DIRECTORATE OF EDUCATION
Govt. of NCT, Delhi

SUPPORT MATERIAL
(2017-2018)

Class : XII
BIOLOGY

Under the Guidance of

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SUBJECTWISE SUPPORT MATERIAL

PREFACE

It is a matter of great pleasure for me to present the Support Material for various subjects prepared for the students of classes IX to XII by a team of dedicated and sincere teachers and subject experts from the Directorate of Education.

The subject wise Support Material is designed to enhance the academic performance of the students and improve their understanding of the subject. It is hoped that this comprehensive study material will be put to good use by both the students and the teachers in order to achieve academic excellence.

I commend the efforts of the team of respective subject teachers and their group leaders who worked sincerely and tirelessly under the able guidance of the officers of the Directorate of Education to complete this remarkable work in time.

Punya Salila

(Punya S Srivastava)

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सत्यमेव जयते

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Date : 30/08/2017

प्रिय विद्यार्थियों,

इस पुस्तक के माध्यम से आपके साथ सीधे संवाद का अवसर मिल रहा हैं । और अपने विद्यार्थियों के साथ जुड़ने के इस अवसर का मैं पूरा लाभ उठाना चाहती हूँ ।

दिल्ली में आपके विद्यालय जैसे कोई १०३० राजकीय विद्यालय हैं , जिनका संचालन 'शिक्षा निदेशालय' करता हैं । शिक्षा निदेशालय का मुख्यालय पुराना सचिवालय (ओल्ड सेक्रेटेरिएट), दिल्ली-५४ में स्थित हैं ।

इस निदेशालय में सभी अधिकारी दिन रात कार्य करते हैं तांकि हमारे स्कूल और अच्छे बन सकें; हमारे शिक्षक आपको नए-नए व बेहतर तरीकों से पढ़ा सकें; परीक्षा में हमारे सभी विद्यार्थी और अच्छे अंक ला सकें तथा उनका भविष्य सुनिश्चित हो ।

इसी क्रम में पिछले कुछ वर्षों से शिक्षा निदेशालय ने कक्षा नवीं से बारहवीं तक के अपने विद्यार्थियों के लिए विभिन्न विषयों में 'सहायक सामग्री' उपलब्ध करवाना प्रारंभ किया है।

प्यारे बच्चो, आपके हाथ में यह जो पुस्तक है, इसे कई उत्कृष्ठ अध्यापकों ने मिलकर विशेष रूप से आप ही के लिए तैयार किया है । इसे तैयार करवाने में काफी मेहनत और धन खर्च हुआ है । इसलिए अपनी मुख्य पाठ्यपुस्तक के साथ-साथ यदि आप इस सहायक सामग्री का भी अच्छे से अभ्यास करेंगे तो परीक्षा में आपकी सफलता तो सुनिश्चित होगी ही, आपको बाजार में बिकने वाली महंगी सहायक पुस्तकें भी खरीदने की जरूरत नही पड़ेगी । और हाँ, इस पुस्तक को हर साल हम CBSE के पाठ्यक्रम के अनुसार संवर्धित और परिमार्जित भी करते हैं ताकि छात्र छात्राओं की परीक्षा-तैयारी अध्यतन रहे ।

अंततः, एक बात और । अपने विद्यार्थी काल के जिस पड़ाव से आप आज गुजर रहे हैं, यह आपके शेष जीवन की नींव के निर्माण का समय है । मुझे आप पर पूरा विश्वास है कि आप इस समय का सदुपयोग करेंगे, खूब अध्ययन करेंगे तथा अपने एवं अपने देश के लिए एक सार्थक भविष्य की नींव डालेंगे ।

मेरी ढेरो शुभकामनाएं ।

सौम्या गुप्ता

आपकी
सौम्या गुप्ता

Dr. Sunita S. Kaushik
Addl. Director of Edn. (School)/Exam

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Directorate of Education
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Tel. : 23890283

D. O. No. PD/Addl.DE/Sch/38

Dated. 14/09/2017

SUBJECTWISE SUPPORT MATERIAL

FOREWORD

I take pride in presenting latest Support Material for the students of classes IX to XII developed and prepared by a team of subject experts and dedicated teachers from different schools of the Directorate of Education.

The Support Material, over the years, has proved to be a blessing for the students of our schools who are unable to purchase quality subject material from the market unlike their public school counter parts. It gives them a fair chance to do well in the public exams . The comprehensive support material presents the material contained in the prescribed texts in a lucid and comprehensible manner.

While the teachers are expected to give ample practice to the students to enhance their academic performance, the students are also expected to utilize the material to the maximum so that they have a better understanding of the concepts of each subject.

I express my sincere appreciation to all team leaders and their respective teams for their valuable contribution to this commendable task.

14/9/17

Dr. Sunita S. Kaushik
Addl D.E. (School & Exam)

DIRECTORATE OF EDUCATION
Govt. of NCT, Delhi

SUPPORT MATERIAL
(2017-2018)

BIOLOGY
Class : XII

NOT FOR SALE

PUBLISHED BY : DELHI BUREAU OF TEXTBOOKS

CLASS — XII
BIOLOGY

S.No.	Name of the Official	Designation	School
1.	ALKA PANWAR	PRINCIPAL	R. P. V. V., GANDHI NAGAR, DELHI.
2.	R. P. SINGH	VICE PRINCIPAL	GSBV, RANA PRATAP BAGH, DELHI.
3.	RANVEER SINGH	LECTURER BIOLOGY	GSBV, TIMAR PUR, DELHI.
4.	V. S. MALIK	LECTURER BIOLOGY	R. P. V. V., CIVIL LINES, DELHI.
5.	SARITA SINGH	LECTURER BIOLOGY	R. P. V. V., SHALIMAR BAGH, DELHI.
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7.	SUNITA KUMAR	LECTURER BIOLOGY	S. K. V., VIVEK VIHAR, DELHI.
8.	IQBAL KAUR	LECTURER BIOLOGY	R. P. V. V., LINK ROAD, DELHI.
9.	MANISHI CHAWLA	LECTURER BIOLOGY	S. K. V., TIMAR PUR, DELHI.
10.	BHUWAN CHANDRA TEWARI	LECTURER BIOLOGY	R. P. V. V., GANDHI NAGAR, DELHI.

Unit wise and type of question wise weightage

Maximum Marks : 70 **Duration : 3 Hours**

The weightage of the distribution of marks over different dimensions of the question paper shall be as follows :

1. Weightage of Content/Subject Units

Units	Content	Marks
1.	Reproduction	14
2.	Genetics and Evolution	18
3.	Biology and Human Welfare	14
4.	Biotechnology and its application	10
5.	Ecology and Environment	14
	Total	**70**

2. Weightage of Different Form of Questions

S. No.	Form of Questions	Marks for each	No. of Questions	Total Marks
1.	Very Short Answer (VSA)	1	05	05
2.	Short Answer (SA I)	2	05	10
3.	Short Answer (SA II)	3	12	36
4.	Value Based Question (VBQ)	4	01	04
5.	Long Answer (LA)	5	03	15
	Total	—	**26**	**70**

3. Scheme of Option

(i) There will be no overall option.

(ii) Internal choice (either/or type) on a very selective basis has been provided. The choice has been given in one question of 2 marks, one question of 3 marks and all the three questions of 5 marks weightage.

BIOLOGY (CODE NO. 044)
QUESTION PAPER DESIGN
CLASS-XII (2016-17)

Time : 3 Hours **Max. Marks : 70**

S. No.	Typology of Questions	Very Short Answer (VSA) 1 Mark	Short Answer-I (SAI) 2 Marks	Short Answer-II (SAII) 3 Marks	Value based question 4 marks	Long Answer (LA) 5 Marks	Total Marks	% Weightage
1.	**Remembering** (Knowledge based simple recall questions, to know specific facts, terms, concepts, principles or theories, identify, define or recite, information)	2	1	1			7	10%
2.	**Understanding** (Comprehension to be familiar with meaning and to understand conceptually, interpret, compare, contrast, explain, paraphrase information)		2	4		1	21	30%
3.	**Application** (Use abstract information in concrete situation, to apply knowledge to new situations, use given content to interpret a situation, provide an example, or solve a problem)		2	4		1	21	30%
4.	**High Order Thinking Skills** (Analysis & Synthesis : Classify, compare, contrast or differentiate between different pieces of information, organize and/or integrate unique pieces of information from a variety of sources)	2		1		1	10	14%
5.	**Evaluation** (Appraise, judge, and/or justify the value or worth of a decision or outcome, or to predict outcomes based on values)	1		2	1		11	16%
	TOTAL	**5 × 1 = 5**	**5 × 2 = 10**	**12 × 3 = 36**	**1 × 4 = 4**	**3 × 5 = 15**	**70(26)**	**100%**

CLASS XII (2016-17)
BIOLOGY (THEORY)

Unit VI Reproduction 30 Periods

Chapter 1 : Reproduction in Organisms

Reproduction – a characteristic feature of all organisms for continuation of species; modes of reproduction – asexual and sexual reproduction; asexual reproduction – binary fission, sporulation, budding, gemmule formation, fragmentation; vegetative propagation in plants.

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 – apomixes, 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 oogensis; menstrual cycle; fertilization, 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 40 Periods

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 humans, 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 Lkinefelter'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 and 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 30 Periods

Chapter 8 : Human Health and Diseases

Pathogens; parasites causing human diseases (malaria, dengue, chickengunia, 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 9 : Strategies for Enhancement in Food Production

Improvement in food production : Plant breeding, tissue culture, single cell protein, Biofortification, Apiculture and Animal husbandry.

Chapter 10. Microbes in Human Welfare

In household food processing, industrial production, sewage treatment, energy generation and microbes as biocontrol agents and biofertilizers; Antibiotics; production and judicious use.

Unit IX Biotechnology and Its Applications 30 Periods

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, bio piracy and patents.

Unit X Ecology and Environment 30 Periods

Chapter 13 : Organisms and Populations

Organisms and environment : Habitat and niche, population and ecological adaptations; population interactions – mutualism, competition, predation, parasitism; population attributes – growth, birth rate and death rate, age distribution.

Chapter 14 : Ecosystem

Ecosystems; Patterns, components; productivity and decomposition; energy flow; pyramids of number, biomass, energy; nutrient cycles (carbon and phosphorus); ecological succession; ecological services – carbon fixation, pollination, seed dispersal, oxygen release (in brief).

Chapter 15 : Biodiversity and its Conservation

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

Chapter 16 : Environmental Issues

Air pollution and its control; water pollution and its control; agro chemicals and their effects; solid waste management; radioactive waste management; green house effect and climate change; ozone layer depletion; deforestation; any one case study as success story addressing environmental issue(s).

PRACTICALS

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

Evaluation Scheme	
One Major Experiment	5 Marks
One Minor Experiment	4 Marks
Slide Preparation	5 Marks
Spotting	7 Marks
Practical Record + Viva Voce	4 Marks
Project Record + Viva Voce	5 Marks
Total	**30 Marks**

A. List of Experiments — 60 Periods

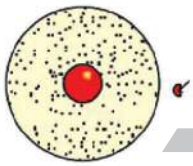
1. Study of pollen germination on a slide.
2. Collect and study soil from at least two different sites and study them for texture, moisture content, pH and water holding capacity. Correlate with the kinds of plants found in them.
3. Collect water from two different water bodies around you and study them for pH, clarity and presence of any living organism.
4. Study the presence of suspended particulate matter in air at two widely different sites.
5. Study the plant population density by quadrat method.
6. Study the plant population frequency by quadrat method.
7. Prepare a temporary mount of onion root tip to study mitosis.
8. Study the effect of different temperatures and three different pH on the activity of salivary amylase on starch.
9. 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.
3. Identification of stages of gamete development, i.e., TS of testis and TS of ovary through permanent slides (from grasshopper/mice).

4. Meiosis in onion bud cell or grasshopper testis through permanent slides.
5. TS 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, Roundworm through permanent slides or specimens. Comment on symptoms of diseases that they cause.
10. Two plants and two animals (models/virtual images) found in xeric conditions. Comment upon their morphological adaptations.
11. Two plants and two animals (models/virtual images) found in aquatic conditions. Comment upon their morphological adaptations.

CONTENTS



Chapter - 1

Reproduction in Organisms

Clone : Morphologically and genetically similar individuals.

Juvenile Phase : It is the period of growth and maturity before an organism can reproduce sexually.

Meiocytes : These are specialized cells of diploid organisms which undergo meiosis to produce gametes.

Pericarp : It is the protective coverning of fruit, may be divided into epicarp, mesocarp and endocarp.

Parthenogenesis : Development of an egg into an embryo without fertilisation. e.g. in rotifers, honeybees, turkey and some lizards.

Monoecious Plants : Plants having both male and female flowers on same plant. e.g. cucurbits and coconut. The term 'homothallic' is used in Fungi for same condition.

Dioecious Plants : Plants having male and female flowers on separate plant. e.g. Papaya and date palm. The term 'heterothallic' is used in fungi for the same condition.

Oestrus Cycle : The reproductive cycle in non-primate mammals like cows, sheep, rats, deer, dogs and tigers etc;. The sexually active females reffered to as being in 'heat' at a specific time of Oestrus cycle. They reabsorbs the endometrium if conception does not occur.

Asexual Reproduction

In single celled organism	In algae, fungi and multicellular lower animals	Vegetative propagation
Binary fission e.g. *Amoeba, Paramoecium*	Zoospore e.g. *Chalamydomonas*	Runner e.g. *Oxalis*

- Multiple fission e.g. *Plasmodium*
- Conidia e.g. *Penicillium*
- Bud e.g. *Hydra*
- Gemmules e.g. Sponge
- Fragmentation e.g. *Spirogyra*
- Sporulation e.g. *Amoeba*, *Paramoecium*
- Regeneration e.g. *Hydra, Planaria*
- Rhizome e.g. Ginger
- Sucker e.g. Banana
- Offset e.g. Water hyacinth
- Bulb e.g. Onion
- Leaf buds e.g. *Bryophyllum*
- Bulbil e.g. *Agave*
- Eye buds e.g. Potato

Gamete Transfer

1. **In Algae, Bryophytes and Pteridophytes :** The male and female gametes are flagellated and motile, need a medium (water) to reach to egg.
2. **In seeded plants :** Pollen grains are transferred to stigma of flower of same species by various agents, like wind, water, insects, birds and ants etc.
3. **In animals :**

(a) By Copulation : e.g., Reptiles, Birds and Mammals.

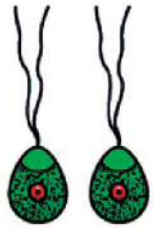
(b) By External medium : e.g., Fishes and Amphibians.

Sporulation : During unfavourable conditions organisms like *Amoeba* surrounded by resistant coat (three layered—hard covering) or cyst. This is called encystation. Within cyst a number of spores are formed. On returning favourable conditions, the cyst brust and spores are liberated and gradually grows in adults. This process is known as sporulation (multiple fission).

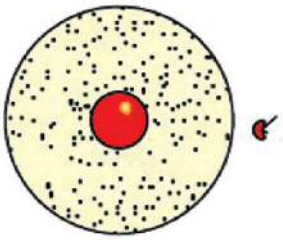
Fragmentation : It is a type of asexual reproduction where an organism splits into fragments. Their fragments develops into fully grown individual. e.g. *spirogyra*, fungi and some annelids.

Regeneration : It is a process of renewal, restoration and growth. It can occur at the level of the cell, tissue and organ. It is common in *Hydra, Planaria* and echinoderms

- In human, liver has power of regeneration, if it is partially damaged.
- During danger a lizard discard a part of its tail which can regenerate later.



Isogametes-
Cladophora (alga)



Heterogametes-
Fucus (alga)

Heterogametes-
Human beings

Events in Sexual Reproduction

- Pre-fertilisation Events
  - Gametogenesis
  - Gamete Transfer
- Fertilisation
  - External
  - Internal
- Post Fertilisation Events
  - The zygote
  - Embryogenesis

Asexual Reproduction	Sexual Reproduction
(i) Being uniparental, mating is not required.	Being biparental, mating is required.
(ii) Gametes are not involved.	Gametes are involved.

Questions

VSA **(1 Marks)**

1. There are 380 chromosomes in meiocytes of a butterfly. How many chromosomes does male gamete of butterfly have ?
2. Which characteristic property of *Bryophyllum* is expolited by gardeners ?
3. Mention the unique flowering phenomenon exhibited by strobilanthus *kunthiana* (Neelakuranji).
4. Mention the unique feature with respect to flowering and fruiting in bamboo species.

SA - I **(2 Marks)**

5. Higher organisms have resorted to sexual reproduction inspite of its complexity. Why ?
6. Bryophytes and Pteridophytes produce a large number of male gametes but relatively very few female gametes. Why ?

SA - II **(3 Marks)**

7. Distinguish between gametogenesis and embryogenesis.
8. Fill the blank spaces a, b, c, and d given in the following table.

S. No.	Organism	Organ	Gamete
(i)	a	Testes	Spermatozoa
(ii)	Human female	b	Ovum
(iii)	Plant (Angiosperm)	c	Pollen grains
(iv)	Plant (Pteridophytes)	antheridium	d

9. (a) Why is vegetative propagation also considered as a type of asexual reproduction ?

   (b) Which is better mode of reproduction : Sexual or Asexual ? Why ?

Answers

VSA **(1 Mark)**

1. 190 chromosomes.
2. Adventitious bud arising from margin of the leaf.
3. Flower one in 12 years.
4. Flower once in their life time after 50-100 years, produce large no. of fruits and die.

SA - I **(2 Marks)**

5. Because of variations, gene pool, vigour and vitality and parental care.
6. Because male gemete need medium (water) to reach egg/female gamete. A large number of the male gametes fail to reach the female gamete. It increases the probability of fertilisation.

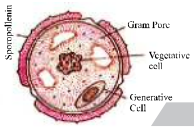
SA - II **(3 Marks)**

7.

Gametogenesis	Embryogenesis
1. Formation of gametes	Formation of Embryo
2. Produces haploid gametes	Embryo is diploid
3. Cell division is meiotic	Cell divison is mitotic.

8. a = Human male b = ovary
   c = Anther d = Antherozoid
9. (a) Vegetative propagation takes place when new individuals arise from vegetative part of parent and have characters similar to that of parent plant.
   (b) Sexual reproduction, it introduces variations in offsprings and has evolutionary significance. It helps offsprings to adjust according to the changes in environment. It produces better off springs due to character combination.

❑❑



Chapter - 2 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, Paper, 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.

Micro-sporangium (Pollen sac) :

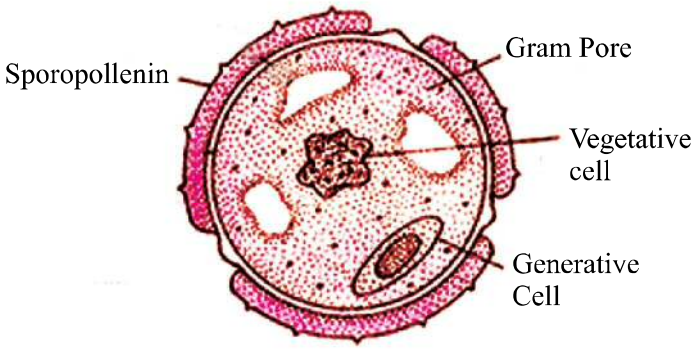
Outermost layer	=	Epidermis
Second layer	=	Endothecium
Middle layer	=	2–4 layers of cells
Innermost layer	=	Tapetum [Nourishes the developing Pollen grains (Microspores)]

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

Sporogenous tissue (2n) → MMC 2n $\xrightarrow{\text{meiosis}}$ Microspore tetrad (n) ↓

4 Pollen Grains (2n) ← 4 Microspores (n)

Pollen grain → (Male gametophyte)
- → outerwall (Exine) – Thick, hard, made of sporopollenin
- → innerwall (Intine) – Thin, made of cellulose and Pectin
- → cells – a vegetative cell (large in size) and a generative cell (small in size)



Pollen Grain (Male gametophyte)

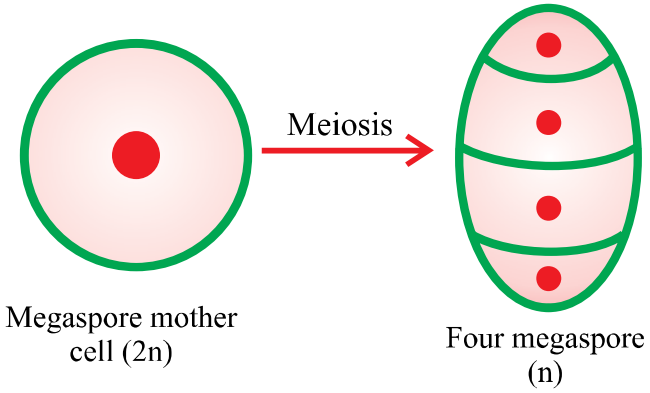
Sporopollenin is one of the most resistant organic substance. It is not affected by high temperature, strong acids or alkali. No enzyme can degrade it.

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. Pollens of same other plants may remain viable for several months. Pollens can be cryopreserved in liquid nitrogent (– 196°C) in pollen banks.

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

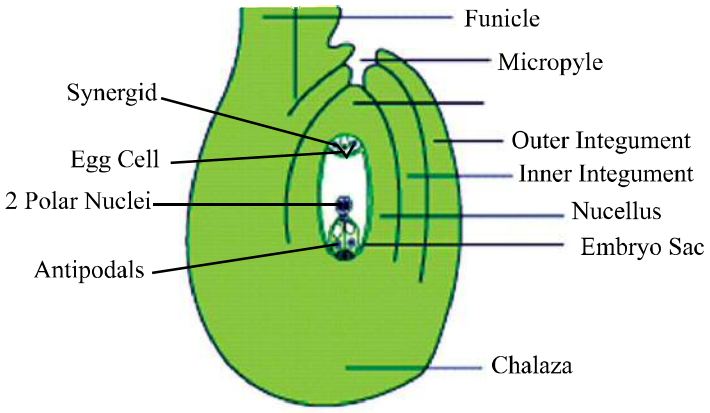
Megasporogensis : Process of formation of haploid megaspores from megaspore mother cells



Megasporangium (Ovule) :

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

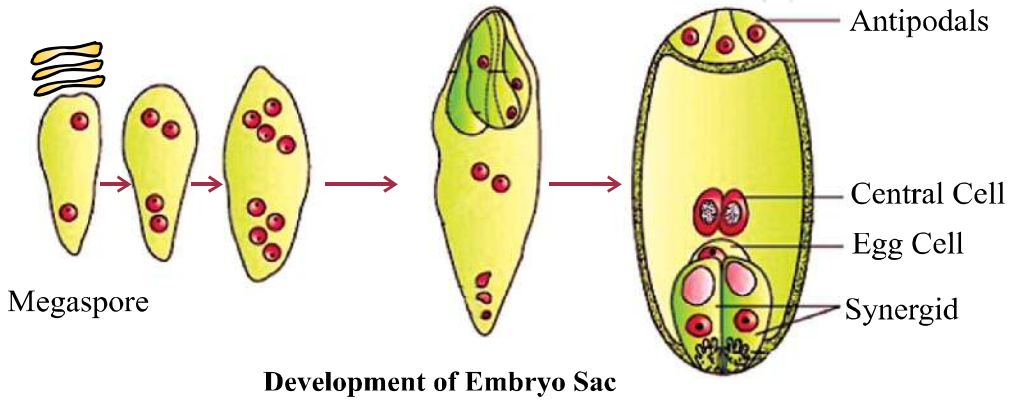
- The point of attachment of the body of the ovule to the funicle is known as hilum. The main body of the ovule is composed of paranchymatous cells known as nucellus.
- Each ovule has one or two protective integument, which encircle the ovule except at the tip having small opening called micropyle.
- 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.



6. Female gametophyte (embryo sac) : In a majority of flowering plant 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 result the formation of eight nucleate stage of embryo sac (free nuclear division).
- The cell wall formation starts at eight nuclear 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, called antipodal cells.
- The remaining 2 nuclei are polar move to the centre of embryo sac, called central cell.

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



Development of Embryo Sac

Kind of Pollination : Autogamy, Geitonogamy and Zenogamy

Agents of Pollination : (a) Biotic Agents— Bees, flies, butterflies, waspa, moths, ant, birds, beetles, rodents, reptiles and some primates, etc.

(b) Abiotic Agents—Wind and water.

In some plants like *oxalis, viola* e.t.c. have two types of flowers :

1. Chasmogamous Flower

Flower remain open after maturity self pollination and cross pollination both can take place.

2. Cleistogamous Flower

Flower remain closed throughout their life. So only self pollination occurs.

Outbreeding Devices : (i) Non synchronisation of pollen release and stigma receptivity. (ii) Self-incompatibility (iii) Monoecius or dioecious plants (iv) Position of anthers and stigma in such a way that pollen cannot come in contact of stigma of same flower.

Pollen—pistil interaction :

- This pistil has the ability to recognize the pollen, whether it is right type (Compatible) or of the wrong type (incompatible).
- If it is compatible then the pistil accepts the pollen.
- 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 Fetilisation : The pollen tube releases to male gamete into the cytoplasm of synergid. One male gamete move towards eggcell 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

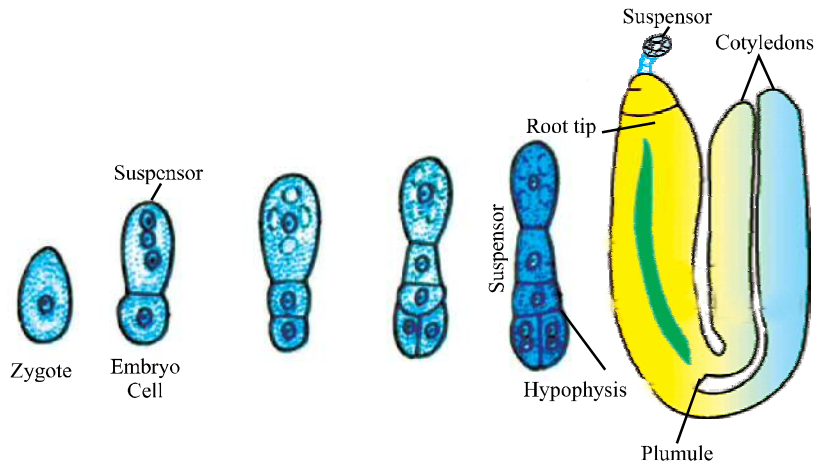
Ovary (2n)	→	Fruit
Ovary Wall (2n)	→	Pericarp
Ovule (2n)	→	Seed
Outer Integument (2n)	→	Testa
Inner integument (2n)	→	Tegmen
Zygote (2n)	→	Embryo
Primary Endosperm Cell (3n)	→	Endosperm
Sepals	→	Fall down
Petals	→	Fall down
Stamens	→	Wither away
Stigma, style	→	Wither away
Nucellus	→	Consumed/may be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

Development of Endosperm : The primary endosperm cell (PEC) in embryo sac devide 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 yound seedling at the time of germination.

PEN $\xrightarrow{\text{nuclear division}}$ Free Nuclear endosperm $\xrightarrow{\text{Cell wall formation}}$ Cellular endosperm

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

Zygote → Pro-embryo → Globular embryo → Heart Shaped embryo → Mature embryo



Development of Dicot Embryo

13. 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.

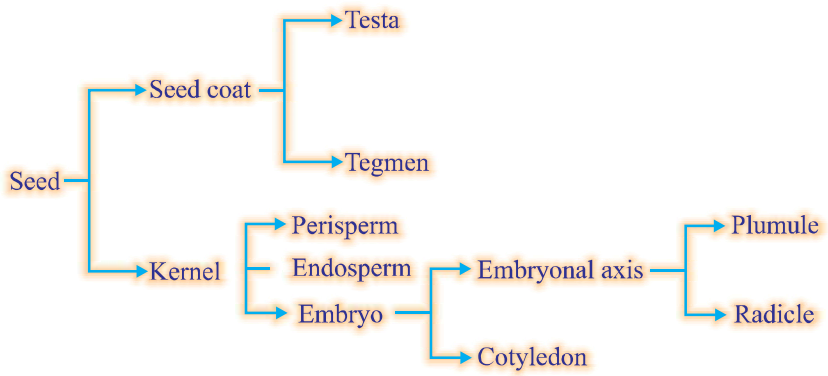
Monocot Embryo : Monocot (Rice, Maize etc.) has one cotyledon called Scutellum. The embryonal axis has the radicle and root cap enclosed by a sheath called Coleorrhiza.

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

Polyembryony : Occurrence of more than one embryo is a seed, is knowan as polyembryony e.g. Orange, lemon, onion, mango, groud 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 repduction 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 Mark**

1. Give the scientific name of a plant with 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, seed 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.

SA-I **2 Marks**

6. Fruits generally develops from ovary, but in few species thalamus contributes to fruit formation.

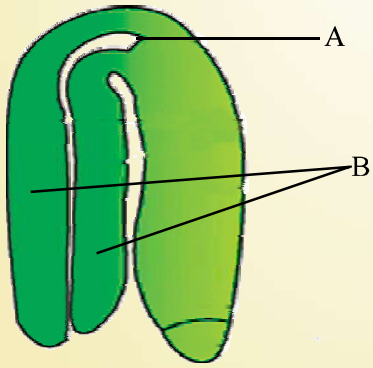
   (a) Name the two categoris of fruits.

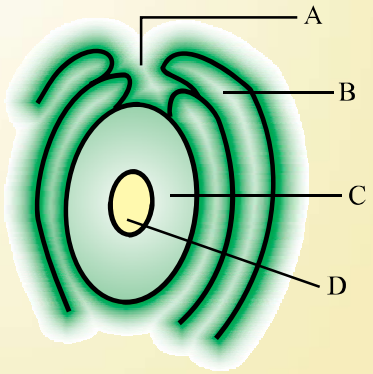
   (b) Give one example of each.

7. Among the animals, insects particularly bees are the domiant pollinating agents. List any four characteristic features of the insect pollinated flower.

8. Differentiate between geitonogamy and xenogamy.

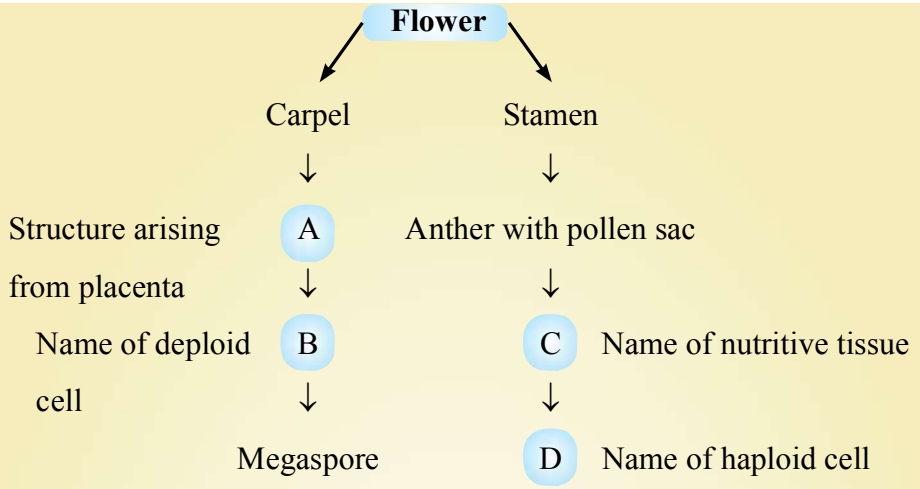
9. In the given figure 1 of a dicot embryo, label the parts (A) and (B) and give their function.





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

11. 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.



12. 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)**

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

14. 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)**

15. (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 atfer fertilisation ?

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

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. Chromosomes in endosperm and 8 chromosomes in antipodal cells.

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
8.

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

9. A = Plumule – To form shoot system
   B = Cotyledons – Storage of food
10. A = Micropyle, B = Outer integument, C = Nucellus, D = Embryo sac
11. A = Ovule/megasporangium, C = Tapetum
    B = Megaspore mother cell, D = Pollen grains
12. Because only one male gamete is involved is syngamy, *i.e.*, fusion of male gamete with egg cell.

SA-II **(3 Marks)**

13. (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).

14. • 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.

15. (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.

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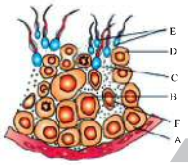


Chapter - 3

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/fertilized egg in uterus. It leads to pregnancy.

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

Menopause : Permanent ceasation 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.

Lactation : 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, espicially the ovum, as distinct from the polar bodies.

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

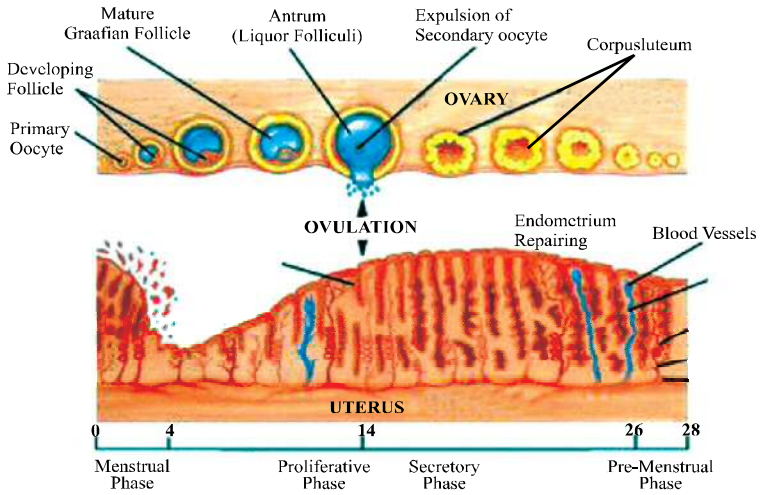
Insemination : The process in which the male transfers the sperms into the genital tract of the female.

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 differentiantion 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.



Menstrual Cycle

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, defferentiation

Primary oocyte 46 (2n)

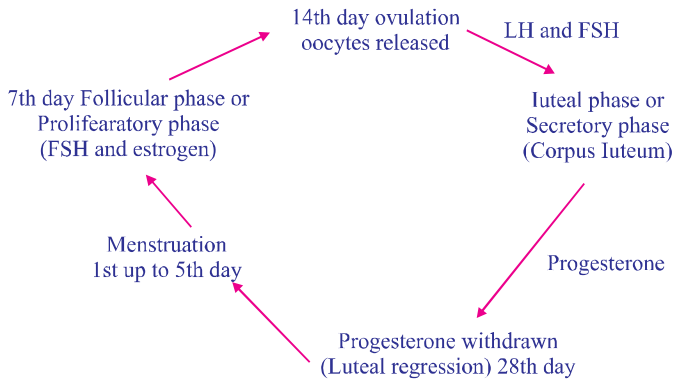
(At puberty) First polar body 23 (n) | Ist meiotic division completed prior to ovulation

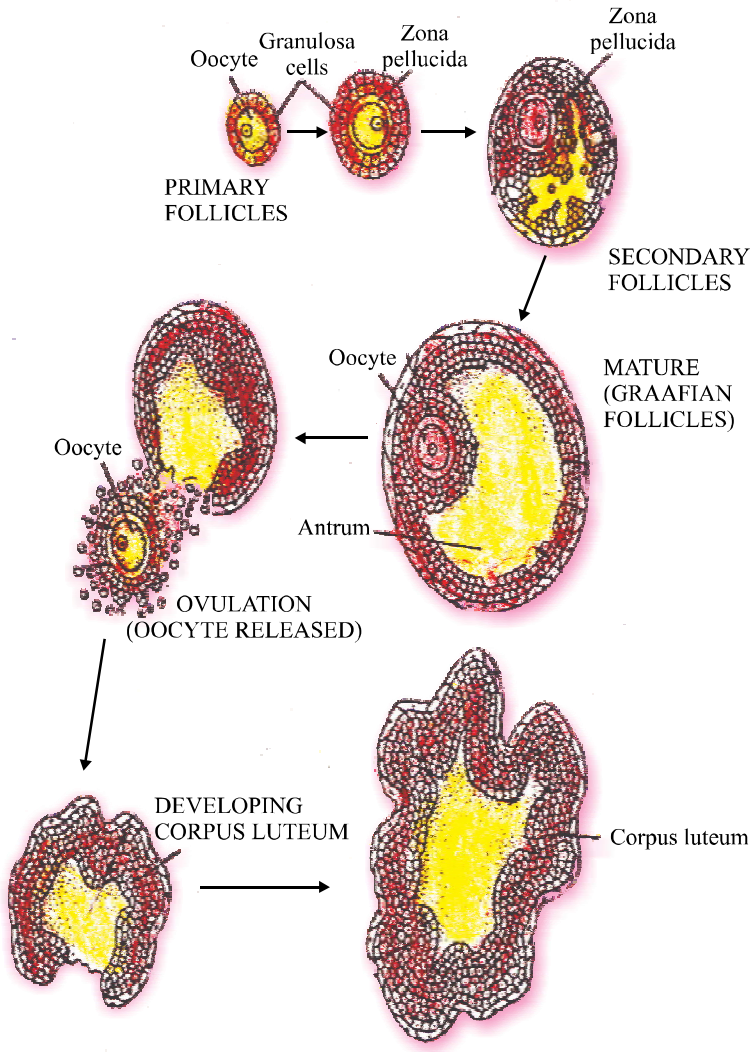
Secondary oocyte 23 (n)

Second polar body 23 (n)

Ovum 23 (n)

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





Fertilisation : Process of fusion of sperm with ovum

Site of fertilisation in human female : Ampullary—isthmic junction. 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.

Secondary oocyte → Ovum 23 (n)
Secondary oocyte → Second Polar body

Sperm, Ovum → zygote —cleavage→ Blastomere —Morula→ Blatocyst
zygote → Falliopian tube → Uterns

Blastocyst → Outer layer → Trophoblast → get attached to endometrium
Blastocyst → Inner layer → Inner call mass → Embryo

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

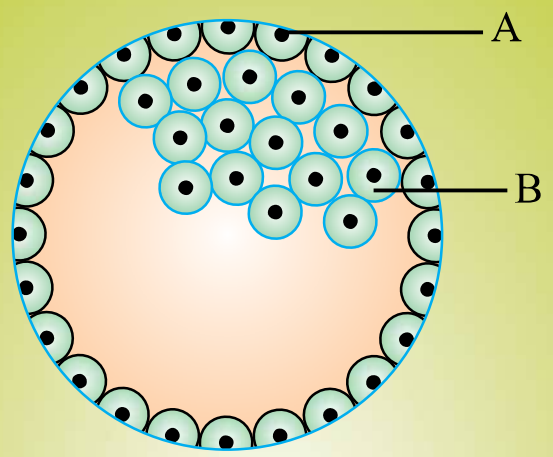
VSA **(I Mark)**

1. Failure of testes to descend into sacrotal 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 ?

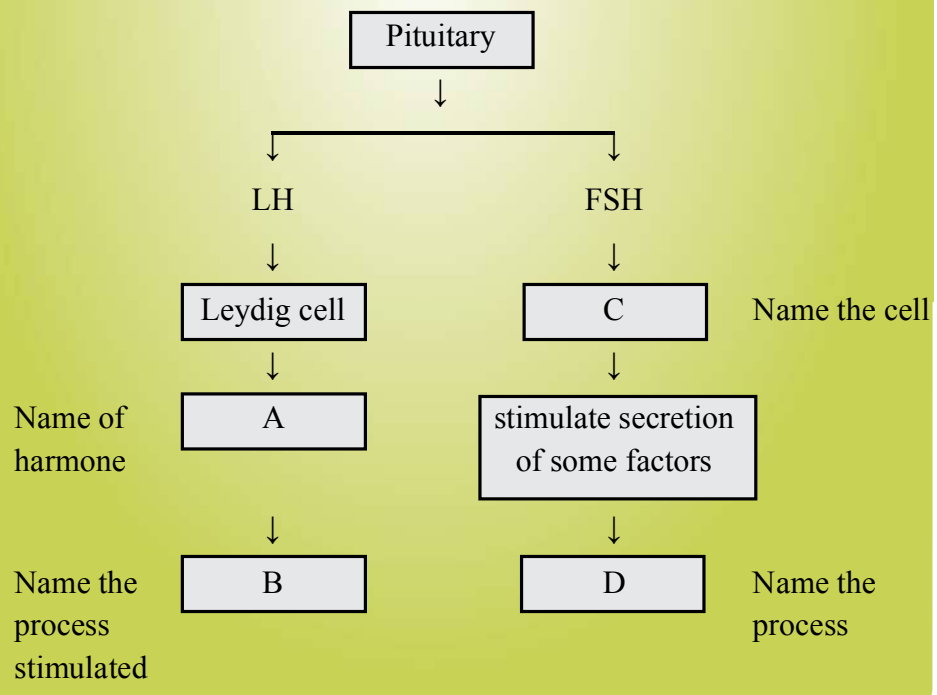
3. In ovary which structure transforms as corpus luteum and name the hormone secreted by corpus luteum ?

SA - I **(2 Marks)**

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



5. 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.



6. Give reason for the following :

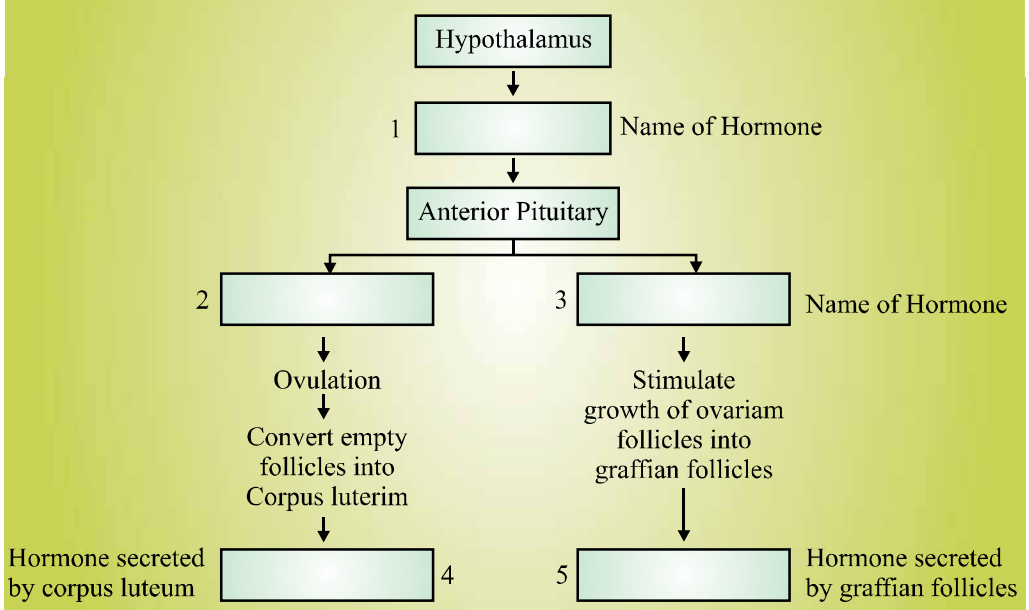
   (a) The first half of the menstrual cycle is called follicular phase as well as proliferative phase.

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

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

SA-II **(3 Marks)**

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



9. 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) ..... .

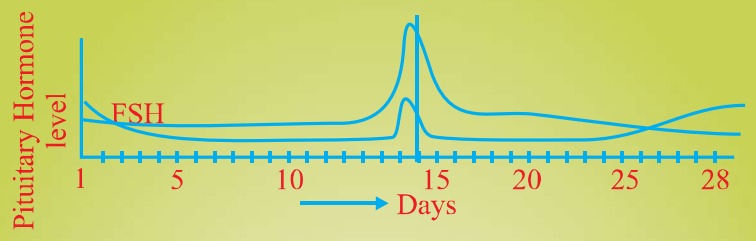
   (c) ..... .

   (d) Oxytocin causes strong uterine contraction

   (e) Uterine contraction stimulates further secretion of oxytocin.

   (f) ..... .

10. (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.

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

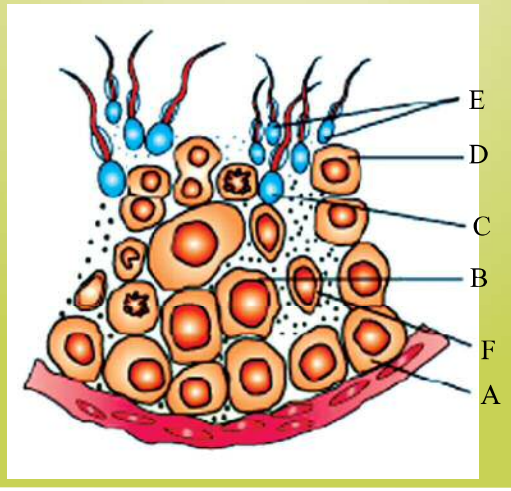
(i) Name the two types of cells of germinal epithelium.

(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)**

12.



Study the figure given :

(i) Pick out the name the 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 **(I 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.

SA - I **(2 Marks)**

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

   B = Inner cell mass – Differentiates as Embryo.
5. A = Testosterone; B = Spermatogenesis

   C = Sertoli cells; D = Spermiogenesis
6. (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.
7. LH surge refers to maximum level of luteihising hormone living middle of menstrual cycle. LH couses ovulation.

SA-II **(3 Marks)**

8. Hypothalamus → 1. GnRH → Anterior pituitary — 2. LH / 3. FSH

4. Progesterone 5. Estrogen

9. (b) Foetal ejection reflex

(c) The reflex triggers release of oxytocin

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

10. (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.

11. (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)**

12. (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.

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Chapter - 4

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.

Sterilization : 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

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 E.g. I pill, unwanted-72 etc.
(viii)	Surgical (Sterilisation)	:	(1) Tubectomy; (2) Vasectomy in male in females.

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) : Fertilization 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 fertilization 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.

SA-I **(2 Marks)**

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

SA-II **(3 Marks)**

9. Give another name for sexually transmitted diseases. Name two sexually transmitted diseases which are curable and two diseases which are not curable.
10. Differentiate between Vasectomy and Tubectomy.
11. 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.

Answers

VSA **(I Mark)**

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

SA-I **(2 Marks)**

5. (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.
6. (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.
7. 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.
8. User friendly, easily available, effective, reversible with no side effects.

SA-II **(3 Marks)**

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

10.

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

11. (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 and syringes and surgical instruments.

LA **(5 Marks)**

12. Refer page no. 64 NCERT textbook for class XII/Points to remember in this chapter.

❑ ❑

Chapter - 5 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 (It)

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) 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.

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

Gregor Mendel Conducted controlled breeding experiment on garden pea (*pisum sativum*) with a single trait. It is called monohybrid cross.

Parent	Tall (Homozygous) TT	Dwarf (Homozygous) tt
	↓	↓
Gametes	T	t
	Crossed	
F_1 Generation	Tt	Tall (heterozygous)
Selfing	Tt × Tt	
	T	t

F_2 generation	T	t
T	TT Tall	Tt Tall
t	Tt Tall	tt Dwarf

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 from 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 who is homozygous recessive for the trait, this cross is know 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	
WW		ww	homozygous recessive

Case 1

	w	w
W	Ww Violet	Ww Violet
W	Ww Violet	Ww Violet

Here, all flowers are violet

If all the off spring dominant trait, it indicate that individual under test is homozygoes (WW) for dominant trait.

Case 2

Violet	×	White	
Ww		ww	homozygous recessive

	w	w
W	Ww Violet	Ww Violet
w	ww White	ww White

50% flowers are violet

50% flowers are white

ratio Ww : ww

1 : 1

If a test cross gives 50% offspring showing dominant trait and 50% showing recessive traits, it indicates that individual parent under test is heterozygous (Ww) for dominant trait.

Incomplete dominance : It is the phenomenon where none of the two contrasting alleles is dominant but express themselves partially when present together in a hybrid and somewhat intermediate stage is seen.

Example : In plant snapdragon or *Antirrhinum* species, when plants with red flower (RR) are crossed with plant having white flower (rr) the hybrid F_1 plants (Rr) bear pink flower. When the F_1 hybrid with pink flower are self pollinated or crossed themselves, they produce red, pink and white flower in ratio of 1 : 2 : 1 in F_2 generation.

P	Red-flowered plant	×	White flowered plant
	RR		rr
Gametes	R		r
F_1 generation		Rr	All pink flower
	Pink	×	Pink
	Rr		Rr

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 sugar Phenotypes :

Blood Group	Genotype	Types of Sugar
A	I^AI^A, I^Ai	A
B	I^BI^B, I^Bi	B
AB	I^AI^B,	both A & B
O	ii	No sugar alleles

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 in the same chromosome.
- They lie in linear sequence in 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 parentel 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.

Chromosomal basis of sex Determination :

(i) XY-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.

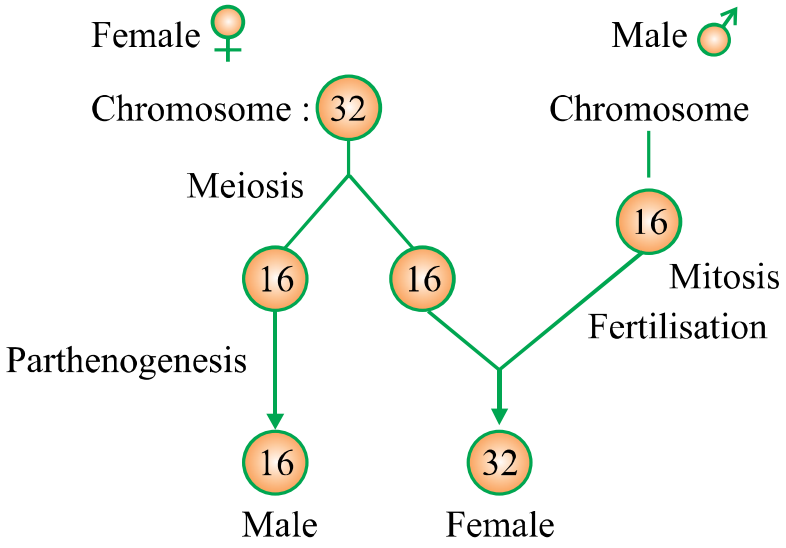
(iii) ZW-ZZ type—The females are heterogametic and have one Z and one W chromosome. The males are homogametic with a pair of Z chromosomes besides autosomes e.g., birds.

(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 = auto some

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 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 heterogygous condition in a particular individudal.

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 transmit 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 – 25% Hb^S Hb^S sufferer – 25%

   Hb^A Hb^S. Apparently unaffected/carriers – 50%

	Hb^AHb^S Carrier ×	Hb^A Hb^S Carrier
	Hb^A	Hb^S
Hb^A	Hb^AHb^A	Hb^AHb^S
Hb^S	Hb^AHb^S	Hb^SHb^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 retaradation.

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

- 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 quantatative problem whereas in sickle cell anaemia there is a synthesis of incorrectly functioning globin and is a qualitative disorder.

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**	**Phen-type**	**Geno-type**
				Normal	XY	Normal	XX
Normal	XY	Carrier	$X^C X$				
				Colour-blind	$X^C Y$	Carrier	$X^C X$
Normal	XY	Colour-blind	$X^C X^C$	Colour-blind	$X^C Y$	Carrier	$X^C X$
Colour-blind	$X^C Y$	Normal	XY	Normal	XY	Carrier	$X^C X$
Colour-blind	$X^C Y$	Carrier	$X^C X$	Colour-blind	$X^C Y$	Colour-blind	$X^C X^C$
				Normal	XY	Carries	$X^C X$

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	Haemopholic	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 retarded.
2. **Klinefelter's syndrome :** extra copy of X chromosome ; karyotype XXY. Affected individual has overall masculine development with famine 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 + x = 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

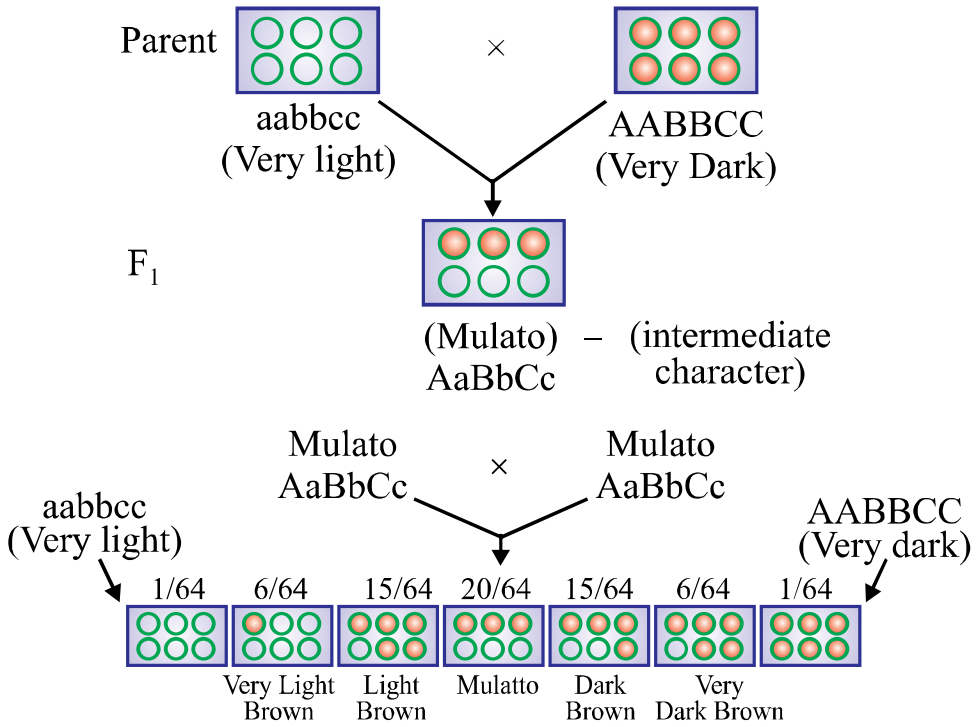
It is a type of inheritance controlled by three or more genes in which the dominant alleles have cumulative effect with each dominant allele expressing a part of the trait, the full being shown only when all the dominant alleles are present.

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.

SA-I **(2 Marks)**

4. 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.
5. The human male never passes on the gene for haemophilia to his son. Why is it so ?
6. Mention four reasons why Drosophila was chosen by Morgan for his experiments in genetics.
7. Differentiate between point mutation and frameshift mutations.

SA-II **(3 Marks)**

8. 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.
9. Give reasons for success of Mendel.
10. 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)**

11. 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?

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.

SA-I **(2 Marks)**

4. (i) Female (ii) Male (iii) Female (iv) Male
5. 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).
6. (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.
7. **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)

8. (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*.

9. (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.

10. (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)

11. (i) It is a dihybrid test cross

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

    Gametes RY, Ry, rY, rY, × ry

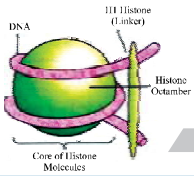
Gametes	RY	Ry	rY	ry
F1 progeny	RrYy Round, Yellow	Rryy Round and green	rrYy wrinkled, yellow	rryy wrinkled, green.

Phenotypic ratio	1	:	1	:	1	:	1
Genotopic ratio	1	:	1	:	1	:	1

F_2 Progeny

Phonotypic ration	Round yellow	:	Round green	:	Wrinkled yellow	:	Wrinkled green
Genotypic ratio	9	:	3	:	3	:	1

(iii) Principle of Independent Assortment.



Chapter - 6

Molecular basis Of Inheritance

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 :

$$\text{replication} \quad \text{DNA} \xrightarrow{\text{Transcription}} \text{mRNA} \xrightarrow{\text{Translation}} \text{Protein}$$

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

VNTR : Variable Number of Tandem Repeats

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 'Nuclien'.
Altman	1889	Separated protein from nuclear substance and named it nucleic acid
Kossel	1893	Discover nitrogen bases (Adenine, guanine, cytocine, Thymine, uracil)
T.H. Morgan	1910	
Frederick Griffith	1928	Provide first clear-cut evidance that DNA in 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 show 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 Frankline	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 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.

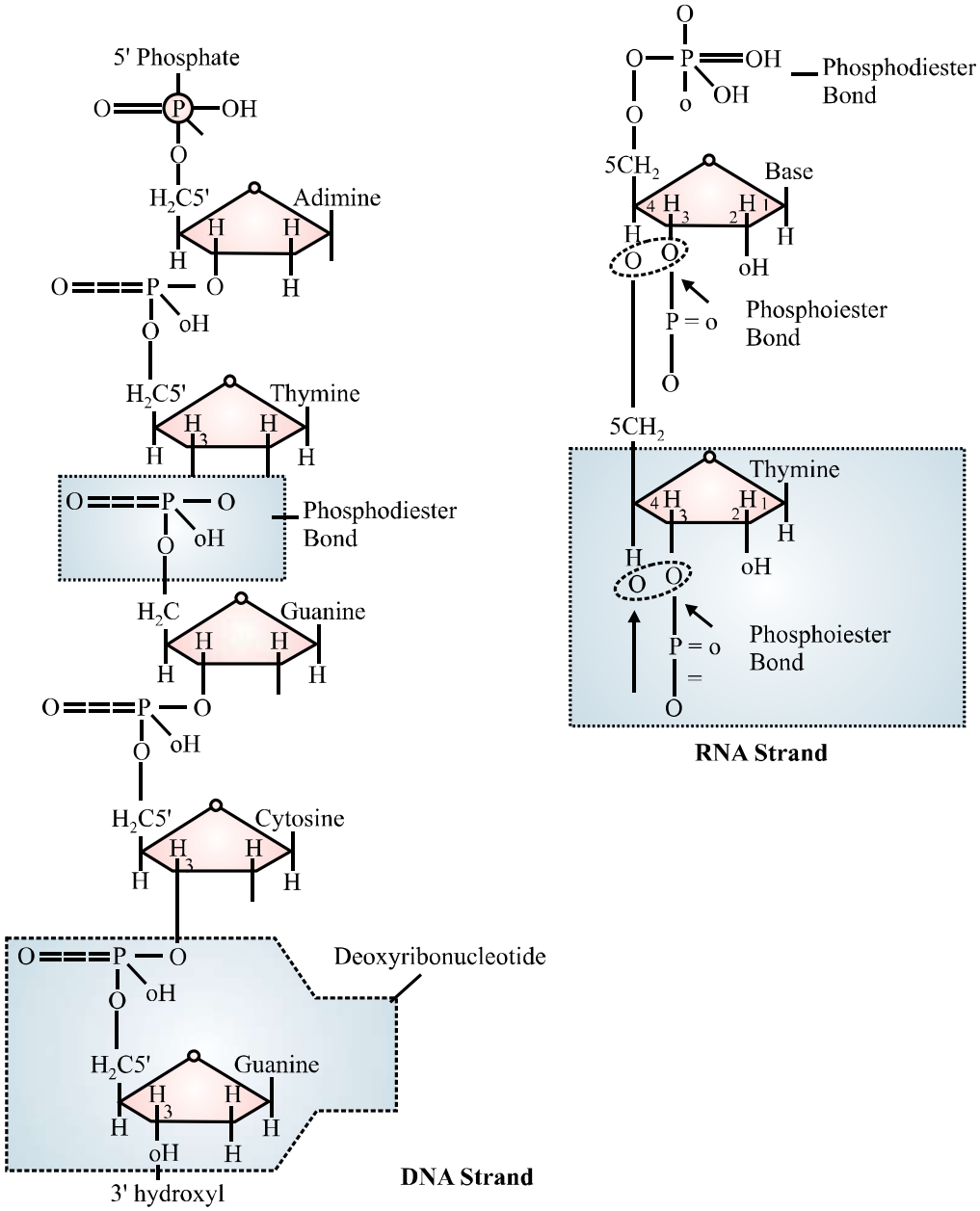
(i) DNA is made up of two polynucleotide chains.

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

(iii) Both polynucleotide chains are antiparallel i.e. on 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.

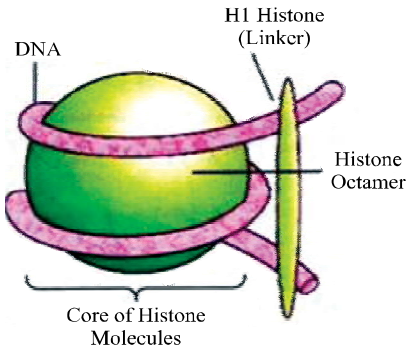
(v) Both chains are coiled in right handed fashion. The pitch of helix is 3.4 nm with 10 base pairs in each turn.



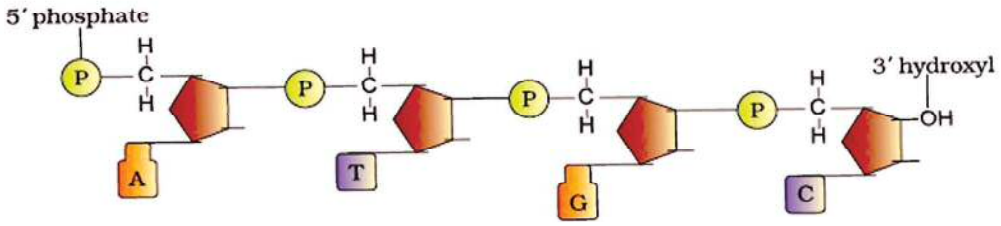
Packaging of DNA Helix

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

- 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 combines together to form histone octamer.
- The negatively charged DNA is wrapped around positively charged histone octamer to form as structure called nucleosome.
- Histone H_1 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 reffered to as Non-histone chromosomal (NHC) proteins. At 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 phenumoniae* 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 nice remain live.
- He than injected a mixture of R-strain bacteria (Non virulent) and heat killed S-strain bacteria (virulent) into mice → mice died due to pnuemonia.
- 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'.

The 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	Bacteriophage
Radioactive (S^{35})	Radioactive (P^{32})
Labelled protein coat	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^{35}) detected in bacterial cells but not in supernatant

Conclusion : DNA is the genetic material.

Meselson and Stahl's Experiment :

- Meselson and Stahl performed the experiment in 1958 on *E. coli* to prove that DNA replication is semiconservative.
- E. coli was grown in $^{15}NH_4CI$ 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

↓

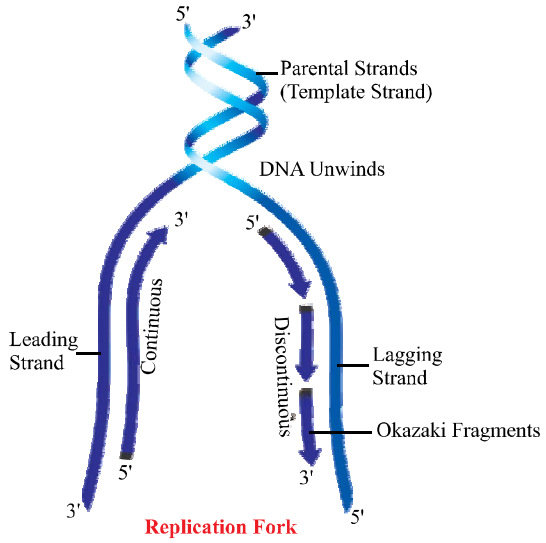
DNA polymerase adds nucleotides on one of the template strand called as leading strand (the template with polarity 3′-5′). In this strand nucleotides are added continuously therefore called as continuous replication

↓

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.

↓

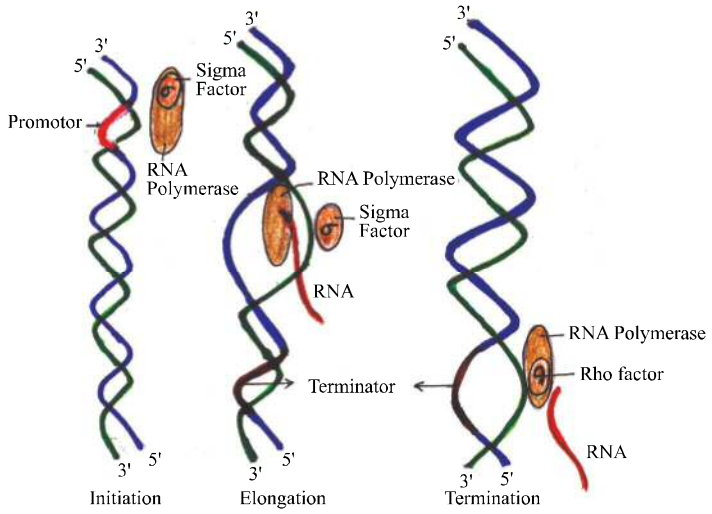
Accuracy of polymerisation is maintained by Proof reading and any wrong base added is removed by DNA polymerase



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. **Elogation :** 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 who factor (terminator factor) As a result nascent RNA separates.



Transcription in Prokaryotes

Transcription in Eukaryotes :

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

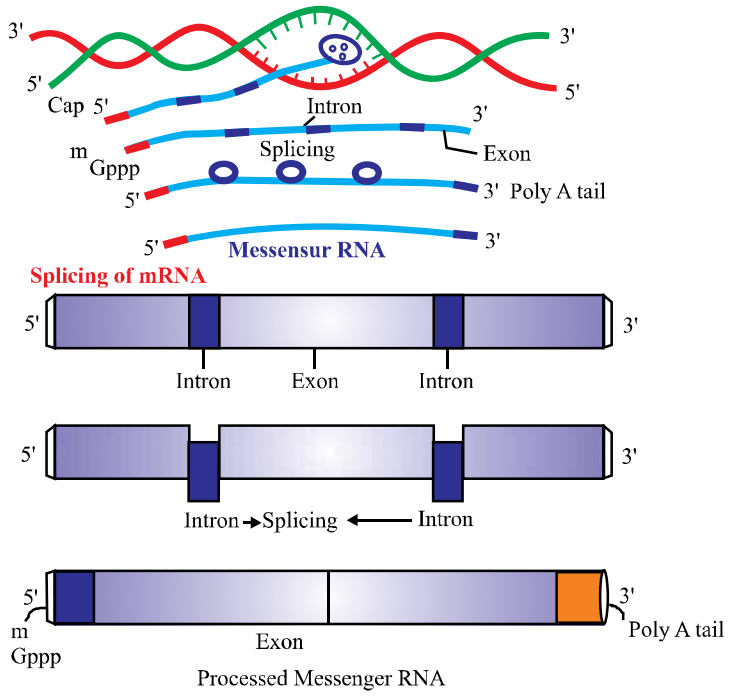
  RNA Polymerase I : Transribes rRNAs.

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

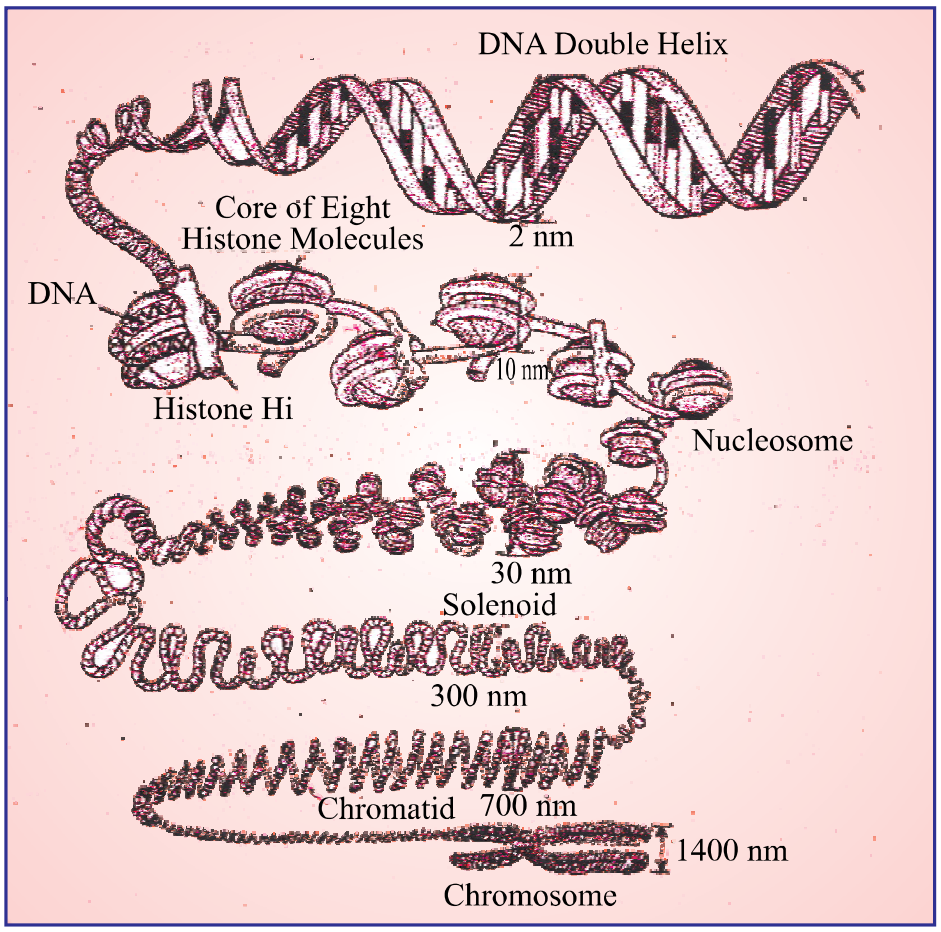
- **RNA Polymerase III :** Transcribes tRNA, 5 srRNA and sn RNA.
- The primary transcription has both exon and intron regions.
- Introns which are non-coding regions removed by a process called splicing.
- hnRNA undergoes who additional process :

  (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 and specific.

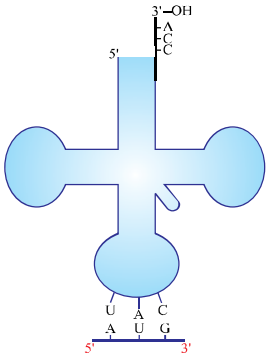
(iii) Some amino acids are coded by more than one codon, hence called as degenerate.

(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.

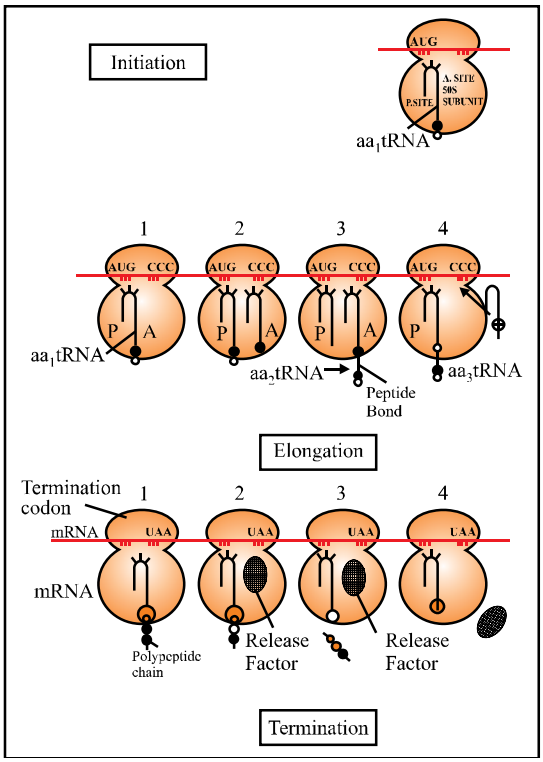
tRNA, the Adapter Molecule

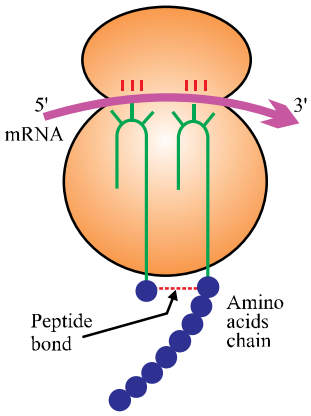


- tRNA has an anticoden loop that has bases complementary to the code, and also has an amino acid aceptor and through which it bind to amino acids.

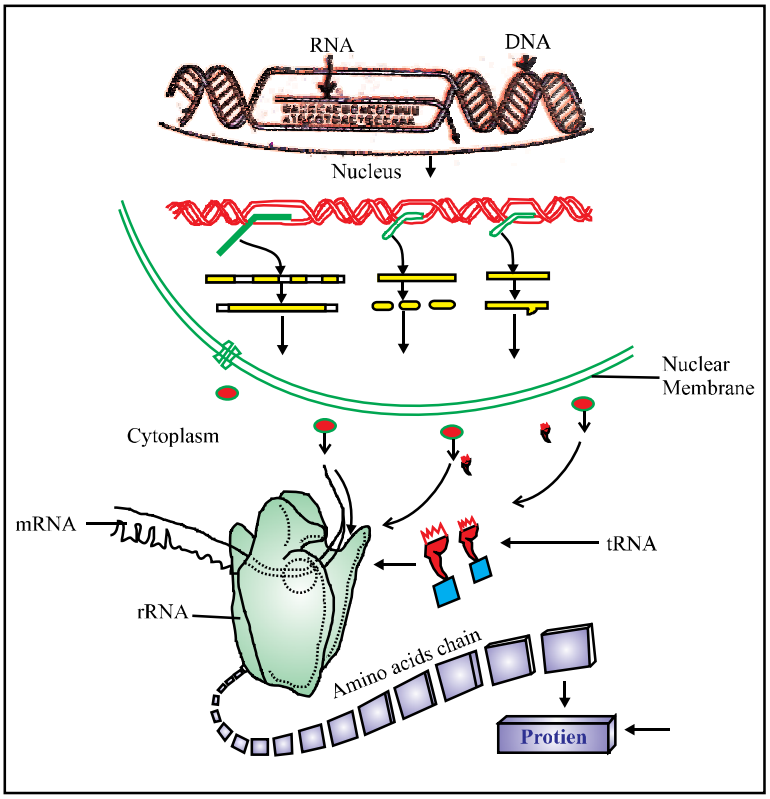
Translation

- 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 tRNA or aminoacylation of rRNA-here amino acids are activated in the presence of ATP and linked to specific tRNA.
- **Initiation :** Ribosome binds to mRNA at the start codon (AUG) that is recognized by the initiator tRNA.
- **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 with rRNA codon. The ribosomes move from codon to codon along with mRNa. Amino acids are added one by one, translated into polypeptide sequences.
- **Termination :** Release facotors 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 inducer (lactose)

Repressor binds to inducer (lactose)

↓

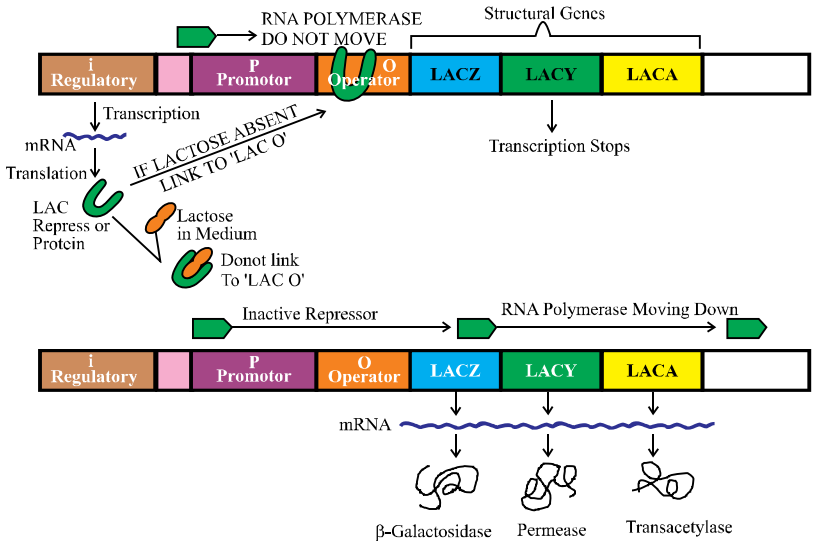
Operator (O) turns ON

↓

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 approzimately 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.

Methodologies-2 major approaches

Expressed Sequences Tags (ESTs) (identifying all genes that are expressed as RNA	Sequence Annotation (Blind approach of simply sequencing the whole set of genome)

Steps for Sequencing :

- DNA isolated from cell and converted into fragments.
- DNA is cloned for amplification is suitable host using specialssed vectors.
- Commonly used hosts—Bacteria, Yeast
- Commonly used Vectors—BAC (Bacterial Artifical 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— $ 200 million.
- India joined in June 2000 and chose 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 of 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 the father.

Steps/Procedure in DNA Fingerprinting

- Extraction of DNA—using high speed refrigerated centriguge.
- 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.

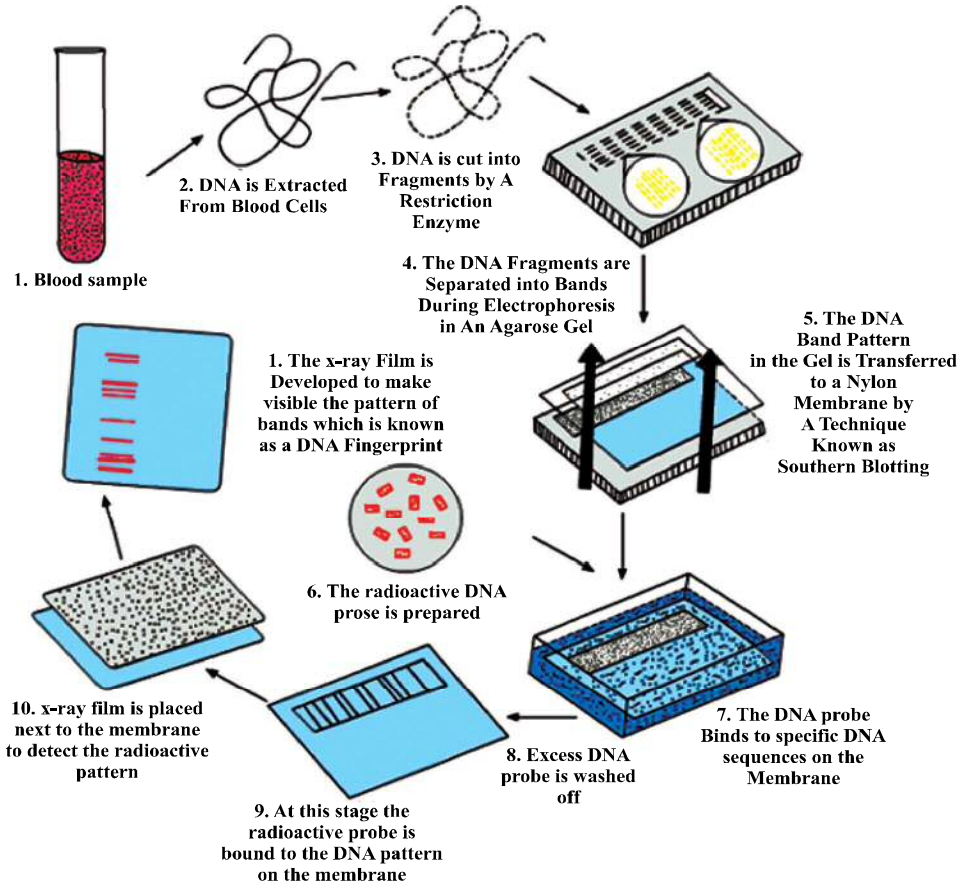
Applications of DNA Fingerprinting

(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) identity racial groups to rewrite biological evolution.

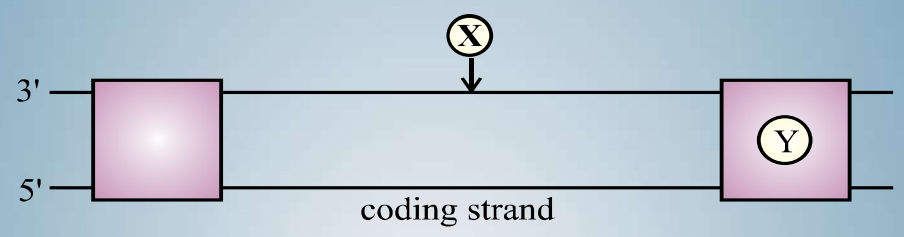


The DNA Fingerprinting Process

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.



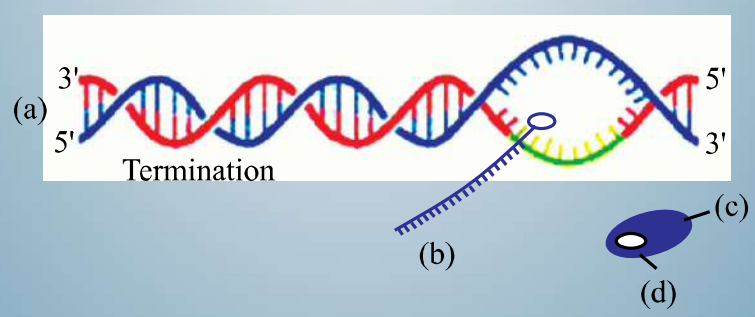
4. Name the two initiating codons
5. Write the segment of RNA transcribed from the given DNA

   3′ – A T G C A G T A C G T C G T A – 5′ – Template Strand

   5′ – T A C G T C A T G C A G C A T – 3′ – Coding Strand.

SA-I **(2 Marks)**

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



7. Give two reasons who both the standard of DNA are not copied during transcription.
8. State the 4 criteria which a molecule must fulfill to act as a genetic material.

SA-II **(3 Marks)**

9. Give six points of difference between DNA and RNA in their structure chemistry and function.
10. Explain how does the hnRNA becomes the mRNA.

OR

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

11. Name the three major types of RNAs, specifying the function of each in the synthesis of Polypeptide.
12. 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)**

13. State salient features of genetic code.
14. Describe the process of transcription of mRNA is an eukaryotic cell.
15. Describe the various steps involved in the technique of DNA fingerprinting.

Answers

VSA **(1 Mark)**

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')

SA-1 **(2 Marks)**

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

7. (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)

8. (i) It should be able to generate its replica.

(ii) Should be chemically and structurally stable.

(iii) Should be able to express itself in the form of Mendelian characters.

(iv) Should provide the scope for slow changes (mutations) that are necessary for evolution.

SA-II **(3 Marks)**

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

10. 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

11. (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.

12. (a) UAC (b) AUG

(c) Amino-acyl-tRNA synthetase.

LA (5 Marks)

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

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

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

Chapter - 7

Evolution

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 : Chance elimination of genes 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 speds 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 have same basic structure and embryonic origin but perform different functions in different species.

Example :

Plants—Thorns of *Bougainvilla* and tendrils of cucurbita

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

Analogous organs : These organs are different in their basic structure and embryonic origin out 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 75000 volts of energy 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 protien 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 siits are functional only in fish.

Ernest 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.

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)

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 Industralisation 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. Some Facts :

Brief Account of Evolution

- 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 coelocanth 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, Hand & 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 **:** 5 lakhs 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 ?

SA-I (2 Marks)

4. Explain Oparin-Haldane theory of chemical evolution of life.
5. How do Darwin and Hugode varies differ regarding mechenism of evolution ?
6. How did Louis Pasteur disprove spontaneous generation theory ?
7. What are the two key concepts of Darwinian theory evolution ?

SA-II (3 Marks)

8. (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 ?
9. 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.
10. 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.
11. 'Industrial Melanism' in peppered moth is an excellent example of 'Natural election'. Justify the statement.

12. 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

13. (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*.

14. 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?

15. Give examples to show evolution by anthropogenic action.

LA **(5 Marks)**

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

Answers

VSA **(I Mark)**

1. Very high temperature, volcanic storms, Reducing atmosphere containing CH4, NH3, H2 and water vapours.
2. Thomas Malthus.
3. Alfred Wallace, Malay Archipelago

SA - I **(2 Marks)**

4. 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.
5. Dawrin : Darvanian variation are small, gradual and directional Hugo de Varies : Variation are sudden, randon and direction less.
6. 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.
7. Branching descent and natural selection.

SA - II **(3 Marks)**

8. (i) The allele frequency in a population are stable and constant from generation to generation.
   (ii) Evolution. (iii) One.
9. (i) Homology (ii) Analogy
   (iii) Analogy (iv) Analogy
   (v) Analogy (vi) Homology
10. (i) To prove Oparin's theory of origin of life.
    (ii) Electric discharge using electrodes.
    (iii) One week; Amino acids and Sugar.
11. Refer Page 131, NCERT Text book of class XII.
    (a) Quaternary (b) Coenozoic (c) Cretaceous
    (d) Mesozoic (e) Carboniferous (f) Paleozoic

13. (i) Near Eastern and Central Asia

(ii) 1400 c.c.

(iii) More brain capacity, use of hides to cover body and burial of dead.

14. (a) Galapagos Island.

(b) Adaptive radiation—Refer page 133, NCERT book.

(c) Through sea voyage in a sail ship called H.M.S. Beagle.

15. 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)**

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

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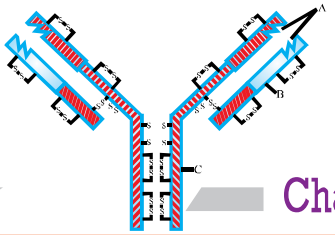


Chapter - 8

Human Health and Disease

Addiction : A psychological attachment to effects like euphoria and temporary well being associated with drugs and alcohol.

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 tire 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	*Salmonalla typhi*	sustained higher fever, stomach pain, loss of appetite, constipation, headache.
3. Pneumonia	*Streptococcus pneumoniae* and *Haemophilus influenzae*	fever, headache, cough, chills in sever cases finger nails may turn grey to bluish in colour

4. Malaria	*Plasmodium viz P. malaria, P. vivax. P. falciparum*	acute headache, muscular pain, feelings of chillness and shivering, nausea and high temp eratures.
5. Amoebic dysentry	*Entamoeba histolytica*	Adbominal pain, cramps, stool with excess mucus and blood clots, constipation.
6. Ringworm	*Microsporum, Epidermohyton 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 vessles, enormous swelling of affected part viz. arm, foot. leg, mamma or scrotum

Dengue

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

Vector—Female mosquito *Aedes aegypti*

Types

Classical Dengue fever	Dengue Haemorrhagic fever
Symptoms-high fever, headache, backache, joint pains, muscles pain, chill, rashes or arms, chest, back	Symptomes-high fever, nausea, vomiting, abdominal pain, palpable liver, internal bleeding, fall in platelets **Drugs :** Paracetamol + blood platelet resplacement Aspirin and dispirin is harmful.

Chikungunya

Caused by—*Alpha virus*

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

Symptoms—rashes on limbs and trunk, asrthritis of multiple joints, fever (102–104°F), conjuctivities 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) A Sexual Phase

- When female anaphelies mosquito bites human sporozoites (infective stage) are injected into blood stream.
- Parasite reaches the lived cells and multiply.
- Level cell brust releasing parasite into the blood.
- Parasite than 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 stomach.
- 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 : inherited by the organism from the parents 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 macrophases

(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.

Acquired Specific Immunity
(Defense Mechanism)

Antibody Mediated Immune System	Cell Mediated Immune System
↓	↓
Antibodies produced by B-cells circulating in blood and lymph defend against virus and bacteria that enter blood.	T-cells protect against pathogens that inavade thet host.
No role in graft rejection	Play role in graft rejection

- 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 affects.	May show side effects like allergic reaction.
4. It lasts for long period.	It lasts for limited period.

Vaccinaition : 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 quikly on subsequent exponsure a 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.

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 play 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 organs. Lymphocytes maturing here are called B-lymphocytes.

Thymus : Lymphocyte which mature 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, anilene 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.
- **Detection and diagnosis**—By radiography (X-rays), CT Scan, MRI, Biopsy.

Drugs

Criteria	Opiods	Cannabinoids	Coca alkaloids
Source	*Papaver sominiferum* (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

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. dapomine.

Adverse Effects :

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

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

Withdrawl Symptoms : Depdence or addiction is a state of compulsion to take drug in absence of which body shows withdrawl symptons 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
- Nausea, vomiting
- Influence body coordinations
- Economic loss to family

Preventing Alcohol/Drug Abuse

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

Questions

VSA **(I Mark)**

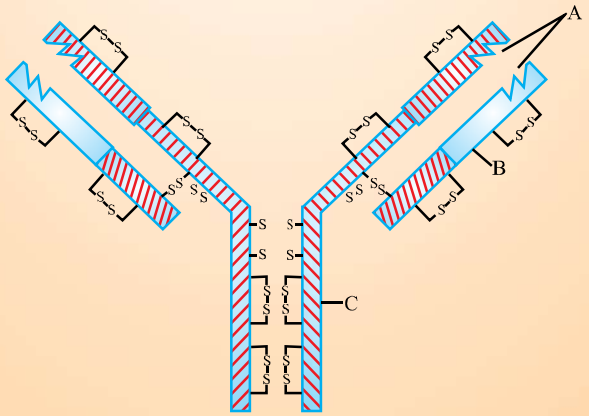
1. Name the diagnostic test which confirms typhoid.
2. You have heard of many indicences of Chickengunya in our country. Name the vector of the disease.
3. Breast fed babies are more immune to diseases than the bottle fed babies. Why ?
4. Name the pathogen which causes malignant malaria.

SA-I **(2 Marks)**

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

SA-II **(3 Marks)**

8. 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.



9. 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.
10. 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 ?

Retrovirus

↓ Virus infects normal cells.

Viral RNA is introduced in host cell

↓ Reverse transcription

(1)

↓ Viral generatic material in nucleus of the cell

Viral DNA incorporates into host genome

↓

(2)

↓

New Viruses are produced

LA **(5 Marks)**

11. 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.
12. 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.
13. 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.

Answers

VSA **(1 Mark)**

1. Widal test
2. Aedes mosquitoes.
3. The mother's milk consists of antibodies (lgA) such antibodies are not available to bottle fed babies.
4. *Plasmodium falciparum.*
5. 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.

6. 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.

7. 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)**

8. (a) A-Antrigen binding, B-Light chain, C-Heavy chain

   (b) B-lymphocytes.

   (c) Heavy Chain

   (d) Antibodies provide acquired immune response.

9. (a) Allergy (b) Allergens

   (c) Mast Cells—Histamine, Serotonin

10. (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 suivive.

LA **(5 Marks)**

11. (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.

12. (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

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

(ii) HIV (Human Immunodeficiency Virus)

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

(iv) Preventive measures :

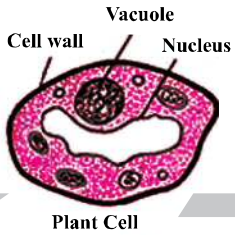
(a) People should be educated about AIDS transmission.

(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.



Chapter - 9 Strategies for Enhancement in Food Production

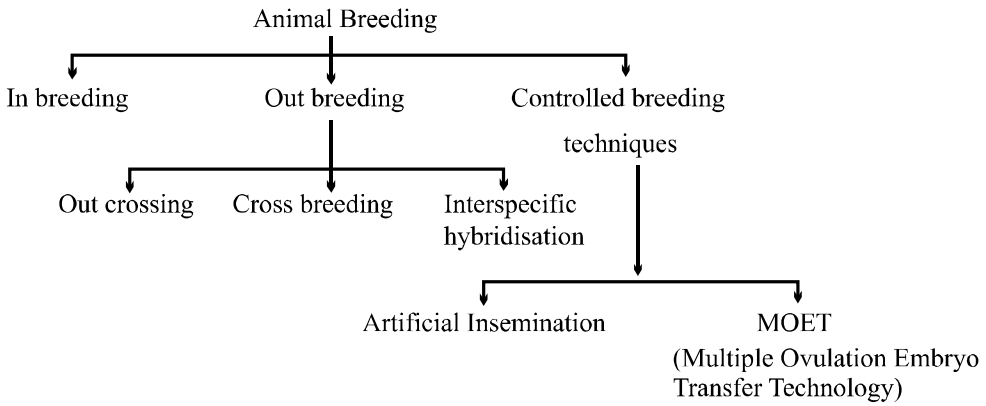
Apiculture : Rearing of honeybees for the production of honey, beewax, royal jelly and bee Venom.

Artificial insemination : Introduction of semen of good quality of male into the vagina of female by artificial means.

Explant : Any part of plant excised from its original location and used for tissue culture.

Germplasm Collection : The entire collection having all the diverse alleles for all the genes in a given crop.

Totipotency : The ability or capacity of a cell or explant to give rise to a complete plant is called totipotency.



Inbreeding : Inbreeding refers to the mating of more closely related individuals within the same breed for 4-6 generations.

Out-breeding : Out-breeding is the breeding of the unrelated animals, which may be between individuals of the same breed (but having no common ancestors), or between different breeds (cross breeding or different species (interspecific hybridisation).

Inbreeding depression : Continued close inbreeding decreases the fertility and productivity.

- **Out crossing :** Out-breeding is the breeding of the unrelated animals, which may be between individuals of the same breed (but having no common acestors), or between different breeds (cross breeding or different species (interspecific hybridisation)

- **Cross breeding :** The practice of mating of animals of same breed but have no common ancestor on either side of pedigree upto 4-6 generations. A single outcross helps to overcome the inbreeding depression.

The Multiple Ovulation Embryo Transfer (MOET) : Technology can improve the success rate of fertilisation. In the procedure, a cow is given hormonal treatment (FSH), so that more than one ova/eggs (6-8) are produced per cycle. After mating or artificial insemination the embryos at 8-32 celled-stage are transferred to different surrogate mother cows. This technology has been successfully used for cattle sheep, rabbit, mares and buffalloes.

Abbreviations

ET	:	Embryo Transfer
IARI	:	Indian Agricultural Research Institute
IRRI	:	International Rice esearch Institute
ICAR	:	Indian Council of Agriculture Research
MOET	:	Multiple Ovulation Embryo Transfer
NDRI	:	National Dairy Research Institute

Bee-keeping

Apiculture or Bee-keeping is the maintenance of hives of honeybees for the production of honey. Apiculture is beneficial for farmers in many ways. Honey bee also produces beewax which in used in industries, such as in preparation of cosmetics and polishes of various kinds. If Bee-keeping if practiced in any area the commercial flowers are cultivated, it will be beneficial in the following ways.

(i) Bees are pollinators of many crop species including flowering crops such as sunflower.

(ii) It improves the honey yieid, because honeybees collect the nectar from flowers for making honey. *Apis Indica* is the most common species which is reared in India.

Management of fisheries :

(i) Fresh water fishes : *Catla, Rohu*, *Common Carp*

(ii) Marine fishes : *Hilsa*, Sardines. Mackerel and Pomfrets etc.

Aquaculture and Pisciculture : The production of useful aquatic plants and animals (both freshwater and marine) like fishes, prawns, lobsters end edible oysters is called aquaculture while the production of fishes only is called pisciculture.

Blue Revolution : Increase in fish production due to utilisation of modern technology.

Plant breeding : Manipulation of plant species to create plants with desired qualities like high yield and disease resistance.

Main steps in breeding a new genetic variety of crop :

(i) Germ-plasm collection or collection of variability

(ii) Evaluation and selection of parents

(iii) Cross breeding or hybridisation of selected parents.

(iv) Selection and testing of superior recombinants

(v) Testing, release and commercialisation of new cultivars.

High Yielding Varieties :

(i) Wheat : *Sonalika, Kalyan Sona.*

(ii) Rice : IR-8, *Jaya, Ratna, Padma*

(iii) Sugarcane :

Saccharum officinarum	***Saccharum barberi***
(South Indian)	**(North Indian)**
Thick stem, High Sugar content	Poor Sugar content and yield
(did not grow in North India)	

Hybrid
High yield, thick stem,
high sugar content
It can grow in North India

Diseases of Plants :

(i) **Viral :** Tobacco mosaic, turnip mosaic

(ii) **Bacterial :** Black rot of crucifers, Blight of rice

(iii) **Fungal :** Rust of wheat, red rot of sugarcane, late blight of potato.

Mutation : Sudden inheritable change in the characters of an organism due to change in the sequence of bases in the gene(s).

- Mutation results in a new character or trait, not found in the parental type.
- It can also be induced by using mutagens like gamma radiations.
- Such plant materials are used as such or used for breeding new varieties.
- Mung bean resistance to yellow mosaic virus and powdery mildew.

Mutational breeding : When mutations are artificially induced and such plants with desirable traits are selected. This process is called mutational breeding.

Steps of mutational breeding : Mutations are induced by physical (low or high temperature) chemical (hydrazines, nitrous acid) or radiations (x-rays)

- Mutants are tested for the desired trait
- If desired trait obtained then they are used to transfer this trait to desirable varieties

e.g. mung bean obtained resistant to yellow mosaic virus.

Biofortification :

Biofortification is the plant breeding programme designed to increase vitamins, minerals, higher proteins and healthier fat content in crops. This programme improves the quality of food products. It is required to prevent hidden hunger. Some of the examples of fortified crops are :

(i) **New hybrid of maize :** twice the amount of amino acid lysine and tryptophan.

(ii) **Wheat :** Atlas 66, having a high protein content

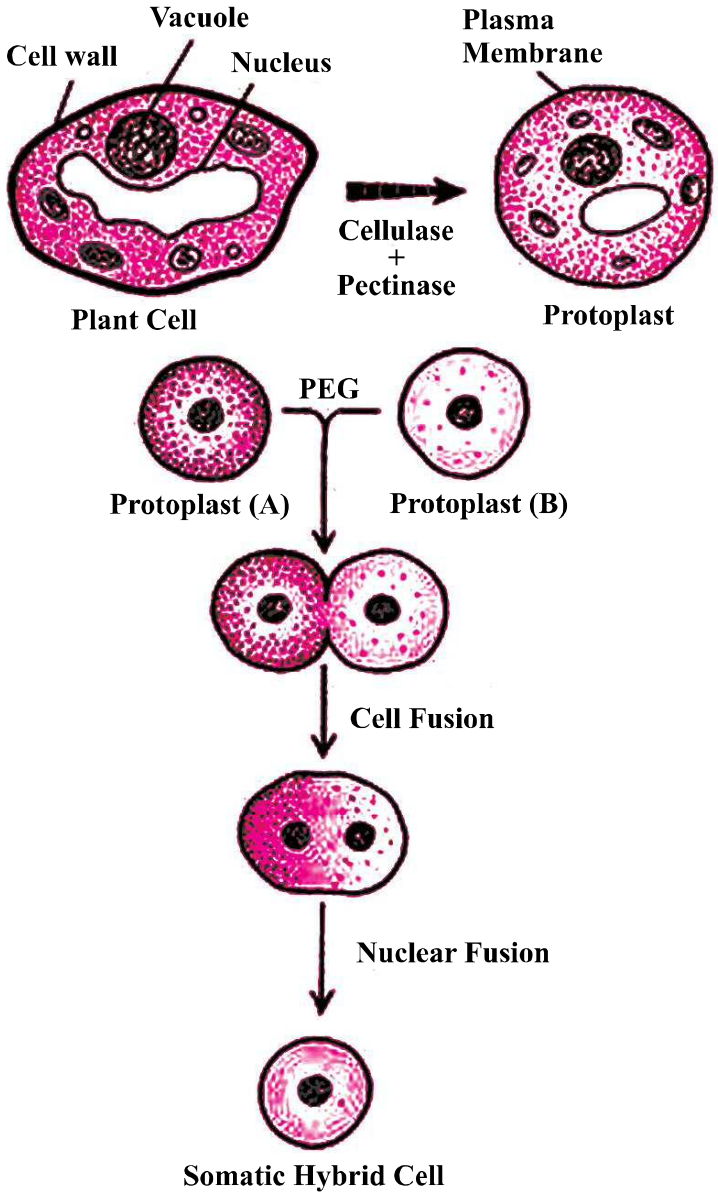
(iii) **Rice :** 5 times iron than the normal amount. IARI Delhi has released several crops which are rich in vitamins and minerals. Consumption of such biofertised food will vastly improve the public health.

Single Cell Protein (SCP) : Protein Rich food obtained from microbes such as algae, bacteria, yeast e.g. *Methylophilus, methylotrophus, spirulina*, Mushrooms.

It is a quick method of protein production because the growth rate of microbes is enormous.

Tissue Culture : In this method any vegetative part of plant such as leaf, stem or meristem is placed in a nutrient medium containing Sugar, Salt, Vitamins and growth regulator under optimal condition. This give rise to plants identical to parent plant.

This method is used for micropropagation as thousands of plants which are genetically identical to parent plant (Somaclones) can be obtained in a short duration.



SOMATIC HYBRIDISATION

QUESTIONS

VSA **(I Mark)**

1. Why is inbreeding necessary in animal husbandry ?
2. Which product of Apiculture is used in cosmetics and polishes ?
3. Semi-dwarf varieties of a crop plant were derived from IR-8. Name that crop.

SA - I **(2 Marks)**

4. A new breed of sheep was developed in Punjab by crossing two different breeds of Sheep. Name the two breeds which were crossed and the new breed developed.

   Study the table given below and fill in the blanks marked A, B, C and D

S.No.	Crop	Variety	Resustant to Disease
1.	Wheat	Himgiri	(A)
2.	*Btassica*	(B)	White rust
3.	(C)	Pusa Komal	Bacterial blight
4.	Chilli	(D)	Chilly mosaic Virus, Tobacco mosaic Virus and leaf curl

6. Enlist objective of breeding for improved nutritional quality.
7. To which product, the following are related (a) Blue revolution (b) White revolution (c) Green revolution.
8. Write disadvantages of continuous inbreeding.

SA-II **(3 Marks)**

9. What is micropropagation ? Why are plant produced by this techneque called somaclones ? Name any two plant which are produced by this method.

LA **(5 Marks)**

10. Briefly describe various steps involved in the development of improved varieties of crop.

ANSWERS

VSA **(1 Mark)**

1. Inbreeding increases homozyosity/accumulate superior genes/eliminate less desirable gene/exposes harmful recessive gene which is eliminated by selection.
2. Beewax.
3. Paddy crop (rice)

SA-I **(2 Marks)**

4. By crossing Bikaneri ewes and Marino rams, the new breed *Hisardale* was developed.
5. A—Leaf and Stripe rust, hill bunt.

   B—*Pusa swarnim* (Karan rai).

   C—Cowpea

   D—*Pusa Sadabahar*
6. **Objective are :** (i) Protein content and quality

   (ii) Oil content and quality

   (iii) Micro nutrient and mineral content

   (iv) Vitamin content.
7. (a) Fish production (b) Milk production

   (c) Crop production
8. Inbreeding causing inbreeding depression, reduces firlity and even productivity.

SA-II **(3 Marks)**

9. • The method of producing many plants through tissue culture is called micropropagation.

   • The plants produced by micropropagation will be genetically identical to the original plant from which they were grown, hence are called somaclones.

   • Tomato, banana, apple.

LA **(5 Marks)**

10. Refer Page No. 171 NCERT Text Book Class-XII.

Chapter - 10

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 fertilizers 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. lady bird beetle can eradicate aphids.

Thermal vents : The sites deep inside the geysers/hot springs and oceams where the average temp 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 infections protien)

Microbes in Household Products

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

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

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

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 (Bt-cotton)
(iii)	*Nucleopolyhedrovirus* (Baculoviruses)	Virus	Kills insects and other arthropods.

Microbes as biofertilizers.

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 2-fixation enrich nitrogen 2-content of soil.

Mycorriza : Symbiotic; association of fungi with roots of higher plants. Fungi help in absorption of phosphorous from soil. It belong to genus *Glomus* Provide 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, *Anabaene, Oscillatoria*.

In paddy fields, these acts as biofertilisers.

Microbes in Industries

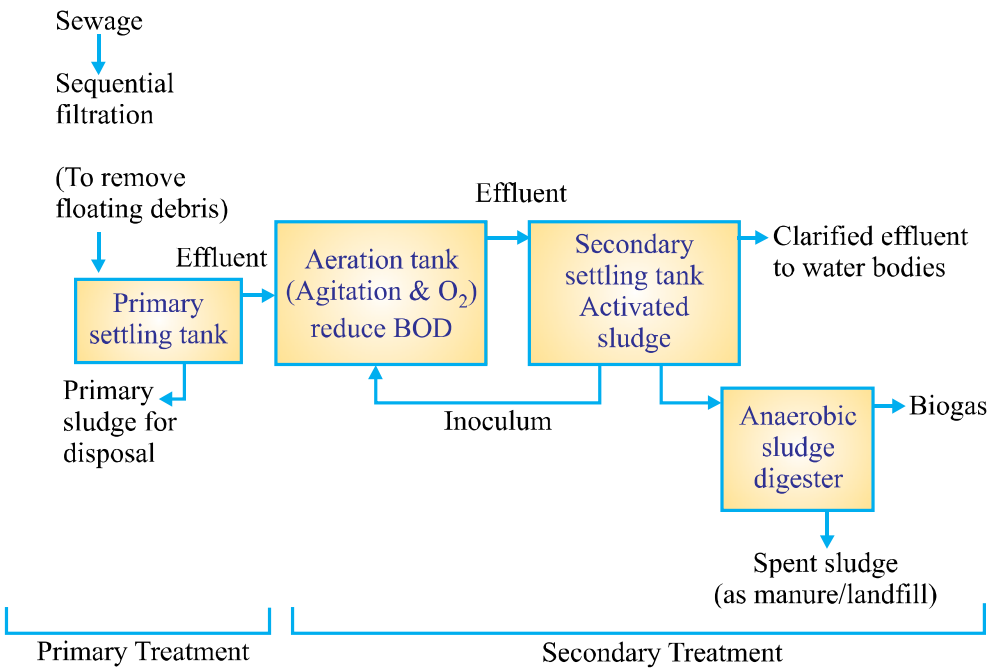
(a) Fermented Beverages : Liquid food made by anaerobic digestion of carbohydrate rich food is called beverage. *Saccharomyces cerevisae* (yeast) is also used to make bread, fermented fruit juice and alcohol.

(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	
7.	*Monascus purpureus*	Fungus (Yeast)	Stain	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 stoping 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 docter till course get completed.
- Avoid overuse 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.

SA-I **(2 Marks)**

5. Name two alcoholic drinks produced in each of the following ways.
   (i) by distillation and
   (ii) without distillation.
6. 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.
7. 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)**

8. 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 suppressive agent
5.	*Saccharomyces cerevisiae*	ethanol	(e)
6.	(f)	Swiss cheese	Food Product

9. 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 ?

10. 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).....

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.

SA-I (2 Marks)

5. (i) Whisky, brandy, rum—by distillation

   (ii) Wine, beer - without distillation

6. (i) LAB in human intestine synthesizes Vitamin B_{12}.

   (ii) LAB in human stomach checks the growth of harmful microbes.

7. 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)

8. (a) to kill disease causing bacteria

   (b) *Lactobacillus*

   (c) remove clots from blood vessels

   (d) Cyclosporin A

   (e) Beverage/medicines

   (d) *Propionibacterium sharmanii*.

9. 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.

10. (a) Primary treatment

    (b) Aeration

    (c) Flocs

    (d) Biochemical oxygen Demand (BOD)

    (e) Activated sludge

    (f) Water bodies like river.

❑ ❑

Chapter - 11

Biotechnology Principles and Processes

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.'

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 enginneering process of growth of desired microbe or cell in large quantity to obtain bio-technological product like enzyme, antibiotic, vaccine etc.

First Artificial re-Combinant 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.

Tools of Recombinant DNA Technology

- Enzymes
  1. Cleaving enzymes
     (a) Exonucleases
     (b) Normal Endonucleases
     (c) Restriction endonucleases
  2. Lysing enzymes
  3. Synthesizing enzymes
  4. Joining enzymes
  5. Alkaline phosphatases
- Cloning Vectors (Carriers) (Plasmid, Bacteriophage)
- Competent Host (For transformation with recombinant DNA)
  - Chemical
  - Electroporation
  - Biolistic technique (Particle bumbardment Gene Gun method)
  - Micro-injection

(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 with in 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 amyloliquefaciensh*	↓ 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	*Halmophilus 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′

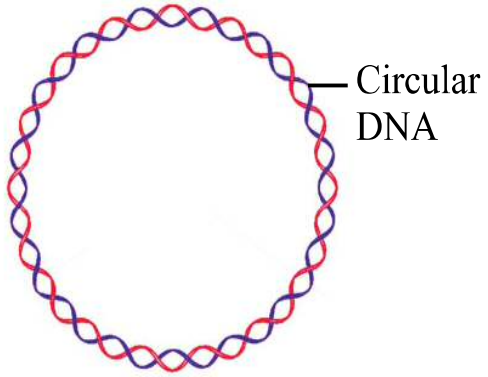
3′—CTTAAG—5′

Complementary DNA (cDNA) : A DNA strand formed from mRNA by using the enzyme reverse transcriptase.

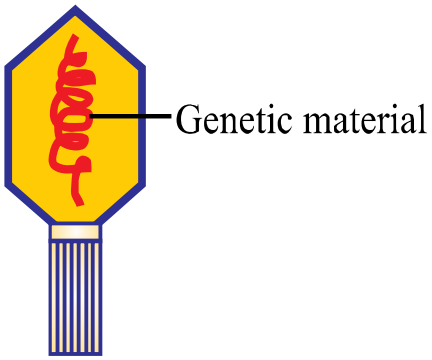
Cloning Vectors : A small, self-replicating DNA molecule into which foreign DNA is inserted. It replicates inside the host cell. The vectors that may be used in genetic engineering are plasmids, bacteriophages, animal, plant, virus, YACs and BACs and some yeasts.

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 Hays and Joshua Leduberg in 1952. The most widely used vector in cloning is pBR322.

Bacteriophage : A virus which infects bacteria is called bacteriophage.



Plasmid



Bacteriophage

Ti Plasmid : It is an extrachromosomal, double stranded and self replicating DNA molucule found in *Agrabacterium tumifaciens*. If 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 choromogenic 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 :

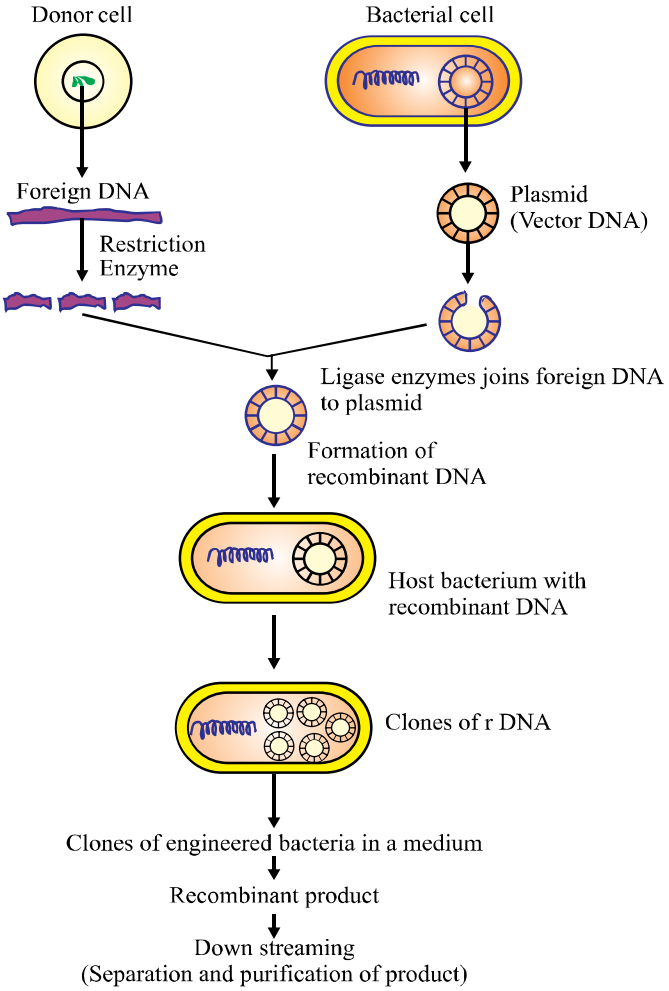
The presence of chromogenic substrate gives blue coloured colonies of bacteria, hence these bacterial colonies are non-recombinant.

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 biacterial 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 *in vitro*. 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

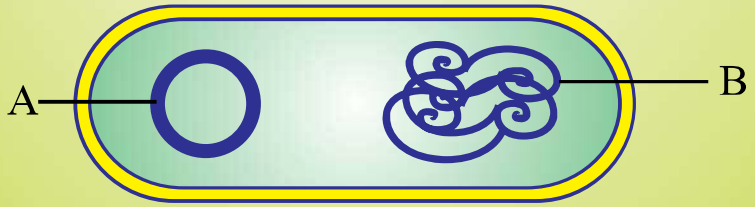
VSA **(I Mark)**

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′

SA- I **(2 Marks)**

5. Name two main steps which are collectively referred to as down streaming process. Why is this process significant ?
6. How does plasmid differ from chromosomal DNA ?
7. (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.



8. 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)**

9. 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.

10. 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.

11. Why is "*Agrobacterium*-mediated genetic engineering transformation" in plants considered as natural genetic engineering ?

12. 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 ?

13. 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)**

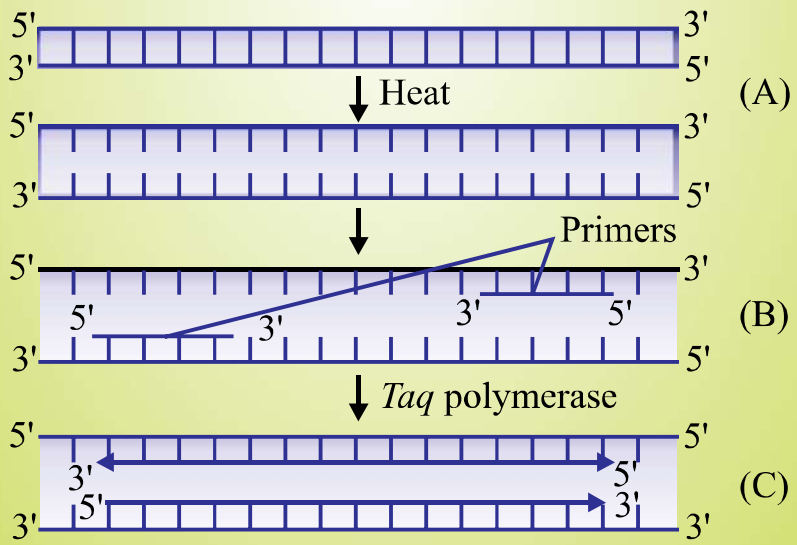
14. The development of bioreactors is required to produced large quantities of products.

(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 ?

15. In the given figure, one cycle of polymerase chain reaction (PCR) is shown :

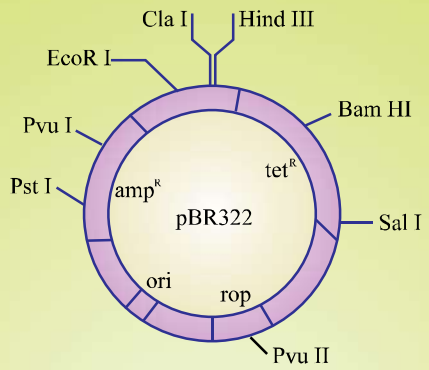


(a) Name the steps A, B and C.

(b) Give the purpose of each of these steps.

(c) State the contribution of *Thermus aquaticus* in this process.

16. 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.

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′

   ↑

SA-I **(2 Marks)**

5. • Separation and Purification

   • This process is essential because reaching into market, the product has to be subjected for clinical trial and quality control.

6.

	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.

7. (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)**

9. (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 tunguston particles, coaled 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.

10. (i) Have origin of replication(Ori)

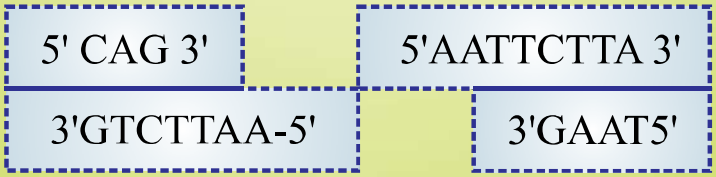
(ii) a selectable marker

(iii) at least one recognition site.

11. *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.

12. (a) EcoRI

(b)



(c) These are named sticky ends, because they form hydrogen bonds with their complementary cut parts.

13. (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)**

14. (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.

15. (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.

16. (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.

❑ ❑

Chapter - 12 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.

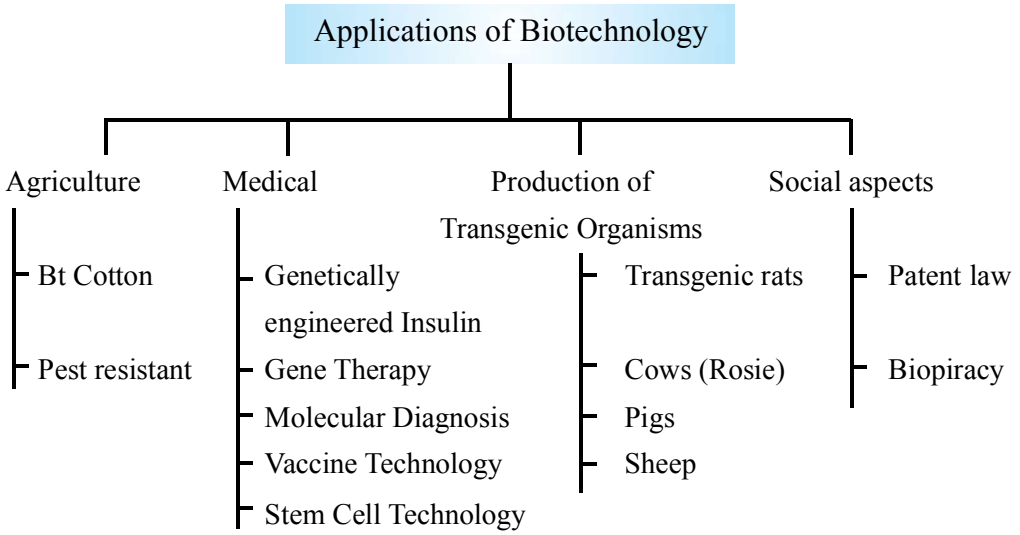
e.g. Bt Cotton, Bt Corn, Transgenic rat, Transgenic cow-Rosie

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.

- Of the nucleotide 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 at 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 infectiouns 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 generated it.

(iii) Vaccine is made by adding adjuvant (to increase immune response of antigen), Stabilizers (to increase storage life) and preservatives (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

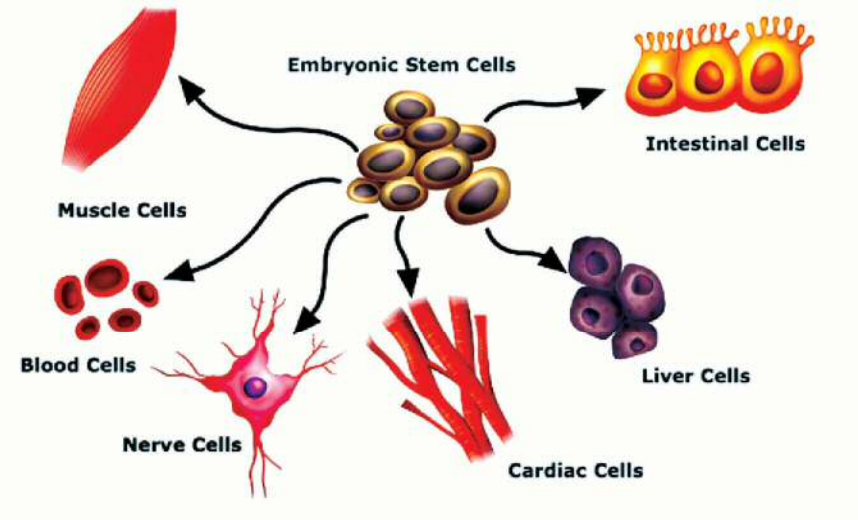
Stem Cells are undifferentiated cells which are able to grow in any type of tissue with specialized function. Stem cells are involved in development, growth and repair in multicellular organisms. Stem cells are used to treat many diseases such as type-I diabetes, heart diseases, cancer, Spinal injuries, 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, umbelical cord and amniotic fluid.

There are three Categories of stem cells :

1. **Embryonic stem cells :** They easy embryo cells are removed 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 *invitro* fatilisation of an egg.
- The Cells are cultured and allow to grow into cells 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 it 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/nature 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, Aizheimers 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 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 pantent 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 ?

SA-I **(2 Marks)**

4. Can a disease be detected before the appearance of its symptoms ?
6. How does a probe used in molecular diagnosis.

7. GEAC is one of the organization set up by Indian Government. Write its full form. Give its two objectives.

SA-II **(3 Marks)**

8. 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.

   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 ?

10. 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)**

11. 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 Iymphocytes.

↓

(D) .....

Observe the therapeutical flow chart and give the answer of the following:

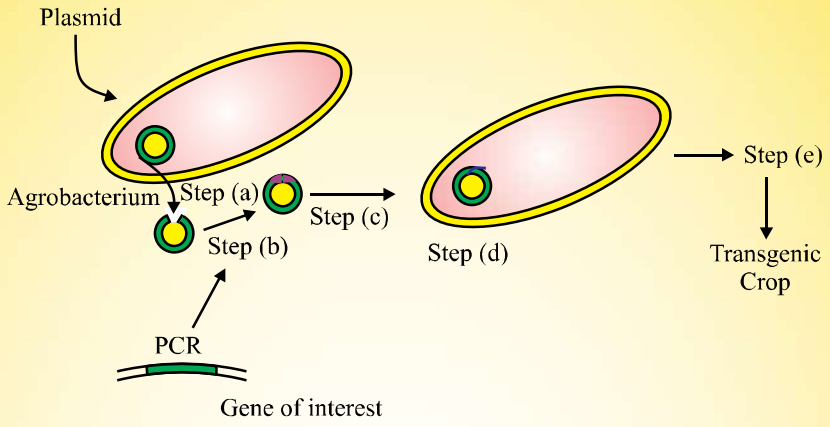
(a) Complete the missing steps (B) and (D)

(b) Identify the disease to be cured.

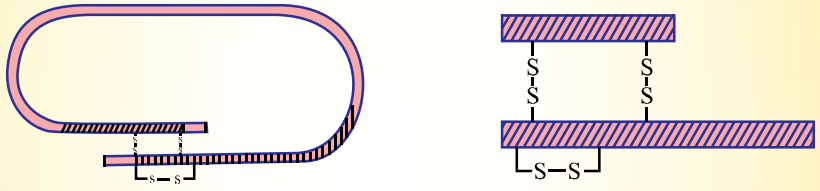
(c) Why the above method is not a complete solution to the problem ?

(d) Scientists have developed a method to cure this disease permanently. How ?

12. 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.



13. 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.

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.

SA-I (2 Marks)

5. Yes, early detection of disease is possible by the use of recombinant DNA technology, PCR, ELISA.

6. 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.

7. 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)

8. (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.

9. (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.

   (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.

10. (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)

11. *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.

12. 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.

13. (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.

Chapter - 13

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 Mishra 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.

Ecosystem : Is a biological system in nature and composed of a biotic community integrated with its physical (abiotic) environment through the exchange of energy and recycling of the nutrients.

Biomes : Biomes is a very large unit, constituting of a major vegetation type and associate fauna found is a specified zone. Annual Variations is the intensity, duration of temperature and precipitation account for the formation of major biomes like desert, rain, forest and Tundra.

Major Biomes of India : Tropical rain forest, deciduous forest, desert, sea coast. Regional and local variations within each biome lead to formation of a wide variety of habitats.

Habitat : Habitat is the place where an organism lives.

Niche : The ecological niche of an organism represents the range of conditions that it can tolerate the resources it utilises and its functional role in the ecological system. Each species occupies a distinct niche and no two species occupy the same niche.

Biosphere : It is the sum total of all the biomes on the earth.

Environment : Environment is a sum total of all biotic and abotic factors that surround and potentially influence an organism. Temperature, water, light and soil are the major abiotic factors.

Major Abiotic factors

1. Temperature : It significantly affects the (a) Latitudinal and Attitudinal distribution of organisms (b) Enzyme kinetics and basal metabolism.

Eurythermal : Organisms which can tolerate and thrive a wide range of temperatures e.g. : Mammals, birds.

Stenothermal : Organisms which can tolerate and thrive a restricted narrow range of temperature. e.g. : Polar bears, penguins.

2. Water : Quantity and quality of water significantly affects the distribution of organism, pH, Salinity and chemical composition is important to aquatic organisms.

Euryhaline : Organisms which tolerate a wide range of salinites e.g. *Salmon*.

Stenohaline : Organisms which are restricted to a narrow range of salinites e.g. : Shark.

3. Light : Light affects significantly the production in autotrophs, photoperiodism and behavioural and physiological adaptations in organisms living in low in intensities. For example dense forest with tall canopied trees and at the depth of oceans. It also affects diurnal and seasonal variations.

4. Soil : Soil is an important factor affecting the distribution of organisms. Properties of soil like grain size, mineral content, percolation, pH are significant in distribution of plants and animals.

5. Homeostasis : Is the ability of an organism to maintain consistent internal environment (for e.g. constant body temperature).

Population Attributes :

A population has certain attributes that an individual does not possesses. 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

$$\text{Population density} = \frac{\text{Number of individual in a region (N)}}{\text{Number of unit area in a region (S)}}$$

(ii) Birth rate or Natality Rate : It is expressed as the number of births per thousand individuals of a population per year

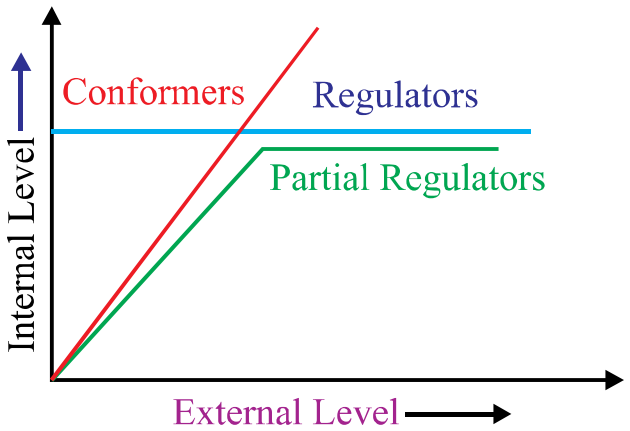
(iii) Death rate or Mortality rate : It is expressed as the number of deaths per thousand individual of a populations during a given period.

(iv) Sex ratio : It is expressed as the number of females per 1000 males of a population in given time.

Response to Abiotic Factors

(i) Regulators : Some organisms are able to maintain homeostastis by physiological (Some times behavioural) means which ensures body temperature, constant osmotic concentration. All birds and mammals, a very few lower vertebrates and invertebrates are regulators (Thermoregulation and osmoregulation). For example, human beings maintain their body temperature by sweating in summer and shivering during winter season. Plants do not have such mechanisms to maintain internal temperatures.

(ii) Conformers : Majority of animals and nearly all plants cannot maintain a constant internal environment. Their body temperature changes with the ambient temperature. In aquatic animals the osmotic concentration of the body fluids change with that of the ambient water and osmotic concentration. Some species have evolved the ability to regulate, but only over a limited range of environmental conditions, beyond which they simply conform.



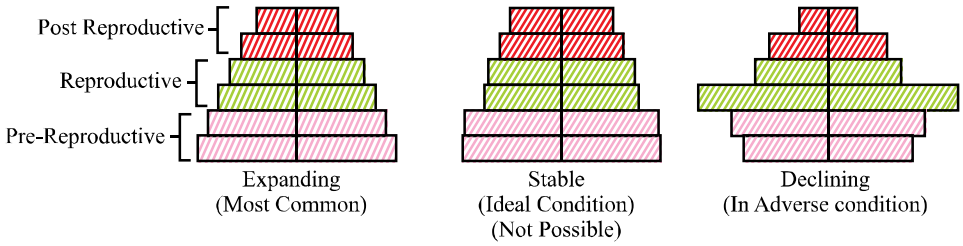
(iii) Partial regulators : Hairs on the body acts as heat insulator. Surface area and volume ratio. In smaller organisms the surface area is large as compared to the volume. But in large animal this ratio is small. So, the larger animals effectively controls the body temperature.

(iv) Migration : The organisms can move away temporarily from the stressful habitat to a more comfortable area and return when stressful period is over.

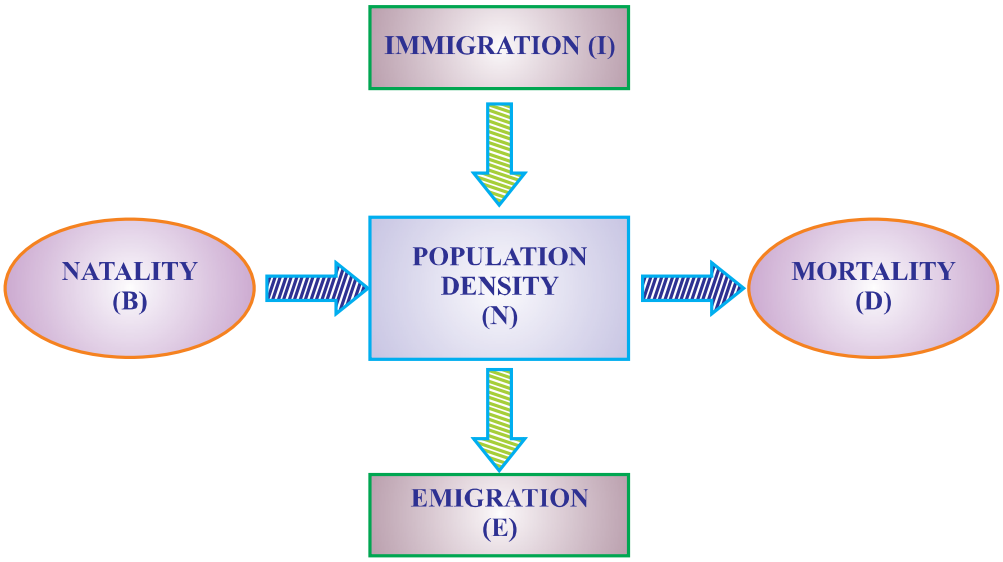
(v) Suspend : The organisms may avoid the stress by escaping in time. Bears go into hibernation during winter (winter sleep). Some snails and fish go into aestivation in summer (summer sleep).

Diapause (Stage of suspended development) in zooplankton, thick walled spores in bacteria, fungi and lower plants.

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 gome 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 :

$dN/dt = rN (K-N / K)$

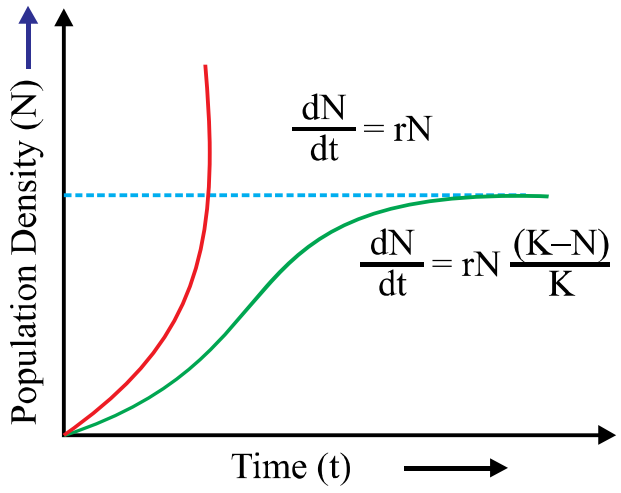
Where, N = Population density at time t

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.



Population Interactions :

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) Biological control methods to control pests

(ii) Carnivorous animals like tiger eating deers, snake eating frog

(iii) Insectivorous plants like *Nepenthes*, *Drosera*, *Utricularia*

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.

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 shoe flower 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.

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

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.

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

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

(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. Fresh water animals are unable to survive for long in sea water. Give reason.
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 ?

SA-I **(2 Marks)**

5. Differentiate between stenohaline and euryhaline organisms.
6. List four features which enable the Xeric plants to survive in the desert conditions.
7. How do stenothermal organisms differ from eurythermal organisms ?
8. Why do clown fish and sea anemone pair up ? What is this relationship called ?

SA-I **(3 Marks)**

9. 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)**

10. What is attitude sickness? What its causes and symptoms ? How does human body try to overcome altitude sickness ?
11. 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. Due to osmotic problems
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.

SA-I **(2 Marks)**

5. **Euryhaline :** Organisms tolerant in wide range of salinities.
   Stenohaline : Organisms tolerant to narrow range of salinities.
6. (i) thick cuticle
   (ii) Stomata in deep pits
   (iii) Stomata closed during day time
   (iv) leaves modified into spines (CAM photosynthetic pathway).
7. **Eurythermal :** Organisms that can tolerate and thrive in wide range of temperatures
   Stenothermal : Organisms restricted to a narrow range of temperature.

8. Clown fish lives in tentacles of sea Anemone and gets protection from predators.

Interaction-commensalism.

SA-II **(3 Marks)**

9. (a) fish caught per trap.

(b) number per unit area

(c) percentage cover in biomass.

10. Breathlessness at high attitudes.

Cause : Low atmospheric pressure at high altitudes due to which body does not get enough oxygen.

Symptoms : Nausea, fatigue and heart palpitations. Body adapts by :

(a) increasing red blood cell production

(b) decreasing binding affinity of haemoglobin

(c) by increasing breathing rate.

11.
- 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.

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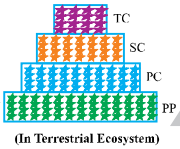


Chapter - 14

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.

Ecological succession : The successive and orderly replacement of one community by the other community in an area, over a period of time.

Climax community : The stable and final biotic community that develops at the end of ecological succession and is in perfect harmony with its physical environment.

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 :

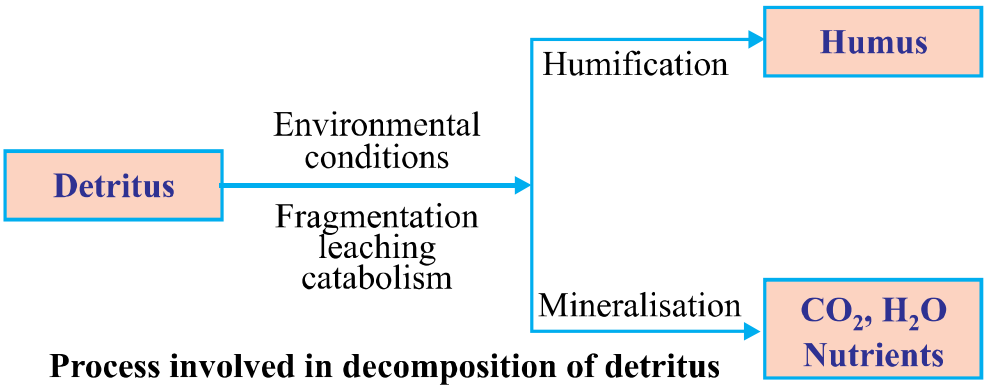
(i) **Fragmentation :** Break down of detritus into smaller particles by detritivores (earthworm).

(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 slower if detritus is rich in lignin and chitin and will 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). Unidirection flow of energy is taken 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 is made up of 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.

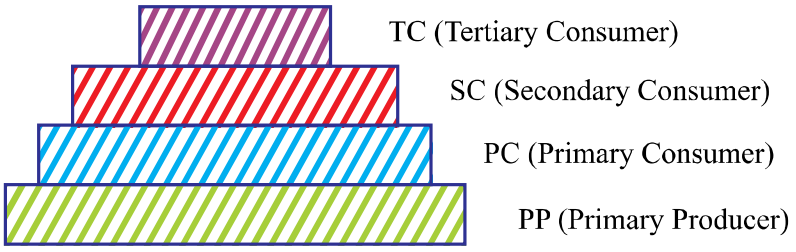
Ten Percent Law of Energy Transfer : Proposed by Lindeman. At each step of food chain, when energy is transferred from one tropic level to the next tropic level, only 10 percent of energy is passed on to the next trophic level.

Standing State : Amount of all the inorganic substances present in an ecosystem per unit area at a given time.

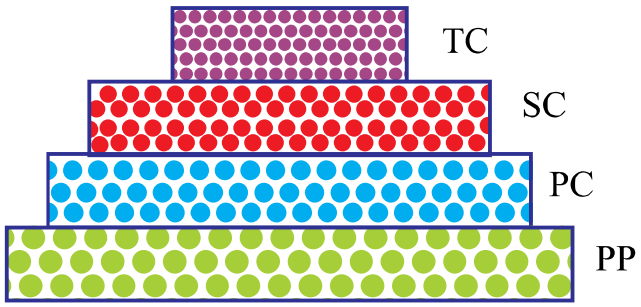
Standing Crop : Amount of living material present in different trophic levels at a given time. It is measured as the mass of living organisms or the number in a unit area.

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)

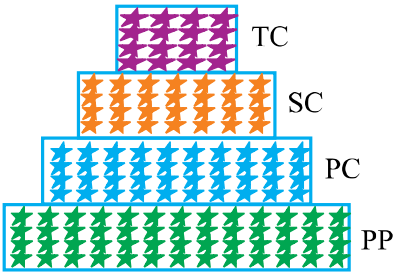


(ii) Pyramid of Energy : (Always upright in all Ecosystems)

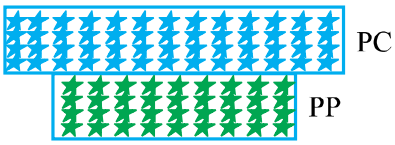


(In Terrestrial Ecosystem)

(iii) Pyramid of Biomass



(In Terrestrial Ecosystem)



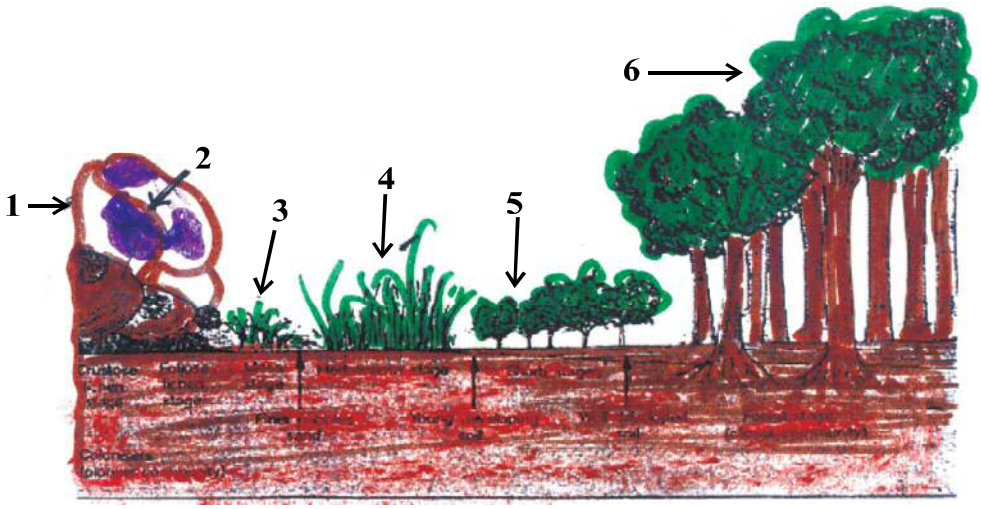
(In Aquatic Ecosystem)

Ecological Succession : The gradual and fairly predictable change in the species composition of a given area is called **ecological succession**. The species that invade a bare area is called pioneer species.

The entire sequence of communties that successively change in a given area is called sere. The stable and final biotic community that develops at the end of ecological succession and is in perfect harmony with its physical environment is called climax.

Xerarch :

Bare rock **1** → Lichen, moss stage (Pioneer Species) **2** → Annual herb stage **3** → Perennial herb stage **4** → Scrub Stage **5** → Forest (Climax Community) **6**

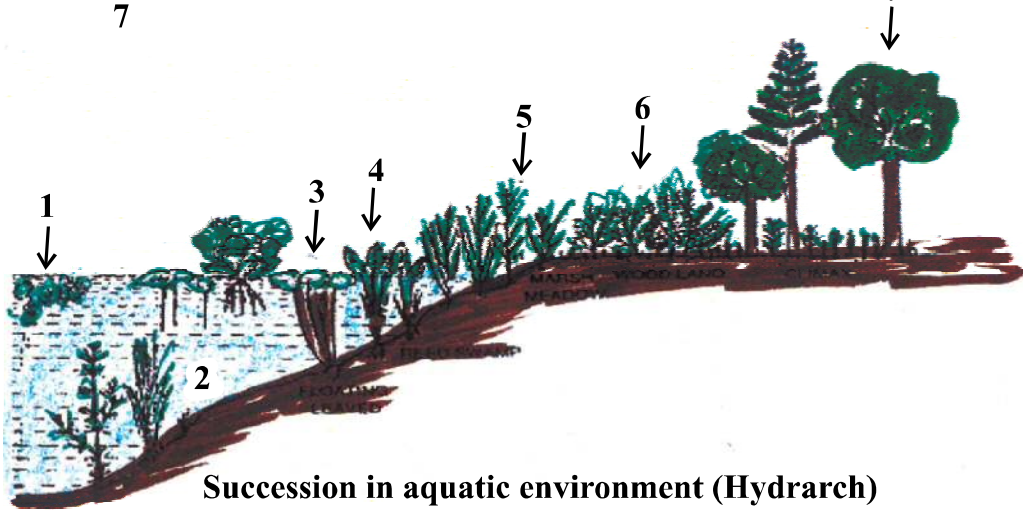


Succession on a bare rock (Xerarch)

Hydrarch :

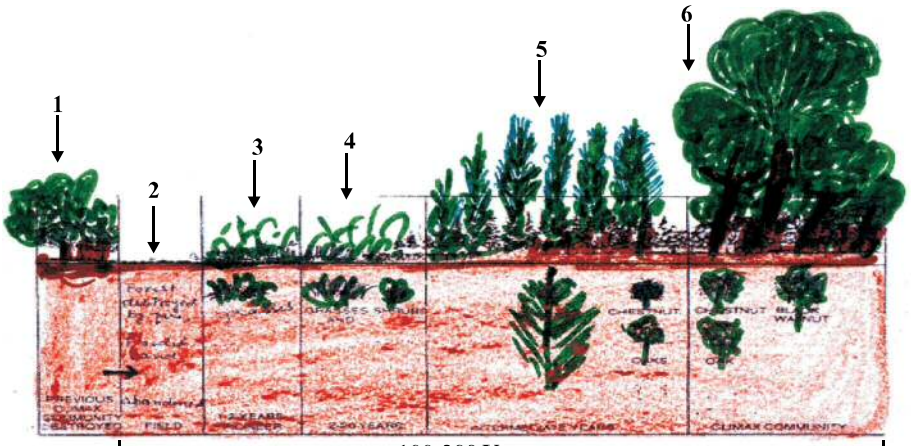
Phytoplankton stage (Pioneer Community) **1** → Submerged Plant Stage **2** → Submerged free floating plant stage **3** ↓

Reed Swamp stage **4** → Marsh-Meadow stage **5** → Scrub stage **6** → Forest (climax community) **7**



Succession in aquatic environment (Hydrarch)

Secondary Succession : The secondary succession begins in the area where natural biotic communities have been destroyed (burned or cut forests, land that have been devastated by flood).



1. Previous climax community
2. Forest destroyed by fire/flooded land/abandoned fluid
3. Grasses/Pioneer Community
4. Grasses and shurbs
5. Intermediate Communities
6. Climax Communities

Nutrient Cycling : Movement of nutrient elements through the various components of an ecosystem also called Biogeochemical cycles.

Nutrient Cycle
- Gaseous-Reservoir is atmosphere
- Sedimentary-Reservoir is earth crust

Carbon cycle : Occurs through atmosphere, ocean, and through living and dead organisms. Considerable amount of carbon returns to atmosphere as CO_2 through respiratory activities. Decomposers also contribute to Carbon di-oxide pool. Burning of wood, forest fire and combustion of organic matter, fossil fuels, volcanic activity also release CO_2, in atmosphere.

Phosphorus cycle : (Sedimentary cycle) Rocks contain phosphorous in the form of phosphates.

Comparison between carbon cycle and phosphorus cycle :

S. No.	Carbon cycle	Phosphorus cycle
1.	Atmospheric inputs is more in amount	Atmospheric inputs is less in amount
2.	Degree of exchange of carbon between organisms and environment is high	Degree of exchange of phosphorus between organisms and environment is negligible

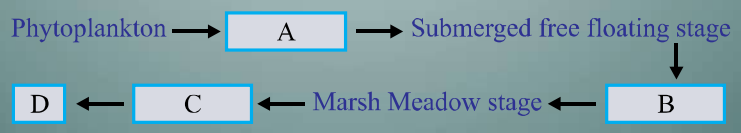
Questions

VSA **(1 Mark)**

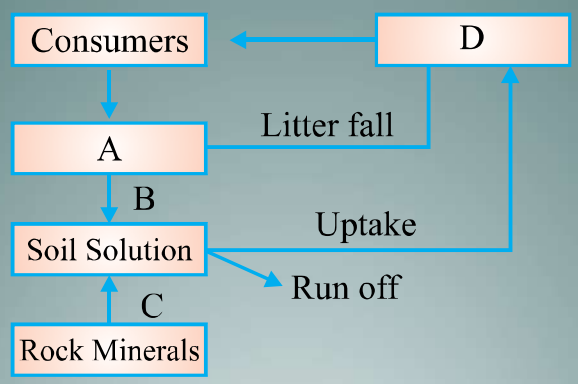
1. If we count the number of insects on a tree and number of small birds depending on those insects and also the number of larger birds eating the smaller, what kind of pyramid of number would we get ?
2. Differentiate between Sere and Seral communities.
3. Who are generally the pioneer species in a Xerarch succession and in a Hydrarch succession ?

SA-I **(2 Marks)**

4. What is the shape of pyramid of biomass in sea ? Why ?
5. Give an example of an ecological pyramid which is always upright. Justify your answer.
6. Differentiate between primary succession and secondary succession. Which one occurs faster ?
7. Gaseous nutrient cycle and sedimentary nutrient cycles have their reservoir. Name them. Why fs a reservoir necessary ?
8. Fill up the missing links depicted as A, B, C and D in the given model of primary succession.



9. In the model of phosphorus cycle given below, what does A, B, C and D refer to ?



10. Differentiate between Hydrarch and a Xerarch succession.

11. 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)**

12. Name any four ecosystem services. Who gave the price tags on nature's life support services ? Which is the most important ecosystem service provider ?

13. 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)**

14. 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.
2. **Sere :** Entire sequence of communities that successively change in a given area.

   Seral community : Individual transitional community.
3. Pioneer species in Hydrarch succession are usually the small phytoplanktons and that in Xerarch succession are usually lichens.

SA-I (2 Marks)

4. Inverted, because biomass of fishes far exceeds that of phytoplankton.
5. 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.
6. **Primary Succession :** A process that starts where no living organisms are there. This is slow.

   Secondary succession : A process that starts in areas which have lost all the living organisms that existed there. Is faster.
7. **Reservoir for Gaseous nutrient cycle :** Atmosphere; for sedimentary nutrient cycle : Earth's crust. Reservoir is needed to meet with the deficit which occurs due to imbalance in the rate of influx and efflux.
8. A = Submerged plant stage
   B = Reed Swamp Stage
   C = Scrub stage
   D = Forest stage
9. A = Detritus
   B = Decomposition
   C = Weathering
   D = Producers.
10. **Hydrarch Succession :** Starts in water proceeds from hydric (aquatic) to mesic (neither dry nor wet) situations.
    Xerarch succession : Starts on barren rock proceeds from Xeric dry to mesic conditions.

11. (a) Decomposition rate is slower.

(b) Decomposition rate is faster.

SA-II **(3 Marks)**

12. (i) Forest (ecosystem) purify water and air

(ii) Mitigate Droughts and floods

(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.

13. (i) Supported trophic level is founded by zooplanktons

(ii) Supporting trophic level is formed by phytoplanktons ecosystem.

It is found in aquatic ecosystem.

LA **(5 Marks)**

14. 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 to content in chapter.

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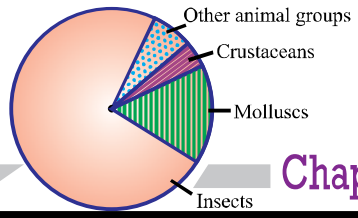


Chapter - 15

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. Its 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% of share of global biodiversity.
- India is one of 12 Mega diversity countries of the world.

Patterns of Biodiversity : Biodiversity 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 1,4000 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 Equator 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) ropical 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 bio diversity 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).

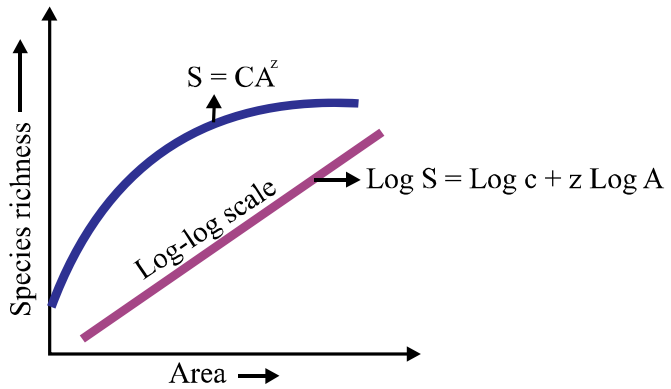
Species-Area relationships

- 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 imporant cause of plants and animals extinction. For example : Tropical rain forest 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 caused 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 obligating 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 benefit 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 mega diversity (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.

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.

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. Ex. 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.

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 Aliens Species : New species which enter a geographical regions.

Bio prospective : 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 Janerio, 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 utlisation 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.

Wetlends : These are the area where water is the primary factor, controlling the environment and the plants and animals life found their in. They occure 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

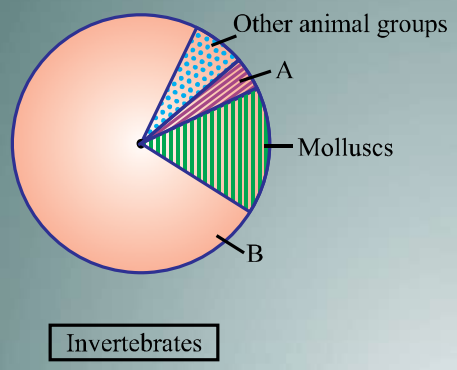
VSA **(I Mark)**

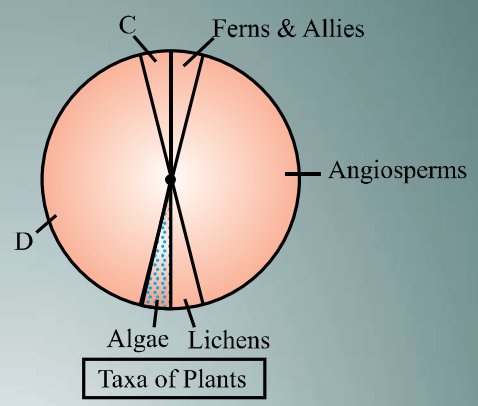
1. Habitat loss and fragmentation has caused severe damage to a particular type of ecosystem. Name it.
2. What trend is observed in respect of species diversity when we move from equator to poles ?
3. Which region is considered as the one with highest biodiversity on earth? What is the name given to such region forests ?

SA-I **(2 Marks)**

4. Study the pie-diagram and answer the questions which follows :

   What do A, B, C and D represent in these diagrams.

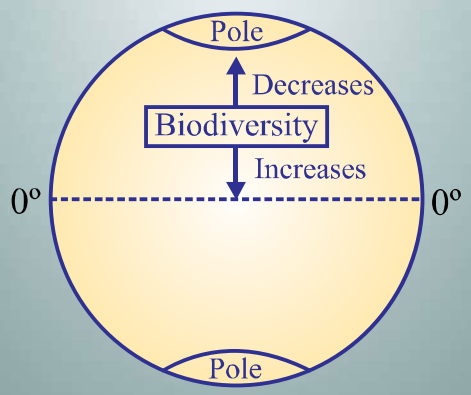




SA-II **(3 Marks)**

5. Hot spots are the regions of exceptionally high biodiversity. But they have become regions of accidental habitat loss too. Name the three hot spots of our country. Why are they called 'Hot spot' ?

6. 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.



7. What is so special about tropics that might account for their greater biological diversity ?

LA **(5 Marks)**

8. Describe at least two approaches each for ex-situ conservation and in situ conservation as a strategy for biodiversity conservation.

Answers

VSA **(I Mark)**

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'.

SA-I **(2 Marks)**

4. A → Crustaceans
   B → Insects
   C → Mosses
   D → Fungi

SA-II **(3 Marks)**

5. 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.
6. Latitudinal gradients
   (i) More solar energy available in tropics, more productivity.
   (ii) Tropical environments are less seasonal, so more predictable.
7. (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)**

8. In situ conservation :
   (i) Identification and maximum protection of 'hot spots'
   (ii) Legal protection to ecologically rich areas.

(iii) Biosphere reserves, national parks and sanctuaries

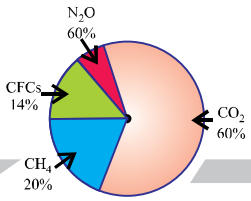
(iv) Sacred groves.

Ex situ Conservation :

(i) Creation of zoological parks, botanical garden, wild life sanctuaries.

(ii) Cryopreservation

(iii) Seed bank.



Chapter - 16

Environmental Issues

Pollution : Undesirable physical/chemical/biological characteristics of air/ water/ land which cause damage to the animals/plants/humans and architectural structures.

Pollutants : Agents which cause pollution.

Slash and Burn Agriculture (Jhum Cultivation) : Farmers cut down trees and burn the plant remains. Ash is used as a fertiser and the land is then used for farming or cattle grazing.

Reforestation : Process of restoring a forest that was removed at some point of time in the past.

Effluents : Something flowing over a large body of water (may be sewage or industrial effluents).

CPCB : Central Pollution Control Board

FOAM : Friends of Arcata Marsh

JFM (Joint Forest Management) : Introduced by the Government of India in 1980s to work closely with local communities for protecting and managing forests.

Control of air pollution :

Air pollution can be controlled by following methods :

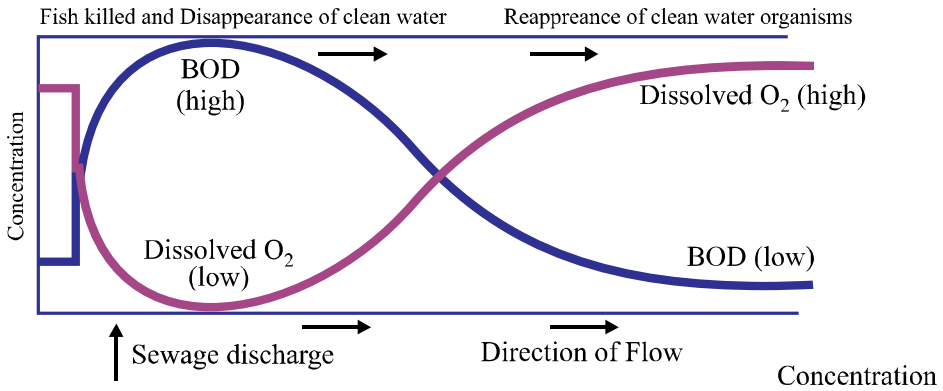
1. Electrostatic precipitator : This device is very efficient, used to remove particulate matter from air. This device can remove 90% particulates which are present industrial or thermal power plant's exhausts. In this device electrode wire at thousand volts are used and dust particles passed out through this device. Electrons released get attached to dust particles giving them negative charge. The collecting plates which are grounded attract these charged particles

2. Scrubber : This device is used to remove gaseous pollutant like sulphur dioxide. The exhaust is passed through a spray of water and lime, which on reacting with sulphur dioxide form precipitate

3. Catalytic converter : This is a device fitted in automobiles for reducing emmission of gases. In catalytic converter metals like rhodium and platinum-palladium acts as catalyst. Only unleaded petrol can be used in vehicle in which catalytic converter is fitted.

Biochemical Oxygen Demand (BOD)

- BOD refer to the amount of oxygen that would be consumed if all the organic matter in one litre of water were oxidized by bacteria. The BOD test measures the rate of uptake of oxygen by micro-organisms in a sample of water.
- Indirectly, BOD is a measure of the organic matter present in the water. The greater the BOD of waste water, more is its polluting potential.
- In the given figure, the effect of sewage on some important characteristics of a river is shown :



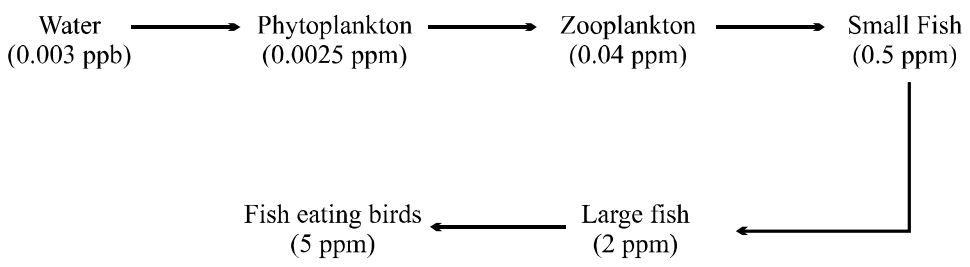
Algal Bloom : Presence of large amounts of nutrients in water causes excessive growth of algae, called an algal bloom.

Harmful effect of algal bloom are :

1. Fish mortality
2. Deterioration of water quality
3. Toxic to animals and human beings.

Biomagnification

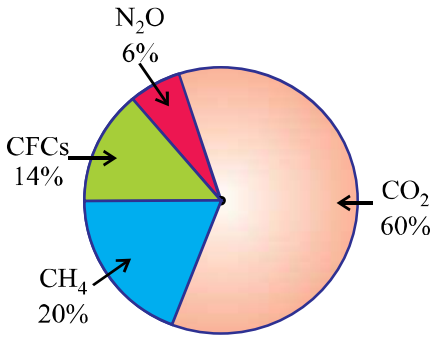
- It refers to increase in concentration of toxic substances at successive trophic levels.
- Biomagnification of DDT in an aquatic food chain is given below :



Harmful Effect : High concentration of DDT disturbs calcium metabolism in birds, which causes thining of egg shell and their premature breaking, causing decline in birds population.

Eutrophication : It is the process of nutrient enrichment of water and subsequent loss of species diversity like fishes. Excess nutrients causes algal bloom which may cover the whole surface of water body and release toxins. It causes oxygen deficiency in water that leads to the death of aquatic animals like fishes.

Global Warming : Increase in the level of greenhouse gases is mainly responsible for global warming, (increase in mean global temperature due to trapping of infrared radiation). Carbon dioxide, Methane, CFCs, N_2O are the main gases that causes greenhouse effect.



Percentage of Green House Gases

Harmful effect of Global Warming :

1. Melting of glaciers
2. Over many years, this will result in a rise in sea level that can flood the coastal areas.

Measures to Control Global Warming

1. Minimise the use of fossil fuel.
2. Improving efficiency of energy usage.
3. Reducing deforestration.
4. Planting trees.

Ozone Depletion

- Ozone gas is continuously formed by the action of UV-rays on molecular oxygen and also degraded into molecular oxygen in stratosphere.
- The thickness of the ozone-layer in a column of air from the ground to the top of the atmosphere is measured in terns of Dobson units (DU).
- Ozone layer absorbs the harmful UV-rays. These rays cause the skin cancer, damages genes, causes inflammation of cornea.
- Chlorofluro Carbons deplete the ozone layer. The part of atmosphere with lesser concentration of ozone is called ozone hole.

Steps leading to ozone depletion

- UV-rays split CFCs and release atomic chlorine (Cl)
- UV-rays also split ozone into oxygen.
- Chlorine atoms trap oxygen atoms and ozone is not formed again from oxygen. This leads to deplection of ozone in the stratosphere.

Ozone Hole : Large area of thinned ozone layer over Antartica.

Control of Vehicular Air Pollution in Delhi : All the buses of Delhi were converted to run on CNG by the end of the 2002. Other steps to reduce air pollution in Delhi include.

1. Phasing out of old vehicles.
2. Use of unleaded petrol and low sulphur petrol and diesel.
3. Use of catalytic converters in vehicles.
4. Application of Euro-IV norms for vehicles from April 1, 2010.

Auto Fuel Policy : The Government of India has laid out a road map to cut down the vehicular air pollution in many cities of India. The goal of this of aromatic hydrocarbons to 35% of the fuel. The Bharat Stage II was applied to

all automobiles in all cities from April, 1,2005. The cities like Delhi, Mumbai, Chennai, Kolkata have to meet Euro emission norms from April 1, 2005 and Euro IV Emission norms April, 1, 2010.

Electronic Wastes (e-waste) : e-wastes are irreparable computer and other electronic goods.

Disposal of e-wastes :

1. Burned in landfills
2. Incineration.
3. Recycling.

El Nino effect : Rise in temperature leading to deleterious changes in the environment and resulting in odd climatic changes is El Nino effect.

Adverse effect : Increased melting of polar ice, submerging of coastal areas, flood, loss of habitat leading to loss of biodiversity.

Questions

VSA **(1 Mark)**

1. Particulate size PM 2.5 is responsible for causing greatest harm to human health. What is it ? How is it harmful ?
2. What is the noise level that can cause permanent impairment of hearing ability of human beings ?
3. Why was the Montreal Protocol signed ?
4. Jhum cultivation has been in practice from earlier days, but it is considered more problematic these days. Why ?

SA-I **(2 Marks)**

5. Landfills are not much a solution for getting rid of solid wastes. Why ?
6. There is a sharp decline in dissolved oxygen downstream from the point of sewage discharge. Why? What are its adverse effects ?
7. Catalytic converters use expensive metals as catalysts.
   (a) Name the metals generally used.
   (b) What precaution should be observed while using catalytic converter ?
8. What are e-wastes? Why are they creating more problem in developing countries in comparison to developed countries ?

SA-II **(3 Marks)**

9. Deforestation is creating a lot of problems in the environments. List the consequences of deforestation.

10. People have been actively participating in the effects for the conservation of forests.

    (i) Name the award instituted in respect of Amrita Devi to Promote such efforts.

    (ii) Name the movement launched to protect the trees by hugging them.

    (iii) Name the step has undertaken by Government of India in 1980's to work closely with the local communities for protecting and mananging forests.

11. What is optimum percentage of forest area recommended by the National Forest policy (1988) for the plains and the hills respectively? List any four problems caused due to deforestation.

LA **(5 Marks)**

12. In Arcata, the towns people have created an integrated waste water treatment process within a natural system. A citizen group called FOAM helps in upkeep of this project.

    (a) What are the main steps in waste water management done in this way ?

    (b) Ecosan, in Kerala and Sri Lanka is also an initiative for water conservation. How ?

Answers

VSA **(1 Mark)**

1. PM2.5 stands for particulate matter of size 2.5 micrometers or less in diameter. Its responsible for causing greatest harm to human health as it can be inhaled deep into lungs and cause breathing problems.
2. 150 dB or more
3. To control emissin of ozone depleting substance.
4. Enough time gap is not being given for the natural process of recovery of land from the effect of cultivation.

SA-I (2 Marks)

5. Landfill sites are getting filled very fast due to large amount of garbage generation. Also underground water resources may get polluted due to seepage of chemicals.

6. Following discharge of sewage into river, micro organisms involved in biodegradation of organic matter present in sewage consume more oxygen. This cause mortality of fish and other aquatic creatures.

7. (a) Catalysts : platinum - palladium and Rhodium

   (b) Motor vehicles equipped with catalytic converters should use unleaded petrol as lead inactivates the catalysts.

8. (a) Irreparable computers and other electronic wastes.

   (b) Recycling in developing countries involves manual participation thus exposing workers to toxic substances. In developed countries its mechanised so less dangerous.

SA-II (3 Marks)

9.
   - Enhanced CO_2 concentration in atmosphere
   - Loss of biodiversity
   - Soil erosion
   - Desertification
   - Disturbed hydrological cycles.
   - Reduce emission of automobile exhaust
   - Growing more trees.

10. (i) Amrita Devi Bishnoi Wildlife Protection Award.

    (ii) Chipko movement

    (iii) Joint Forest Management (JFM).

11. 3% forest cover for the plains and 67% for the hills

1. Deforestation increases atmospheric carbon dioxide.
2. Loss of biodiversity and germplasm.
3. Leads to desertification.
4. Soil erosion and disturbance in water cycle.

LA **(5 Marks)**

12. (a) Conventional sedimentation, filtering and chlorine treatment. Absorption and assimilation of pollutants by algae fungi and bacteria.

(b) 'Ecosan' derived from ecological sanitation. Handling human excreta using dry composting toilets. Its practical, hygienic and cost effective method.

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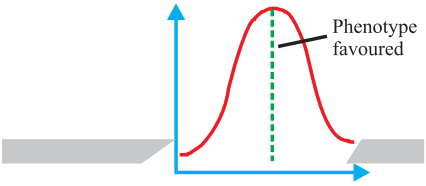


Unsolved Practice

Paper

Class XII

Practice Paper-1

Biology (Theory)

Time : 3 hours **Maximum Marks : 70**

- All questions are compulsory.
- Draw well labelled diagrams wherever required
- Marks of each question are indicated against it.

Section A

1. What do you mean that codon is degenerative ? 1
2. Why are gametes produced in large number in organisms that exhibit external fertilisation ? 1
3. State the principle on which ELISA works. 1
4. Name the mode of reproduction by which *plasmodium* multiplies in the human body and where does it do so? 1
5. Why do cattles avoid browsing on *calotropis* plants ? 1

Section B

6. 'Fertilisation is not an obligatory event for fruit formation in certain plants'. Explain the statement and give its justification. 2

7. What does the organisation GEAC check with reference to genetic engineering ? 2

8. Explain how do "ori" and "selectable markers" facilitate cloning into a vector. 2

9. How is somatic hybrid different from a hybrid ? 2

10. A population of *paramecium caudatum* was grown in a culture medium. After 5 days, the culture medium became over-crowded with *paramecium* and has depleted nutrients. What will happen to the population and what type of growth curve will population attain. Draw the growth curve.

Or

Write two points of differences between grazing food chains and Detritus food chains.

Section C

11. What are the adaptations in flowering plants to encourage cross-pollination ? Mention any three. 3

12. (a) A bilobed, dithecus anther has 100 microspore mother cells per microsporangium. How many male gametophytes this anther can produce ?

(b) Mention the pollinating agents of an inflorescence of small dull coloured flower with well exposed stamen and large feathery stigma. Give one characteristic of pollen grain produced by such flowers. 3

13. How do auto mobiles fitted with catalytic converters reduce air pollution ? Suggest the best fuel for such vehicles. 3

14. (a) What is cryopreservation ? What is the advantage of this method?

(b) What are Ramsar sites ? 3

15. How is a transgenic tobacco plant protected against *Meloidegyne incognitia* ? Explain the procedure of making such plants. 3

16. What are antibiotics ? Why should they be used judiciously ?

17. Following methodology has been used for cattles, sleeps etc.

Cow is administered with FSH hormone

↓

(A)

↓

6-8 eggs per cycle are derived

↓

Aritificial Insemination

↓

Fertilised egg at 8-32 celled stage recovered

↓

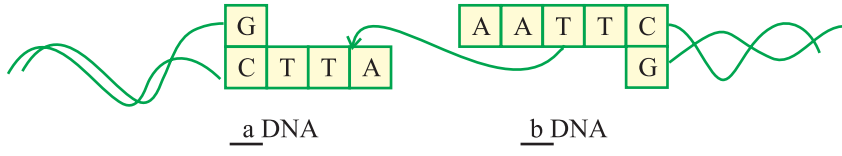
(B)

(i) Complete (A) and (B) in above methodology

(ii) Name the technology.

(iii) Give significance of this technology. 3

18. The following figure illustrate the linking of DNA fragments



(i) Name (a) and (b)

(ii) Complete the palindrome which is recognised by EcoRI

(iii) Name the enzyme that can link the two DNA fragments. 3

19. Explain the salient features of Hugo de Vries theory of mutation. How is Darwin's theory of natural selection different from it ? Explain. 3

20. (a) Draw a schematic representation of the structure of a transcription unit and show the following in it—

(i) Direction in which transcription occurs

(ii) Polarity two stands

(iii) Template strand

(iv) Terminator gene

(b) What is the function of promoter gene in transcription? 3

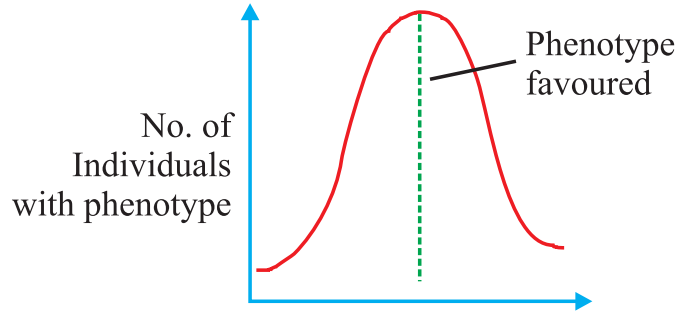
21. A man with blood group AB married with a woman having blood group O, work out the cross to show possible blood groups of their progeny. How many alleles are involved in the inheritance of these blood groups in human beings?

OR

(a) Why is haemophilia generally observed in human males ? Explain the condition under which a human female can be haemophilic.

(b) A pregnant human female was advised to undergo M.T.P. It was diagnosed by the doctor that the foetus she is carrying has developed from a zygote formed by on (xx)-egg fertilised by (y) carrying sperm. Why was she advised to undergo M.T.P. ? 3

22. What does the following changes represent in given graph ?



(i) If operation of natural selection makes peak higher and narrower

(ii) If peak shift to right direction

(iii) Two peaks are formed instead 3

Section D

23. During exam days, Akram started taking antisleep pills for keeping himself awake and alert so that he can study for long hours. Is it a good practice ? As his friend, how will you deal with the situation? Mention two values associated with you. 4

Section E

24. Define decomposition and describe the processes and products of decomposition.

Or

(a) What is difference between primary succession and secondary succession ? Also explain the term pioneer community and serial community.

(b) Mention two factors which determine the productivity of the biosphere. 5

25. (a) Draw a sectional view of seminiferous tubule of a human being and label following parts in it.

(i) Cells that undergo mitosis to increase their number.

(ii) Cells that undergo meiosis I

(iii) Cells that undergo meiosis II

(iv) Cells that help in process of spermiogenesis.

(b) Name two copper releasing IUD's. Give reason that makes them an effective contraceptive.

OR

Give Reason for following :

(a) Human testis are located outside abdominal cavity.

(b) It is important to feed the new born babies on colostrum.

(c) Father is responsible for determining the sex of child in human beings

(d) Corpus luteum plays important role in pregnancy. 5

26. Who proposed the concept of lac. operon ? Draw a labelled schematic representation of lac operon. Explain how does this process get switch on and switch off.

OR

How did Alfred Hershey and Martha chase arrive at the conclusion that DNA is the genetic material? Explain. 5

Class XII
Practice Paper-2
Biology (Theory)

Time : 3 hours **Maximum Marks : 70**

Section-A

1. State one use and one misuse of amniocentesis. 1
2. Name the organism used as biocontrol agent for controlling mosquitoes. 1
3. What is the advantage of enzyme restriction endonuclease for a prokaryotic cell ? 1
4. Name the two plants for which India got biopatents revoked. 1
5. Write the mathematical expression for the Verhulst Pearl Logistic Growth of Population 1

Section-B

6. Why are offsprings of oviparous animals at a greater risk as compared to offsprings of viviparous animals ? 2
7. Mention four ill effects of smoking on health. 2
8. Keeping a beehive near the crop field is helpful both to farmers and honey bees explain. 2
9. Specify the role of ethidium bromide and UV-radiations in gel electrophoresis. 2
10. Give any two reasons for occurrence of greater biodiversity in tropical regions. 2

Or

Explain the phenomenon of co-extinction with help of a suitable example.

Section-C

11. Describe various events that occur during foetal development after implantation. 3

12. What are the outbreeding devices ? Explain any two such devices. 3

13. How does operon is switched on and off? Explain with the help of diagram. 3

14. Explain natural selection taking the example of industrial melanism in *Biston betularia* (winged moth). 3

15. With reference to malignant malaria, answer the following : 3

    (a) Name of causal organism.

    (b) Cause of increase in body temperature, during fever.

    (c) Site of storage of sporozoites.

16. Explain the phenomenon of pleiotropism with help of example of sickle cell anaemia. 3

17. Fill in the blanks :

Organism	Product	Function
Trichoderma polysporum	Cyclosporin-A	a
Streptococcus	b	Clot buster
c	Methane	As Fuel
Lactobacillus	d	Nutritional improvement
e	Ethanol	industrial use
Azotobacter	Nitrogen-fixation	f

18. Mention the methods used to make plant cell, animal cell & bacterial cell as competent host to receive rDNA. 3

19. How does the mature functional insulin differs from Pro-insulin ? In what way the natural insulin obtained from animal source may cause harm to patients ? 3

20. Name and explain the kind of interaction in followings 3

    (a) Head lice and human

    (b) Hermit crab and clown fish

    (c) Algae and fungi in lichen

21. Give schematic representation of phosphorus cycle in nature. 3

22. Name with an example each of three kinds of IUDs. 3

Or

Explain the events that occur after fertilisation till implantation of embryo in humans.

Section-D

23. A couple has a child who is mentally retarded, with rounded face, permanently open mouth, short necked and broad palm. The couple consulted the doctor.

    (a) Explain how did doctor convince the couple that the disorder is not curable.

    (b) Name this disorder.

    (c) What values are reflected in convincing the parents by the doctor about incurability of the disorder ? 4

Section-E

24. (a) Draw a neat diagram of L.S. of pistil showing following parts and state the function of each part : (i) stigma (ii) polar nuclei (iii) synergids. 5

    (b) What is double fertilisation? Explain its significance.

Or

    (a) Draw a labelled diagram of human sperm. Write function of any two parts.

    (b) Explain the functions carried out by hormones FSH and LH during menstual cycle.

25. (a) A tall pea plant with yellow seeds (heterozygous for both the traits) is crossed with a dwarf pea plant with green seeds. Work out the cross to show Phenotypes and Genotypes of F_1 generation. 5

    (b) Correlate dominance, co-dominance and incomplete dominance.

Or

    (a) Explain various steps involved in transcription in an Eukaryotic cell.

    (b) Differentiate between exon and intron

26. (a) Explain ecological succession on a bare rock. 5

    (b) Why ecological succession is faster in a forest devastated by fire than on a bare rock ?

Or

Differentiate good ozone and bad ozone citing their significance. Explain the degradation of ozone by CFCs. Mention the delerious affects of ozone depletion.

Class XII
CBSE Question Paper-2017 (Foreign)
Code: 57/2/1 (Set-1)

Time : 3 hours **Maximum Marks : 70**

Section-A

1. Name the vegetative propagules in (i) Potato, and (ii) Pistia 1
2. Mention the combination(s) of sex chromosomes in a male and female bird. 1
3. A region of a coding DNA strand has the following nucleotide sequence:

   –ATTIC–

   What shall be the nucleotide sequence in

   (i) sister DNA segment it replicates, and

   (ii) m-RNA polynucleotide it transcribes?
4. List the type of fury genes that provide resistance to corn plants and cotton plants respectively against lepidopterans. 1
5. Very small animals are rarely found in polar regions, Give two reasons. 1

Section-B

6. Mention the relationship between concentration of lutienising hormone and maintenance of endometrium in the human uterus. 2
7. Explain codominance with the help of one example. 2

   OR

   What do the forlimbs of whales, bats and cheetah with respect to evolution signify? Provide one such example in plants.
8. What is outbreeding? Mention any two ways it can be carried out. 2
9. State how does ex-situ conservation help in protecting biodiversity. 2
10. Explain the relationship between green house gases and global warming. 2

Section-C

11. Apomixis resembles asexual reproduction, as well as mimics sexual reproduction in plants. Explain with the help of suitable example. 3
12. Describe the embryonic development of a zygote upto its implantation in human. 3
13. Explain the cause of chromosomal disorder in humans. Describe the effect of such disorder with the help of an example each involving (i) autosomes, and (ii) sex chromosomes. 3
14. Describe the experiments that established the identity of "transforming principles" of Griffith. 3
15. State the contribution of Louis Pasteur in understanding the origin of life on earth. Explain the procedure that the followed to arrive at his conclusion. 3
16. A farmer while working on his farm was bitten by a poisonous snake. The workers in the form immediately rushed him to the nearby health centre. The doctor right away gave him an injection to save his life. What did the doctor inject and why? Explain. 3
17. Explain three basic steps to be followed during genetic modification of an organism. 3
18. How can a bioreactor be made to function at optimal state in order to obtain a desired foreign gene product? Explain. 3
19. How does β-galactosidase coding sequence act as a selectable marker? Explain. Why is it a preferred selectable marker to antibiotic resistance genes? 3
20. When do you describe the relationship between two organisms as mutualistic, competitive and parasitic? Give one example of each type. 3
21. Describe the effect of human activities in influencing natural ecosystem cycle with special reference to carbon cycle. 3
22. Combination and introduction of alien species to are responsible for the loss of bio diversity. Explain, how 3

    OR

    Explain how bio magnification of DDT occurs in an aquatic food chain.

Section-D

23. Your school's atteletic team along with atheletic teams from different schools reach the venue two days before the inter district school athletic event was

to be held. A day before the competition, a team of officials from an agency arrive and ask for blood and urine samples from all the participating atheletes.

(a) Would you support or object to this sample collection? Provide explanation to your answer.

(b) Write a note that you would like to read out to your team-mates to explain the purpose of this visit of these officials. 4

Section-E

24. (a) What are the benefits of choosing a dioecious plant species for plant breeding experiments. 5

(b) How would you proceed to cross-pollinate a monoecious flower?

(c) Draw a labelled schematic diagram of T.S of an author of an angio sperm.

OR

(a) Explain the hormonal regulation of spermatogenesis in humans.

(b) Draw the diagram of a human sperm. Label and write the functions of the components of its head.

25. Describe the dihybrid cross carried on Drosophila melanogaster by morgan and his group. How did they explain linkage, recombination and gene mapping on the basis of their observation? 5

OR

Describe the interaction of t-RNA and ribosomes during the events of translation. 5

26. (a) Name the types of lymphoid organs lymph nodes and thymus. Explain the role played by them in causing immune response.

(b) Differentiate between innate immunity and acquired immunity. 5

OR

(a) How does *Bacillus thuringiensis* acts as a bio control agent for protecting Brassica and fruit trees? Explain.

(b) (i) List the components of biogas.

(ii) What makes methanogens a suitable source for biogas production?

5

Marking Scheme
CBSE Question Paper-2017 (Foreign)
Code: 57/2/1 (Set-1)

Time : 3 hours **Maximum Marks : 70**

Section-A

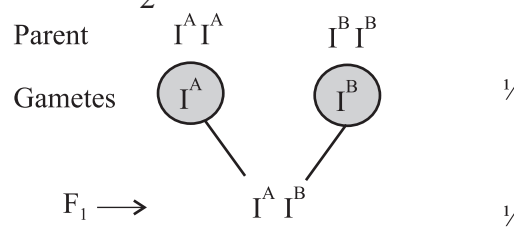
1. (i) Eye/Eye buds = $\frac{1}{2}$, (ii) Offset = $\frac{1}{2}$ 1
2. Male – ZZ = $\frac{1}{2}$, Female – ZW = $\frac{1}{2}$ 1
3. (i) TACG = $\frac{1}{2}$, (ii) AUG C = $\frac{1}{2}$ 1
4. Cry IAC/Cry IIAb-cotton= $\frac{1}{2}$

   Cry IAb-corn = $\frac{1}{2}$ 1
5. Small animals have larger surface area relative to their volume loose heat veryfast. Due to small size, expend much energy to generate body heat through metabolism. 1

Section-B

6. (Mid cycle) LH surge → formation of corpus luteum → progesterone, maintains the growth of endometrium. 2
7. When the dominant alleles of the same gene which are contributed by both parents are expressed in called codominance. F1 generation resembles both the parents = $\frac{1}{2}$

   In human blood group = $\frac{1}{2}$



OR

- Homologous organs or divergent evolution. 1
- Thorns of *Bougainvillea* and tendrils of cucurbita . 1

8. • Breeding of unrelated animals, if from the same breed having no common an cestors for 4-6 generations. 1
   - Out crossing/crossbreeding/ interspecific hybridisation (any two). 1
9. Threatened animals and plants are taken out from their natural habitat and placed in special settings/by cryopreservation technique, in vitrofertilisation of eggs, tissue culture, seed banks (any four). 2
10. Green house gases absorb a major fraction of infrared radiation emitted by earth, and do not allow it to escape into space and reflects it back to earth, leading to considerable heating of earth and its atmosphere causing global warming. 2

Section-C

11. Since there is no fertilisation in apomixis it resemble asexual reproduction and development of embryo/seed/fruit formation is mimicing sexual reproduction. 1
    - In citrus/Mango some of the nuclellar cells surrounding the embryo sac, act as diploid egg cell. Which are formed without reduction division, and develop into embryo, without fertilisation. 2
12. Zygote moves through isthmus and undergoes cleavage (forming morula), morula, continues to divide and transform into bastocyst, Blastomeres in the blastocyst are arranged into an outer layer trophoblast, and innercell masss, The trophoblast layer gets attached to endometrium, uterine cells divide and cover the blastocyst. $\frac{1}{2} \times 6 = 3$
13. Gain or loss of chromosome (due to non disjunction) 1

    (i) Down syndrome. Additional copy of 21st chromosome/trisomy of 21. 1

    (ii) Klinefelter's syndrome. Presence of an additional copy of X-cromosome leading to XXY. 1

    Turner's syndrome-absence of one of the X chromosome i.e., 45 with XO.
14. Purification of biochemical like proteins, RNA and DNA from 'S' cells (heat killed).

    Presence of protein and RNA in medium did not affect transformation.

    DNA alone from 'S' Bacteria cuased 'R' Bacteria to transform. $\frac{1}{2} \times 6 = 3$

Digestion with DNA ase did inhibit transformation.

Conclusion : DNA is the transforming biochemical.

15. Pasteur in his experiment took a flask containing sugar solution and added yeast to it. Then boiled the constents of the flask so that yeast got killed. 1
    - In pre sterlized sealed flask, life did not come from killed yeast. 1
    - In open flask life comes from pre-existing life, new living organisms arose in pressenc of killed yeast. 1
16. Antitoxin/Antivenoms/Performed antibodies. 1
    - Whenever quick immune respones is required we need to directly inject performed antibodies/Antitoxins. 1
    - To neuralize snake venom quickly, passive immunity is provided. 1
17. (i) Identification of DNA with desirable genes, so that the genetically modified organisms has largely desirable genes. 1

    (ii) Introduction of the DNA with desirable genes, into the host using vector. 1

    (iii) Maintenance of introduced DNA in the host, and transfer of the DNA to its progeny through cloning. 1
18. By providing optimum growth conditions :

    Temperature, pH, substrate, salts, vitamins, oxygen $\frac{1}{2} \times 6 = 3$
19. (i) Presence of a chromogenic substrate gives blue colour, if the plasnid in the bacteria does not have an insert (non-recombinants) 1

    (ii) With has insert do not produce any colour, recombinant colories. 1

    (iii) Selection of recombinants due to inactivation of antibioties requires simultanneous plating on two plates having differnnt antibiotics process is more cumber some. 1
20. **Mutulistic:** Both the interacting organisms are benefited from each other eg. **Lichens:** Algal and fungi or any other appropriate example. 1

    · **Competition:** Two organisms belonging to closly related species unrelated groups compete for the same resources that are limiting both are losers eg superior barnacle dominates and excludes the small barnacles or any other appropriate example. 1

    Parasitic: one of the two organisms is dependent on the other (host) for nutrition and suppoort the host is harmed and the parasite is benefitted. eg. malarial parasite and human or cuscuta on host plant or any other appropriate example. 1

21. Rapid deforestation, massive burning of fossilfuel have significantly increased the rate of release of carbondioxide, polluting atmosphere, this green house gas, contributes to global warming. 3

22. Co-extinction - When a species becomes extinct, the plant and animal species associated with it in the obligatory way, also becomes extinct. 3

OR

DDT in water taken up by on organism cannot be metabolised or excreted and thus passed on to successive tropic level in higher concentration. 3

· Water 0.003 ppm → Zooplankton 0.04 ppm → small fish 0.5 ppm → large fish 2 ppm → fish eating birds 25 ppm.

Section-D

23. (a) Yes I support ½

· Many times children take drugs, to improve their performance in sports out of curivsity/anxiety/intentionally. 1½

· To test the fact that performance of child in the sports is natural or drug induced, to be fair on everybody's part this test is essential. 1

(b) A team of officials from an agency have asked for blood and urine sample from all participants because these samples when analysed will show the presence of drugs, if anybody has taken, this is as per the rule all over the world for any sports competition. 1

Section-E

24. (a) (Unisexual) self pollination avoided, emasculation not required. 1

(b) Emasculation

· Bagging, 2

· Pollination by spraying desired pollen grains

· Rebagging 2

(c) Figure 2.3 (a) page 22, NCERT-Biology (any four tables)

OR

(a) Initiation by GnRH from hypothalamus which acts on Anterior Pituitarry to release FSH and LH (gonadotropins). 1

- LH acts on cells of leydig/Interstitial cells to secrete androgens

- Androgens in turn stimulate the process of spermatogenesis. 2

- FSH acts on sertoli cells and stimulates the secretions of some factors that stimulate spermiogenesis

(b) Fig 3.6- pg. 48 NCERT Biology with any two labelling of head. 2

- Function of plasma membrane : Envelopes the whole body of sperm

Acrosome : contains enzymes for fertilisation

Nucleus : Contains haploid chromosomal material. (*Any two*)

25. According to Morgan and his group if genes were very tightly linked they showed very low recombination. 1

(Shown in cross A) in text book. 1

If genes were loosely linked they showed very high recombination. 1

(Shown in cross B) in text book. 1

The group used the frequency of recombination between gene pairs on the same chromosome as a measure of distance between genes and 'mapped' their position on the chromosome. 1

Cross A and cross B Fig 5.11 page 84 NCERT BIOLOGY

OR

- For imitiation the ribosome binds to the m RNA at the start codon AUG. 1

- Charged t-RNA binds to the appropriate codon on m-RNA forming complementary base pairs on t-RNA as anticodeon in the ribosome. 2

- Ribosomes moves from codon to codon along m RNA. aminocids are added one by one brough by t-RNA, from the polypeptide chain. 2

26. (a) Thymus- Primary lymphoid organ, immature lymphocytes differentiate here, into antigen. Sensitive lymphucytes. 1½

Lymph Nodes: secondary lymphoid organ, they seen to trap the micro organisms or other antigen, which are responsible for activation of lymphocytes present there. 1½

(b)

Innate Immunity	**Acquired Immunity**
– non-specific type of response	– Pathogen specific defense
– Present at the time of birth	– acguired by the body after birth
– Provide barrier to the entry of foreign agents into our body	– Characterised by memory
– Four types (physical barriers) physiological barriers, cellular barriers, cytokine bariers	– four types primary and secondary

2

(*any two difference*)

OR

(a) Bacterium *Bacillus thuringiensis* (Bt) are available in sachets as dried spores, mixed with water and sprayed on to plants, these are eaten up by the insect larvae, the toxins are released in the gut and larvae gets killed.

(b) Methane, H_2S, CO_2, H_2 (any two or any three = 1)

(c) Methanogens grow anaerobically, on cellulosic material produce large amount of methane, alongwith CO_2 and H_2.

Some Values for reference, which may be helpful to students to answer the value based question.

Peace, Honesty, Dignity of labour. Nonviolence, Patriotism, Sobriety, Fellow feeling. Scientific temper, Equality, Friendship .Team spirit, Cooperation, International understanding, love for animals, Environmental protection, Tolerance, Social cohesion, Loyalty, morality, Public welfare and National solidarity, critical thinking, critical analysis. Problem solving, Inter personal relationship, copying with stress, gender bias, scientific, attitudes.

Abstinence, appreciation of culture and values of other, anti-touchabiliy, awareness, Consideration for others, concern for others, cleanliness, compassion, common cause, common good, courage, courtesy, curiosity, democratic, decision making, devotion, dignity of manual work, discipline, dutiful, dignity of the individual, endurance, equality, friendship, faithfuless, freedom, forward look, Good Manner, gratitude, gentle manliness, honesty, helpfulness, hygienic living, humanism, initiative, integrity, justice, kindness, loyalty to duty, leadership, national unity, national integration, obedience, proper utilization of time, punctuality, purity, patriotism, quest for knowledge, resourcefulness, regularity, respect for others, reverence for old age, is nicety, simple living, self-discipline, self-respect, self-support, self-reliance, restraint, social justice, self-help, self-confidence, self-study, self-coitrol, social service, solidarity of mankind, sense of discrimination between good and bad, sense of social responsibility, socialism, sympathy, secularism and resect for all religions, spirit of equality, team work, truthfulness, universal truth, universal love, value for national and civic property etc.

Example of Value based question

1. A couple quarreled with the hospital authority on suspicion that their child had been exchanged after birth The couple based their arguments on the fact that their child is O blood group whereas they are A and B blood groups respectively The doctor smiled, explained and convinced the parents.

   (a) What values of the doctor are reflected here?

   (b) How can the child be of O blood group as explained by the doctor? Name the authentic test method to identify the biological parents of the child.

2. Ramesh planned to introduce MOET in his farm. He purchased one high milk yie ding exotic breed of cow Within a few years he earned a lot of money by selling calves but the mother cow met with a premature death. Ratan objected to Ramesh earning money by this way

   (a) What values in life did Ratan possess?

(b) Expand MOET
(c) Briefly describe the process.

3. Vivek was one of the best students in the class. In spite of his best efforts he was not doing ‘ well in class XI His father wanted him to qualify for medical sciences. He got frustraed with his results and resorted to drugs. He started misbehaving with his parents and friends is school. His friends started neglecting him. The school authorities counseled Vivek but to no effect. His parents were upset and took him to a rehabilitation centre After a few months he came back recovered

   (a) What values did the principal through his initiative?
   (b) What should be the attitude of his parents after his recovery?
   (c) What id drug abuse? Name two commonly abused drugs and their source.

4. A teenage girl accidently became pregnant She stopped coming to college and preferred to remain isolated She was very upset and scared to inform her parents One of her friend Maya met her and came to know all about the problem She took her to a qualified doctorind got her aborted. Later on she convinced the parents and kept the matter concealed

   (a) What precautions may be taken to avoid pregnancy?
   (b) Did Maya take the correct decision? What valued did she show?
   (c) Name the medical term used for abortion. What is the period which is considered safe for abortion?

5. Komal and her parents were watching a TV serial in the evening. During a commersrcial break, an advertisement flashed on the screen which was promoting use of sanitary napkins Komal was still watching the TV. The parents embarrassed and changed the channel Komal objected to her parents” behavior and explained the need for these advertisement

   (a) What values did the parents show?
   (b) Give any two values shown in the behavior of Komal
   (c) List the phases of menstrual cycle.

Suggestions to our come some common Errors/Mistakes committeed by students in answering to questions.

- **Don't start with the most difficult question:** Before answering, go through the whole question paper once. Without glancing the question paper, you may start with the most difficult question which could put you under mental stress and you may not impress your examiner by your answers. As you mind is focused to the first difficult question, you may find difficulty in answering other questions also
- **Don’t miss out important Instructions:** Read all the instructions writ-

ten in the front page of question paper and go through he complete paper This will get you time to segregate between easy and difficult problems by ignoring those instructions, you may end up answering those questions which are not required.

- **Don't forget to answer ail the questions:** Most of you effort to attempt easy questions first and leaving some to be attend at the end There can be a situation that you get stuck with difficult questions at last, leaving no time to return to those questions
- **Not reading the question paper:** One of the most common mistakes students make is not utilising the 15 minute leading time properly. Students should read the question paper carefully so that they can organise their thoughts and manage their time during the exam.
- **Time mismanagement:** Time management is crucial for getting a perfect score in the board exams. It istmportant to not spend more than the required time on a particular question: otherwise you'l struggle to complete the paper. While writing the paper, students should stick to the word limit and the time limit they are allocated for attempting questions of different weightage. Plah in advance how much time you will dedicate to each question and category.
- **Not following the hierarchy: (Writing unplanned answer):** Generally, students answer the questions without planning the order properly according to the points that need to be covered at first Thus, the students should regularly analyse the content of their answers by keeping in mind the value points given in the marking scheme and compare their answers with model papers. This is how the students will be able to develop the skill of determining the hierarchy of relevance of content and will able to score better marks in boards
- **Copying incorrect data:** Sometimes students copy the data given in the question paper incorrectly in the questions Students should take extra care as it might save a couple of marks in the exam.
- **Diagrams:** For questions where diagrams are asked for, students should draw and label them properly and preferably, in pencil. Using diagrams can help scoring better marks.
- **Highlight:** While presenting answers underline the headings and highlight the important keywords and phrases. This will help in improving your marks
- **Answer length:** The answer length should be in accordance to the marks provided for the question. A question of 1 mark should not be answered in half a page or a whole page.
- **VBQ:** In value based question (Question no. 23), which is of 4 marks,

students tend to write only one sentence. This question generally has two parts. One is related with the content of text book and another related with the values. The student ought to write the positive values (aspects/ views) related with the concept of the question in at least 3-4 sentences in order to get full marks.

- **Correct question number:** Students should make sure they write the correct question number for the answer they are writing. Any mistake here means they would lose the entire marks even if their answer is correct.
- **Reason based questions** must be answered in two points: (i) cause (ii) consequence Though these questions carry one mark each, two key points are expected from students Most of the time students write only one point.
- **Principle involved in a process:** Students often write the process or steps involved but do not mention the principle behind the process.
- **Writing full length answers when running out of time:** Another common mistake in board exams because of which you can easily loose marks is working hard on answering a question or an essay when your time is running out. In such critical situations quickly write down the bullet points. That way the examner can see that you've though about the question, and they'll know what you would have written if you had the time top openly deal with the question.
- **Check your Answer sheet Before Submwting:** Most of you may not find this step necessary but by proper checking before submitting helps you notice some errors and if time left, you can attempt those left out questions also.
- **Don't attempt easy questions in the eleventh hour:** The questions which you think can be answered easily, do them first. This way you pick up marks uptront' It you start with difficult questions, you may end up spending a lot of time on them, leaving mistake or no time for the ones from which you could have gained more marks.

Leaving the easiest questions until last. Leaving the exam room early.

Poor spelling and grammar (Biological terms and scientific names).

Providing irrelevant responses.

Providing multiple answers hoping one answer is correct.

Misinterpreting the key words.

Failing to bring along required stationery or items.

Panicking before or during a paper.

Jumping straight into answering a question without proper planning.

How to prepare for the Examination

- **Reach early to the Examination**

Make sure to arrive almost half hour before at your exam centre If you get late, you may not be allowed to sit for the **Board Exams** Even if you allowed to sit, your mind may not be is ready to start answering the questions. Plan your travel time according to traffic and transport to reach early.

Use flashcards to remember definition.

Create flowcharts to effectively remember processes.

The students are advised to thoroughly go through each and topic of the NCERT text book and revising the important ones more than thrice. As the basics of all the questions that would be asked lies in the textbook only one is advised to practice them well.

Questions asking for diagrams will definitely be framed. Practice labeling carefully.

Make footnotes and point-wise summaries for important topics, so that they become easy to revise a day before.

Practice drawing neat diagrams as they will help you understand the concept better and also score better marks

Attempt sample papers/practice papers to identify the exam trends and you own weak areas

Thoroughly go through all the pie charts, flow charts, tables and graphs-related questions.

Focus on the topics and chapters which you are good at.