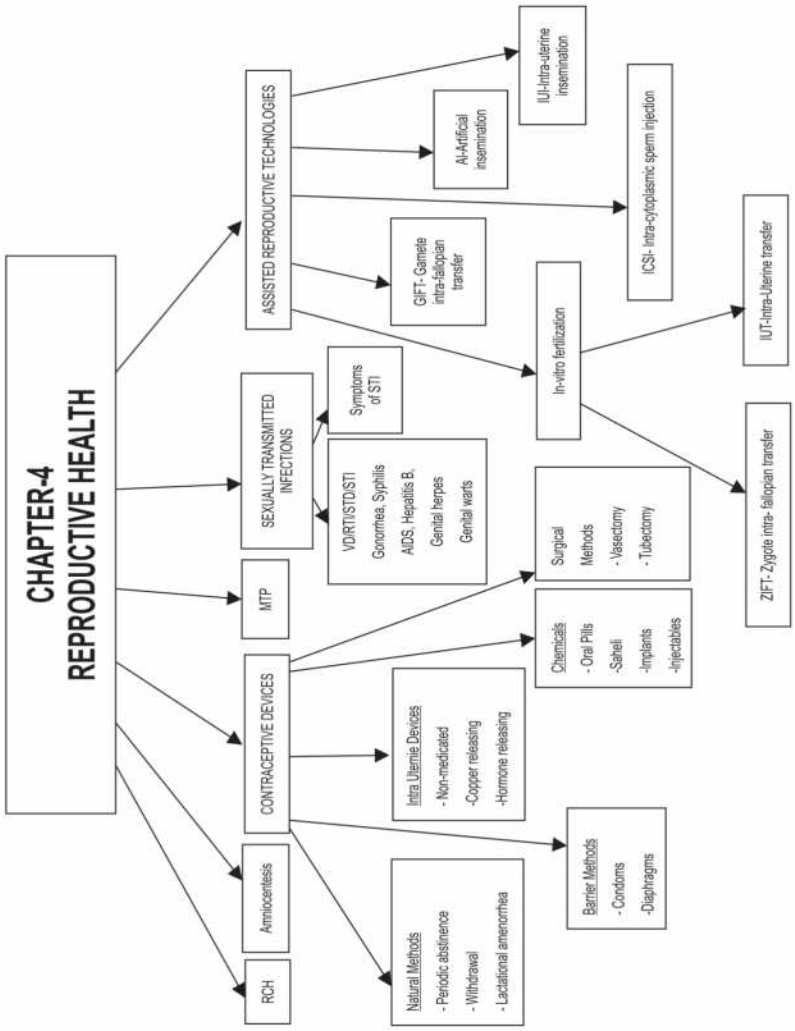
(ii) A—Spermatogonium; B—Primary spermatocyte
C—Secondary spermatocyte F—Sertoli cells

(iii) B—Diploid E—Haploid

(iv) Provide nourishment to germ cells.

Chapter - 3

Reproductive Health



Amniocentesis : Diagnostic technique to detect chromosomal pattern in the foetus used to detect the genetic disorder and often misused to determine the sex of the foetus.

Sterilisation : A permanent method of birth control through surgery in male or female.

IUCD : Intra Uterine Contraceptive Device

RCH : Reproductive and Child Health care

STD : Sexually Transmitted Disease

CDRI : Central Drug Research Institute

MMR : Maternal Mortality Rate

MTP : Medical Termination of Pregnancy

VD : Venereal Disease

RTI : Reproductive Tract Infection

PID : Pelvic Inflammatory Disease

ART : Assisted Reproductive Technologies

IVF : In Vitro Fertilisation

ZIFT : Zygote Intra Fallopian Transfer

GIFT : Gamete Intra Fallopian Transfer

Methods of Birth Control

(i) Natural Methods : Periodic abstinence
Coitus interruptus or withdrawl
Lactational amenorrhea.

(ii) Barrier Methods : Condom, Diaphragms, Cervical cap. and vault

(iii) Intra Uterine Devices : Non—medicated (e.g. Lippes loop)
Copper releasing (e.g., Cu-T, multiload 375)
Hormone releasing (e.g. LNG-20, progestasert)

(iv)	Oral contraceptives	:	Pills / Saheli, Mala-D Small doses of either progestogens or Progestogen—estrogen combination
(v)	Injections	:	Progestrone derivates given every three months.
(vi)	Implants	:	Synthetic progestrone patches are implanted under the skin. Prevents pregnancy upto 4 years.
(vii)	Emergency pills	:	Must be taken within 72 hours of coitus. They have high concentration of progestrone and oestrogen which prevent ovulation eg. I pill, unwanted-72 etc.
(viii)	Surgical (Sterilisation)	:	(1) Tubectomy in females; (2) Vasectomy in male.

MTP (Medical Termination of Pregnancy)

Voluntary or intentional abortion performed to end pregnancy before the completion of full term.

MTP is legalised :

- To abort unwanted pregnancies.
- If pregnancy is likely to produce a congenitally malformed child.
- Pregnancy leads due to failure of contraceptive or result of rape.

S T D (Sexually Transmitted Diseases)

Name of Disease	Causative agent	Symptoms
Gonorrhoea	Bacterium	Painful urination, Pain around urethra
Syphilis	Bacterium	itching, fluid discharge, pain in urinogenital tract.
Genital Herpes	Virus (Herpes simplex)	Reddish ulcers over external genitalia, vaginal discharge.

Genital warts	Virus	Warts over external genitalia, vagina & cervix etc.

Infertility : Inability to produce children, inspite of unprotected sexual co-habitation of a couple is termed as infertility.

Reasons for Infertility

(i) Physical

(ii) Congential diseases

(iii) Drugs

(iv) Immunological reaction

The couple can be assisted to have children through certain special techniques commonly known as assisted reproductive technologies (ART).

(i) In Vitro Fertilisation (IVF) : Fertilisation outside the body in almost similar conditions as that in the body, followed by embryo transfer (E.T.).

Test Tube baby Programme : Ova from the wife/donor female and sperm from husband/donor male are allowed to fuse under simulated condition in the laboratory.

ZIFT : Zygote intra fallopian transfer—Zygote or early embryo upto eight blastomeres is transferred into the fallopian tube.

IUT : Intra Uterine Transfer—Embryo with more than eight blasomeres are transferred.

(ii) **Gamete intra fallopian transfer (GIFT) :** Transfer of an ovum collected from a donor to fallopian tube of another female who can not produce ova, but can provide suitable conditions for fertilisation and further development of the foetus upto parturition.

(iii) **Intra Cytoplasmic sperm injection (ICSI) :** The sperm is directly injected into the ovum to form an embryo in the laboratory and then embryo transfer is carried out.

(iv) **Artificial Insemination :** This method is used in cases where infertility is due to the inability of the male partner to inseminate the female or due to very low sperm counts in the ejaculates. In this method, the semen collected from the husband or a healthy donor is artificially introduced into the vagina or into the uterus (IUI-Intra uterine insemination).

Questions

VSA **(I Mark)**

1. Give the term for prenatal diagnostic technique aimed to know the sex of developing foetus and to detect congenital disorders.
2. After a successful in-vitro fertilisation, the fertilised egg begins to divide. Where is this egg transferred before it reaches the 8-celled stage and what is this technique called ?
3. Give the term for rapid population growth.
4. Name the fluid from which foetal cells are extracted for chromosomal analysis.

Multiple Choice Question

5. Oral contraceptives prevent pregnancy by
   a) Killing the ovum
   b) Blocking fertilisation
   c) Preventing ovulation
   d) Preventing implantation
6. Tubectomy is method of sterilisation in which
   a) Small part of the fallopian tube is removed or tied up
   b) Ovaries are removed surgically
   c) Small part of vas deferens is removed or tied up
   d) Uterus is removed surgically
7. Which of the following is a hormone releasing Intra-Uterine Device (IUD)?
   a) Multiload - 375
   b) LNG-20
   c) Cervical cap
   d) Vault
8. Which of the following is not a sexually transmitted disease?
   a) Syphilis
   b) AIDS
   c) Trichomoniasis
   d) Encephalitis

9. Embryo with more than 16 blastomeres formed due to in vitro fertilisation is transferred into

a) Cervix

b) Uterus

c) Fallopian tube

d) Fimbriae

Assertion-Reason Question

10. **Assertion** : In IUT, zygote or early embryo with up to eight blastomeres is transferred into the fallopian tube.

Reason : In ZIFT, embryo with more than eight blastomeres is transferred into the fallopian tube.

a) Both assertion and reason are true, and reason is the correct explanation of assertion.

b) Both assertion and reason are true, but reason is not the correct explanation of assertion.

c) Assertion is true but reason is false.

d) Both assertion and reason are false.

11. **Assertion :** In Vitro Fertilisation involves fertilisation outside the body.

Reason : Ova from female and sperm from male are allowed to fuse under simulated condition in the laboratory.

a) Both assertion and reason are true, and reason is the correct explanation of assertion.

b) Both assertion and reason are true, but reason is not the correct explanation of assertion.

c) Assertion is true but reason is false.

d) Both assertion and reason are false.

SA-I **(2 Marks)**

12. Lactational Amenorrhea is a method of contraception. Justify. What is the maximum effectiveness of this method in terms of period/duration?
13. Why is CuT (copper T) considered as good contraceptive device to space children ?
14. Briefly explain two natural barriers for birth control.
15. Write any four characteristics of an ideal contraceptive.

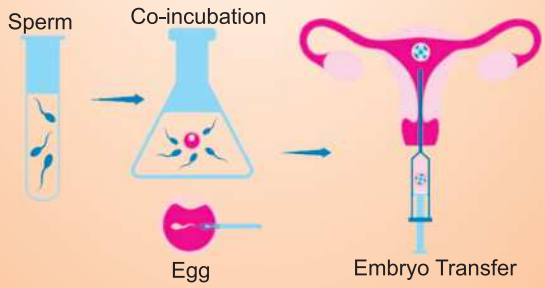
SA-II **(3 Marks)**

16. Give another name for sexually transmitted diseases. Name two sexually transmitted diseases which are curable and two diseases which are not curable.
17. Differentiate between Vasectomy and Tubectomy.
18. Mention the various precautions one has to take in order to protect himself/ herself form STDs.

LA **(5 Makrs)**

Briefly explain the various reproductive technologies to assist an infertile couple to have children.

19. A couple visited a fertility clinic with their reports. Doctor observed the report and explained the possibility of getting child by the method mentioned in the given picture. Answer the following questions regarding the mentioned technique.



(a) How the fertilisation took place in this technique?
(b) What is the probable test report of the female partner?
(c) At which stage, the embryo is transferred in uterus? Write the term used for the same.
(d) Expand ZIFT.

Answers

VSA (1 Marks)

1. Amniocentesis.
2. Fallopian tube : Zygote intra fallopian transfer (ZIFT)
3. Population explosion.
4. Amniotic fluid.

Answer of Multiple-Choice Question :

5. (c) 6. (a) 7. (B) 8. (d) 9. (b)

Answer of Assertion-Reason Question :

10.(d) 11. (a)

SA-I (2 Marks)

12. (a) Ovulation and menstrual cycle do not occur during the period of intense lactation following parturition. Therefore, as the mother breast feeds, chances of conception are nil.
    (b) It is effective only upto a maximum period of six months following parturition.

13. (a) Copper releasing IUDs (CuT, Multiload 325) → These increase phagocytosis of sperms within uterus and release copper ions which suppress sperm motility and fertilising capacity of sperm.
    (b) Hormone releasing IUDs—Progestasert, LNG—20—These makes uterus unsuitable for implantation and the cervix hostile to sperms.
14. Periodic abstinence—couple should avoid coitus from 10th to 17th day of menstrual cycle.
    Coitus interruptus—male partner withdraws his penis from the vagina just before ejaculation of semen.
15. User friendly, easily available, effective, reversible with no side effects.

SA-II (3 Marks)

16. Venereal disease (VD)/Reproductive tract infection (RTI)
    Curable-Syphilis, Gonorrhoea
    Non Curable—Hepatitis B, AIDS

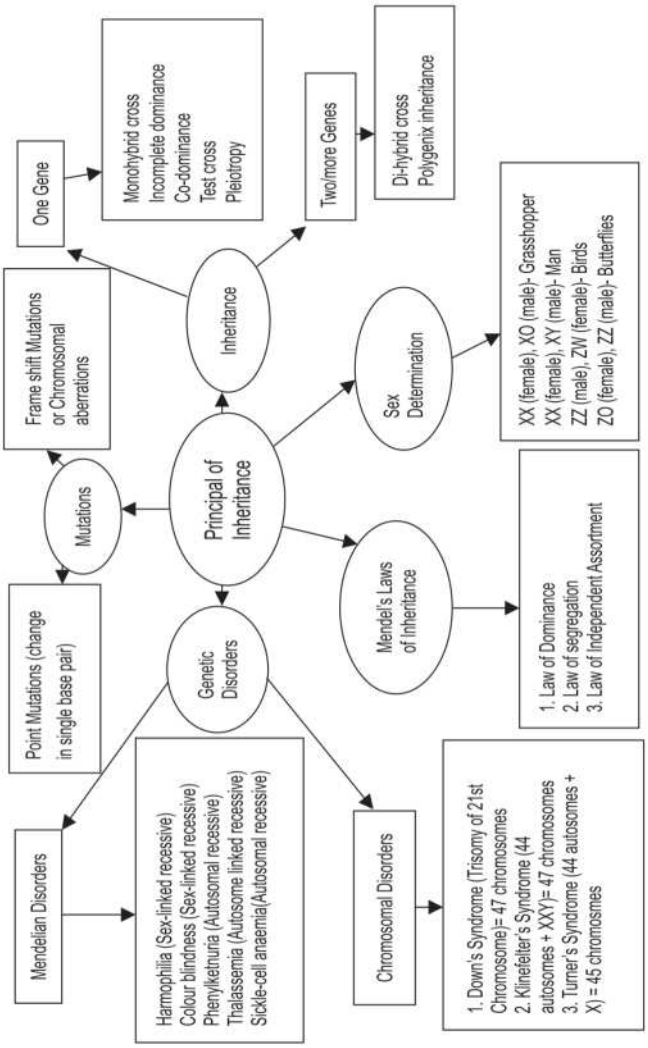
17.

Vasectomy	Tubectomy
1. Method of sterlisation in males 2. Vas differential of both sides cut and tied 3. Prevent movement of sperms at cut end.	Method of sterilisation in females. Fallopian tube of both sides cut and tied. Prevent movement of egg at cut end.

18. (i) Avoid blood transfusion from an infected person.
(ii) Avoid sex with an unknown partner and multiple partners.
(iii) Always use condom.
(iv) Avoid sharing of injections, needles, syringes and surgical instruments.

19. (a) By IVF (in vitro fertilisation) — fertilization outside the body in almost similar conditions as that in the body.
(b) Blockage in fallopian tube.
(c) More than 8 blastomeres. IUT – Intra uterine transfer.
(d) Zygote Intra Fallopian Transfer.

Chapter - 4 Principles of Inheritance and Variation



Allele : Various or slightly different forms of a gene, having same position on the two homologous chromosomes.

Phenotype : The observable or external characteristics of an organism.

Genotype : The genetic constitution of an organism.

Monohybrid cross : A cross between two individuals of species, considering the inheritance of single pair of contrasting character, e.g. a cross between pure tall (TT) and Dwarf (tt)

Dihybrid cross : A cross between two individuals of a species, considering the inheritance of two pairs of contrasting traits/characters e.g., a cross between Round and Yellow (RRYY) seed and wrinkled and green (rryy) seed.

Aneuploidy : The phenomenon of gain or loss of one or more chromosome(s) that results due to failure of separation of homologous pair of chromosomes during meiosis.

Trisomy : The condition in which a particular chromosome is present in three copies in a diploid cell/nucleus.

Male heterogamety : When male produces two different types of gametes/ sperms e.g. In human beings X and Y. Sperm with X chromosome or sperm with Y chromosome

Female Heterogamety : When female produces two different types of gametes/ova, e.g., female bird produces Z and W gametes.

Gene- It is a segment of DNA called cistron and the unit of in heritance which is carried from parent by a gamete.

Genome- The entire genetic set of a prokaryote or virus or the haploid genetic set of a eukaryote.

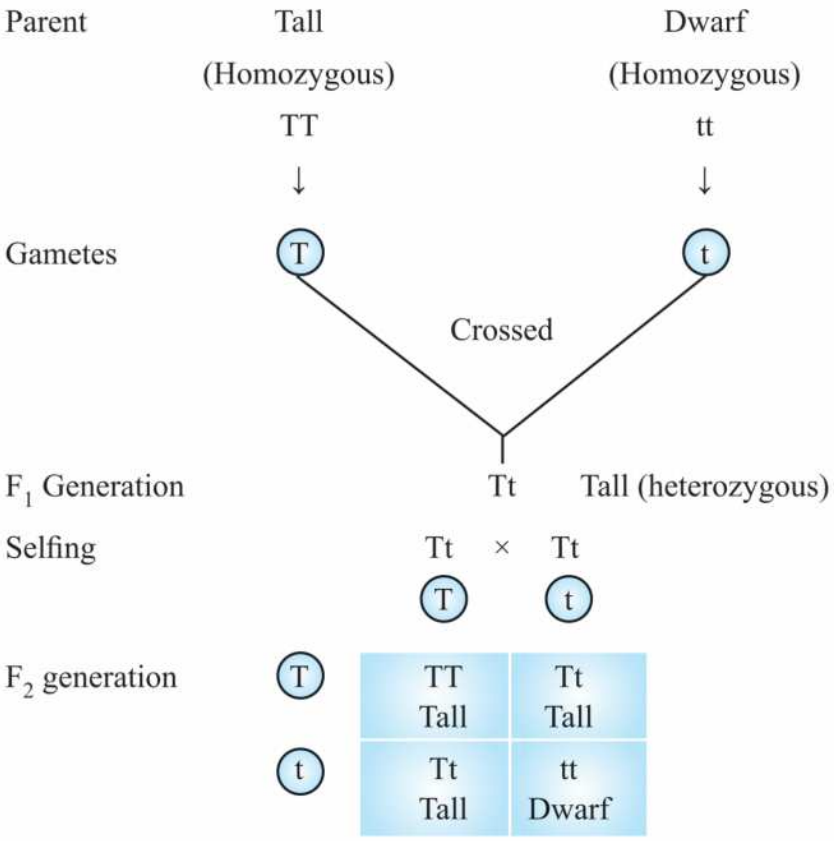
Gene Pool- An aggregate of all genes and their alleles, present in an interbreeding population.

Test Cross- A cross between an individual of unknown genotype and recessive parent. It is used to test whether an individual is homozygous (pure) or heterozygous (hybrid). It is also used as test for linkage.

Heredity- Also called inheritance is the process of transmission of genetic characters (traits) from parents to their offsprings.

Gregor Johann Mendel Conducted controlled breeding experiment on garden pea

(*Pisum sativum*) with a single trait. It is called monohybrid cross.



Tall homozygous (TT) – 25% Pure

Tall heterozygous (Tt) – 50% Hybrid.

Dwarf homozygous (tt) – 25% Pure.

Law of Dominance : When two individuals of a species differing in a pair of contrasting characters/traits are crossed, the trait that appears in the F_1 generation is dominant and the alternate form that remain hidden, is called recessive.

Law of Segregation (law of purity of gametes) : The members of allelic pair that remained together in the parent, segregate/separate during gamete formation and only one of the factors enters a gamete.

Law of Independent Assortment : In the inheritance of two pairs of contrasting characters (dihybrid cross) the factors of each pair of characters segregate independently of the factors of the other pair of characters.

Test Cross : When offspring or individual with dominant phenotype, whose genotype is not known, is crossed with an individual which is homozygous recessive for the trait, this cross is known as test cross.

Test cross is done to determine whether the individual parent exhibiting dominant traits is homozygous or heterozygous.

Flower colour is → Violet (Dominant phenotype, Genotype is unknown)

Genotype may be WW or Ww

Example :

Violet	×	White	
VV		vv	homozygous recessive

Case 1

	v	v
V	Vv Violet	Vv Violet
V	Vv Violet	Vv Violet

Here, all flowers are violet

If all the offsprings show dominate trait, it indicate that individual under test is homozygous (WW) for dominant trait.

Violet	×	White	
VV		vv	homozygous recessive

Case 2

	v	v
V	Vv Violet	Vv Violet
v	vv White	vv White

50% flowers are violet

50% flowers are white

ratio Ww : ww

Incomplete Dominance : In this, both alleles of a gene at a locus, are partially expressed.

Example : In Mirabilis jalapa.

	Red RR	x	White rr

F1

	R	R
r	Rr Pink	Rr Pink
r	Rr Pink	Rr Pink

Parents	Pink Rr	×	Pink Rr
Gametes			

F2 generation

	R	r
R	RR Red	Rr Pink
r	Rr Pink	rr White

Phonotypic ratio	Red	:	Pink	:	White
	1	:	2	:	1
	RR	:	Rr	:	rr
Genotypic ratio	1	:	2	:	1

In incomplete dominance, phenotypic ratio is equal to the genotypic ratio.

Multiple Allelism : It is a phenomenon in which a single character is governed by more than two alleles.

Example :

- ABO blood groups are controlled by gene I
- 'I' has three alleles—I^A, I^B, and *i*

I^A and I^B alleles produce slightly different form of sugar present on plasma membrane of red blood cells.

- In allele 'i' do not produce any sugar.
- In any diploid individual only two alleles can be found. So multiple alleles can be detected only in a population.

Co-dominance : The alleles which do not show dominance recessive relationship and are able to express themselves independently when present together are called co-dominant alleles and this phenomenon is known as codominance. Example : Human blood groups.

There are 3 different alleles, 6 different genotypes control 4 different type of Phenotypes :

Blood Group	Genotype	Blood Type
A	I^AI^A, I^Ai	A
B	I^BI^B, I^Bi	B
AB	I^AI^B,	both A & B
O	ii	O

In humans, blood group AB shows co-dominance as both the alleles I^A and I^B express themselves fully in presence of each other.

Chromosomal Theory of Inheritance : Proposed by Sutton and Boveri. The pairing and separation of a pair of chromosomes would lead to the segregation of a pair of factors they carried. They united the knowledge of segregation with Mendelian principles.

- **Linkage-** is the tendency of genes on a chromosome to remain together.
- Linked genes occur on the same chromosome.
- They lie in linear sequence on the chromosome - There is a tendency to maintain the parental combination of genes except for accessional choosers.
- Strength of linkage between genes is inversely proportional to the distance between the two.

Recombination : is the generation of non-parental gene combinations to the offsprings.Tightly linked genes show very low recombination frequency. Loosely linked genes show higher recombination frequency.

The frequency of recombination between gene pairs on the same chromosome is a measure of distance between genes and is used to map the position of genes on the chromosome.

Linkage and Recombination.

T. H. Morgan carried out several dihybrid crosses in *Drosophila melanogastor.* Two of them are given below :

Cross–I : Yellow-bodied and white eyed females crossed with brown-bodied, red eyed males (wild type)

- F_1 Progeny intercrossed and F_2 generation ratio deviated from 9 : 3 : 3 : 1 (two genes didn't segregate independently)
- The Parental combinations were 98.7% and recombinats were 1.3%

Conclusion : The two genes (body colour and eye-colour) are tightly linked ; results in less crossing over and less no. of non-parental progeny.

Cross-II : White bodied female with miniature wings and yellow-bodied male with normal wings (wild type) were crossed.

- The parental combinatios were 62.8% while the recombinants were 37.2%.

Conclusion : The two genes (body colour & wing's size) are loosely-linked ; results in more crossing over and more no. of non-parental progeny.

The seven character : Mendel Studied in garden pea, had their genes located on different (non-homologous) ehromusomes or far apart on the same chromosome that they got separated by crossing over. So he was lucky that he could not note linkage and propose law of independent assortment.

Chromosomal basis of sex Determination :

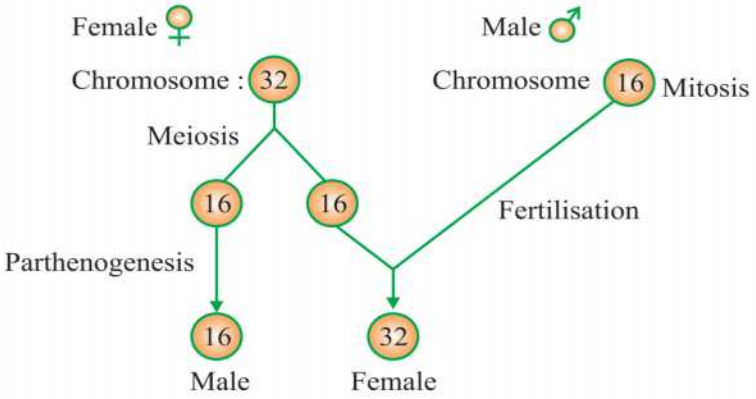
(i) XX-XY type - Female homogametic i.e. XX and male heterogametic i.e. XY in *Drosophila*, humans.

(ii) XX-XO type—All eggs bear additional X chromosome, Males have only one X chromosome besides autosomes whereas females have a pair of X chromosomes e.g., grasshoppers.

(iii) ZW-ZZ type—The females are heterogametic and have one Z and one W chromosome. The males are homogametic with a pair of Z chromosomes besides autosomes e.g., birds.

(iv) ZO-ZZ type—Females are heterogametic and produce 2 types of eggs - (A + Z) and (A + O). The males are homogametic with all the sperms having (A + Z) e.g. moths and butterflies.
here A = autosome

Sex determination in honey Bee : In Honey bee fertilized eggs develop into female (Queen or Worker) While unfertilized egg develops into male (drone) by parthenogensis, the males have half no. of chromosomes than a female. The males are haploid (16-chromosomes), females are diploid (32-chromosomes).



There are three types of individuals :

1. Queen — diploid
   - developed from fertilized egg
   - functional female
2. Worker — diploid
   - developed from fertilized egg
   - non-functional female
3. Drone (male) — haploid
   - developed from unfertilized egg parthenogenetically
   - functional Male.

Pedigree Analysis

A record of inheritance of certain genetic traits for two or more generation presented in the form of diagram or family tree is called pedigree.

Usefulness of Pedigree Analysis

1. It is useful for genetic counsellors to advice intending couples about the possibility of having children with genetic defects like haemophilia, thalassemia etc.
2. It is helpful to study certain genetic trait and find out the possibility or absence or presence of that trait in homozygous or heterozygous condition in a particular individual.
3. It can indicate the harms a marriage between close relatives, may cause.

Mendelian disorders

These are mainly determined by a alternation or mutation in single genes.

1. **Haemophilia :** Sex linked recessive disease which is transmitted from unaffected carriers female to male progeny. A single protein is affected which is a part of the cascade of proteins involved in the clotting of blood.

   $X^h Y$ = affected male

   $X^h X$ = carrier female

   The heterozygous female for haemophila may transmits the disease to her sons. The possibility of a female suffering from the disease is extremely rare (only when the mother of the female is a carrier is $X^h X$ and father is haemophilic i.e. $X^h Y$.

2. **Sickle-cell anaemia :** This is an autosome linked recessive trait. This defect is caused by substitution of glutamic acid by valine at the 6th position of the beta globin chain of the haemoglobin molecule. The mutant Hb molecule undergoes polymerisation under low oxygen tension which results change in shape of RBC from biconcave disc to elongated sickle like structure. The disease is controlled by a pair of allele, Hb^A and Hb^S

Hb^A Hb^A. Normal Hb^S Hb^S sufferer

Hb^A Hb^S. Apparently unaffected/carriers

Example Hb^AHb^S (Carrier) × Hb^A Hb^A (Normal)

	Hb^A	Hb^A
Hb^A	Hb^AHb^A	Hb^AHb^A
Hb^S	Hb^AHb^S	Hb^AHb^S

Phenylketonuria : Inbron error of metabolism, autosomal recessive trait. Affected individual lacks an enzyme that converts amino acid phenylalanine into tyrosine. Phenylalanine is accumulated and converted into phenylpyruvic acid which accumulates in brain resulting in mental retardation.

Thalassemia : Thalassemia is autosome linked recessive disease. This disorder caused by defers in the synthesis of globin chain. Thalassemia is of three types—Alpha (α) Thalassemia, Beta (β) Thalassemia and delta(s).

- In alpha Thalassemia production of alpha globin chain is affected. This Thalassemia is controlled by genes HBA1 and HBA2 located on chromosome 16th of each parent. Thalassemia occurs due to mutation or deletion of one or more of the four genes.
- In Beta Thalassemia production of (β-globin chain is affected, this thalassemia is controlled by gene HBB located on 11th chromosome of each parent. It occurs due to one or both HBB genes
- In Thalassemia very few globin is synthesized and is quantitative problem whereas in sickle cell anaemia there is a synthesis of incorrectly functioning globin and is a qualitative disorder.

Delta Thalassemia- It is caused due to defective allele of HBD gene present on chromosome II that form delta chain of heamoglobius. The effect of this thalassemia is minor as the adults have about 3% harmoglobius consisting of a and of chains.

These are caused due to absence or excess of one or more chromosomes.

Colour blindness : Colour blindness is sex-linked recessive trait in which a person fails to distinguish red and green colour. The gene for normal vision is dominant. The normal genes and its recessive alleles are carried by X-chromosome.

X^c X^c — Colour blind female

X X^c — Carrier female

X^c Y — Colour blind male

Y Chromosome of male do not carry any gene for certain vision.

Inheritance Pattern in Colour Blindness

Father		Mother		Son		Daughter	
Pheno-type	**Geno-type**	**Pheno-type**	**Geno-type**	**Pheno-type**	**Geno-type**	**Pheno-type**	**Geno-type**
Normal	XY	Carrier	X^CX	Normal	XY	Normal	XX
				Colour-blind	X^CY	Carrier	X^CX
Normal	XY	Colour-blind	X^CX^C	Colour-blind	X^CY	Carrier	X^CX
Colour-blind	X^CY	Normal	XX	Normal	XY	Carrier	X^CX
Colour-blind	X^CY	Carrier	X^CX	Colour-blind	X^CY	Colour-blind	X^CX^C
				Normal	XY	Carrier	X^CX

Inheritance Pattern in Haemophilia

Father		Mother		Son		Daughter	
Pheno-type	Geno-type	Pheno-type	Geno-type	Pheno-type	Geno-type	Phen-type	Geno-type
Normal	XY	Haemophilic	X^hX^h	Haemophilic	X^hY	Carrier	X^hX
Normal	XY	Carrier	X^hX	Normal	XY	Normal	XX
				Haemophilic	X^hY	Carrier	X^hX
Haemop-hilic	X^hY	Carrier	X^hX	Normal	XY	Carrier	X^hX
				Haemophilic	X^hY	Haemop-hilic	X^hX^h
Haemop-hilic	X^hY	Normal	XX	Normal	XY	Carrier	X^hX

Chromosomal Disorder :

1. **Down's syndrome :** Trisomy of chromosomes number 21 (2n + 1) Affected individual is short statured with small round head, furrowed tongue, partially open month, broad palm. Physical, psychomotor and mentaly development is retarded.
2. **Klinefelter's syndrome :** extra copy of X chromosome ; karyotype XXY. Affected individual has overall masculine development with feminine characters like gynaecomastia (development of breast) and is sterile

   44 autosomes + xxy = 47 chromosomes
3. **Turner's syndrome :** has absence of one X chromosome i.e. 45 with XO. Affected females are sterile with rudimentary ovaries and lack secondary sexual characters.

   44 autosomes +xo= 45 chromosomes

Pleiotropy

The ability of a gene to have multiple phenotypic effects because it influences a number of characters simultaneously is known as pleiotropy. The gene having a multiple phenotypic effect because of its ability to control expression of a number of characters is called pleiotropic gene. E.g. in Garden Pea, the gene which controls the flower colour also controls the colour of seedcoat and presence of red spot in the leaf axis.

The disorder phenylketonuria shows pleiotropy.

Polygenic Inheritance

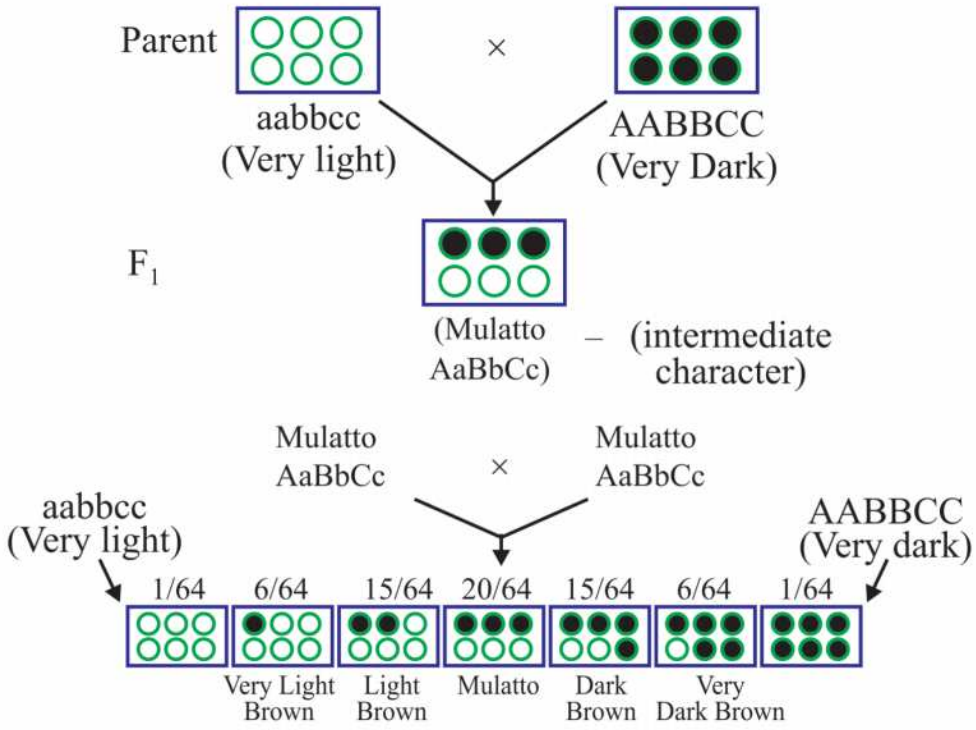
It is a type of inheritance controlled by three or more genes in which the dominant alleles have cumulative effect with each dominant allele expressing a part of the trait, the full being shown only when all the dominant alleles are present.

E.g., Kernel colour in wheat, skin colour in human beings, height in humans, cob length in maize etc.

In polygenic inheritance, a cross between two pure breeding parents produces an intermediate trait in F_1. In F_2 generation, apart from the two parental types, there are several intermediates (gradiations, show a bell shaped curve). F_1 hybrid form 8 kinds of gametes in each sex giving 64 combination in F_2 having 7 phenotypes.

Polygenic inheritance skin tone

3 loci : each has two possible alleles : Aa, Bb, Cc, each capital allele adds one unit of darkness, each lower case allele adds nothing. Parents produce F_1 offsprings with intermediate tone.



Offspring can have tone darker or lighter than either parent

Questions

VSA **(I Mark)**

1. Name the base change and the amino acid change, responsible for sickle cell anaemia.
2. Name the disorder with the following chromosome complement.
   (i) 22 pairs of autosomes + X X Y
   (ii) 22 pairs of autosomes + 21st chromosome + XY.
3. A test is performed to know whether the given plant is homozygous dominant or heterozygous. Name the test and phenotypic ratio of this test for a monohybrid cross.
4. Write the number of chromosomes body cells of honey bee workers and drone have.

Multiple Choice Question

5. When red blood corpuscles containing both A and B antigens are mixed I a person's blood serum, they agglutinate. The blood group of the person is
   a) O
   b) AB
   c) B
   d) A
6. The offspring produced from a marriage have only 0 or A blood groups. Of the genotypes given below, the possible genotypes of the parents would be
   a) ii and ii
   b) I^AI^A and ii
   c) l^Ai and ii or l^Ai and l^Ai
   d) I^AI^A and I^Ai
7. The gene of sickle cell anaemia is inherited by
   a) Haemoglobin
   b) Autosomes and sex chromosomes
   c) Sex chromosomes
   d) Autosomes

8. More men suffer from colour blindness than women because

a) women are more resistant to disease than men

b) the male sex hormone testosterone causes the disease

c) the colour-blind gene is carried on the 'Y' chromosome

d) men are hemizygous and one defective gene is enough to make them Colour blind

9. if a cross between two individuals produces offsprings with 50% dominant character P and 50% recessive character p the genotypes of parents are

a) Pp x Pp

b) Pp xpp

c) PP x x pp

d) PP x Pp

Assertion-Reason Questions

10. **Assertion:** Aneuploidy is the phenomenon of gain or loss of one or More chromosome(s).

Reason: Sometimes homologous chromosomes are unable to separate

a) Both assertion and reason are true, and reason is the correct explanation of assertion.

b) Both assertion and reason are true, but reason is not the correct explanation of assertion

c) Assertion is true but reason is false.

d) Both assertion and reason are false.

11. Assertion: Genes of body-colour and eye-colour of Drosophila melanogaster are tightly linked. Reason: Genes of body-colour and wing-size of Drosophila melanogaster are loosely linked.

a) Both assertion and reason are true, and reason is the correct explanation of assertion.

b) Both assertion and reason are true, but reason is not the correct explanation of assertion.

c) Assertion is true but reason is false.

d) Both assertion and reason are false.

SA-I **(2 Marks)**

12. Identify the sex of organism as male or female in which the sex chromosome are found as (i) ZW in bird (ii) XY in Drosophila (iii) ZZ in birds, (iv) XO in grasshopper.

13. The human male never passes on the gene for haemophilia to his son. Why is it so ?

14. Mention four reasons why Drosophila was chosen by Morgan for his experiments in genetics.

15. Differentiate between point mutation and frameshift mutations.

SA-II **(3 Marks)**

16. A woman with O blood group marries a man with AB blood group

(i) Work out all the possible phenotypes and genotypes of the progeny.

(ii) Discuss the kind of dominance in the parents and the progeny in this case.

17. Give reasons for success of Mendel.

18. In Mendel's breeding experiment on garden pea, the offspring of F_2 generation are obtained in the ratio of 25% pure yellow pod, 50% hybrid green pods and 25% green pods State (i) which pod colour is dominant (ii) The Phenotypes of the individuals of F_1 generation, (iii) Workout the cross.

LA **(5 Marks)**

19. A dihybrid heterozygous round, yellow seeded garden pea (*Pisum sativum*) was crossed with a double recessive plant.

(i) What type of cross is this?

(ii) Work out the genotype and phenotype of the progeny.

(iii) What principle of Mendel is illustrated through the result of this cross?

Case Based Questions

20. Read the following and answer the questions given below:

TURNER'S SYNDROME

Turner's syndrome is an example of monosomy. It is formed by the union of an allosome free egg and a normal 'X' containing sperm or a normal egg and an allosome free sperm. The individual has 2n = 45 chromosomes (44 + XO) instead of 46. Such individuals are sterile females who have rudimentary ovaries, under-devloped breasts, small uterus, short stature, webbed neck and abnormal intelligence. They may not menstruate or ovulate. Individuals with Turner's syndrome have deficiency of FSH and oestrogen secretion. This disorder can be treated by giving female sex hormone to the women from the age of puberty to make them develop breasts and have menstruation. This makes them feel more normal.

(a) What organ does turner syndrome affect?

(b) What is the couse of turner syndrome?

(c) What are clinical features of turner syndrome?

OR

Who suffer from turner syndrome? It is an example of which plaid?

21. Read the following and answer the questions given below:

In case of honey bee, the male is haploid while the female is diploid. Similar conditions are found in some other insects like ants and wasps. Male insects are haploid because they develop parthenogenetically from unfertilised eggs. The phenomenon is called arrhenotoky. Meiosis does not occur in the formation of sperms. Females grow from fertilized egg and are hence diploid.

Queen bee picks up all the sperms from drone during nuptial flight and stores them in seminal receptacle. When the queen visits drone cells it lays eggs but seminal receptacles fails to emit the sperms. The male honey bee develops parthenogenetically from these unfertilised eggs. However in all other cells, i.e., cells of workers, the female lays eggs and sperms are emitted properly from its seminal receptacle, upon these eggs leading to their fertilization. Hence except drones other honey bees (worker and queen) are diploid.381718.

(i) The 2n number of chromosomes for honey bee is 32. How many chromosomes will be present in the cells of drone?

(a) 64 (b) 32
(c) 16 (d) 8

(ii) The purpose of queen and drone for performing nuptial flight is

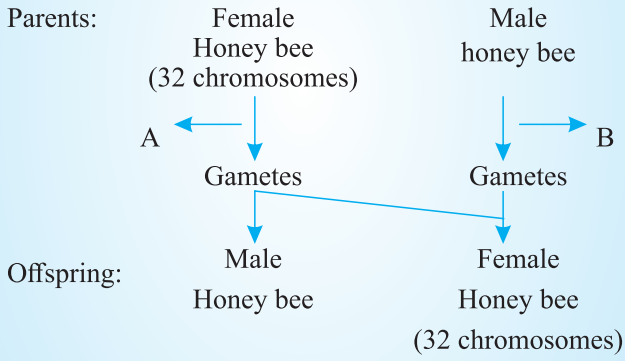
(a) to estabilish a new life (b) to perform copulation
(c) to collect pollen and necter (d) all of these

(iii) What type of cell division is involved in spermatogenesis in honey bee?

(a) Meiosis (b) Endomitosis
(c) Mitosis (d) None of these

(iv) Which of the following factors is responsible for the fertilized eggs to develop into queen or worker?

(a) Amount of temperature for incubation of eggs
(b) Type of nutrition given to the larvae
(c) Type of sperm performing fertilization of eggs
(d) All of these



(a) What forms the basis of sex determination in honey bees? What term is given to this method of sex

(b) Identify the type of cell division at 'A' and 'B' occuring during gamete formation in the female and malehoney bees respectively.

(c) Name the scientist who conducted the cytological studies during gametogenesis in insects. What did heobserve?

OR

(c) How many chromosomes does a male honey bee possesses? Give reason for the difference in the number of chromosomes between males and females of honey bees.

Answers

VSA (1 Mark)

1. GAG changes GUG, Glutamic acid is substituted by valine.
2. (i) Klinefetter's Syndrome (ii) Down's syndrome
3. Test cross 1 : 1.
4. Honey bee workers : 32 and Drones : 16 chromosomes

Answer of Multiple-Choice Question :

5. (a) 6. (c) 7. (d) 8. (d) 9. (b)

Answer of Assertion-Reason Question :

10. (a) 11. (b)

SA-I (2 Marks)

12. (i) Female (ii) Male (iii) Female (iv) Male
13. The gene for haemophilia is present on X chromosome. A male has only one X chromosome which he receives from his mother and Y chromosome from father. The human male passes the X chromosome to his daughters but not to the male progeny (sons).
14. (i) Very short life cycle (2-weeks)
    (ii) Can be grown easily in laboratory
    (iii) In single mating produce a large no. of flies.
    (iv) Male and female show many hereditary variations
    (v) It has only 4 pairs of chromosomes which are distinct in size and shape.
15. **Point Mutations :** Arises due to change in a single base pair of DNA e.g., sickle cell anaemia.

    Frame shift mutations : Deletion or insertion/duplication/addition of one or two bases in DNA.

SA-II **(3 Marks)**

9. (i) Blood group AB has alleles as I^A, I^B and O group has ii which on cross gives the both blood groups A and B while the genotype of progeny will be I^Ai and I^Bi.

   (ii) I^A and I^B are equally dominant (co-dominant). In multiple allelism, the gene I exists in 3 allelic forms, I^A, I^B and *i*.

10. (i) He used large samples for his experiments.

    (ii) He selected only pure breeding varieties.

    (iii) He choose the character which had distinctive contrasts.

    (iv) He selected pea plant which can be cross-bred as well as self bred.

    (v) Use of statistical methods and law of probability.

11. (i) Green pod colour is dominant

    (ii) Green pod colour

    (iii) Parents GG (green) X gg (yellow)

    Gametes (G) (g)

    F1 generation Gg (Hybrid green)

    Gametes (G) (g) X (G) (g)

    F2 generation GG Gg Gg gg

    Phenotypic ratio 3 : 1

    Genotypic ratio 1 : 2 : 1

LA **(5 Marks)**

12. (i) It is a dihybrid test cross

    (ii) Parent RrYy (Round Yellow) rryy (Wrinkled green)

    Gametes (RY), (Ry), (rY), (ry), × (ry)

Gametes	RY	Ry	rY	ry
F1 progeny	RrYy Round, Yellow	Rryy Round and green	rrYy wrinkled, yellow	rryy wrinkled, green.

Phenotypic ratio	1	:	1	:	1	:	1
Genotypic ratio	1	:	1	:	1	:	1

F_2 Progeny

Phenotypic ratio	Round yellow	:	Round green	:	Wrinkled yellow	:	Wrinkled green
Genotypic ratio	9	:	3	:	3	:	1

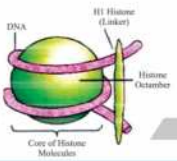
(iii) Principle of Independent Assortment.

20. (a) Tumer syndrome affect veins, heart, eyes bones and kidneys.
    (b) Loss of 'x' chromosome 44 + x0
    © Short neck, underdeveloped breast, no menstral cycle, rudimentary overlies.
    (d) It is an example of monosomy in females.
21. No. of sets of chromosome and received by an individual called as haplodiploid system of sex determination.
    (a) A – Meiosis
    (b) B – Mitosis
    (c) Henking. He observe a specific nuclear structure all through Spermatogenesis in few Insects.

OR

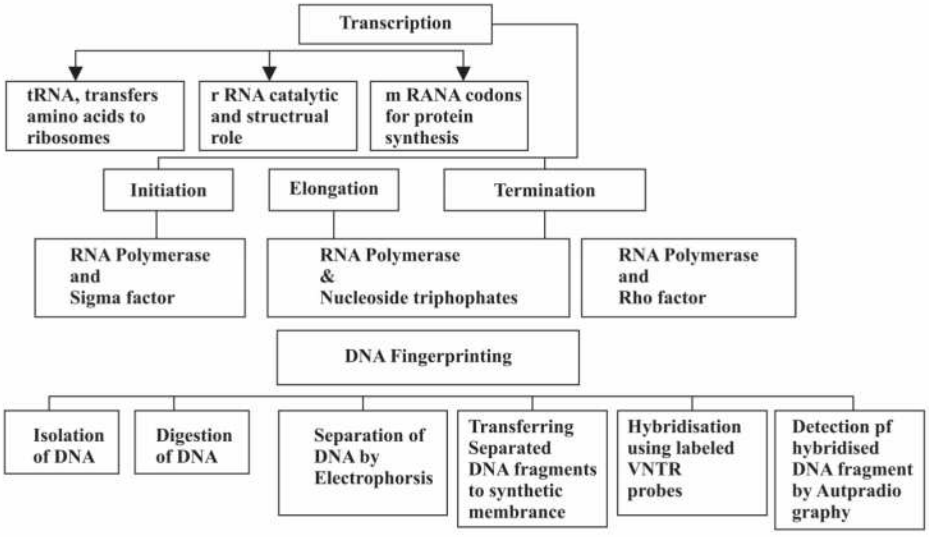
A male honey bee develops pantheon genetically C without fertlisation /from an ovum. Hence haploid. A female honey bee develops from fertilized eg. so diploid (32 chromosome.)

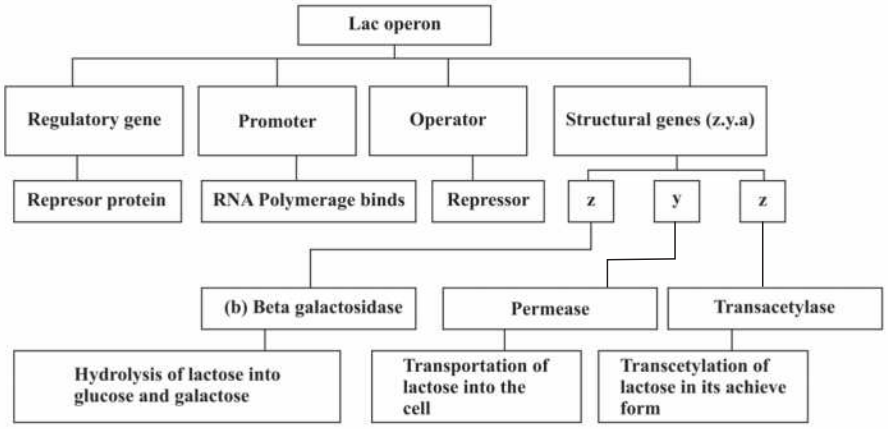
●●●

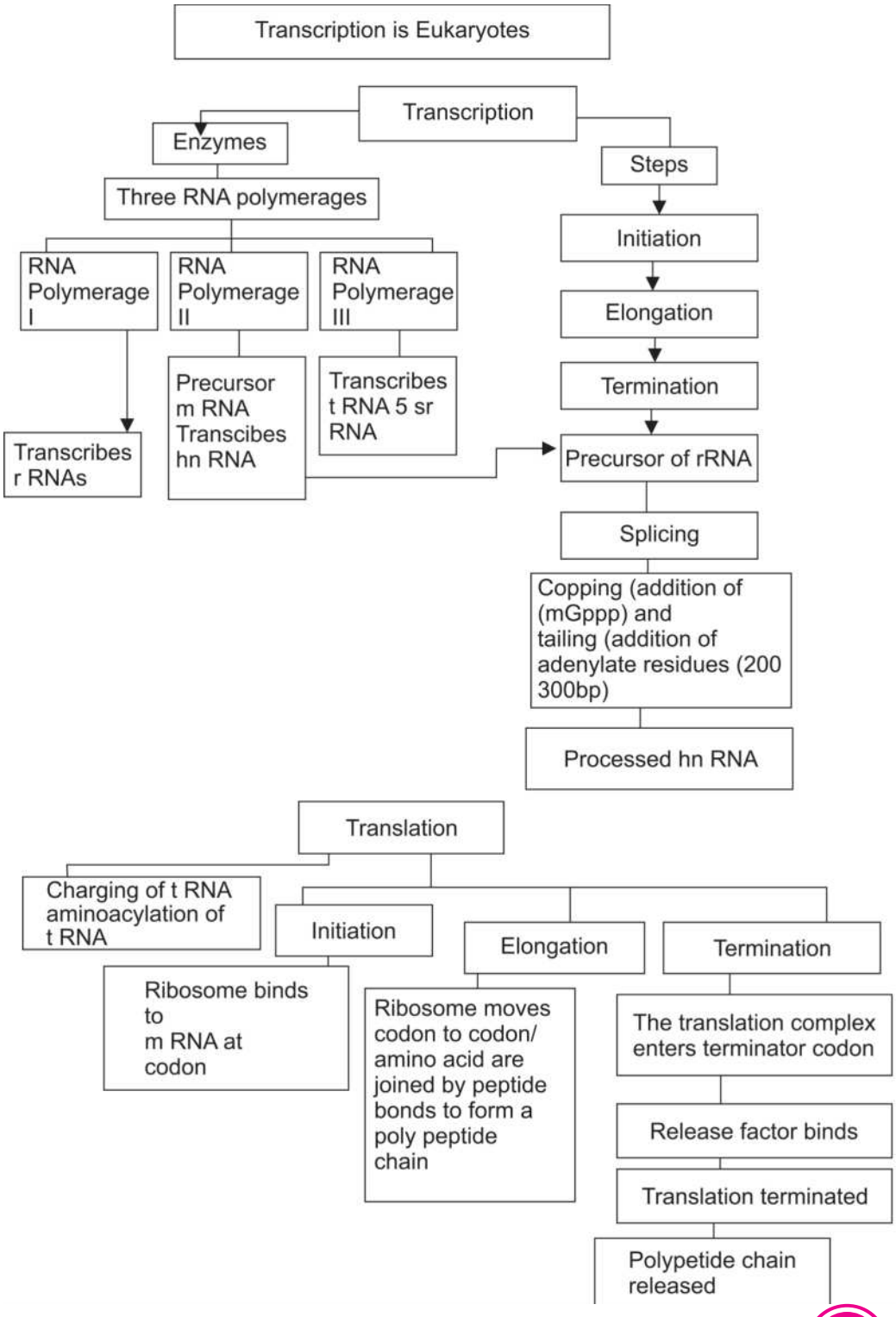


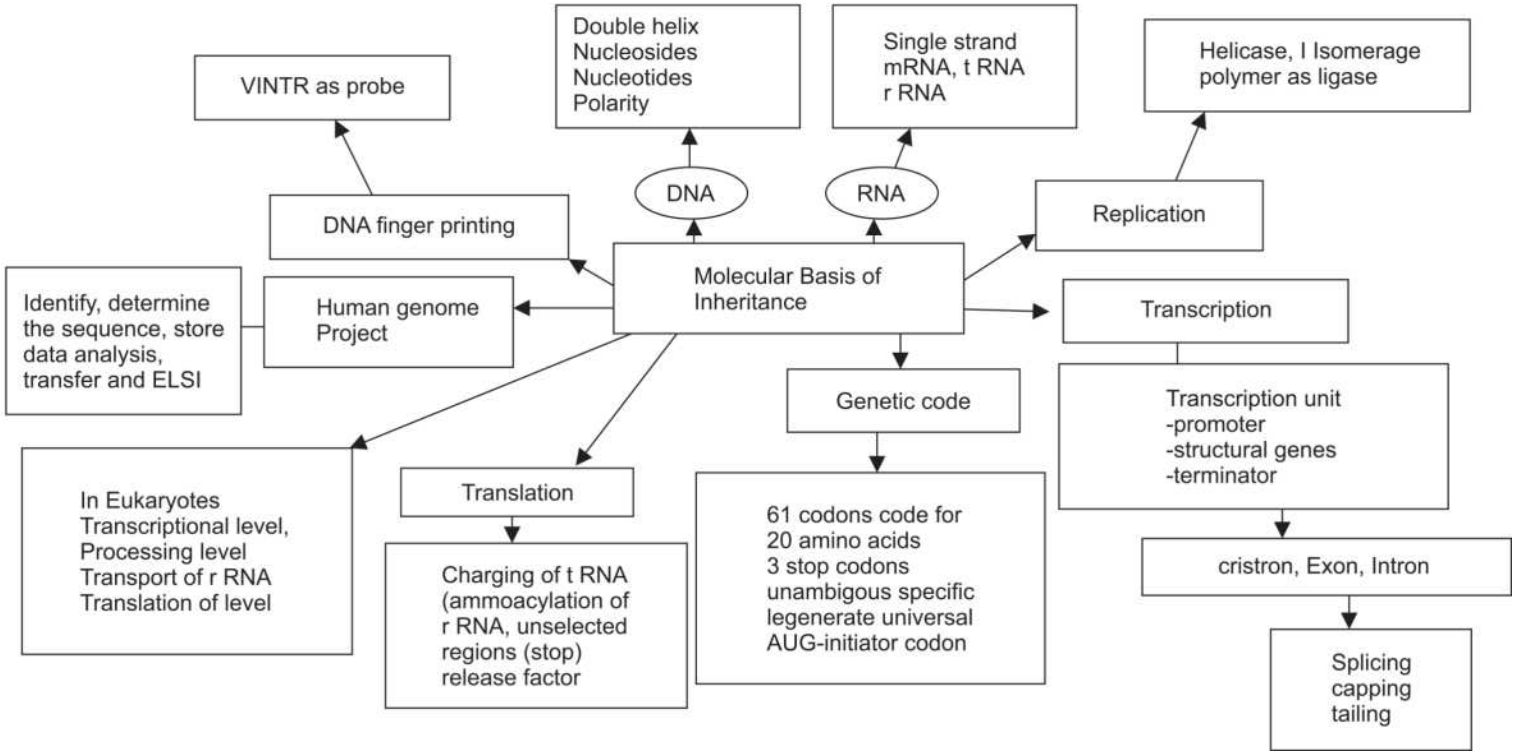
Chapter - 5

Molecular basis of Inheritance






Transcription is Eukaryotes
Transcription
Enzymes
Three RNA polymerages
RNA Polymerage I
RNA Polymerage II
RNA Polymerage III
Transcribes r RNAs
Precursor m RNA Transcibes hn RNA
Transcribes t RNA 5 sr RNA
Steps
Initiation
Elongation
Termination
Precursor of rRNA
Splicing
Copping (addition of (mGppp) and tailing (addition of adenylate residues (200 300bp)
Processed hn RNA
Translation
Charging of t RNA aminoacylation of t RNA
Initiation
Elongation
Termination
Ribosome binds to m RNA at codon
Ribosome moves codon to codon/ amino acid are joined by peptide bonds to form a poly peptide chain
The translation complex enters terminator codon
Release factor binds
Translation terminated
Polypetide chain released


Molecular Basis of Inheritance
DNA
RNA
Double helix
Nucleosides
Nucleotides
Polarity
Single strand
mRNA, t RNA
r RNA
VINTR as probe
DNA finger printing
Identify, determine the sequence, store data analysis, transfer and ELSI
Human genome Project
Replication
Helicase, I Isomerage polymer as ligase
Transcription
Transcription unit
-promoter
-structural genes
-terminator
cristron, Exon, Intron
Splicing
capping
tailing
Genetic code
61 codons code for
20 amino acids
3 stop codons
unambigous specific
legenerate universal
AUG-initiator codon
Translation
Charging of t RNA
(ammoacylation of
r RNA, unselected
regions (stop)
release factor
In Eukaryotes
Transcriptional level,
Processing level
Transport of r RNA
Translation of level

Anticodon : A sequence of three nitrogenous bases on tRNA which is complementary to the codon on mRNA.

Genome : Sum total of genes in haploid set of chromosomes.

DNA Polymorphism : The variations at genetic level, where an inheritable mutation is observed, in a population at high frequency.

Satellite DNA : The repetitive DNA sequences which form a large portion of genome and have high degree of polymorphism but do not code for any proteins.

Operon : A group of genes which control a metabolic pathway.

Exons : The regions of a gene which become part of mRNA and code for different regions of proteins.

Introns : The regions of a gene which are removed during the processing of mRNA.

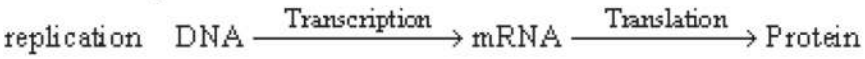
Euchromatin : The region of chromatin which is loosely packed and transcriptionally active, it stains lighter.

Heterochromatin : The chromatin that is more densely packed, stains dark and is transcriptionally inactive.

Splicing : The process in eukaryotic genes in which introns are removed and the exons are joined together to form mRNA.

Bioinformatics : Science of use of techniques including statistics, storing as data bases, analysing, modelling and providing access to various aspects of biological information usually on the molecular level.

Central Dogma :



Replication fork : The Y shaped structure formed when double stranded DNA is unwound upto a point during its replication.

VNTR : Variable Number of Tandem Repeats

Glycosidic bond (N-gylcosidic linkage)-A linkage between a nitrogenous base and a pentose sugar to form a nucleoside.

Phosphodiester bond - The bond between two adjacent nucleutides to two adjacent sugar modecules at 3' and 5' positions with phosphate group.

Tandem Repeat-(One behind the other)-A DNA segment in which a nucleotide sequence is repeated one after another two or more times eg ATTCCGATTCCG ATTCCG is a tandem repeat in which the sequence ATTCCG is repeated threetimes.

KB-Kilobase-A unit for length for nucleic acids consisting of 1000 nucleotides abbreviated kb or kbp (kilobase pairs) DNA.

Oncogene-A gene that induces uncontrolled cell proliferation.

YAC : Yeast Artificial Chromosome

BAC : Bacterial Artificial Chromosome

SNPs : Single Nucleotide polymorphism

HGP : Human Genome Project

hnRNA : Heterogenous nuclear RNA. It is precursor of mRNA.

Friedrich Meischer	1869	First identified and isolated a acidic substance from pus cell and named it 'Nuclein'.
Altman	1889	Separated protein from nuclear substance and named it nucleic acid
Kossel	1893	Discover nitrogen bases (Adenine, Guanine, Cytosine, Thymine, Uracil)
T.H. Morgan	1910	Father of experimental genetics (experimental verification of chromosomal theory of inheritance)
Frederick Griffith	1928	Provide first clear-cut evidance that DNA is the hereditary material while working on *Streptococus pneumoniae.* Biochemical nature of genetic material was not defined
Avery, Macleod and McCarty	1944	Discover that transforming principle is DNA, not a protein or RNA. First identification that DNA is the hereditary material
Erwin Chargaff	1950	Purine and pyrimidine components occur in equal amount in a DNA molecule. $A + G = T + C$
Harshey and Chase	1952	Performed experiment with *Escherichia coli* and bacteriophage and showed that it is the viral DNA and not protein that passed from virus to bacteria and therefore DNA serves as the genetic material.
Wilkins and Franklin	1952	Produce X-ray diffraction data of DNA.
Watson and Crick	1953	Double helical structure of DNA.
Messelson and Stahl	1958	Experimentaly proved the semiconservative nature of DNA replication.
Jacob and Monod	1961	Proposed operon model - genetic material has a number of functional unit is called operon.
Alec Jaffery	1985	Discovered the technique of DNA finger printing.

Chemical Structure of Polynucleotide Chain (DNA/RNA) : A nucleotide has three components.

1. **Nitrogen base**
   (i) **Purines :** Adenine and Guanine
   (ii) **Pyrimidines :** Cytosine, Thymine and Uracil (Thymine in DNA and Uracil in RNA.)
2. **Pentose Sugar :** Ribose (in RNA) or Deoxyribose (in DNA).
3. **Phosphate Group**

- Nitrogen base is linked to pentose sugar through N-Glycosidic linkage.
- Nitrogen base + Sugar = Nucleoside
- Phosphate group is linked to 5′-OH of a nucleoside through phosphoester linkage.
- Nucleoside + Phosphate group = Nucleotide
- Two nucleotides are linked through 3'-5 phosphodiester linkage to form a dinucleotide
- A polynucleotide chain has free phosphate group at 5' end of ribose sugar and a free 3′-OH group at other end.

RNA is highly reactive than DNA : In RNA nucleotide has an additional OH group at 2′ positions in the ribose; RNA is also catalytic.

Double-helix Structure of DNA : Proposed by Watson and Crick in 1953.

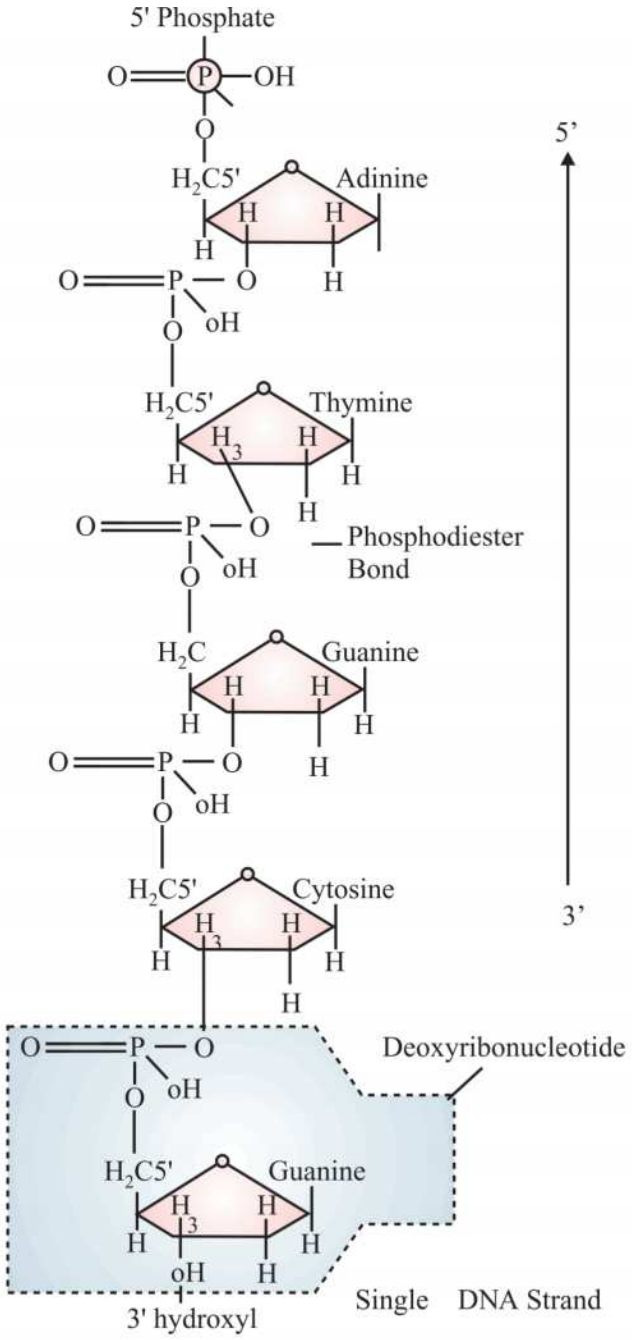
(i) DNA is made up of two polynucleotide chains.

(ii) The backbone is made up of sugar and phosphate and the bases project inside.

(iii) Both polynucleotide chains are antiparallel i.e. one chain has polarity 5′-3′ and other chain has 3′-5′.

(iv) These two strands of chains are held together by hydrogen bonds i.e. A = T, C ≡ G.

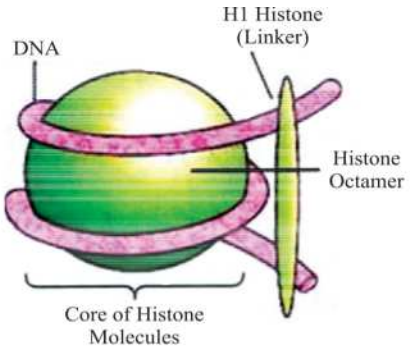
(v) Both chains are coiled in right handed fashion. The pitch of helix is 3.4 nm with 10 base pairs in each turn.



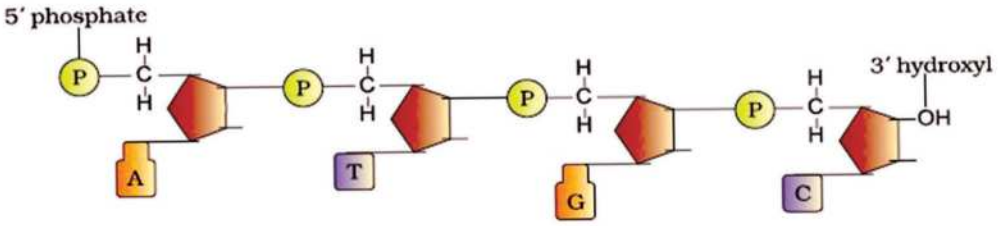
Packaging of DNA Helix

- The average distance between the two adjacent base pairs is 0.34 nm (0.34×10^{-9}m or 3.4 Å)

- The number of base pairs in *Escherichia coli* is 4.6×10^6.
- **DNA Packaging in Prokaryotes :** DNA is not scattered throughout the cell. DNA (negatively Charged) is held by some proteins (has positive charges) in a region termed as nucleoid. The DNA in nucleoid is organised in large loops held by proteins.
- **DNA packaging in Eukaryotes :** There is a set of positively charged basic proteins called histones. Eight histone molecules combine together to form histone octamer.
- The negatively charged DNA is wrapped around positively charged histone octamer to form as structure called nucleosome.
- Histone H1 is situated outside of nucleosomal DNA in linker region.
- Nucleosomes constitute the repeating unit of a structure in nucleus called chromatin.
- The beads-on-string structure in chromatin is packaged to form chromatin fibres that are further coiled and condensed at metaphase stage of cell division to form chromosomes.
- The packaging of chromatin at higher level requires additional set of protein that collectively are referred to as Non-histone chromosomal (NHC) proteins. At some places chromatin is density packed to form darkly staining heterochromatin. At other places chromatin is loosely packed to form euchromatin.
- Euchromatin is said to be transcriptionally active chromatin, whereas heterochromatin is inactive.



Structure of Nucleosome



A Polynucleotide Chain of DNA

Transforming Principle :

Frederick Griffith (1928) performed experiments with *Streptococcus peumoniae* and mice. This bacterium has two strains.

1. S-strain (Virulent)-which possess a mucilage coat and has ability to cause pneumonia.
2. R-strain (Nonvirulent) which do not possess mucilage coat and is unable to cause pneumonia.

- Griffth injected R-strain bacteria into mice.

  → No disease noticed and mice remain live.

- On injecting S-strain bacteria into mice.

  → Mice died due to pneumonia.

- When heat-killed S-strain bacteria were injected into mice → No pneumonia symptoms noticed and mice remain alive.
- He than injected a mixture of R-strain bacteria (Non virulent) and heat killed S-strain bacteria (virulent) into mice → mice died due to pneumonia.
- Moreover Griffith recovered living S-strain (virulent) bacteria from the dead mice.

Conclusion : He concluded that presence of heat-killed S-strain bacteria caused transformation of some R-strain bacteria into virulent by a chemical substance, called 'transforming principle'. But biochemical nature of the genetic material was not defined by him.

Chemical Nature of Transforming Principle

In 1944, Avery, MacLeod and McCarty worked to determine the chemical nature of 'transforming principle'.

They purified biochemicals from heat killed S-cells :

- Proteins $\xrightarrow{\text{Proteases}}$ Transformation takes place. So, protein is not a 'transforming principle'.
- RNA $\xrightarrow{\text{RNases}}$ Transformation takes place. So, RNA is not a 'transforming Principle'.
- DNA $\xrightarrow{\text{DNases}}$ Transformation inhibited. Therefore, DNA is the 'Transforming Principle'.

Hershey and Chase Experiment : In 1952, Hershey and Chase performed an experiment on bacteriophages (Virsues that infect bacteria) and proved that DNA is the genetic material.

Bacteriophage Radioactive (S^{35}) Labelled protein coat	Bacteriophage Radioactive (P^{32}) labelled DNA
↓	↓
Infection : E. coli	E. coli
Blending : Viral coats removed from the bacteria.	
↓	↓
Centrifugation : Viral particles separated from the bacerial cell.	
↓	↓
No radioactive (S^{35}) Detected in bacterial cells but detected in supernatant	Radioactive (P^{32}) detected in bacterial cells but not in supernatant

Conclusion : DNA is the genetic material.

Messelson and Stahl's Experiment :

- Messelson and Stahl performed the experiment in 1958 on *E. coli* to prove that DNA replication is semiconservative.
- E. coli was grown in $^{15}NH_4Cl$ for many generations.
- N^{15} was incorporated into newly synthesised DNA.
- This heavy DNA could be differentiated from normal DNA by centrifugation in cesium chloride (CsCl) density gradient.
- Then they transferred these *E.coli* into medium with normal $^{14}NH_4Cl$.
- After 20 minutes, it was found that all the DNA molecules of daughter cells were hybrid-**First generation.**
- After 40 minutes, it was found that 50% DNA molecules were hybrid and 50% were normal-**second generation.**

DNA replication

DNA strands start separating from ori (origin of replication). This unwinding is catalysed by many enzymes. Y-shaped structure is formed at ori called replication fork

↓

DNA polymerase attaches to the replication fork and add nucleotides complementary to the parental DNA strand. The direction of polymerisation is 5′-3′.

↓

DNA polymerase cannot initiate the polymerisation itself, so a small segment of RNA called primer is attached at replication start point

↓

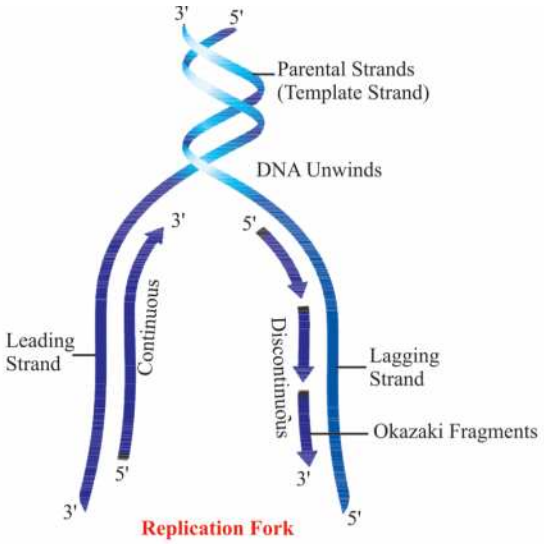
DNA polymerase adds nucleotides on one of the template strand, called as leading strand (the template with polarity 3′-5′). In this strand nucleotides are added continuously therefore called as continuous replication

↓

On the other strand the replication is discontinuous, small fragment of DNA are formed called okazaki fragments which are later joined by DNA ligase. This strand is called as lagging strand.

↓

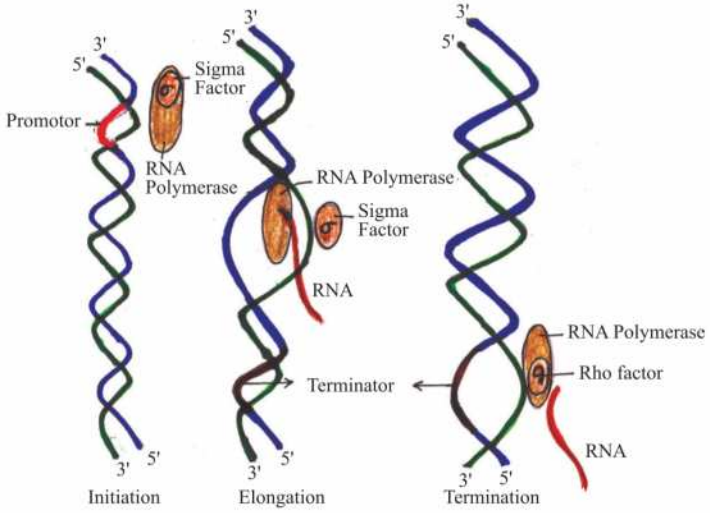
Accuracy of polymerisation is maintained by Proof reading and any wrong base added is removed



Replication Fork

Transcription in Prokaryotes : In prokaryotes the process of transcription is completed in three steps :

1. **Initiation :** RNA polymerase binds with initation factor (sigma factor) and then binds to promotor site.
2. **Elongation :** RNA polymerase separates from sigma factor and adds nucleoside triphosphate as substrate. RNA is formed during the process following the rule of complementary and remains bound to enzyme RNA polymerase.
3. **Termination :** On reaching terminator region, RNA polymerase binds with rho factor (terminator factor) as a result nascent RNA separates.



Transcription in Prokaryotes

Transcription in Eukaryotes :

- In eukaryotes three types of RNA polymerases are found in the nucleus. (In addition to the RNA polymerase found in the organelles) are involved in transcription.

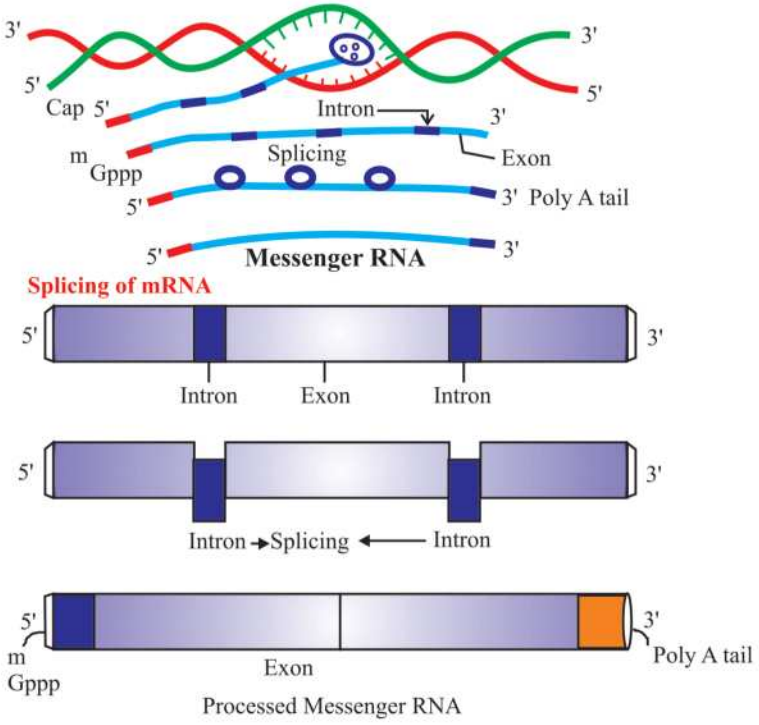
  RNA Polymerase I : Transcribes rRNAs.

  RNA Polymerase II : Transcribes hnRNA (which is precursor of mRNA).

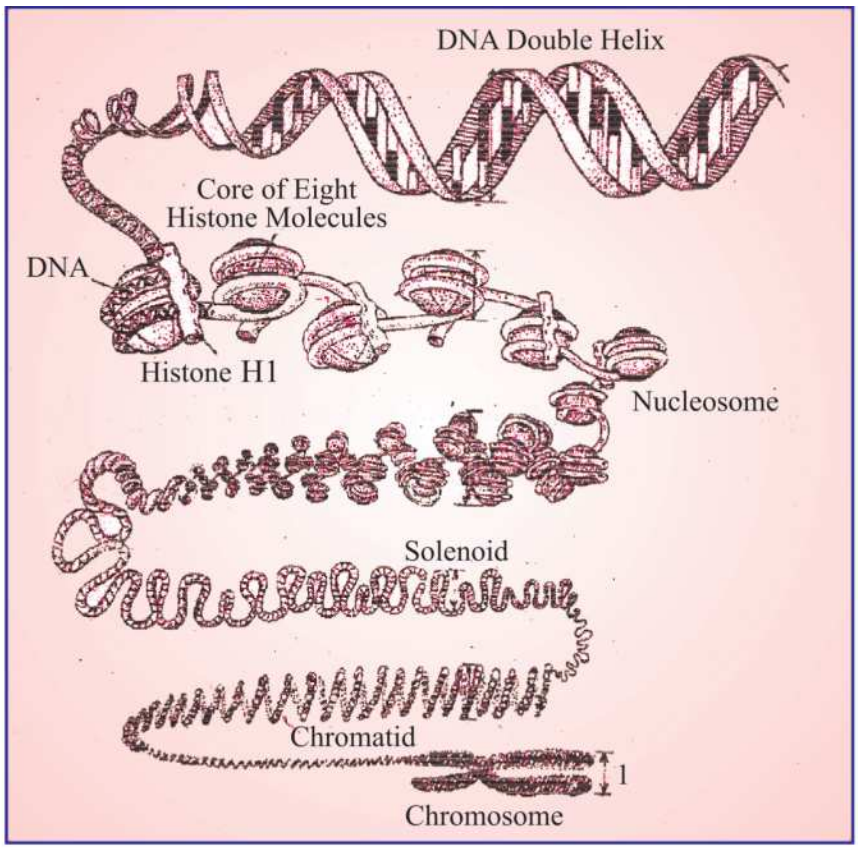
- **RNA Polymerase III :** Transcribes tRNA, 5 srRNA and sn RNA.
- The primary transcription has both exon and intron regions.
- Introns which are non-coding regions removed by a process called splicing.
- hnRNA undergoes two additional process :

  (a) **Capping :** An unusual nucleotide (methylguanosine triphosphate) is added to 5'–end of hnRNA.

  (b) **Tailling :** Adenylate residues (200-300) are added at 3′–end. It is fully processed hnRNA. (now called mRNA) is transported out of the nucleus.



Transcription in Eukaryotes



Genetic Code

(i) The codon is triplet 61 codons code for amino acids and 3 codons function as stop codons (UAG, UGA, UAA)

(ii) One codon codes for only one amino acid, hence the codon is unambiguous

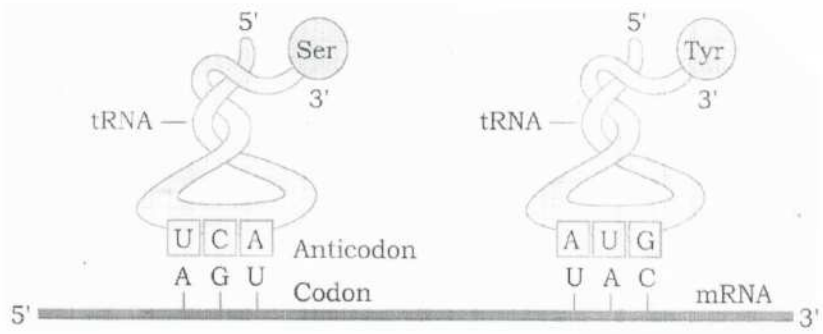
(iii) Some amino acids are coded by more than one codon, hence called as degenerate.

(iv) The codon is read in mRNA in a contiguous fashion. There are no punctuations.

(v) The code is nearly universal.

(vi) AUG has dual functions. It codes for Methionine (met) and it also acts as initiator codon.

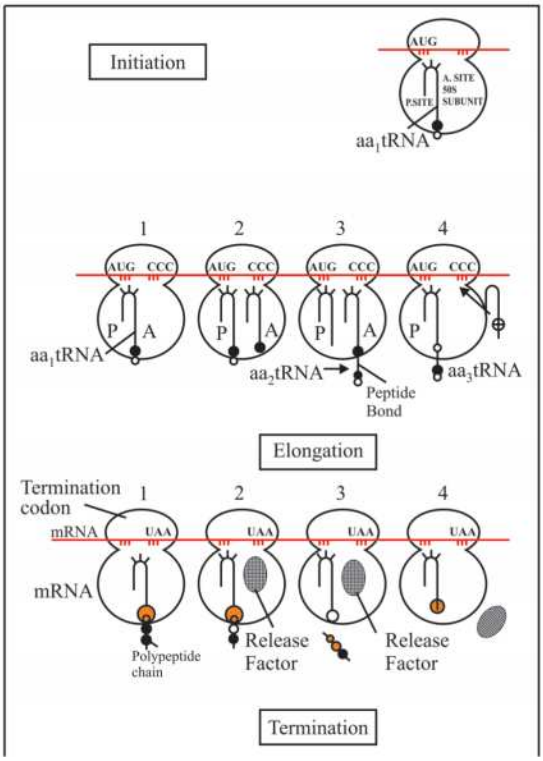
tRNA, the Adapter Molecule

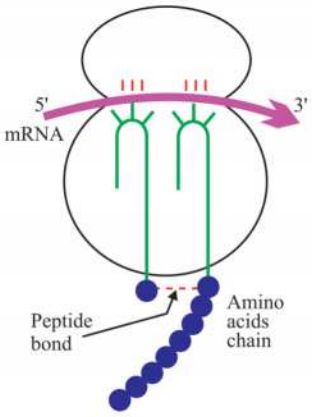


- tRNA has an anticodon loop that has bases complementary to the code, and also has an amino acid acceptor and through which it binds to amino acids.

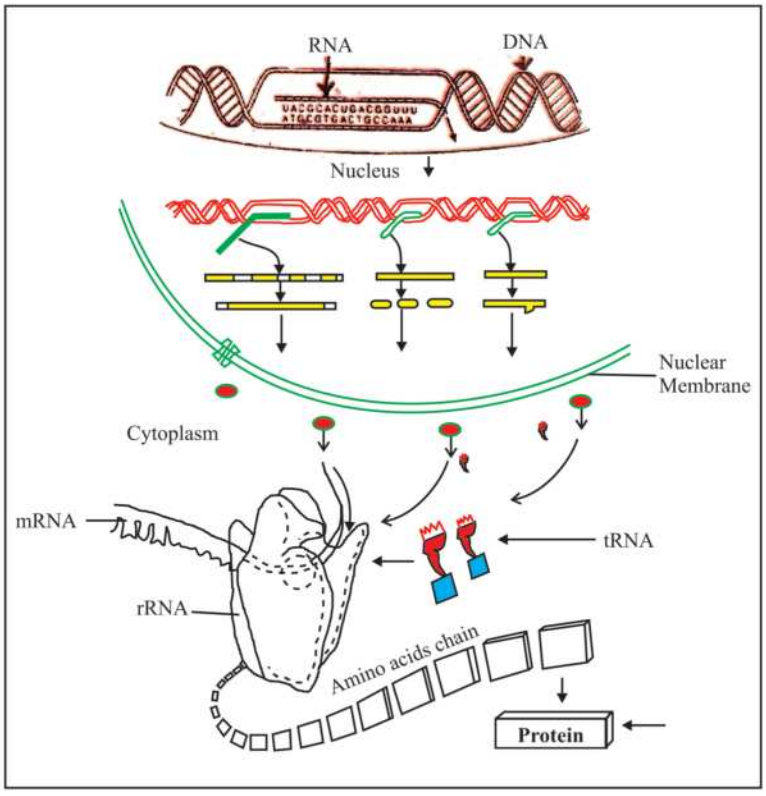
Translation

- Translation refers to the process of polymerization of amino acids to form a polypeptide. The order and sequence of amino acids are defined by the sequence of bases in the mRNA. 20 amino acids participate in naturally occuring protein synthesis.





- First step is—charging of t-RNA or aminoacylation of t-RNA-here amino acids are activated in the presence of ATP and linked to specific t-RNA.
- **Initiation :** Ribosome binds to mRNA at the start codon (AUG) that is recognized by the initiator t-RNA.
- **Elongation phase :** Here complexes composed of an amino acid linked to tRNA. Sequentially bind to the appropriate codon in mRNA by forming complementary base pairs on t-RNA as anticodon. The ribosomes move from codon to codon along with mRNA. Amino acids are added one by one, translated into polypeptide sequences.
- **Termination :** Release factors binds to the stop codon (UAA, UAG, UGA) translation and releasing the complete polypeptide from the ribosome.



Lac Operon

- The concept of operon was proposed by Jacob and Monod. Operon is a unit of prokaryotic gene expression.

- The lac operon consists of one regulatory gene (the i-gene) and three structural genes (z, y and a).
- The i-gene codes for repressor of lac operon.
- Promoter - It is the site where RNA-polymerase binds for transcription.
- Operator—acts as switch for operon.
- Lactose is an inducer.
- Operator : Act as switch for operon.
- Gene z—Codes for b-galactosidase

  Gene y—Codes for permease

  Gene a—Codes for transacetylase.

In the absence of Inducer (lactose)

Repressor (i-gene) binds with operator (o)

↓

Operator (O) turns off

↓

RNA polymerase stops the transcription

↓

structural genes (z, y and a) do not produce lac mRNA and enzymes

In the presence of inducer (lactose)

Repressor binds to inducer (lactose)

↓

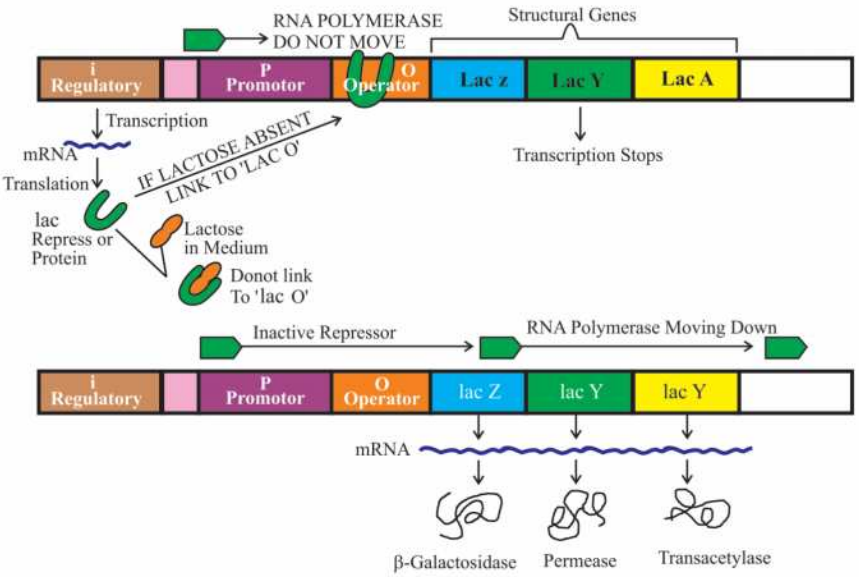
Operator (O) turns ON

↓

RNA polymerase starts the transcription

Structural genes (z, y and a) produce mRNA and enzymes

(β-galactosidase, permease and transacetylase respectively)



Human Genome Project was a 13 year project coordinated by the U.S. Department of Energy and National institute of Health, it was completed in 2003.

Important goals of HGP

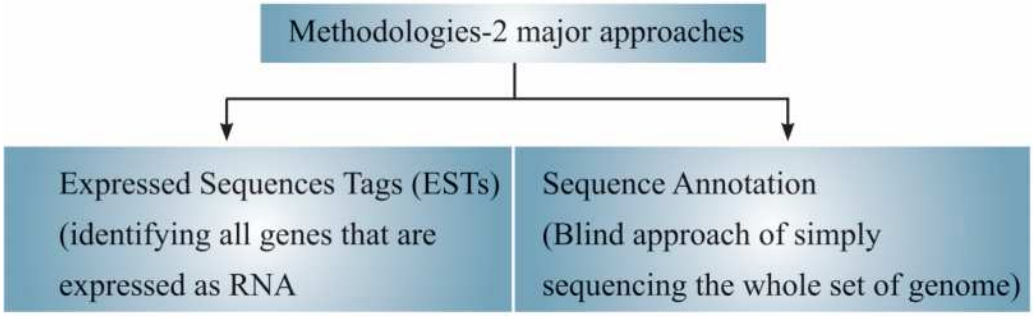
(i) Identify all the approximately 20,000-25,000 genes in human DNA.

(ii) Determinate the sequence of the 3 millon chemical base pairs that make up human DNA.

(iii) Store this information in database.

(iv) Transfer the related technologies to other sectors, such as industries.

(v) Address the ethical, legal and social issues (ELSI) that may arise from the project.



Steps for Sequencing :

- DNA isolated from cell and converted into fragments.
- DNA is cloned for amplification is suitable host using specialised vectors.
- Commonly used hosts—Bacteria, Yeast
- Commonly used Vectors—BAC (Bacterial Artificial Chromosomes) YAC (Yeast Artificial Chromosomes)

International Rice Genome Sequencing Project (IRGSP)

- Rice benefits from having the smallest genome of the major cereals, dense genetic maps.
- The IRGSP, formally established in 1998, pooled the resources of sequencing groups in 10 nations (Japan, Korea, UK, Taiwan, China, Thailand, India, United States, Canada and France)
- Estimated Cost— Rs. 200 million.
- India joined in June 2000 and chosed to sequence a part of chromosome 11.
- Tools used in sequencing were :

  BAC (Bacterial Artificial chromosomes)

  PAC (P1-Phase derived artificial chromosomes)

- **How Sequenced**

  Shotgun sequencing involved—generation of short DNA fragments that are then sequenced and linearly arranged.

  It enables full coverage of the genome in a fraction of time required for the atternative BAC sequence approach.

- **Salient Features of Rice Genome**

  Rice is monocarpic annual plant, wind pollinated. It is with only 389 base pairs.

The world's first genome of a crop plant that was completely sequenced.

2,859 genes seem to be unique to rice & other cereals.

Repetitive DNA is estimated to constitute at least 505 of rice genome. The transposon content of rice genome is at least 35%.

- **Applications**
- To improve efficiency of Rice breeding.
- To improve nutritional value of rice, enhance crop yield by improving seed quality, resistance to pests and diseases and plant hardiness.

DNA Fingerprinting :

It is a technique to determine nucleotide sequence of certain areas of DNA which are unique to each individual.

Principle of DNA Fingerprinting : Short nucleotide repeats in the DNA are very specific in each individual and vary in number from person to person but are inherited, these are Variable Number Tandem Repeats (VNTRs.). Each individual inherits these repeats from his/her parents which is used as genetic markers. One half of VNTR alleles of the child resembles that of mother and other half of the father.

Steps/Procedure in DNA Fingerprinting

- Extraction of DNA—using high speed refrigerated centrifuge.
- Amplification—many copies are made using PCR
- Restriction Digestion—using restriction enzymes DNA is cut into fragments.
- Separation of DNA fragments—using electrophoresis agarose polymer gel
- **Southern Blotting :** Separated DNA sequences are transferred on to nitrocellulose or nylon membranes.

- **Hybridization :** The nylon membranes exposed to radio active probes.
- **Autoradiography :** The dark bands develop at the probe site.

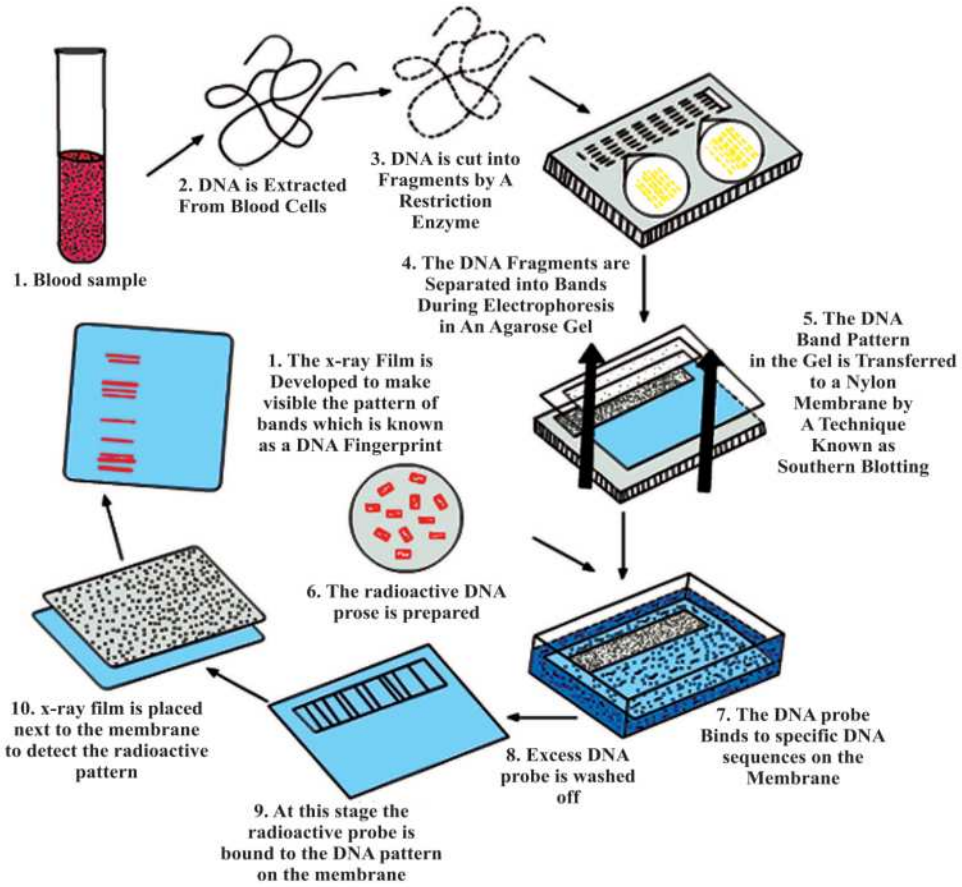
Applications of DNA Fingerprinting

(i) identify criminals if their DNA from blood, hair follicle, skin, bone, saliva, sperm etc is available in forensic labs.

(ii) determine paternity

(iii) verify whether a hopeful immigrant is really close relative of an already established resident.

(iv) identify racial groups to rewrite biological evolution.

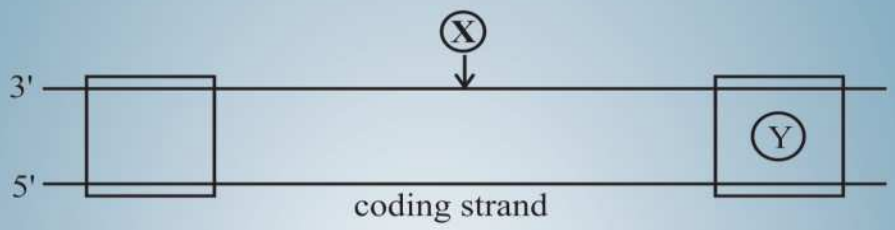


The DNA Fingerprinting Process

Questions

VSA **(I Mark)**

1. Name the factors for RNA polymerase enzymes which recognises the start and termination signals on DNA for transcription process in Bacteria.
2. RNA viruses mutate and evolve faster than other viruses. Why ?
3. Name the parts 'X' and 'Y' of the transcription unit given below.



4. Name the two initiating codons
5. Write the segment of RNA transcribed from the given DNA

Multiple - Choice Question :

6. Purines of DNA are represented by:
   a) Uracil and Thymine.
   b) Guanine & Adenine.
   c) Uracil & Cytosine.
   d) Thymine & Cytosine.
7. Which is the DNA unwinding protein?
   a) DNA polymerase.
   b) Ligase.
   c) Endonuclease.
   d) Helicase.
8. Sigma factor (o) is a component of
   a) RNA polymerase
   b) DNA ligase
   c) DNA polymerase
   d) Endonuclease.

9. The diagram shows an important concept in the genetic implication of DNA. Fill the 'A', 'B' & 'C'.
   a) A Transcriptase,B — Replication , C — James Watson
   b) A Translation, B — Transcription, C — Erevin Chargaff.
   c) A — Transcription, B — Translation, C — Francis Crick.
   d) A — Translation, B — Extension, C — Rosalind Franklin.

   In Questions 10 to 13 a statement of Assertion is followed by a statement of Reason. Mark the correct choices as:
   a) Both Assertion and Reason are true, and the Reason is the correct explanation of the Assertion.
   b) Both Assertion and Reason are true, and the Reason is not the correct explanation of the Assertion.
   c) Assertion is true statement but Reason is false.
   d) If both Assertion & Reason are false statements.

10. **Assertion :** In prokaryotes, they do not have a defined nucleus, the DNA is scattered throughout the cell. Reason : DNA is held with some protein in a region termed as `nucleolus'.

11. **Assertion** : The chromatin that is more densely packed and stains dark are called as heterochromatin.
    Reason : Heterochromatin is said to be transcriptionally active chromatin.

12. **Assertion** : Eukaryotic mRNA requires post-transcription processing for formation of functional mRNA.
    Reason : Eukaryotic transcripts possess extra non- functional segments called introns.

13. **Assertion** : Cistron is defined as a segment of DNA coding for a polypeptide.
    Reason : Mostly in eukaryotes transcription unit could be said as monocistronic.

14. Read the following and answer the questions (1) to 1 (V) given below:
    During the 1950s and 1960s, it became apparent that DNA IS essential in the synthesis of proteins. The key to a protein molecule is how the amino acids are linked. The sequence of amino acias a protein is a type of code that specifies the protein A genetic code in DNA determines this amino acid code. The genetic code consists of the sequence of nitrogenous bases in DNA. Now the nitrogenous base code is translated to an amino acid sequence in a protein is the basis for protein synthesis.

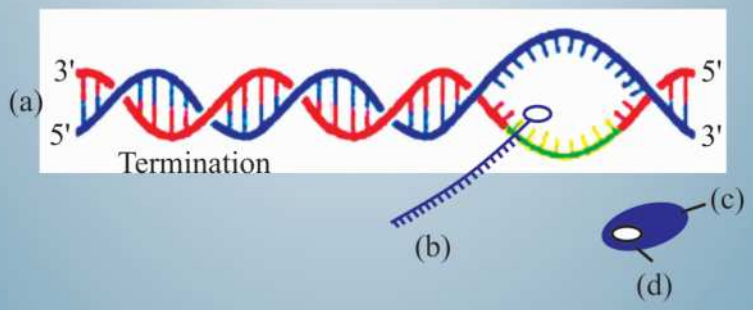
I. The process by which protein synthesis from genetic code occurs is best described by
   a) Transcription
   b) Replication
   c) Translation
   d) Reproduction

ii. In protein synthesis, translation is initiated with the movement of
   a) t-RNA from P - site to the A - site.
   b) Dipeptidyl t RNA from A - site to P - site.
   c) t-RNA from A - site to P - site.
   d) t-RNA from P - site to E - site.

iii. This is incorrect about the nature of genetic code.
   a) Comma less b) Triplets c) Universal
   d) Overlapping iv. In translation, this is not an essential component.
   a) Amino acid b) Ligase. C) mRNA
   d) Anticodon. V. The initiation t-RNA has an anticodon 'A' and carries amino acid 'B'. Identify 'A' & 'B'
   a) AUG, methionine.
   b) GUG, Valine
   c) UAC, methionine
   d) CAC, Valine

SA-I **(2 Marks)**

15. The process of termination during transcription in a prokaryotic cell is being represented here. Name the label a, b, c and d.



16. Give two reasons why both the strand of DNA are not copied during transcription.

17. State the 4 criteria which a molecule must fulfill to act as a genetic material.

SA-II **(3 Marks)**

18. Give six points of difference between DNA and RNA in their structure chemistry and function.

19. Explain how does the hnRNA becomes the mRNA.

OR

Explain the process of splicing, capping and tailing which occur during transcription in Eukaryotes.

20. Name the three major types of RNAs, specifying the function of each in the synthesis of Polypeptide.

21. A tRNA is charged with the aminoacids methionine.

(i) Give the anti-codon of this tRNA.

(ii) Write the codon for methionine.

(iii) Name the enzyme responsible for binding of aminoacid to tRNA.

LA **(5 Marks)**

22. State salient features of genetic code.

23. Describe the process of transcription of mRNA in an eukaryotic cell.

24. Describe the various steps involved in the technique of DNA fingerprinting

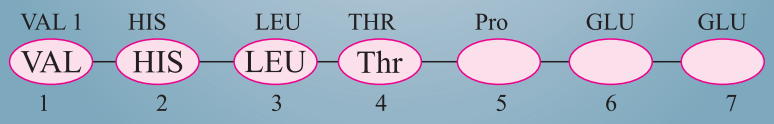
Molecular both

25. Conchiporns of a key type 2n + 1, 2n – 1, and 2n + 2, 2n – 2 are called:
(a) Aneuploidy (b) polyploid (c) allopolyploicty (d) Monosomy

26. Occasionally, a single gene may express more than one effect. The phenomenon is called.
(a) Multiple allelism (b) Monogamy
(c) Pleiotropy (d) polygon

Case Based Questions

27. A relevant portion of b-chain of haemoglobin's of a normal human is given below:



The codon for the six the amino acid as GAG. The sixth codon GAG mutates to GAA as a result of mutation 'A' and into GUG as a result of mutation 'B'. Haemoglobin's structure did not charge as a result of mutation

mutation 'B'. Haemoglobin's structure did not charge as a result of mutation 'A' where as haemoglobin's structure changed because of mutation of leading to sickle shaped RBC's.

(a) What will be the genotype of an individual what is comer of sickle cell anemia gene but apparently unaffected?

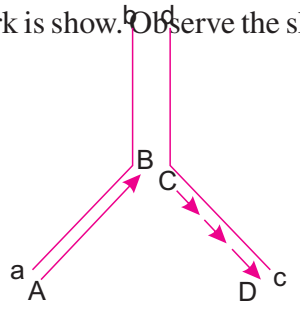
(b) What is the cause of this disease.

28. What are the symptoms of the disease sickle cell anemia?

No. 29 and 30 are case based questions. Each question has subparts with internal choice in one subpart.

Just as they proposed the double helical structure of DNA, Watson and Crick had immediately proposed a scheme for replication of DNA. The scheme suggested that the two strands would separate and each of them acts as a template for the synthesis of a complementary strand. After completion of replication, each of the new DNA molecules would possess one parental strand and one newly synthesized strand. This scheme has been termed as semiconservative replication.

A DNA replication fork is show. Observe the sketch and answer the question that follow:



(a) When and where does replication of DNA occur in eukaryotic calls?

(b) Identify the polarity of the strands a-b and c-d.

(c) Why does DNA replication occur in such small forks? Name the major enzyme that catalysis this process.

or

Why is DNA synthesis continuous and discontinuous on the two stands? What name is given to (i) the continuously synthesised strand (A – B) (ii) the small segments of strand (C – D)?

Answers

VSA **(1 Marks)**

1. Sigma (σ) factor and Rho(ρ) factor
2. OH group is present on RNA, which is a reactive group so it is unstable and mutate faster.
3. X Template strand, Y – Terminator.
4. AUG and GUG
5. 5′ – U A C G U C A U G C A G C A U – 3′ (In RNA 'T' is replaced by 'U')

6. (b) 7. (d) 8. (a) 9. (c) 10. (d)
11. (c) 11. (a) 13. (b) 14. (i) - c (ii) - b (iii) - d (iv) - b (v) - c

15. (a) DNA molecule
    (b) mRNA transcript
    (c) RNA polymers
    (d) Rho factor

16. (a) If both the strands of DNA are copied, two different RNAs (complementary to each other) and hence two different polyeptides; if a segment of DNA produces two polypeptides, the genetic information machinery becomes complicated.
    (b) The two complementary RNA molecules (produced simultaneously) would form a double-stranded RNA rather than getting translated into polypeptides.
    (c) RNA polymerase carries out polymerisation in 5′ – 3′ direction and hence the DNA strand with 3′ – 5′ polarity acts as the template strand. (Any two)

17. (i) It should be able to generate its replica.
    (ii) It Should be chemically and structurally stable.
    (iii) It Should be able to express itself in the form of Mendelian characters.
    (iv) It Should provide the scope for slow changes (mutations) that are necessary for evolution.

SA-II (3 Marks)

18.

DNA	RNA
(i) Double stranded molecules	Single stranded molecules
(ii) Thymine as pyrimidine base	Uracil as pyrimidine base
(iii) Pentose sugar is deoxyribose	Sugar is ribose
(iv) Quite stable and not very reactive	2′-OH makes it very reactive and unstable.
(v) Dictates the synthesis of Polypeptides	Perform other function in protein synthesis.
(vi) Found in the nucleus.	They are transported into the cytoplasm.

19. hnRNA is precursor of mRNA. It undergoes

(i) **Splicing :** Introns are removed and exons are joined together.

(ii) **Capping :** an unusual nucleotide (methyl guanosine triphosphate is added to the 5′ end of hnRNA.

(iii) Adenylate residues (200-300) are added at 3′ end of hnRNA.

Or

Refer fig. 6.11, page 110, NCERT book. Biology-XII

20. (i) mRNA-(Messenger RNA) : decides the sequence of amino acids.

(ii) tRNA-(Transfer RNA) : (a) Recognises the codon on mRNA (b) transport the aminoacid to the site of protein synthesis.

(iii) rRNA (Ribosomal RNA) : Plays the structural and catalytic role during translation.

21. (a) UAC (b) AUG

(c) Amino-acyl-tRNA synthetase.

LA **(5 Marks)**

22. Refer page 6.9.1., Page No. 120 NCERT Biology XII.

23. Refer notes 35 and figure 6.11, page 110, NCERT Biology XII.

24. Refer points to remember. Steps involved in DNA fingerprinting.

25. (i) (a)

(ii) (c)

26. (a) HbA HbS

(b) People who have sickle cell Anaemia inherit two faulty hemoglobin genes called HbSHbS are from each parent. It occur due to mutation in Hb chain as glutmic acid is replaced by valine.

(c) Symptons are Anaemia, i.e., oxygen carrying capacity of Hb decreases. So pain in joints, palpitation, swelling in hands and that feet. Sickle cell anemia is quantitative and Thalassemia is qualitative disorder.

27. (a) DNA replication in S-phase, of interpolate in the cell cycle.

(b) Strand a – b – 3' 5'

(c) Replication of DNA occurs in small replication bark because DNA is such a long molecular that the separation of two strands along its entire length requires a very high amount of energy. DNA – Dependent DNA polymerase is the enjoy.

or

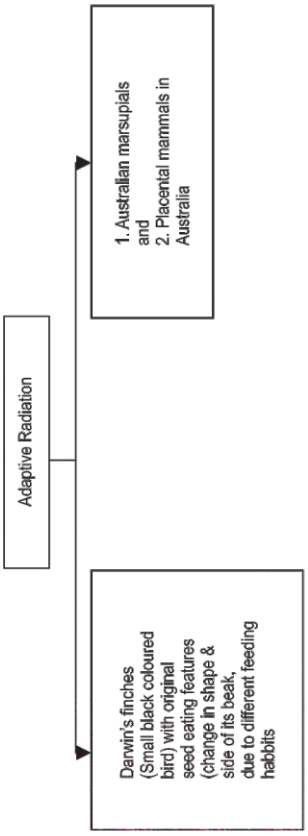
Since DNA dependent polymerase can catalyse the polymerisation in the 5'–3' direction only on the template strand with 3' — 5' polarity, synthesis is continous and on the template strand with 5' — 3' polarity synthesis is discontinous.

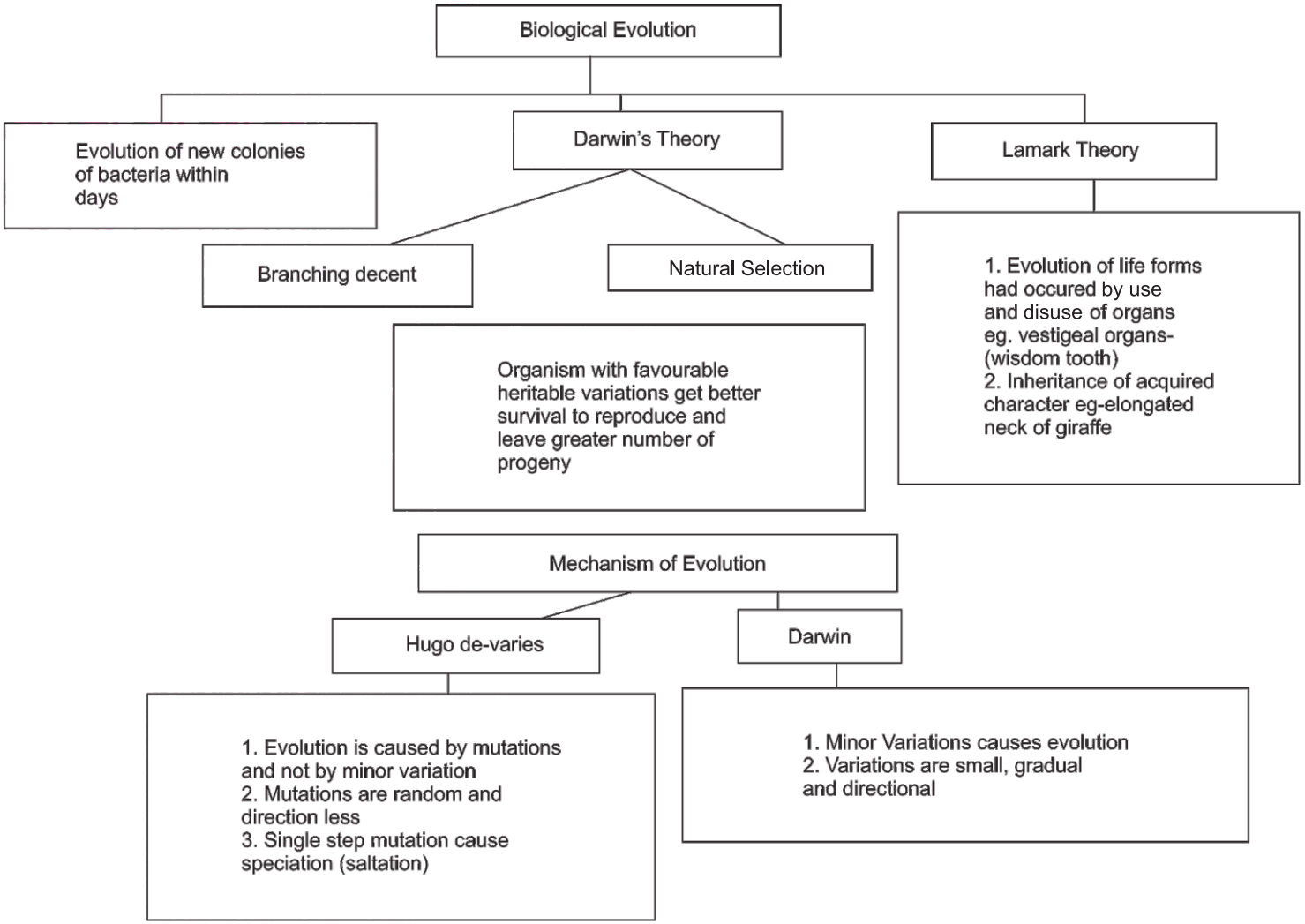
(i) Strand A – B is called leading strand.

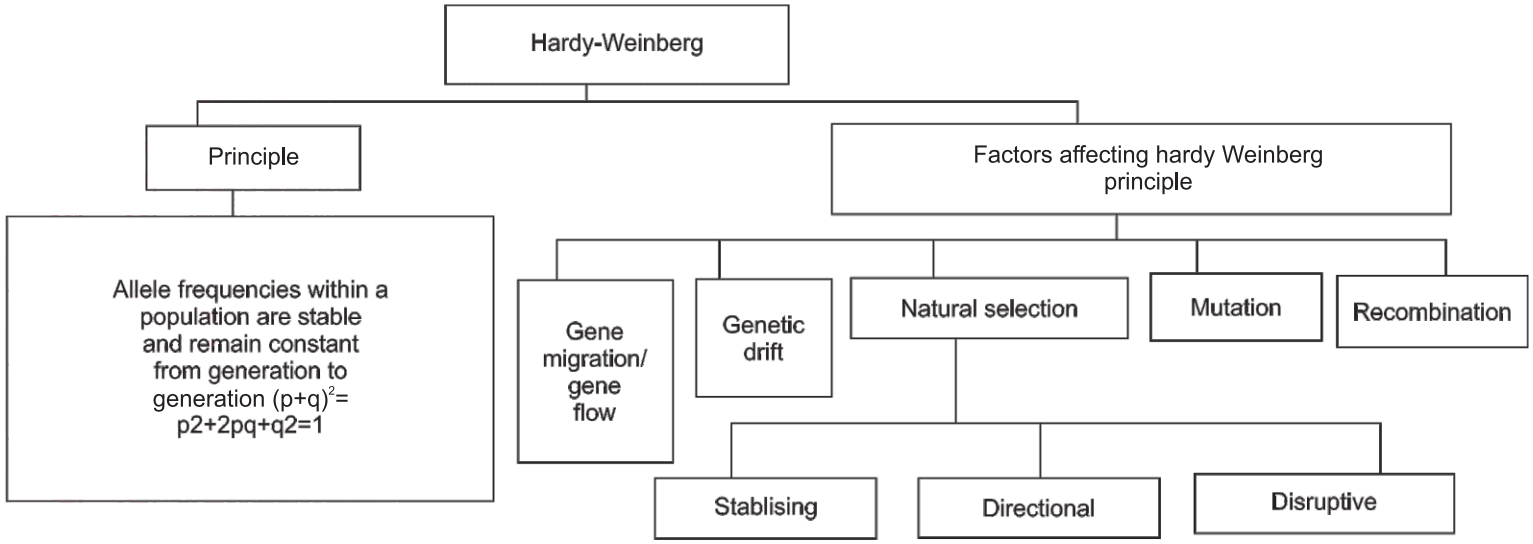
(ii) Okazaki Fragments.

Chapter - 6

Evolution




Biological Evolution
Evolution of new colonies of bacteria within days
Darwin's Theory
Lamark Theory
Branching decent
Natural Selection
1. Evolution of life forms had occured by use and disuse of organs eg. vestigeal organs- (wisdom tooth)
2. Inheritance of acquired character eg-elongated neck of giraffe
Organism with favourable heritable variations get better survival to reproduce and leave greater number of progeny
Mechanism of Evolution
Hugo de-varies
Darwin
1. Evolution is caused by mutations and not by minor variation
2. Mutations are random and direction less
3. Single step mutation cause speciation (saltation)
1. Minor Variations causes evolution
2. Variations are small, gradual and directional



Brief account of Evolution

Time	Origin
3 billion year ago	First non-cellular form of life
2000 million year ago	First cellular form of life appeared
500 million year ago	Invertebrate formed
350 million year ago	fishes with back to water-coelacnth called labefine
	evolved into the first amphibians
320 million year ago	sea weeds and plant exist

Big-bang Theory- proposed by Abbe Lemaitre in 1931. About 20 billion years ago on explosion took place which broke the condesend cosmic matter and scattered its fragments into space at an enormous velocity making a big bang sound.

Artificial Selection : It is the process carried out by man to select better breeds of plants and animals.

Founders Effect : A genetic drift in human population where a population in a new settlement have different gene frequency from that of the parent population. The original drifted population said to be founder.

Gene Pool : Sum total of all the genes in a population.

Genetic Drift : By chance elimination of genes or any other changes in gene, of certain traits from a population due to migration or death.

Panspermia : Units cf life in the form of so called spores, which were transferred to search from outer space, as believed by some scientists.

Saltation : Single step large mutations.

Speciation : It is the formation of new species from the pre-existing ones.

Organic (Biological) Evolution : Changes at the characteristics/features of originisms or groups of such population over a number of generations.

Homologous organs : (These are the result of divergent evolution) these have same basic structure and embryonic origin but perform different functions in different species.

Example :

Plants—Thorns of *Bougainvillea* and tendrils of *Cucurbita*

Animals—For limbs of whales, bat, cheetah and human

Analogous organs : (These are the result of convergent evolution) These organs are different in their basic structure and embryonic origin but perform similar functions.

Example :

Animals—Wings of insects and birds
Plants—potato and sweet potato.

Human Evolution : *Ramapithecus → Australopithecines → Homo habilis Homo erectus → Homo sapiens → Homo sapiens sapiens.*

The Theories of Origin of Life

1. Theory of Special Creation : According to this theory God has created life within 6 days.

2. Theory of Spontaneous Generation : According to this theory life originated from decaying and rotting matter like straw and mud.

3. Panspermiatic Theory : According to this theory life came from space in the form of spores called Panspermia.

4. Modern Theory or Oparin-Haldane Theory : According to this theory life originated upon earth spontaneously from non-living matter. First inorganic compounds then organic compounds were formed in accordance with ever changing environment conditions, this is called chemical evolution. The conditions on earth were high temperature, volcanic storms, reducing atmosphere (without free oxygen) containing methane and ammonia.

Experimental Evidence for abiogenesis (Miller's Experiment) : Stanley Miller in 1953 demonstrated in a laboratory that electric discharges can produce complex organic compounds from a mixture of methane, ammonia, water vapours and hydrogen. In this experiment he found that simple organic compounds including some amino acids are formed. In similar experiments others observed the formation of sugar, nitrogen bases, fats and pigments.

He used Spark chamber with two electrodes(to provide Very high-voltage spark for simulation of lightening), a flask for boiling (Simulation for evaporation and circulation) to a temperature of 800°C and a condenser (simulation of raining and, Haldane's Soup). He used mixture of gases like CH_4, NH_3, H_2 and water vapours to simulate conditions of primeval atmosphere.

Molecular evidences : These evidences show common ancestory based on parallel nucleic acid and amino acid sequences as well as universal genetic codes, e.g. Human and Chimpanzee DNA is 98.2% same and protein cytochrome c is similar.

Evidences from embryology : These evidences based on comparative development studies of embryo of different vertebrates based upto the observation during embryonic stage of all vertebrates.

The embryo of vertebrates develop a row of gill slit, but these gill slits are functional only in fish.

Ernst Haeckel's biogenetic law : This law states that "ontogeny (development of the embryo) recapitulates phylogeny (development of race)."

e.g. Vertebrate head at embronic stage has vestigial gill slits like fishes.

Hugo de vries mutation.	**Darwinian Variation**
1. Mutation appear all of a sudden	1. Darwinian variations are gradual
2. Mutations are due to sudden change in genetic make-up	2. Genes were not known to Darwinian
3. Mutations are raw material of evolution	3. The basis of evolution are continous variafions.

Divergent evolution : Development of different functional structures from a common ancestral form is called divergent evolution, e.g. Development of homologous organs.

Convergent evolution : Development of similar adaptive functional structures in unrelated groups of organisms, e.g. Development of analogous organs.

Parallel evolution : When more than one adaptive radiation appeared to have occured in an isolated geographical area then it is called parallel evolution.

e.g. Australian marsupials and placental mammals (corresponding)

Example of Natural Selection
1. Industrial Melanism
2. Restance of insects to pesticides
3. Antibiotic resistance in Bacteria

Industrial Melanism : It is an adaptation where moth living in the industrial area developed melanin pigments to match their body colour to the tree-trunk. Before Industrilisation in England, it was observed that there were more white-winged moths on trees than dark-winged moths (melanised moths). After industrialisation (in 1920), there were more dark winged moths in some areas. After industrialisation, trees got covered by smoke. So whitewinged moth were picked up by the birds but dark-winged moths escaped and survived. Thus, industrial melanism supports the evolution by natural selection.

Adaptive radiation : The process of evolution of different species in a geographical area starting from a point and literally radiating to other habitats is called adaptive radiation. Examples : (i) Darwins finches found in Galapagos Island (ii) Marsupials of Australia.

Evolution of Plants : Unicellular → Multicellular → Algae → Rhynia type plants → Cycads → Gnetales → Dicot → Monocot.

Hardy-Weingberg principle : The allele frequencies in a population are stable and is constant generation to generation. Sum total of all the allele frequencies is 1.

i.e. $p^2 + 2pq + q^2 = 1$ (Where p and q are frequency of Allele A and a)

Factors Affecting Hardy-Weinberg Equilibrium : Gene migration, Genetic drift, Mutations, Recombination, Natural Selection.

(I) Over population (ii) Limited food and space (iii) Struggle for Existence (iv) Variations (v) Natural Selection (Survival of the fittest) (vi) Inheritance of useful variation (vii) formation of new species.
Artificial Selection : (Selective breeding)-Crop plants developed from wild mustard eg. cabbage, kohlrabi, kali, broccoli, cauliflower etc.
Three types of Natural selection.
(i) stabilising selection (Balancing Selection)
(ii) Directional Selection (Progressive Selection)
(iii) Dibruptive Selection (Diversifying Selection)

Brief Account of Evolution

(mya - million years ago)

- 2000 mya : first cellular forms of life appeared on earth
- 500 mya : invertebrates formed
- 350 mya : jawless fish evolved probably, fish with stout and strong fins evolved which can move on lands as well as go back to water.
- 320 mya : Sea weeds and few plants existed probably.
- In 1938 : Fish caught in south Africa happened to be a coelacanth which was thought to be extinct. These animals are called lobefins (evolved into first amphibians)
- 200 mya : Some of land reptiles went back into water to evolve into fish like reptiles e.g. *Ichthyosaurs*. Land reptiles were Dinosaurs. Biggest Dinosours *Tyrannosaurus* rex (20 feet in height, have huge dagger like teeth.)
- First mammals were like shrews—They were small sized, viviparous intelligent.

Evolution of Man :

About 15 mya, primates called *Dryopithecus* and *Ramapitheus* were existing.

Dryopithecus **:** Were more ape-like, live in Asia, Africa and Europe. Walk semierect, Hands & Skull were monkey like.

Ramapithecus **:** First man-like, walk straight on legs, not taller than 4 feet.

Australopithecines **:** 2 mya, lived in east african grassland, hunted with stones, ate fruits, Teeth larger.

Homo habilis **:** 2 mya, brain capacity 650-800cc, did not eat meat, dentition like humans.

Homo erectus **:** 1.5 mya, brain capacity 900cc, ate meat, walk erect.

Homo sapiens **:** 75000-10000 years ago., in Africa, and spread to all parts of world.

Neanderthal man : 40,000-1,00,000 years ago, brain capacity 1400cc, broad forehead, lives in caves, use hides to protect their bodies.

Questions

VSA **(1 Mark)**

1. If abiotic origin of life is in progress on a planet other than earth, what should be the conditions there?
2. Name the person who proposed that population tends to increase geometrically while food production supply arithmetically.
3. Name the scientist who had also come to similar conclusion as that of Darwin about natural selection as a mechanism of evolution. Which place did he visit to come to conclusions ?
4. State the two principal outcomes of the experiements conducted by Louis on origin of life.

SA-I **(2 Marks)**

Multiple - Choice Question :

5. Abiogenesis means
   a) Origin of life from non-living molecules.
   b) Origin of life from living organisms.
   c) Origin of viruses & microbes.
   d) Spontaneous generation.
6. Hardy - Weinberg principle explains.
   a) Chromosomal abberation
   b) Genetic drift.
   c) Genetic equilibrium.
   d) All of these

7. Which is correct chronological sequence of human evolution?
   a) Ramapithecus - Australopithecus - Homo erectus - Neanderthalensis - Homo sapiens.
   b) Ramapithecus - Homo habilis - Homo sapiens - Homo erectus.
   c) Australopithecus - Ramapithecus - Homo habilis - Homo sapiens.
   d) Homo habilis - Australopithecus - Homo erectus - Homo sapiens.

In Questions from 8 to 11, a statement of Assertion is to statement of Reason. Mark the correct choices as:

   a) Both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.
   b) Both Assertion and Reason are true and the Reason is not the correct explanation of the Assertion.
   c) Assertion is true statement but Reason is false.
   d) If both Assertion & Reason are false statements.

8. **Assertion :** Vertebrate hearts are an example of homology
   Reason: Homologous organs indicates convergent evolution.
9. **Assertion** : Excess use of herbicides, pesticides etc., has only resulted in selection of resistant varieties in a much lesser time scale.
   Reason: This is due to anthropogenic action.
10. **Assertion** : Hardy-Weinberg principle says that allele frequency in a population are stable and constant from generation to generation.
    Reason: Change in frequency of alleles in a population would be interpreted as resulting in evolution.
11. **Assertion** : Homo erectus has a large brain around 1400°C.
    Reason: Homo erectus used hides to protect their bodies and buried their dead.
12. Explain Oparin-Haldane theory of chemical evolution of life.
13. How do Darwin and Hugo de varies differ regarding mechenism of evolution?
14. How did Louis Pasteur disprove spontaneous generation theory?
15. What are the two key concepts of Darwinian theory of evolution?

16. How would the gine flow or genetic drift affect the population in which either of them happen take place?

17. Write two difference between Homo erectus and Homo habilis?

SA-II **(3 Marks)**

18. (i) State the Hardy-Weinberg principle.

(ii) When there is a disturbance in the Hardy-Weinberg equilibrium, what would it result in?

(iii) According to this principle, what is the sum total of all allelic frequencies ?

19. Classify the following as examples of homology and analogy-

(i) Hearts of fish and crocodile

(ii) Wings of butterfly and birds

(iii) Eyes of Octopus and Mammals

(iv) Tubers of Potato and sweet potato

(v) Thorns of *Bougainvillea* and spines of *Opuntia*

(vi) Thorn of *Bougainvillea* and tendrils of Cucurbits.

20. Stanley Miller and Harold Urey performed an experiment by recreating in the laboratory the probable conditions of the atmosphere of the primitive earth.

(i) What was the aim of the experiment ?

(ii) In what forms was the energy supplied for chemical reactions to occur ?

(iii) For how long was the experiment run continuously? Name two products formed.

21. 'Industrial Melanism' in peppered moth is an excellent example of 'Natural selection'. Justify the statement.

22. Fill up the bianks left in the table showing Era, period and organism.

Era	Period	Organism
Cenozoic	a	Modern man, Mammals, Birds, rise of monocot
b	Teritiary	Rise of first Primate, angiosperm
Mesozoic	c	Gingko, Gnetales
d	Jurassic	Conifers, cycads, Reptiles
Paleozoic	e	Early reptiles (extinct)
f	Silurian	Psilophyton

23. (i) In which part of the world, Neanderthal man lived ?

(ii) What was his brain's capacity ?

(iii) Mention the advancement which Neanderthal man showed over *Homo erectus*.

24. Figures given below are of Darwin's finches ?

1 2 3 4

Variety of beaks of Darwin's finches

(a) Mention the specific geographical area where these were found.

(b) Name and explain the phenomenon that has resulted in the evolution of such diverse species in the region.

(c) How did Darwin visit the particular geographical area?

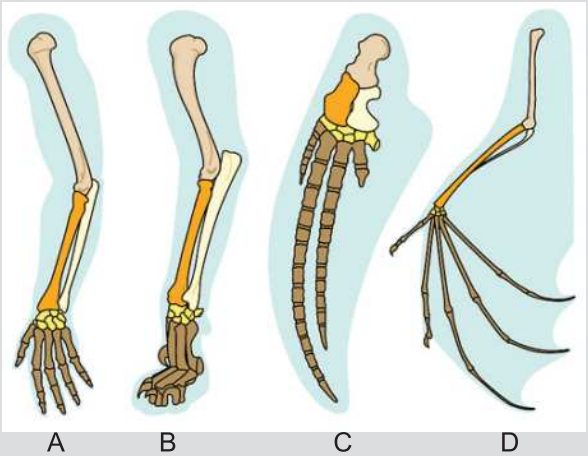
25. Give examples to show evolution by anthropogenic action.

LA **(5 Marks)**

26. Is evolution a process or the end result of a process, discuss. Describe various factors that effect Hardy-Weingberg equilibrium.

Read the following and answer the questions that follow:

Evidences that evolution of life form has indeed taken place on the Earth, have come from many quarters. There are evidences from comparative anatomy and morphology too. They show similarities and differences among organisms of today and those that existed in the past. Such similarities can be interpreted to understand whether common ancestry was shared or not. The forelimbs of whale, bat, cheetah and human share similarities in the pattern of bones of forelimbs, but perform different functions in these animals.



(a) Name and define the type of evolution, these organs of different animals exhibit.

(b) What are such organs called? What do they indicate about ancestry?

(c) Contrary of the above condition, organs that are not anatomically similar, but perform similar functions in different groups are also found.

(i) What are such organs called and what type of evolution do they exhibit?

(ii) Give two example (one from plants and one from animals) of such organs.

Answers

VSA (1 Mark)

1. Very high temperature, volcanic storms, Reducing atmosphere containing CH_4, NH_3, H_2 and water vapours.
2. Thomas Malthus.
3. Alfred Wallace, Malay Archipelago
4. Life comes from pre-existing life/biogensis(ii) Dismissed the concept of spontaneous generation.

5. (a) 6. (c) 7. (a) 8. (c) 9. (a) 10. (b) 11. (d)

SA-I (2 Marks)

12. The first life form could have come from the pre-existing, non-living organic molecules (like RNA, Proteins, etc.) and the formation of life was preceded by chemical evolution.
13. **Darwin :** Darwinian variation are small, gradual and directional

    Hugo de Varies : Variation are sudden, random and directionless.
14. Louis Pasteur showed that in pre-sterilized flasks, life did not come from killed yeast while in another flask open to air, new organisms arose from killed yeast.
15. Branching descent and natural selection.
16. Result in changed frequency of genes (or allies) in both population cuasing variation, leading to evolution/speciation/gounder effect.
17. Homo erectus
    (i) Brain capacity 900 c.c.
    (ii) (Probabely) ate meat

    Homo habilis
    (i) Brain capacity 650-800 cc
    (ii) (Probabely) did not eat meat

SA - II (3 Marks)

18. (i) The allele frequency in a population are stable and constant from generation to generation.
    (ii) Evolution. (iii) One.
19. (i) Homology (ii) Analogy
    (iii) Analogy (iv) Analogy
    (v) Analogy (vi) Homology

20. (i) To prove Oparin's theory of origin of life.
(ii) Electric discharge using electrodes.
(iii) One week; Amino acids and Sugar.

21. Refer Page 131, NCERT Text book of class XII.

22. (a) Quaternary (b) Coenozoic (c) Cretaceous
(d) Mesozoic (e) Carboniferous (f) Paleozoic

23. (i) Near Eastern and Central Asia
(ii) 1400 c.c.
(iii) More brain capacity, use of hides to cover body and burial of dead.

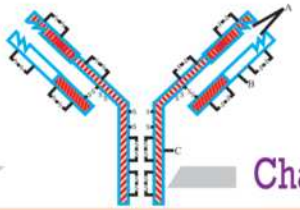
24. (a) Galapagos Island.
(b) Adaptive radiation—Refer page 133, NCERT book.
(c) Through sea voyage in a sail ship called H.M.S. Beagle.

25. Excess use of herbicides, pesticides etc. has resulted in selection of resistent varieties in a much lesser time scale. Same is true for antibiotic or drug resistant microbes.

LA **(5 Marks)**

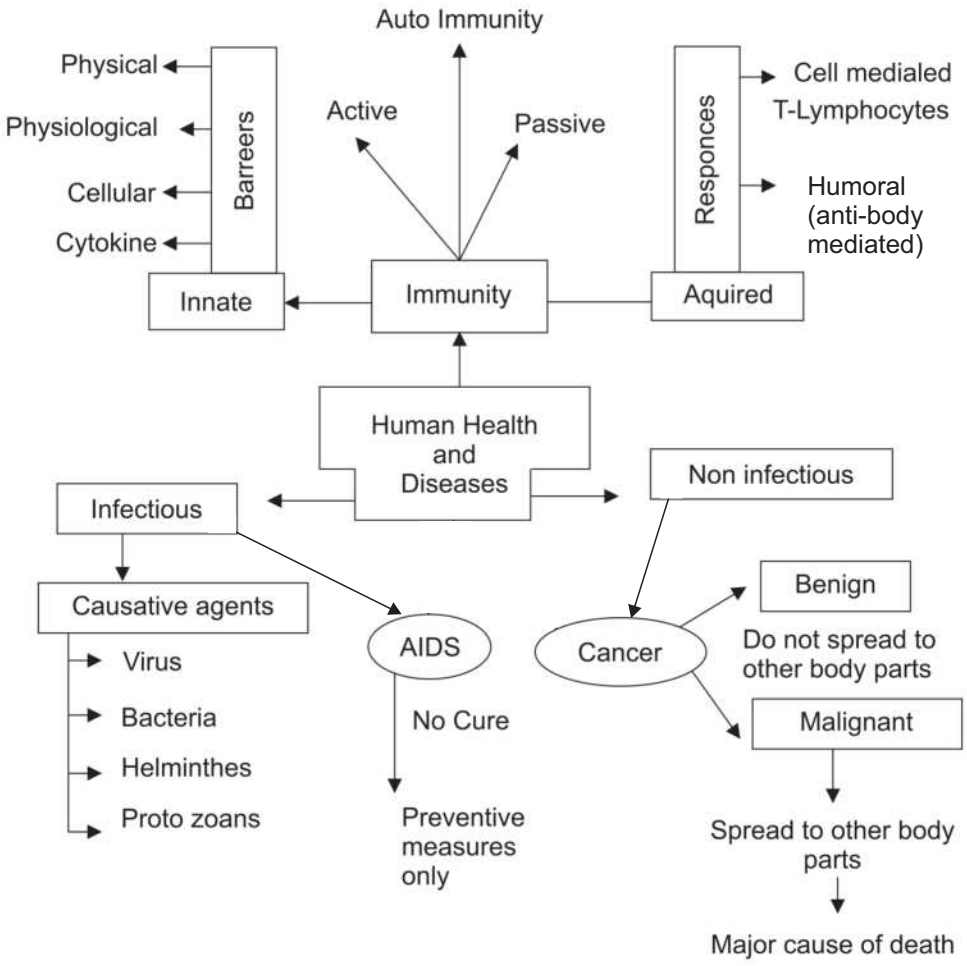
26. Refer page 135, NCERT Text book, Biology—XII.

27. They show divergent evolution.
(a) The evolutionary process in which same structure developed along with different directions as adaptations to different needs.
(b) They are called homologous organs. They indicate common ancestry.
(c) (i) They are called of Analogous organs. They exhibit convergent evolution.
(ii) Tubers of potato and sweet potato from Animals.
Eyes of octopus and of mammals. Flippers of pinging and dolphin.



Chapter - 7

Human Health and Disease



Carcinogens : Cancer causing agents e.g., gamma rays, UV rays, dyes and lead.

Interferon : The glycoproteins produced by our body cells in response to a viral infection.

Incubation Period : The time period between infection and first appearance of symptoms.

Metastasis : The property in which the cancer cells spread to different sites through blood and develop secondary tumours.

Oncogenes : Viral genome which causes cancer/Cancer causing genes.

Retrovirus : A virus having RNA as genetic material and forms DNA by reverse transcription and then replicate e.g., Human Immunodeficiency Virus (HIV).

Sporozoites : The infective stage of protozoa Plasmodium which is injected into human blood through saliva of female Anopheles mosquito.

Withdrawal Syndrome : If a drug dependent person stop taking drugs then his body stop functioning normally and he feels severe physical and psychological disturbance called withdrawal syndrome.

Contact Inhibition : It is a property of normal cells in which the cells stop dividing when comes in contact with its surrounding cells.

Abbreviations

PMNL	:	Polymorpho-Nuclear Leukocytes
CMI	:	Cell Mediated Immunity
ELISA	:	Enzyme Linked Immunosorbent Assay
HLA	:	Human Leukocyte Antigen
MALT	:	Mucosal Associated Lymphoid Tissue
SCID	:	Severe Combined Immuno Deficiency
NACO	:	National AIDS Control Organisation
MRI	:	Magnetic Resonance Imaging

- **Health :** The state of complete physical, mental and social well beings
- Goods health can be achieved by
  (i) Awareness about disease and their effects on different body functions.
  (ii) Vaccination
  (iii) Control of vectors
  (iv) Proper disposal of wastes
  (v) Maintenance of hygienic food and resources,
- **Infectious Diseases**
  (i) Viral Diseases—e.g., polio, common cold, measles, rabies
  (ii) Bacterial diseases—e.g., Typhoid, Pneumonia, Diptheria, Tetanus.
  (iii) Fungal diseases—e.g., Ring worm & Scabies
  (iv) Helminthic diseases—e.g. Ascariasis, Filariasis, Taeniasis
  (v) Protozoan diseases—e.g. Malaria, Amoebiasis.

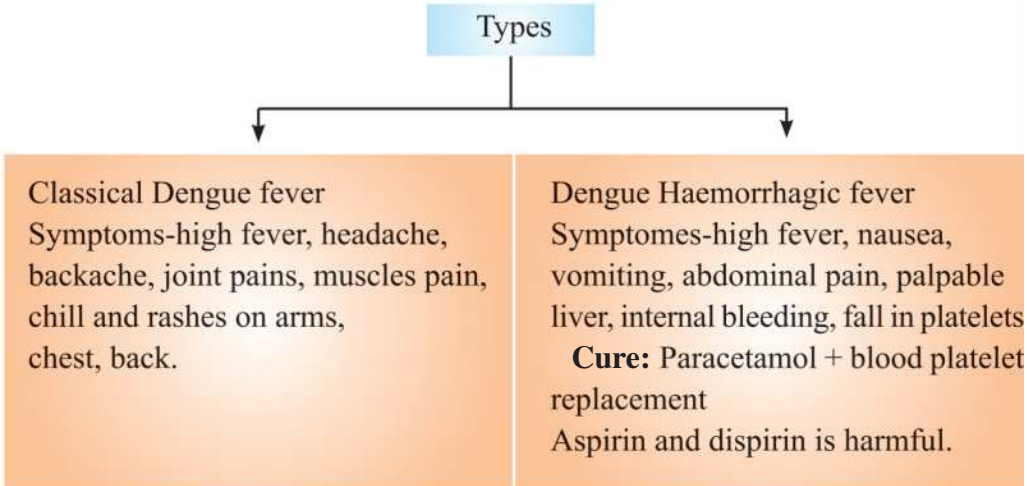
Disease	Causative Agents	Symptoms
1. Common cold	*Rhinoviruses*	Nasal congestion and discharge, sore throat cough, headache, tiredness and hoarseness.
2. Typhoid	*Salmonella typhi*	sustained higher fever, stomach pain, loss of appetite, constipation, headache.
3. Pneumonia	*Streptococcus pneumoniae* and *Haemophilus influenzae*	fever, headache, cough, chills in severe cases finger nails may turn grey to bluish in colour

4. Malaria	*Plasmodium viz P. malaria, P. vivax. P. falciparum*	acute headache, muscular pain, fachills and shivering, nausea and high temperatures.
5. Amoebic dysentry	*Entamoeba histolytica*	Abdominal pain, cramps, stool with excess mucus and blood clots, constipation.
6. Ringworm	*Microsporum, Epidermophyton and Trichophyton*	Dry scaly lesions on skin, nails and scalps itching
7. Ascariasis	*Ascaris lumbricoides*	Anaemia, muscular pain, internal bleeding, insomnia, blockage of intestinal passage.
8. Filariasis or Elephantiasis	*Wuchereria bancrofti* and *W. malayi*	Fever, blockage of lymphatic vessels, enormous swelling of affected part viz. arm, foot, leg.

Dengue

Caused by—Viruses DEN-1, DEN-2, DEN-3, DEN-4

Vector—Female mosquito *Aedes aegypti*



Chikungunya

Caused by—*Alpha virus*

Vector—mosquitoes (*Aedes aegypti* and *A. albopictus*)

Symptoms—rashes on limbs and trunk, arthritis of multiple joints, fever (102–104°F), etc.

Drug—Chloroquine phosphate reduces impact of disease.

Treatment—Rest & increase in fluid intake.

Preventation of Dengue and Chikungunya : Protection against mosquitoes by wearing long sleeves and fullpants, window and doors should have wire gauze screens, use mosquito repellents and there should be no stagnant water nearby.

Life cycle of *Plasmodium*

(A) Asexual Phase

- When female anopheles mosquito bites human sporozoites (infective stage) are injected into blood stream.
- Parasite reaches the liver cells and multiply.
- Liver cell burst releasing parasite into the blood.
- Parasite then enters into RBCs and multiply.
- RBCs ruptured and release haemozoin that causes symptoms of malaria like chill and high fever.
- Finally gametocytes develop in RBCs and are released in blood.

(B) Sexual Phase :

- Female *Anopheles* mosquito takes up gametocytes with blood meal from infected person.
- Fertilisation and development takes in mosquito's gut.
- Mature infective stage (sporozoites) escape from intestine.
- Sporozoites migrate to the salivary gland.

Immunity : Resistance to infections or antigens.

Two types of immunities.

(i) **Innate immunity :** It is non-specific and present at the time of birth, It consists of four types of barriers:

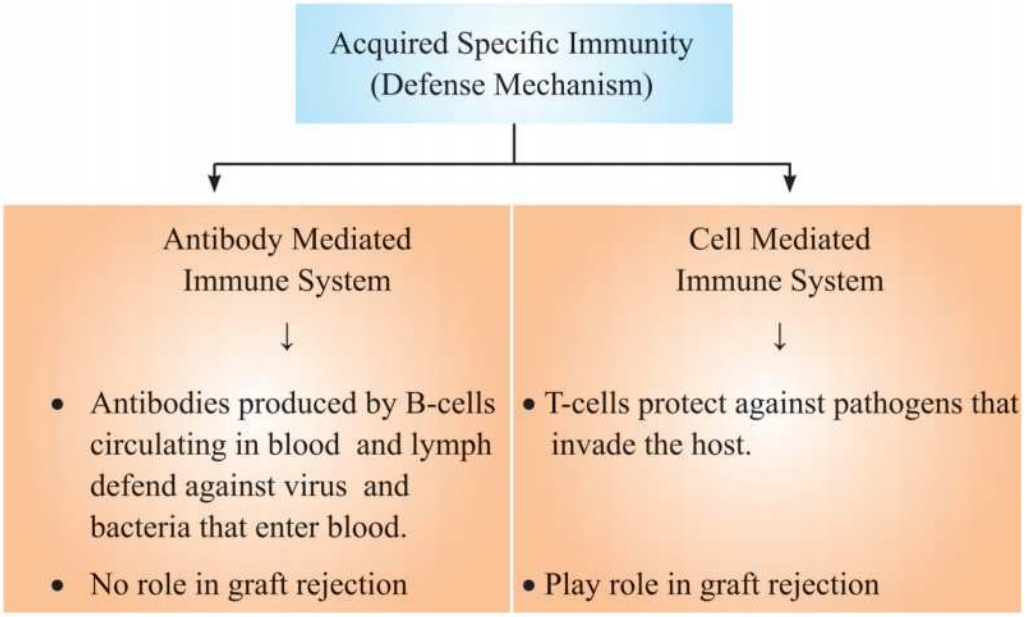
(a) Physical : e.g. skin, mucus coating of epithelium of respiratory, gastrointestinal and urinogenital tracts.

(b) Physiological : e.g. acid of stomach, lysozymes of saliva and tears

(c) Cellular e.g. PMNL, monocytes, neutrophils and macrophages

(d) Cytokine barriers : e.g. virus infected cells secrete proteins called interferons which protect non-infected cells from further infection

(ii) **Acquired Immunity.** Acquired by a person after birth by vaccination or contacting the disease. It is pathogen specific



- It is based on the principle of memory and immunity
- The antigenic preparations of proteins of pathogens or a solution of inactivated or weakened pathogens are introduced in the body.
- The antigenic properties are recognised.
- Cascade of reactions forms antibodies.
- History of reactions is stored as memory.
- Subsequent exposures result in intensified response.

Active Immunity	Passive Immunity
1. Body prepares antibody itself due to exposure of antigen (Pathogen) Example : Typhoid vaccination	Preformed antibodies are injected in the body in case of deadly microbe attack. Example : Anti-snake venom, ATS.
2. Immunity is not immediate	Very quick immune response.
3. It has very few side effects.	May show side effects like allergic reaction.
4. It lasts for long period.	It lasts for limited period.

Vaccination : A preparation of weakened or attenuated pathogen is introduced in the human body. Antibodies are formed against the pathogen. B and T memory cells are generated that recognises the pathogen quickly on subsequent exposure kills it with quick and massive production of antibodies.

Allergy : Exaggerated response of immune system to certain antigens present in the environment.

Allergens : Substances to which immune system shows exaggerated response.

e.g. mites in dust, pollens, animal dander, perfume, wool, nail polish and drugs.

Symptoms of Allergy : Sneezing, watery eyes, rashes, running nose and difficulty in breathing.

Cause: release of chemicals like histamine and serotonin from mast cells

Treatment: using drugs like anti-adrenalin and steroids to reduce symptoms of allergy.

Auto Immunity : When the immune system of body starts destroying 'self' cells and molecules, called auto immune diseases e.g. Rheumatoid arthritis, multiple sclerosis and insulin-dependent diabetes.

Immune system in the body plays an important role in organ transplantation, allergic reactions and auto immune diseases.

Lymphoid Organs : Organs where lymphocytes are formed proliferate and mature are called lymphoid organs.

Bone Marrow : It is a primarylymphoid organ. Lymphocytes maturing here are called B-lymphocytes.

Thymus : Lymphocyte which matures in thymus are called T-lymphocyte.

Secondary Lymphoid Organs : Spleen, lymph nodes, tonsils, Peyer's patches of small intestine are secondary lymphoid organs.

MALT : (Mucosal associated lymphoid tissue) is a lymphoid organ present in the lining of respiratory tract, digestive tract and urinogenital tract.

AIDS-(Acquired Immuno Deficiency Syndrome)

- caused by HIV (Human Immuno deficiency Virus) which belongs to retrovirus category of viruses.

Modes of transmission

- By sexual contact with infected person
- By transfusion of contaminated blood and blood products
- By Sharing the infected needles
- From infected mother to child through placenta

Persons who are at high risk of getting infection include

- Individuals who have multiple sex partners.
- Drug addicts taking drugs intravenously, individuals who require repeated blood transfusions
- Children born to HIV infected mother.

Prevention of AIDS

- Using disposal syringes and needles, screening the blood of HIV, controlling drug abuse, free distribution of condoms and advocating safe sex.
- Main test for AIDS is ELISA (Enzyme Linked Immuno Sorbent Assay)

Cancer

- Cells loose the property of contact inhibition.
- Carcinogens induce the transformation of normal cells into cancerous cells e.g. UV rays, X-rays, gamma-rays, aniline dyes and tumour viruses, cadmium oxide, mustard gas, Ni & Cr compounds etc.
- **Two types of tumors,** (a) Benign—confined to the area of formation and do not spread to other parts, (b) Malignant—show metastasis i.e. cells of

these tumors can be carried by blood stream or lymph to other parts of body and form secondary tumors in neighbouring organs.

- **Treatment**—through surgery, radiotherapy, chemotherapy, immunotherapy**, biological response modifiers such as a-interferon which activates immune system and helps in destroying tumor.**
- **Detection and diagnosis**—By radiography (X-rays), CT Scan, MRI, Biopsy.

Drugs

Criteria	Opiods	Cannabinoids	Coca alkaloids
Source	*Papaver somniferum* (Poppy Plant)	*Cannabis sativa* (Hemp Plant)	*Erythroxylum coca* (Coca plant)
Part of Plant	Fruits (Unripen Capsules)	Inflorescence, leaves resin	Leaves and Young twigs
Product	Opium, Morphine Heroin/Smack	Charas, Ganja Hashish, Marijuana	Cocaine (Coke/ Crack)
Mode of Intake	Snorting, Injection	Oral, Inhalation	Snorting
Effects (Property)	Neuro depressant, Slow down the functions of the body	Interact with cannabinoid receptors, Cardio-vascular system effects	Sense of euphoria interferes with neunotransmitters, Hallucination
Receptors	in CNS & GIT	in Brain	–

Drug Abuse :

Adolescents are vulnerable for drug abuse

1. Need for adventure, experimentation
2. First use of drugs for curiosity but later uses to escape facing problems (like academic stress)

Sports person use drugs to enhance performance to fluid up muscles and for aggressiveness. e.g. dopamine.

Adverse Effects :

In males : Acne, mood swing, depression, premature boldness, reduced male hormones.

In females : Masculinisation, aggressiveness, hirsutism (excessive hair growth) disturbed ovulation, stunted growth.

Withdrawal Symptoms: Dependence or addiction is a state of compulsion to take drug in absence of which body shows withdrawal symptoms such as insomnia, craving, tremors, cramps, twitching and convulsions.

Harmful effects of Drugs and Alcohol Abuse

- Change in behaviour i.e. vendelism, violence
- Damage to liver and kidney
- Disturbed respiratory system
- Affects cardiovascular system
- Sexual dysfunctions

Preventing Alcohol/Drug Abuse

- Avoid peer pressure
- Education and counselling
- Help from parents and peers
- Seeking medical help.

Questions

VSA **(I Mark)**

1. Name the diagnostic test which confirms typhoid.
2. You have heard of many incidences of Chikungunya in our country. Name the vector of the disease.
3. Breast fed babies are more immune to diseases than the bottle fed babies. Why ?
4. Name the pathogen which causes malignant malaria.
5. Elephantiasis (Filariasis) in man is caused by
   a) Ancyclostoma
   b) Ascaris lumbricoides
   c) Entamoeba histolytica.
   d) Wuchereria bancrofti
6. Humoral immunity is due to
   a) B-Lymphocytes
   b) T - Lymphocytes
   c) L-Lymphocytes
   d) P-Lymphocytes
7. A person is injected with globulins against hepatitis, it is
   a) Naturally acquired active immunity.
   b) Naturally acquired passive immunity.
   c) Artificially acquired passive immunity.
   d) Artificially acquired active immunity.

In Question from 8 to 11 a statement of Assertion is followed by a statement of Reason. Mark the correct choices as :

a) Both Assertion and Reason are true, and Reason is the correct explanation of the Assertion.
b) Both Assertion and Reason are true, and the Reason is not the correct of the Assertion.
c) Assertion is true statement but Reason is false.
d) If both Assertion & Reason are false statements.

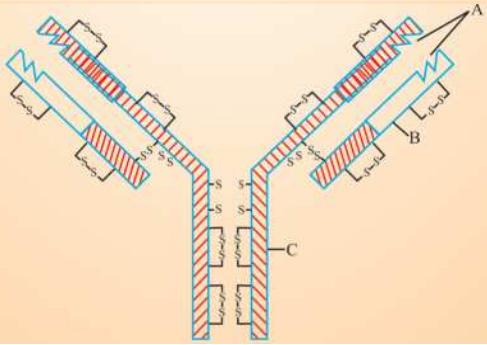
8. **Assertion :** In Malaria, a person experience chills and high fever recurring every three to four days.
   Reason : This is caused by the release of haemozoin with rupture of liver cells
9. **Assertion :** Ascaris, the common round worm causes amoebiasis.
   Reason : The mode of transmission is through droplets.
10. **Assertion :** Virus infected cells secrete proteins called interferons.
    Reason : Interferons are substances which protect non-infected cells from further viral infection.
11. **Assertion :** Active immunisation stimulates the immune system to produce antibodies against a particular infectious agents.
    Reason : Colostrum secreted by mother during initial days of lactation has abundant antibodies to protect the infant.

SA-I **(2 Marks)**

12. Where are B-cells and T-cells formed? How do they differ from each other ?
13. Lymph nodes are secondary lymphoid organs. Describe the role of lymph nodes in our immune response.
14. What is the role of histamine in inflammatory response ? Name few drugs which reduce the symptoms of allergy.

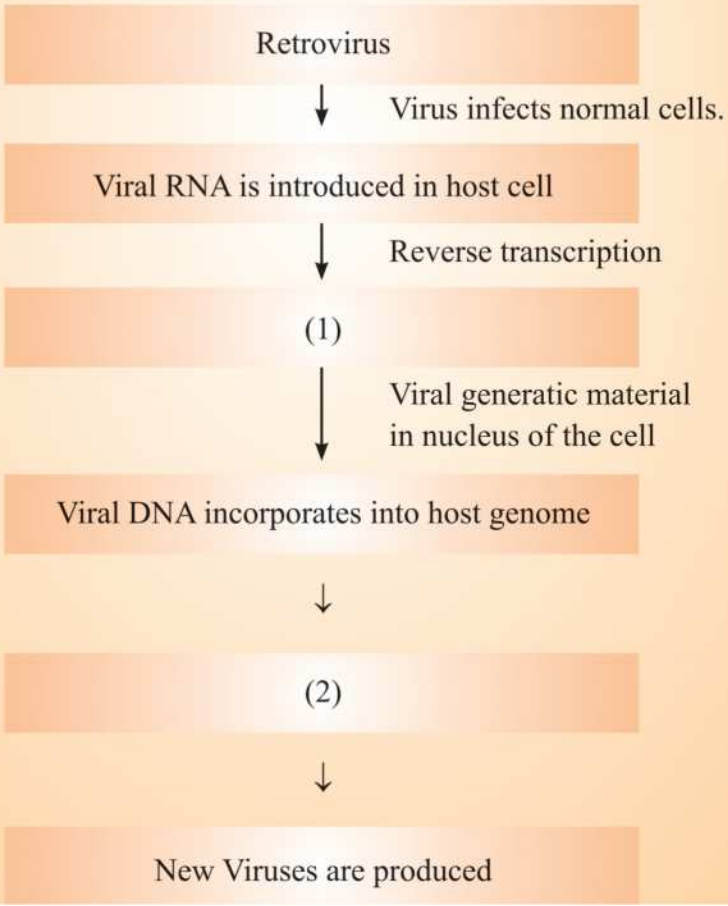
SA-II **(3 Marks)**

15. In the figure, structure of an antibody molecule is shown. Observe it and Give the answer of the following questions.
    (i) Label the parts A, B and C.
    (ii) Which cells produce these chemicals ?
    (iii) State the function of these molecules.



16. A person shows unwelcome immunogenic reactions while exposed to certain substances.
    (a) Name this condition.
    (b) What common term is given to the substances responsible for this condition?
    (c) Name the cells and the chemical substances released which cause such reactions.

17. In the given flow diagram, the replication of retrovirus in a host cell is shown. Examine it and answer the following questions.
    (a) Why is virus called retrovirus?
    (b) Fill in the blank (1) and (2)
    (c) Can infected cell survive while viruses are being replicated and released by host cell ?



LA **(5 Marks)**

18. Answer the following with respect to Cancer.
    (a) How does a cancerous cell differ from a normal cell?
    (b) Benign tumor is less dangerous than malignant tumor. Why?
    (c) Describe causes of cancer.
    (d) Mention two methods of treatment of the disease.
19. The pathogen of a disease depends on RBCs of human for growth and reproduction. The person with this pathogen suffers with chill and high fever.
    (a) Identify the disease.
    (b) Name the pathogen.
    (c) What is the cause of fever?
    (d) Represent the life cycle of the pathogen diagrammatically.
20. The immune system of a person is suppressed. He was found positive for a pathogen in the diagnostic test ELISA.
    (a) Name the disease, the patient is suffering from.
    (b) Which pathogen is identified by ELISA test?
    (c) Which cells of the body are attacked by the pathogen?
    (d) Suggest preventive measures of the infection.
21. A mosquito bites a malaria infected person and is observed for a few days. It was however, found out that the mosquito had not developed the infection. What could be the reason for the same?
22. A woman suffering from arteries visited a doctor who after diagnosis told her that her body calls are attacking self-cells. What is this phenomenon called? Which type of arthritis is the woman suffering from?
23. A person continue tobacco smoking for a long time. What would be effect of this habit on.
    (a) his blood (b) his heart rate (c) Oral cavity

Answers

VSA (1 Marks)

1. Widal test
2. Aedes mosquitoes.
3. The mother's milk consists of antibodies (IgA) such antibodies are not available to bottle fed babies.
4. Plasmodium falciparum.
5. (d) 6. (a) 7. (c) 8. (c) 9. (d) 10. (a) 11. (b)
12. B-cells and T-cells are formed in bone marrow. B-cells produce antibodies but T-cells do not produce antibodies but help B-cells produce them.
13. Lymph nodes provide the sites for interaction of lymphocytes with the antigen. When the microorganisms enter the lymph nodes, lymphocytes present there are activated and cause the immune response.
14. Histamine acts as allergy-mediator which cause blood vessles to dilate. It is released by mast cells. Antihistamine steroids and adrenaline quickly reduce the symptoms of allergy.

SA-II (3 Marks)

15. (a) A-Antrigen binding, B-Light chain, C-Heavy chain
    (b) B-lymphocytes.
    (c) Heavy Chain
    (d) Antibodies provide acquired immune response.
16. (a) Allergy (b) Allergens
    (c) Mast Cells—Histamine, Serotonin
17. (a) HIV has RNA genome. It produces DNA by reverse transcription.
    (b) 1 : Viral DNA is produced by reverse transcriptase.
    2 : New Viral RNA is produced by the infected cell.
    (c) Infected cell can survive.

LA **(5 Marks)**

18. (a) In normal cells, growth and differentiation is highly controlled and regulated (contact inhibition). The cancerous cells have lost the property of contact inhibition, hence continue to divide giving rise to masses of cells (tumors).

(b) The benign tumor remains confined in the organ affected as it is enclosed in a connective tissue sheath and does not enter the metastatic stage.

(c) Cancer may be caused due to carcinogens which are physical (X-rays, gamma rays and UV rays), chemicals (Nicotine, Aflatoxin, Cadmium oxide, Asbestos) and biological (viral oncogens and proto oncogenes).

(d) Surgery, radiotherapy, Chemotherapy, immunotherapy by using biological response modifiers like α-interferons.

19. (a) Malaria

(b) Different species of *Plasmodium viz P. vivax, P. Malariae and P. falciparum.*

(c) Malaria is caused by the toxins (haemozoin) produced in the human body by the malarial parasite. This toxin is released by the rupturing of RBCs.

(d) Life cycle of Plasmodium : Fig. 8.1 Page 148, NCERT book, Biology- XII

20. (i) AIDS (Acquired Immuno Deficiency Syndrome)

(ii) HIV (Human Immunodeficiency Virus)

(iii) Helper T-cells, macrophages, B-lymphocytes.

(iv) Preventive measures :

(a) People should be educated about AIDS transmission.

(b) Disposable needles and syringes should be used

(c) Sexual habits should be changed immediately

(d) High-risk groups should be discouraged from donating blood.

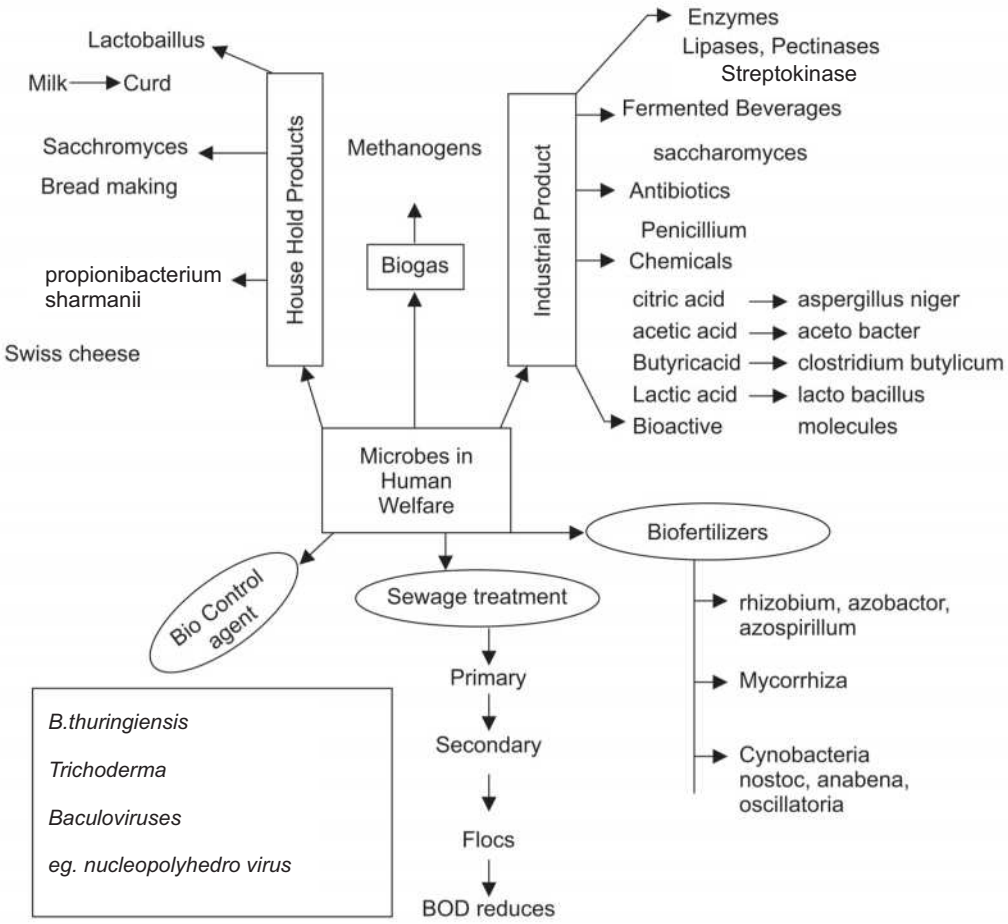
(e) Routine screening may be done.

21. Both the gametes types (male and female) were not taken in by the mosquito. Hence, no fertilisation and no further development of the parasite.
22. Auto immunity, Rheumatoid Arthritis.
23. (a) Increased levels of carbon mono ride in blood.
    (b) Increased heart rate.
    (c) Increased risk of cancer of oral cavity.

❑❑

Chapter - 8

Microbes in Human Welfare



Biofertilisers : Microorganisms which produce fertilisers and enrich the soil *e.g.*, bacteria, cyanobacteria and fungi.

Bioactive Molecules : Molecules produced for commercial use from microbes and used for various purposes *e. g., Trichoderma polysporum* (fungus) is used to obtain immunosuppressive agent cyclosporin–A.

Biochemical Oxygen Demand (BOD) : Total amount of oxygen consumed by bacteria for oxidation of organic matter present in one litre of water.

Baculovirus : Pathogens that attack insects and other arthropods. They are used to kill harmful pests and arthropods *e.g., Nucleopolyhedrovirus.*

Flocs : During secondary treatment of effluent, excessive growth of aerobic bacteria and fungi form a mass of mesh like structure called flocs.

Immunosuppressive Agent : Chemicals which suppress the immunity against organ transplant.

Organic Farming : Technique of farming, in which biofertilisers are used to enrich the soil, without using chemical fertilisers and pesticides to reduce their harmful effect on human health.

Biological Control : Reduction of pest population by natural enemies minimising the use of harmful chemical pesticide. e.g. ladybird beetle can eradicate aphids.

Thermal vents : The sites deep inside the geysers/hot springs and oceans where the average temperature is as high as 100°C.

Methanogens : Bacteria producing large quantity of methane during decomposition of organic matter.

GAP	**:**	Ganga Action Plan
KVIC	**:**	Khadi and Village Industries Commission
TMV	**:**	Tobacco Mosaic Virus
YAP	**:**	Yamuna Action Plan
IPM	**:**	Integrated Pest Management.

- Microbes includes protozoa, bacteria, fungi, microscopic plants, viruses, viroids and prions (the infectious protein)

Microbes in Household Products

Milk $\xrightarrow[\text{LAB}]{\text{Lactobacillus}}$ Curd

Dough $\xrightarrow[\text{Fermentation}]{\text{Yeast}}$ Swollen, Little fermented dough

Palm sap $\xrightarrow[\text{Yeast}]{\text{Microbes}}$ Toddy (fermented drink)

Microbes in production of Biogas

- Some bacteria which grow anaerobically on cellulosic material produce large amount of Methane (CH_4), along with Carbondioxide and hydrogen. These bacteria are called methanogens.
- Methanogen are naturally found in rumen of cattle, Cowdung and sewage.

Microbes as Biocontrol Agents

	Microorganisms	Category	Action
(i)	*Trichoderma* Species	fungus	Kills pathogen in the root system
(ii)	*Bacillus thuringiensis*	bacteria	Kills the insect pest (cotton bollworms)
(iii)	*Nucleopolyhedrovirus* (Baculoviruses)	Virus	Kills insects and other arthropods.

Microbes as biofertilisers.

Rhizobium **:** Have symbiotic association with roots of leguminous plants, help in atmospheric nitrogen fixation.

Azospirillum **and** ***Azotobacter*** **:** Free living in soil and help in nitrogen fixation enrich nitrogen content of soil.

Mycorrhiza : Symbiotic; association of fungi with roots of higher plants. Fungi help in absorption of phosphorous from soil. It belongs to genus *Glomus* It provides resistance to root borne pathogens, tolerance to salinity and drought.

Cyanobacteria : Found in aquatic or terrestrial environment, help in nitrogen fixation, add organic matter to the soil, increase fertility of soil, e.g., Nostoc, *Anabaena, Oscillatoria*.

In paddy fields, these acts as biofertilisers.

Microbes in Industries

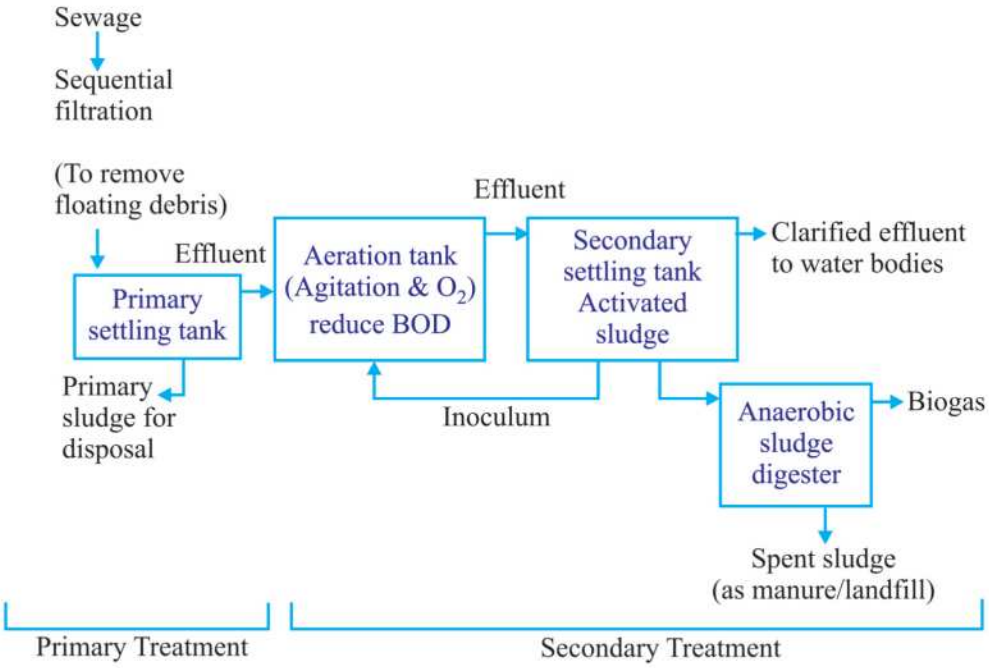
(a) Fermented Beverages : Liquid food made by anaerobic digestion of carbohydrate rich food is called beverage. *Saccharomyces cerevisae* (yeast) is also used to make bread, fermented fruit juice and alcohol.

(b) Antibioitics : *Penicillium notatum*

(c) Other chemicals/enzymes/Bioactive molecules Many organic acids, enzymes are also produced by microorganisms.

S. No.	Microbe	Category	Product	Role (Used as)
1.	*Aspergillus niger*	Fungus (Yeast)	Citric Acid	Used in beverages
2.	*Acetobacter*	Aceto bacterium	Acetic acid (Vinegar)	Preservative
3.	*Saccharomyces cerevisae*	Fungus	Ethanol	Disinfectant, fuel
4.	*Lactobacillus*	Bacteria	Lactic acid	In making Curd
5.	*Streptococcus*	Bacteria	Streptokinase	Clot buster
6.	*Clostridium butylicum*	Bacteria	Butyric acid	Prolective agent against in flammatory bowel diseases
7.	*Monascus purpureus*	Fungus (Yeast)	Statin	Blood cholestrol lowering agent
8.	*Trichoderma polysporum*	Fungus	Cyclosporin A	immunosupressive agent

Sewage treatment :



Antibiotics : Secondary metabolites produced by microbes and used to kill pathogenic microbes.

Penicillin, First antibiotic discovered by Alexander Flemming from fungus *Penicillium notatum*.

Mode of action of antibiotics

(1) Bacteriocidal : To kill bacteria by stopping cell wall formation

(2) **Bacterio-static :** To stop growth or multiplication of bacteria by stopping DNA replication or other cellular metabolism.

Production of Antibiotics : Mass production of antibiotics is done in fermentor tanks from lichens, fungi, actinomycetes, eubacteria etc. Maximum antibiotics are produced from bacillus (eubacteria)

Precautions in taking antibotics :

- Keep intake continuous as prescribed by doctor till course gets completed.
- Avoid over use otherwise our body become resistant to antibiotics.

QUESTIONS

VSA **(1 Mark)**

1. Why is secondary treatment of water in sewage treatment plant called biological treatment ?
2. An antibiotic called 'Wonder Drug' was used to treat the wounded soldiers of America during World War-ll. Name the drug and the scientist who discovered it.
3. You have observed that fruit juice in bottles bought from the market are clearer as compared to those made at home. Give reason.
4. Name the plant whose sap is used in making 'Toddy'. Mention the process involved in it.

MULTIPLE CHOICE TYPE QUESTIONS

5. Spirulina is :

a) Bio fertilizer

b) Bio pesticide

c) Edible fungus

d) Single cell protein

6. Baker's yeast is

a) S. Cerevisae

b) Ludwingi

c) S. octosporus

d) Schizo Saccharomyes

7. Which one is wrongly matched?

a) Streptomyces - Antibiotics

b) Coli forms - Vingar

c) Methanogens - Gobar gas

d) Yeast - ethanol

8. Bt. cotton is resistant to

a) Insects

b) Herbicides

c) Salt

d) Drought

9. Which is wrongly matched

a) Alcohol - Nitrogen

b) Detergents - Lipase

c) Textiles - Amylase

d) Fruit juice - Pectinase

10. Assertion : Curdling is required in the manufacture of cheese.

Reason : Lactic acid bacteria are used for the purpose.

a) If both assertion and reason are true and reason is the correct explanation of assertion.

b) If both assertion and reason are true but reason is not true correct explanation of assertion.

c) If assertion is true but reason is false.

d) If both assertion and reason are false.

11. Assertion : Yeasts such as Saccharomyces cerevisiae are used is baking industry.

Reason : Carbon dioxide produced during fermentation causes bread dough to rise by thermal expansion.

a) If both assertion and reason are true and the reason is the correct explanation of the assertion.

b) If both assertion and reason are true but the reason is not the correct explanation of the explanation of the assertion.

c) If assertion is true statements but reason is false.

d) If both assertion and reason are false.

12. More than 25% of human population is suffering from hunger and malnutrition. Scientist from developed techniques where microbes are grown on industrial scale as a source of good protein which can be grown from waste water animal and even sewage.

Answer the following questions:

i) Example of SCP is

a) Azolla b) Anabaena c) Oscillatoria d) Spirulina

ii) SCP is

a) Single cell protein

b) Single cytoplasmic protein

c) Solute cell protein

d) Soluble cell protein

iii) The malnutrition due to protein and carbohydrate is

a) Vitamin deficiency

b) Mineral deficiency

c) PEM

d) Carbohydrate disorders

iv) Hunger signs are due to

a) Mineral deficiency

b) Protein deficiency

c) Vitamin deficiency

d) All of the above

SA-I **(2 Marks)**

13. Name two alcoholic drinks produced in each of the following ways.
    (i) by distillation and
    (ii) without distillation.
14. Lactic Acid Bacteria (LAB) is commonly used in the conversion of milk into curd. Mention any two other functions of LAB that are useful to humans.
15. Which Ministry of Govt, of India had initiated Ganga Action Plan and Yamuna Action Plan ? What are the objectives of these plans?

SA-II **(3 Marks)**

16. Fill in the blanks spaces a, b, c, d, e, and f, given in the following table :

S. No.	Name of Organism	Commercial Product	Application
1.	*Penicillium notatum*	*Penicillium*	(a)
2.	(b)	Lactic acid	Making Curd.
3.	*Streptococcus*	Clot buster enzyme	(c)
4.	*Trichoderma polysporum*	(d)	Immuno supp-ressive agent
5.	*Saccharomyces cerevisiae*	ethanol	(e)
6.	(f)	Swiss cheese	Food Product

17. What is biochemical oxygen demand (BOD) test ? At what stage of Sewage treatment this test is performed?
    BOD level of three samples of water labelled as A, B and C are 30 mg/L, 10mg/L and 500 mg/L respectively. Which sample of water is most polluted ?
18. Given below is the Flow chart of Sewage treatment. Fill in the blank spaces marked 'a' to 'f'.

Sewage treatment is done in step, subjected to filtration and sedimentation, called.....(a).....

↓

Supernatant is shifted to separate tanks and air is pumped mechanically, called.....(b).....

↓

Microbes grow into masses, called.....(c).....

↓

There is reduction in.....(d).....

↓

Bacterial flocs are allowed to settle, the sedimentation is called .....(e).....

↓

After Secondary treatment, the water is released into .....(f).....

19. A girl visits a cotton field and observes that a liquid is being sprayed on the plants. On being enquired she comes to know that it is to protect the crop from the insects. As a biology students can you explain the process to her that how would this liquid help in getting rid of the insects.
20. Plants have symbiotic associations with fungi show many benefits. Mention 5 such advantages.
21. What are biofertilisers? How are they useful instead of chemical fertilises?

Answers

VSA **(1 Mark)**

1. In this treatment Organic wastes of sewage water are decomposed by certain microorganisms in presence of water.
2. Penicillin, Alexander Fleming.
3. Bottle juices are clarified by the use of pectinase and proteases.
4. Palm tree, by fermentation.

Solution Lesson : 10

MCQ

5. d) 6. a) 7. b) 8. a) 9. a) 10. b) 11. d)

Solution

Ans. 12 i) d) ii) a) iii) c) iv) d)

SA-I (2 Marks)

13. (i) Whisky, brandy, rum—by distillation

    (ii) Wine, beer - without distillation

14. (i) LAB in human intestine synthesizes Vitamin B_{12}.

    (ii) LAB in human stomach checks the growth of harmful microbes.

15. The Ministry of Enviorment and Forests.

    The objective of Ganga Action Plan and Yamuna Action Plan is to save these rivers from pollution. It was proposed to build a large number of sewage treatment plants. So that only treated sewage may be discharged into these rivers.

SA-II (3 Marks)

16. (a) to kill disease causing bacteria

    (b) *Lactobacillus*

    (c) remove clots from blood vessels

    (d) Cyclosporin A

    (e) Beverage/medicines

    (d) *Propionibacterium sharmanii*.

17. The BOD test measures the rate of uptake of oxygen by microorganisms in a sample of water.

    Biological treatment or Secondary treatment

    Sample 'c' is most polluted because it has highest BOD level among the three samples of water.

18. (a) Primary treatment

    (b) Aeration

    (c) Flocs

    (d) Biochemical oxygen Demand (BOD)

    (e) Activated sludge

    (f) Water bodies like river.

19. Liquid containing spores of Bacillus thuringiensis; eated by insect larvae; toxin released inside gut; larvae killed.

20. (i) Increased absorption of phosphorus
    (ii) Resistance to root-borne pathogens;
    (iii) tolerance to salinity and drought;
    (iv) Overall increase in plant growth;
    (v) Overall increase in plant developmet

21. Biofertilisers are organisms that enrich the nutrient quality of the soil.
    Advantage no negative impact on soil. Doesn't cause water pollution

Chapter - 9

Biotechnology: Principles and Processes

Steps involved in Recombinant DNA Technology

↓

Isolation of DNA from organism by using enzymes like lysozymes (bacterial cells), Chitinase (fungal cell wall), protease (Proteins), RNA s (RNA) and its precipitating in chilled ethanol

↓

Cutting of DNA at recognition sites by Restriction enzymes. The same enzyme cuts the cloning vector at similar recognition site providing sticky ends.

↓

The cut fragments are separated using gel-electrophoresis and amplified using PCR.

↓

The genes (DNA-fragments) are joined with the cloning vector DNA using ligase.

↓

The re-combinant DNA so formed is transferred into host cell using methods like biolistics, Electroporation, Micro injection or pathogens like bacteria and retroviruses whose pathogenic properties have been removed.

↓

The host cell containing the r-DNA is cultured in Bioreactors to provide the product at large scale.

↓

The product is separated, purified, (downstream processing) formulated with preservation followed by quality control testing and marketing.

GEL ELECTROPHORESIS

Negatively charged DNA fragments are - Separated by forcing them to move through Agarose gel get aligned towards anode under an electric field.

↓

The smaller fragments move faster through the gel towards anode

↓

The larger fragments remain near the walls at the cathode end (where poured initially) as they sieve slowly)

↓

The separated fragments are stained with ethidium bromide and visualized under UV light

↓

The DNA fragments are cut out from agarose gel by the process known as elution.

↓

These DNA fragments are used in recombinant DNA by joining them with cloning vectors

Polymerase Chain Reaction (PCR)

Denaturation-Separation of DNA into single strand) by applying high temperature upto $95^{0}C$

↓

Annealing-Two sets of primers (Short stretches of RNA) attach to the single stranded DNA at compementary sites.

↓

Extension-The primers extend by addition of nucleotides in the presence of thermostable DNA polymerase complimentary to the DNA strand. The primers are removed.

↓

Repetition- This cycle get repeated so time and the DNA fragments get amplified about one billion times.

Biotechnology : The application of living organisms or of substances made by living organisms to make products for welfare of mankind.

The definition of Biotechnology given by the European Federation of Biotechnology (EFB) : 'The integration of natural science and organisms, cells, parts there of, and molecular analogues for products and services.'

Molecular scissors- Restriction endonuclease
Molecular glues- DNA ligases
Natural genetic engineer- Agrobacterium tumefaciens
Three basic steps involved in creating genetically modified organism (GMO) or transgenic organisms-
(i) Identification of DNA with described genes
(ii) Introduction of the identified DNA into the host
(iii) Maintenance of Introduced DNA into the host and transfer of DNA to its progeny

Principles of Biotechnology :

1. Genetic Engineering : The techniques used to alter the chemistry of genetic material (DNA/RNA) and introduction of it into organisms to change its phenotype.

2. Chemical Engineering : Use of contamination free chemical engineering process of growth of desired microbe or cell in large quantity to obtain bio-technological product like enzyme, antibiotic, vaccine etc.

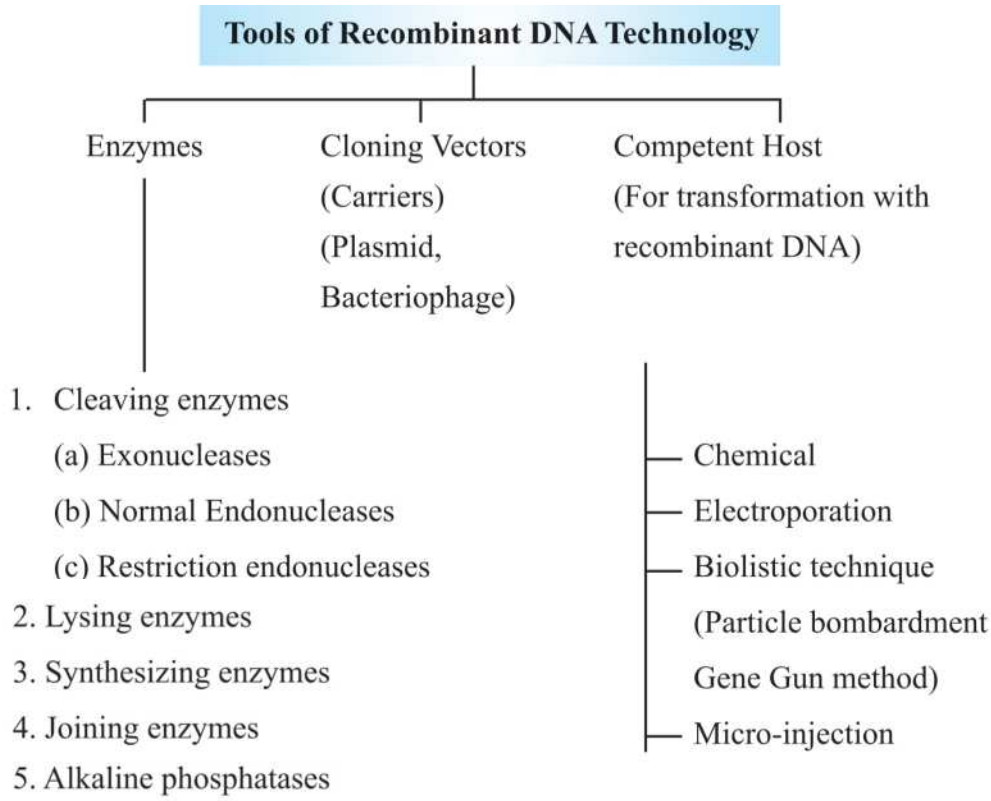
First Artificial reccombinant DNA Molecule :

(i) The two scientists of USA, Stanley Cohen and Herbert Boyer (1972) isolated the antibiotic resistance gene by cutting the desired piece of DNA from the plasmid of the bacterium *Salmonella typhimurium* with the help of restriction enzymes (molecular scissors).

2. This piece of DNA was then linked with the plasmid DNA acting as vector by DNA ligase enzyme.

3. The newly formed recombinant DNA was transferred to bacterium *Escherichia coli* for replication by using the enzyme DNA polymerase. This process is called Cloning.

Recombinant DNA (rDNA) : The hybrid DNA formed by combining DNA segment of two different organisms.



(1) Cleaving Enzymes : These enzymes are used to break DNA molecules.

(a) Exonucleases : Cut off nucleotides from terminal ends of DNA

(b) Endonucleases : Make cut DNA at any point within a DNA.

(c) Restriction Endonucleases : Make cut only specific position within a DNA. Single stranded free ends of DNA which can form hydrogen bonds with their complementary cut DNA segments are called 'Sticky Ends'. These ends can be joined by enzyme ligase.

(2) Lysing Enzymes : These enzymes are used to open the cells to get DNA. For example : Lysozyme is used to dissolve the bacterial cell wall.

(3) Synthesizing :

(a) Reverse Transcriptases : Used in the synthesis of Complementary DNA strands on RNA templates.

(b) DNA Polymerases : Used in the synthesis of Complementary DNA strands on DNA templates.

(4) Joining Enzymes : Are used to join the cut ends of double stranded DNA (act as molecular glue). They join DNA fragments by forming phosphodiester bonds e.g., Ligase.

(5) Alkaline Phosphatases : These enzymes cut the phosphate group from the 5′ end of linearised circular DNA to check its recircularization.

Some Restriction Enzymes

S. No.	Restriction Enzymes	Source	Recognition Site
1.	Alu 1	*Arthrobacter luteus*	↓ 5′-A-G-C-T-3′ 3′-T-C-G-A-5′ ↑
2.	EcoR I	*Escherichia coli* RY 13	↓ 5′-G-A-A-T-T-C-3′ 3′-C-T-T-A-A-G-5′ ↑
3.	Bam H I	*Bacillus amyloliquefaciens*	↓ 5′-G-G-A-T-C-C-3′ 3′-C-C-T-A-G-G-5′ ↑
4.	Sal I	*Streptomyces albus*	↓ 5′-G-T-C-G-A-C-3′ 3′-C-A-G-C-T-G-5′ ↑
5.	Hind II	*Haemophilus influenzae* RD	↓ 5′-G-T-C-G-A-C-3′ 3′-C-A-G-C-T-G-5′ ↑

Palindromic Sequence : Complementary DNA sequences that are the same when each strand is read in the same direction (5′ → 3′). These sequence act as recognition sites for restriction endonuclease.

5′—GAATTC—3′

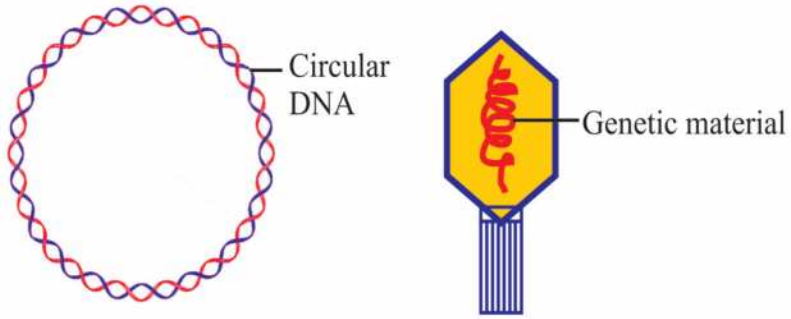
3′—CTTAAG—5′

Complementary DNA (cDNA) : A DNA strand formed from mRNA by using the enzyme reverse transcriptase.

Cloning Vectors : A small, self-replicating DNA molecule into which foreign DNA is inserted. It replicates inside the host cell. The vectors that may be used in genetic engineering are plasmids, bacteriophages, animal, plant, virus, YACs and BACs and some yeasts.

Plasmid : Extra chromosomal, self replicating circular DNA molecule found in certain bacteria and in some yeasts. It has a few genes. Plasmids are used as cloning vectors in genetic engineering. Plasmids were discovered by Willium Haes and Joshua Leduberg in 1952. The most widely used vector in cloning is pBR322. (an artificial plasmid)

Bacteriophage : A virus which infects bacteria is called bacteriophage.



Ti Plasmid : It is an extrachromosomal, double stranded and self replicating DNA molecule found in *Agrobacterium tumifaciens*. It causes tumor in plants. But now Ti Plasmid has been modified into a cloning vector by which desired genes can be delivered into many plants.

Features of cloning vector : Origin of replication (Ori), selectable marker and cloning sites are the features that are required to facilitate cloning into a vector.

(a) **Origin of Replication (Ori) :** This is a sequence from where replication starts and any piece of DNA when linked to this sequence can be made to

replicate within the host cells. This sequence is also responsible for controlling the copy number of the linked DNA.

(b) **Selectable Marker :** It is a gene which helps in identifying and eliminating non-transformants from transformants (having recombinant DNA) by selectively permitting the growth of transformants. The process through which as piece of DNA is introduced in a host bacterium is called transformation. The genes encoding resistance to antibiotics are considered useful selectable marker for *E. coli*.

(c) **Cloning Sites :** A location on a cloning vector into where a foreign gene can be introduced is called recognition site. The vector must have very few (preferably single) recognition sites. The presence of more than one recognition sites within the vector will produce several fragments which will make the process of gene cloning more complicated. Therefore, the foreign DNA is ligated at a restriction site present in one of the two antibiotic resistance gene.

(d) **Small Size of Vector :** This facilitates the intoduction of DNA into the host easily.

Insertional Inactivation : This method is used to differentiate recombinants from non-recombinants on the basis of ability to produce colour in the presence of a chromogenic substrate. When a rDNA is inserted in the coding sequence of an enzyme. It results in inactivation of the enzyme. This is called insertional inactivation.

Case I : The absence of insert in the plasmid of bacteria :

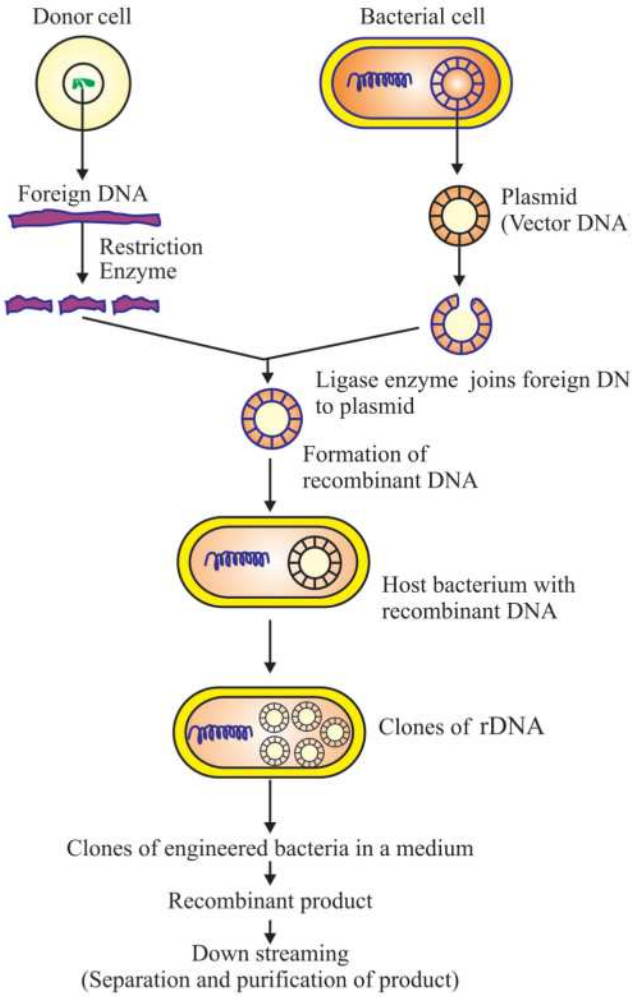
The presence of chromogenic substrate gives blue coloured colonies of bacteria, hence these bacterial colonies are non-recombinant.

Case II : The presence of insert in the plasmid of bacteria :

It results insertional inactivation of the β-gatactosidase, therefore bacterial colonies do not give any colour. Hence the bacterial colonies are recombinant.

Steps in Formation of rDNA by action of EcoRI : EcoRI cuts the DNA between bases G and A only → sticky ends of cut DNAs are formed → DNA fragments join at stickly ends by DNA ligase → Recombinant DNA is formed.

Recombinant DNA Technology :



Process of Recombinant DNA Technology : Isolation of DNA → Cutting of DNA using restriction endonuclease → Amplification of Gene using PCR → Making rDNA and insertion of it into host cell/organism → obtaining the foreign gene product → Downstream processing.

(i) Isolation of Genetic Material (DNA) :

- DNA can be obtained from the cell by treating with enzymes like, Lysozyme for bacteria, Cellulase for plant cell, Chitinase for fungus.
- Histone protein and RNA can be removed by treating with proteases and ribonuclease respectively.
- Purified DNA precipitated by the addition of chilled ethanol, fine threads of DNA are obtained in the suspension.

GEL Electrophoresis :

(1) DNA fragments are separated by forcing them to move towards anode under an electric field through a medium. Agarose gel is used as medium.

(2) Ethidium bromide is used as stain for DNA.

(3) Then on exposure to UV-light appear as orange coloured bands.

(4) Separated bands of DNA are cut out from agrose gel, this is called elution.

(5) These DNA fragments are used in recombinant DNA by joining them with cloning vectors.

(ii) Cutting of DNA at specific location : The purified DNA is cut by use of restriction enzymes. Agarose gel electrophoresis is used to check the progression of restriction enzymes digestion.

(iii) Amplification of gene of interest using PCR : Amplification is the process of making multiple copies of desired DNA segment *invitro*. Polymerase chain reaction involves three steps :

(a) **Denaturation :** The target DNA is heated to high temperature (94°C), resulting the separation of two strands of DNA. Each strand acts as template.

(b) **Annealing :** Two oligonucleotide primers anneal to each of the single stranded DNA template.

(c) **Extension of Primers :** DNA polymerase (*Taq* polymerase) extends the primers using the nucleotides provided in the reactions.

Taq polymerase is a heat stable (Thermostable) DNA polymerase which is isolated from thermophilic bacterium named *Thermus aquaticus*.

(iv) Ligation : The cut out gene of interest from the source of DNA and cut vector with appropriate space, are mixed and ligase enzyme is added. This results recombinant DNA (r-DNA).

(v) Transfer of recombinant DNA into the host : the ligated DNA is introduced into the recipient cell makes itself competent to receive and take up DNA present in the surrounding.

(vi) Obtaining the foreign gene product : The cell containing the foreign gene is cultured on suitable medium and the product can be extracted from the medium.

Bioreactors are used for processing large volume of culture for obtaining products of interest in sufficient quantities. Bioreactor is a large vessel in which raw material is biologically converted into specific product under optimal condition.

(vii) Downstream Processing : The products so obtained undergo a series of processes before putting them in market as a final product. This process includes separation and purification. The products are formulated with suitable preservation and subjected to quality control testing and clinical trials, (in case of drugs).

Questions

VSA **(I Mark)**

1. Write conventional nomenclature of EcoRI.
2. An extra chromosomal segment of circular DNA is used to carry gene of interest into the host cell. What is the name given to it ?
3. Mention the uses of cloning vectors in biotechnology.
4. Identify the recognition sites in the given sequences at which *E.coli* will cut and make sticky ends.

   5′GAATTC-3′
   3′CTTAAG-5′

MULTIPLE CHOICE TYPE QUESTIONS

5. Restriction endonucleose cut

a) Single stranded DNA

b) Single stranded RNA

c) Double stranded DNA

d) Double stranded RNA.

6. Ti phasmid is obtained from

a) Azotobacter

b) Agrobacterium

c) Yeast

d) Rhizobium

7. PCR is required for

a) DNA synthesis

b) DNA amplification

c) Protein synthesis

d) Amino acid synthesis

8. Restriction endo nucleases

a) Break DNA at specific sites

b) Create sticky ends

c) Produce cross - overs

d) Both 'A' and 'B'

9. (I) GAATTC is recognition site for restriction endonuclease.

a) HIND III) b) ECOR I c) Bam I d) Hae III

(ii)Assertion- DNA ligase plays important role in rDNA technology

Reason: Linking of antibiotic resistant gene with plasmid vector became possible by DNA ligase.

a) If both Assertion and Reason are true and Reason is the correct explanation of assertion.

b) If both assertion and reason are true but reason if not the correct explanation of Assertion.

c) If assertion is true but reason is false.

d) If both assertion and reason are false.

10. Assertion : DNA fragments move to words anode in get electrophoresis.

Reason : DNA fragments are negatively charged

a) If both assertion and reason are true and reason is are correct explanation of assertion.

b) If both assertion and reason are true but reason is not the correct explanation of assertion.

c) If assertion is true but reason is false.

d) If both assertion and reason are false.

12. Mr. Sunderam wants to start his business of making drugs at low cost developed by team researcher now, he needs to buy an instrument for his factory. He went to a company to purchase it. The salesman explain features of various types of reactors and Mr. Sunderam purchased the best.

Q.12

I) The optimum conditions in a bio reactor are :

a) Ph, temp, nutrient supply

b) Moisture, Humidity

c) Soil, moisture, Humidity

d) Heat, Cold, Moisture

ii) Downstream processing refers to

a) Making of rDNA

b) Recovery and purification of biosynthetic products

c) Preparation of hybrid DNA

d) Testing of DNA

iii) DNA can be separated in

a) PVC

b) Agar - agar

c) Agoruse gel

d) Hydro gel

iv) The type of bio reactors is

a) Sparged and ring type

b) Sparged and stirred type

c) only sparged type

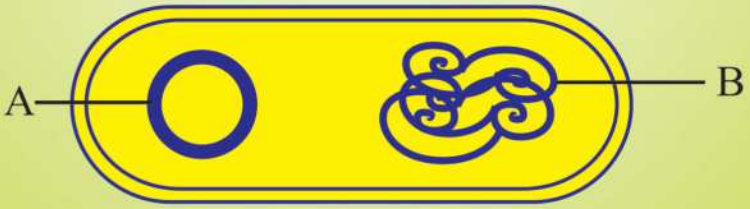
d) only stirred type

SA- I **(2 Marks)**

13. Name two main steps which are collectively referred to as down streaming process. Why is this process significant ?

14. How does plasmid differ from chromosomal DNA ?

15. (A) bacterial cell is shown in the figure given below. Label the part (A) and (B). Also mention the use of part 'A' in rDNA technology.



16. In the given process of separation and isolation of DNA fragments, some of the steps are missing, Complete the missing steps :

A : Restriction digestion of DNA fragments

↓

B : .....

↓

C : Staining with ethidium bromide

↓

D : Visualisation in U.V. light

↓

E : .....

↓

F : Purification of DNA fragments.

SA-II **(3 Marks)**

17. Since DNA is a hydrophilic molecule, it cannot pass through cell membranes. Name and explain the technique with which the DNA is forced into (i) a bacterial cell (ii) a plant cell (iii) an animal cell.

18. In recombinant DNA technology, vectors are used to transfer a gene of interest in the host cells. Mention any three features of vectors that are most suitable for this purpose.

19. Why is "*Agrobacterium*-mediated genetic engineering transformation" in plants considered as natural genetic engineering ?

20. Observe the given sequence of nitrogenous bases on a DNA fragment and answer the following questions.

5′—CAGAATTCTTA—3′

3′—GTCTTAAGAAT—5′

(a) Name of restriction enzyme which can recognise this DNA sequence.

(b) Write the sequence after digestion.

(c) Why are the ends generated after digestion called sticky ends ?

21. A selectable marker is used in the section of recombinants on the basis of their ability to produce colour in presence of chromogenic substrate.

(a) Mention the name of mechanism involved.

(b) Which enzyme is involved in production of colour ?

(c) How is it advantageous over using antibiotic resistant gene as a selectable market ?

LA **(5 Marks)**

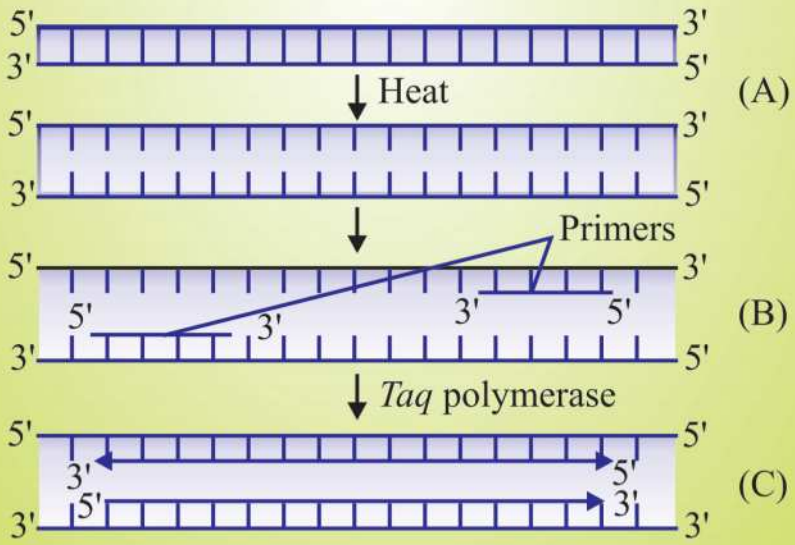
22. The development of bioreactors is required to produced large quantities of products.

(a) Give optimum growth conditions used in bioreactors.

(b) Draw a well labelled diagram of simple stirred-tank bioreactor.

(c) How does a simple stirred tank bioreactor differ from sparged stirred tank bioreactor ?

23. In the given figure, one cycle of polymerase chain reaction (PCR) is shown :

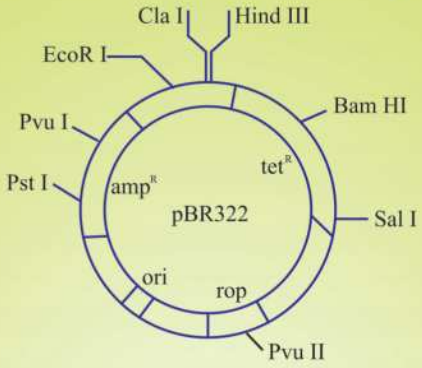


(a) Name the steps A, B and C.

(b) Give the purpose of each of these steps.

(c) State the contribution of *Thermus aquaticus* in this process.

24. Study the figure of vector pBR322 given below in which foreign DNA is ligated at the Bam HI site of tetracyline resistance gene.



Answer the following questions :

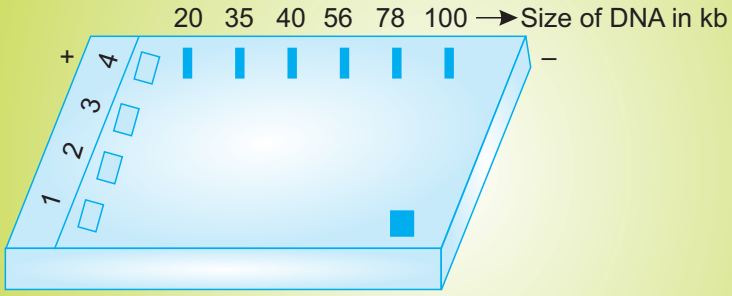
(a) Mention the function of rop.

(b) What will be the selectable marker for this recombinant plasmid and why ?

(c) Explain transformation.

25. A recombinant protein was formed, using the cloning vector pBR322 at the doing side to BamHI. However, the labels test tubes containing, transformants having recombinant and non-recombinant cloning vector got dettached accidentally. How would you differentiate between the two test tubes [Hints: You can use different antibiotics.]

26. While performing get electrophoresis, a student mistakenly attached wrong electrodes i.e., he attached the positive electrode towards the loading the well. Would you expect same results in the process? Why or why not?

27. 

The above figure shows the result of agrarose gel electrophoresis performed by a student of undigested DNA fragment (lane 1) and digested DNA fragment. However, while drawing the above diagram, student committed a mistake. Identify the mistake and rectify it.

28. Given below is some information of a restriction enzyme:
(i) Isolated form H-strain Bacillus amyloliquefacies
(ii) This was the 3rd restriction enzyme isolated from the said organism.
As per convention, what should be its name?

Answers

VSA (I Mark)

1. E. = *Escherichia* ; co = *coli*; R = Name of Strain; I = order in which enzyme is isolated from strain of bacteria.
2. Plasmid.
3. Gene cloning, gene transfer.
4. ↓
   5′—GAATTC 3′
   3′—CTTAA G 5′
   ↑

SOLUTION : LESSON 11

MCQ

5. c) 6. b) 7. B) 8. D) 9. B) 10. B) 11. A)

Ans 12.

I) a iii) c

SA-I (2 Marks)

13. • Separation and Purification
    • This process is essential because reaching into market, the product has to be subjected for clinical trial and quality control.

14.

Plasmid DNA	*Chromosomal DNA*
(i) Circular DNA	Linear DNA
(ii) Occurs in bacterial cells	Occurs in nucleus of eukaryotic cells and bacterial cell
(iii) Used as Vector in rDNA technology.	Not used as vector in rDNA technology.

15. (A)—Plasmid, (B)—Nucleoid

Plasmid is used as vector to transfer the gene of interest in the host cell.

8. B—Gel Electrophoresis

E—Elution

SA-II **(3 Marks)**

16. (i) Chemical treatment: treated with divalent cation such as Calcium) and exposure to cold and high temp. (42° C) alternatively (Bacterial cell)

(ii) Biolistics or gene gun. (Plant cell). In this method gold and tungsten particles, coated with DNA are bombarded with high velocity.

(iii) Micro-injection, (animal cell). In this method r DNA is directly injected into the nucleus of an animal cell.

17. (i) Have origin of replication(Ori)

(ii) a selectable marker

(iii) at least one recognition site.

18. *Agrobacterium tumifaciens* is a pathogen in many dicot plants. It is able to deliver a piece of DNA (T-DNA) to transform normal plant cell into a tumor and directs these tumor cells to produce the chemicals required by pathogen.

19. (a) EcoRI

(b)

(c) These are named sticky ends, because they form hydrogen bonds with their complementary cut parts.

20. (a) Insertional inactivation

(b) β-galactosidase.

(c) Selection of recombinants due to inactivation of antibiotics requires simultaneous plating on two plates having different antibiotics.

LA **(5 Marks)**

21. (i) Temperature, pH, substrates, salts, vitamins and oxygen.

(ii) Figure 11.7(a) simple stirred-tank bioreactor Page No. 204 NCERT book, Biology-XII

(iii) The stirrer facilitates even mixing and oxygen availability throughout simple-stirred tank bioreactor, whereas in case of sparged stirred tank bioreactor, air is bubbled throughout the reactor for proper mixing.

22. (A) *Denaturation* : Heat denatures DNA to separate complementary strands.

(B) *Annealing :* Primers hybridises to the denatured DNA strands.

(C) *Thermus aquaticus.* This enzyme induces denaturation of double stranded DNA at high temperature.

(D) *Extension* : Extension of primers resulting in synthesis of copies of target DNA sequence. Enzyme Tag polymerase is isolated from the bacterium.

23. (a) 'Rop' codes for the proteins involved in the replication of plasmid

(b) *Selectable marker* : Ampicillin resistance gene. It will help distinguishing transformants from non-transformants after plating them on ampicillin containing medium.

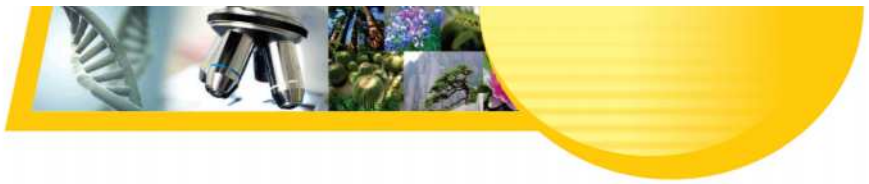
(c) *Transformation* : It is the phenomenon by which the DNA isolated from one type of cell and introduced into another type, is able to bring about some of the properties of former to the later.

25. The test tube having recombinant DNA transformants will die on adding tetracycline,

26. No, the DNA bands will not be separated due to wrong electrode connection. DNA will not move towards negative electrode.

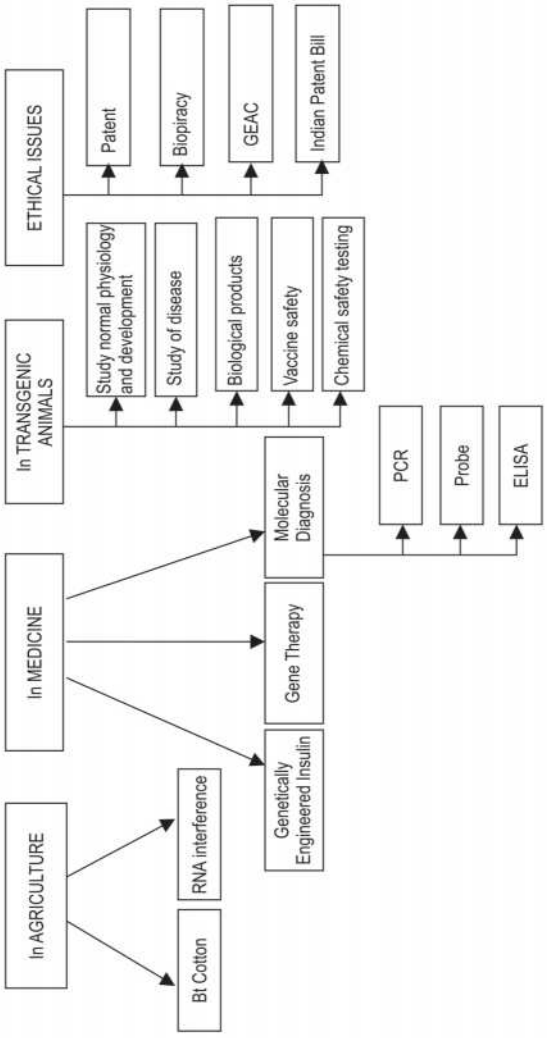
27. The mistake is that the loading wells have been drawn on the left side instead of right side.

28. Bam HIII



Chapter - 10

Biotechnology and its Applications



Biopesticides : Biological agents that are used to control weeds, insects and other pests.

***cry* Gene :** The Bt toxins are coded by a gene named cry.

***Cry* Protein :** The insecticidal protein which is produced by *Bacillus thuringiensis.*

Green Revolution : Substantial increase in crop yields due to use of high yielding varieties, use of fertilisers and pesticides, improved agricultural practices etc.

Genetically Modified Organisms (GMO) : The organisms which have altered genes in them. These are also known as transgenic organisms.

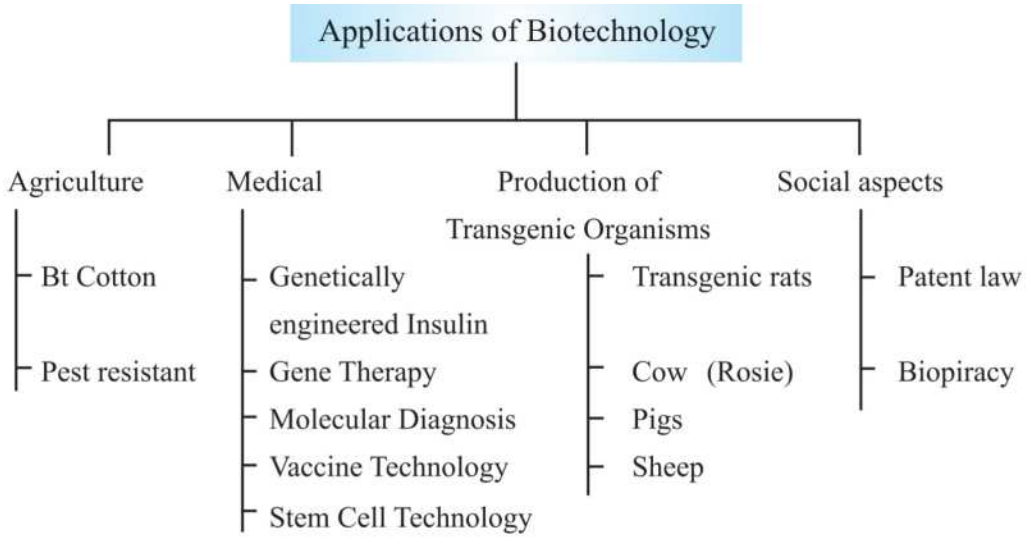
e.g. Bt Cotton, Bt Corn, Transgenic rat, Transgenic cow-Rosie

Molecular Diagnosis : Refers to early detection of diseases using recombinant DNA molecules and techniques like PCR and autoradiography.

RNA Interference (RNAi) : Process used to develop pest resistant plants. It involves silencing of a specific mRNA due to complementary double stranded RNA.

Sustainable Agriculture : It involves organic farming and other integrated management practices which maintain soil fertility while increasing crop productivity.

Use of GM Plants : Tolerant to abiotic stress, Reduced dependence on chemical pesticides, less post harvest-loss, Efficient use of minerals, enhanced nutritional value.



Bt. Cotton : The soil bacterium *Bacillus thuringiensis* produced crystal protein called cry protein that kills certain insects larvae such as tobacco budworm, armyworm, beetles and flies.

- Bt, toxin protein exists as inactive pro-toxins, but once an insect ingest this inactive toxin, it is converted into active form of toxin due to the alkaline pH of the gut which solubilize the crystal. This causes swelling and lysis of epithelial cells of midgut leading to death of insect larvae.
- Bt toxin genes were isolated form *Bacillus thuringiensis* and incorporated into the several crop plants such as cotton.
- The proteins encoded by the genes : crylAc and cryllAb control the cotton bollworms and crylAb controls corn borer.

Pest Resistant Plants : A nematode *Meloidegyne incognitia* infects tobacco plants and reduces their yield.

- Nematode specific genes were introduced into the host plant using *Agrobacterium* as a vector.
- The introduction of DNA was such that it produced both sense and antisense RNA in the host cells.
- These two RNAs being complementary to each other formed a double stranded RNA (dsRNA) making it inactive.

- The nucleotide formed by the process called RNA interference (RNA i).
- The result was that the parasite could not survive in the transgenic host and the transgenic plant got protected for the parasite.

Genetically engineered insulin :

Insulin contains 'A' 'B' and overstrech 'C' polypeptide chain

↓

'C' Polypeptide is removed in mature insulin

↓

Eli Lily prepared two chains corresponding to chains 'A' and 'B' of human insulin

↓

Chain 'A' and 'B' were joined to plasmid to different *E. coli* for replication

↓

Chain 'A' and 'B' were then extracted separately

↓

Separated 'A' and 'B' chains were joined to each other by disulphide bonds.

↓

Mature insulin was obtained.

Gene Therapy : It is a technique of inserting genes into the cells and tissue of an individual to treat a hereditary disease.

- The first clinical gene therapy was given in 1990 to a four year old girl with adenosine deaminase (ADA) deficiency. ADA enzyme is required for proper functioning of immune system.
- This disorder is caused due to the deletion of the gene for adenosine deaminase enzyme. In some children ADA deficiency can be cured by bone marrow transplantation. Lymphocytes from the blood of patient are grown in a culture. A functional ADA cDNA is then introduced into these lymphocytes using retroviral vector. The lymphocytes are transferred into the body of patients.

- As these cells are not immortal, the patient required periodic infusion of such genetically engineered lymphocytes.
- If a functional gene is Introduced into a bone marrow cells at early embryonic stage. It could be a permanent cure of ADA deficiency.

Vaccine Production

Vaccine are used to protect many infectious diseases such as small pox, cholera, Hepatitis B. These are made up of killed or weakened pathogens like viruses and bacteria.

Vaccines are commonly produced through cell cultures or animals or recombinant DNA technology.

Vaccine production involves the following steps.

(i) Generating the antigens : The antigens are generated from the microbes. Virus are grown in primary cells *i.e.*, chicken egg (influenza vaccine) or on continuous cell lines *i.e.*, Human Cultured cells (Hepatitis B). Bacteria against which the vaccines are developed may be grown in bioreactors (Hib Vaccine)

(ii) Isolation of antigens : Antigen are isolated from the cells used to generate it.

(iii) Vaccine is made by adding adjuvant (to increase immune response of antigen), Stabilizers (to increase storage life) and preservativesto allow for the use of multi-dose vials).

Production of Vaccines through Recombinant DNA Technology : Injectable and edible vaccines may be produced through recombinant DNA technology.

- Gene for antigen is isolated from pathogen like Virus.
- This desired gene is introduced in the host cells (yeast).
- Antigen gene is incorporated with genetic material of host.
- The host cell is allowed to grow in the culture.

Agrobacterium tumefaciens is commonly used to deliver the antigen genes into plant cells. Antigens are produced in the plant cells. The edible part of the plants can be consumed to get vaccinated. The transgenic crop plants have the capability to produce vaccine at larger scale and cheaper price.

Stem Cells Technology

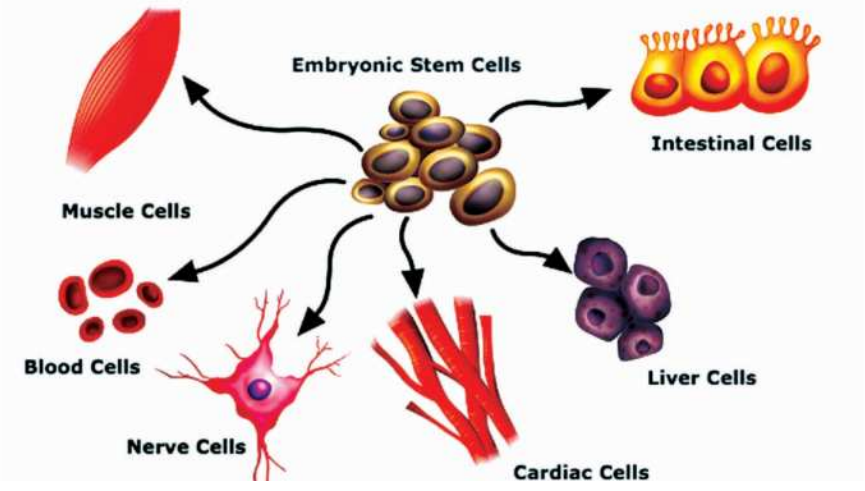
Stem Cells are undifferentiated cells which are able to grow into any type of tissue with specialized function. Stem cells are involved in development, growth and repair in multicellular organisms. Stem cells are used to treat many diseases such as type-I diabetes, heart diseases, cancer, Spinal injuries, arthritis, muscular dystrophy, Alzheimer. It can also be used to make new organs like heart, liver, kidneys, skin, even to produce transgenic animals.

Sources of Stem Cells : Stem cells can be obtained from inner cell mass of embryos, from bone marrow, umbilical cord and amniotic fluid.

There are three Categories of stem cells :

1. **Embryonic stem cells :** The embryo cells are removed easily and cultured in laboratory.
2. **Tissue stem cells :** Bone marrow stem cells can be used to produce bone or cardiac muscle cells.
3. **Reprogrammed stem cells :** Adult special cells are reprogrammed to act as embryonic cells with the help of genetic engineering. Organs for transplantation are developed by this technique.

- Embryonic stem cells have the ability to differentiate into any at the three germ layers-ectoderm, mesoderm or endoderm.
- These cells are isolated from inner cells mass of the blastocyst, 4 to 5 days after *in vitro* fertilisation of an egg.
- The cells are cultured and allowed to grow into cell lines.



The transgenic animals can be produced by stem cell technology the stem cells are isolated from the embryo of selected animal and the desired gene is inserted into these cells. Then, these cells are incorporated in the embryo of host. The embryo is now implanted into the uterus of host animal to grow normally.

Transgenic animals : The animals which carry foreign genes are called transgenic animals.

Steps to produce transgenic animals :

1. Identification and isolation of desired gene.
2. Selection of proper vector or direct transmission of desired gene.
3. Combining of desired gene with the vector using ligase enzyme.
4. Introduction of vector in cells/tissue/embryo/mature individual.
5. Expression of foreign gene in transgenic animal.

Advantages of transgenic animals :

1. Transgenic animals are used to produce the biological products. For example, Rosie (First transgenic cow) produced human alpha-lactalbumin protein enriched milk which was more balanced product for human babies than natural cow-milk.
2. Transgenic mice are used in testing of the vaccine safety before these vaccines are used on humans e.g. Polio Vaccine.
3. Transgenic animal are used to test the toxicity of substances.
4. These animals are used to study how genes contribute to the development of disease and also treatment. Example : cancer, Alzheimer's etc.
5. These animals are used to study the regulation of genes and their affect for normal functioning of the body and its development.

Patent : Patent is a set of exclusive right granted by a state (National Government) to an inventor or their assignee for a limited period of time to prevent others from commercial use of his invention. Biopatents are granted for biological entities and for products derived from them.

Criteria for grant of patents:-

1. **Novelty :** It implies that the innovation must be new.
2. **Non-obviousness :** It implies that it may not be documented but is otherwise well-known.

3. **Utility :** The discovered fact or product should be of a particular use for humans.

Controversies in India regarding patent and biopiracy :

Turmeric : In 1995, the US patent office granted a patent to the University of mississippi medical centre for "Use of Turmeric in wound healing". Dr. R.A. Mashelkar, an Indian scientist challenged the patent. It was established that the use of turmeric as healing agent was well-known in India for centuries and the patent was revoked.

Neem : The European Patent office, Munich granted a patent to the firm of W.R. grace & Co. for 'Fungicidal uses of neem oil'. The patent had been granted on an extraction of oil technique but not on the neem tree itself. In 1996, Vandana Shiva and Ajay Phadke who had rereared neem in India, challenged the patent. Legal action was followed by India Government. Finally, the patent was revoked in 2005.

Basmati Rice : Basmati Rice is a variety of rice which is distinct for its unique aroma and flavour. In India, 27 varieties of basmati are grown.

In September 1997, a Texas company patented Basmati rice lines and grains through the US patent and trademark office. This act caused diplomatic crisis between India and US. Later due to revised decision by the United State patent office, theTexas company lost most of the claims of the patent. This was a case of biopiracy.

Questions

VSA **(I Mark)**

1. Which recombinant vaccine is currently being used in vaccination programme?
2. Name the technique based on the principles of antigen-antibody interaction used in detection of a virus (HIV).
3. The first transgenic cow, produced human protein - enriched milk. Name the cow and the protein found in milk.
4. The insulin produced using recombinant DNA technology is more advantageous than the insulin extracted from pancreas of slaughtered cattle and pigs. How ?

BIOTECHNOLOGY AND ITS APPLIANCES
MULTIPLE CHOICE TYPE QUESTIONS

5. Bt toxin is a

a) Intracellular lipid

b) Intracellular crystalline protein

c) Extracellular crystalline protein

d) Lipid

6. Cry-I endotoxins obtained from Bacillus thuringinusis are effective against.

A) Nematodes

B) Mosquitoes

C) Flies

D) Bell worn

7. In Bt Cotton, the Bt toxin present in plant tissue as protoxin in converted into active toxin due to.

A) Acidic Ph of the insect gut

B) Alkaline Ph of the insect

C) Presence of conversion factors in insect gut

D) Action of gut micro organism

8. The process of RNA interference has been used in the development of plants resistant to.

A) Insects

B) Nematodes

C) Fungi

D) Viruses

9. C-peptidle of Human insulin is :

A) A part of mature insulin molecule

B) Responsible for formation of disulphide bridges

C) Removed during maturation of proinsulin to insulin

D) Responsible for its biological activity

10. Assertion : Bacillus thuringiensis forms protein crystals during particular phase of growth.

Reason : There crystal contain a toxic insecticidal protein that kills the certain insects.

a) If both assertion and reason are true and reason is the correct explanation of assertion.

b) If both assertion and reason are true but reason is not the correct explanation of assertion.

c) If assertion is true but reason is false.

d) If both assertion and reason are false.

11. Assertion : For toxicity testing, transgenic animal are made to carry genes which make them more sensitive.

Reason : Transgenic animals are exposed to toxic substance to be study to know their effect.

A,B,C,D are some as in above question

12. Gene therapy is most recent and advanced therapeutic treatment of defective gene. That has been diagnosed in a child/embryo. It involves insertion of normal healthy and functional gene into a person cells and tissues to treat the

Q12.

i) Gene therapy is "

a) Correction of faulty gene

b) Recovery of faulty gene

c) Addition of a new gene

d) Mutation of a gene

ii) Temporary treatment is to culture :

a) Erythrocyte

b) Lymphocytes

c) Thrombocyte

d) All of the above

iii) Permanent cure of ADA is :

a) Culturing of the cells

b) Transfer of new gene

c) Bone marrow transplantation at embryo stage

d) Culturing of enzyme

iv) ADA deficiency is a :

a) Sexual disorder

b) Mental disorder

c) Physical disorder

d) SCID

SA-I **(2 Marks)**

13. Can a disease be detected before the appearance of its symptoms ?
14. How does a probe help molecular diagnosis.
15. GEAC is one of the organization set up by Indian Government. Write its full form. Give its two objectives.

SA-II **(3 Marks)**

16. Some multinational companies and other organisations are using bioresources for commercial benefits, without proper authentication and compensation to concerned authorities.
    (a) Give the term for this unauthorised act.
    (b) Suggest any two ways to get rid of this.
17. A bacterium *Bacillus thuringiensis* produces a toxic protein named 'Cry protein' that is lethal to certain insects but not to bacterium.
    (a) Why this toxin does not kill the bacteria ?
    (b) What type of changes occur in the gut of insects on consuming this protein ?
    (c) How man has exploited this protein for his benefit ?

18. Given below is an incomplete flow chart showing the process of production of nematode resistant tobacco plants based on RNAi technique.

(i) Write the missing steps in proper sequence.

(ii) At which level RNAi silences the gene ?

(a) Splicing of a specific mRNA

↓

(b) .....

↓

(c) Formation of sense and antisense RNA in host cell

↓

(d) .....

↓

(e) Initiate RNA interference

↓

(f) .....

↓

(g) .....

↓

(h) Transgenic plant got protected from parasite.

LA **(5 Makrs)**

19. The clinical gene therapy is given to a 4 years old patient for an enzyme which is crucial for the immune system to function.

(A) Lymphocytes of the Patient.

↓

(B) .....

↓

(C) Introduction of functional ADA cDNA into lymphocytes.

↓

(D) .....

Observe the therapeutical flow chart and give the answer of the following:

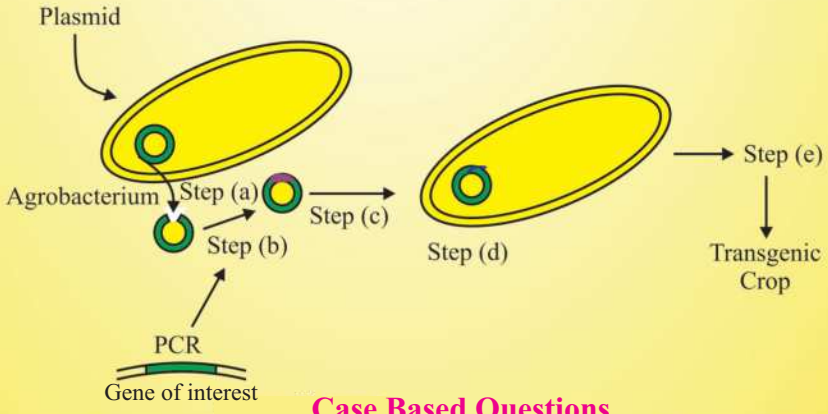
(a) Complete the missing steps (B) and (D)

(b) Identify the disease to be cured.

(c) Why the above method is not a complete solution to the problem ?

(d) Scientists have developed a method to cure this disease permanently. How ?

20. In the given figure, *Agrobacterium* is utilized for the production of a transgenic crop. Explain the steps a, b, c, d and e shown in the figure.



Case Based Questions

21. In the given figure, Form (A) and Form (B) represents different forms of a proteinaceous hormone secreted by pancreas in mammals.

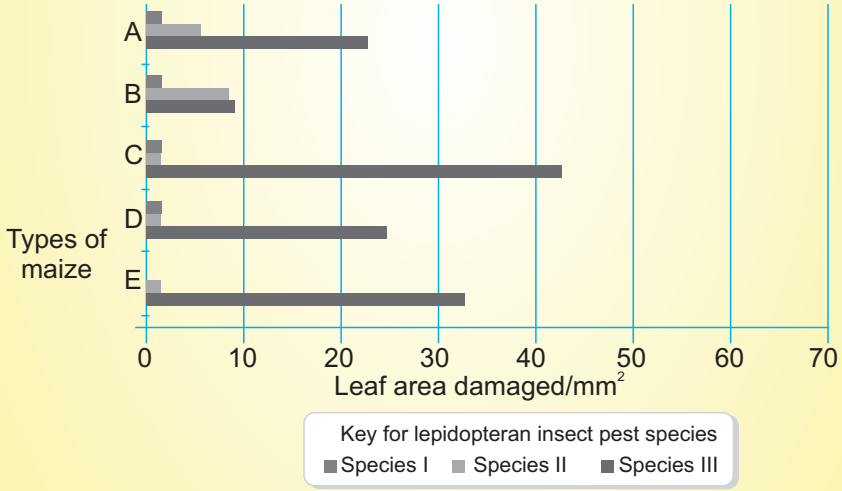
Form (A) Form (B)

(a) Name the hormone. What type of bonding is present between chains of this hormone ?

(b) What are these form (A) and form (B)? How these forms differ from each other ?

(c) Explain how was this hormone produced by Eli Lilly, an American company, using rDNA technology.

22. Insects in the Lepidopteran group lay eggs on maize crops. The tarvae on hatching feed on maize leaf and tender cob. In order to arrest the spread to three such Lepidopteran pests, Bt maize crops were introduced in an experimental field.



A study was carried out to see which of the three species of lepidopteran pests was most susceptible to Bt genes and its product.

The lepidopteran pests were allowed to food on the same Bt-maize crops grown on 5 fields (A-E).

The graph below shows the leaf area damaged by these three pests after feeding on maize leaves for five days.

Insect gut pH was recorded as 10, 8 and 6 respectively for Species I, II and III respectively.

(a) Which of the three species is least susceptible to Bt toxin?

(b) Name the gene used to make Bt-maize and its source organism.

(c) Why is the effect of Bt toxin on lepidopteran species not similar in the three species?

(d) How does the Bt toxin kill the insect, but not the bacterium?

Answers

VSA **(1 Mark)**

1. Hepatitis B recombinant vaccine.
2. ELISA (Enzyme linked immuno-sorbent Assay)
3. Rosie, alpha-lactalbumin
4. Insulin obtained from animal source causes allergy.

SOLUTION LESSON 12

MCQ

5. B) 6. D) 7. B) 8. B) 9. C) 10. B) 11. d)

Q12 :

i) a ii) b iii) c iv) d

SA-I **(2 Marks)**

13. Yes, early detection of disease is possible by the use of recombinant DNA technology, PCR, ELISA.

14. A single stranded DNA/RNA tagged with a radioactive molecular probe is allowed to hybridise to its complementary DNA in a clone of cells. It followed by detection using autography. The clone having the mutated gene will not appear on the photographic film.

15. GEAC—Genetic Engineering Approval Committee. Objectives of GEAC are :

(i) To make decisions regarding validity of GM research.

(ii) Safety of introducing GMO for public use.

SA-II **(3 Marks)**

16.(a) Biopiracy

(b) (i) Benefits of bio resources should be shared between developed and developing nations.

(ii) Laws should be developed to prevent unauthorised exploitation of the bioresources.

17.(a) In bacteria, cry protein remains in inactive form as Prototoxin.

(b) Prototoxin becomes active toxin in alkaline pH of gut of insects. Toxins bind to surface of midgut and cause perforation, swelling, lysis of cells ultimately leading to death of insect.

(c) Specific Bt toxin genes isolated from *Bacillus thuringiensis* and incorporated into several crop plants such as cotton and corn which become pest resistant against certain insects.

18.(i) (b) Using *Agrobacterium* as a vector, introduced into tobacco

(d) dsRNA (double stranded RNA)

(f) Silenced specific mRNA of the nematode

(g) Parasite could not survive.

(ii) RNAi silences the gene at translation level

LA **(5 Marks)**

19.*Step* (B) : Lymphocytes are grown in culture medium.

Step (D) : Infusion of genetically engineered lymphocytes into patients.

(b) Adenosine deaminase (ADA) deficiency.

(c) As genetically engineered lymphocytes are not immortal, the patient requires periodic infusion of cells.

(d) If the gene isolated from bone marrow cells producing ADA is introduced into cells at early embryonic stages, it could be a permanent cure.

20. Step (a) Plasmid is removed and cut open with restriction endonuclease.

Step (b) Gene of interest is isolated from another organism and amplified using PCR.

Step (c) New gene is inserted into plasmid

Step (d) Plasmid is put back into *Agrobacterium*

Step (e) *Agrobacterium* based transformation.

21. (a) Insulin, Disulphide bonds

(b) Form (A) : Proinsulin

Form (B) : Mature insulin.

Proinsulin contains an extra stretch called C - peptide which is absent in mature insulin.

(c) Eli-Lilly company prepared two DNA sequences corresponding to A and B peptide chains of human insulin and introduced them in plasmid *E. coli* to produce insulin chains. Chains A and B were produced separately, extracted and combined by creating disulphide bonds to form insulin.

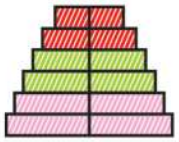
22. (a) Species III

(b) — Cry gene

— Source: Bacillus thuringiensis.

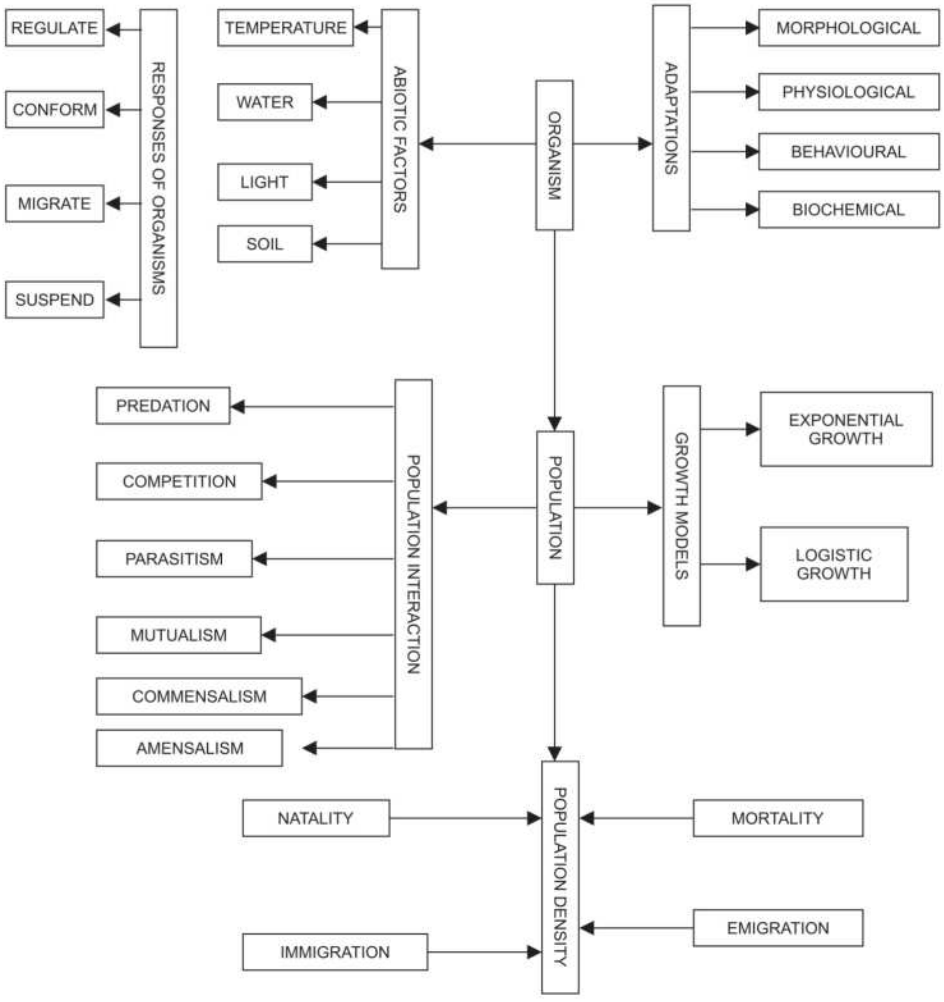
(c) pH in the got of insects is different and toxin gets activated at optimum pH.

(d) Bt toxin gets activated in gut of insects and absent in bacterium.



Chapter - 11

Organisms And Population



Ecology : A branch of science that studies interactions among organisms and their physical environment. Ecology is basically concerned with four levels of biological organisation— Organisms, population, communities and biomes.

Ramdeo Misra is called as the Father of Ecology in India.

Organisms : Organisms form the basic unit of study in ecology.

Species : Organisms with similar features and the potential to interbreed among themselves and produce fertile offspring, constitute a species.

Populations : Population is a group of individuals of the same species, inhabiting in a given area. Interspecific competition for basic needs operate among the individuals of population.

Biological Community : Biological community is constituted by an assemblage of the populations of all different species that live in an area and interact with each other. A biotic community has a distinct species composition and structure.

Population Attributes :

A population has certain attributes that an individual does not possess. Important characterstics of a population are :

(i) Population density : Population density of a species is the number of individuals of a species per unit area or volume

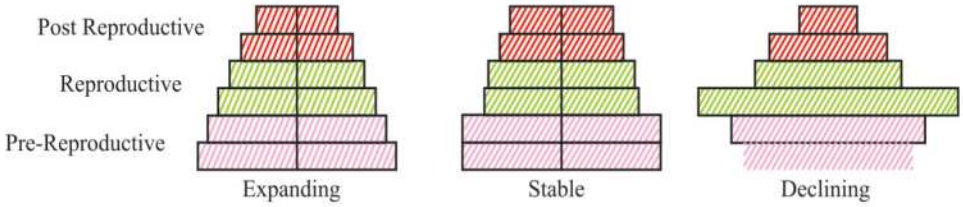
$$\text{Population density} = \frac{\text{Number of individual in a region (N)}}{\text{unit area in a region (S)}}$$

(ii) Birth rate or Natality Rate : It is expressed as the number of births per thousand individuals of a population per year

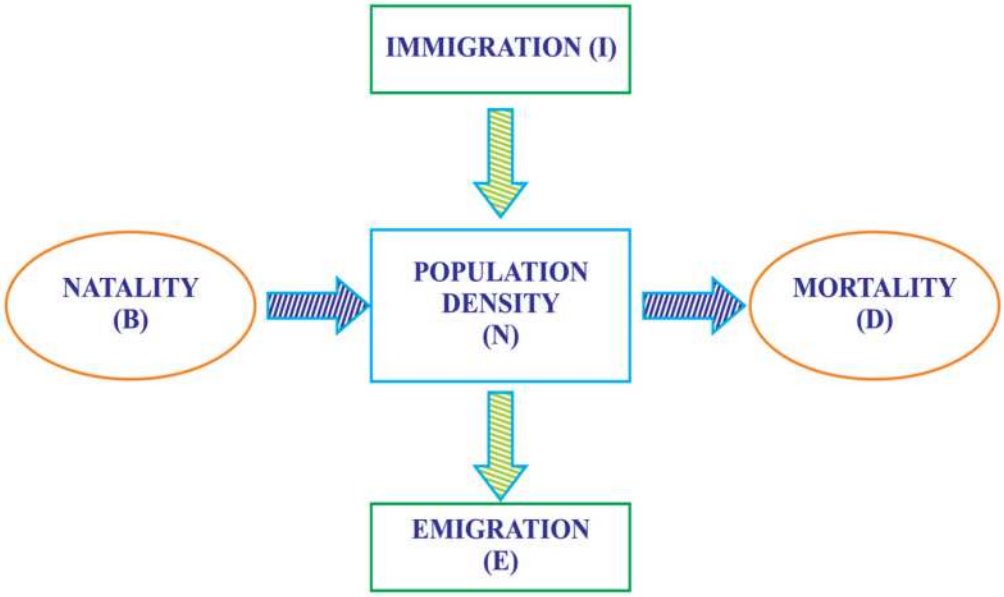
(iii) Death rate or Mortality rate : It is expressed as the number of deaths per thousand individual of a populations during a given period.

(iv) Sex ratio : It is expressed as the number of females per 1000 males of a population in given time.

Age Pyramids of Populations : A population at any given time is composed of individuals of different ages. If the age distribution is plotted for the population, the resulting structure is called an age pyramid. The shape of the pyramids reflects the growth status of the populations. Whether (a) it is growing (expanding) (b) Stable or (c) Declining. The pyramids for human population (males and females) are presented below :



Population Growth : If 'N' is the population density at time t' then its density at time t + 1 is : $N_{t+1} = N_t + (B + I) - (D + E)]$



Immigration : Number of individuals of the same species that have come into the habitat from elsewhere during a given period.

Emigration : Number of individuals of the population who have left the habitat and gone elsewhere during a given time period.

Growth Models : The two growth models are :

(i) **Exponential growth model** : If food and space for a population are unlimited and each species has the ability to grow, then the population grows in exponential or geometric fashion.

Exponential Growth Equation is $N_t = N_0 e^{rt}$

Where,

N_t = Population density after time t

N_0 = Population density at time zero

r = intrinsic rate of natural increase

e = the base of natural logarithms (2.71828)

Exponential growth : 'J' shape curve is obtained.

- When resources are not limiting the growth.
- Any species growth exponentially under unlimited resources conditions can reach enormous population densities in a short time.
- Growth is not so realistic.

(ii) **Logistic growth model :** A population growing in a habitat with limited resources (food and space) shows logistic growth :

Verhulst-Pearl Logistic Growth is described by the following equations :

$dN/dt = rN (K-N / K)$

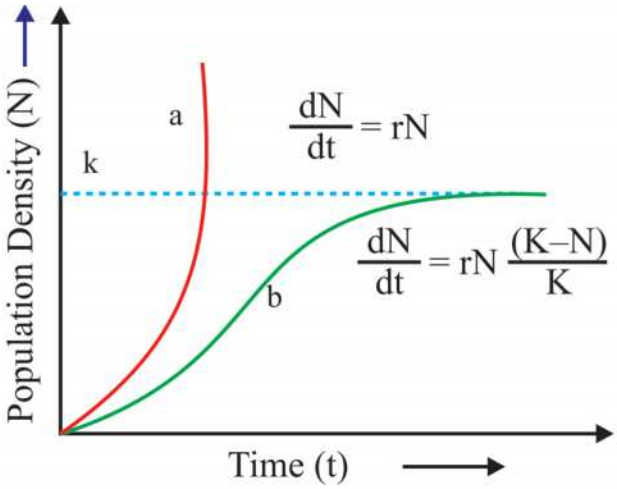
Where, N = Population density at time t

r = Intrinsic rate of natural increase

K = Carrying capacity

Logistic Growth: Sigmoid curve is obtained

- When resources are limiting the Growth.
- Resources for growth for most animal populations are finite and become limiting.
- The logistic growth model is a more realistic one



a-Exponetial growth
b- Logistic growth

k- Carrying capacity

Population Interactions :

1. **Predation :** Interaction between species involving killing and consumption of prey is called predation. The species which eats the other is called the predator and the one consumed is termed as the prey. The predator keeps check on prey population. The reduction in predator population may lead to increase in prey population.

- Predators play important roles in ecosystem :
  - (a) Transfer of energy across trophic levels.
  - (b) Keep prey population under control : The invasive prickly pear cactus was brought under control by introduction of a cactus-feeding predator (moth) in Australia.
- Biological pest control methods : Used in agricultural are based on the ability of predator to regulate prey population.
- Maintain species diversity in a community.

Examples of Predation :

(i) Carnivorous animals like tiger eating deers, snake eating frog

(ii) Insectivorous plants like *Nepenthes*, *Drosera*, *Utricularia*

2. **Competition :** In this fitness of one species is significantly lower in presence of another species.

Gause's Competitive Exclusion Principle : Two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior one will be eliminated.

3. **Parasitism :** Parasitism is a kind of relationship between two species in which one derives its food from the other (host). Parasitism also involves shelter, in addition to food obtained by a parasite. Parasites may be ectoparasites or endoparasites. Ectoparasites live on the surface of their host while endoparasites live inside the body of the host.

Examples of Parasitism

(i) Cuscuta growing on hedge plant

(ii) Head lice and humans

(iii) *Ascaris*, *Taenia*, *Plasmodium* causing diseases in humans

Example of Brood parasitism

(i) Koel laying its eggs in crow's nest.

4. **Mutualism :** In mutualism both the interacting species are benefited mutually. It is also known as symbiosis.

Examples of Mutualism

(i) Mycorrhiza living in roots of higher plants

(ii) *Rhizobium* in root nodules of legumes

(iii) Algae and fungi in lichens

(iv) Orchid *Ophrys* and bee for pollination (Sexual deceit-resemblance of flower to female bee)

Co-evolution : (1) Fig species and wasp. Female wasp uses the fruit as an Oviposition (egg-laying) and also uses the developing seeds within the fruits for nourishing its larvae. Wasp pollinates the fig inflorescence while searching for egg laying site, in return fig offers developing seeds as food for developing larvae. (2) Mediterranean orchid Ophrys and bee.

5. **Amensalism :** Interaction between two different species, in which one species is harmed and the other is neither benefited nor harmed.

Example of Amensalism

(i) *Penicillium* whose toxin kills many bacteria is neither benefitted nor harmed

6. **Commensalism :** This is the interaction in which one species is benefited and the other is neither harmed nor benefited under normal conditions.

Examples of Commensalism

(i) Clown fish living among tentacles of sea anemone

(ii) Pilot fish (*Remora*) accompanies sharks

(iii) Orchid growing on mango tree (epiphyte)

(iv) Sea anemone on the shell of hermit crab

(v) Barnacles on back of whales

(vi) Egret and grazing cattle

Questions

VSA **(1 Mark)**

1. Name the two intermediate hosts of human liver fluke.
2. Calculate the death rate if 6 individuals in a laboratory population of 60 fruiflies died during a particular week.
3. An organism has to overcome stressful condition for a limited period of time. Which strategies can it adopt to do so ?
4. What do phytophagous insects feed on ?

MULTIPLE CHOICE QUESTIONS

5. Which part of human body is a unique habitat for hundred of species of microbes?

a) Urinary bladder

b) Mouth

c) Intestine

d) Stomach

6. select the statement which explains best commensalism

a) One organism is benefited

b) Both organisms are benefited

c) One organism is benefited, other is not affected

d) One organism is benefited, other is affected

7. Which of the following statement is not true for logistic growth.

a) Resources are limited.

b) It is represented by sigmoid curve

c) Population density never reaches the carrying capacity.

d) The final phase is asymptote.

8. Select the incorrect match

a) Predation-biological control

b) Competition-cuckoo bird

c) Commensalism- epiphyte

d) Mutualism-mycorrhizae

9. When a population grows in a habitat with limited resources then following phases of achievement are observed -

a) Lag – Acceleration – Deceleration – Asymptote

b) Log – Deceleration – Acceleration – Asymptote

c) Log – Acceleration – Deceleration – Asymptote

d) Log – Acceleration – Asymptote – Deceleration

Assertion And Reason Questions

Read the assertion and reason carefully and work the correct option out of the options given below :

a) If both assertion and the reason are true and the reason is a correct explanation of the assertion.

b) If both the assertion and reason are true but reason is not a correct explanation of the assertion.

c) If the assertion is true but the reason is false.

10. Assertion :– Female mosquito is not considered as parasite although it needs our blood for reproduction.
Reason : Parasitism is aimed to obtain either food or shelter.

11. Assertion : The monarch butterfly is highly distasteful to its predator
Reason : This is evolved to lessen the impact of its prey

SA-I

12. Differentiate between commensalism and amensalism **(2 Marks)**

13. Write any two adaptations evolved by parasites.

14. Why abingdon tortoise became extinct in Galapagos Islands after introduction of Goats.

15. Why do clown fish and sea anemone pair up? What is this relationship called?

SA-II **(3 Marks)**

16. How will you measure population density in following cases ?
(i) fish in a lake
(ii) tiger census in a national park
(iii) single huge banyan tree with large canopy.

LA **(5 Marks)**

17. Orchid flower, Ophrys co-evolves to maintain resemblance of its petal to female bee. Explain how and why does it do so ?

Answers

VSA **(I Mark)**

1. Snail and fish.
2. 6/60 = 0.1 individuals per fruitfly per week.
3. (i) Migration
(ii) Suspension of active life by hibernation/aestivation/spore formation.

4. Plant sap and other parts of the plant.

Answer

5. c) 6. e) 7. c) 8. b) 9. a) 10. a) 11. c0

SA-I **(2 Marks)**

12. **Commensalism:** interaction in which one species benefits qnd the other is neither harmed nor benefited. E.g cattle egret and grazing cattle.

Amensalism: Interaction in which one species is harmed and the other is neither harmed nor benefited. E.g Penicillum toxins kills many bacteria is neither benefited nor harmed.

13. Loss of unnecessary sense organs, presence of adhesive organs, suckers to cling host, loss of digestive system, high reproductive capacity (any2)

14. Due to greater browsing efficiency of goats.

15. Interaction-commensalism.

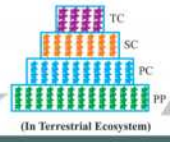
SA-II **(3 Marks)**

16. (a) fish caught per trap.
(b) number per unit area
(c) percentage cover in biomass.

LA

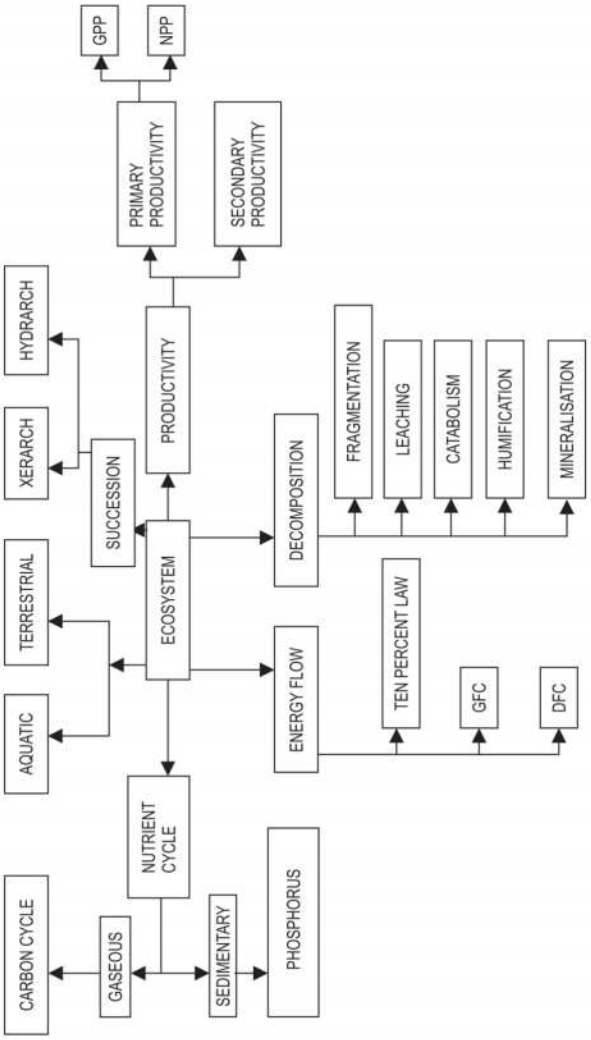
17.
- employs 'sexual deceit'
- one petal bears uncanny resemblance to female of the bee.
- Male bee is attracted to what it perceives as a female 'pseudo-copulates,' during which pollen dusted on male bee's body.
- Male bee transfers pollen to another flower when the same been pseducopulates with another flower.
- *Ophrys* does so because pollination success will be reduced unless it co-evolves with female bee.

❑❑



Chapter - 12

Ecosystem



Ecosystem : It is the basic functional unit of biosphere in which living organisms interact among themselves and with their surrounding physical environment.

Stratification : Vertical distribution of different species occupying different levels in an ecosystem. Trees occupy top vertical strata, shrubs the second layer and herbs the third layer and herbs/grasses occupy the bottom layers.

Primary Production : Amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis.

Gross Primary Productivity : Rate of production of organic matter during photosynthesis.

Net Primary Productivity : NPP = GPP-R (Gross primary productivity minus the respiration losses).

Secondary Productivity : Rate of formation of new organic matter by consumers.

Detritus : Dead leaves, twigs, animal remains etc. constitute detritus.

Detrivore : Organisms who break down detritus into smaller particles, e.g., earthworm.

Process of Decomposition : The decomposers break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients.

This process is called decomposition. Steps of decomposition are :

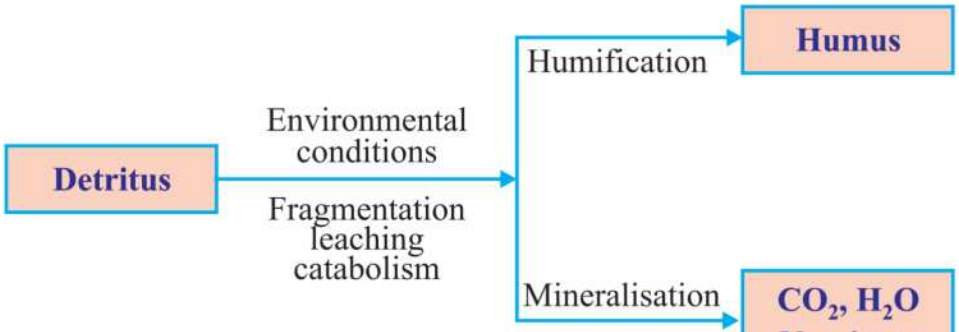
(i) **Fragmentation :** Break down of detritus into smaller particles by detritivores (earthworm).

(ii) **Leaching :** Water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.

(iii) **Catabolism :** Bacterial and fungal enzymes degrade detritus in simple inorganic substances.

(iv) **Humification :** Accumulation of a dark coloured amorphous substance called humus which is highly resistant to microbial action and rich in nutrients.

(v) **Mineralisation :** The humus is further degraded by some microbes and release of inorganic nutrients occur.



Process involved in decomposition of detritus

Factors affecting decomposition :

Decomposition is controlled by :

(a) **Chemical composition of detritus :** The decomposition will be slower if detritus is rich in lignin and chitin and will be faster if detritus is rich in nitrogen and water soluble substance (sugar).

(b) **Climatic factors :** In warm and moist environment, the process of decomposition increases whereas low temperature and anaerobiosis inhibit the decomposition.

Energy Flow : Energy flow is the key function in the ecosystem. The plants (producers) capture only 2-10 percent of the photosynthetically active radiation (PAR). Unidirectional flow of energy is takes place from the sun to producers and then to consumers. About 10% energy flows from one trophic level to another.

Grazing Food Chain (GFC) : It begins with producers.

Grass ⟶	deer ⟶	Lion
(Producer)	(Primary Consumer)	(Secondary consumer)

Detritus Food Chain : (DFC) It begins with dead organic matter. It includes decomposers (Fungi, Bacteria). They meet their energy and nutrient requirements by degrading detritus. Decomposers are also known as saprotrophs.

Food Web : A number of food chains interconnected with each other forming a web-like pattern.

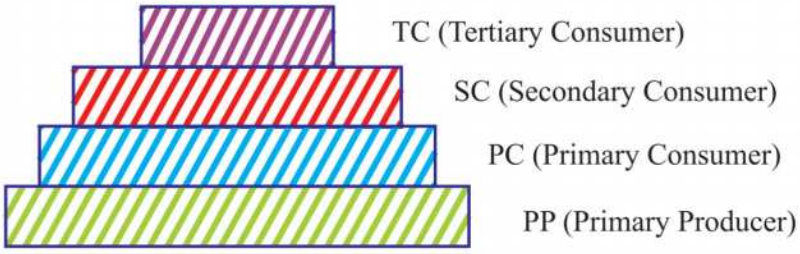
Ten Percent Law of Energy Transfer : Proposed by Lindeman. At each step of food chain, when energy is transferred from one trophic level to the next trophic level, only 10 percent of energy is passed on to the next trophic level.

Standing State : Amount of all the inorganic substances present in an ecosystem per unit area at a given time.

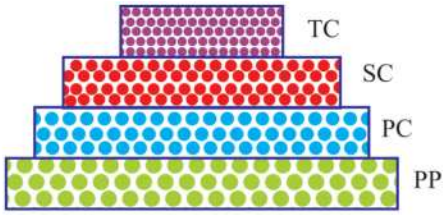
Standing Crop : Amount of living material present in different trophic levels at a given time. It is measured as the mass of living organisms or the number in a unit area.

Ecological Pyramids : The sequential graphic representation of an ecological parameter (energy/number/biomass) depicting different trophic levels in a food chain.

(i) Pyramid of Numbers : (Grassland Ecosystem)

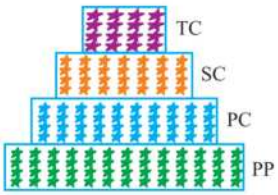


(ii) Pyramid of Energy : (Always upright in all Ecosystems)

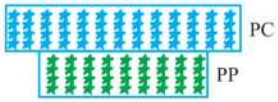


(In Terrestrial Ecosystem)

(iii) Pyramid of Biomass



(In Terrestrial Ecosystem)



(In Aquatic Ecosystem)

Questions

VSA **(1 Mark)**

1. If we count the number of insects on a tree and number of small birds depending on those insects and also the number of larger birds eating the smaller, what kind of pyramid of number would we get ?
2. What is the unit of measurement of productivity.
3. Out of 1,000,000 J of sunlight, how much energy will be converted by primary producers into NPP.

Multiple choice Question:

4. Which of the following occupy top vertical strata of forest ecosystem?

a) Shrubs b) Herbs and grasses c) Phytoplankton d) Trees.

5. Decomposition is favoured by

a) Warm and moist environment b) Aerobic Environment

c) Rich enwound of nitrogen and water soluble substance like sugar in detritus.

d) All of the above

6. If 20 J energy is available at producer level, then how much energy will be transferred to the lion in the food chain :

Producer – Dear – Lion.

a). 0.2 J b) 0.02 J c) 0.002J d) 2J.

7. Pyramid of numbers is

a) Always upright

b) Always inverted

c) Either upright or inverted

d) Neither upright nor inverted

Assertion And Reason Question

Read the assertion and reason carefully and mark the correct option out of the options give below :

a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion.

b) If both assertion and reason are true but reason is not a correct explanation of the assertion.

c) If the assertion is true but the reason is false.

d) If both the assertion and reason are false.

8. Assertion : Despite occupying about 70% of surface the productivity of oceans is only 55 billion tons.

   Reason : Light and minerals are limiting factor for productivity of ocean.

9. Assertion : Amount of nutrient present in soil at any given time, in an ecosystem is raffered as standing state.

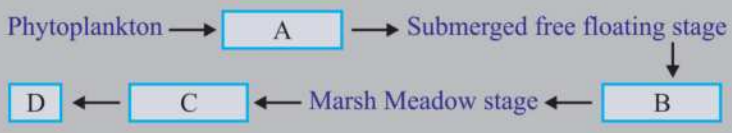
   Reason : Each tropic level has a certain mass of living material at a particular time, known as standing crop.

SA-I **(2 Marks)**

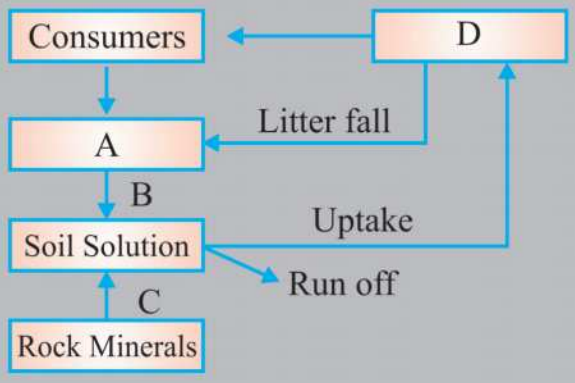
10. What is the shape of pyramid of biomass in sea ? Why so ?

11. Give an example of an ecological pyramid which is always upright. Justify your answer.

12. Fill up the missing links depicted as A, B, C and D in the given model of primary succession.



13. In the model of phosphorus cycle given below, what does A, B, C and D refer to ?



14. What is the effect on decomposition rate if :

(a) Detritus is rich in lignin and chitin

(b) Detritus is rich in nitrogen and sugars

SA-II **(3 Marks)**

15. Name any four ecosystem services. Who gave the price tags on nature's life support services ? Which is the most important ecosystem service provider ?

16. In the pyramid of biomass drawn below, name the two crops (i) one which is supported (ii) one which supports. In which ecosystem is such a pyramid found.

LA **(5 Marks)**

17. Detrivores like earthworm are involved in the process of decomposition of dead plants and animals. Describe the different steps involved in the process of decomposition.

Answers

VSA (1 Mark)

1. Inverted Pyramid of Number.

Answer

2. $g^{-2}yr^{-1}$ or $(Kcal\ m^{-2})\ yr^{-1}$
3. 10,000 J
4. d) 5. d) 6. a) 7. c) 8. a) 9. b)

SA-I (2 Marks)

10. Inverted, because biomass of fishes far exceeds that of phytoplankton.
11. Pyramid of energy is always upright and can never be inverted, because when energy flows from a trophic level to the next trophic level some energy is always lost as heat at each step.
12. A = Submerged plant stage
    B = Reed-Swamp Stage
    C = Scrub stage
    D = Forest stage
13. A = Detritus
    B = Decomposition

11. (a) Decomposition rate is slower.
    (b) Decomposition rate is faster.
14.

SA-II (3 Marks)

(i) Forest (ecosystem) purify water and air
(ii) Mitigate Droughts and floods
15. (iii) Nutrient cycling
(iv) Generate fertile soil
(v) Provide habitat for wildlife

(vi) Pollinate flowers

(vii) Maintain Biodiversity

(viii) Provide aesthetic, cultural and spiritual values

- Robert Constanza and his colleagues gave price tags to ecosystem services.
- Most important ecosystem services provider : Soil formation.

16. (i) Supported trophic level is formed by zooplanktons

(ii) Supporting trophic level is formed by phytoplanktons ecosystem.

It is found in aquatic ecosystem.

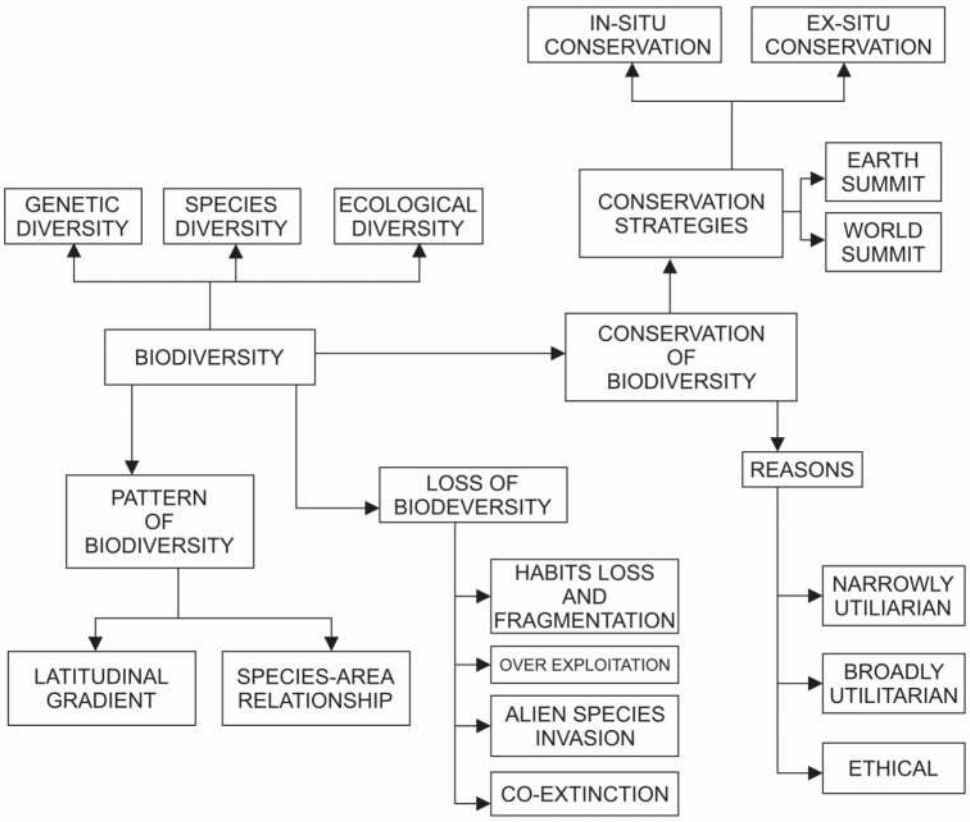
LA **(5 Marks)**

17. The dead remains of plants and animals called detritus undergo decomposition and are converted into simpler substances. The steps of this process are fragmentation, leaching, catabolism, humification, mineralisation.

Steps involved : Refer content in chapter.

Chapter - 13

Biodiveristy and Conservation



Biodiversity : Term coined by socio-biologist Edward Wilson and was also used by Walter G Rosen for the diversity of life forms. Biodiversity refers to the sum total of diversity that exists at genetic, species and ecosystem level of biological organisation.

Three inter-related levels of Biodiversity : Genetic diversity, Species diversity, Ecological diversity.

- **Genetic diversity :** Diversity in the number and types of genes, as well as chromosomes present in different species and the variations in the genes and their alleles in the same species. It helps in speciation.
- **Species diversity :** Varieties in the number and richness of the species of a region.
- **Ecological diversity :** Variety in the types of ecosystems.

IUCN : International Union for Conservation of Nature and Natural Resources. It is situated in Morges, Switzerland.

India has : More than 50,000 genetically different varieties of rice; 1000 varieties of mango;

- India has 1,42,000 known species of plants and animals (Around 45,000 species of plants and rest of animals).
- India has 8.1% share of global biodiversity.
- India is one of 12 Mega diversity countries of the world.

Patterns of Biodiversity : Biodiversity is not uniform but shows uneven distribution.

Altitudinal Patterns of Biodiversity

- In general, species diversity decreases as we move away from the equator towards the poles.
- With very few exceptions, tropics (latitudinal range of 23.5° N to 23.5°S) harbour more species than temperate or polar areas.
- Colombia located near the equator has nearly 1,400 species of birds while New York at 41° N has 105 species and Greenland at 71° N only 56 species.
- India has more than 1,200 species of birds.
- A forest in a tropical region like Equador has up to 10 times as many species of vascular plants as a forest of equal area in a temperate region like the Midwest of the USA.
- The largely tropical Amazonian rain forest in South America has the greatest biodiversity on the earth.

Reasons for greater biological diversity in tropics

(a) Tropical lattitudes have remained relatively undisturbed for millions of years and thus had a long evolutionary time for species diversification.

(b) Topical environments are less seasonal, relatively more constant and predictable which promote niche specialisation and lead to greater species diversity.

(c) There is more solar energy available in the tropics, which contributes to higher productivity and indirectly leads to greater biological diversity.

The importance of species diversity to the ecosystem

(1) Ecosystems with higher biodiversity are more productive than ecosystems with lower biodiversity. David Tilman showed in his experiments that increased diversity contributes to higher productivity.

(2) Biodiversity is essential for the stability of an ecosystem. Communities with more species are more stable than those with less species.

(3) Rich biodiversity is also essential to make an ecosystem more functional and survival of the human race on the earth.

(Rivet popper hypothesis proposed by Paul Ehrlich).

Species-Area relationships

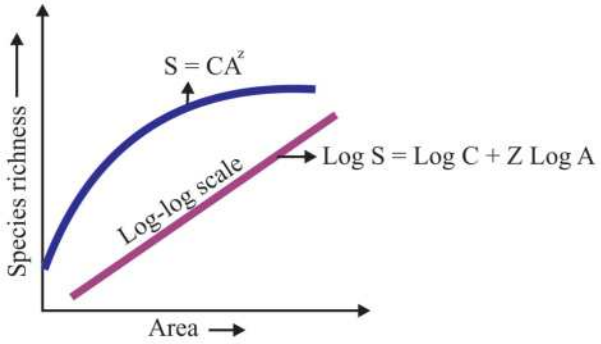
- German naturalist and geographer Alexander von Humboldt observed that within a region, species richness increases with increasing explored area, but only up to a limit.
- The relation between species richness and area for a wide variety of taxa (angiosperm plants, birds, bats, freshwater fishes) turns out to be a rectangular hyperbola.
- On a logarithmic scale, the relationship is a straight line described by the equation

$$\log S = \log C + Z \log A$$

Where S = Species richness, A = Area; Z = slope of the line (regression coefficient) C = Y-intercept.

- Value of Z lies in the range of 0.1 to 0.2, regardless of the taxonomic group or the region.

- The species-area relationships among very large areas like the entire continents has much steeper slope of the line (Z values in the range of 0.6 to 1.2).



Causes of Biodiversity Losses [The Evil Quartet]

(i) **Habitat loss and fragmentation :** This is most important cause of plants and animals extinction. For example: Tropical rain forest is being destroyed faster. The Amazonian rain forest is called the lungs of the planet. It is being cut for cultivating soyabeans.

(ii) **Over exploitation :** Many species extinctions are due to over exploitation by humans e.g. extinction of Steller's sea cow, passenger pigeon in last 500 years.

(iii) **Alien species invasions :** When alien species are introduced in new habitat, some of them turn invasive and cause decline or extinction of indigenous species, e.g. Carrot grass (*Parthenium*), *Lantana* and water hyacinth (*Eichhornia*) posed threat to native species.

(iv) **Co-extinctions :** When a species becomes extinct, the plant and animal species associated with it in an obligatory way also become extinct.

Example 1 : When a host fish species becomes extinct, its assemblage of parasites also becomes extinct.

Example 2 : This is true in case of plant pollinator mutualism where extinction of one species leads to extinction of other species in nature.

Reasons for Conservation of Biodiversity

1. Narrowly utilitarian : Humans derive countless direct economic benefits from nature food (cereals, pulses, fruits), firewood, fibre, construction material, industrial products (tannins, lubricants, dyes, resins, perfumes) and products of medicinal importance.

2. Broadly utilitarian : Biodiversity plays a major role in many ecosystem services that nature provides like oxygen, pollination, flood and soil erosion control.

3. Ethical : Every species has an intrinsic value, even if it may not be of any current economic value to us. We have a moral duty to care for their well-being and pass on our biological legacy in good order to future generations.

Types of Conservation Strategies

In-situ conservation : Conservation and protection of the whole ecosystem and its biodiversity at all levels in order to protect the threatened species. Endangered species protected in natural conditions.

- **Sacred Groves :** Tracts of forest are set aside and all the trees and wildlife within are venerated and given total protection. *e.g.* some forest in Khasi and Jaintia hills in Meghalaya, Aravalli hills of Rajasthan.
- **Biodiversity Hot Spots :** An areas with high density of biodiversity or megadiversity (high level of species richness and high degree of endemism) *e.g.* Out of 34 hot spots in world, 3 occur in India, i.e., Western Ghats and Sri Lanka, Indo-Burma (North-East India) and Himalaya.
- **Protected Areas :** Ecological or Biogeographical areas where biological diversity with natural and cultural resources are protected. *e.g.* National parks, sanctuaries and Biosphere reserves.

National Parks : Areas reserved for wild life where they are able to obtain all the required natural resources and proper habitats. India has 90 national parks at present. Example Corbett national park, Kaziranga national park.

Sanctuaries : An area where animals are protected from all types of exploitation and habitat disturbance. India has 492 sanctuaries at present.

Biosphere Reserve : Large tracts of protected land with multiple use preserving the genetic diversity of the representative ecosystem by protecting wild life, traditional life styles of the tribals and varied plant and animal genetic resources. India has 14 biosphere reserves.

Ex-situ conservation : Conservation and protection of selected rare plants or animals in places outside their natural habitat.

- **Offsite collections :** Live collections of wild and domesticated species in Botanical gardens, Zoological parks etc.
- **Gene Banks :** Institutes which maintain stock of viable seeds, live growing plants, tissue culture and frozen germplasm with the whole range of genetic variability.

Cryopreservation : Preservation of seeds, embryos etc. at – 196°C in liquid nitrogen.

Red Data Book : Record of threatened species of plants and animals maintained by IUCN. It has 8 categories → Extinct, Extinct in wild, critically endangered, Vulnerable, lowest risk, data deficient, Not evaluated.

Important Wild Life Protection in India :

- **Project tiger :** Started in 1973 to check depletion in population of tiger. Jim Corbett National Park.

Endemic Species : Species which are confined to a particular region and not found anywhere else.

Exotic or Alien Species : New species which enter a geographical regions.

Bioprospective : Exploration of molecular, genetic and species level diversity for products of economic importance.

International efforts for Biodiversity conservation :

- **World Conservation Union (formerly IUCN) :** provides leadership, common approach and expertise in the area of conservation.
- **The Earth Summit** : Historical convention on Biological diversity held in 1992 at Rio de Janeiro, Brazil.
- **The World Summit on Sustainable Development :** Held in 2002 in Johannesburg, South Africa to pledge to reduce biodiversity losses at global and local levels.

The Biological Diversity Act, 2002 :

The Biological Diversity Act, 2002 is the Indian response to the conservation of biological diversity. The main objectives of the Act are :

1. Conservation of biological diversity.

2. Sustainable use of its components

3. Fair and equitable sharing of the benefits arising out of utilisation of genetic resources. In execise of the powers conferred by Sec-62 of the Biological Diversity Act 2002 and in super session of the National Biodiversity authority Rules, 2003, the central government of India made some rules, which come into force on 15th April 2004.

Ramsar sites : Named after city Ramsar in Iran where the Ramsar convention was signed in 1971 to develop awareness about the importance of wetlands.

Wetlands : These are the areas where water is the primary factor, controlling the environment and the plants and animals life found there in. They occur where the water table is at or near the surface of land or where the land is covered by water.

- These sites are mentioned for the conservation and sustainable utilisation of wetlands and recognising their ecological function, economic, cultural, scientific and recreational values.

Ramsar site in India : Chandra Taal (H.P), Chilka lake (Odisha) Deepor beel (Assam), Loktak Lake (Manipur), Sambhar lake in Rajasthan and Wular lake (J and K) etc.

Threats to wetland : Loss of vegetation, Saliniation, excessive inundation, water pollution, invasive species, excessive development and road buildings.

Questions

VSA **(I Mark)**

1. Habitat loss and fragmentation has caused severe damage to a particular type of ecosystem. Name it.
2. What trend is observed in respect of species diversity when we move from equator to poles ?
3. Which region is considered as the one with highest biodiversity on earth? What is the name given to such region forests ?

Biodiversity and Conservation

M.C.Q.

4. The active chemical drug reserpine is obtained from.

a) Atropa

b) Papaver

c) Datura

d) Rouwolfia

5. Which technique can be used for preservation of gametes of threatened species.

a) PCR technique

b) CTAB

c) Cryopreservation

d) In site conservation.

6. Which of these are invasive weeds?

a) Carrot grass (Parthenium)

b) Gandhari (Lantana)

c) Water hyacinth (Eicchornia)

d) All of these.

7. Which group is most vulnerable to extinction?

a) Fishes

b) Reptiles

c) Amphibians

d) Birds

Assertion And Reason Questions:

Read the assertion and reason carefully and mark the correct option out of th options given below:

a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion.

b) If both assertion and reason are true but reason is not a correct explanation of the assertion.

c) If the assertion is true but the reason is false.

d) If both the assertion and reason are false.

8. Assertion : Insects are the most diversified organisms on earth.

   Reason : Insect have compound eyes.

9. Assertion : India is one of the 12 mega biodiversity countries of the world.

   Reason : India has only 2.4% of the world's land area. It shares 8.1% of the global species diversity.

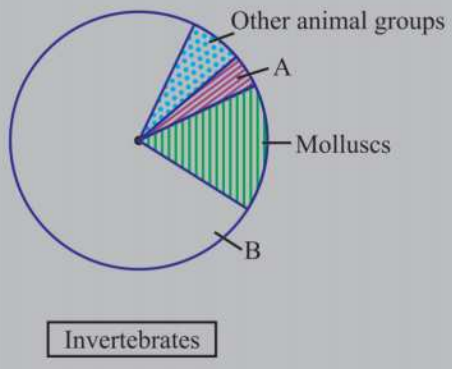
10. Assertion : Removal of key species from an ecosystem leads to destruction of ecosystem.

    Reason : Key species drive major ecosystem functions.

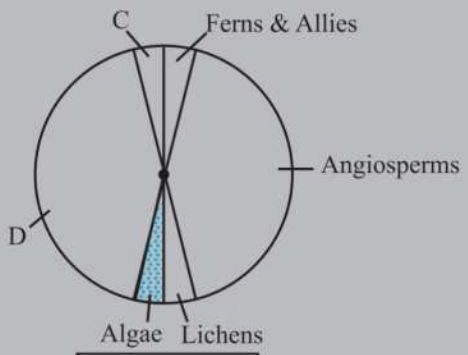
SA-I **(2 Marks)**

11. Study the pie-diagram and answer the questions which follows :

    What do A, B, C and D represent in these diagrams.



Invertebrates

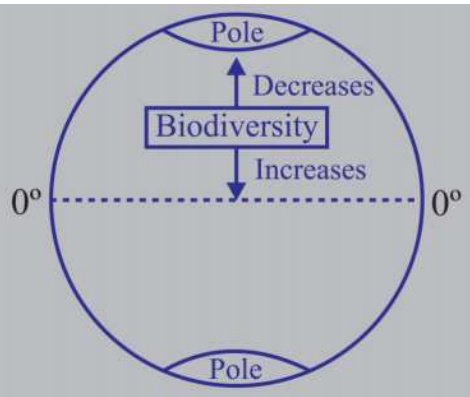


Taxa of Plants

SA-II **(3 Marks)**

12. Hot spots are the regions of exceptionally high biodiversity. But they have become regions of accidental habitat loss too. Name the three hotspots of our country. Why are they called 'biodiversity hotspots' ?

13. Study the diagram of the earth given below. Give the name of the pattern of biodiversity therein. Suggest any two reasons for this type of occurrence.



14. What is so special about tropics that might account for their greater biological diversity ?

LA **(5 Marks)**

15. Describe at least two approaches each for ex-situ conservation and in situ conservation as a strategy for biodiversity conservation.

Answers

VSA **(1 Marks)**

1. Tropical Rain Forest.
2. In general, species diversity decreases as we move away from the equator towards poles.
3. Amazonian rain forests. They are also called the 'Lungs of the planet'.

Answer :

4. d) 5. c) 6. d) 7. c) 8. b) 9. a) 10. a)

SA-I **(2 Marks)**

11. A → Crustaceans
    B → Insects
    C → Mosses
    D → Fungi

SA-II **(3 Marks)**

12. Western Ghats and Sri lanka; Indo-Burma; Himalaya called 'biodiversity hot spots' as they show
    (i) High level of species richness
    (ii) High degree of endemism
    (iii) Under constant threat of extinction.

13. Latitudinal gradients
    (i) More solar energy available in tropics, more productivity.
    (ii) Tropical environments are less seasonal, so more predictable.

14. (a) Speciation is a function of time, unlike temperate regions subejcted to frequent glaciations in the past, tropical latitude have remained relatively undisturbed for milion of years and thus had long evolutionary time for species diversification.
    (b) Tropical environment are less seasonal, more constant and prodicatable.
    (c) More solar energy available in the tropics contributing to high productivity leading to greater diversity.

LA **(5 Marks)**

15. In situ conservation :
    (i) Identification and maximum protection of 'hotspots'
    (ii) Legal protection to ecologically rich areas.
    (iii) Biosphere reserves, national parks and sanctuaries
    (iv) Sacred groves.

    Ex situ Conservation :
    (i) Creation of zoological parks, botanical garden, wild life sanctuaries.
    (ii) Cryopreservation
    (iii) Seed bank.

PRACTICE QUESTION PAPER (SOLVED)
CLASS XII 2023-24

TIME: 3 HOURS **Maximum Marks: 70**

General Instructions

1. All questions are compulsory.
2. The question paper has five sections and 33 questions. All questions are compulsory.
3. Section-A has 16 questions of 1 mark each; Section-B has 5 questions of 2 marks each; Section-C has questions of 3 marks each; Section-D has 2 case-based questions of 4 marks each; and Section-E has 3 questions of 5 marks each.
4. There is no overall choice. However, internal choices have been provided in some questions.
5. A student has to attempt only one of the alternatives in such questions.
6. Wherever necessary, neat and properly labelled diagrams should be drawn.

SECTION – A

1. Gynoecium of Michelia is

   (a) Monocarpellary (b) Multicarpellary syncarpous

   (c) Multicarpellary apocarpous (d) Absent.

2. What would be the number of chromosomes in the cells of the Aleurone layer in a plant species with 8 chromosomes in its synergids?

   (a) 16 (b) 24

   (c) 32 (d) 4

3. 10 E.coli cells with 15 N-ds DNA are incubated in medium containing ^{14}N (normal NHCI). After 80 minutes, how many E.coli will have DNA totally free from ^{15}N?

   (a) 80 cells (b) 60 cells

   (c) 140 cells (d) 160 cells

4. Select the type of inheritance mismatched with example from the list given below:

(a) Incomplete dominance: Antirrhinum

(b) Codominance: 'AB' blood group.

(c) Polygenic inheritance: Mirabilis jalapa

(d) Pleiotropy: phenylketonuria disease

5. Which of the following refer to correct example(s) of organisms which have evolved due to changes in environment brought about by anthropogenic action.

(A) Drawin's finches of Galapagos Islands

(B) Herbicides resistant weeds

(C) Antibiotic resistance in eukaryotes

(D) Man created breeds of domesticated animals like dog.

(a) (A) & (B) (b) (B), (C) & (D)

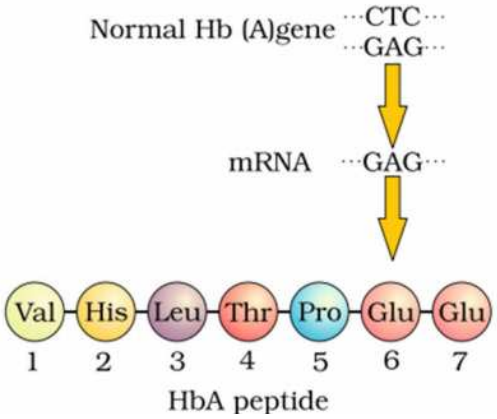
(c) Only (D) (d) Only (A)

6. Flippers of Penguins and Dolphins are examples of:

(a) Convergent (b) Industrial evolution

(c) Natural selection (d) Adaptive radiation

7. In the figure given below what does (a) and (b) represents :



(a) GAG, Glutamic acid (b) GUG, Valine

(c) GAG, Valine (d) GUG, Glutamic acid

8. In E.coli, the lac Operon gets switched on when :

(a) Repressor binds to operator

(b) Lactose is present and binds to repressor

(c) Lactose is present in binds to RNA polymerase

(d) RNA polymers binds to operator.

9. Monascus purpureus is a yeast used commercially in the production of

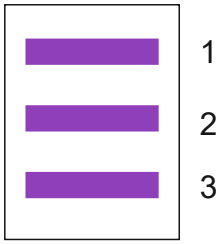
(a) Ethanol

(b) Streptokinase for removing clots from the blood vessels.

(c) Blood cholesterol lowering statins.

(d) Lipase to formulate detergents.

10. DNA fragments separated by gel electrophoresis are shown in the figure. Mark the correct statement.



(a) Band 3 contains more positively charged DNA molecule than band 1

(b) Band 3 indicates more charge density than bands 1 and 2

(c) Band 1 has longer DNA fragment than bands 2 and 3.

(d) All bands have equal length and charges but differ in base c omposition.

11. Cry gene(s) that controls the Corn borer.

(a) Cry 1 Ac & Cry II Ab (b) Cry I Ab & Cry II Ac.

(c) Cry I Ab. (d) Cry II Ab

12. Read the following statements and select the correct statement(s)

(A) India has only 2.4% of the world's land area.

(B) India's share of global species diversity is less than 5%.

(C) India is one of the 12 mega diversity countries of the world.

(D) Nearly twice the plant species as many as animals species have been recorded in India.

(a) A, B, C (b) A, B, C, D

(c) Only D (d) A, C

Question No. 13 to 16 consist of two statements - Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true and R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

13. Assertion: The regions inside the seminiferous tubules contains leydig cells

Reason: Leydig cells synthesise and secrete androgens.

14. Assertion: tRNA is an adaptor molecule that on one hand read the code and on other hand would bind to specific amino acid.

Reason: RNA Polymerase III is responsible for transcription of tRNA.

15. Assertion: Unlike mammals, desert lizards lack the physiological ability required to deal with the high temperature.

Reason: Desert lizards change their body temperature in accordance to ambient conditions by behavioural means.

16. Assertion: Insertion of recombinant DNA within the coding sequence of β-galactosidase results in colourless colonies.

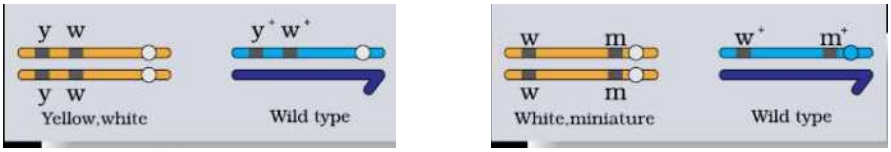
Reason: Presence of insert results in inactivation of enzyme β-galactosidase known as insertional inactivation.

SECTION - B

17. Differentiate between spermatogenesis and oogenesis.

18. Study the figure given below and answer the following questions:

Cross A **Cross B**



(a) Identity in which of the above given crosses is the strength of linkage between the genes is higher and why?

(b) Out of cross 'A' and cross 'B', when would the proportion of non-parental gene combinations be higher?

19. Lymphoid organs are the main component of human immune system.

(a) Name the primary lymphoid organs present in human body.

(b) Expand MALT.

20. DNA is a hydrophilic molecule and can't pass through a cell membrane. So, the bacterial cell is made competent to take up the plasmid.

(a) What is the role of $CaCl_2$ in making the cell competent?

(b) How one can introduce alien DNA into host plant cell directly?

21. What will be the amount of energy available to the organisms of tertiary consumer level of a food chain, if the energy available at the producer level is 20,000 joules?

OR

"Decomposition is an Oxygen requiring process". Comment.

SECTION-C

22. (a) Write two ways of development of apomictic seeds.

(b) Write one advantage of apomictic seeds.

23. (a) Mention the relationships between pituitary and ovarian hormones during a menstrual cycle.

(b) How many primary follicles are left in each ovary in a human female at puberty.

24. (a) "A mother of 1 year old daughter wanted to space her second child. Which contraceptive method may be suggested by the doctor to her?

(b) How the action of LNG 20 is different from Cu-T?

(c) Name one non-medicated IUD.

25. (a) Name the primates that lived about 15 million years ago.

(b) Write the order in which Neanderthals, Homo habilis and Homo appeared on the earth, State the brain capacity of each of them erectus?

(c) How Homo habilis were different from Homo erectus? 26. Describe how do 'flocs' and 'activated sludge help in sewage treatment.

26. Describe how do 'flocs' and 'activated sludge' help in sewage treatment.

27. A vector is engineered with three features, which facilitate its cloning within the host cell. List down and mention the three features and explain each of them.

OR

Explain with example how have transgenic animals proved to be beneficial in:

(i) Production of biological products. (ii) Chemical safety testing.

28. (a) Why are mango trees unable to grow in temperate climate?

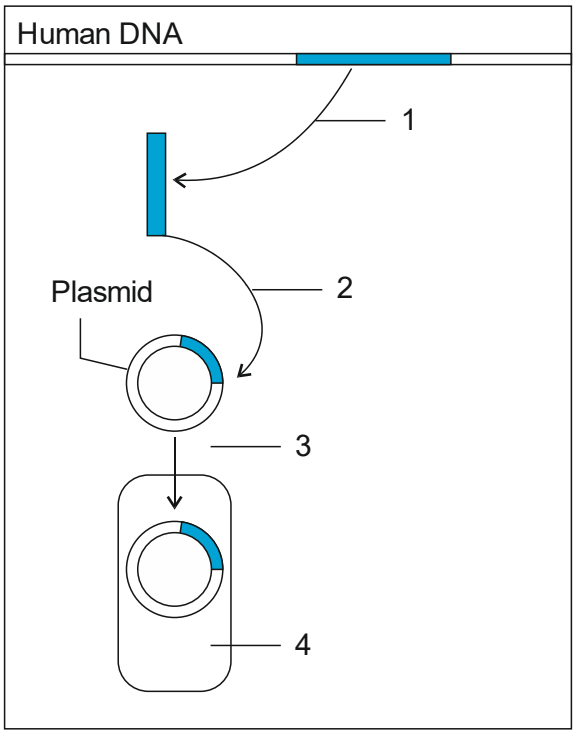
(b) Give an example of crop shows genetic diversity.

(c) Write the use of sacred groves.

SECTION-D

Q. No. 29 and 30 are case-based questions. Each question has 3 subparts with internal choice in one subpart.

29.



(a) Name the technique in biotechnology whose steps are shown in the above figure.

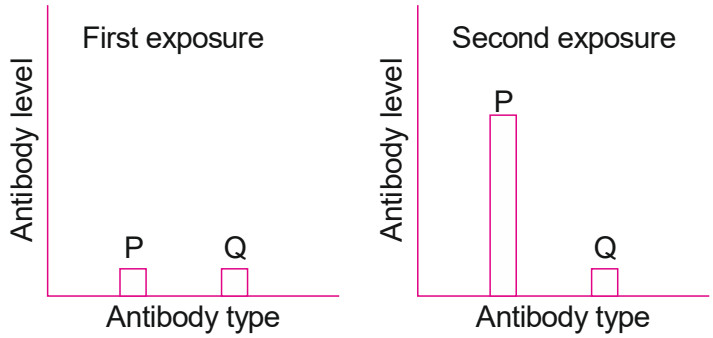
(b) Name the steps 1 to 4 marked in the figure.

(c) Give an example where a human gene product is obtained from transgenic bacteria

OR

Draw the structure of immature insulin.

30. In a study to test a new vaccine against the viral disease, mouse model testing is done. In this process, mice were vaccinated and their blood samples were tested. After a few days those mice were again infected with the virus. This time they do not show any disease symptoms. Their blood samples were tested. Two graphs show antibody concentration for the first and second infection in mice blood.



(a) Why the antibody concentration is high during second infection in mice?

(b) Which of the following cells is involved in humeral immunity?

(i) T-cells (ii) B-cells

(iii) Mast cells (iv) Both T & B cells.

(c) Which type of immunity is gained by the mice after second exposure with virus?

OR

Draw the labelled diagram of antibody.

SECTION-E

31. (a) Where does microsporogenesis occur in an angiosperm? Describe the process of microsporogenesis.

(b) Draw a labelled diagram of the two-celled male gametophyte of an angiosperm. How is the three celled male gametophyte different from it?

OR

(a) Explain the events taking place at the time of fertilization of an ovum in human female.

(b) Name and draw a labelled sectional view of the embryonic stage that gets implanted.

32. (a) State the reasons for which Hershey and Chase used different radioactive isotopes and explain how they used them.

(b) What is the use of blending and centrifugation of culture? c) Write the observation and conclusion they arrived at.

OR

Given below is a stretch of DNA showing the coding strand of a structural gene of a transcription unit.

5- ATG ACC GTA TTT TCT GTA GTG CCC GTA CTT CAG GCA TAA - 3

(a) Write the corresponding template strand and the mRNA strand that will be transcribed, along with its polarity.

(b) If GUA of the transcribed mRNA is an intron, depict the sequence involved in the formation of hnRNA/the mature processed mRNA strand.

(i) In a bacterium (ii) In humans

(c) Upon translation, how many amino acids will the resulting polypeptide have in case of humans?

33. (a) Tropical regions in the world account of greater biological diversity. Justify with two reasons.

(b) Why habitat loss and alien species invasion considered as the cause of biodiversity loss? Explain each with an example.

OR

(a) Name the cells that act as HIV factory in humans when infected by HIV.

(b) Explain the events that occur in thses infected cells.

(c) How HIV causes the immune deficiency?

SAMPLE QUESTION PAPER

SOLUTION

SECTION - A

1. (c) multicarpellary apocarpus.
2. (b) 24
3. (c) 140 cells
4. (c) Polygenic inheritance: Mirabilis jalapa
5. (b) (B), (C) & (D)
6. (a) Convergent evolution
7. (b) GUG, Valine
8. (b) lactose is present in binds to repressor
9. (c) blood cholesterol lowering statins
10. (c) band I has longer DNA fragment than bands 2 and 3
11. (c) Cry I Ab
12. (d) A,C
13. (d) A is false but R is true.
14. (b) Both A and R are true and R is not the correct explanation of A.
15. (a) Both A and R are true and R is the correct explanation of A.
16. (a) Both A and R are true and R is the correct explanation of A.

Spermatogenesis	Oogenesis
The production of sperms from spermatogonia is known as spermatogenesis	The production of eggs from oogonia is known as oogenesis
Equal cytokinesis occurs during the spermatogenesis producing four sperms	Unequal cytokinesis occurs during oogenesis ultimately producing one large ovum and tiny polar bodies
Begins at puberty	Begins at foetal stage

18. (a) In cross 'A' as genes are closely placed. Less the distance between the genes greater is the strength of linkage.

(b) Non parental combinations be higher in case of cross 'B' as the distance between genes is more and chance of crossing over will be more which leads to new combinations.

19. (a) Bone marrow & Thymus

(b) Mucosal associated lymphoid tissue.

20. (a) increases the efficiency with which DNA enters the bacterium through pores in its cell wall.

(b) By gene gun (biolistics): cells are bombarded with high velocity micro-particles of gold or tungsten coated with DNA.

21. According to 10% law of energy entering a particular trophic level of organism is available for transfer to the next trophic level.

Producer level = 20,000 Joules

Primary Consumer level 10% of 20,000 = 2,000 Joules

Secondary Consumer level = 10% of 2,000 = 200 Joules

Tertiary consumer level = 10% of 200 = 20 Joules.

OR

Detritus is composed of nitrogen and water-soluble substances like sugars. In the presence of oxygen, complex carbon compounds are oxidized to produce carbon dioxide.

SECTION-C

22. (a) • Apomictic seeds developed by diploid egg cell if it is formed without reduction division.

• In some species like of citrus and mango, nucellar cells develop into embryos

(b) If hybrids are made into apomictic seeds, there is no segregation of characters in the hybrid and farmers can keep on using these seeds.

23. (a) FSH stimulate follicular development and secretion of estrogen.

LH induces ovulation and development of corpus luteum which secrets progesterone.

(b) 60000-80000 primary follicles

24. (a) IUDs (Intra Uterine Devices)

(b) LNG-20, a hormone releasing IUD make the uterus unsuitable for implantation and cervix hostile to sperms. While Cu ions of Cu-T suppress the motility of sperms.

(c) Lippes loop 25

25. (a) Dryopithecus & Ramapithecus

(b) Homo habilis (brain capacity-650-800cc) - Homo erectus (brain capacity - 900cc) - Neanderthal man (brain capacity - 1400cc).

(c) Homo habilis probably did not eat meat while Homo erectus probably ate meat.

26. 'Flocs' are masses of aerobic bacteria as associated with fungal filaments to form mesh like structures. These aerobic microbes consume the major part of the organic matter in the effluent. This significantly reduces biological oxygen demand (BOD) of the effluent. A small part of the activated sludge is used as inoculum and pumped back to aeration tank. The remaining major part of the sludge is pumped into anaerobic digester where microbes or bacteria grow anaerobically to produce CH_4, H_2S and CO_2 or biogas.

27. Features that facilitate cloning of vectors

• Origin of Replication (Ori): sequence of DNA from where replication starts. Piece of foreign DNA linked to it is made to replicate within the host cell. It also decides copy number of linked DNA.

• Selectable Marker: Antibiotic resistant genes that helps in selecting the host cells, which are transformants / recombinants from the non- recombinant ones.

• Cloning Site : unique recognition site in a vector to link the foreign DNA. It helps the particular restriction enzyme to cut the vector DNA.

• Small size of the vector : it facilitates the introduction of the DNA into the host easily.

OR

(i) Transgenic animals produced by the introduction of the portion of DNA which codes for a particular product such as human protein (α-1- antitrypsin) used to treat emphysema, phenyl ketonuria and cystic fibrosis.

(ii) Animals are made to carry genes which make them more sensitive to toxic substances or chemicals than non-transgenic animals and when they are exposed to the toxic substances, the effects can be studied. Toxicity testing takes less time in such animals.

28. (a) Temperature affects the kinetics of enzymes and through it the metabolic activity and other physiological functions of the organisms.

(b) Rice/ Mango/ Rauwolfia vomitoria.

(c) Sacred groves are tracts of forests which are regenerated around places of worship. This is in situ conservation of forests.

SECTION - D

29. (a) Recombinant DNA technology/ genetic engineering

(b) 1 - cutting & isolation of human gene

2 - incorporation of human gene into plasmid to produce recombinant DNA.

3 - transformation of plasmid into bacteria

4 - transformant bacteria with rDNA

(c) Insulin obtained from transgenic bacteria

OR

Diagram on pg no. 211 of NCERT

30. (a) Second encounter shows the secondary response. Memory of the first encounter leads to the production of higher amount of antibodies.

(b) (b) B-cells

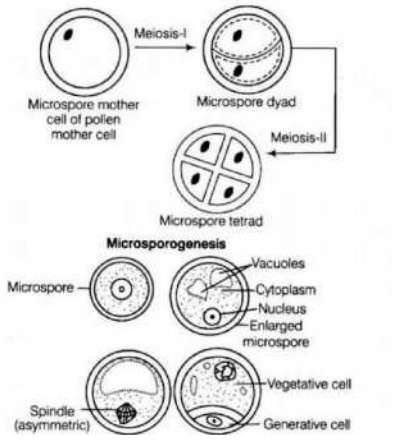
(c) Acquired Active immunity

OR

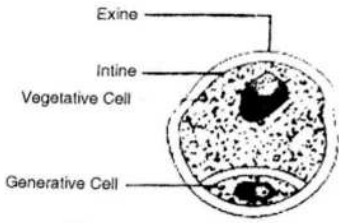
Diagram on pg no. 151 of NCERT

SECTION - E

31. (a) In pollen sacs or microsporangia of each another lobe.



(b)

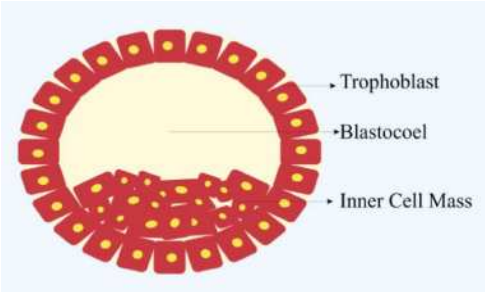


In Over 60% of angiosperms, pollen grains are shed at two-celled stage (one generative and other vegetative). In others, the generative cell divides mitotically to give rise to 2 male gametes before pollen grains are shed, called 3-celled stage.

OR

(a) Sperms comes in contact with zona pellucida layer of ovum, induces the changes in the membrane of ovum and block the entry of other sperms (prevent polyspermy), lytic enzymes/secretions of acrosome helps the entry of sperm head, completion of meiotic division of secondary oocyte, formation of second polar body and ovum/ootid, fusion of nuclei of sperm and ovum forming zygote.

(b) Blastocyst



32. (a) Some bacteriophages grown on medium having radioactive (^{35}S) to obtain radioactive protein coat and some bacteriophages grown on medium having radioactive (^{32}P) to obtain radioactive DNA.

(b) Blending or agitating to remove viral coats from bacteria. Centrifugation to separate""virus particles from bacteria by spinning them.

(c) Bacteria which was infected with viruses that had radioactive DNA were radioactive, indicating that DNA was the material that passed from virus to bacteria/ bacteria that were infected with viruses that had radioactive proteins were not radioactive; indicating that protein did not enter the bacteria from viruses. Thus DNA is genetic material.

OR

(a) Template strand

3-TAC TGG CAT AAA AGA CAT CAC GGG CAT GAA GTC CGT ATT— 5'mRNA Strand

5'-- AUG ACC GUA UUU UCU GUA GUG CCC GUA CUU CAG GCA UAA - 3'

(b) GUA is intron““mRNA in bacterium““5-AUG ACC GUA UUU UCU GUA GUG CCC GUA CUU CAG GCA UAA-3'

Processed mRNA in humans after removal of introns :

5'-AUG ACC GUA UUU UCU GUA GUG CCC GUA CUU CAG GCA UAA -3'

5'-AUG ACC UUU UCU GUG CCC CUU CAG GCA UAA -3'

(c) 9 amino acids forms polypeptide as UAA is stop codon.

33. (a) • Tropical regions relatively undisturbed for millions of years and had long evolutionary time for species diversification.

• Environment less seasonal/more constant and predictable and promotes niche specialisation.

• More solar energy available in tropics leads to higher productivity.

(b) Habitat loss : Amazon forests is being cut for cultivation of soyabeans/ degradation by pollution/clearing of forest for commercial or tourism purpose.

Alien species invasion : Nile perch introduced in Lake Victoria leads to extinction of cichlid fish/Introduction of African catfish Clarias gariepinus threat to indigenous catfish/carrot grass and water hyacinth causes threat to indigenous species.

OR

(a) Macrophages

(b) Diagram on pg no. 155 of NCERT

(c) Progeny HIV enters into helper T-lymphocytes, replicates, released in blood attack other helper T-lymphocytes, leads to immune deficiency.

PRACTICE QUESTION PAPER (UNSOLVED)
BIOLOGY THEORY (SUBJECT CODE 0-44)

TIME: 3 HOURS **Maximum Marks: 70**

General Instructions

(i) This Question paper contains 33 questions. All questions are compulsory.

(ii) Question paper is divided into Five sections: Section A, B, C, D and E.

(iii) In Section A - Question Number 1 to 16 b multiple choice (MCQ) type questions carrying 1 mark each.

(iv) In Section B - Question number 17 to 21 are short answer (VSA) type questions carrying 2 marks each.

(v) In Section C - Question number 22 to 28 are short answer (SA) type questions carrying 3 marks each.

(vi) In Section D - question number 29 and 30 are case based questions carrying 4 marks each. Each question has subparts with internal choice in one subpart.

(vii) In Section E - question number 31 to 33 are long answer type carrying 5 marks each.

(viii) Wherever necessary, neat and properly labelled diagrams showed be drawn.

(ix) There is no overall choice. However internal choice has been provided.

SECTION – A

1. Interferons are most effective in making non-infected cells resistant against the spread of which of the following diseases in humans?

   (a) Asariasis (b) ringworm

   (c) Amoebasis (d) AIDS

2. Sea Anemone gets attached to the surface of the hermit crab. The kind of population interaction exhibited in this case is.

   (a) amensalism (b) Commensalism

   (c) Mutualism (d) Parasitism

3. Which of the following in an ex-situ conservation?

(a) Sacred groups (b) National Park

(c) Biosphere Reserve (d) Seed Bank

4. Log S = Log C + Z Log A. In the given equation of specials - area relationship, the value of regression coefficient for a whole continent would be

(a) 0.1 – 0.2 (b) 0.5 – 0.7

(c) 0.6 – 1.2 (d) 0.3 – 0.5

5. Identify the correct path of Milk secreted by the mammary glands.

(a) Alveoli → mammary ducts → Ampullas → mammary tubules → Lactiferous ducts.

(b) Alveoli → Ampulla → mammary ducts → mammary tubules → Lactiferous ducts.

(c) Alveoli → mammary tubules → mammary ducks → Ampulla → Lactiferous ducts.

(d) Lactiferous duct → Alveoli → mammary tubules → Ampulla → mammary duct.

6. Which of the following statements about RNA interferrence (RNAi) is not correct?

(a) Silencing of a specific mRNA by complementary is RNA

(b) Formation of both sense and Antisense RNA in me host all.

(c) Silencing of a specific mRNA by complementary ssRNA

(d) Formation of dsRNA for the two complementary RNAs.

7. Which of the following is a wrongly matched pair?

(a) Ampullary isthmic junction → site of fertilisation

(b) Perimetrium - Site of implantation of blastocyst

(c) Myometrium - involved in the contraction movement of uterine wall

(d) Endometrium - undergoes cyclic changes during Menstrual cycle.

8. Which one of the following is not a major characteristic feature of Biodiversity hotspots?

(a) Large number of species (b) abundance of endemic species

(c) Large number of exotic species (d) Destruction of habitat

9. Which of the following statements is incorrect?

(a) Genetically engineered insulin is produced in E coli

(b) In man, insulin is synthesised of proinsulin

(c) The proinsulin has three peptide chains A, B and C

(d) The functional insulin has two peptide chains, A and B hold together by hydrogen bonds.

10. The construction of the first recombinant DNA was achieved by using the native plasmid of:

(a) Escherichia coli (b) Agrobacterium tumefaciens

(c) Salmonella typhi (d) Bacillus thuringiensis

11. Select the correct statement from the following.

(a) Toddy is made by fermenting the sap of plants

(b) Brandy having high alcohol content is produced without distillation

(c) wine and beer are produced after distillation

(d) Citric acid is produced by using the bacterium, clostridium

12. Emasculation and bagging are the two steps in artificial hybridisation programs. Which of the following statements is incorrect regarding this programme?

(a) These two steps ensure that only desired pollen grains are used to produce the hybrids.

(b) Emasculation is to prevent the contamination of the stigma with other pollen grains.

(c) Bagging is carried out to prevent the contamination of the stigma with unwanted pollen grains.

(d) Emasculation prevents contamination of the stigma with self pollen.

Question No. 13 to 16 consist of two statements.

Assertion (A) and Reason (R). Answer these questions selecting the Appropriate option given below:

(a) Both (A) and (R) are true and (R) is the correct explantion of (A).

(b) Both (A) and (R) are true, but (R) is not the correct explantion of (A).

(c) (A) is true, but (R) is false.

(d) (A) is false, but (R) is true.

13. Assertion (A) : There is expression of only one of the parential character in Fi progeny of mendelion monohybrid cross.

Reason (R) : In a dissimilar pair of factors, one member of the pair dominates the other.

14. Assertion (A) : A pomictic embryos are genetically idestical to the parent plant.

Reason (R) : Appomixis is the production of seeds without fertilisation.

15. Assertion (A) : Progesterone reaches its peak level in the Luteal phase.

Reason (R) : Corpus luteum that secrets progresterone is formed from the ruptured graafian follicle of her ovulation.

16. Assertion (A) : In Gala pago islands, the Abingdon tortoise became extinct within a decade after goat were introduced into the Island.

Reason (R) : Competition is the process in which the fitness of the species is significontly reduced in the presence of another species.

SECTION - B

17. (a) Write the two crucial changes, the seeds undergo white reaching maturity that enable them to be in a visible state until the on set of favourable conditions.

(b) Name the oldest viable seed excavated from Arctic Tundra as per records.

18. A true breeding pea plant, homogenous dominant for inflated green pods crossed with another pea plant with constricted yellow pods (ffgg) with the help of punnett square shows the above cross and mention the results obtained phenotypically and genotypically in F1 generation?

19. During a field trip, one of your friend in the group suddenly become unwell, she started sneezing and hold trouble in breathing.

Name and Explain the term associated with such sudden responses. What would the doctor recommed for relief?

20. (a) A plasmid DNA and a linear DNA (both are of same size) here one site for a restriction endonuclease. When cut and separated on agarose gel electrophoresis, plasmid shows on DNA band, while the linear DNA shows two progmenits. Explain.

(b) Name two restriction / cloning sites present in the ampR gene in the E. coli coloning vector, PBR322.

21. Given below is a pyramid of biomass is an

(a) Ecosystem where each bar represents the standing crop available in a trophic level. With the help of an example explan the conditions where this kind of pyramid is possible in nature.

(b) Will the pyramid of Energy be also of the same shape in this situation? Give reason for your respective.

OR

(a) Draw a pyramid of Number where a large number of insects or feeding on the leaves of a tree. What is the shape of this pyramid.

(b) Will the pyramid of Energy be also of the same shape in this situation? Give reason for your response.

SECTION - C

22. Explain the functions of the following structure in the human male reproductive system.

(a) scrotum (b) leydig cells

(c) male accessory glands

23. State the agent (s) which helps in pollinating in the following plants. Explain the adaptations in these plants to ensure pollination?

(a) Corn (b) Water hyacinth

(c) vallisneria

24. (a) Differentiate between humoral and cell mediated immunse response.

(b) Why is a patient, who has undergone organ transplant put on Immunosuppressant ? Explain.

OR

(a) Explain the life cycle of plasmodium starting from its entry in the body of female anopheles till the completion of its life cycle in humans.

(b) Explain the course of periodic recurrence of chill and high fever during malarial attack in humans.

25. (a) How is Hardy weinberg expression $(p^2 + 2pq + q^2) = 1$ is derived?

(b) List any two factors that can disturb the genetic equilibrium.

26. (a) Identify the polarity of x to x^1 in the diagram below.

(b) Mention the codon and Anticodon for methionine

(c) Why are some untranslated sequences of bases sem in mRNA coding for a polypeptidee? Where exactly are they present on mRNA?

27. (a) There was loss of biodiversity in an ecosystemdue to a near construction project in that area. What would be its impact on the ecosystem. State any three.

(b) List any three major causes of loss of Biodiversity?

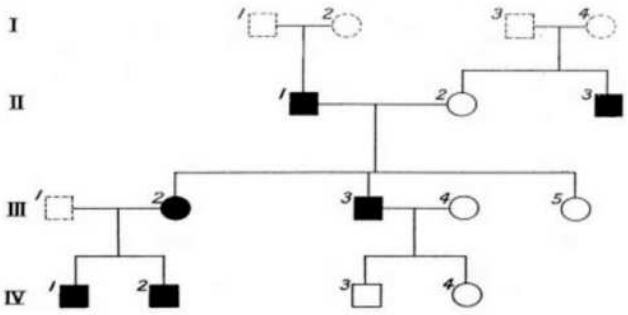
28. (a) Give a schematic representation of the transformation of proinsulin into insulin.

(b) Give an example of a transgenic animal that is being used to test vaccine satety for a specific human disease. Name the disease also.

SECTION - D

Question No. 29 and 30 are case based questions. Each question has subsports with internal choice in one subsport.

29. Study the perdigree chart given below and answer the questions that follow.



Symbols used in the given Pedigree Chart are as follows:

Carrier male, - Affected male, - Normal male

-Carrier female, - Affected Female, - Normal female

(a) On the basis of inheritance pattern in this pedigree chart, what conclusion can you drawn about the pattern of inheritance?

(b) If the Female homozygous for the affected trait then what percentage of her sons will be affected?

(c) Give the genotype of offsprings 1, 2, 3 and 4 is III generation.

OR

(c) In this type of inheritance pattern, out of male and female children which one hot lies probability of receiving the trait from the parents. Give a reason.

30. A youth in his twenties met with an accident and succumbed to the injuries. His parents divided to donate his organs.

(a) List two essential clinical steps to be under taken before any orgam transplant.

(b) How do the cells involved in the above function in our immune system?

(c) Why is the organ transplant rejected sometimes? Name the kind of Immunity and the cells involved.

OR

(c) Name the cells that produce antibodies. What types of acquired Immunity is constiuted by antibodies? Why are they described as H_2L_2?

SECTION - E

31. Trace the events from copulation to zygote formation in a human female?

OR

Trace the development of a megaspore mother cell to the formation of mature Embryo sac in a following plant.

32. Observe the segment of mRNA given below.

(a) Explain and illustrate the steps involved to make fully processed in hnRNA.

(b) Gene encoding RNA polymerase I and III have been affected by mutation in a cell. Explain its impact on the synthesis of polypetide, stating reasons.

OR

Study the schemetic representation of the genes involved in the Lac operon. Given below and Answer the Questions :

(a) The active site of enzyme permease present in the cell membrane of a bacteria has been blocked by an inhibitor, How will, it affect the operon.

(b) The protein produced by the i gene has become abnormal due to unknown reasons. Explain its impact on lactose metabolism stating the reason.

(c) If the nutrient medium for the bacteria contains only galactose, will operon be expressed? Justify your answer.

33. (a) 'In situ' conservation can help endangered/threatened species. Justify the statement.

(b) List any four tech where the principle of Ex. situ conservation of biodiversity has been employed.

OR

Define Decomposition and Describe the process and products of Decomposition.

PRACTICE PAPER (UNSOLVED) – II

TIME: 3 HOURS **Maximum Marks: 70**

General Instructions

1. All questions are compulsory.
2. The question paper has five sections and 33 questions. All questions are compulsory.
3. Section-A has 16 questions of 1 mark each; Section-B has 5 questions of 2 marks each; Section-C has questions of 3 marks each; Section-D has 2 case-based questions of 4 marks each; and Section-E has 3 questions of 5 marks each.
4. There is no overall choice. However, internal choices hav been provided in some questions. A student has to attempt only one of the alternatives in such questions.
6. Wherever necessary, neat and properly labelled diagrams should be drawn.

SECTION – A

1. Match columnx and select the correct option.

Column I	Column II
A. Baculoviruses	1. Nitrogen-fixing cyano bacterium
B. Methanogens	2. Mycorrhiza
C. Glomus	3. Blood clot-remover
D. Anabaena	4. Biogas plant
	5. IPM programmes

(a) A – 5, B – 4, C – 1, D – 1 (b) A – 5, B – 4, C – 2, D – 1

(c) A – 4, B – 5, C – 2, D – 1 (d) A – 3, B – 4, C – 2, D – 1

2. The theory of evolution supported by the experiment conducted by Louis Pasteur, is

(a) Spontaneous generation theory (b) Life comes from pre-existing life

(c) Abiogenesis of life (d) Big Bang theory

3. In angiosperms, after double fertilisation

(a) the zygote and the primary endosperm mucleus cell start dividing simultaneously

(b) both the zygote and the primary endosperm nucleus cell undergo a period of rest before they start dividing simultaneously

(c) the primary endosperm cell starts dividing to form the endosperm before the zygote starts dividing

(b) the egote starts dividing before the primary endosperm cell and forms the embryo.

4. Penetration of the sperm in the ovum is followed by

(a) formation of first polar body (b) completion of meiosis II.

(c) first meiosis (d) dissolution of zona pellucida.

5. A botanist studying Vista (common pansy) noticed that one of the two flower types withered and developed no further due to some unfavorable condition, but the other flower type on the same plant survived and it resulted in an assured seed set. Which of the following will be correct?

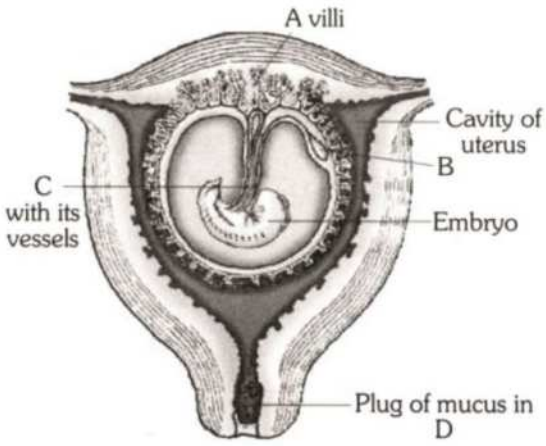
(a) The flower type which survived is Cleistogamous and it always exhibits autogamy

(b) The flower type which survived is Chasmogamous and it always exhibits geitonogamy.

(c) The flower type which survived is Cleistogamous and it exhibits both autogamy and geltonogamy.

(d) The flower type which survived is Chasmogamous and it never exhibits autogamy.

6. Concentration of which of the following substances will decrease in the maternal blood as it flows from embryo to placenta through the umbilical cord?



The human foetus within the uterus

(i) Oxygen (ii) Amino Acids

(iii) Carbon dioxide (iv) Urea

(a) (i) and (ii) (b) (ii) and (iv)

(c) (iii) and (iv) (d) (i) and (iv)

7. Identify the correctly matched pair

(a) Free-living N_2 – fixing bacterium-Frankia

(b) Free-living N_2 – fixing cyanobecterium-Azospirillum

(c) Symbiotic fungus – Glomas

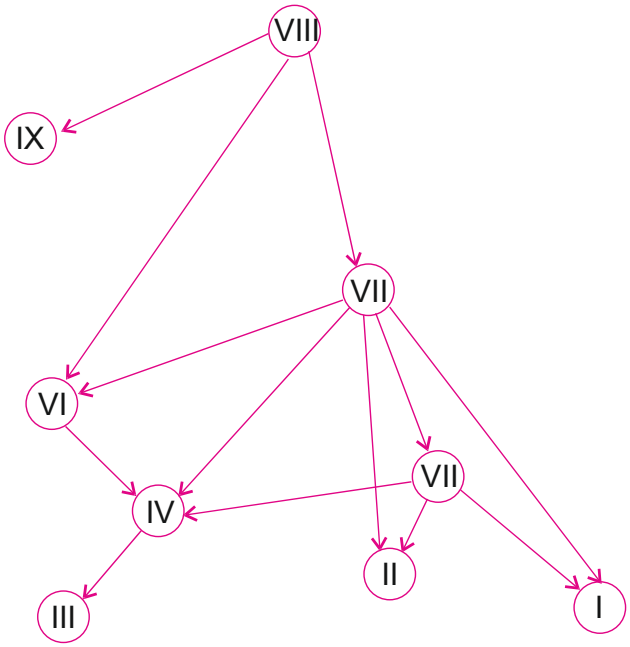
(d) Mycorrhizae – Nostoc

8. In the illustration given below of a simplified food web on an island, the arrows indicate the direction of energy flow and the Roman numbers indicate species within the food web.

At which trophic level or levels does the species VIII function?

(a) 2^{nd} and 3^{rd} consumer Producer (b) 1st consumer

(c) Producer (d) 3^{rd} and 4^{th} consumer



9. Asymptote in a logistic growth curve is obtained when

(a) the value of approaches zero (b) the value of K is equal to N

(c) the value of K is greater than N (d) the value of K is less than N

10. The repetitive/satellite DNA is separated from the bulk genomic DNA for genetic experiments, by

(a) gel electrophoresis (b) elution

(c) density gradient centrifugation (d) chromatography

11. Which of the following statements is incorrect?

(a) Patients who have undergone surgery are given morphine as painkiller.

(b) Malignant tumours exhibit the property of metastasis.

(c) Heroin accelerates the brain functions.

(d) The plant Erythroxylum coca that yields cocaine. is a native of South America.

12. A frog that feeds on the insects, which in turn feed on plants, is a

(a) primary consumer (b) primary carnivore

(c) secondary carnivore (d) tertiary carnivore

Question No. 13 to 16 consist of two statements-Assertion (A) and Reason (R). Answer these questions selecting the““appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true, but R is not the correct explanation of A.

(c) A is true, but R is false. **(d) A is false, but R is true.**

13. Assertion (A): Parturition is induced by a complex neuro-endocrine mechanism.

Reason (R): At the end of the gestation period, the maternal pituitary releases prolactin which causes uteritie contractions.

14. Assertion (A): In the dihybrid crosses conducted by Morgan on Drosophila, the results deviated from those of Mendel.

Reason (R): The genes studied by Morgan in Drosophila showed linkage and did not segregate independently of each other.

15. Assertion (A): Retroviruses are used efficiently as vectors in DNA technological experiments.

Reason (R): Agrobacterium tumefaciens is the most commonly used vector for transformation of plant cells.

16. Assertion (A): When certain exotic species are introduced into a geographical area, they become invasive, start spreading fast and cause damage to the native species.

Reason (R): The new geographical area invaded by the species does not have their natural predators.

SECTION - B

17. Why does the son of a carrier mother and a normal father suffer from haemophilia, whereas the son of a haemophilic father and a normal mother would not? Explain.

18. Name the type of immunity a baby is born with. How is it different from the one he gets fr the other's milk after birth?

19. Name and explain the interaction that is seen between clown fish and sea anemone.

OR

Apart from plants and animals, microbes form a permanent biotic component in an ecosystem. While plants have been referred to as autotrophs and animals as heterotrophs, what are microbes referred to as? How do microbes fulfil their energy requirements?

20. Match the items in Column I with those in Column II.

Column I	Column II
A. Rosie	1. Polio vaccine safety
B. T_i plasmid	2. Human alpha-lactalbumin
C. RNAi	3. Agrobacterium tunefaciens
D. ELISA	4. Meloidegyne incognitia
	5. Antigen-antibody interaction

21. State two advantages of an apomictic seed to a farmer.

SECTION - C

22. Explain the characteristic features of flowers that facilitate and pollination.

23. Draw a schematic diagram of the E. coli vector pBR 322 and mark the following in it:

(a) Ori (b) rop

(c) ampicillin-resistant gene (d) tetracycline-resistant gene

(e) restriction site BamHI (f) restriction site EcoRI

OR

Draw a schematic sketch of pBR 322 plasmid and label the following in it:

(a) Any two restriction sites. (b) Ori and rop genes.

(c) An antibiotic resistant gene.

24. Draw a labelled diagrammatic view of human male reproductive system.

25. (a) Explain the cause in a human to have sex chromosomes as 'XXY' instead of 'XX' or 'XY'.

(b) What a true-breeding lines that are used to study mheritance pattern of traits in plants?

26. Were the three basic facts that are highlighted in Mendel's Law of Dominance.

27. Baculoviruses are good examples of biocontrol agents. Justify giving three reasons.

OR

(a) A patient had suffered myocardial infarction and clots were found in his blood vessels Name a 'clot buster can be well to dissolve the clots and the microorganism from which it is obtained.

(b) A woman had ust undergone a kidney transplant. A bioactive molecular drug is administered to oppose kidney rejection by the body. What is the have molecule Name the microbe from which this is extracted.

28. Name the different types of polymerases in a eukaryotic cell. Write their roles in transcription.

SECTION - D

Question No. 29 and 30 are case based question has subparts with internal choice in one subpart.

29. Sickle cell anemia is a genetic disorder where the body produces an abnormal hemoglobin called hemoglobin S. Red blood cells are normally flexible and round, but when the hemoglobin is defective, blood cells take up a "sickle" ir crescent shape. Sickle tell anemia is caused by mountains in a gene called HBB.

It is an inherited blood disorder that occurs if both the maternal and paternal copies of the HBB gene are defective. In other words, if an individual receives just one copy of the defective HBB gene, either from mother or father, then the individual has no sickle cell anemia but has what is called "sickle cell trait". People with sickle cell trait usually do not have any symptoms or problems but they can pass the mutated gene onto their children. There are three inheritance scenarious that can lead to a child having sickle cell anemia:

– Both parents have sickle cell trait

– One parent has sickle cell anemia and the other has sickle cell trait

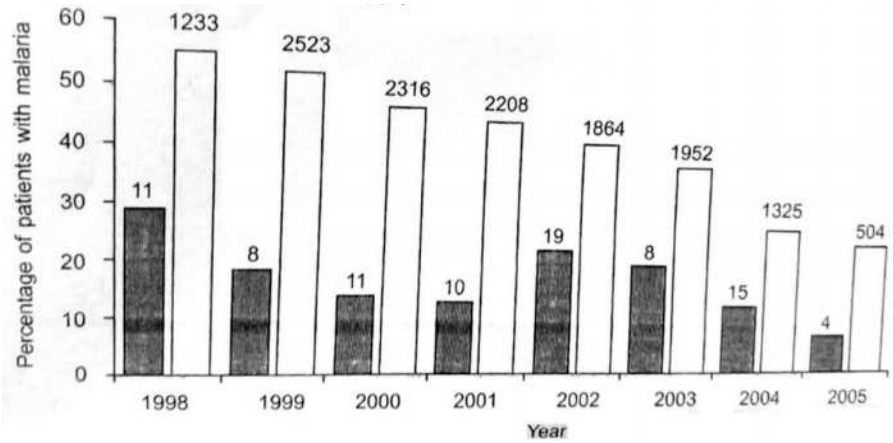
– Both parents have sickle cell anemia

(a) What type of inheritance is shown by this disorder? Name another disease of this category.

(b) If both the parents have the sickle trait, what per cent of their children will have

(i) sickle-cell anaemia (ii) sickle-cell trait, respectively?

(c) Write any two conclusions that can be drawn from the data given.



OR

(c) How does sickle-cell anaemia differ from haemophilia?

30. There is growing public awareness and anger that certain companies are being granted patents for products and technologies that make use of the genetic materials, plants and other biological resources that have long been identified, developed and used by the farmers and indigenous people of a particular Country In 1997 an American company got patent rights on Basmati rice through the US patent and Trademark office this allowed the company to sell a new variety of Basmati in the US and abroad Several attempts have been made to patent the processes, products and uses of Indian traditional herbal medicines.

Answer the following questions.

(a) What term is given to such an act by the countries?

(b) What is the new variety of Basmati developed by the US company?

(c) Mention the efforts of the Indian Government to prevent such deeds.

OR

(c) Indian Government has set up organisations like GEAC. Mention two objectives of setting up GEAC by our government.

SECTION - E

31. (a) List any four major goals of Human Genome project.

(b) Write any four ways the knowledge from HGP is of significance for humans.

(c) Expand BAC and mention its importance.

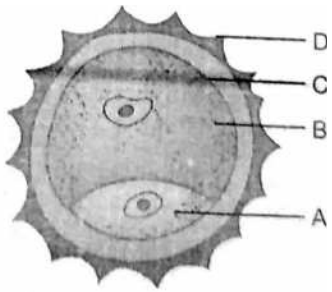
OR

State what is disturbance in Hardy-Weinberg equilibrium indicative of. Write any four factors that affect the equilibruim. Explain how?

32. The pollen grains represent the partially developed male gametophyte of angiosperms. They show an amazing variety of architecture, when observed under a microscope. They are generally spherical and measure about 25-50 micrometres in diameter. Each pollen grain has a prominent two-layered wall. Pollen grains are well-preserved as.

(a) How many cells are present in a pollen grain, at the time of its release from the anther? Name them.

(b) Refer to the figure given and match the parts (with their names) labelled with their characteristics mentioned.



1. It is made of a highly-resistant organic material.

2. It is spindle-shaped in time and has dense cytoplem with a prominem nucleus.

3. It has vacuolated cytoplasm and an irregularly-shaped nucleus.

4. It is made of pectin and cellulose

(c) What are germ pores?

OR

Study the flow chart given below. Name the hormones involved at each stage and explain the functions.

Hypothalamus

↓

Pituitary

↓

Ovary

↓

Pregnancy

33. Cowdung is mixed with water and the durry is fed into the biogas plant for digestion by mcbes. The person in charge of the biogas plant shares that there is no need to provide any inoculum to it.

(a) Give reason, why no inoculums needed.

(b) What is the role of the microbes at the source?

(c) Mention the condition under which they will be most active and effective.

(d) Who developed the technology of biogas production in India?

(e) Why are biogas plants more often buit in rural areas?

OR

The use of chemical fertilisers to meet the ever-increasing demand of agricultural prodiace to feed the ever- increasing human population, has contributed significantly to environmental pollution. Now that we have realised the problems associated with the overuse of chemical fertilisers, there is large pressure to switch over to organ farming there is a need these days to push for the use of biofertilisers. Currently, in our country a biofertilisers are available in the market and farmers do use them regularly in their field.

(a) What are biofertilisers?

(b) Name (i) two free-living bacteria and (ii) two canobacteria that are nitrogen fixers.

(c) Name the fungal genus that often forms mycorrhizal association with higher plants. Mention any three advantages, the mycorrhizal association provides to the plants.