केन्द्रीय विद्यालय संगठन

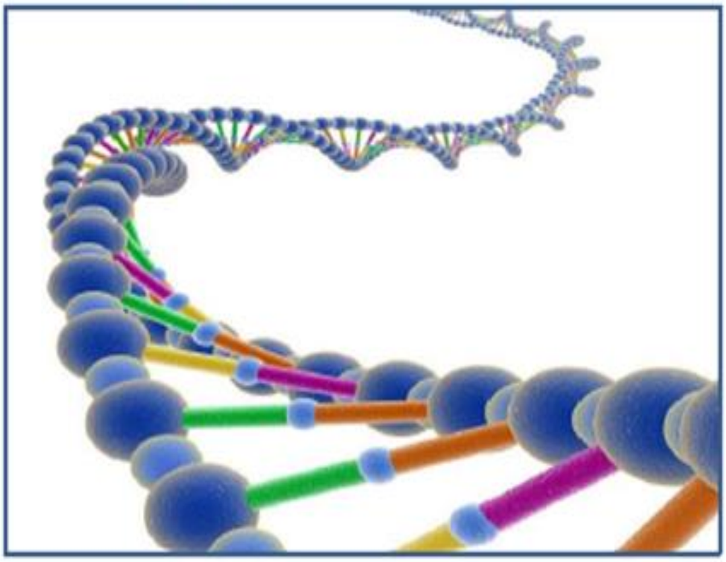
STUDENT SUPPORT MATERIAL

आज़ादी का अमृत महोत्सव

2022-23

BIOLOGY

CLASS XII



KENDRIYA VIDYALAYA SANGATHAN
ERNAKULAM REGION

ADVISORS

Shri R SENTHIL KUMAR
Deputy Commissioner
KVS, Ernakulam Region

Shri. SANTHOSH KUMAR N
Assistant Commissioner
KVS, Ernakulam Region

Smt. DEEPTI NAIR
Assistant Commissioner
KVS, Ernakulam Region

Shri. AJAY KUMAR
Assistant Commissioner
KVS, Ernakulam Region

CO-ORDINATOR

Shri T VIJAYAN
Principal KV Kannur

PREPARED BY

ALL PGTs (BIOLOGY) OF KVS ERNAKULAM REGION

MARKS WEIGHTAGE OF MARKS- 2022-23

CLASS XII

BIOLOGY (044)

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

Unit	Title	Marks
Unit-VI	**Reproduction**	16
	Chapter 2: Sexual Reproduction in Flowering Plants Chapter-3: Human Reproduction Chapter 4: Reproductive Health	
Unit-VII	**Genetics and Evolution**	20
	Chapter-5: Principles of Inheritance and Variation Chapter-6: Molecular Basis of Inheritance Chapter-7: Evolution	
Unit-VIII	**Biology and Human Welfare**	12
	Chapter-8: Human Health and Disease Chapter-10: Microbes in Human Welfare	
Unit-IX	**Biotechnology and its applications**	12
	Chapter-11: Biotechnology: Principles and Processes Chapter-12: Biotechnology and its Applications	
Unit-X	**Ecology and Environment**	10
	Chapter-13: Organisms and Populations Chapter-14: Ecosystem Chapter-15: Biodiversity and its conservation	
	Total marks	**70**

CBSE- THEORY TOPICS INCLUDED FOR 22-23

Unit-VI Reproduction

Chapter-2: Sexual Reproduction in Flowering Plants

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

Chapter-3: Human Reproduction

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

Chapter-4: Reproductive Health

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

Unit-VII Genetics and Evolution

Chapter-5: Principles of Inheritance and Variation

Heredity and variation: Mendelian inheritance; deviations from Mendelism – incomplete dominance, co-dominance, multiple alleles and inheritance of blood groups, pleiotropy; elementary idea of polygenic inheritance; chromosome theory of inheritance; chromosomes and genes; Sex determination - in 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 Klinefelter's syndromes.

Chapter-6: Molecular Basis of Inheritance

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

Chapter-7: Evolution

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

Unit-VIII Biology and Human Welfare

Chapter-8 Human Health and Diseases

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

Chapter-10: Microbes in Human Welfare

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

Unit-IX Biotechnology and its Applications

Chapter-11: Biotechnology

Principles and Processes Genetic Engineering (Recombinant DNA Technology).

Chapter-12: Biotechnology and its Applications

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

Chapter-13: Organisms and Populations

Population interactions- mutualism, competition, predation, parasitism; population attributes - growth, birth rate and death rate, age distribution. (Topics excluded: Organism and its Environment, Major Abiotic Factors, Responses to Abiotic Factors, Adaptations)

Chapter-14: Ecosystem

Ecosystems: Patterns, components; productivity and decomposition; energy flow; pyramids of number, biomass, and energy (Topics excluded: Ecological Succession and Nutrient Cycles)

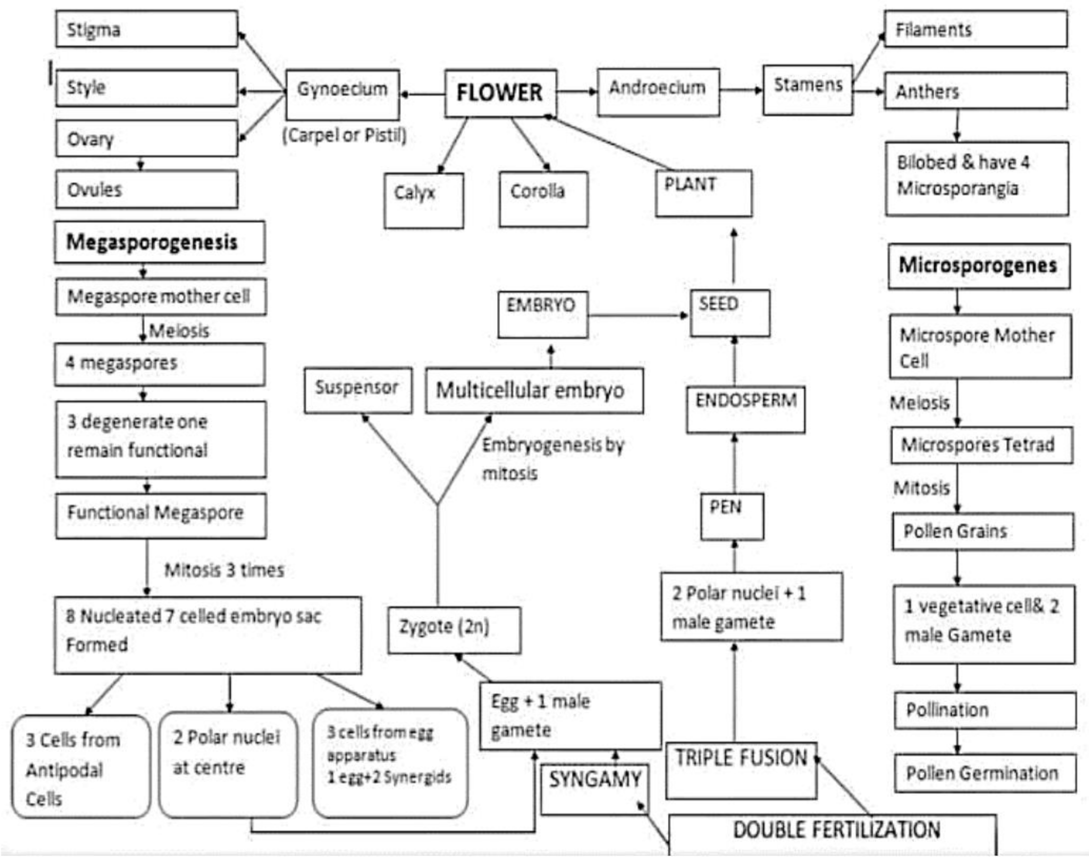
Chapter-15: Biodiversity and its Conservation

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

CHAPTER 2: SEXUAL REPRODUCTION IN FLOWERING PLANTS

SEXUAL REPRODUCTION IN FLOWERING PLANTS

Concept Map:



Gist of the Major /Minor concepts

FLOW CHARTS :

1. Development of Male gametophyte and Male gametes from the microsporangium

Male reproductive structure - Androecium

↓

Stamen

↓

Anther – bilobed , dithecous

↓

Four microsporangia –Epidermis , endothecium , middle layers & tapetum

↓

Microsporangium - sporogenous tissue undergoes meiosis

↓

Microspore Tetrad

↓

Microspore

↓

Pollen grain

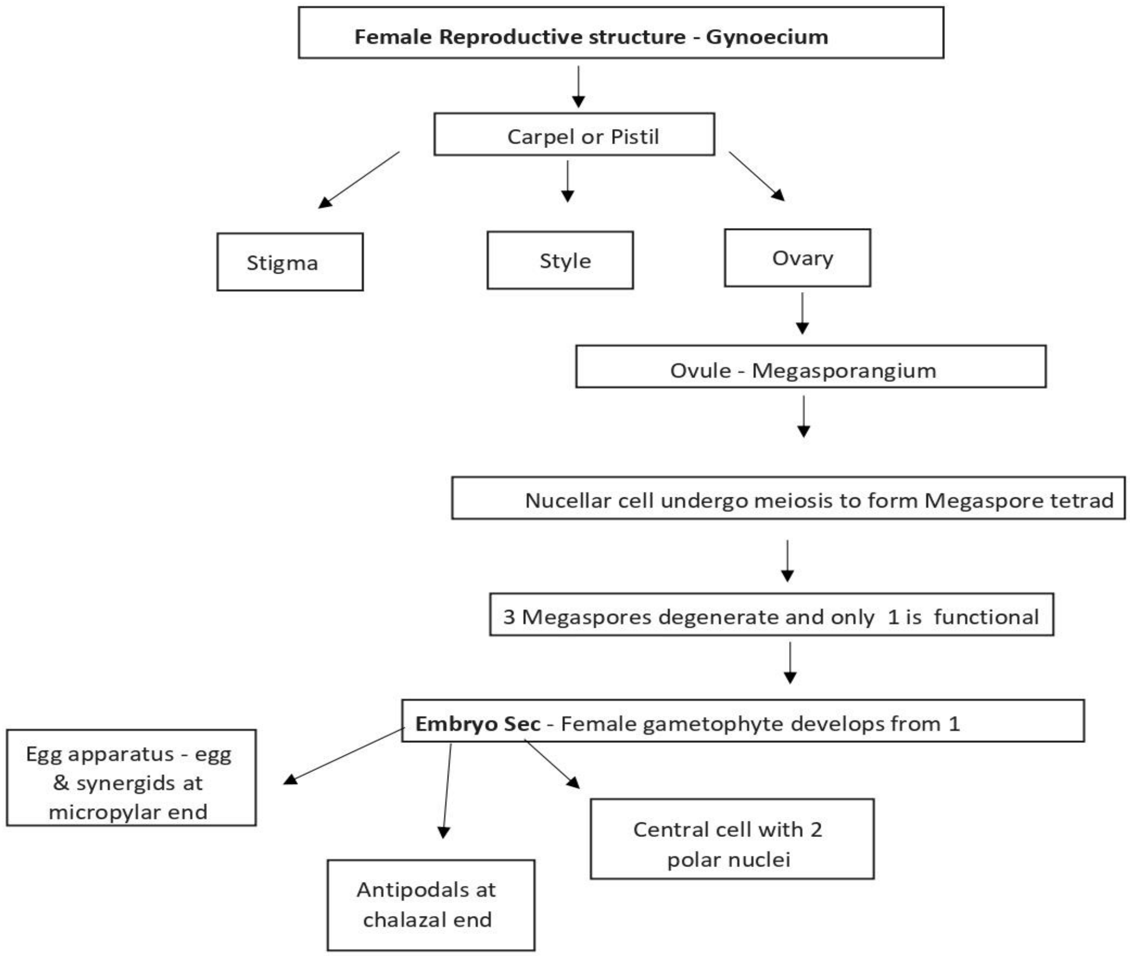
(Wall layers)

- Exine - Sporopollenin
- Intine - cellulose, pectin

(Cells)

- Vegetative cell (Large)
- Generative cell – **2 male gametes** (Small)

2. Development of Female gametophyte and Egg from Megasporangium.



Monosporic Development
Mature embryo sac is 7 celled structure.

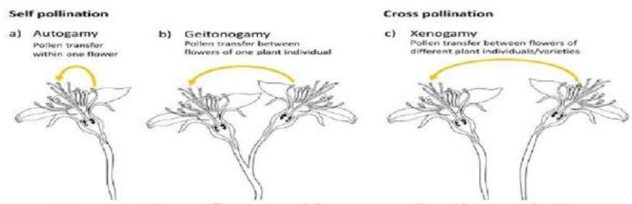
3.Pollination - Types.

Pollination : transfer of pollen grains from anther to stigma

Autogamy – same flower

Geitenogamy- different flower

Xenogamy – different plants



Chasmogamous flower: Open flower with exposed anther and stigma

Cleistogamous flower: Flowers do not open. Assured seed set even in the absence ofpollinators

Oxalis, Commelina and Viola produce both Chasmogamous Cleistogamous flowers

Agents of Pollination

Agents of Pollination & characteristics of flower/ Pollen Grain

Wind –
Flowers colourless odourless, nectarless, small in size, arranged in inflorescence.
Well exposed stamens and feathery stigma.
Pollen grains light, non sticky and produced enormous amount .

Water
Pollen grains produced in large number, mucilaginous covering, long and ribbon like.

Insects -
Flowers are large, colourful, nectar bearing with characteristic smell.
Pollen grains are sticky.

5.Outbreeding devices:

- **i.** Non-synchronisationof pollen release andstigma receptivity
- **ii.** Anther and stigma are placed at different positions
- **iii.** Self - incompatibility
- **iv.** Production of Unisexual flower

6. Artificial hybridization – Different steps:

Emasculation	Bagging	Pollination	Tagging	Rebagging
Removal of stamens from a bisexual flower at the bud stage.	Emasculated flower is covered with a bag made up of butter paper to prevent the deposition of unwanted pollen	Dusting of pollen collected from male parent on the stigma of emasculated flower	After pollination a tag is put with information such as date of emasculation, pollination male and female parents etc.	After the pollen grains are dusted the stigma id again bagged to prevent undesired pollen landing on stigma.

7. Double fertilisation **(Unique event to flowering plants)**

SYNGAMY :

Male gamete +Female gamete $\rightarrow$ Zygote
(n) **(n)** **(2n)**

TRIPLE FUSION:

Male gamete + Polar nuclei $\rightarrow$ PEN
(n) **(2n)** **(3n)**

8. Post Fertilisation- Structures and events :

PEN → **Endosperm**

- **Free Nuclear Endosperm** (Eg:Coconut water)
- **Cellular Endosperm** (Eg:White kernel)

ZYGOTE develops into **Embryo**

- Dicot Embryo
- Monocot Embryo

Ovule → **Seed**

- Albuminous (Seeds retain A part endosperm)
- Non Albuminous (Seed have no Residual endosperm)

Ovary → **Fruit**

- **True fruit** Fruit develops from ovary
- **False Fruit** Develops from Thalamus
- **Parthanocarpic fruit** Develops without Fertilisation

9. <u>Special mechanism of reproduction</u>

Apomixis

i. Some Species of Asteraceae and Grasses produce seed without fertilisation this phenomenon is called Apomixis.
ii. This is a form of asexual reproduction that mimics sexual reproduction.
iii. Diploid egg cell is formed without meiosis and develops into embryo.

Polyembryony

i. Occurence of more than one embryo in a seed, this phenomenon is called polyembryony.
ii. Some of the nucllar cells surrounding the embryo sac start diving and protrude into the embryo sac, develops into the embryo.
iii. Polyembryony is shown my many Citrus and Mango varieties.

MULTIPLE CHOICE QUESTIONS

Choose the correct answer:

1. The root cell of a wheat plant has 42 chromosomes. What would be the number of chromosomes in the synergid cell?

(a) 7 (b) 14 (c) 21(d) 28.

2.In Banana edible part is:

(a) Fleshy epicarp (b) Rudimentary mesocarp and fleshy endocarp

(c) Pericarp (d) Rudimentary endocarp and fleshy mesocarp

3 Egg apparatus consists of

(a)Egg (b) Egg and polar nuclei (c) Egg and synergids (d) Egg and antipodal cells.

4. Endosperm of flowering plants develops from:

(a) Haploid nucleus (b) Diploid nucleus (c) Triploid nucleus (d) Tetraploid nucleus.

5. Persistent nucellus in black pepper is called

(a) Pericarp (b) Perisperm(c) Primary endospermic nucleus

(d) Endosperm

6. In a monocot, endosperm cells have24 chromosomes. What shall be the chromosome

number in embryo:

(a) 24 (b) 16 (c) 12 (d) 8

7. Secondary nucleus present in the middle of embryo sac is:

(a) Tetraploid (b) Triploid (c) Diploid (d) Haploid.

8.In nature cleistogamous flowers are:

(a) Wind pollinated (b) Bird pollinated (c) Self-pollinated (d) Insect pollinated

9.Triploid tissue in angiosperms is:

(a) Nucellus (b) Endosperm (c) Endothecium (d) Tapetum.

10. The outermost layer of maize endosperm is known as:

(a) Perisperm (b) Aleurone (c) Tapetum Endothecium

11. Through which cell of the embryo sac, does the pollen tube enter the embryo sac?

(a) Egg cell (b) Central cell (c) Persistent synergid (d) degenerated synergid.

12. Double fertilisation involves:

(a) Syngamy + triple fusion (b) Double fertilisation (c) Development of

antipodal cell (d) None of the above.

ASSERTION TYPE QUESTIONS

These questions consist of two statements each, printed as Assertion and Reason. While answering these questions, you are requested to choose any one of the following four responses.

A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
B. If both Assertion and Reason are true but reason is not the correct explanation of Assertion.
C. If Assertion is true but Reason is false.
D. If both Assertion and Reason are false.

1. Assertion: Megaspore mother cell undergoes meiosis to produce four megaspores.
   Reason: Megaspore mother cell and megaspores both are haploid.
2. Assertion: Insects visit flowers to gather honey.
   Reason: Attraction of flowers prevents the insects from damaging the parts.
3. Assertion: 7-celled 8- nucleate and monosporic embryo sac is called polygonum type of embryo sac.
   Reason: It was discovered by Hofmeister for the first time in Polygonum.
4. Assertion: Seed disposal by wind is called as anemochory.
   Reason: The seeds are light, minute and may be winged.
5. Assertion: Ovule after fertilisation forms the fruit.
   Reason: The fruit contains diploid endosperm.
6. Assertion: Continued self-pollination generation after generation results in pure line formation.
   Reason: By continued self-pollination, plants become pure or homozygous for its characters.
7. Assertion: Cross pollination in true genetic sense within species is called xenogamy.
   Reason: When there is cross pollination, resultant hybrid is a combination of characters of two plants.
8. Assertion: The first part of the dicot embryo to appear above ground is the leaf.
   Reason: Leaves increase the size of plants.
9. Assertion: If an endosperm cell of angiosperm contains 24 chromosomes, the number of chromosomes in the cell of root will be 16.
   Reason: As the endosperm is triploid and root cells are diploid, the chromosome number in each of root cell will be 16.
10. Assertion: Some fruits are seedless or contain empty or non-viable seeds.
    Reason: They are produced without fertilisation.
11. Assertion: Red colour of flowers attracts butterflies and wasps, but not bees.
    Reason: Bees are colour-blind to red.
12. Assertion: Seeds fail to germinate at very low and high temperatures.
    Reason: Seed sown deep into the soil fails to germinate.

SHORT ANSWER QUESTIONS.

1. Gynoecium of a flower may be apocarpous or syncarpous. Explain with the help of an Example each.
2. Mention the ploidy of the different types of cells present in the female gametophyte of an Angiosperm.

3. Name all the haploid cells present in an unfertilised mature embryo sac of a flowering plant. Write the total number of cells in it.

4. Mention one advantage and a disadvantage of a cleistogamous flower.

5. Explain the mechanism of pollination in marine /seagrass like Zostera.

6. Write the cellular contents carried by the pollen tube. How does the pollen tube gain its entry into the embryo sac?

7. Name the product of fertilisation that forms the kernel of coconut. How does the kernel differ from coconut water?

8. You are given caster and bean seeds. Which one of the two, would you select to observe the endosperm?

9. Name the type of fruit, apple is categorised under and why? Mention two other examples, which belong to the same category as apple.

10. It is said apomixes is a type of asexual reproduction. Justify.

11. If you squeeze a seed of orange, you might observe many embryos of different sizes. How is it possible? Explain.

12.Name and explain the mechanism by which the seeds from hybrid plants are developed that are able to retain the desired hybrid characters in the progeny.

THREE MARK QUESTIONS

1. Where are the following structures present in a male gametophyte of angiosperms? Mention the function of each of them.
2. Do all pollen grains remain viable for the same length of time? Support your answer with two suitable examples.
3. Explain the different modes of pollination that can occur in a chasmogamous flower.
4. Write the differences between wind-pollinated and insect pollinated flowers. Give examples of each type.
5. Majority of angiosperms have hermaphrodite flowers, but self-pollination is discouraged by them. Explain any three outbreeding devices that they have developed to achieve it.
6. In plant breeding experiments, pistillate flowers are not emasculated, but are still bagged. Explain.
7. Differentiate between parthenocarpy and parthenogenesis. Give one example of each.
8. State what apomixis is. Comment on its significance. How can it be commercially used?
9. Apomixis resembles asexual reproduction as well as mimics sexual reproduction in plants. Explain the help of a suitable example.
10. Parthenocarpy and apomixis have been observed in some plants. Give an example of each. State a similarity and a difference observed between the two processes.

LONG ANSWER TYPE QUESTION 5 MARKS

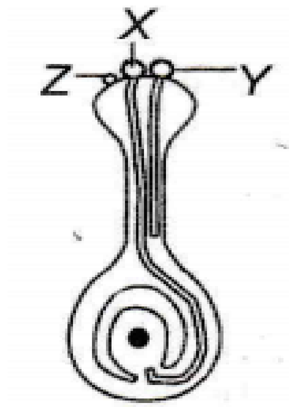
1. (a) Describe any two devices in a flowering plant, which prevent both autogamy and geitonogamy.
   (b)Explain the events up to fertilisation after the pollen tube enters one of the synergids in an ovule of an angiosperm

2. (a) when a seed of an orange is squeezed, many embryos, instead of one, are observed. Explain how it is possible.

(b) Are these embryos genetically similar or different? Comment.

DIAGRAM BASED QUESTION

1. Read the following and answer any four questions from (1) to (v) given below:
   Cross pollination is the transfer of pollen grains from one flower to the stigma of a genetically different flower. It is performed with the help of an external agency which may be abiotic (Eg., wind, water) or biotic (eg.; insects, birds, bats, snails). The diagram shows the carpel of an insect pollinated flower.



i. The given diagram shows the carpel of an insect pollinated flower. What is the most likely reason for the non-germination of pollen grain Z?

(a) Pollen grains X and Y were brought to the stigma earlier, therefore, their germination inhibited the germination of pollen grain Z.

(b) Pollen grain Z was brought to the flower by wind, while pollen grains X and Y were brought to the flower by insects.

(c) Pollen grain Z lacks protrusions that allow it to adhere properly onto the stigma surface.

(d) Pollen grain Z comes from a flower of an incompatible species.

ii. Pollination by insect is called

a. entomophily

b. chiropterophily

c. anemophily

d. ornithophily

iii. Out of the following characters which one is not applicable for wind pollination

a. Stamen hang out of the flowers exposing the anthers to the wind

b. the pollen grains are tiny and light

c. the flowers are nectar less

d. the petals are brightly coloured

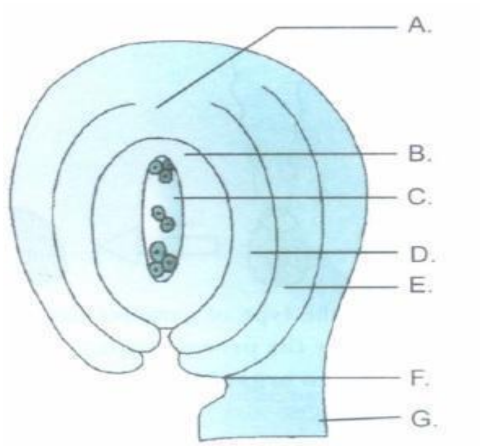
iv. How many of the above characteristics are of insect pollinated flower

a. 1 b.2 c. 3 d. 4

v. Pollen kit is generally found in

a. anemophilous flowers b. Entomophilous flowers c. ornithophilous flowers d. malacophilous flowers

2.



The diagram of an angiosperm ovule is presented above.

(a) Give the technical term for ovule.

(b) Identify and name the part that
(i) attaches the ovule to the placenta
(ii) remains as perisperm in some seeds.
(iii) forms the testa of seed.
(iv) represents the basal part of the ovule.
(v) represents the female gametophyte.

ANSWER KEY

MULTIPLE CHOICE QUESTION –ANSWERS

1. (D) 2. (D) 3. (C) 4. (C) 5. (C) 6. (B) 7. (C) 8. (C) 9. (B) 10. (B) 11. (D) 12. (A).

ASSERTION –REASON TYPE QUESTIONS--ANSWERS

1.C 2.C 3.C 4.A 5. D 6.A 7.A 8.C 9.C 10.A 11.A 12.B.

SHORT ANSWER TYPE TWO MARKS QUESTIONS –ANSWERS.

1. Apocarpous pistil:
When the carpels of a multicarpellary pistil are free, it is called an apocarpous pistil.

Eg. Michelia.

Syncarpous pistil:

When the carpels of a multicarpellary pistil are fused together, it is called a syncarpous pistil.

Eg. Papaver, brinjal.

2. (1). Antipodal cell—Haploid.
(2) Central cell—Diploid (when the two polar nuclei fuse to form a secondary nucleus)

(3). Female gamete (egg cell)—Haploid.

(4) Synergids- Haploid.

3. One female gamete, two synergids, and three antipodal cells are the haploid cells.

In total, there are seven cells in the mature embryo sac.

4. Advantage: Since cleistogamous flowers are autogamous, there is an assured seed set.

Disadvantage: Continued self-pollination leads to inbreeding depression.

5. In sea grasses like Zostera, the female flowers remain submerged in water.

The pollen grains are released inside the water.

pollen grains are long and ribbon like, they are carried passively by water

Some of them reach the stigma and achieve pollination.

6.Pollen tube carries two male gametes and the vegetative nucleus.

Pollen tube grows through the tissues of stigma and style to reach the ovary.

It enters the ovule through the micropyle and then enters the embryo sac through

The filiform apparatus of one of the synergids.

7. Primary endosperm cells form the kernel of coconut.

The kernel of coconut is the cellular endosperm, while the coconut water is the

Free-nuclear endosperm.

8. (a) Caster seeds.

(b) The development of endosperm precedes that of embryo as an adaptation

to Provide assured nutrition to the developing embryo.

9. Apple is categorised as false fruit, because the thalamus, a part of a flower other than the ovary, also contributes to fruit formation.

When the part of the flower other than the ovary becomes a part of the fruit,

The fruit is said to be a false fruit.

The other examples are strawberry and cashew.

10. Since apomixis does not involve formation and fusion of gametes, it is considered as a method of asexual reproduction.

Embryos develop from the cells of integument or nucellus involving mitotic division, apomictic, embryos are genetically similar.

11. It is a case of polyembryony, the phenomenon of occurrence of more than one embryo

In a seed.

Some of the nucellar cells surrounding the embryo sac start dividing, protrude

Into the embryo sac and develop into embryos.

12. Apomixis is the mechanism.

It refers to the form of asexual reproduction that mimics sexual reproduction and

Seeds are formed without fertilisation.

Since there will be no segregation of the hybrid characters in the progeny plants,

They will be maintained for a number of generations.

SHORT ANSWER TYPE (3 MARK QUESTIONS)ANSWERS.

1. (a) Germ pore present in the exine, where sporopollenin is absent.
   The intine grows out through the germ pore as pollen tube

   (b) Sporopollenin forms the exine of pollen grain.

   (c)Generative cell floats in the cytoplasm of the vegetative cell of the

   Pollen grain.

   It divides mitotically to form two male gametes.

2. (a) No, the pollen grains of two different species remain viable for different periods of time.
   Eg. Pollen grains of cereals remain viable for less than 30 minutes whereas some members of Rosaceae, Leguminosae and Solanaceae retain the pollen viability for months.

   (b) In the pollen banks, pollen grains are stored in liquid nitrogen (at -196 C).

   such stored pollen grains can be used for breeding programmes whenever necessary.

3. (a) Autogamy: It refers to the transfer of pollen grains from the anther to the stigma of the same flower.
   (b) Geitonogamy: It refers to the transfer of pollen grains from the anthers of flowers to the stigma of another flower of the same plant.

   (c) Xenogamy: It refers to the transfer of pollen grain from the anther of a flower to the stigma of another flower on a different plant of the same species.

4. Wind pollinated flowers:
   The flowers are small, and not showy or fragrant

   They do not produce nectar.

   Stamens are well exposed.

   Pollen grains are light and non-sticky

   Often, they have feathery stigma

   Eg. Maize, Cannabis

   Insect pollinated flowers:

   The flowers are large, showy and fragrant.

   They produce a large quantity of nectar.

   Stamens are not exposed

   Pollen grains are sticky

   stigma is also sticky

   Eg. Yucca, Sunflower.

5.The outbreeding devices are as follows.

(1) Self incompatibility is the genetic mechanism that prevent self-pollen from Fertilising the ovule by inhibiting pollen germination or retarding the growth of Pollen tube.

(2) Certain plant species produce male and female flowers on different plants, i.e. the plants are Dioecious; this prevents both autogamy and geitonogamy

(3) Pollen release and stigma receptivity are not synchronised, either the anthers Mature first or the pistil mature first

(4) The anthers and stigma of a flower are placed in such a way that the pollen of the flower cannot fall on the stigma of the same flower.

6. (a) In plant breeding experiments, pollen from the selected male parent only, are used for pollination

To prevent contamination of the stigma by any other pollen grain, the pistillate flowers are bagged.

(b) Continued self-pollination leads to inbreeding depression; hence

To discourage self-pollination, out breeding devices are developed by flowers.

7. Parthenocarpy:

Parthenocarpy is the phenomenon of formation of fruits without fertilisation

usually seeds are not produced or not viable

Eg. Banana.

Parthenogenesis:

Parthenogenesis is the phenomenon in which the unfertilised female gamete

Or ovum develops into an adult/individual

Eg. Drones of honey bees.

8. Apomixis is a form of asexual reproduction that mimics sexual reproduction and seed are formed without fertilisation

Apomixis Is of significance in the hybrid seed industry.

If the hybrids are made into apomicts, there will be no segregation of the hybrid characters in the progeny plant

The farmers can use the hybrid seeds to raise new crops year after year and they need not buy the costly hybrid seeds.

9.Apomixis resembles asexual reproduction, as there is no formation of gametes and fertilisation and the apomictic embryos are genetically identical among Themselves and to the parent cell.

It mimics sexual reproduction as embryos and seeds are formed.

In citrus and mango, some of the cells of nucellus around the embryo Sac starts dividing, get pushed into the embryo sac and develops into embryos.

In members of Asteraceae, a diploid egg cell is formed without meiosis

In the megaspore mother cell, it develops without fertilisation into an Embryo.

10 Parthenocarpy is seen in banana

Apomixis is seen in Citrus, mango, some members of Asteraceae and grasses.

Similarity: -
There is no fertilisation involved in both parthenocarpy and apomixis
Difference: -
Parthenocarpy is fruit formation without fertilisation, the fruits are seedless or the Seeds are not viable
Apomixis is seed formation without fertilisation

LONG ANSWER TYPE 5 MARK ANSWERS

1. (A) Dioecy and self-incompatibility are the two phenomenon which can prevent Both autogamy and geitonogamy.

   Dioecy is a phenomenon in which male and female flowers are produced on different plants of the same species, as in date palm and papaya.

   Self-incompatibility is a genetic mechanism that prevents the self-pollen from fertilising the ovule by inhibiting pollen germination of pollen tube growth on the pistil.

   (b) Double fertilisation:

   The pollen tube discharges two male gametes after entering one of the synergids.

   One of the male gametes fuses with the female gamete to form a zygote; this process is called syngamy

The other male gamete fuses with the secondary nucleus (formed by the fusion of two polar nuclei) to form the primary endosperm nucleus (PEN); this process is called triple fusion

2. (a) It is a case of polyembryony, i.e. the occurrence of more than one embryo in a seed. In oranges, some of the nucellar cells around the embryo sac start dividing, protrude into the embryo sac and develop into the embryos, i.e. apomictic embryos are formed without fertilisation.

   (b All the apomictic embryos are genetically similar among themselves and to the female parent as they have developed from the nucellar cells and involve only mitotic division.

   The zygotic embryo in the same seed will be genetically different from these

   apomictic embryos, as it has developed from the zygote, which is formed by fusion of gametes from two different parents.

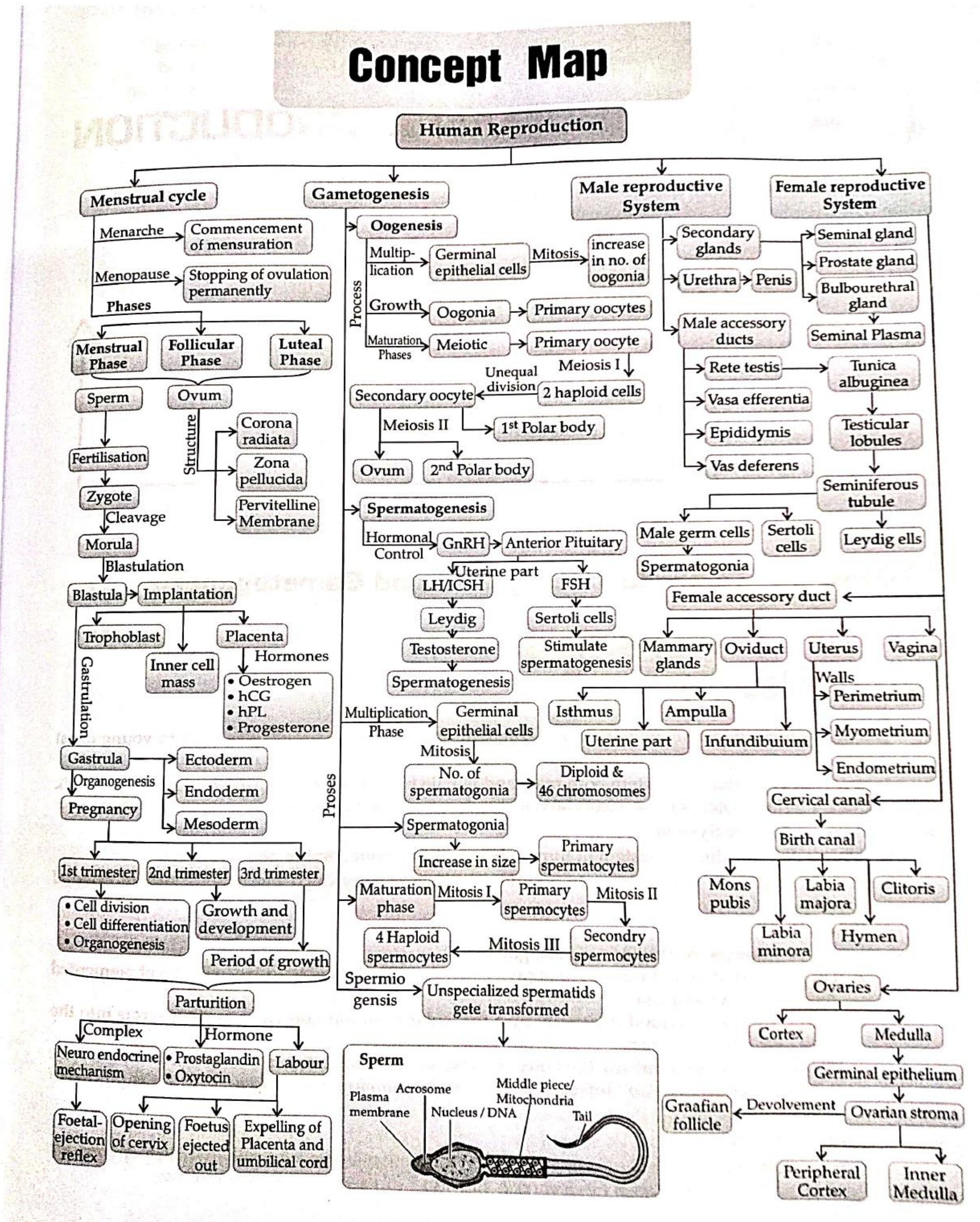
DIAGRAM BASED QUESTION -ANSWERS

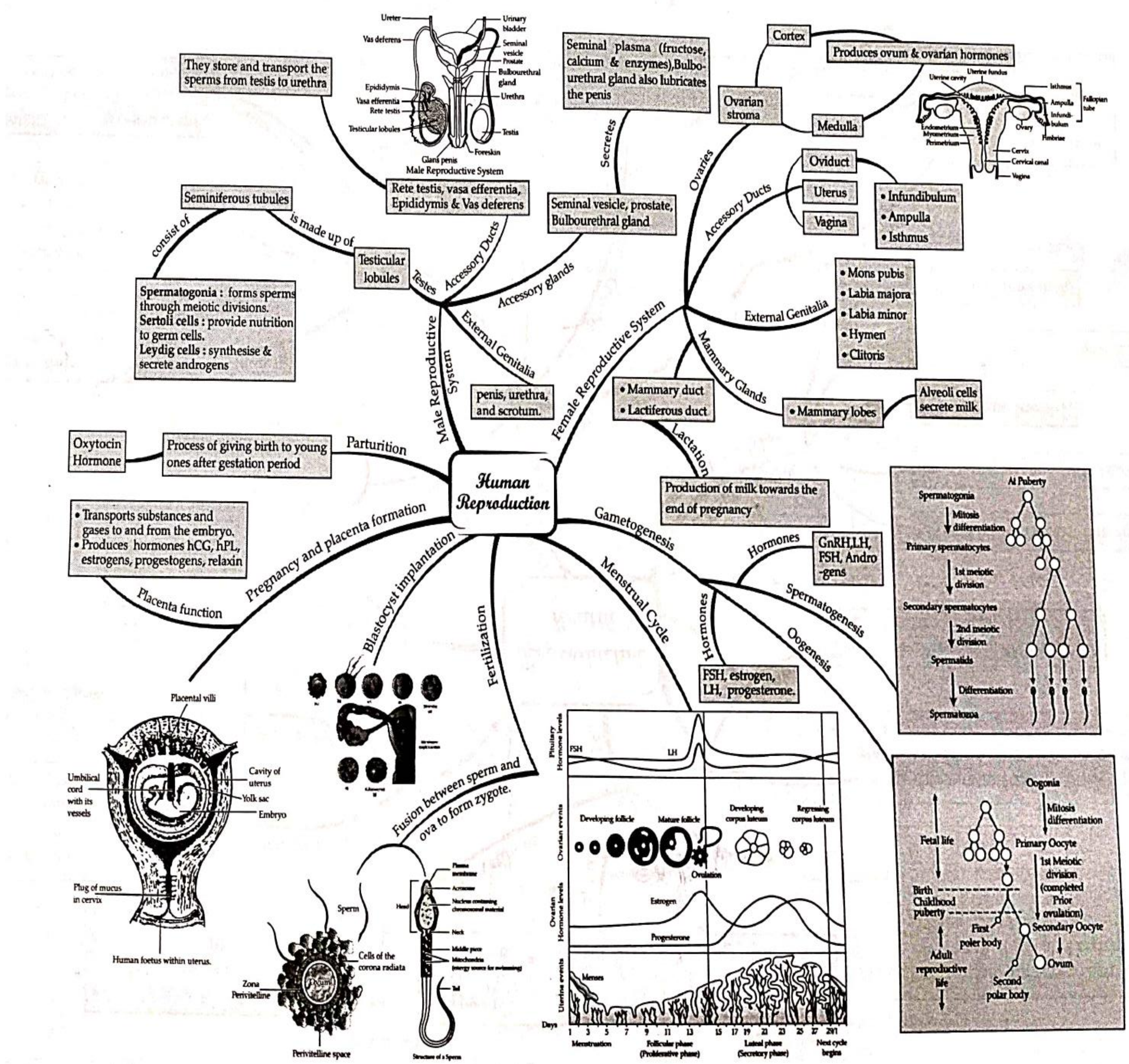
1. i. d ii. a iii. d iv. a v. b
2. (a) Megasporangium (b) i. F – Hilum ii. D – Nucellu iii. E – Outer Integument iv. A – Chalaza v. C – Embryo Sac

Prepared by:

1.ASHADEVI.PK 2. P. KRISHNAN ,KV TRISSUR

CHAPTER 3: HUMAN REPRODUCTION




Human Reproduction
Male Reproductive System
Testes
Testicular lobules
is made up of
Seminiferous tubules
consist of
Spermatogonia : forms sperms through meiotic divisions.
Sertoli cells : provide nutrition to germ cells.
Leydig cells : synthesise & secrete androgens
Accessory Ducts
Rete testis, vasa efferentia, Epididymis & Vas deferens
They store and transport the sperms from testis to urethra
Male Reproductive System
Accessory glands
Seminal vesicle, prostate, Bulbourethral gland
Secretes
Seminal plasma (fructose, calcium & enzymes),Bulbo-urethral gland also lubricates the penis
External Genitalia
penis, urethra, and scrotum.
Female Reproductive System
Ovaries
Ovarian stroma
Cortex
Medulla
Produces ovum & ovarian hormones
Accessory Ducts
Oviduct
Uterus
Vagina
• Infundibulum
• Ampulla
• Isthmus
External Genitalia
• Mons pubis
• Labia majora
• Labia minor
• Hymen
• Clitoris
Mammary Glands
• Mammary lobes
Alveoli cells secrete milk
• Mammary duct
• Lactiferous duct
Lactation
Production of milk towards the end of pregnancy
Parturition
Process of giving birth to young ones after gestation period
Oxytocin Hormone
Pregnancy and placenta formation
Placenta function
• Transports substances and gases to and from the embryo.
• Produces hormones hCG, hPL, estrogens, progestogens, relaxin
Blastocyst implantation
Fertilization
Fusion between sperm and ova to form zygote.
Placental villi
Umbilical cord with its vessels
Cavity of uterus
Yolk sac
Embryo
Plug of mucus in cervix
Human foetus within uterus.
Sperm
Cells of the corona radiata
Zona Perivitelline
Perivitelline space
Structure of a Sperm
Gametogenesis
Hormones
GnRH,LH, FSH, Andro-gens
Spermatogenesis
Oogenesis
Menstrual Cycle
Hormones
FSH, estrogen, LH, progesterone.
Pituitary Hormone levels
FSH
LH
Ovarian events
Developing follicle
Mature follicle
Ovulation
Developing corpus luteum
Regressing corpus luteum
Ovarian Hormone levels
Estrogen
Progesterone
Uterine events
Menses
Days
Menstruation
Follicular phase (Proliferative phase)
Luteal phase (Secretory phase)
Next cycle begins
At Puberty
Spermatogonia
Mitosis differentiation
Primary spermatocytes
1st meiotic division
Secondary spermatocytes
2nd meiotic division
Spermatids
Differentiation
Spermatozoa
Oogonia
Mitosis differentiation
Fetal life
Primary Oocyte
1st Meiotic division (completed Prior ovulation)
Birth
Childhood
puberty
First polar body
Secondary Oocyte
Adult reproductive life
Second polar body
Ovum

<u>**GIST OF THE MAJOR/MINOR CONCEPTS**</u>

Male and Female Reproductive Systems

● Human beings reproduce sexually and are viviparous.

● In humans, the reproductive phase starts after puberty.

● It involves:

○ Gametogenesis

○ Insemination

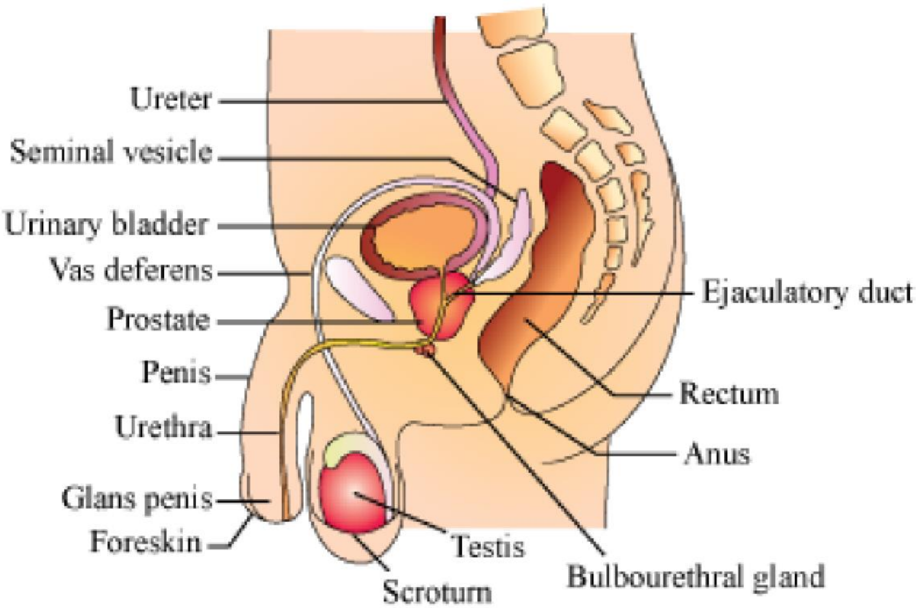
○ Fertilisation

○ Implantation

○ Gestation

○ Parturition

The Male Reproductive System



It is located in the pelvic region.

● It consists of:

○ A pair of testes

○ Accessory glands and ducts

○ External genitalia

Testes

● Situated within the scrotum, which protects the testes and also helps in maintaining the temperature.

● Each testis is 4 to 5 cm in length, and 2 to 3 cm in width, and has about 250 compartments called testicular lobules.

● Testicular lobules have seminiferous tubules which are the sites of sperm formation.

● Seminiferous tubules are lined by two types of cells:

○ Male germ cells − They undergo meiosis to form sperms.

○ Sertoli cells − They provide nourishment to the germ cells.

● Region outside the seminiferous tubules is called the interstitial space, which contains Leydig cells (interstitial cells). The Leydig cells produce androgens.

Accessory Ducts and Glands

● Accessory ducts include:

○ Rete testis

○ Vasa efferentia

○ Epididymis

○ Vas deferens

● The seminiferous tubules open into the vasa efferentia through the rete testis.

● The vasa efferentia open into the epididymis, which leads to the vas deferens. The vas deferens opens into the urethra along with a duct from the seminal vesicle called the ejaculatory duct.

● The ejaculatory duct stores the sperms and transports them to the outside

● The urethra starts from the urinary bladder, extends through the penis and opens via the urethral meatus.

● Accessory glands include:

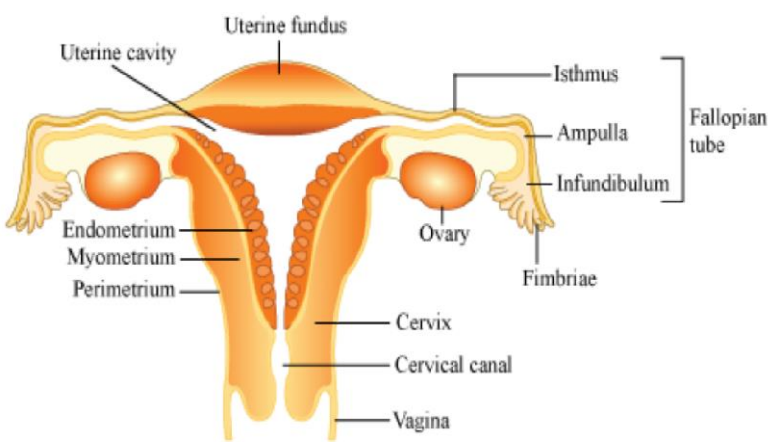
○ A pair of seminal vesicles

○ Prostate gland

○ A pair of bulbourethral glands

● The secretions of these glands make up the seminal plasma, and provide nutrition and a medium of motility to the sperms.

The Female Reproductive System



● It is located in the pelvic region:

● It includes:

○ A pair of ovaries

○ A pair of oviducts

○ Uterus

○ Cervix

○ Vagina

○ External genitalia

○ Mammary glands (not part of the reproductive system, but aids in child care)

Ovaries

● They are the primary female sex organs. They produce the ovum and other ovarian hormones.

● They are located in the lower abdomen, and are 2 to 4 cm in length.

● They are connected by ligaments to the pelvic walls and to the uterus.

● Each ovary is covered by epithelium, and contains the ovarian stroma.

● The ovarian stroma is made up of:

○ Peripheral cortex

○ Inner medulla

Oviducts

● They are also called fallopian tubes.

● They are 10 to 12 cm long, and extend from the ovary to the uterus.

● The part of each oviduct lying towards the ovary is funnel shaped, and is called infundibulum. It has finger like projections called fimbriae.

● The infundibulum leads to the ampulla, and then to the isthmus, which has a narrow lumen opening into the uterus.

Uterus

● It is also called womb, and is pear shaped.

● It is connected to the pelvic walls by ligaments.

● The uterine wall consists of:

○ External perimetrium

○ Middle myometrium

○ Internal endometrium, which lines the uterine cavity

● The endometrium undergoes changes during the menstrual cycle.

Cervix and Vagina

● The cervix connects the uterus to the vagina.

● The cervix and the vagina constitute the birth canal.

External Genitalia

● Consists of:

○ Mons pubis − Fatty tissue covered by skin and pubic hair

○ Labia majora − Extends from mons pubis and surrounds the vaginal opening

○ Labia minora − Fold of skin beneath the labia majora

○ Hymen − Partially covers the vaginal opening

○ Clitoris − Lies at the junction of labia minora

Mammary Glands

● Present in all female mammals

● It is paired and is glandular.

● Each breast contains 15 to 20 mammary lobes with alveoli which secrete milk.

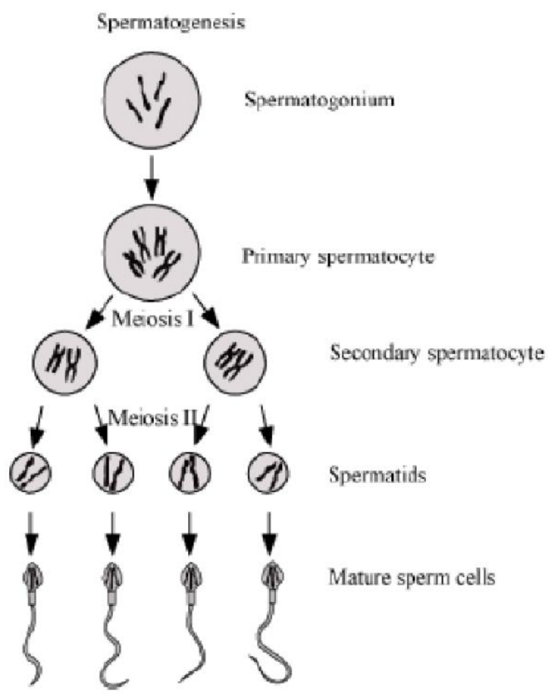
● The alveoli open into the mammary tubules, which unite to form a mammary duct.

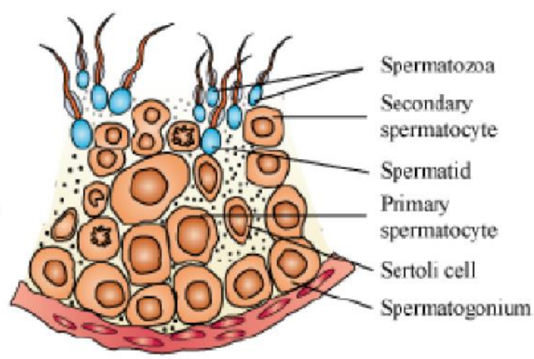
● Many mammary ducts constitute the mammary ampulla, which is connected to the lactiferous duct.

Gametogenesis

The testis and ovary produce the male and female gametes respectively by gametogenesis (spermatogenesis in males and oogenesis in females).

Spermatogenesis





● In males, sperms are produced by the spermatogonia (immature germ cells), which are present in the inner walls of the seminiferous tubules.

● Spermatogonia increase in number by mitosis. These are diploid.

● Some of the spermatogonia called primary spermatocytes periodically undergo meiosis.

● After the first meiotic division, two haploid and equal secondary spermatocytes are formed.

● These further undergo meiosis to give rise to four haploid spermatids.

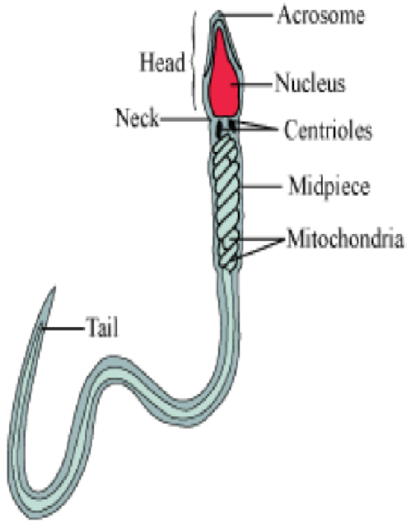
● These spermatids are converted into sperms by spermiogenesis.

● The sperm head gets embedded in the Sertoli cells after spermiogenesis and is released from the seminiferous tubules by spermiation.

● Spermatogenesis starts at puberty by the action of the gonadotropin releasing hormone (GnRH), which in turn causes the release of two gonadotropins called Luteinizing Hormone (LH) and Follicle Stimulating Hormone (FSH).

● LH acts on Leydig cells and causes them to release androgens, which stimulate the process of spermatogenesis while the FSH acts on the Sertoli cells, which help in spermiogenesis.

Structure of a Sperm



Sperm cell

● A mature sperm consists of:

○ Head

○ Neck

○ Middle piece

○ Tail

● The whole sperm is enclosed in a plasma membrane.

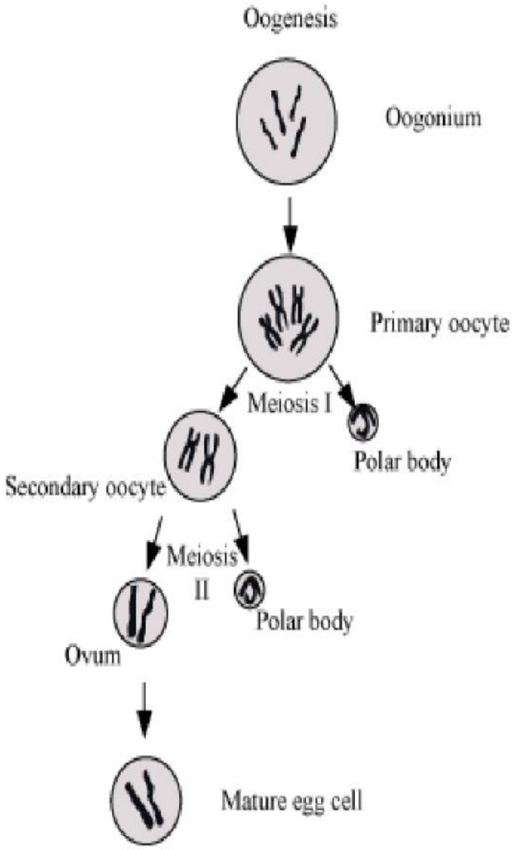
● The head consists of a haploid nucleus and a cap like acrosome, which contains enzymes that aid in fertilisation.

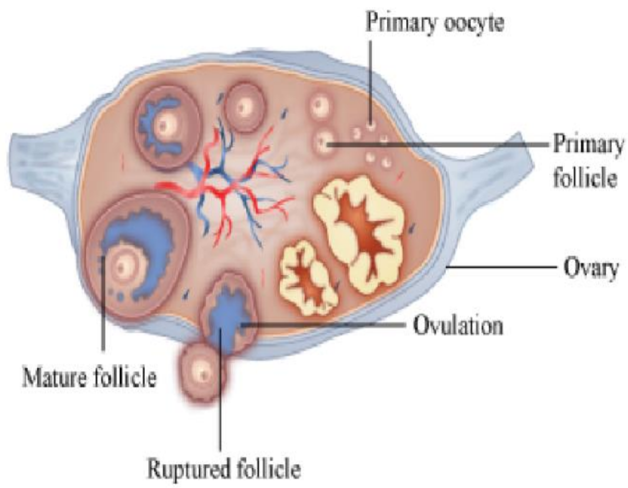
● The middle piece contains several mitochondria, which produce energy for the motility of the sperm.

● Sperms released by the seminiferous tubules are transported by the accessory ducts.

● Secretions of epididymis, vas deferens, seminal vesicles, and prostate are essential for maturation and motility of sperms.

Oogenesis





● The ovum is formed by the process of oogenesis.

● It starts during embryonic growth and millions of gamete mother cells (oogonia) are formed in the foetal ovary.

● These cells undergo meiosis, but get temporarily arrested at the prophase and are called primary oocytes.

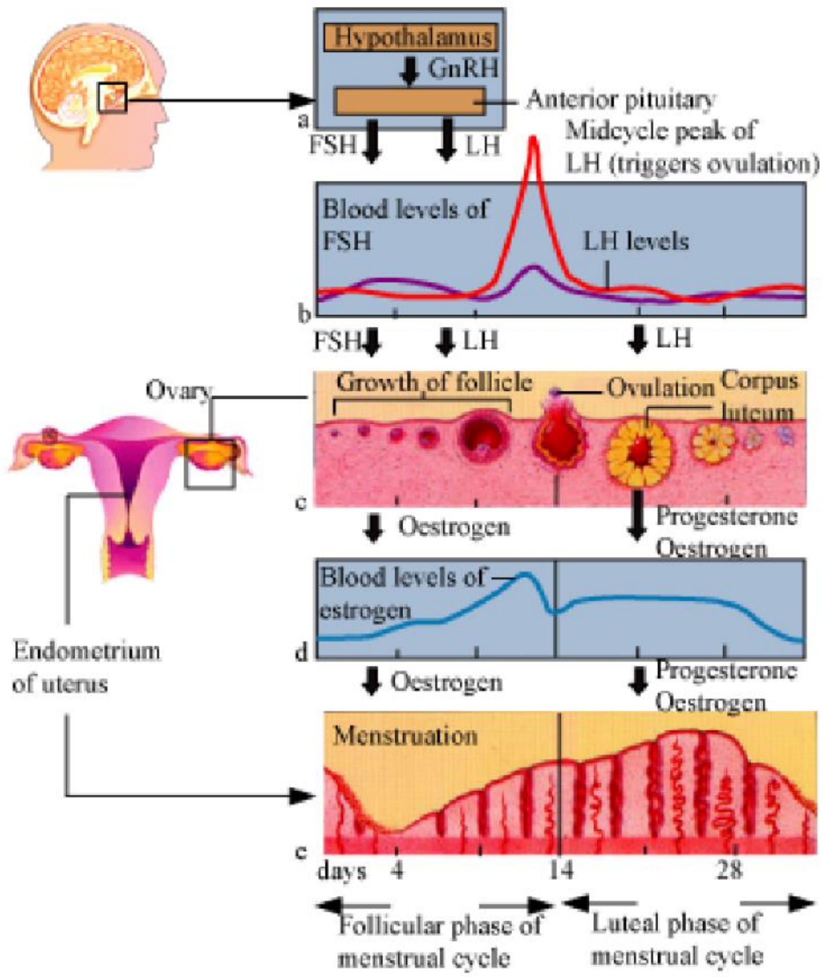
● Before reaching puberty, a large number of primary oocytes degenerate and the remaining ones get surrounded by layers of granulosa cells and new theca and are called secondary follicles.

● The secondary follicles are then converted into tertiary follicles that have characteristic fluid filled cavity called antrum. At this stage, the primary oocyte present within the tertiary follicle completes meiosis, which results in the formation of haploid secondary oocyte and a tiny polar body.

● This tertiary follicle further changes into the Graafian follicle. The secondary oocyte is surrounded by the zone pellucida.

● Then the Graafian follicle ruptures to release the ovum by ovulation.

Menstrual Cycle & Fertilisation



● Menstrual cycle is the reproductive cycle in all primates and begins at puberty (menarche).

● In human females, menstruation occurs once in 28 to 29 days. The cycle of events starting from one menstruation till the next one is called the menstrual cycle.

● During the middle of the menstrual cycle, one ovum is released (ovulation).

● The cycle starts with the menstrual flow (3 to 5 days), caused due to the breakdown of the endometrium of the uterus. Blood vessels in liquid state are discharged, but this occurs only when the ovum is not fertilised.

● It is followed by the follicular phase. In this phase, the primary follicles mature into the Graafian follicles. This causes the regeneration of the endometrium. These changes are brought about by ovarian and pituitary hormones. In this phase, the release of gonadotropins (LH and FSH) increases. This causes follicular growth and the growing follicles produce oestrogen.

● The LH and FSH are at their peak in the middle of the cycle (14 th day), and cause the rupture of the Graffian follicles to release ovum. This phase is called the ovulatory phase.

● The remains of the Graffian follicles get converted into the corpus luteum, which secretes progesterone for the maintenance of the endometrium.

● In the absence of fertilisation, the corpus luteum degenerates, thereby causing the disintegration of the endometrium and the start of a new cycle.

● In humans, the menstrual cycle ceases to operate at the age of 50 years. This phase is known as the menopause.

Fertilisation and Implantation

● During coitus, the semen is released into the vagina, passes through the cervix of the uterus and reaches the ampullary isthmic junction of the fallopian tube.

● The ovum is also released into the junction for fertilisation to occur.

● The process of fusion of the sperm and the ovum is known as fertilisation.

● During fertilisation, the sperm induces changes in the zona pellucida and blocks the entry of other sperms. This ensures that only one sperm fertilises an ovum.

● The enzymatic secretions of the acrosomes help the sperm enter the cytoplasm of the ovum.

● This causes the completion of meiotic division of the secondary oocyte, resulting in the formation of a haploid ovum (ootid) and a secondary polar body.

● Then, the haploid sperm nucleus fuses with the haploid nucleus of the ovum to form a diploid zygote.

● Mitosis starts as the zygote moves through the isthmus of the oviduct (cleavage) and forms 2, 4, 8, 16 daughter cells called blastomeres.

● The 8−16 cell embryo is called a morula, which continues to divide to form the blastocyst. The morula moves further into the uterus.

● The cells in the blastocyst are arranged into an outer trophoblast and an inner cell mass.

● The trophoblast gets attached to the uterine endometrium, and the process is called implantation. This leads to pregnancy.

● The inner cell mass gets differentiated to form the embryo.

Pregnancy, Parturition and Lactation

Pregnancy

● After implantation, the trophoblast forms finger like projections called chorionic villi, surrounded by the uterine tissue and maternal blood.

● The chorionic villi and the uterine tissue get integrated to form the placenta, which helps in supplying the developing embryo with oxygen and nutrients, and is also involved in

the removal of wastes.

● The placenta is connected to the embryo by the umbilical cord. The placenta acts as an endocrine gland, and produces the human chorionic gonadotropins, human

placental lactogen, oestrogen, progesterone and relaxin (later stages of pregnancy).

● These hormones support foetal growth and help in the maintenance of pregnancy. Hormones like oestrogen, progestogen, cortisol, prolactin, etc., are increased several

folds in the maternal blood.

● Immediately after implantation, the inner cell mass (embryo) gets differentiated into the ectoderm, mesoderm and endoderm, which give rise to the different tissues. This ability of the inner cell mass is due to the presence of multipotent cells called stem cells.

● Most of the major organs are formed at the end of 12 weeks of pregnancy; during the 5 th month, the limbs and body hair are formed; by the 24 th week, the eyelids separate and eyelashes are formed. At the end of nine months, the foetus is fully formed.

Parturition and Lactation

● Human pregnancy has the duration of 9 months. This duration is called the gestation period

● At the end of this period, vigorous uterine contractions lead to the delivery of the foetus. This process is called parturition.

● Parturition is a neuroendocrine mechanism, and is started by the signals from the developed foetus and the placenta, which produce the foetal ejection reflex.

● This causes the release of oxytocin from the pituitary, which causes stronger uterine contractions.

● This leads to the expulsion of the baby along with the placenta.

● During pregnancy, the mammary glands undergo differentiation, and milk is produced during the end of pregnancy.

● The milk produced during the first few days of lactation is known as colostrum. It contains several antibodies that aid the new born to develop resistance.

MCQ

Question 1.

Ovulation in the human female normally takes place during the menstrual cycle

(a) at the mid secretory phase

(b) just before the end of the secretory phase

(c) at the beginning of the proliferative phase

(d) at the end of the proliferative phase.

Question 2.

After ovulation Graafian follicle regresses into

(a) corpus atresia

(b) corpus callosum

(c) corpus luteum

(d) corpus albicans

Question 3.

Immediately after ovulation, the mammalian egg is covered by a membrane known as

(a) chorion

(b) zona pellucida

(c) corona radiata

(d) vitelline membrane.

Question 4.

Which part of the sperm plays an important role in penetrating the egg membrane?

(a) Allosome

(b) Tail

(c) Autosome

(d) Acrosome

Question 5.

Which among the following has 23 chromosomes?

(a) Spermatogonia

(b) Zygote

(c) Secondary oocyte

(d) Oogonia

Question 6.

Which of the following hormones is not secreted by human placenta?

(a) hCG

(b) Estrogens

(c) Progesterone

(d) LH

Question 7.

The nutritive cells found in seminiferous tubules are

(a) Leydig’s cells

(b) atretic follicular cells

(c) Sertoli cells

(d) chromaffin cells.

Question 8.

Sertoli cells are regulated by the pituitary hormone known as

(a) LH

(b) FSH

(c) GH

(d) prolactin.

Question 9.

In human adult females oxytocin

(a) stimulates pituitary to secrete vasopressin

(b) causes strong uterine contractions during parturition

(c) is secreted by anterior pituitary

(d) stimulates growth of mammary glands.

Question 10.

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

(a) At puberty

(b) During menarche

(c) During menopause

(d) During embryonic development

Question 11.

Delivery of developed foetus is scientifically called

(a) parturition

(b) oviposition

(c) abortion

(d) ovulation.

ASSERTION-REASON QUESTIONS

In the following questions a statement of assertion and reason is correct explanation for assertion correct answer out of the following choices.

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

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

c. Assertion is true but reason is false

d. Both assertion and reason are false.

1. Assertion-The uterus is shaped like an inverted pear.

   Reason- The inner glandular layer lining the uterine cavity is called as myometrium.

2. Assertion-The middle piece of the sperm is called is powerhouse.

   Reason- Numerous mitochondria in the middle piece produce energy for the movement of the tail.

3. Assertion-All sperms released at a time do not fertilise the ovum.

   Reason-Fertilisation occur only when ovum and sperm fuse at the ampullary-isthmic junction.

4. Assertion-The embryo with 8 to 16 blastomeres is called a morula.

   Reason-The morula continuously divides to transform into trophoblast.

5. Assertion-The endometrium undergoes cyclic changes during the menstrual cycle.

   Reason- Perimetrium contracts strongly during delivery of the baby.

6. Assertion- Signals for parturition originate from placenta and the developed foetus.

   Reason- Relaxin is released by the placenta.

7. Assertion-the female gamete is produced at the time of puberty.

   Reason- gonadotropin releasing hormone controls the process of oogenesis.

8. Assertion- the fertilized egg contains 23 pairs of chromosomes

   Reason-zygote is formed by the fusion of egg and the sperm.

9. Assertion-Colostrum produced in first 2-3 days after parturition is rich in nutrients.

Reason-placenta induces the signals for expulsion of the fully developed.

Short Answer type (2 or 3 marks)

1. At what stage of life is oogenesis initiated in a human female? When does the oocyte complete oogenesis?
2. Give a scientific term for the following:
   a) Layer of follicle cells that envelops the egg outside the zona pellucida.
   b) The finger-like projection appearing on the trophoblast after implantation.
3. a) How many lobules are found in each testis?
   b) What is the function of Bulbourethral glands?
4. What is pregnancy hormone? Why is it so called? Name two sources of this hormone in a human female.
5. Name the hormone which stimulates the secretion of ovarian hormones. What would happen if the blood concentration of ovarian hormones increases?
6. Explain the formation of placenta after implantation in a human female.
7. What is the role of following hormones in the female reproductive cycle:
   1) FSH
   2) LH
   3) Progesterone
8. a) In which part of the human female reproductive system do the following events take place.
   I. Release of 1st polar body
   II. Release of 2nd polar body
   III. Fertilization
   IV. Implantation
   b) From where do the signals for parturition originate and what does maternal pituitary release for stimulating uterine contractions for childbirth.
9. Define spermatogenesis. Where does it occur?
10. Write the location and functions of Sertoli cells in humans?
11. Differentiate between spermiogenesis and spermiation.
12. How does colostrum provide initial protection against diseases to new born infants? Give one reason.
13. State the fate of the trophoblast of a human blastocyst at the time of implantation and that of the inner cell mass immediately after implantation.
14. What is ovulation? What happens to the Graafian follicle after ovulation?

Long Answer (5marks)

1. What is spermatogenesis? Briefly describe the process of spermatogenesis.

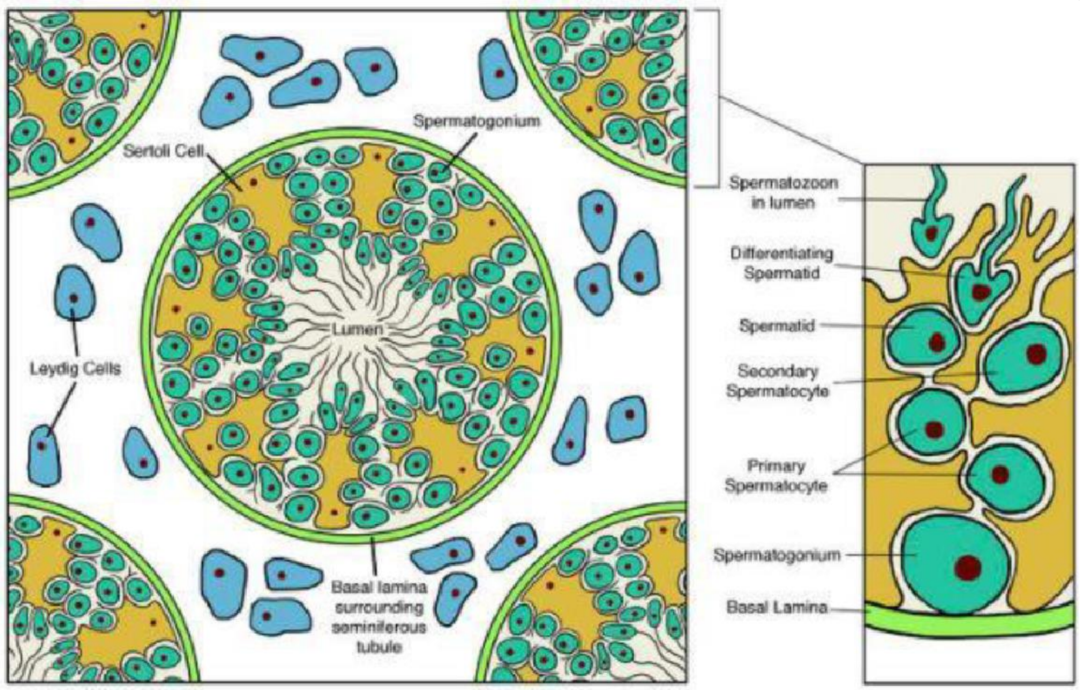
2. Briefly describe the process of oogenesis.

3. Describe the roles of pituitary and ovarian hormones during the menstrual cycle in a human female.

4. Explain in detail the various developmental stages of the zygote until implantation with suitable diagrams.

Diagram based/case based/passage-based questions

Q1.



Study the figure given and answer the questions that follows: (answer any four) 1x4

i) The function of Sertoli cell is:

a) Nutrition to the sperms

b) Nutrition to the Leydig cell

c) Nutrition to the basal lamina

d) Excretion from sperm

ii) Cross section of testes shows:

a) Seminiferous tubules with different stages of development of sperm

b) Development of Sertoli cells

c) Many testicular lobules

d) Many spermatogonia

iii) Pick out and name the cells that undergo spermiogenesis.

a) Spermatogonia undergo spermiogenesis

b) Spermatids undergo spermiogenesis

c) Secondary spermatocytes undergo spermiogenesis

d) Primary spermatocytes undergo spermiogenesis.

iv) How many sperms will be produced from 50 primary spermatocytes?

a) 400 sperms

b) 1000 sperms

c) 200sperms

d) 100sperms

v) Testosterone is secreted which cell:

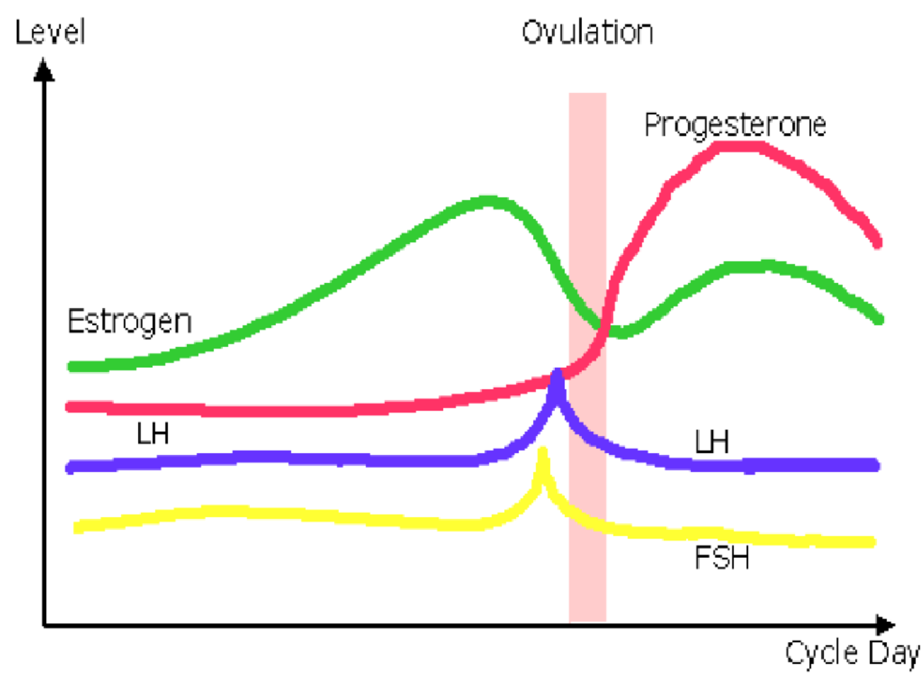
a) Sertoli cell

b) Spermatids

c) Leydig cells

d) Spermatogonia

Q2



Study the graph given and answer any four questions:1x4

i) Name the ovarian and pituitary hormones that are responsible for development of follicles.

a) Estrogen and LH

b) Estrogen and progesterone

c) FSH and LH

d) Progesterone and FSH

ii) In which phase of menstrual cycle corpus luteum is formed and names the hormone it secretes.

a) Ovulatory phase and progesterone

b) Luteal phase and progesterone

c) Follicular phase and progesterone

d) Menstrual phase and progesterone

iii) What are the three phases of oogenesis?

a) Multiplication phase, growth phase and reproductive phase

b) Multiplication phase, growth phase and maturation phase

c) Growth phase, maturation phase and secretory phase

d) Secretory phase, growth phase and maturation phase

iv) The phase in woman's life when ovulation and menstruation stops is called:

a) Menarche

b) Puberty

c) Menopause

d) Reproduction

v) Withdrawing of which hormone causes menstruation?

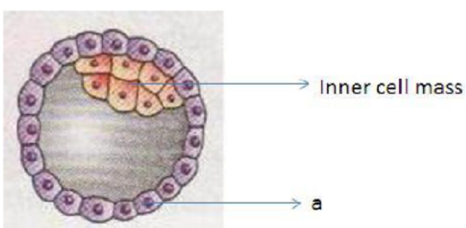
a) Estrogen

b) Progesterone

c) FSH

d) LH

Q3	Study the diagram and answer any four questions:1x4	



i) Name the stage of human embryo the figure represents.

a) Gastrula

b) Blastocyst

c) Oocyte

d) Primary oocyte

ii) Where are the stem cells located in this embryo?

a) Inner cell mass

b) Blastocoel

c) Blastomeres

d) Blastocyst

iii) Write the name of "a"

a) Blastomere

b) Trophoblast

c) Morula

d) Gastrula

iv) Which layer gets attached to the cells of endometrium and names the part which develops into embryo?

a) Trophoblast and inner cell mass

b) Trophoblast and ectoderm

c) Ectoderm and endoderm

d) Trophoblast and mesoderm

v) How is the placenta connected to the embryo?

a) By chorionic villi

b) By umbilical cord

c) By inner layer

d) By trophoblast

Answer key

MCQ

1. (d) at the end of the proliferative phase.
2. (c) corpus luteum
3. (c) corona radiata
4. (d) Acrosome
5. (c) Secondary oocyte
6. (d) LH
7. (c) Sertoli cells
8. (b) FSH
9. (b) causes strong uterine contractions during parturition
10. (d) During embryonic development
11. (a) parturition

ASSERTION-REASON QUESTIONS

1. Ans. c
2. Ans. a
3. Ans. b
4. Ans .c
5. Ans. c
6. Ans. b
7. Ans. d
8. Ans. a
9. Ans. b

Short Answer type (2 or 3 marks)

1. Ans. Embryonic life. When the sperm enters the egg
2. (a). Ans. corona radiata (b). Ans. Chorionic villi
3. (a). Ans. 250 (b). Ans. Secretion of alkaline fluid. They also secrete mucus that lubricates the end of the penis and the lining of the urethra.

4. Ans.Human chorionic gonadotropin(hcG) chorionic thyrotropin, chorionic corticotropin and relaxin are secreted by placenta. The hcG stimulates and maintains the corpus luteum to secrete progesterone. Progesterone maintains endometrium throughout the pregnancy. These hormones are associated with pregnancy and therefore known as pregnancy hormone.
5. Ans. FSH and LH stimulate the ovarian hormones. A feedback system becomes operative when the level of estrogen increases. The anterior pituitary is inhibited from secreting FSH and stimulated to secrete LH.
6. Ans.Trophoblast forms finger -like projections called chorionic villi that are surrounded by uterine tissue and maternal blood. The chorionic villi and uterine tissue become interdigitated with each other to form placenta.
7. Ans.1.FSH- Stimulates growth of Graafian follicle and maturation of ovum in it. Stimulates secretion of estrogen from follicle cells.
   2.LH- Stimulates ovulation and induces the formation of corpus luteum. Stimulates secretion of progesterone from corpus luteum.
   3.Progesterone- brings about uterine growth, facilitates the implantation of embryos and formation of the placenta. Prevents other Graafian follicles from maturing.
8. Ans. a) I) Ovary II) In the isthmus- ampullary junction of fallopian tube III) Isthmus- ampullary junction of fallopian tube. IV) In the uterus
   b) Fully developed foetus and placenta, oxytocin
9. Answer: The transformation of non-motile spermatids into motile spermatozoa is called spermiogenesis. It occurs inside seminiferous tubules of testes.
10. Answer: Sertoli cells. These are present in the seminiferous tubules of the testis. They provide nutrition to germ cells. They play a vital role in the maturation of spermatids into motile sperms.
11. Answer: Difference between spermiogenesis and Spermiation: Spermiogenesis is the process of transformation of non-motile spermatids into mature motile sperms (male-gametes) whereas speciation is the release of sperms from Sertoli cells of seminiferous tubules.
12. Answer: The colostrum provides antibodies that are essential to developing resistance for new born babies.
13. Answer: The trophoblast layer of the human blastocyst gets attached to the endometrium and the inner cell mass gets differentiated into an embryo. After attachment, the uterine cells divide rapidly and cover the blastocyst. As a result, the blastocyst becomes embedded in the endometrium of the uterus. It is termed Implantation.
14. Answer: Ovulation: The release of eggs (at secondary oocyte stage) after rupturing of Graafian follicle is called ovulation. After the ovulation, the granulosa cells as well as the stroma cells from theca Interna rapidly multiply to fill the cavity of the Graafian follicle which becomes the corpus luteum. If fertilization occurs, the corpus luteum grows further and secretes hormones. If fertilization does not take place, the corpus luteum regresses and forms a yellow body.

LONG ANSWER QUESTIONS (5marks)

1. Answer:

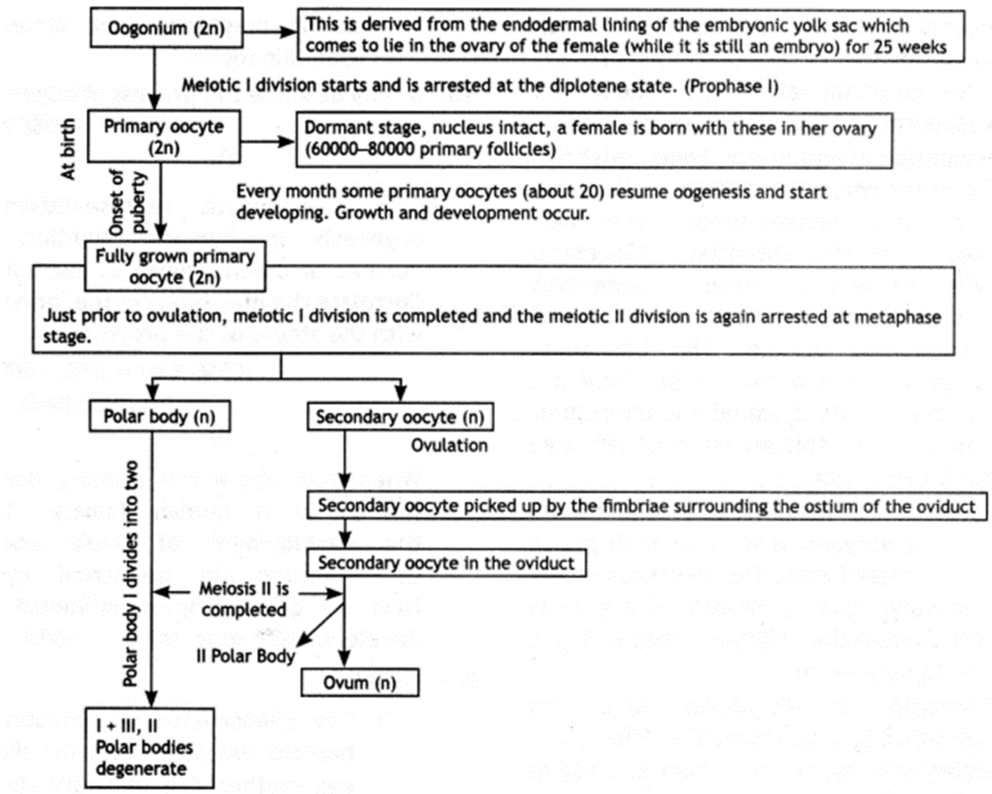
Spermatogenesis. The process of sperm formation from the sperm mother cells of testis (male gonad) is called spermatogenesis. It is completed in four phases, viz. spermatocytogenesis, meiosis I, meiosis II, and spermiogenesis. Spermatocytogenesis, Meiosis I and Meiosis II. The sperms are formed from the sperm mother cells present in the germinal layer of seminiferous tubules of the testis. Some of the mother cells enlarge to divide mitotically to form spermatogonia.

Growth phase: Some of them enter a period of growth and are called primary spermatocytes which are diploid.

Maturation phase: These cells divide meiotically to form two haploid secondary spermatocytes. Each secondary spermatocyte again divides mitotically. Thus, one primary spermatocyte forms haploid spermatids.

Spermiogenesis: These develop into complete spermatozoan. These possess head which is embedded in the nourishing cells called Sertoli cells. The process of conversion of spermatid into spermatozoan is called spermiogenesis.

2. Answer.



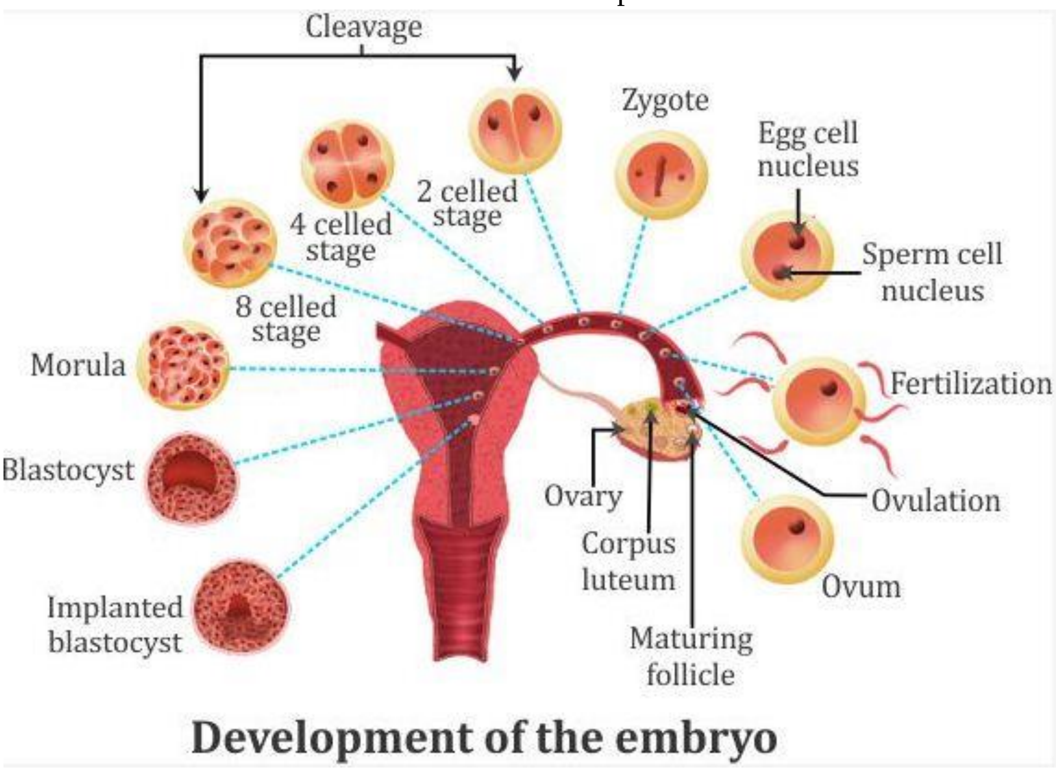
Flow chart of oogenesis in female

3. Answer:
The cycle of events starting from one menstruation till next in female primates is called menstrual cycle. It comprises of four phases which are regulated by both pituitary (LH and FSH) and ovarian (oestrogen and progesterone) hormones that affect ovaries and uterus, respectively. The events occurring in a menstrual cycle are as follows

Menstrual phase (from 3rd-5th day in a 28-day cycle) Initiated by reduced secretion of LH, progesterone and oestrogen. The endometrium breaks down and blood along with unfertilised ovum constitutes menstrual flow.
Follicular phase (from 6th-13th day in a 28-day cycle) The FSH (Follicle Stimulating Hormone) secreted by anterior pituitary stimulates ovarian follicle to secrete oestrogens. These oestrogens stimulate proliferation of uterine walls as a result of which endometrium gets thickened (due to rapid cell division and increase in uterine glands and blood vessels).
Ovulatory phase (14th day in 28-day cycle) -Pituitary hormones, i.e. LH and FSH reach the highest level in middle of the cycle. Rapid secretion of LH causes ovulation thus, inducing the rupture of Graafian follicle to release secondary oocyte and a polar body.
Luteal or secretory phase (from 15th-28th day in a 28-day cycle) The pituitary hormone LH stimulates the remaining cells of ovarian follicles to develop into corpus luteum. This corpus

luteum secretes large amount of progesterone and maintains endometrium thickening for the implantation of fertilised ovum during pregnancy. In the absence of fertilisation, the hormone levels are reduced (LH and progesterone) and endometrium disintegrates leading to onset of another menstrual cycle.

4. When the zygote moves through the isthmus of the oviduct, the mitotic division is initiated and is called the cleavage towards the uterus to form 2,4,8,16 daughter cells called blastomeres. It is an embryo containing 8 to 16 blastomeres from the morula. It continues to transform and divide into blastocysts as it further approaches the uterus. In the blastocyst, the blastomeres are organized into an outer layer referred to as the trophoblast and the inner cell mass, which is an inner collection of cells attached to the trophoblast. This layer gets attached to the endometrium and the inner cell mass transforms into the embryo. After attachment, the cells of the uterus rapidly divide and covers up the entire blastocyst. This causes the blastocyst to implant in the endometrium of the uterus which leads to conception.



ANSWER KEY

Diagram based/case based/passage-based questions.

Q.NO.1

1. Ans. a
2. Ans. a
3. Ans. b
4. Ans c
5. Ans c

Q.NO.2

1. Ans. a
2. Ans. b
3. Ans. B

4. Ans. c
5. Ans. b

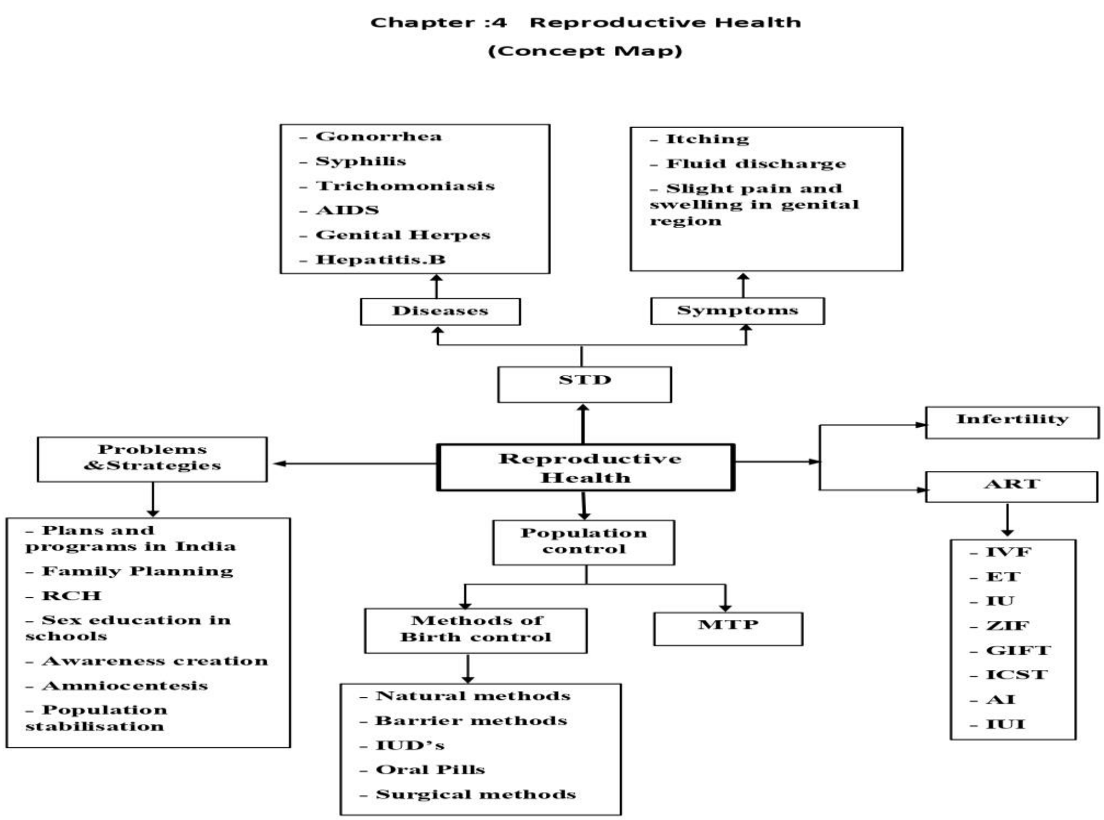
Q.NO.3

1. Ans. b
2. Ans. a
3. Ans. b
4. Ans. a
5. Ans. b

Prepared by:

1. Mr. Tom P Jacob
2. Mr. Sujith Kumar P K

CHAPTER 4: REPRODUCTIVE HEALTH



GIST OF MAJOR AND MINOR CONCEPTS

HEALTH – PROBLEMS AND STRATEGIES:

- The programme "family planning" was initiated in 1951.

- Reproductive and child health care (RCH) programmes to create awareness among the people about reproduction related aspects
- Sexually transmitted diseases (STD).
- Introduction of sex education in schools should be encouraged to provide right information and to remove myth and misconception about sex related aspects among the young
- Amniocentesis: A foetal sex determination test based on the chromosomal pattern in the amniotic fluid surrounding the developing embryo.
- Saheli‟ an oral contraceptive for females, developed by CDRI.

POPULATION EXPLOSION AND BIRTH CONTROL:

- Increased health facilities, better living conditions are the cause of population explosion.
- Out of 6 billion world population 1 billion are Indians.
- Rapid decline in death rate, maternal mortality rate (MMR) and infant mortality rate (IMR) are major causes of population growth.
- Indian population growth rate is around 1.7 percent.

Characteristics of ideal contraceptives.

- User friendly, easily available, Effective, Nor or least side – effects, no way interferes with sexual drive.

BIRTH CONTROL METHODS:

Natural methods: work on the principle of avoiding chances of ovum and sperms meeting.

Periodic abstinence:

- Avoid or abstain from coitus from day 10 to 17 of the menstrual cycle when ovulation could be expected.
- Chance of fertilization is very high in this period.
- It is called the fertile period.

Withdrawal or coitus interruptus

- The male partner withdraws his penis from the vagina just before ejaculation, so as to avoid insemination into the vagina.

Lactational amenorrhea:

- No menstruation during lactation period.
- Chance of fertilization is nil.
- It is effective for up to six months.

Barrier methods:

- Principle of working: prevents physical meeting of sperm and ovum.
- Such methods are available both for male and females.

Condoms:

- Barriers made of thin rubber/latex sheath.
- Used to cover the penis in male or vagina and cervix in females.
- Used just before coitus so that semen not enter into the female reproductive tract.
- Male and female condoms are disposable.
- Prevents AIDS and STDs.

Diaphragm, cervical caps and vaults:

- Barriers made of rubber.
- Inserted into the female reproductive tract to cover the cervix.
- Prevents conception by blocking the entry of sperm through the cervix.
- They are reusable.

Intrauterine Devices:

- These devices are only used by females.
- Inserted by a doctor or by expert nurses in the uterus through vagina.
- Non-medicated IUDs e.g. Lippe's loop.
- Copper releasing IUDs (CuT, Cu7, Multiload 375)
- Hormone releasing IUDs (Progestasert, LNG-20)

Principle of working:

- Increase phagocytosis of sperm within the uterus.
- Cu ion released suppresses sperm motility and fertilizing capacity of sperm.
- Hormone releasing IUDs make the uterus unsuitable for implantation and the cervix hostile to the sperm.

Oral contraceptives:

- This method is used by females only.
- Used in the form of tablets hence popularly called pills.
- Pills contain progestogens or progestogen - estrogen combination.
- Pills have to be taken daily for a period of 21 days.
- Started within the first five days of menstruation.
- Pills are very effective with lesser side effects.
- Saheli: a non-steroidal preparation used as oral contraceptive pills.

Principle of working:

- Inhibit ovulation.
- Inhibit implantation.
- Alter the quality of cervical mucus to prevent/retard entry of sperms.

Injections or implants:

- Progestogens alone or in combination with estrogen used as injections or implants under the skin by females.
- Mode of action is similar as in pills
- It is very effective for long periods.

Emergency contraceptives:

- These methods are used within 72 hours of coitus, rape or casual unprotected intercourse.
- Administration of progestogens or progestogen-estrogen combination.
- Use of IUDs.

Surgical methods:

- It is also called the sterilization method.
- Advised to both male and female partners.
- Permanent or terminal method to prevent pregnancy.
- Sterilization process in male is called „vasectomy,
- Sterilization process in female is called „Tubectomy'
- In vasectomy, a small part of the vas deferens is removed or tied up.

- In Tubectomy a small part of the fallopian tube is removed.
- Reversibility is very poor.

MEDICAL TERMINATION OF PREGNANCY:

- Intentional or voluntary termination of pregnancy before full term is called medical termination of pregnancy (MTP) or induced abortion.
- MTP has a significant role in decreasing population.
- It accounts for 1/5th of the total number of conceived pregnancies.
- Legal restriction only to reduce female foeticide.
- This method is safe within the 1st trimester.

SEXUALLY TRANSMITTED DISEASES:

- Diseases or infections which are transmitted through sexual intercourse.
- Also known as Venereal diseases (VD) or reproductive tract infections (RTIs)
- Gonorrhoea, Syphilis, Genital herpes, chlamydiasis, genital warts, trichomoniasis, hepatitis-B and HIV are some common STDs.
- Except hepatitis-B, genital herpes and HIV infections, others are curable.

Symptoms:

- Itching, fluid discharge, slight pain, swelling in the genital region.
- STDs remain asymptomatic in females and remain undetected for long.
- In the later stage it may leads to Pelvic inflammatory diseases (PID), abortion, still births, ectopic pregnancy, infertility or even cancer in RT.

Preventions:

- Avoid sex with unknown partners/ multiple partners.
- Always use condoms during coitus.
- In case of doubt, consult with a qualified doctor for early detection.
- Get complete treatment if diagnosed with disease.

INFERTILITY:

- The couple unable to produce children in spite of unprotected sex.
- The reason for infertility may be: physical, congenital, diseases, drugs, immunological or Even psychological.
- Problems of infertility may be in male or females.
- Infertility clinics can diagnose and correct the cause of infertility.
- In case no corrections are possible, some special technologies used to have children are called assisted reproductive technologies. (ART)

Assisted reproductive technologies:

(a) In vitro fertilization:

- Fertilization outside the body in the laboratory.
- Conditions created in the laboratory are similar to the body.

(b) Embryo transfer:

- Popularly known as the test tube baby programme.
- Ova from the wife/donor and sperm from the husband/donor are collected and induced to form zygote under simulated conditions in the laboratory.
- The zygote or early embryos (with up to 8 blastomeres) could be transferred into the fallopian tube

- ZIFT- Zygote intra fallopian transfer.
- IUT- Intrauterine transfer (embryo with more than 8 blastomeres).
- Further development took place within the female body.
- Embryo formed by in-vivo fertilization can also be transferred to assist those females who cannot conceive.

(c) Gamete intra fallopian transfer- GIFT

- Transfer of ovum collected from the donor into the fallopian tube of another female who cannot produce it.
- Such females can provide a suitable environment for fertilization and development.

(d) Intra cytoplasmic sperm injection (ICSI):

- The sperm is directly injected into the ovum.
- After in vitro fertilization either ZIFT or embryo transfer technique is followed.

(e) Artificial insemination (AI)

- Semen is collected either from the husband or donor and is artificially introduced into vagina or into the uterus (IUI-intrauterine insemination) of the female.
- Such technology is useful in cases either the male partner is unable to inseminate the female or very low sperm counts in the ejaculates.

MCQs

Q.1. Tubectomy is a method of sterilization in which

(a) one fallopian tube is removed

(b) both fallopian tubes are removed

(c) small part of fallopian tube is removed

(d) small part of vas deferens is removed

Q.2. Following statements are given regarding MTP.

(i) MTPs are generally advised during first trimester

(ii) MTPs are used as a contraceptive method

(iii) MTPs are always surgical

(iv) MTPs require the assistance of qualified medical personnel

Choose the correct option.

(a) (ii) and (iii)

(b) (i) and (iii)

(c) (i) and (iv)

(d) (i) and (ii)

Q.3. The method of directly injecting a sperm into ovum in Assisted Reproductive Technology is called

(a) GIFT

(b) ZIFT

(c) ICSI

(d) ET

Q.4. Increased IMR and decreased MMR in a population will

(a) cause rapid increase in growth rate

(b) result in decline in growth rate

(c) not cause significant change in growth rate

(d) result in an explosive population

Q.5. In-vitro fertilization involves transfer of ____ into the fallopian tube.

(a) embryo up to eight cell stage

(b) embryo of thirty-two cell stage

(c) zygote

(d) either zygote or embryo up to eight cell stage

Q.6. Intensely lactating mothers do not generally conceive due to the

(a) suppression of gonadotropins

(b) hyper secretion of gonadotropins

(c) suppression of gametic transport

(d) suppression of fertilisation

Q.7. Sterilisation techniques are generally fool proof methods of contraception with least side effects. Yet, this is the last option for the couples because

(i) it is almost irreversible

(ii) of the misconception that it will reduce sexual urge

(iii) it is a surgical procedure

(iv) of lack of sufficient facilities in many parts of the country

Choose the correct option.

(a) (i) and (iii)

(b) (ii) and (iii)

(c) (ii) and (iv)

(d) (i), (ii), (iii) and (iv)

Q.8. Which of the following STDs are caused by bacteria?

(a) AIDS and Genital Herpes

(b) Syphilis and gonorrhoea

(c) Trichomoniasis and scabies

(d) All of these

Q.9. Which of the followings is example of hormone releasing IUDs?

(a) CuT and Multilobed 375

(b) LNG-20 and Progestasert

(c) Lippe's loop

(d) Both (b) and (c)

Q10.A national level approach to build up a reproductively healthy society was taken up in our country in

(a) 1950s

(b) 1960s

(c) 1980s

(d) 1990s

Q.11. Emergency contraceptives are effective if used within

(a) 72 hrs of coitus

(b) 72 hrs of ovulation

(c) 72 hrs of menstruation

(d) 72 hrs of implantation

Q.12. Choose the right one among the statements given below.

(a) IUDs are generally inserted by the user herself

(b) IUDs increase phagocytosis reaction in the uterus

(c) IUDs suppress gametogenesis

(d) IUDs once inserted need not be replaced

Q.13. IUDs release copper ions to

(a) prevent ovulation

(b) suppress mortality

(c) increase phagocytosis of sperm

(d) make the uterus unsuitable for implantation.

Q.14. From the sexually transmitted diseases mentioned below, identify the one which does not specifically affect the sex organs.

(a) Syphilis
(b) AIDS
(c) Gonorrhoea
(d) Genital warts

Q.15. Condoms are one of the most popular contraceptives because of the following reasons.

(a) These are effective barriers for insemination

(b) They do not interfere with coital act

(c) These help in reducing the risk of STDs

(d) All of the above

Q.16. Which of the following is/are barrier method of contraception?

(a) Rhythm method/Periodic abstinence

(b) Lactational amenorrhea

(c) Withdrawal method

(d) None of these

Q.17. Which of the following is not a cause of population explosion in India?

(a) Better health care

(b) Increased IMR

(c) Decline MMR

(d) Increased population of reproductive age

Q.18. Choose the correct statement regarding the ZIFT procedure.

(a) Ova collected from a female donor are transferred to the fallopian tube to facilitate zygote formation.

(b) Zygote is collected from a female donor and transferred to the fallopian tube

(c) Zygote is collected from a female donor and transferred to the uterus

(d) Ova collected from a female donor and transferred to the uterus

Q.19. The correct surgical procedure as a contraceptive method is

(a) ovariectomy

(b) hysterectomy

(c) vasectomy

(d) castration

Q.20. Diaphragms are contraceptive devices used by females. Choose the correct option from the statements given below:

(i) They are introduced into the uterus

(ii) They are placed to cover the cervical region

(iii) They act as physical barriers for sperm entry

(iv) They act as spermicidal agents

Choose the correct option:

(a) (i) and (ii)

(b) (i) and (iii)

(c) (ii) and (iii)

(d) (iii) and (iv)

Q.21. Lactational amenorrhoea means

(a) absence of menstruation during pregnancy

(b) absence of menstruation during lactation

(c) excessive bleeding during menstruation

(d) no production and secretion of milk

Q.22. Medical Termination of Pregnancy is safe up to

(a) 8 weeks of pregnancy

(b) 12 weeks of pregnancy

(c) 18 weeks of pregnancy

(d) 24 weeks of pregnancy

ASSERTION-REASON QUESTIONS

Directions: In the following questions, a statement of assertion is followed by a statement of reason.

Mark the correct choice as:

(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) If Assertion is true but Reason is false.

(d) If both Assertion and Reason are false.

1. Assertion: Amniocentesis is often misused

   Reason: Amniocentesis is meant for determining the genetic disorders in the foetus, but it is being used to determine the sex of the foetus, leading to the death of the normal female foetus.

2. Assertion: Cu-T and Cu-7 do not suppress sperm-motility.

   Reason: Hormones released by them do not affect sperm motility.

3. Assertion: Pills are very effective contraceptive methods with lesser side effects.

   Reason: Pills inhibit ovulation and implantation as well as retard entry of sperms.

4. Assertion: In zygote intra fallopian transfer the zygote is transferred to the fallopian tubes of the female.

   Reason: ZIFT is an in vivo fertilisation method.

5. Assertion: Artificial insemination is the method of introduction of semen inside the female.

   Reason: This technique is used in those cases where males have low sperm count.

6. Assertion: IUT is the transfer of embryo with more than 8 blastomeres into the fallopian tubes.

   Reason: This is a very popular method of forming embryos in-vivo.

7. Assertion: Saheli, the new oral contraceptive for the females, contains a steroidal preparation.

   Reason: It is "once in a day" pill with very few side effects.

SHORT ANSWER TYPE QUESTIONS

1. Lactational Amenorrhea is a method of contraception. Justify. What is the maximum effectiveness of this method in terms of period/duration?
2. How are Copper releasing IUDs different from Hormone releasing IUDs?
3. Give another name for sexually transmitted diseases. Name two sexually transmitted diseases which are curable and two diseases which are not curable.
4. Differentiate between Vasectomy and Tubectomy.
5. Mention the various precautions one has to take in order to protect himself/herself from STDs.
6. When is the medical termination of pregnancy advised by the doctors?
7. What are the important features of an ideal contraceptive?
8. Justify the statement, "All reproductive tract infections are sexually transmitted diseases, but all sexually transmitted diseases are not reproductive tract infections."
9. Justify the ban on amniocentesis in our country?
10. Name the hormone composition of oral contraceptives used by a human female. Explain how it act as a contraceptive?

LONG ANSWER TYPE QUESTIONS

11. Why should sex education be introduced to school-going children? List any five reasons.
12. Suggest some methods to assist infertile couples to have children.
13. List the objectives of Reproductive and Child Health Care Programmes (RCH

ANSWER KEY

MCQs

1. C 2.C 3.C 4.C 5D 6.A..7. D.8. B 9.B 10A. 11.A.12.B 13B 14.B 15D.16D.17.D18. B19.C 20.C 21. B 22.B

ASSERTION-REASON

1. A 2.D 3. B 4.C 5. A 6.D 7. D

SHORT ANSWER QUESTIONS

1. (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 up to a maximum period of six months following parturition.

2. (a) Copper releasing IUDs (CuT, Multiload 325) These increase phagocytosis of sperms within the uterus and release copper ions which suppress sperm motility and fertilising capacity of sperm.
   (c) Hormone releasing IUDs – Progestasert, LNG-20. These make the uterus unsuitable for implantation and the cervix hostile to sperms.
3. Venereal disease (VD)/Reproductive tract infection (RTI). Curable-Syphilis, Gonorrhoea Non-Curable – Hepatitis B, AIDS
4. <u>Vasectomy</u> – Method of sterilization in males. Vas deferens of both sides cut and tied. Prevents movement of sperms at cut end

   <u>Tubectomy</u> – Method of sterilisation in females. Fallopian tube of both sides cut and tied. Prevents movement of egg at cut end.
5. (i) Avoid blood transfusion from an infected person. (ii) Avoid sex with an unknown partner and multiple partners. (iii) Always use a condom. (iv) Avoid sharing injections needles and syringes and surgical instruments.
6. The medical termination of pregnancy is advised under the following circumstances:

   If the pregnancy endangers the health (physical/mental) of the woman.
   If the child is malformed or handicapped
   In cases of rape

   If the girl is unmarried, consent of the guardian is required.
   In the case of mentally ill mothers
7. It is safe
   It lasts long
   It is cost-effective
   It is highly effective
   Its effect can be reversed
   It is independent of coitus
   It can be administered easily
   Does not require any medical supervision
8. The reproductive tract infections are transferred from one partner to another during sexual intercourse. Hence called sexually transmitted diseases. For eg., gonorrhoea, genital herpes, syphilis, etc. However, some sexually transmitted diseases such as hepatitis, AIDS are transferred during sexual intercourse but do not cause any infections in the reproductive tract or genitals. These are therefore not referred to as reproductive tract infections.
9. Amniocentesis is a technique in which the amniotic fluid is collected from the uterus with the help of a needle to determine any genetic abnormalities in the foetus by analysing the chromosomal patterns. This technique was being misused to know the gender of the foetus and if the foetus was a girl, it was aborted. To stop the female foeticide, amniocentesis was banned under Prenatal Diagnostics Technique Act in the year 1994.
10. Progesterone or progesterone- estrogen combination is used as an oral contraceptive by human females.

    These pills inhibit ovulation as well as implantation. They also alter the quality of cervical mucus to prevent or retard entry of sperms.

LONG ANSWER QUESTIONS

11. Sex education should be introduced to school going children for the following reasons:
    To make the students aware that the bodily changes they are experiencing during puberty are absolutely normal and natural.
    To help them speak up when they face any sexual harassment in society.
    The students will get to know about the facts of life from a supportive source instead of some absurd show or movie.
    They will be made aware of the risks involved in having sex.
12. There are numerous assisted reproductive technologies (ART) available that can bless infertile couples with children.
    They are:
    IVF: In Vitro Fertilisation (Test-tube babies).
    ET: Embryo Transfer
    ZIFT: Zygote Intra Fallopian transfer.
    GIFT: Gamete Intra Fallopian Transfer.
    ICSI: Intracytoplasmic sperm injection.
    IUI: Intrauterine Insemination.
13. Objectives of RCH are as follows:
    Creating awareness about various reproduction-related problems.
    Providing facilities and support for building up a reproductively healthy society.
    Providing audio-visual and print media support to various government and non-government organizations.
    Educating the people and providing the right information to save them from myths and misconceptions.
    Providing proper education regarding reproductive organs, adolescence and related changes, safe and hygienic sexual practices.
    Providing information regarding the danger of sexually transmitted diseases, AIDS, etc.

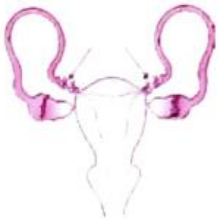
DIAGRAM BASED QUESTION ANSWERS

QUESTIONS:

1. Given diagram is the surgical methods of birth control. Answer the following related questions:

(a) What does the above figure depict?
(b) Does vasectomy prevent spermatogenesis in male?
(c) Which structure is removed or tied up during vasectomy?
(d) What type of semen is ejaculated by vasectomy in male?

2. Examine the given figure and answer the related questions that follows:



(a) What does the above figure depict?
(b) Does tubectomy prevent ovulation in females?
(c) Which structure of the fallopian tube is removed or tied up in tubectomy?
(d) How does tubectomy act as a contraceptive method in females?

ANSWERS:

1. (a) The figure depicts vasectomy in male human beings.
   (b) No, vasectomy never prevents spermatogenesis but prevents the ejaculation of sperms.
   (c) Two vasa deferens are interrupted by giving cuts or ligation.
   (d) Nature of semen is azoospermia and discharge is only composed of seminal plasma i.e., sex gland's secretion.

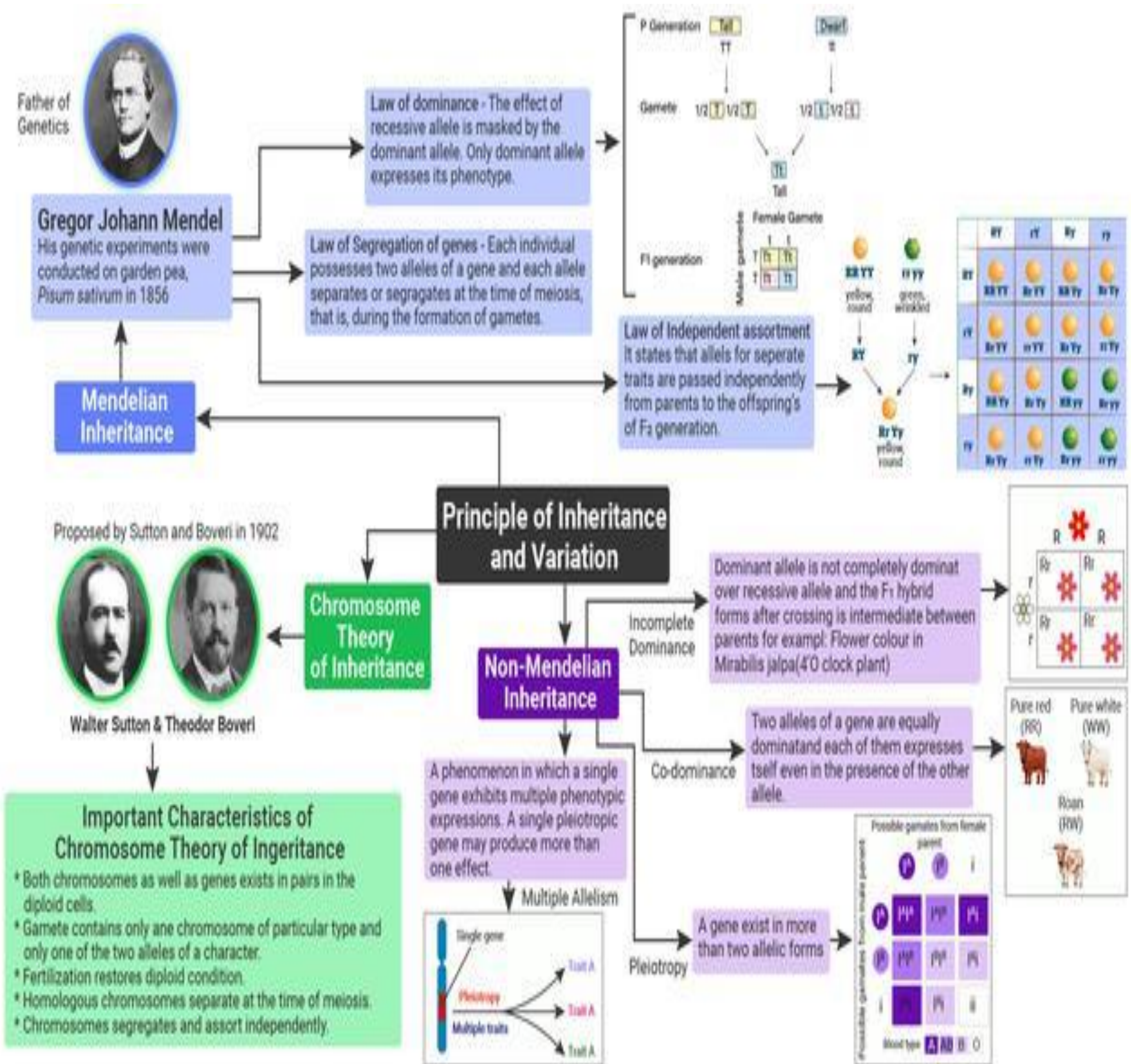
2. (a) The given figure depicts tubectomy.
   (b) No, tubectomy never prevents ovulation in female human beings but it blocks the movement of ovum toward the ampulla of fallopian tube or oviduct.
   (c) Two oviducts or fallopian tubes are interrupted by giving cuts or ligation.
   (d) It always prevents the passage of ovum to the ampulla i.e., site of fertilization. Thus, prevent contraception.

Prepared by:

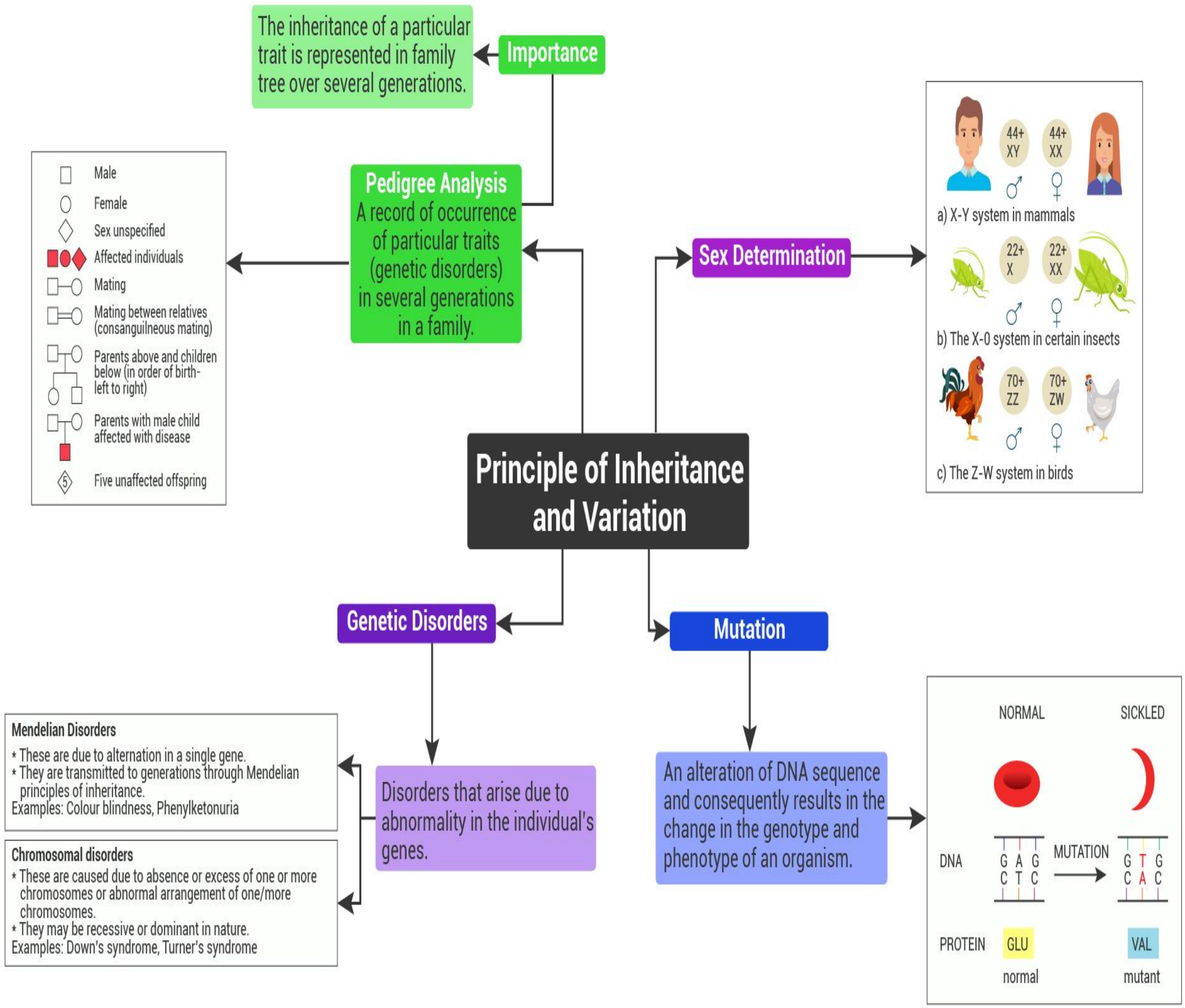
1.E XAVIER RAJ, KV AFS AKKULAM 2.GAYATHRI KRISHNA, KV SAP THIRUVANANTHAPURAM

PRINCIPLES OF INHERITANCE AND VARIATION

Concept map 1



Concept map 2



GIST OF MAJOR & MINOR CONCEPTS

1.MENDEL'S LAWS OF INHERITANCE

1. Gregor Mendel, conducted hybridisation experiments on garden peas for seven years (1856-1863) and proposed the laws of inheritance in living organisms
2. Mendel investigated characters in the garden pea plant that were manifested as two opposing traits.
3. Mendel conducted artificial pollination/cross pollination experiments using several true-breeding (produced by continuous self-pollination, shows the stable trait inheritance and expression for several generations) pea lines.

4. Types of genetic crosses

Type	Definition	Phenotypic ratio	Genotypic ratio
Monohybrid Cross	Cross between parents differing in only one trait or in which only one trait is being considered	F1: 100% dominant trait F2: 3:1	F1: All heterozygous F2: 1:2:1
Dihybrid Cross	Cross between parents differing in two pairs of contrasting characters are studied simultaneously	F1: 100% dominant trait F2: 9:3:3:1	F1: All heterozygous F2: 1:2:1:2: 4:2:1: 2:1
Test Cross	Cross between an organism with unknown genotype and a recessive parent. It is used to determine whether an individual is homozygous or heterozygous for a trait	Organism with unknown genotype is ❖ Homozygous All off springs resemble unknown ❖ Heterozygous 50% resemble unknown parent and 50% resemble recessive parent	

5. Law of Dominance
   (i) Characters are controlled by discrete units called factors.
   (ii) Factors occur in pairs.
   (iii) In a dissimilar pair of factors one member of the pair dominates (dominant) the other (recessive)
   Law of segregation
   Allele pairs separate or segregate during gamete formation and the paired condition is restored by the random fertilization of gametes.
   Law of independent assortment
   If the inheritance of two or more genes is considered at a time, their distribution in the gametes and in the progeny of subsequent generation is independent of each other
6. Allelic interaction

Type	Interaction	Example
a. Incomplete dominance	A cross between organisms with two different phenotypes (RR X rr) produces offspring with *third (Rr)* phenotype One allele is incompletely dominant	Flower colour in snap dragon Starch grain size in pea
b. Multiple alleles	Existence of more than two allele Heterozygotes express both dominant phenotypes - Codominance	ABO blood group system in humans

7. Pleiotropy: Multiple effect of a gene
   Example In *Drosophila* white eye mutation leads to depigmentation in many other parts of the body.
   Phenyl ketonuria is characterized by mental retardation and a reduction in hair and skin pigmentation.
8. Polygenic Inheritance: Phenotype is influenced by three or more gene and each type of allele in the genotype would determine the phenotype
   Example A - B - C gene control human skin

   In 1900, three Scientists (de Vries, Correns and von Tschermak) independently rediscovered Mendel's results on the inheritance of characters
9. Chromosomal Theory of Inheritance
   Walter Sutton and Theodore Boveri noted that the behaviour of chromosomes was parallel to the behaviour of genes
   1. Both chromosomes and genes occur in pairs
   2. Segregate at the time of gamete formation such that only one of each pair is transmitted to a gamete
   3. Independent pairs segregate independently of each other

   Chromosome theory of inheritance states that individual genes are found at specific locations on particular chromosomes, and that the behaviour of chromosomes during meiosis can explain inheritance of genes according to Mendel's laws

10. Thomas Hunt Morgan worked with fruit flies; *Drosophila melanogaster*
    He coined the term linkage to describe this physical association of genes on a chromosome and the term recombination to describe the generation of non-parental gene combinations.
    Alfred Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes and 'mapped' their position on the chromosome.
11. Sex determination
    Henking (1891) traced a specific nuclear structure in 50 per cent of the sperm received after spermatogenesis in few insects and named it X body. X body was later renamed as X chromosome

Type	Male	Female	Example	
XO	X0	XX	Insects-Grasshopper	Males heterogamety
XY	XY	XX	Human, Fruit fly	
ZW	ZZ	ZW	Birds	Females heterogamety
Haplodiploidy	Haploid	Diploid	Honey Bees	------------

12. Mutation is a phenomenon which results in alteration of DNA sequences leading to changes in the genotype and the phenotype of an organism. Chemical and physical factors that induce mutations are referred to as mutagens.

13. Genetic disorders

Mendelian disorders	Chromosomal disorders	
Due to alteration or mutation in the single gene	chromosomal disorders on the other hand are caused due to absence or excess or abnormal arrangement of one or more chromosomes. Two types	
Transmitted to the offspring on the same lines as in the principle of inheritance of Mendel	Aneuploidy	Polyploidy
Can be traced in a family by pedigree analysis	Failure of segregation of chromatids during cell division cycle results in the gain or loss of a chromosome(s)	Failure of cytokinesis after telophase stage of cell division results in an increase in a whole set of chromosomes

14. Examples of Mendelian disorders

Name of disorder	Type	Cause	Symptoms
Colour Blindness	Sex-linked recessive	mutation in certain genes present in the X chromosome	failure to discriminate between red and green colour
Haemophilia	Sex linked recessive	A single protein that is a part of the cascade of proteins involved in the clotting of blood is affected	Simple cut will result in non-stop bleeding.
Sickle-cell anaemia	Autosome linked recessive	Point mutation in the beta globin gene of Hb, Valine substitutes glutamic acid at sixth position	Mutant haemoglobin molecule undergoes polymerisation under low oxygen tension causing the change in the shape of the RBC
Phenylketonuria	Autosomal recessive trait	Lacks an enzyme (phenyl alanine hydroxylase) that converts the amino acid phenylalanine into tyrosine	Accumulation of phenyl pyruvic acid in brain results in mental retardation
Thalassemia α thalassemia β thalassemia	Autosomal recessive trait	Mutation or deletion of genes HBA1 and HBA2 on chromosome 16 Mutation HBB on chromosome 11	Reduced production of α globin chain Reduced production of β globin chain

15. Examples of chromosomal disorder

Name of the disorder	Karyotype	Symptoms
Down’s Syndrome	47, Due to additional copy of the chromosome number 21 (trisomy of 21).	Short stature with small round head, furrowed tongue and partially open mouth. Palm is broad with characteristic palm crease. Physical, psychomotor and mental development is retarded.
Klinefelter’s Syndrome	47, XXY	Overall masculine development, however, the feminine development is expressed (Gynaecomastia), sterile
Turner’s Syndrome	45, XO	Females are sterile as ovaries are rudimentary besides other features including lack of other secondary sexual characters

MCQs

11. If a F1 expresses a character, it is called __________
1. Incomplete dominance
2. Dominant
3. Co-dominant
4. Recessive

2 Colour blindness is an __________ linked recessive trait
1. Z chromosome
2. Y chromosome
3. X chromosome
4. None of the above

3 __________ is a type of trait whose phenotype is influenced by more than one gene
1. Oncogenic Trait
2. Monogenic trait
3. Polygenic trait
4. None of the above

4 A man marries a woman and both do not show any apparent traits of inherited disease. Five sons and two daughters
are born, and three of their sons suffer from a disease. However, none of the daughters is affected. The following mode
of inheritance for the disease is
1. Sex-linked recessive
2. Sex-linked dominant
3. Autosomal dominant
4. None of the above

5 Two genes very close on a chromosome will show:
(1) No crossing over
(2) High crossing over
(3) Hardly an crossing over
(4) Only double crossing over
6 A true hybrid condition is:
(1) tt Rr
(2) Tt rr
(3) tt rr
(4) Tt Rr
7 A point mutation is:
(1) Thalassemia
(2) Sickel-cell anaemia
(3) Down's syndrome
(4) Nightblindness
8 Mendel's laws were rediscovered by:
(1) Correns
(2) TShermak

(3) De vries
(4) All of these.
9 Failure of segregation of chromatids during cell division Cycle result in the gain or loss of a cromosome (s) is called :
(1) Female heterogamety
(2) Male heterogamety
(3) Aneuploidy
(4) None of these
10 Down's syndrome is a:
(1) Mendelian disorder
(2) Chromosomal disorder
(3) can be both
(4) None of these
ANSWER KEY
1 .2 dominant
2- 3 x chromosome
3-3 polygenic inheritance
4-1sex linked inheritance
5-1 no crossing over
6-4 ttrr
7-2 sickle cell anemia
8-4 all of these
9-3 aneuploidy
10-2 chromosomal disorder

ASSERTION-REASON TYPE QUESTIONS

The following questions consist of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

A. Both A and R are true and R is the correct explanation of A

B. Both A and R are true and R is not the correct explanation of A

C. A is true but R is false

D. A is False but R is true

1. Assertion: Sickle cell anaemia occurs due to a point mutation.
   Reason: The mRNA produced from Hb^S gene has GUG instead of GAG.
   Ans. A

2. Assertion: The possibility a human male becoming haemophilic is extremely rare.
   Reason: Mother of such a male should be normal and the fathers should be haemophilic.
   Ans. D

3. Assertion: In dog flowers F1 plants produce pink flowers.
   Reason: It is due to codominance of flower colour alleles with both genes expressing themselves equally.
   Ans. C

4. Assertion: XO type of sex determination is found in large number of insects.
   Reason; 50 % of sperms contain X chromosome and the other 50% contain "O" chromosome.

   Ans. C

5. Assertion: A test cross is used to determine the phenotype of an organism.
   Reason: F2 generation of a monohybrid test cross produces one or two phenotypes depending upon the genotype of the unknown organism.
   Ans. D

6. Assertion: Mendel used true-breeding pea lines for artificial pollination experiments for his genetic studies.
   Reason: For several generations, a true-breeding line shows the stable trait inheritance and expression.
   Ans. A

7. Assertion: Cross of F1 individual with recessive homozygous parent is test cross.
   Reason: No recessive individual is obtained in the monohybrid test cross progeny.
   Ans. C

8. Assertion: In monohybrid cross, at F2 stage, both parental traits are expressed in 3 : 1 proportion.
   Reason: At F2 stage, the contrasting parental traits show blending.
   Ans. C

9. Assertion: Gametes receives only one allele of a gene.

Reason: During gamete formation, mitosis takes place leads to formation of haploid cells.
Ans. C

10. Assertion: A good example of multiple alleles is ABO blood group system.
Reason: When I^A and I^B are present together in ABO blood group system, they both express their own types.
Ans. B

TWO MARKS QUESTIONS

1. 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.

Ans. (i) Female; (ii) Male; (iii) Female (iv) Male

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

Ans. 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).

3.How will you find out whether a given plant is homozygous or heterozygous?

Ans. To test whether a plant is homozygous or heterozygous, test cross is performed in which individual is crossed with homozygous recessive for the trait. If plant is heterozygous, progeny of test cross consists of tall and dwarf plants in the ratio l:l

If plant is homozygous, progeny of test cross will have all tall plants

4.Why do sons of haemophilic father never suffer from this trait?

Ans. Since haemophilic is a sex – linked character, it shows criss – cross inheritance i-e from father to his daughter therefore son of haemopilic father is never haemophilic.

5. How is the child affected if it has grown from the zygote formed by an XX-egg fertilized by Y-carrying sperm? What do you call this abnormality?

Ans. If a child has grown from the zygote formed by XX-egg fertilized by Y-sperm, the child will suffer from klinefiter syndrome & will have XXY genotype. It is characterized by prominent feminine characters e.g. tall stature with feminised physique, Breast development pubic hair pattern, poor beard growth &sterility.

6. .The map distance in certain organism between genes A & B is 4 units, between B & C is units, &between C &D is 8 units which one of these gene pairs will show more recombination frequency? Give reason.

Ans. C& D will show maximum gene recombination because genes which are more closely linked, frequency of recombination is least & vice versa.

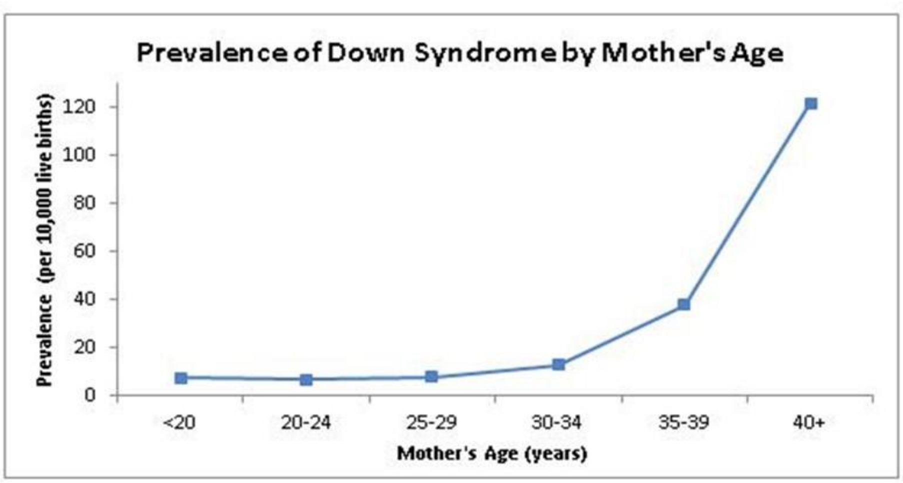
CASE BASED QUESTION

1.Nondisjunction is the failure of homologous chromosomes to disjoin correctly during meiosis. It leads to the formation of a new cell with an abnormal amount of genetic material. A number of clinical conditions are the result of this type of chromosomal mutation. This results in the production of gametes containing a greater or lesser chromosomal amount than normal ones. Consequently, the individual may develop a trisomal or monosomal syndrome. Non disjunction can occur in both

Meiosis Iand Meiosis II of the cellular division. Non disjunction can occur in both Meiosis I and Meiosis II of the cellular division. It is also the main cause of many genetic disorders; however, its

origin and process remain vague. Although it results in the majority of cases from errors in the maternal meiosis II, both paternal and maternal meiosis I do influence it. The maternal age, is considered a risk factor of trisomy's, as well as recombination alterations and many others that can affect the chromosomal segregation.

1. Which of the following conclusions can be true regarding aneuploidy?
   i. It is the presence of an extra chromosome in a diploid cell.
   ii. An aneuploid cell differs from other cells only in size.
   iii. It can be less number of chromosomes in a diploid cell.
   iv. Aneuploidy always affects female individuals.
      a. I only
      b. both I and iii
      c. both ii and iii
      d. I, iii and iv.
2. Considering the different phases of meiosis, select the correct statements from thefollowing.
   i. Errors in meiosis I is the only cause of aneuploidy
   ii. Aneuploidy always affects sex chromosomes.
   iii. Most of the aneuploidy results from errors in cell division involved in egg formation.
   iv. Nondisjunction in meiosis I can lead to more abnormal cells than disjunction inmeiosis II.
      a. I only
      b. both I and iii
      c. both iii and iv
      d. I, iii and iv.
3. By interpreting the graph of Down syndrome frequency and mothers age, select the bestconclusion (s) from the following options.



i. Aneuploidy is not influenced by mother's age.
ii. Delivery before 30 years of age can decrease the incidence of aneuploidy in most cases
iii. The chance of aneuploidy increases up to 22 years of age.
iv. There is a dramatic increase in aneuploidy if maternal age exceeds 30

a. I only
b. both I and iii
c. both ii and iv
d. I, iii and iv.

4. The type of genetic disorders mainly caused by chromosomal non-disjunction is
   a. Chromosomal disorders
   b. Mendelian disorders
   c. Incomplete dominance
   d. All the above
5. Assertion: All types of genetic disorders are caused by chromosomal nondisjunctionReason: Chromosomal nondisjunction always affects female individuals.
   a. Both assertion and reason are correct and reason is the correct explanation of assertion
   b. Both assertion and reason are correct but reason is not the correct explanation ofassertion
   c. Assertion is correct but reason is incorrect
   d. Both Assertion and reason are incorrect.

ANSWER KEY

1	**B**
2	**C**
3	**C**
4	**A**
5	**D**

2.The word parthenogenesis originates from the Greek language meaning virgin birth. In honeybees, the drones are entirely derived from the queen, their mother. Parthenogenesis is a form of reproduction where the unfertilized egg will develop into a DRONE BEE while fertilized eggs will hatch into the WORKER BEES. This type of reproduction occurs in various species in nature. Fertilized eggs will developinto QUEEN BEES or WORKER BEES. It will depend on the size and type of the cells and on the composition of food fed by WORKER BEES to BEE LARVAE. The DRONE BEES are always born from unfertilized eggs. Drones produce sperm cells that contain their entire genome, so the sperm are all genetically identical except for mutations. The male bees' genetic makeup is therefore entirely derived from the mother, while the genetic makeup of the female worker bees is half derived from the mother, and half from the father. The QUEEN BEES mate with numerous DRONE BEES high in the air. This polyandry and the phenomenon of parthenogenesis in honey bees create a super-organism in the beehive populations. The WORKER BEES who share the same father and mother are called SUPER SISTERS because they are more closely related to each other than their sisters who have different fathers.

i. Identify the members of a bee colony which possess same chromosome number.

a. Drone and Queen
b. Drone and Worker
c. Queen and Worker
d. Both a and c.

ii. The cell division involved in the formation of egg and sperm in honey bees respectively
   a. Mitosis and meiosis
   b. Mitosis only
   c. Meiosis and mitosis
   d. Meiosis only.

iii. In a honey bee colony, the queen is different from workers in
   a. Chromosome number
   b. The way of production in sexual or asexual method
   c. The type of gametes involved in production
   d. The type of food given in larval stage.

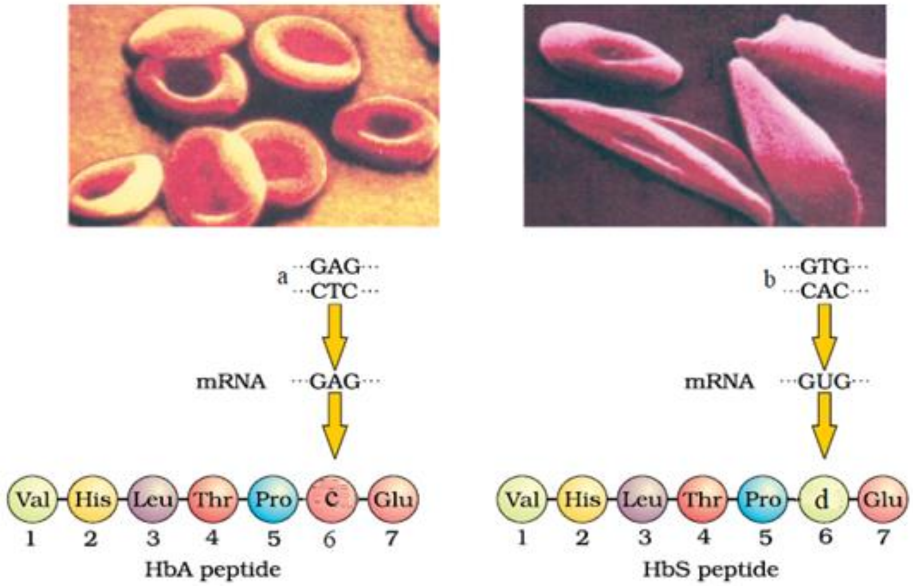
iv. Some of the members in a honey bee colony have no father but have grandfather, they are
   a. Workers
   b. Drones
   c. Queen
   d. Both drones and workers.

v. What can be the advantage of parthenogenesis for species survival?
   a. It leads to much variation in offspring
   b. It helps isolated female individuals to reproduce
   c. It helps to evolve clones
   d. It conserves same chromosome number in generations.

ANSWER KEY

i	**c**
ii	**c**
iii	**d**
iv	**b**
v	**b**

3.Study the given figure and answer



the questions that follow.

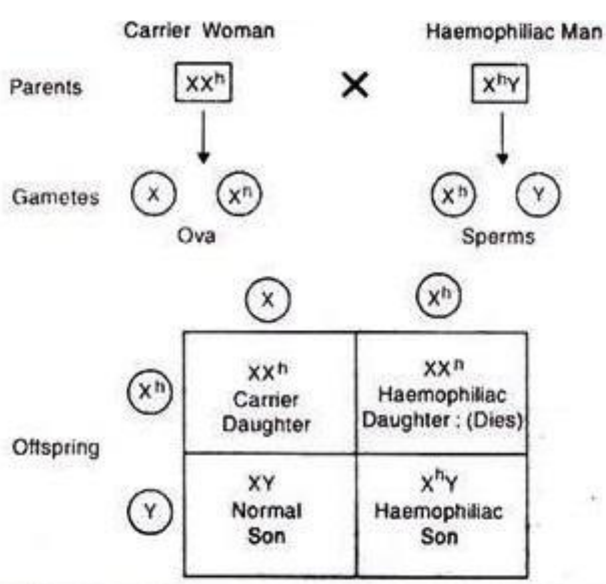
a. Name disorder that is shown in the figure.
b. How is this disorder inherited?
c. What is the cause of this disease?
d. What are the possible phenotypes of children born to a couple of Carrier woman and hemophilic man.

Ans: (a) Sickle cell anemia. (1)

(b) Inherited as Autosome linked recessive trait. (1)

(c) Substitution of Glutamic acid by Valine at the sixth position of the beta globin chain of the hemoglobin molecule. (1)

(d)



Normal, Carrier and Sickle celled children. (2)

4.In 1911, while studying the chromosome theory of heredity, biologist Thomas Hunt Morgan had a major breakthrough. Morgan occasionally noticed that "linked" traits would separate. Meanwhile, other traits on the same chromosome showed little detectable linkage. Morgan considered the evidenceand proposed that a process of crossing over, or recombination, might explain his results. Specifically, heproposed that the two paired chromosomes could "cross over" to exchange information. When proposing the idea of crossing over, Morgan also hypothesized that the frequency of recombination wasrelated to the distance between the genes on a chromosome, and that the interchange of genetic information broke the linkage between genes. Morgan imagined that genes on chromosomes were similar to pearls on a string; in other words, they were physical objects. The closer two genes were to one another on a chromosome, the greater their chance of being inherited together. In contrast, genes located farther away from one another on the same chromosome were more likely to be separated during recombination. Therefore, Morgan correctly proposed that the strength of linkage between two genes depends upon the distance between the genes on the chromosome. This proposition became the basis for construction of the earliest maps of the human genome

i. The traits which are found tightly linked in Morgan's experiments were
   a. Body colour and wing size
   b. Eye colour and wing size
   c. Body colour and eye colour
   d. Body size and wing size.

ii. Which of the following condition favours linkage?
   a. Genes on the same chromosome and are closely placed.
   b. Genes on different chromosomes and distantly placed.
   c. Genes on the same chromosome but distantly placed
   d. Genes present on different autosomes.

iii. How does the concept of linkage help in gene mapping?
   a. Distance between the linked genes can be measured by frequency of recombination.
   b. Linked genes express the characters easily than non-linked genes
   c. Linked genes are larger in size
   d. Position of linked genes can be observed in ultra-microscopy.

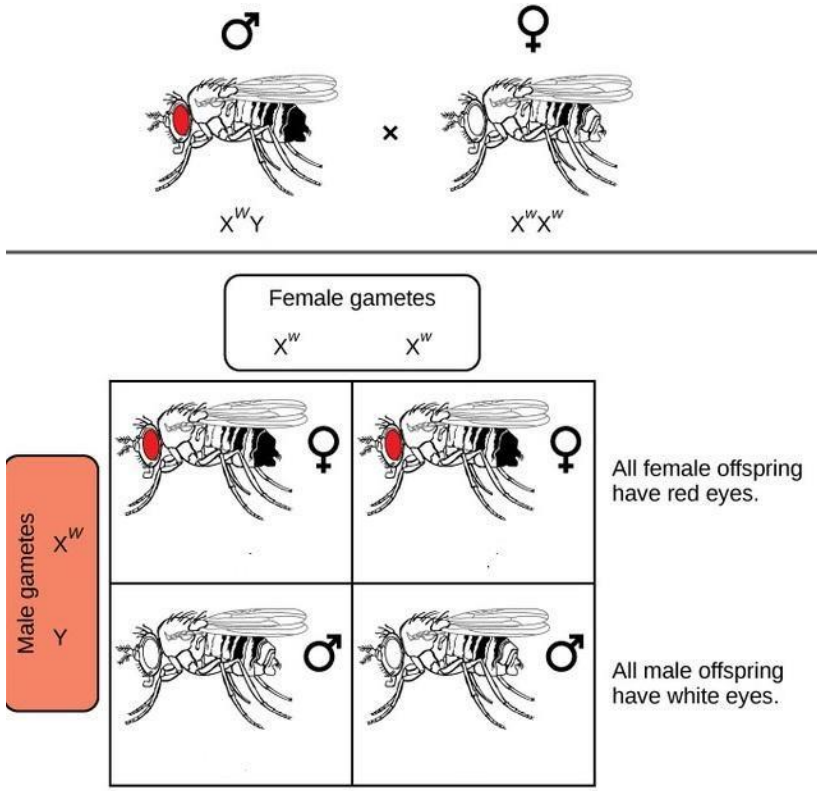
iv. The linked genes behave differently in the way that
   a. Linked genes assort easily and enter different gametes

b. Linked genes don’t segregate easily and inherit as a unit

c. Linked genes lead to high cross over and recombination

d. Linked genes segregate only at the time of cell division

v. In Morgan’s experimental crosses, the white eyed flies were all males. The clue that it



gives

a. White eye colour is X-linked dominant trait
b. White eye colour is Y linked dominant trait
c. White eye colour is X-linked recessive trait
d. White eye color is Y-linked dominant trait.

ANSWER KEY

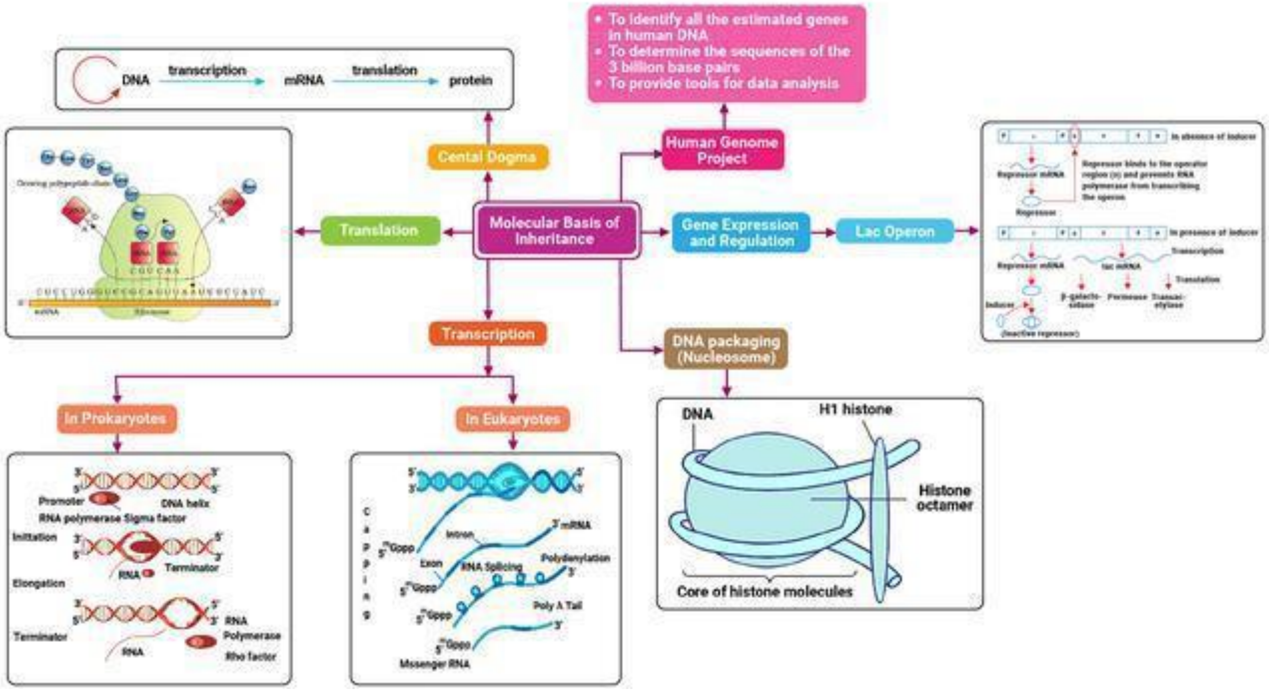
i	**c**
ii	**a**
iii	**a**
iv	**b**
v	**c**

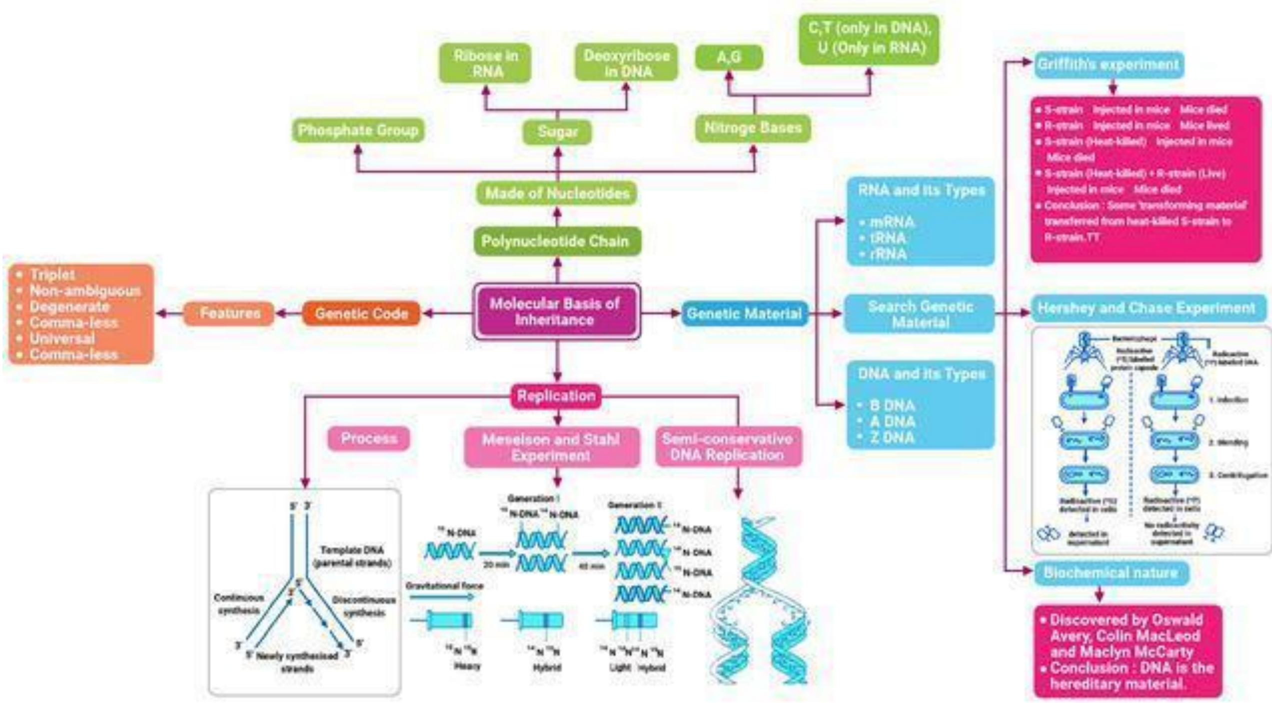
Prepared by:

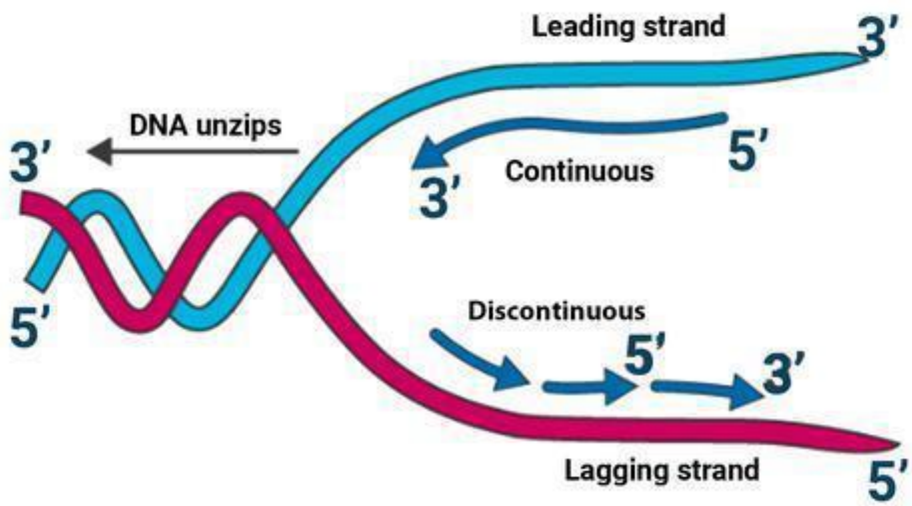
1.Lini Nair KV Port trust 2. Santhosh Kumar & Sarala, KV Adoor 3. Sony George & Ajith SR KV 1 Kochi

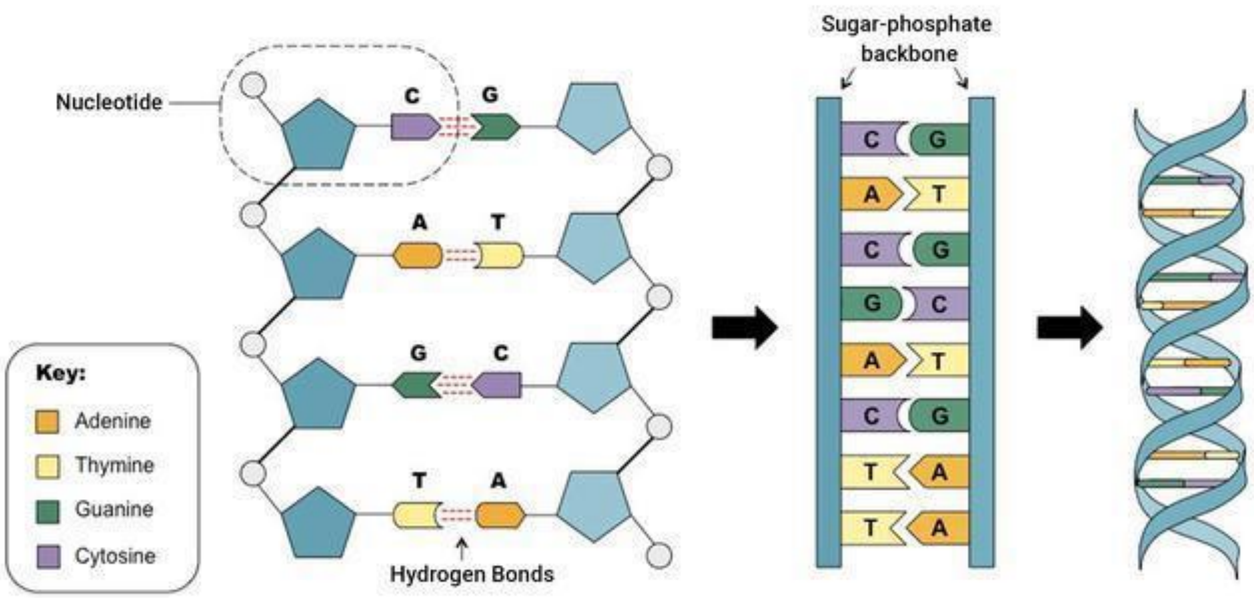
CHAPTER 6: MOLECULAR BASIS OF INHERITANCE

CONCEPT MAP





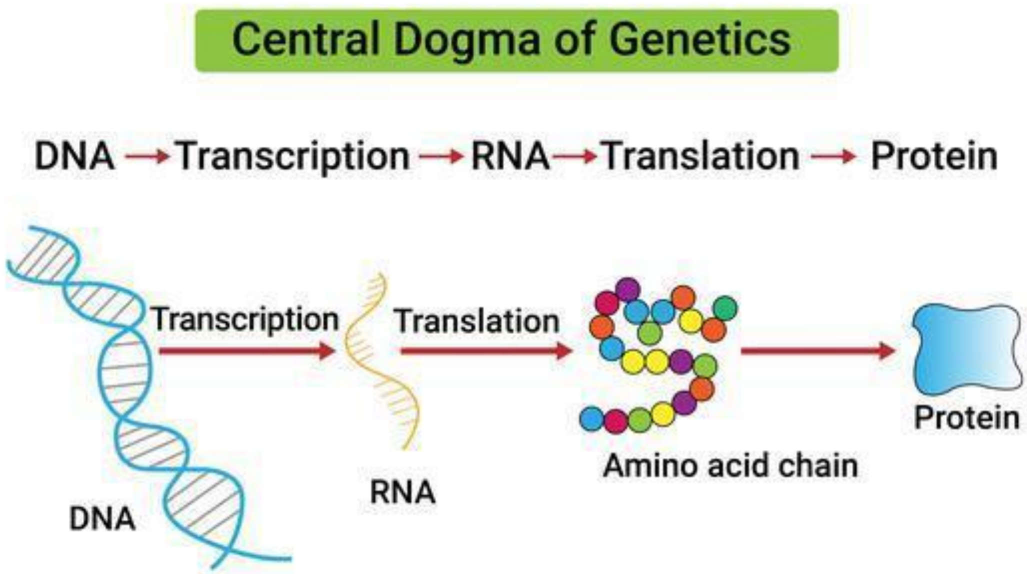


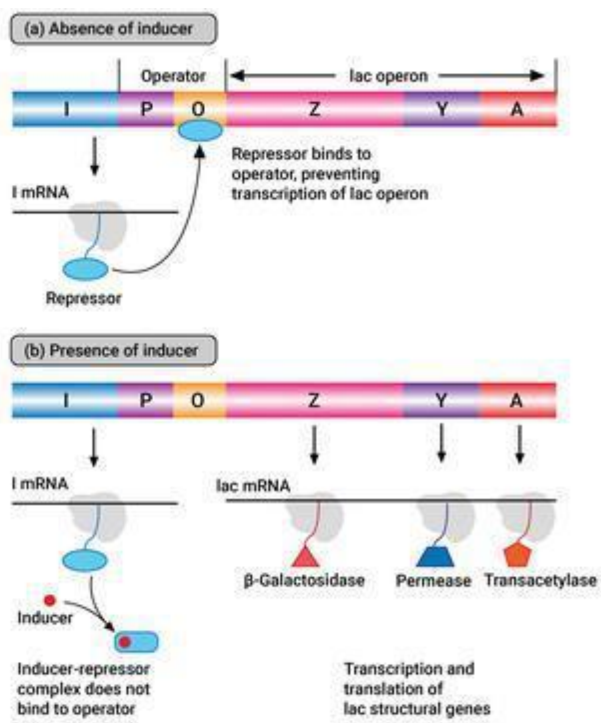


Antiparallel DNA Strands

DNA Ladder

Double Helix





GIST OF MAJOR & MINOR CONCEPTS

THE DNA: DNA is a long polymer of deoxyribonucleotides.
● The length of the DNA depends on, number of nucleotide pairs present in it.
● Characteristics of the organism depend on the length of the DNA.
● Bacteriophage ø174 has 5386 nucleotides.
● Bacteriophage lambda has 48502 base pairs
● Escherichia coli have 4.6 X 106 base pairs.
● •Human genome (haploid) is 3.3 X 109 bp
Structure of polynucleotide chain:
● A nucleotide has three component:-
• A nitrogen base

• A pentose sugar (ribose in RNA and deoxyribose in DNA)
• A phosphoric acid.
● There are two types of nitrogen bases:
• Purines (Adenine and Guanine)
• Pyrimidines (Cytosine, Uracil and Thymine)
● Adenine, Guanine and Cytosine are common in RNA and DNA.
● Uracil is present in RNA and Thymine is present in DNA in place of Uracil.
● Pentose sugar is ribose in RNA and Deoxyribose in DNA.
● A nitrogen base attached to the pentose sugar at C1 of pentose sugar by
● Phosphoric acid attached to the 5’ OH of a nucleoside by Phosphodiester linkage a corresponding nucleotide is formed. (Ribonucleotide or deoxyribonucleotides depending on the sugar unit).
● Two nucleotides are joined by 3’-5’ Phosphodiester linkage to form dinucleotide.
● More than two nucleotides joined to form a polynucleotide chain.
● Polynucleotide chain has a free phosphate moiety at 5’ end of sugar, which is referred to as 5’ end.
● In the other end of the polymer with 3’-OH group called 3’ end.
● The backbone of the polynucleotide chain is sugar and phosphate.
● Nitrogen bases linked to the sugar moiety project from the backbone.
● In RNA every nucleotide has an additional –OH group at 2’ of ribose.
● In RNA Uracil is found in place of thymine.
● 5-methyl uracil is the other name of thymine

History of DNA:

● DNA is an acidic substance in the nucleus that was first identified by Friedrich Meischer in 1869. He named it as ‘Nuclein”.
● 1953 double helix structure of DNA was given by James Watson and Francis Crick, based on X-ray diffraction data produced by Maurice Wilkins and Rosalind Franklin.
● Hallmark of their proposition was base pairing between two strands of polynucleotide chains. This was based on the observation of Erwin Chargaff.
● Chargaff ’s observation was that for a double stranded DNA, the ratio between Adenine and Thymine, and Guanine and Cytosine are constant and equal.

Salient features of Double helix structure of DNA:

● Made of two polynucleotide chains.
● Sugar and phosphate forms the backbone and bases projected to the inside.
● Two chains have antiparallel polarity.
● Two strands are held together by hydrogen bonds present in between bases.
● Adenine of one strand pairs with Thymine of another strand by two hydrogen bonds and vice versa.
● Guanine of one strand pairs with Cytosine of another strand by three hydrogen bonds and vice versa.

● A purine comes opposite to a pyrimidine. This generates approximately uniform distance between the two strands of the helix.
● The two chains are coiled in a right – handed fashion.
● The pitch of the helix is 3.4 nm or 34 A0.
● There are roughly 10 bp in turn.
● The distance between the bp in a helix is 0.34nm or 3.4 A0 .
● The plane of one base pair stacks over the other in a double helix.
● H-bond confers stability of the helical structure of the DNA.
● Central dogma of flow of genetic information: DNA→ RNA→ Protein.

Packaging of DNA Helix:

● Distance between two conjugative base pairs is 0.34nm, the length of the DNA in a typical

mammalian cell will be 6.6 X109 bp X 0.34 X10-9 /bp, it comes about 2.2 meters.
● The length of DNA is more than the dimension of a typical nucleus (10-6m).
Packaging in prokaryotes:
● They do not have a definite nucleus.
● The DNA is not scattered throughout the cell.
● DNA is held together with some proteins in a region called 'nucleoid'.
● The DNA in the nucleoid is organized in large loops held by proteins.
Packaging in Eukaryotes:
● In eukaryotes the packaging is more complex.
● There is a set of positively charged, basic proteins called Histones.
● Histones are positively charged due to being rich in basic amino acids like Lysines and arginines.
● Histones are organized to form a unit of eight molecules called histone octamer.
● Negatively charged DNA wrapped around positively charged histone octamer to form a structure called nucleosome.
● A typical nucleosome contains 200 bp of DNA helix.
● Nucleosome constitutes the repeating unit of a structure in the nucleus called chromatin, thread like stained bodies seen in the nucleus.
● The nucleosomes are seen as a 'beads-on-string' structure when viewed under electron microscope.
● The chromatin is packaged to form chromatin fibers that are further coiled and condensed at the metaphase stage to form chromosomes.
● Packaging at a higher level required an additional set of proteins called Non-histone Chromosomal (NHC) proteins.
● In a typical nucleus some loosely coiled regions of chromatin (light stained) is called euchromatin.
● The chromatin that is more densely packed and stains dark are called Heterochromatin.
● Euchromatin is transcriptionally active chromatin and heterochromatin is inactive.
The Search of genetic material: Transforming principle:
● **Given by Frederick Griffith in 1928.**
● His experiment was based on Streptococcus pneumoniae (caused pneumonia).
● There is a change in the physical form of bacteria.
● There are two colonies of bacteria:
● Smooth shiny colonies called S strain.
● Rough colonies called R strain.
● S-strain bacteria have a mucous (polysaccharide) coat.
● R-strain does not have a mucous coat.
● S-strain is virulent and causes pneumonia in mice and dies when infected.
● R-strain is non-virulent and does not cause pneumonia in mice when infected.
● Heat killed S-Strain is non-virulent and does not cause pneumonia.

● The heat killed S-Strain mixed with live R-Strain injected into mice; the mice developed pneumonia and died.
● He recovered live S-Strain bacteria from the dead mice.
Biochemical characterization of transforming principle:
● Biochemical nature of transforming principle was discovered by Oswald Avery, Colin Macleod and Maclyn McCarty. (1933-44)
● Prior to their work genetic material was thought to be protein.
● They worked to determine the biochemical nature of the 'transforming principle' of Griffith's experiment.
● They purified biomolecules (proteins, DNA and RNA) from the heat-killed S cells to see

which one could transform live R cells to S cells.
● Heat killed S-Strain + protease + Live R-Strain → transformation.
● Heat killed S-Strain + RNase + Live R-Strain → transformation.
● Heat killed S-Strain + DNase + Live R-Strain → No transformation.
Conclusion of the experiments:
● Protein of heat killed S-Strain is not the genetic material.
● RNA of heat killed S-Strain is not the genetic material.
● DNA of heat killed S-Strain is the genetic material, because DNA digested with DNase mixed with R-strain unable to transform R-Strain to S-Strain.
Conclusion of experiment:
● R – Strain bacteria had somehow been transformed by the heat killed S-Strain bacteria.
● Some 'transforming principle', transferred from heat-killed S-Strain bacteria, had enabled the R-Strain to synthesize smooth polysaccharide coats and become virulent (S-Strain).
● The transformation of R-Strain to S-Strain is due to transfer of Genetic material.
● However the biochemical nature of genetic material was not defined from his experiment.
The Genetic Material is DNA:
● 'DNA is the genetic material' was proved by Alfred Hershey and Martha Chase (1952).
● They worked on the virus that infects bacteria called bacteriophage.
● During normal infection the bacteriophage first attaches the bacteria cell wall and then inserts its genetic material into the bacterial cell.
● The viral genetic material became an integral part of the bacterial genome and subsequently manufactured more virus particles using host machinery.
● Hershey and Chase worked to discover whether it was protein or DNA from the viruses that entered the bacteria.
● Experiment :(blenders experiment)
● They grew some viruses on a medium having radioactive phosphorus and some others on a medium having radioactive sulfur.
● Viruses grown in radioactive Phosphorus have radioactive DNA but not radioactive protein because Phosphorus present in DNA not in protein.
● Viruses grown in radioactive sulfur have radioactive protein not radioactive DNA because sulfur is present in protein but not in DNA.
● Infection: radioactive phages were allowed to attach to E.coli bacteria; the phages transfer the genetic material to the bacteria.
● Blending: the viral coats were separated from the bacteria surface by agitating them in a blender.
● Centrifugation:The virus particles were separated from the bacteria by spinning them in a centrifuge machine.
● Observation:
● Bacteria infected with viruses that had radioactive DNA were radioactive and had no radioactivity in the supernatant.
● Bacteria infected with viruses that had radioactive protein were not radioactive, but radioactivity found in the supernatant.

● Conclusion of Experiment:
DNA is the infecting agent that makes the bacteria radioactive hence DNA is the genetic material not the protein.
Properties of genetic material(DNA versus RNA):
Criteria for genetic material:
● It should be able to generate its replica (replication).
● It should be chemically and structurally stable.
● It should provide the scope for slow changes (mutation) that are required for evolution.
● It should be able to express itself in the form of 'Mendelian Character'.

● Protein does not fulfill the criteria hence it is not the genetic material.

● RNA and DNA fulfill the criteria.
● RNA is unstable:
● 2'-OH group present at every nucleotide (ribose sugar) in RNA is a reactive group and makes RNA liable and easily degradable.
● RNA is also now known as catalyst, hence reactive.
● RNA is unstable and mutates faster. Consequently the viruses having RNA genome and having shorter life span mutate and evolve faster.
● DNA is more stable:
● Stability as one of the properties of genetic material was very evident in Griffith's 'transforming principle' itself that heat, which killed the bacteria at least, did not destroy some of the properties of genetic material.
● Two strands being complementary if separated by heating come together, when appropriate conditions are provided.
● Presence of Thymine in place of uracil confers additional stability to DNA.
● DNA is chemically less reactive and structurally more stable when compared to RNA.
● Therefore among the two nucleic acids the DNA is a better genetic material. Better genetic material (DNA or RNA).
● Presence of thymine at the place of uracil confers more stability to DNA.
● Both DNA and RNA are able to mutate.
● In fact RNA being unstable mutates at a faster rate.
● RNA can directly code for the synthesis of proteins, hence easily expressed.
● DNA however depends on RNA for protein synthesis.
● The protein synthesis machinery has evolved around RNA.
● Both RNA and DNA can function as genetic material, but DNA being more stable is preferred for storage of genetic information.
● For the transmission of genetic information RNA is better.

RNA World:

● RNA is the first genetic material.
● Essential life processes evolved around RNA.
● RNA used to act as a genetic material as well as catalyst.
● But RNA being the catalyst was reactive and hence unstable.
● Hence DNA has evolved from RNA with chemical modifications that make it more stable.
● DNA being double stranded and having complementary strands further resists changes by evolving a process of repair.

Types of RNA:

● In prokaryotes there are three major types of RNAs: mRNA (messenger), tRNA (transfer), and rRNA(ribosomal).
● All three RNAs are required to synthesize protein in a cell.
● The mRNA provides the template and has genetic information in the form of genetic code.
● The tRNA brings the amino acids and reads the genetic code of mRNA.

● The rRNA is the structural part of the ribosome and also has a catalytic role during the process of translation.

Replication: The Process

● Watson and Crick proposed a scheme for replication of DNA.
● The Original statement that "It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for the genetic material (Watson and Crick, 1953).
● The scheme suggested that the two strands would separate and act as template for the

synthesis of new complementary strands.
● New DNA molecule must have one parental strand and one new strand.
● This scheme of replication is called the Semiconservative type of replication.
● Experimental Proof of semiconservative nature of replication:
● It is now proved experimentally that replication is a semiconservative type.
● It was first shown in Escherichia coli and subsequently in higher organisms.
● Mathew Messelson and Franklin Stahl performed the following experiment in 1958.
● Steps:
● They grew E.coli in 15NH4Cl medium for many generations. (15N is heavy nitrogen, not a radioactive element).
● The result was that 15N was incorporated into newly synthesized DNA and other nitrogen-containing compounds as well.
● This heavy DNA molecule could be distinguished from normal DNA by centrifugation in a cesium chloride (CsCl) density gradient.
● Then they transferred the E.coli into a medium with normal 14NH4Cl and let them grow.(E.coli divides in 20 minutes).
● They took samples at definite time intervals as the cells multiplied, and extracted the DNA that remained as double-stranded helices.
● Various samples were separated independently on CsCl gradients to measure the densities of DNA.
● The DNA that was extracted from the culture one generation after the transfer from 15N to 14N medium had a hybrid or intermediate density.
● DNA extracted from the culture after another generation (after 40 min.) was composed of equal amounts of this hybrid DNA and of 'light 'DNA.
● Experiment by Taylor and colleagues:
● Used radioactive thymidine to detect distribution of newly synthesized DNA in the chromosomes.
● They performed the experiment on Vicia faba (faba beans) in 1958.
● They proved the semiconservative nature of DNA replication in eukaryotes
Replication Machinery and Enzymes:
● In all living cells such as E.coli replication requires a set of enzymes.
● E.coli completes the replication of its DNA within 38 min.
● The average rate of polymerization has to be approx. 2000 bp per sec.
● The polymerization process must be accurate; any mistake during replication would result in mutation.
● Deoxyribonucleoside triphosphates (dATP, dGTP, dCTP, dTTP) serve dual purposes:
● Provide energy for polymerization.
● Acts as substrates for polymerization.
● The replication process occurs within a small opening of the DNA helix called replication fork.
● The region where, replication fork formed is called the origin of replication.
● The replication fork is formed by an enzyme called helicase.
● Two separated strands are called template strands.

● Main enzyme is DNA-dependent DNA polymerase, since it uses a DNA template to catalyze the polymerization of deoxyribonucleotides.
● DNA polymerase catalyses polymerization only in one direction i.e. 5'→3'.
● On one strand (template with 3'→5' polarity) the replication is continuous hence called the leading strand.
● In another strand (template with 5'→3' polarity) the polymerization takes place in the form of a short fragment called Okazaki fragment.
● The short fragments are joined by DNA ligase, hence called lagging strand. • In

eukaryotes replication takes place in the S-phase of the cell cycle.
● A failure of cytokinesis after replication results in polyploidy.

TRANSCRIPTION:

● 'The process of copying genetic information from one strand of the DNA into RNA is termed as transcription'.

Transcription vs. Replication:

● Principle of complementarity governs the process of transcription except Adenine of DNA forms base pair with the Uracil instead of thymine. During replication Adenine pairs with thymine instead of uracil.
● During replication once started the whole DNA is duplicated, whereas transcription takes place only a segment of DNA.
● In replication both strand acts as template, whereas in transcription only one strand acts as template to synthesize RNA.
● In replication DNA copied from a DNA, whereas in transcription RNA copied from the DNA.
● Why both strands of DNA not copied during transcription:
● If both strands of DNA act as a template, they would be translated into two RNA of different sequences and in turn if they code for proteins, the sequence of amino acids in the protein would be different. Hence one segment of DNA would be coding for two different proteins.

The two RNA molecules if produced simultaneously would be complementary to each other, hence will form double stranded RNA. This would prevent RNA translation into protein.

Transcription unit:

● A transcription unit in DNA consists of three regions:
● A promoter
● The structural gene
● A terminator.
● DNA dependent RNA polymerase catalyses the polymerization in only one direction that is 5'→3'.

Structural gene:

● The DNA strand having polarity 3'→5' is called template strand for transcription.
● The other strand of DNA having polarity 5'→3' is called the coding strand.
● The sequences of nitrogen bases in the RNA transcribed from the template strand are the same as the coding strand of DNA except having Thymine in place of Uracil.
● All the reference points defining a transcription unit are made with the coding strand only, not the template strand.
● Promoter and Terminator present on either side of the structural gene.
● The promoter is located towards the 5' end (upstream) of the structural gene.
● It is a short sequence of DNA that provides binding sites for RNA polymerase. (mostly TATA , Commonly called TATA box)
● Presence of the promoter defines the template and coding strands.
● If the position of promoter is changed with terminator the definition of coding and template strand will be reversed.

Terminator:

● The terminator is located towards the 3' end (down stream) of the coding strand.
● It terminates the process of transcription.
● It is also a short segment of DNA which recognizes the termination factor. (ρ-factor)

Transcription unit and the gene:

● Gene is defined as the functional unit of inheritance.
● Genes are located on the DNA.
● The DNA sequence coding for tRNA and rRNA molecules also defines a gene.
● Cistron: a segment of DNA (structural gene) coding for a polypeptide.

● Monocistronic: most eukaryotic structural gene codes for single polypeptide.
Polycistronic:
● Most prokaryotic structural gene code for more than one polypeptide. In eukaryotes the monocistronic structural genes have interrupted coding sequences, the genes are said to be split gene:
● The coding sequences or expressed sequences are called Exons.
● Exons are interrupted by Introns.
● Exons are said to be those sequences that appear in mature or processed mRNA.
● Introns never appear in the mature or processed mRNA. They are spliced out Process of transcription: prokaryotes.
● There is a single DNA dependent RNA polymerase that catalyses transcription or synthesis of all three types of RNAs in prokaryotes.
● The process of transcription completed in three steps:
● Initiation:
● RNA polymerase binds to the specific site of DNA called promoter.
● Promoter of the DNA is recognized by initiation factor or sigma (σ).
● RNA polymerase along with initiation factor binds to the promoter.
● Elongation:
● RNA polymerase unzips the DNA double helix and forms an open loop.
● It uses ribonucleoside triphosphates as substrate and polymerizes in a DNA template following the rule of complementarity.
● Only a short stretch of polymerized RNA remains binds with the enzyme.
● The process of polymerization continues till the enzyme reaches the terminator gene.
● Termination:
● RNA polymerase recognizes the terminator gene by a termination-factor called rho (ρ) factor.
● The RNA polymerase separated from the DNA and also the transcribed RNA.
Additional complexities in eukaryotes:
There are three different types of RNA polymerases in the nucleus:
● RNA polymerase I transcribes rRNA (28S, 18S, and 5.8S)
● RNA polymerase II transcribes heterogeneous nuclear RNA (hnRNA).
● RNA polymerase III transcribes tRNA, 5srRNA and snRNA.
Post transcriptional processing: (occurs inside the nucleus)
(a) Splicing:
● The primary transcript (hn RNA) contains both exons and introns and is required to be processed before translationally active (mRNA).
● The introns are removed and exons are joined in a defined order.
● This process is catalyzed by SnRNP, introns removed as spliceosomes.
(b) Capping: an unusual nucleotide called methyl guanosine triphosphate is added to the 5’ end of hnRNA.
(c) Tailing: Adenylate residues (200-300) are added at 3’ end of hnRNA in a template independent manner.

● The processed hnRNA is now called mRNA and transported out of the nucleus for translation.
GENETIC CODE:
Contribution to discovery:
● The process of replication and transcription based on complementarity.
● The process of translation is the transfer of genetic information from a polymer of nucleotides to a polymer of amino acids. There is no complementarity between nucleotides and amino acids.

● If there is change in the nucleic acid (genetic material) there is change in amino acids in proteins.
● There must be a genetic code that could direct the sequence of amino acids in proteins during translation.
● George Gamow proposed the code should be a combination of bases, he suggested that in order to code for all the 20 amino acids, the code should be made up of three nucleotides. • Har Govind Khorana enables instrumental synthesizing RNA molecules with desired combinations of bases(homopolymer and copolymers).
● Marshall Nirenberg's cell – free system for protein synthesis finally helped the discovery of genetic code.
● Severo Ochoa enzyme (polynucleotide phosphorylase) was also helpful in polymerizing RNA with desired sequences in a template independent manner (enzymatic synthesis of RNA)
Salient features of genetic code:
● The codon is a triplet. Three nitrogen base sequences constitute one codon.
● There are 64 codons, 61 codes for amino acids and 3 codons are stop codons.
● One codon codes for only one amino acid, hence it is unambiguous.
● Degeneracy: some amino acids are coded by more than one codon.
● Comma less: the codon is read in mRNA in a continuous fashion. There is no punctuation.
● Universal: From bacteria to human UUU codes for phenylalanine.
● Initiation codon: AUG is the first codon of all mRNA. And also it codes for methionine (met), hence has dual function.
● Non-overlapping: The genetic code reads linearly
● Direction: the code only reads in 5' → 3' direction.
● Anticodon: Each codon has a complementary anticodon on tRNA.
● Nonsense codon: UAA, GUA, and UAG do not code for amino acids and have no anticodon on the tRNA.
Mutation and Genetic code:
● Relationships between DNA and genes are best understood by mutation.
Point mutation:
● It occurs due to replacement nitrogen base within the gene.
● It only affects the change of particular amino acids.
● Best understood the cause of sickle cell anemia.
Frameshift mutation:
● It occurs due to insertion or deletion of one or more nitrogen bases in the gene.
● There is change in the whole sequence of amino acids from the point of insertion or deletion.
● Best understood in β-thalasemia.
tRNA-the Adaptor molecule:
● The tRNA is called sRNA (soluble RNA)
● It acts as an adapter molecule.
● tRNA has an anticodon loop that is complementary to the codon.
● It has an amino acid acceptor end to which it binds with amino acid.

● Each tRNA binds with specific amino acids i.e 61 types of tRNA found.
● One specific tRNA with anticodon UAC called initiator tRNA.
● There is no tRNA for stop codons. (UAA, UGA, UAG)
● The secondary structure is like clover-leaf. • The actual structure of tRNA is compact, and looks like an inverted 'L'.
Translation:
● It refers to polymerization of amino acids to form a polypeptide.
● The number and sequence of amino acids are defined by the sequence of bases in the mRNA.

● The amino acids are joined by peptide bonds.
● Amino acids are activated in the presence of ATP and linked to their specific tRNA is called charging of tRNA or aminoacylation of tRNA.
● Ribosome is the cellular factory for protein synthesis.
● Ribosomes consist of structural rRNA and 80 different proteins.
● In inactive state ribosome(70S) present in two subunits:-
● A large subunit 50S.
● A small subunit 30S.
Initiation:
● The process of translation or protein synthesis begins with attachment of mRNA with a small subunit of ribosome.
● The ribosome binds to the mRNA at the start codon (AUG).
● AUG is recognized by the initiator tRNA.
Elongation:
● Larger subunit attached with the initiation complex.
● Larger subunit has two sites, ‘A’ site and ‘P’ site.
● Initiator tRNA accommodates in the ‘P’ site of a large subunit, the subsequent amino-acyl-tRNA enters into the ‘A’ site.
● The sub subsequent tRNA selected according to the codon of the mRNA.
● Codon of mRNA and anticodon of tRNA are complementary to each other.
● Formation of peptide bond between two amino acids of ‘P’ and ‘A’ site, catalyzed by ribozyme, (23S rRNA in bacteria)
● The moves from codon to codon along the mRNA are called translocation.
Termination:
● Elongation continues until a stop codon arrives at ‘P’ site.
● There is no tRNA for stop codon.
● A release factor binds to the stop codon.
● Further shifting of the ribosome leads to separation of polypeptide.
● An mRNA also has some additional sequences that are not translated called untranslated regions (UTR).
Regulation of gene expression:
● Regulation of gene expression in eukaryotes takes place in different level:
● Transcriptional level (formation of primary transcript)
● Processing level (regulation of splicing)
● Transport of mRNA from nucleus to the cytoplasm.
● Translational level.
● In prokaryotes control of rate of transcriptional initiation is the predominant site for control of gene expression.
● The activity of RNA polymerase at the promoter is regulated by accessory proteins, which affects its ability to recognize the start site.
● The regulatory proteins can acts both positively (activators) or negatively (repressor)
● The regulatory proteins interact with a specific region of DNA called the operator, which regulates the accessibility of RNA polymerase to the promoter.

Lac operon:
● Francois Jacob and Jacque Monod first to describe a transcriptionally regulated system of gene expression.
● A polycistronic structural gene is regulated by common promoter and regulatory genes. Such a regulation system is common in bacteria and is called operon.
Lac operon consists of:-
● One regulator gene (i-gene).
● Three structural genes (z,y,a).
● Operator. (binding site of repressor protein).

● Promoter.(binding site of the RNA polymerase).
● The i-gene codes for the repressor of the lac operon.
● The structural gene consists of three genes (z, y and a).
● 'z'-gene codes for beta-galactosidase, which hydrolyzes lactose into Galactose and glucose.
● 'y' –gene codes for permease, which increases the permeability of bacterial cells. to lactose.
● 'a'-gene codes for transacetylase.
● All three genes are required for the metabolism of lactose in bacteria.
● Inducer: lactose is the substrate for β- galactosidase and it regulates the switching on and off of the lac operon. Hence it is called inducer.
● In the absence of glucose, if lactose is added in the growth medium of the bacteria, the lactose is transported into the cell by permease.
● Very low level of expression of lac operon has to be present in the cell all the time; otherwise lactose cannot enter the cell.
● Mechanism of regulation of lac operon:
● The repressor protein is synthesized from i-gene (all time constitutively)
● In the absence of the inducer i.e. lactose the active repressor binds to the operator and prevents RNA polymerase from transcribing the structural gene
● In the presence of the inducer such as lactose or allolactose, the repressor is inactivated by interaction with the inducer.
● This allows RNA polymerase access to the promoter and transcription proceeds.
● The regulation of lac operon by repressor is referred to as negative regulation.

Human Genomic project:
● Genetic make-up of an organism or an individual lies in the DNA sequences.
● Two individuals differ in their DNA sequences at least in some places.
● Finding out the complete DNA sequence of the human genome.
● Sequencing the human genome was launched in 190.

Goals of HGP:
● Identify all the approximately 20.000 – 25000 genes in human DNA.
● Determine the sequence of all 3 billion chemical base pairs.
● Store this information in databases.
● Improve tools for data analysis.
● Transfer related technologies to other sectors, such as industries.
● Address the ethical, legal, and social issues (ELSI) that may arise from the project.

Methodology:
● To identify all the genes that expressed as RNA referred asExpressed Sequence Tags (ETSs).
● Simply sequencing the whole set of genome that contained all the coding and non-coding sequence, and later assigning different regions in the sequence with functions calledSequence Annotation.
● The commonly used hosts for sequencing were bacteria and yeast and vectors were called BAC (bacterial artificial chromosome) and YAC (yeast artificial chromosome). Salient

features of
Human Genome:
● The human genome contains 3164.7 million nucleotide bases.
● The average gene consists of 3000 bases.
● The largest known human gene being dystrophin at 2.4 million bases.
● The total number of genes is estimated at 30.000.
● 99.9 percent nucleotide base sequences are the same in all peoples.
● The function of 50% of genes discovered is unknown.

● Less than 2 percent of the genome codes for proteins.
● Repeated sequences make up a very large portion of the human genome.
● Chromosome I has the most genes (2968) and the Y has the fewest (231).
● About 1.4 million locations where single-base DNA differences (SNPs – single nucleotide polymorphism) occur in humans.

DNA Fingerprinting:

● DNA fingerprinting is a very quick way to compare the DNA sequences of any two individuals.
● DNA fingerprinting involves identifying differences in some specific regions in DNA called repetitive DNA,because in these sequences, a small stretch of DNA is repeated many times.
● During centrifugation the bulk DNA forms a major peak and the other small peaks are called satellite DNA.
● Depending on base composition (A:T rich or G:C rich), length of segment, and number of repetitive units, the satellite DNA is classified into many types, such as mini –satellite and micro – satellite.
● These sequences do not code for any proteins.
● These sequences show a high degree of polymorphism and form the basis of DNA fingerprinting.
● Polymorphism in DNA sequence is the basis of genetic mapping of the human genome as well as of DNA fingerprinting.
● Polymorphism (variation at genetic level) arises due to mutations. • If an inheritable mutation is observed in a population at high frequency it is referred to as DNA polymorphism.

The process:

● DNA fingerprinting was initially developed by Alec Jeffreys.
● He used satellite DNA as the basis of DNA fingerprinting that shows a very high degree of polymorphism. It was called as Variable Number Tandem Repeats.(VNTR).

Different steps of DNA fingerprinting are:-

● Isolation of DNA.
● Digestion of DNA by restriction of endonucleases.
● Separation of DNA fragments by gel electrophoresis.
● Transferring (blotting) of separated DNA fragments to synthetic membranes, such as nitrocellulose or nylon.
● Double stranded DNA made single stranded.
● Hybridization using labeled VNTR probes.
● Detection of hybridized DNA fragments by autoradiography.
● The VNTR belongs to a class of satellite DNA referred to as minisatellite.
● The size of VNTR varies from 0.1 to 20 kb.
● After hybridization with the VNTR probe the autoradiogram gives many bands of different sizes. These bands give a characteristic pattern for an individual DNA. It differs from individual to individual.
● The DNA from a single cell is enough to perform DNA fingerprinting.

Applications:

● Test of paternity.
● Identify the criminals.
● Population diversity determination.
● Determination of genetic diversity.

<u>Multiple Choice Questions(MCQs)</u>

1. Which of the following enzymes is used for *transcription*?
   a) Amino acid synthetase.
   b) DNA polymerase III.
   c) RNA polymerase.
   d) DNA ligase.
2. In the DNA molecule –
   a) Proportion of *adenine* in relation to *thymine* varies with the organism.
   b) There are two strands which runs *antiparallel* -one in the 5’-3’ direction and the other in 3’-5’ direction.
   c) The total amount of *purine nucleotides* is not always equal.
   d) There are two strands which runs *parallel* -both in the 5’-3’ direction.
3. Which one of the following pairs of codons is correctly matched with its function or a signal for a particular amino acid?
   a) AUG; ACG -Start/ Methionine.
   b) UUA; UCA -Leucine.
   c) GUU; GCU -Alanine
   d) UAG; UGA -Stop.
4. Choose the ‘*wrongly*’ matched following pairs of nitrogenous bases in nucleic acids.
   a) Guanine -Adenine -purines
   b) Adenine -Thymine -purines.
   c) Thymine -Uracil -pyrimidines.
   d) Uracil -Cytosine -pyrimidines.
5. According to *Chargaff’s rule*, which one of the following is correct?
   a) A+T =G+C
   b) A+C =G+T
   c) A+G =T+C
   d) Both (a) and (c).
6. DNA has genetic properties was revealed for the first time by –
   a) Avery.
   b) Griffith.
   c) Wilkins.
   d) Chargaff.
7. Choose the particular process used by Matthew Meselson and Franklin Stahl in order to study the *semi -conservative* replication of DNA.
   a) Centrifugation.
   b) Chromatography.
   c) Buoyant density centrifugation.
   d) Density gradient centrifugation.
8. Copying genetic information from one strand of DNA into RNA is –
   a) Translation.
   b) Transcription.
   c) Transformation.
   d) Transduction.
9. The portion of the DNA which contains the information for an entire polypeptide is called –
   a) Cistron.
   b) Muton.

c) Recon.
d) Operon.

10. Repressor protein is produced by –
a) Operator gene.
b) Structural gene.
c) Regulator gene.
d) Promotor gene.
11. Retrovirus has the genetic material –
a) DNA only.
b) RNA only.
c) Both DNA and RNA.
d) Either DNA or RNA only.
12. Out of 64 codons, only 61 codons code for the *twenty different amino acids*. This character of the genetic code is called –
a) Degeneracy.
b) Non -ambiguous nature.
c) Redundancy.
d) Overlapping.
13. Which one is referred to as '*soluble RNA*?
a) mRNA.
b) rRNA.
c) tRNA.
d) ssRNA.
14. If the percentage of *cytosine* is 18%, then the percentage of *adenine* will be –
a) 64%
b) 32%
c) 36%
d) 23%
15. Removal of *introns* and joining of *exons* in a defined order in a transcription unit is called –
a) Tailing.
b) Transformation.
c) Capping.
d) Splicing.
16. What will be the correct gene expression pathway?
a) Gene -mRNA -Transcription -Translation -Protein.
b) Transcription -Gene -Translation -mRNA -Protein.
c) Gene -Transcription -mRNA - Translation -Protein.
d) Gene -Translation -mRNA -Transcription - Protein.
17. The main aim of the Human Genome Project is –
a) To introduce new genes into Humans.
b) To identify and sequence all the genes present in Human DNA.
c) To develop better techniques for comparing two different human DNA samples.
d) To remove disease causing genes from Human DNA.
18. DNA gyrase that participates in the process of DNA replication is a type of –

a) Reverse transcriptase.
b) DNA ligase.
c) DNA topoisomerase.
d) DNA polymerase.

19. In genetic fingerprinting, the '*probe*' refers to ….
a) A radioactively labelled single stranded DNA molecule.
b) A radioactively labelled single stranded RNA molecule.
c) A radioactively labelled double stranded RNA molecule.
d) A radioactively labelled double stranded DNA molecule.

20. In bacteria, the formation of peptide bond during translation is affected by –
a) Lysozyme.
b) Nucleosome.
c) Ribozyme.
d) Microsome.

LONG ANSWER QUESTIONS

1. One chromosome contains one molecule of DNA. In Eukaryotes, the length of the DNA molecule is enormously large. Explain how such a long molecule fits into the tiny chromosomes seen during *metaphase*. (5)

2. (a) Draw a neat and labelled diagram of a '*Replicating fork*' showing '*polarity*'. Why does DNA replication occur within such *replication fork*?
(b) Name the enzyme involved in the process of DNA replication along with their properties. (5)

3. (a) Describe the series of experiments conducted by Frederick Griffith. Comment on the significance of the results obtained.

(b) State the contributions of Oswald Avery, Colin McLeod and Maclyn McCarthy. (5)

4. (a) Describe the structure and function of the tRNA molecule.
(b) Why is the tRNA referred to as an '*adaptor*' molecule?
(c) Explain the process of '*splicing*' of hnRNA in a Eukaryotic cell. (5)

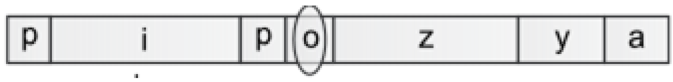
5. (a) Why did Hershey and Chase use radio isotopes of Phosphorus (P^{32}) and Sulphur (S^{35}) in their experiments? Explain the experiment. (5)

(b) Following the experiments conducted by them, state the conclusion they arrived at and how?

6. One chromosome contains one molecule of DNA. In Eukaryotes, the length of the DNA molecule is enormously large. Explain how such a long molecule fits into the tiny chromosomes seen during *metaphase*. (5)

DIAGRAM BASED QUESTIONS:

1. Study the schematic representation of the genes involved in *lac operon* given below and answer the questions that follow:

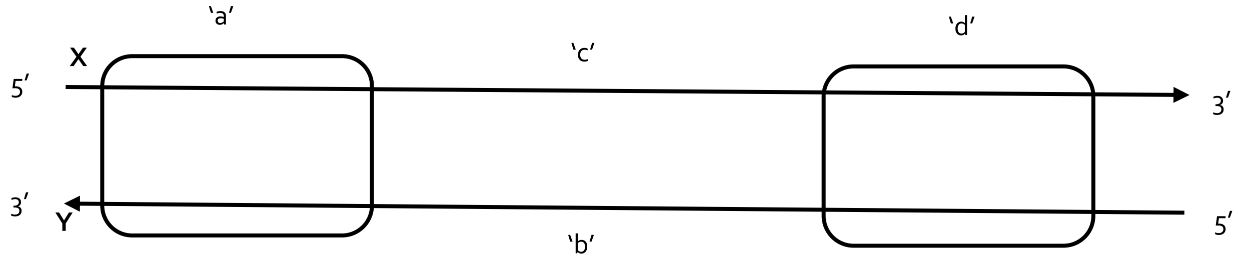


a) Identify and name the regulatory gene in this operon. Explain its role in '*switching off*' the operon. (1½)

b) Why is the *lac operon's* regulation referred to as '*negative regulation*'? (1)

c) Name the inducer molecule and the products of the genes' '*z*' and '*y*' of the operon. State the functions of these gene products. (2½)

2. Study the following illustration and answer the questions below:



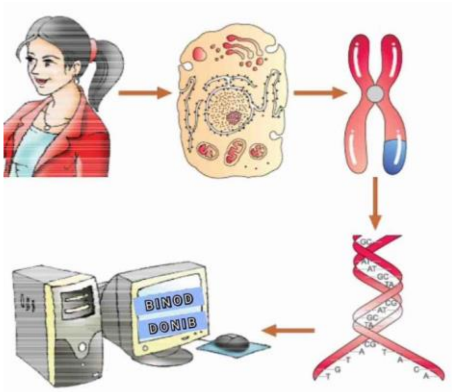
a) Considering that information from ***strand 'X'*** is to be *transcribed*, identify and name the parts labelled as 'a', 'b', 'c' and 'd'. (2)

b) Explain the function of each of the labelled part. (2)

c) Name the enzyme involved in the process. (1)

CASE BASED QUESTIONS:

1. A Representative Diagram of the Human Genome Project:



i. In the history of Biology, the Human Genome Project led to the development of:
   a) Biotechnology b) Biomonitoring c) Bioinformatics d) Biosystematics. (1)

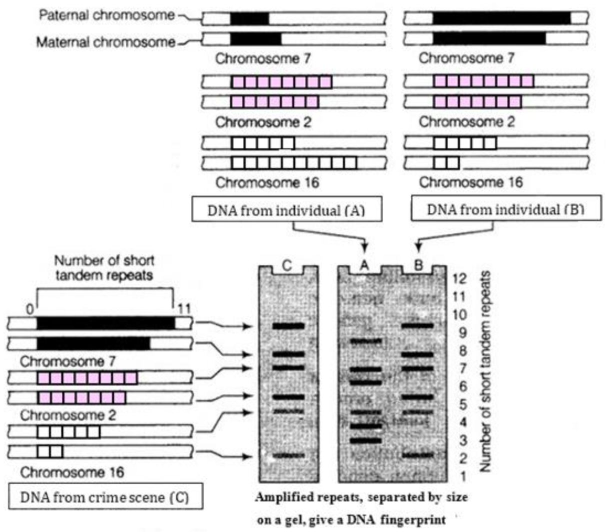
ii. Name a free living, non-pathogenic nematode, the DNA of which has been completely sequenced. (1)

iii. Summarize the methodology adopted in the Human Genome Project. (1)

iv. What are SNPs'? How are they useful in human genomics? (1)

v. Mention at least four salient features of the Human Genome Project. (1)

2. Two blood samples of suspects ‘A’ and ‘B’ were sent to the Forensic Department along with the sample ‘C’ from the crime scene. The Forensic Department assigned the responsibility of running the samples and matching the samples of the suspects with that of the sample from the scene of the crime and thereby identify the culprit.



i. In genetic fingerprinting the ‘*probe*’ refers to – (1)
  a) A radioactively labelled double stranded RNA molecule.
  b) A radioactively labelled double stranded DNA molecule.
  c) A radioactively labelled single stranded DNA molecule.
  d) A radioactively labelled single stranded RNA molecule.

ii. What does ‘*minisatellite*’ and ‘*microsatellite*’ mean in relation to DNA Fingerprinting. (1)

iii. How does *polymorphism* arise in a population? (1)

iv. State the steps involved in DNA Fingerprinting in a sequential manner. (2)

(<u>ANSWER KEY</u>)

MCQ

1. c) RNA polymerase
2. b) There are two strands which runs antiparallel -one in the 5’-3’ direction and the other in 3’-5’ direction
3. d) UAG; UGA -Stop
4. b) Adenine -Thymine -purines
5. b) A+T =G+C
6. a) Avery.
7. d) Density gradient centrifugation.
8. b) Transcription.
9. a) Cistron
10. c) Regulator gene.
11. b) RNA only
12. a) Degeneracy.
13. c) tRNA.
14. b) 32%

15. d) Splicing.
16. c) Gene -Transcription -mRNA - Translation -Protein
17. b) To identify and sequence all the genes present in Human DNA.
18. c) DNA topoisomerase
19. a) A radioactively labelled single stranded DNA molecule.
20. c) Ribozyme.

LONG ANSWER QUESTIONS

1. The distance between two consecutive base pairs = 0.34 nm i.e. (0.34×10^{-9}m).

- ✓ If the length of DNA double helix in a typical mammalian cell = 6.6 × 109 bp.
- ✓ The length of the DNA molecule = 6.6 × 109 bp × 0.34 × 10-9m/bp =2.2 meters -a length that is far greater than the dimension of a typical nucleus (approximately 10^{-6} m).
- ✓ In eukaryotes, there is a set of positively charged, basic proteins called histones.
- ✓ A protein acquires charge depending upon the abundance of amino acids residues with charged side chains.
- ✓ Histones are rich in the basic amino acid residues lysine and arginine -both of carry positive charges in their side chains. which
- ✓ Histones are organised to form a unit of eight molecules called histone octamer (H2A, H2B, H3 and H4). H1 is found associated with 'linker DNA' -between the nucleosomes.
- ✓ The negatively charged DNA is wrapped around the positively charged histone octamer to form a structure called nucleosome.
- ✓ A typical nucleosome contains 200 bp of DNA helix.
- ✓ Nucleosomes constitute the repeating unit of chromatin, threadlike stained (coloured) bodies seen in nucleus. The nucleosomes in chromatin are seen as 'beads-on-string' structure when viewed under electron microscope.
- ✓ The packaging of chromatin at higher level requires additional set of proteins that collectively are referred to as Non-histone Chromosomal (NHC) proteins

2 a)

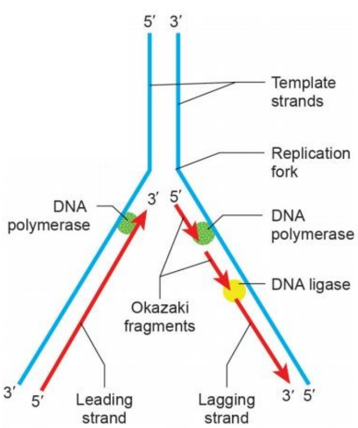


Fig 5.6 Mechanism of replication showing a replication fork

For long DNA molecules, since the two strands of DNA cannot be separated in its entire length (due to very high energy requirement), the replication occur within a small opening of the DNA helix, referred to as replication fork.

S.No	ENZYME	FUNCTION
1.	HELICASE	‘*Unzipping*’ the DNA helix at the *origin of replication*.
2.	SSB PROTEINS	‘*Single Strand Binding Proteins*’ - helps to stabilize the DNA strands.
3.	PRIMASE	Synthesising ‘*RNA Primer*’ which provides a free 3’-OH terminal for DNA polymerase to extend the new strand.
4.	DNA POLYMERASE III	The main enzyme catalysing the 5'→3' polymerisation of DNA strand during replication. It also has 3'→5' exonuclease activity for proofreading.
5.	DNA POLYMERASE I	The main enzyme for repair, removal of primers and filling the gaps in the lagging strand.
6.	DNA LIGASE	Final ‘*binding*’ of nicks in DNA during synthesis and repair.
7.	DNA GYRASE	‘*Supercoiling*’ of the DNA molecule after *DNA helicase unwound* the DNA molecule during its replication.

b)

2. a) Transforming Principle

✓ Frederick Griffith (1928), conducted a series of experiments with Streptococcus pneumoniae (bacterium responsible for pneumonia).

✓ When Streptococcus pneumoniae (pneumococcus) bacteria are grown on a culture plate, some produce smooth shiny colonies (S) while others produce rough colonies (R).

✓ This is because the S strain bacteria have a mucous (polysaccharide) coat, while R strain does not.

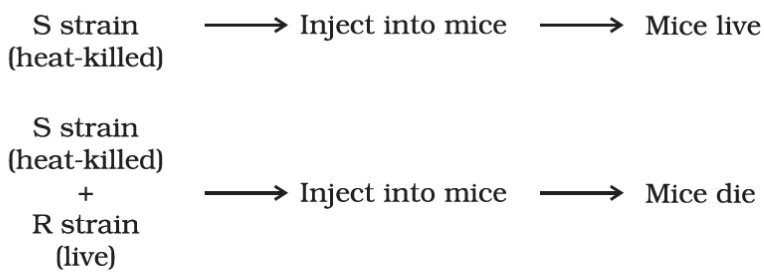
✓ Mice infected with the S strain (virulent) die from pneumonia infection but mice infected with the R strain do not develop pneumonia.

S strain ⟶ Inject into mice ⟶ Mice die

R strain ⟶ Inject into mice ⟶ Mice live

✓ Griffith was able to kill bacteria by heating them. He observed that heat-killed S strain bacteria injected into mice did not kill the mice.

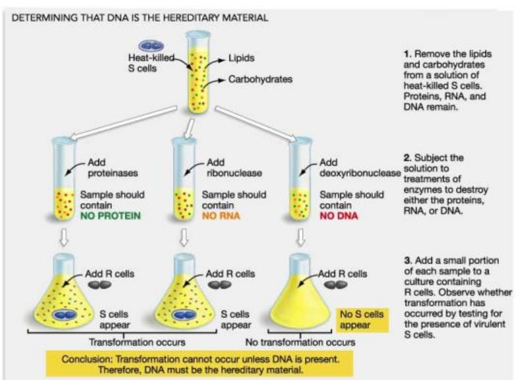
✓ When he injected a mixture of ‘heat-killed S’ and ‘live’ R bacteria, the mice died. Moreover, he recovered living S bacteria from the dead mice.



- ✓
- ✓ He concluded that the R strain bacteria had somehow been transformed by the heat-killed S strain bacteria. Some ‘transforming principle’, transferred from the heat-killed S strain, had enabled the R strain to synthesise a smooth polysaccharide coat and become virulent.
- ✓ This must be due to the transfer of the genetic material.

b) **<u>Biochemical Characterisation of Transforming Principle</u>:**

- ✓ Earlier (before 1933), the genetic material was thought to be a protein.
- ✓ Oswald Avery, Colin McLeod and Maclyn McCarthy, worked to determine the biochemical nature of ‘transforming principle’ in Griffith's experiment.
- ✓ They purified biochemicals (proteins, DNA, RNA, etc.) from the heat-killed S cells to see which ones could transform live R cells into S cells

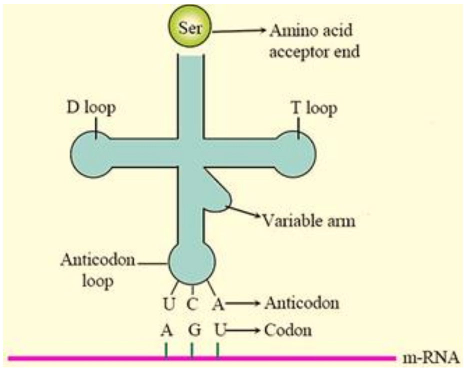


- ✓ They discovered that DNA alone from heat killed *S strain bacteria* caused R bacteria to become transformed
- ✓ They also discovered that protein-digesting enzymes (proteases) and RNA-digesting enzymes (RNases) did not affect transformation.
- ✓ Therefore, the transforming substance was not a protein or RNA.
- ✓ Digestion with DNase did inhibit transformation, suggesting that the DNA caused the transformation.
- ✓ They concluded that DNA is the hereditary material, but not all biologists were convinced

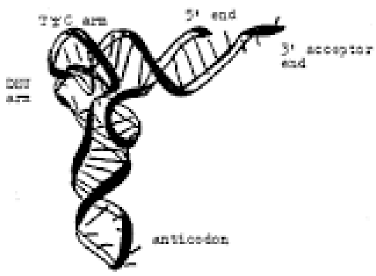
3. a)

- ✓ tRNA has an anticodon loop that has bases complementary to the triplet codon.
- ✓ It also has an amino acid acceptor end to which it binds to amino acids.
- ✓ tRNAs are specific for each amino acid.

<u>Clover leaf model of tRNA</u>



Inverted ‘L’ shaped model of tRNA



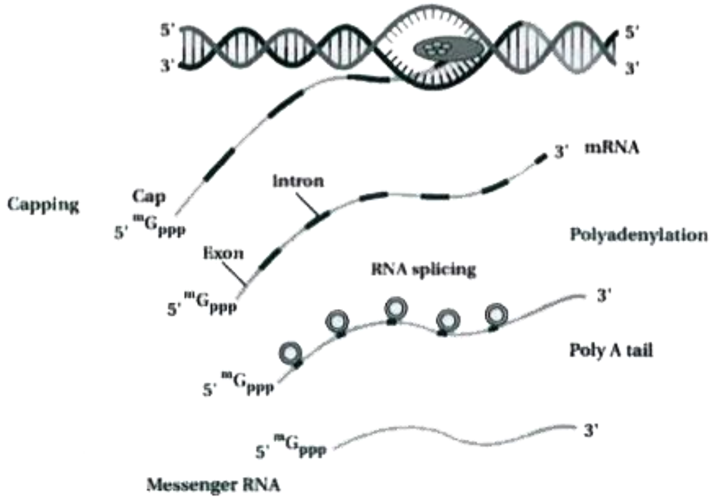
- ✓ For **initiation**, there is **another specific tRNA** that is referred to as **initiator tRNA**.
- ✓ There are **no tRNAs for stop codons**.
- ✓ The **secondary structure of tRNA** has been depicted that **looks like a clover-leaf**.
- ✓ In **actual structure**, the tRNA is a compact molecule which **looks like inverted ‘L’**.

b)
Answer:

- ✓ Francis Crick postulated the presence of an adapter molecule that would **on one hand read the code** and **on other hand would bind to specific amino acids**.
  - ✓ tRNA was the ideal molecule that fits the role of ‘*this*’ adaptor molecule

c)

- ✓ The primary transcripts contain both the **exons** and the **introns** and are **non-functional**.
- ✓ Hence, it is subjected to a process called **splicing** -where the **introns are removed** and **exons are joined** in a defined order.
- ✓ hnRNA undergoes **additional processing** called as **capping** and **tailing**.
- ✓ In **capping** an unusual nucleotide (**7-methyl guanosine triphosphate**) is **added to the 5′-end** of hnRNA. In **tailing**, **adenylate residues** (**200-300**) are **added at 3′-end** in a template independent manner.
- ✓ It is the **fully processed hnRNA**, now **called mRNA**, that is transported out of the nucleus for translation.



Process of Transcription in Eukaryotes

4. a)

(i) Viruses grown in the presence of radioactive phosphorus contained radioactive DNA but not radioactive protein **because DNA contains phosphorus** but protein does not. (½)

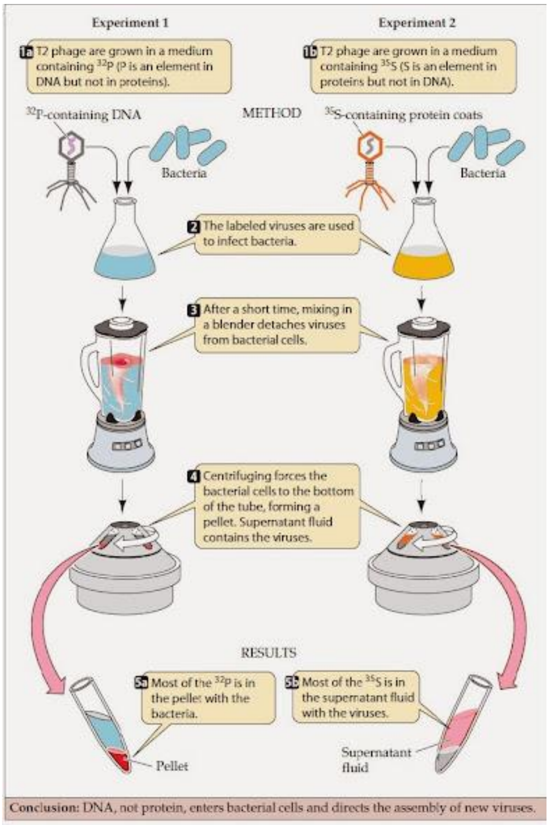
(ii) Similarly, viruses grown on radioactive sulphur contained radioactive protein but not radioactive DNA **because DNA does not contain sulphur**. (½)

- Hershey and Chase worked to discover whether it was protein or DNA from the viruses that entered the bacteria.
- They grew some viruses on a medium that contained radioactive phosphorus and some others on medium that contained radioactive sulphur.
- Radioactive phages were allowed to attach to *E. coli* bacteria.
- Then, as the infection proceeded, the viral coats were removed from the bacteria by agitating them in a blender. The virus particles were separated from the bacteria by spinning them in a centrifuge. (2)

b)

(i) Bacteria which was infected with viruses that had radioactive DNA were radioactive, indicating that DNA was the material that passed from the virus to the bacteria.

(ii) Bacteria that were infected with viruses that had radioactive proteins were not radioactive. This indicates that proteins did not enter the bacteria from the viruses. **DNA is therefore the genetic material that is passed from virus to bacteria**. (2)



The Hershey-Chase Experiment Because only DNA entered the bacterial cell during infection by labeled bacteriophage, the experiment demonstrated that DNA, not protein, is the hereditary material.

6.

- ✓ One chromosome contains one molecule of DNA. In Eukaryotes, the length of the DNA molecule is enormously large. Explain how such a long molecule fits into the tiny chromosomes seen during *metaphase*.

- ✓ The distance between two consecutive base pairs = 0.34 nm i.e. (0.34×10^{-9}m).
- ✓ If the length of DNA double helix in a typical mammalian cell = 6.6×10^{9} bp.
- ✓ The length of the DNA molecule = 6.6×10^{9} bp $\times$ 0.34×10^{-9}m/bp =2.2 meters -a length that is far greater than the dimension of a typical nucleus (approximately 10^{-6} m).
- ✓ In eukaryotes, there is a set of **positively charged, basic proteins** called **histones**.
- ✓ A protein acquires charge depending upon the abundance of amino acids residues with charged side chains.
- ✓ **Histones** are **rich in** the **basic amino acid residues lysine** and **arginine** -both of carry **positive charges** in their side chains. which
- ✓ Histones are organised to form <u>a unit of eight molecules</u> called **histone octamer (H_2A, H_2B, H_3 and H_4). H_1** is found associated with '***linker DNA***' -between the nucleosomes.
- ✓ The **negatively charged DNA** is **wrapped around the positively charged histone octamer** to form a structure called **nucleosome**.
- ✓ A <u>typical nucleosome</u> contains **200 bp of DNA helix**.
- ✓ **Nucleosomes** constitute the **repeating unit of chromatin**, threadlike stained (coloured) bodies seen in nucleus. The nucleosomes in chromatin are seen as '**beads-on-string**' structure when viewed under electron microscope.
- ✓ The packaging of chromatin at h
- ✓ igher level requires additional set of proteins that collectively are referred to as **Non-histone Chromosomal** (NHC) **proteins**.

DIAGRAM BASED QUESTIONS

1. a)
   i. The lac operon consists of one regulatory gene (the i gene – here the term i does not refer to inducer, rather it is derived from the word inhibitor).
   ii. The repressor of the operon is synthesised (all-the-time – constitutively) from the i gene. The repressor protein binds to the operator region of the operon and prevents RNA polymerase from transcribing the operon.

   b) Repressor proteins have an inhibiting property whose '*absence*' or '*presence*' controls the switching '*on*' or '*off*' of the operon respectively. Thus, regulation of *lac operon* is referred to as '*negative regulation*'.

   c) Lactose is the substrate for the enzyme beta-galactosidase and it regulates switching on and off of the operon. Hence, it is termed as inducer.

   - ✓ The '*z*' gene codes for beta-galactosidase (b-gal), which is primarily responsible for the hydrolysis of the disaccharide, lactose into its monomeric units, galactose and glucose.
   - ✓ The '*y*' gene codes for permease, which increases permeability of the cell to b-galactosides. The '*a*' gene encodes a transacetylase an enzyme that catalyzes the transfer of an acetyl group from *Acetyl CoA* to another molecule (galactosides, lactosides and glucosides) during *metabolism of lactose.*
   - ✓ Hence, all the three gene products in *lac* operon are required for metabolism of lactose.

2. a)
   'a' =Terminator (ii) 'b' =Coding strand (iii) 'c' =Template strand (iv) 'd' =Promotor

   b)
   All the reference point while defining a transcription unit is made with coding strand.

   (i) **'a' = <u>Terminator</u>** –The terminator is located towards 3′-end (downstream) of the coding strand and it usually defines the end of the process of transcription.

   (ii) **'b' = <u>Coding strand</u>** –the strand which has the polarity (5′®3′) and the sequence same as RNA (except thymine at the place of uracil), is displaced during transcription. Strangely, this strand (which does not code for anything), is referred to as coding strand.

   (iii) **'c' = <u>Template strand</u>** –the strand that has the polarity 3′®5′ acts as a template, and is also referred to as template strand.

   (iv) **'d' = <u>Promotor</u>** -The promoter is said to be located towards 5′-end (upstream) of the structural gene (the reference is made with respect to the polarity of coding strand). It is a DNA sequence that provides binding site for RNA polymerase, and it is the presence of a promoter in a transcription unit that also defines the template and coding strands.

   c)
   DNA-dependant RNA polymerase -catalyse the polymerisation in only one direction, that is, 5′ to 3′.

CASE BASED QUESTIONS

1.

.i) Biotechnology

ii) - *<u>Caenorhabditis</u> <u>elegans</u>*

✓ iii) **<u>Expressed Sequence Tags</u> (<u>ESTs</u>):** The approach focused on identifying all the genes that are expressed as RNA.

<u>Sequence Annotation</u>: The other took the blind approach of simply sequencing the whole set of genome that contained all the coding and non-coding sequence, and later assigning different regions in the sequence with functions.

- ✓ iv) Scientists have identified about **1.4 million locations** where **single base DNA differences** (**SNPs – single nucleotide polymorphism, pronounced as 'snips'**) occur in humans. This information promises to revolutionise the processes of finding chromosomal locations for disease-associated sequences and tracing human history.
- ✓ An example of an SNP is the **substitution of a C for a G in the nucleotide sequence** AACGAT, thereby producing the sequence **AACCAT**. The DNA of humans may contain many SNPs, since these variations occur at a rate of one in every 100–300 nucleotides in the human genome.
- ✓ Single nucleotide polymorphism (SNP) technologies can be used to identify disease-causing genes in humans and to understand the inter-individual variation in drug response.
- ✓ By establishing an association between the genetic make-up of an individual and drug response it may be possible to develop a genome-based diet and medicines that are more effective and safer for each individual.
- ✓ SNPs can be used to understand the molecular mechanisms of sequence evolution. It is possible that disease-associated SNPs (or pathology) and evolution can be related to one another.

v)

(i) The human genome contains 3164.7 million bp.

(ii) The average gene consists of 3000 bases, but sizes vary greatly, with the largest known human gene being dystrophin at 2.4 million bases.

(iii) The total number of genes is estimated at 30,000–much lower than previous estimates of 80,000 to 1,40,000 genes. Almost all (99.9 per cent) nucleotide bases are exactly the same in all people.

(iv) The functions are unknown for over 50 per cent of the discovered genes. Less than 2 per cent of the genome codes for proteins.

(v) Repeated sequences make up very large portion of the human genome.

(vi) Repetitive sequences are stretches of DNA sequences that are repeated many times, sometimes hundred to thousand times. They are thought to have no direct coding functions, but they shed light on chromosome structure, dynamics and evolution.

(vii) Chromosome 1 has most genes (2968), and the Y has the fewest (231).

(viii) Scientists have identified about 1.4 million locations where single base DNA differences (SNPs – single nucleotide polymorphism, pronounced as 'snips') occur in humans. This information promises to revolutionise the processes of finding chromosomal locations for disease-associated sequences and tracing human history.

2.

i) A radioactively labelled single stranded DNA molecule**.**

ii) The **main difference** between microsatellite and minisatellite:

(a) <u>Microsatellite</u> - **the repeating unit consists of 2-6 base pairs.** Microsatellite **array** contains 5-200 repeats.

(b) <u>Minisatellite</u> - **the repeating unit consists of 10-100 base pairs.** Minisatellite **array** contains 10-1,500 repeats.

iii)

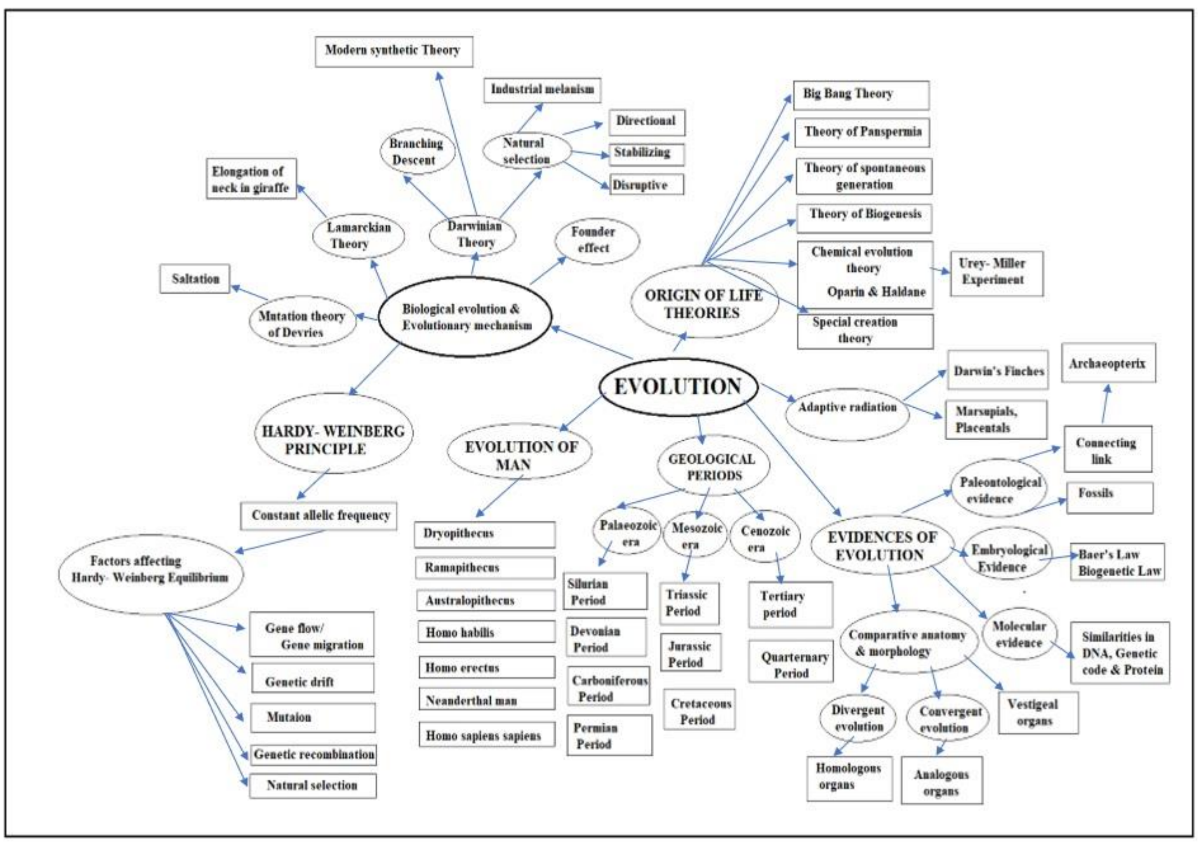
- ✓ Polymorphism (variation at genetic level) arises due to mutations.
- ✓ Allelic sequence variation has traditionally been described as a DNA polymorphism if more than one variant (allele) at a locus occurs in human population with **a frequency greater than 0.01**.
- ✓ That is, if an inheritable mutation is observed in a population at **high frequency**, it is referred to as DNA polymorphism

iv) Steps involved in DNA Fingerprinting:

(i) Isolation of DNA.
(ii) Digestion of DNA by restriction endonucleases.
(iii) Separation of DNA fragments by electrophoresis.
(iv) Transferring (blotting) of separated DNA fragments to synthetic membranes, such as nitrocellulose or nylon.
(v) Hybridisation using labelled VNTR probe, and
(vi) Detection of hybridised DNA fragments by autoradiography.

Prepared By:1. M M JOSEPH & 2.ANITHA SARMA,KV INS DRONACHARYA, KOCHI.

CHAPTER : EVOLUTION
CONCEPT MAP



GIST OF MAJOR & MINOR CONCEPTS

The Origin of Life and Evidences of Evolution:
1. The study of history of life forms on earth is called evolutionary biology.

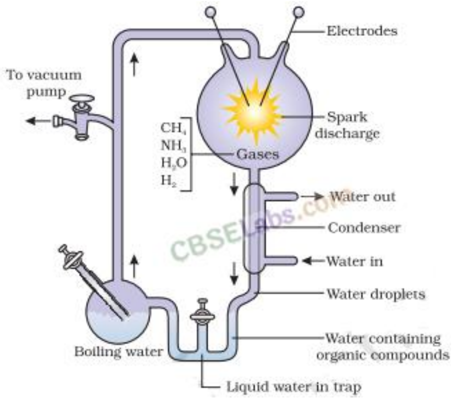
2. Evolution is a process that results in heritable changes in population spread over many generations leading to diversity of organisms on earth.

3. Origin of life is considered a unique event in the history of universe.
(i) The Universe
(a) It is very old-almost 20 billion years ago. It contains huge galaxies.
(b) Galaxies contain stars and clouds of gas and dust.
(c) The origin of universe is explained by Big Bang theory.
(d) The Big Bang theory states that a huge explosion occurred, the universe expanded, temperature came down and hydrogen and helium were formed later. The galaxies were then formed due to condensation of gases under gravitation.
(ii) The earth was supposed to have been formed about 4.5 billion years back in the solar system of the milky way galaxy.
(a) Water vapour, methane, carbon dioxide and ammonia released from molten masses covered the surface.
(b) UV rays from the sun broke up water molecule into hydrogen and oxygen and lighter hydrogen escaped

(c) Oxygen combined with ammonia and methane to form water, carbon dioxide and others.
(d) Ozone layer formed, as it cooled, the water vapour fell as rain to fill depression and form oceans.
(e) Life appeared 500 million (about 4 billion years back) years after the formation of earth.

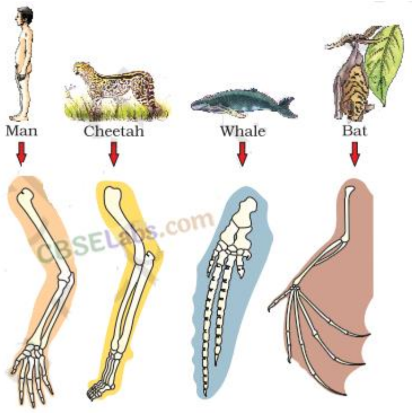
4. Theories of origin of life were given by different thinkers and scientists.
(i) Theory of special creation states that God created life by his divine act of creation.
(iii) Theory of panspermia/cosmozoic theory, given by early Greek thinkers states that the spores or panspermia came from outer space and developed into living forms.
(iii) Theory of spontaneous generation states that life originated from decaying and rotting matter like straw, mud, etc.
(a) Louis Pasteur rejected the theory of spontaneous generation and demonstrated that life came from pre-existing life.
(b) In his experiment, he kept killed yeast cells in pre-sterilised flask and another flask open into air. The life did not evolved in the former but new living organisms evolved in the second flask.
(iv) Theory of chemical evolution or Oparin-Haldane theory states that life originated from pre-existing non-living organic molecules and that formation of life was preceded by chemical evolution. The conditions on the earth that favoured chemical evolution were very high temperature, volcanic storms and reducing atmosphere that contained CH_4,NH_3, water vapour, etc.

5. Miller's experiment provided experimental evidence for chemical evolution.
(i) The experiment was carried out by SL Miller and HC Urey in 1953.
(ii) He took a closed flask containing CH_4, H_2, NH_3 and water vapour at 800°C and created electric discharge. These conditions were similar to those in primitive atmosphere.
(iii) After a week, formation of amino acids was observed. Complex molecules like sugars, nitrogen bases, pigments and fats were seen in the flask by other scientists.
(iv) Analysis of the meteorite also revealed the presence of similar compounds.
(v) Chemical evolution of life was more or less accepted.

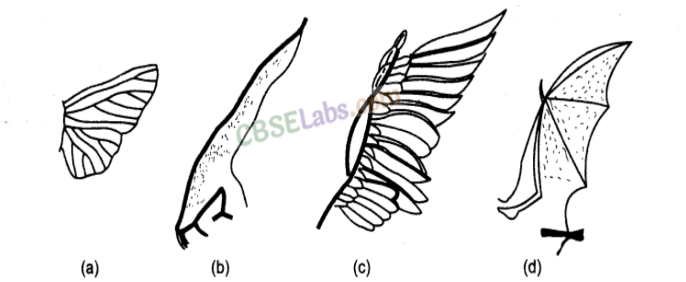


6. Origin of First Cell
(i) First non-cellular life forms originated three million years ago.
(ii) These molecules were like RNA, protein and polysaccharides.
(iii) Cellular life form first evolved about 2000 million years ago.
(iv) These were single-celled formed in aquatic environment.
(v) This form of abiogenesis, i.e. the first form of life arose slowly through evolutionary forces from non-living molecules It is accepted by many scientists.
7. Evidences of evolution come from
(i) Palaeontology (ii) Comparative anatomy and morphology
(iii) Biochemical/Physiology (iv) Biogeography
(v) Embryology
(i) Palaeontology is the study of fossils. The fossils are the remains of past organisms preserved in sedimentary rocks
(a) Rocks form sediments and a cross-section of earth's crust indicates the arrangement of sediments one over the other during the long history of earth.
(b) Different aged rock sediments contain fossils of different life forms, who died during the formation of the particular sediment,
(c) Some organisms appear similar to modern organisms. They represent extinct organisms like dinosaurs.
(d) A study of fossils in different sedimentary layers indicates the geological period in which they existed.
(e) The study showed that life forms varied over time and certain life forms are restricted to certain geological time-scale Hence, new forms of life have evolved at different times in the history of earth.

(ii) Comparative anatomy and morphological evidences show the similarities and differences among the organisms of today and those that existed years ago.
The evidences come from comparative study of external and internal structure.
I. (a) The organs with same structural design and origin but different functions are called homologous organs
(b) Homology in organ indicates common ancestry.
(c) Homology is based on divergent evolution. The same structure developed along different directions due to adaptations to different needs. The condition is called divergent evolution.
(d) Examples are forelimbs of some animals like whales, bats and cheetah have similar anatomical structure, such as humerus, radius, ulna, carpals, metacarpals and phalanges.
Other examples of homology are vertebrate hearts or brains. In plants also, thorns and tendrils of *Bougainvillea* and Cucurbita represent homology.



II. (a) Organs which are anatomically different but functionally similar are called analogous organs. For example, wings of butterfly and birds.
(b) Analogy refers to a situation exactly opposite to homology.
(c) Analogous organs are a result of convergent evolution. It is the evolution in which different structures evolve for same function and hence, have similarity.
(d) Other examples of analogy are eyes of Octopus and mammals; flippers of penguins and dolphins. In plants, sweet potato (root modification) and potato (stem modification).
(c) There was alternation in beaks enabling some to become insectivorous and some vegetarian.



Analogous organs (a) Wing of insect (b) Wing of *Pterodactyl* (c) Wing of bird (d) Wing of bat

(v) Embryological evidences Study of comparative embryology shows common patterns of development.
(a) The principles of embryonic development were given by Von Baer.
(b) Ernst Haeckel propounded The theory of recapitulation or Biogenetic law which states that an individual organism in its development (ontogeny) tends to repeat the stages passed through by its ancestors (phylogeny), i.e. ontogeny recapitulates phylogeny.
(c) This means that the life history of an animal reflects its evolutionary history.
For example, during the life history, frog's tadpole larva resembles fishes, the ancestors of amphibia.
The presence of gill clefts in all vertebrate embryos including human provides a strong evidence in support of organic evolution.
(d)Examples from plant kingdom
Protonema of moss or fern gametophyte, resembles the filamentous green algae in structure, physiology and growth pattern
Primitive gymnosperms such as *Cycas* and *Ginkgo* have flagellated sperms and need water for fertilization just like the pteridophytes
seedlings of acacia tree initially develop simple leaves, but the leaves that develop later are compound.

(vi) Anthropogenic evidences Excess use of herbicides, pesticides, etc has resulted in selection of resistant varieties in a lesser time scale. This is also true for microbes against which antibiotics or drugs have been used. All these evidences tell us that "Evolution is a stochastic process based on chance events in nature and chance mutation in the organisms".

(vii) Molecular evidence in Evolution

Similarity in the base sequence in their nucleic acids, and amino acid sequence in their proteins indicate phylogenetic relationship.
Example Similarity in the molecular structure of cytochrome C, actin and tubulin proteins in all animals point to their common ancestry. Almost universal nature of common genetic code is evidence that all organisms are related.

Adaptive radiation is an evolutionary process in which an ancestral stock gives rise to new species adapted to new habitats and new ways of life. Examples are Darwin's finches These were small black birds, which Darwin observed in Galapagos Island.
(a) He observed many varieties of finches in the same island.
(b) All varieties of finches had evolved from original seed-eating finches.
(c) There was alternation in beaks enabling some to become insectivorous and some vegetarian.
(ii) Marsupials of Australia A number of marsupials, different from each other evolved from an ancestral stock, all within the Australian island continent.

II. Parallel evolution refers to independent development of similar characters in two animal groups of common ancestry living in similar habitats of different continents. Examples are
Marsupial mammals in Australia show parallel evolution as they have evolved from placental mammals. All these closely resemble and look similar to a corresponding marsupial.
Few examples are mentioned in the page 134 of NCERT fig: 7.7
Convergent evolution is development of similar adaptive functional structures in unrelated groups of organisms. Examples are:
(i) Wings of insect, bird and bat.
(ii) Spiny anteater and scaly anteater belong to different orders of class-Mammalia. They have acquired similar adaptations for food, e.g. leg ants, termites and insects.

Lamarck had said that evolution of life forms had occurred but driven by use and disuse of organs. Lamarck gave the example of Giraffes who in an attempt to forage leaves on tall trees had to adapt by elongation of their necks and they passed on this acquired character of elongated neck to succeeding generations.
Giraffe, slowly over the years came to acquire long necks.

<u>Darwin's theory of evolution</u>
The essence of Darwinian Theory about evolution is natural selection.
Natural selection is based on certain observations which are factual.

1. Population size grows exponentially if all organisms reproduced maximally (this fact can be seen in a growing bacterial population) and the fact that population sizes in reality are limited, means that there had been competition for resources.
2. Any population has built in variation in characteristics.
3. Those variations, which are heritable and which make resource utilisation better for few (adapted to habitat better) will enable only those to reproduce and leave more progeny. This is referred to as fitness of the individual or population. (reproductive fitness)
4. Hence, those who are better fit in an environment, leave more progeny than others. These, therefore, will survive more and hence are selected by nature. - natural selection
5. Over many generations, survivors will leave more progeny and there would be a change in population characteristic and hence new forms appear to arise.

Interpretations
The rate of appearance of new forms is linked to the life cycle or the life span.
Nature selects for fitness. Fitness is based on characteristics which are inherited. Hence there is genetic basis for getting selected and to evolve.
Some organisms are better adapted to survive in an otherwise hostile environment.

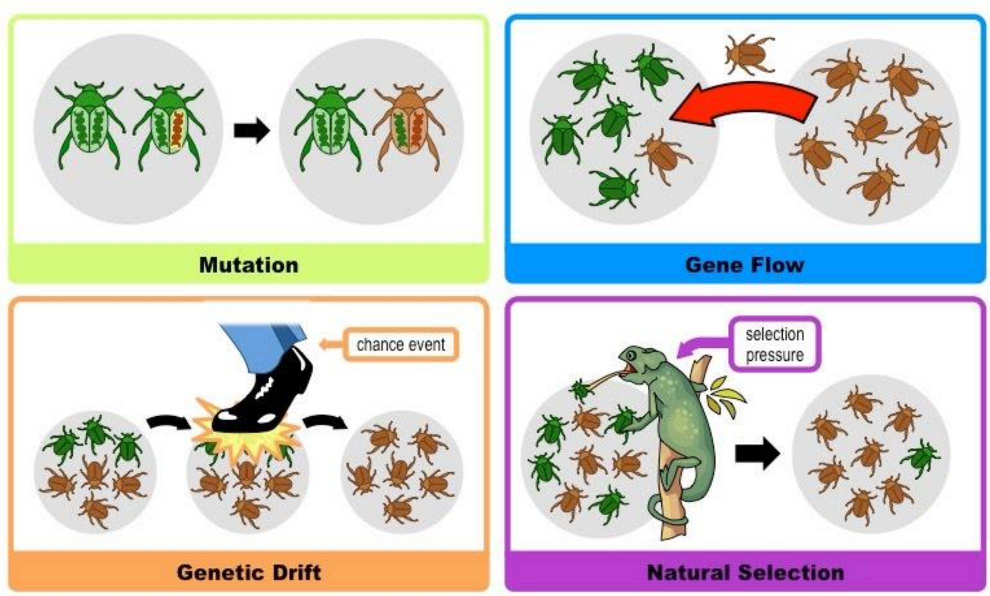
Adaptive ability is inherited and it has genetic basis.
Fitness is the end result of the ability to adapt and get selected by nature.
Branching descent and natural selection are the two key concept of Darwinian Theory of evolution.

Mechanism of evolution
Evolution for Darwin was gradual and was due to variations which were small and directional.
Evolution according to Hugo de Vries was due to mutations that are random and directionless changes

Synthetic theory of evolution states that the origin of species is based on the interaction of genetic variation and natural selection

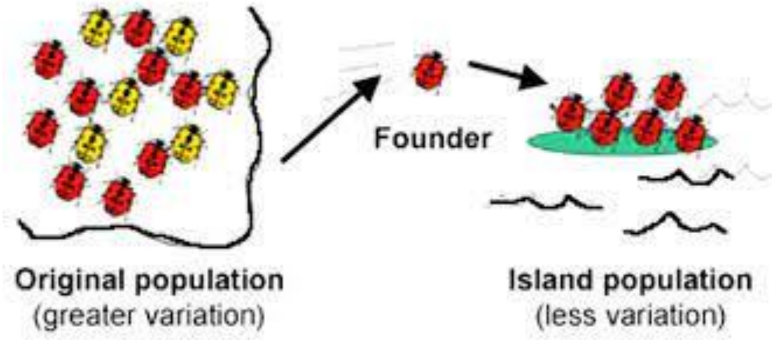
HARDY- WEINBERG PRINCIPLE

Hardy- Weinberg principle is also called genetic equilibrium.
Allele frequency remains constant from generation to generation. The gene pool (total genes and their alleles in a population) remains a constant and is stable, this is called genetic equilibrium.
Sum total of all allelic frequencies is 1
Consider two alleles of a gene as A and a
individual frequencies can be named as p, q.
In diploids, the frequency of AA is $p^{2,}$
aa is q^2 and of
Aa is 2pq.
Hence, the formula is $p^2 + 2pq + q^{2.} = 1$which is a binomial expansion of $(p+q)^2$ which can be applied to any population to find out the gene frequency.
Disturbance in genetic equilibrium, or Hardy- Weinberg equilibrium, i.e., change of frequency of alleles in a population would be interpreted as resulting in evolution.
When frequency measured differs from expected value, the difference indicates the extent of evolutionary change.
Factors affecting Hardy- Weinberg principle are



Gene flow –
The transfer of section of population to another place resulting in a change in gene frequencies in both old and new population is called gene flow.
New genes and alleles are added to new population which are genetically different but can interbreed.
Genetic drift-
The random change in gene frequency occurs by chance is called genetic drift.
Sometimes, the change in allelic frequency is so different in the new population, that they become a

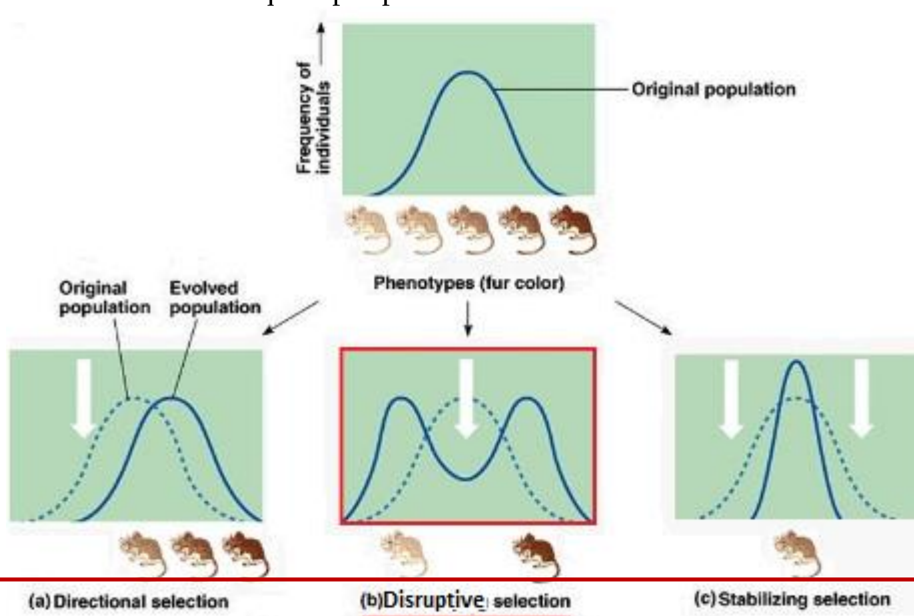
different species and the original drifted population becomes founders hence the effect is called founder effect.



Mutation-
The spontaneous change in the genetic makeup of an individual is called mutation.
Pre-existing advantageous mutations when selected will result in observation of new phenotypes and over few generations this would result in
Genetic recombination-
Exchange of genes between non sister chromatids of homologous chromosomes during gametogenesis is called genetic recombination.
Variation due to recombination during gametogenesis, or due to gene flow or genetic drift results in changed frequency of genes and alleles in future generation.

Natural selection-
The process by which better adapted individuals with useful variations are selected by nature and leave greater number of progenies is called natural selection.

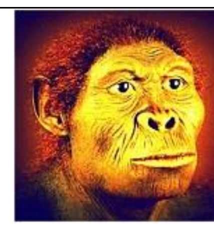
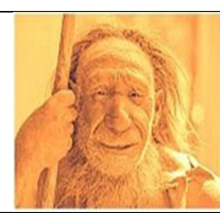
Natural selection can lead to-
Stabilizing selection – Individuals at both the individuals contribute relatively fewer offspring to the next generation than those closer to average phenotype. It reduces the variation but does not change mean value.
Directional selection - individuals at either of the extreme phenotype contribute more offsprings to the next generation, more individuals acquire value other than the mean character value.
Disruptive selection – individuals at both extremes of the distribution contribute more offspring's, more individuals acquire peripheral character value at both ends of the distribution curve.



<table>
<tr><td></td><td colspan="2">A BRIEF ACCOUNT OF EVOLUTION</td></tr>
<tr><td>S.No</td><td>Duration of origin</td><td>Group oforganism</td></tr>
<tr><td>1</td><td>About 2000 million years ago (mya)</td><td>The first cellular forms of life appeared on earth</td></tr>
<tr><td colspan="3">Some cellular forms had the ability to release O_2 and slowly single cell organisms became multicellular organisms.</td></tr>
<tr><td>2</td><td>500 mya</td><td>Invertebrates were formed and active</td></tr>
<tr><td>3</td><td>350 mya</td><td>Jawless fish probably evolved</td></tr>
<tr><td>4</td><td>320 mya</td><td>Sea weeds and few plants probably existed</td></tr>
<tr><td colspan="3">First organisms that invaded land were plants.</td></tr>
<tr><td>5</td><td>350 mya</td><td>Fish with stout and strong fins that could move on land and go back to water</td></tr>
<tr><td colspan="2">Fish with stout and strong fins could move on land and go back to water was about 350 mya.
In 1938, a lobe finned fish caught in South Africa happened to be a Coelacanth which evolved into first amphibians that lived on both land and water and these were the ancestors of modern-day frogs and salamanders</td><td>
Fig. Coelacanth</td></tr>
<tr><td colspan="3">The amphibians evolved into reptiles which lay thick shelled eggs which do not dry up in sun.
The modern-day descendants of reptiles are the turtles, tortoises and crocodiles.
In the next 200 million years or so, reptiles of different shapes and sizes dominated on earth.
Giant ferns (pteridophytes) were present but they all fell to form coal deposits slowly</td></tr>
<tr><td>6</td><td>around 200 mya.</td><td>Some of the reptiles went back into water to evolve into fish like reptiles</td></tr>
<tr><td colspan="2">The land reptiles were the dinosaurs and the biggest of them is Tyrannosaurus rex was about 20 feet in height and had huge fearsome dagger like teeth</td><td></td></tr>
<tr><td>7</td><td>About 65 mya</td><td>the dinosaurs suddenly disappeared from the earth, some of them evolved into birds or might be killed by the climatic changes.</td></tr>
<tr><td colspan="3">The first mammals were like shrews and their fossils were small sized.
Mammals were viviparous and protected their unborn young inside the mother’s body.
Mammals dominated the earth when the population of reptiles came down.</td></tr>
<tr><td colspan="2">Due to continental drift South America joined North America,</td><td>South America animals were overridden by North America by North American fauna.</td></tr>
<tr><td colspan="2">The population of pouched mammals in Australia survived and increased</td><td>lack of competition from any other mammal.</td></tr>
<tr><td colspan="3">Some mammals live wholly in water.
Examples- Whales, dolphins, seals and sea cows</td></tr>
</table>

ORIGIN AND EVOLUTION OF MAN

The stages of evolution of man are-

S.No	Time	Name of Human Ancestor	Characters	
1	15 mya	*Dryopithecus*	Hairy and walked like gorillas and chimpanzees. More ape-like	
2	15 mya	*Ramapithecus*	Hairy and walked like gorillas and chimpanzees. More man-like	
3	3-4 mya	Man like primate (bones have been discovered in Ethiopia and Tanzania)	Probably not taller than 4 feet but walked up right	
4	2 mya	*Australopithecines*	They hunted with stone weapons but essentially ate fruit.	
5		*Homo habilis*	first human-like being the hominid The brain capacities were between 650-800cc. They probably did not eat meat	
6	1.5 mya	*Homo erectus*	brain capacity around 900cc. probably ate meat	
7	1, 00,000-40,000 years back	Neanderthal man	brain size of 1400cc lived in near east and central Asia	
8.	75,000-10,000	Modern *Homo sapiens*	Pre-historic cave art developed about 18,000 years ago Agriculture came around 10,000 years back and human settlements started	

MULTIPLE CHOICE QUESTIONS

1.’The theory of spontaneous generation stated that
(a) life arose from living forms only
(b) life can arise from both living and non-living
(c) life can arise from non-living things only
(d) life arises spontaneously, neither from living nor from the non-living.

2.Animal husbandry and plant breeding programmes are the examples of
(a) reverse evolution
(b) artificial selection
(c) mutation
(d) natural selection.

3.Palaentological evidences for evolution refer to the
(a) development of embryo
(b) homologous organs
(c) fossils
(d) analogous organs.

4.The bones of forelimbs of whale, bat, cheetah and man are similar in structure, because
(a) one organism has given rise to another
(b) they share a common ancestor
(c) they perform the same function.
(d) the have biochemical similarities

5.Analogous organs arise due to
(a) divergent evolution
(b) artificial selection
(c) genetic drift
(d) convergent evolution.

6.$(p+q)^2 = p^2 + 2pq + q^2 = 1$ represents an equation used in
(a) population genetics
(b) Mendelian genetics
(c) Biometrics
(d) molecular genetics.

7.Appearnace of antibiotic-resistant bacteria is an example of
(a) adaptive radiation
(b) transduction
(c) pre-existing variation in the population
(d) divergent evolution.

8.Fossils are generally found in
(a) sedimentary rocks
(b) igneous rocks
(c) metamorphic rocks
(d) any type of rock.

9.Which type of selection is industrial melanism observed in moth, *Biston betularia*?
(a) Stabilising
(b) Directional
(c) Disruptive
(d) Artificial

10'Which of the following is an example for link species?
(a) Lobe fish
(b) Dodo bird
(c) Seaweed
(d) Chimpanzee

11.Variations during mutations of meiotic recombination are
(a) random and directionless
(b) random and directional
(c) random and small
(d) random small and directional

12.One of the possible early sources of energy was/were
(a) CO_2
(b) chlorophyll
(c) green plants
(d) UV rays and lightning.

13.Abiogenesis theory of origin supports
(a) spontaneous generation
(b) origin of life from blue-green algae
(c) origin of life is due to pre-existing organisms
(d) organic evolution is due to chemical reactions.

14.Who proposed that the first form of the could have come from pre-existing non-living organic molecules?
(a) S.L. Miller
(b) Oparin and Haldane
(c) Charles Darwin
(d) Alfred Wallace

15. Stabilising selection favours
(a) both extreme forms of a trait
(b) intermediate forms of a trait
(c) environmental differences
(d) one extreme form over the other extreme form and over intermediate forms of a trait.

ASSERTION REASON QUESTIONS

Directions: In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as:
(a) Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Assertion is false and Reason is true.

1) Assertion- Darwin's finches have different types of modified beaks according to their feeding habits.
   Reason- Adaptive radiation leads to development of structures with different function arising from a common ancestor.
2) Assertion -Hardy Weinberg principle explains the occurrence of variation in population and species.
   Reason- It concludes that disturbances in genetic equilibrium results in evolution.
3) Assertion - Among the primates, chimpanzee is the closest relative of the present-day humans.
   Reason -DNA matching shows that human similarity is 100% with chimpanzee.
4) Assertion Disruptive selection changes the population into two or more groups.
   Reason -This type of selection favours average sized individuals.
5) Assertion- Wings of butterfly and bat show analogy.
   Reason- Analogous organs are anatomically different but functionally similar.
6) Assertion -Theory of Biogenesis explains that life arises from pre-existing life.
   Reason- Louis Pasteur finally disapproved the theory of spontaneous generation of life.

SHORT ANSWER TYPE (2M,3M)

1.Why is Archaeopteryx called a connecting link between reptiles and birds? (2M)

2.Why are wings of a butterfly and of a bat called analogous? (2M)

3.How is artificial selection different from natural selection? (2M)

4.Consider a thorn in Bougainvillea and a tendril in Cucurbita. Are these two organs homologous or analogous? Give reason. (2M)

5.What are vestigial organs? Give examples. Write significance of vestigial organs. (2M)

6. State the theory of abiogenesis. How does miller's experiment support this theory? (3M)

7. Evolution is the change of gene frequencies in a population in response to changes in environment in the time scale of years and not centuries. Justify the statement with reference to DDT. How does the theory of Hugo de varies support this? (3M)

8. How did Darwin theory of natural selection explain the appearance of new forms on the earth? (3M)

9.Explain how natural selection has worked on population of peppered moth in industrial area of England. (3M)

10.Define genetic drift. How does it produce founder effect and genetic bottleneck?

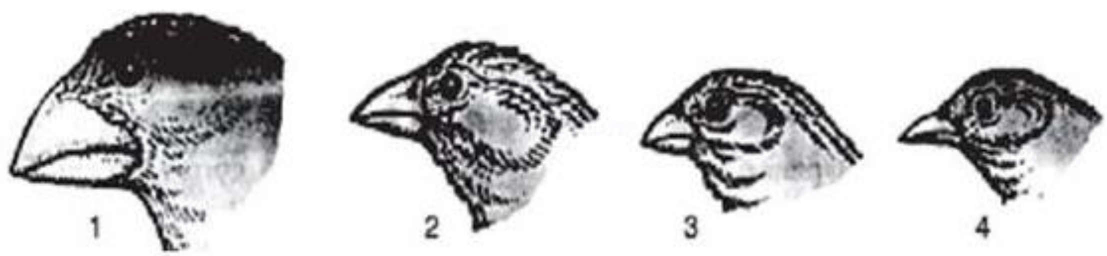
11. State and explain any three factors affecting allele frequency in populations.

12. You have studied the story of Pepper moths in England. Had the industries been removed, what impact could it have on the moth population? Discuss.

13. 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.

14. **S**tanley 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.

15 Figures given below are of Darwin's finches?



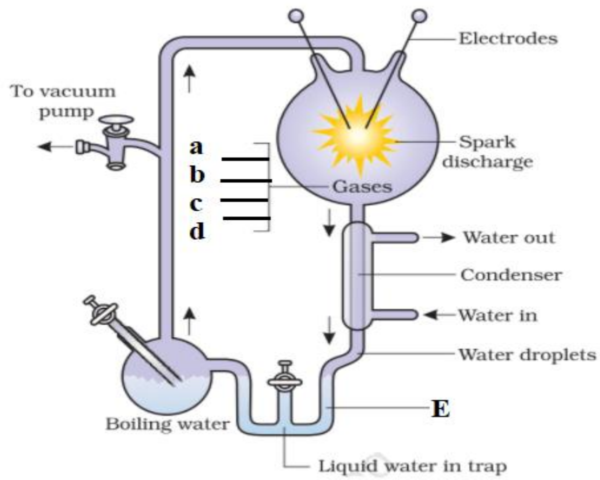
Variety of beaks of Darwin's finches.
(a) Mention the specific geographical area where these were found.
(b) Name and explain the phenomenon that has resulted in the evolution of such diverse species in the region.
(c) How did Darwin visit the particular geographical area?

LONG ANSWER QUESTIONS -5M

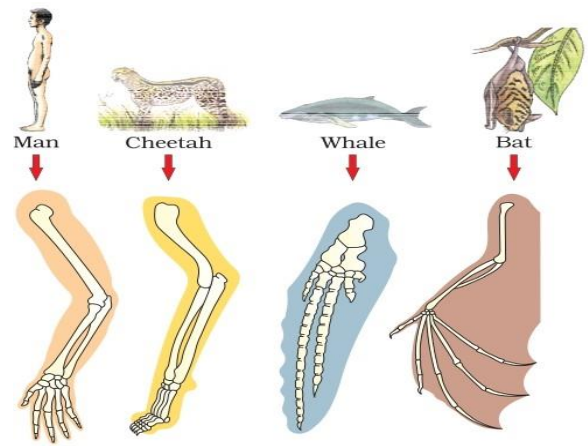
1. Based on the experiment conducted by Miller in 1953 , answer the following questions:
   a. Which gases were used in the experiment?
   b. What was the purpose of the electrodes in the flask?
   c. What was their observation?
   d. What did they conclude?
2. Study of light & dark winged moths in England between1850 to 1920 revealed a phenomenon.
   a. Name the phenomenon.
   b. What statistics regarding the number of moths was observed? Compare.
   c. What explanation was given for these observations?
   d. List another characteristic example of evolution by anthropogenic action.
3. How does Hardy –Weinberg equation explain genetic equilibrium? Describe how this equilibrium gets disturbed leading to founder effect?

DIAGRAM BASED QUESTIONS

1. Observe the given diagram and answer the questions.
   i) Label the gases marked as a,b,c and d.
   ii) Mention the nature of the content marked as E
   iii) Write on the conclusion of this experiment.

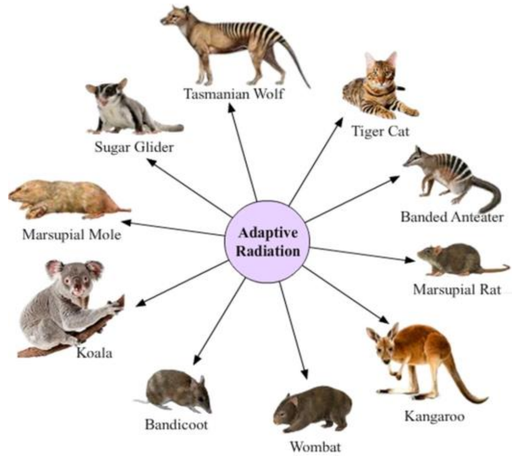


2. Observe the forelimbs in the following animals. What kind of organs they represent, in evolutionary context? What kind of evolution resulted in these organs?

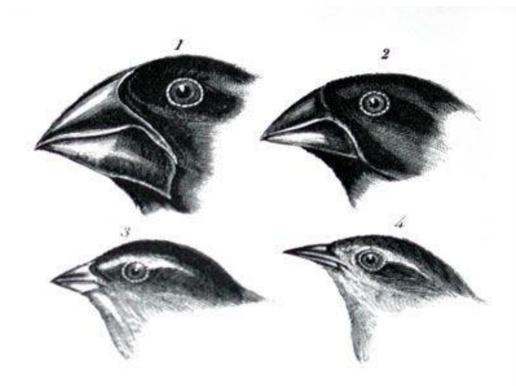


3. Observe the given diagram. Explain the evolutionary process which is considered as a classic example of natural selection

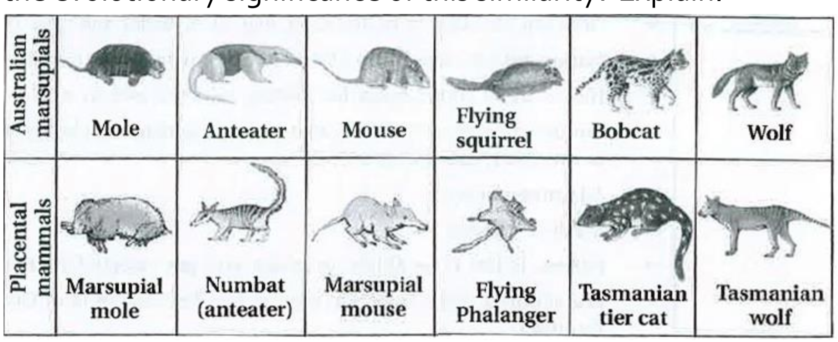
4. The picture is a representation of adaptive radiation of marsupials in Australia. What is meant by adaptive radiation? Cite any other example for the same



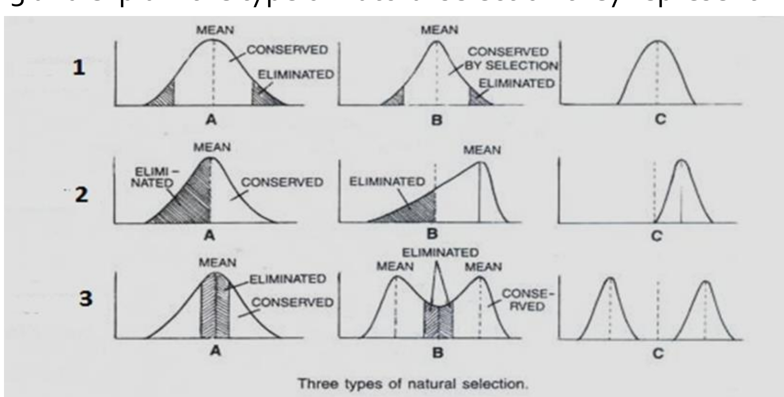
5. The picture represents the observation of Darwin in Galapagos Island. What did he observe in these birds? What was the conclusion from his observation?



6. Australian marsupials and placentals show remarkable similarity in their appearance. What is the evolutionary significance of this similarity? Explain.

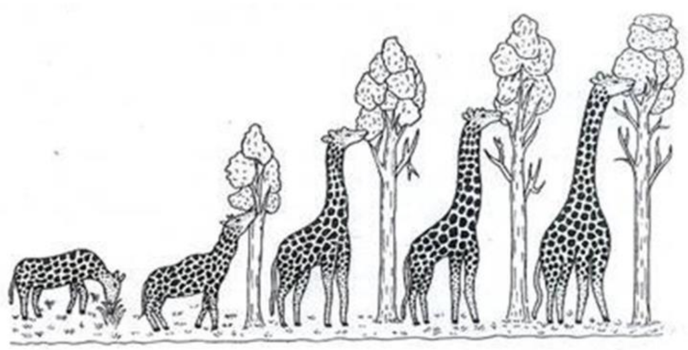


7. The given picture is a representation of three types of natural selection. Observe the figures 1,2 and 3 and explain the type of natural selection they represent.

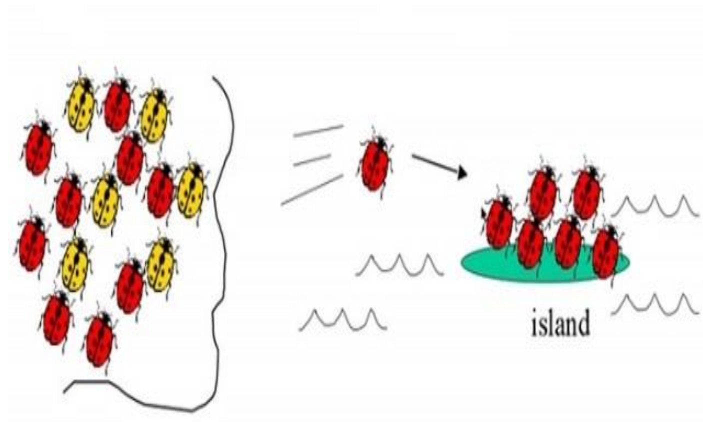


Three types of natural selection.

8. Study the diagram and comment upon the theory of evolution that is illustrated here.



9. The picture represents a factor which can affect Hardy- Weinberg equilibrium. Name and explain the evolutionary process?



ANSWERS TO MCQ'S

1. (c) life can arise from non-living things only
2. (b) artificial selection
3. (c) fossils
4. (b) they share a common ancestor
5. (d) convergent evolution
6. (a) population genetics
7. (c) pre-existing variation in the population
8. (a) sedimentary rocks
9. (b) Directional
10. (a) Lobe fish
11. (a) random and directionless
12. (d) UV rays and lightning
13. (a) spontaneous generation
14. (b) Oparin and Haldane
15. (b) intermediate forms of a trait

ANSWERS TO ASSERTION REASON QUESTIONS

1) (a) 2) (d) 3) (a) 4) (c) 5) (a) 6) (b)

ANSWERS TO SHORT ANSWER QUESTIONS

1.***Archaeopteryx*** is a bird as it has feathers and a beak. But like reptiles it has a long tail, jaws full of teeth claws on fore fingers and keelless sternum. Thus it represents a stage between reptiles and birds through *Archaeopteryx* like intermediate form.

2.They are analogous organs due to the fact that the basic structure of wing of insects is different from the wings of a bird. However, their function is similar. Analogous organs are result of convergent evolution.

3.

ARTIFICIAL SELECTION	NATURAL SELECTION
It is selection by man	Selection is through nature
Variants suited to human requirement are selected by man.	Variants are adapted to the environment are able to thrive better.

4.Thorn in Bougainvillea and tendril in Cucurbita are homologous organs as both are stem modifications.

5.Vestigial organs are non-functional organs in an organism which are functional in related animals and were functional in the ancestors. There are 90 vestigial organs in human body and mainly include coccyx (tail bone), nictitating membrane (3^{rd} eyelid), caecum and vermiform appendix, canines, wisdom teeth, body hair, auricular muscles. Vestigial organs are also present in some other animals eg: splint bones in horse, hindlimbs and pelvic girdles in python, wings and feathers in flightless birds etc.

Significance of vestigial organs:

(I)Vestigial organs were functional in the ancestral forms but have become nonfunctional due to changes in their function and may finally disappear. So, the presence of vestigial organs is convincing evidence of organic evolution and is supported by Lamarck's Theory of use and disuse of organs.

6. Theory of chemical evolution of abiogenesis was proposed by Operon and Haldane.

It states that the first form of life could have come from pre-existing non-living organic

molecules like RNA's etc., and that and that formation of life was preceded by chemical

evolution, i.e. Formation of diverse organic molecules from in organic constituents.

7. As the environment changes the organism which are better adapted to the changed

environment could survive better and reproduce.

- When DDT was used, initially most of the mosquitoes died, but a few survived.

-These few mosquitoes reproduce and their off springs were also resistant to DDT.

- Today, the population of mosquitoes mostly contains DDT resistance mosquitoes.

- The DDT resistant mosquitoes have evolved in a time scale of years or months and not centuries.

- So, evolution is a direct process but stochastic process based on chance mutation and chance events.

- According to Hugo de Varies, evolution occurs due to mutations. Large differences

arising suddenly in a population.

- According to him large, single-step mutation, called saltation, must have been the

cause of DDT- resistance in mosquitoes.

8**. Darwin's theory of Natural selection:**

Any population has built in variation for every character.

Individuals with those characters which enable them to survive better would outbreed the others, who are less adapted.

Fitness, according to Darwin's is reproductive fitness, i.e., individuals who are better fit in an environment leaves more progeny than others.

These progenies now comes to possess more fit individuals, i.e., nature selects the better fit individuals and over a long period of time, through a number of generations, the population slowly becomes modified into a different form, or a species, which is called evolution.

9.**Industrial melanism**: It is an example of natural selection shown by peppered moth *Biston betularia*. The moth had a dull grey coloured body before industrial revolution in England. The colour of moth enabled it to adapt to the light-coloured background. After the industrial revolution the environment changed with the deposition of tar soot. As a result, light coloured species of moth disappeared but a new black coloured moth *Biston carbonaria* a dominant mutant appeared within a couple of hundred years. The change enabled the animal to adjust with the changed environment.

However, with the replacement of coal and petroleum by gas and electricity the situation has changed once again and the grey form has become abundant with a sharp decline in the number of black. The reason being the decrease in pollution and restoration of grey colour of the lichens on the tree trunk which provide safety to the grey form and exposes the black one to predator. Thus industrial melanism is an interesting example of evidence in favour of natural selection.

10.Random change occurring in the allele frequency by chance alone are called genetic drift.

Founder effect: When a population gets separated from the existing population, it becomes founder of new population. This is called **the founder effect** which is the result of genetic drift ie by chance.

Genetic bottle neck: When in a season the one population died leaving few individuals of the population which become the founder of new population then it will produce only few genes by selection only ie by chance new population is emerged and it is similar to a bottle in which only certain population is allowed to flow as in neck of bottle.

11. 1. Gene migration or gene flow – it is the movement of alleles into a gene pool or out of a gene pool.

2. Genetic drift – If the movement of alleles into a gene pool or out of a gene pool takes place by chance is called Genetic Drift.

3. Mutation – It is the large difference arising suddenly in a population, they are random and occur in all directions.

12. The story of Pepper moths in England happened because, in the post industrialisation period, the lichens did not survive due to increased pollution. Soot covered the tree trunks making them dark. Now, had the industries be removed, the pollution level would have gone down, allowing lichen to grow back and the number of white-winged moths would have gone up again.

13. **(i)** Homology **(ii)** Analogy **(iii)** Analogy **(iv)** Analogy **(v)** Analogy **(vi)** Homology

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

15.(a) Galapagos Island.
(b) Adaptive radiation – The process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation.

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

ANSWERS TO LONG ANSWER QUESTIONS

1. a. gases used were methane, ammonia, hydrogen & water vapour

b. electrodes were used to produce electric discharge, similar to the lightening that occurred on primitive earth, which provided energy for chemical evolution on earth.

c. They observed the formation of biomolecules like amino acids

d. They concluded that the first forms of life arose slowly through evolutionary forces from non – living molecules.

2. a. Industrial melanism

b. Lighter moths were more in number in the pre industrial revolution period & melanic moths were more in the post-industrial revolution period

c. During the pre –industrial period, there was hardly any air pollution, lichens thrived & light winged moths were not spotted by predators & they survived.

In the post industrialization period, pollution increased, carbon particles were deposited on tree trunks & the white moths were easily spotted by their predators & hence their numbers decreased

e. Use of pesticides that led to the evolution of resistant varieties of insect pests
Use of antibiotics that led to the evolution of resistant bacteria

3. The Hardy-Weinberg equilibrium is a principle stating that the genetic variation in a population will remain constant from one generation to the next in the absence of disturbing factors.

The Hardy-Weinberg equation used to determine genotype frequencies is: $\mathbf{p^2 + 2pq + q^2 = 1}$. Where '$p^2$' represents the frequency of the homozygous dominant genotype (AA), '2pq' the frequency of the heterozygous genotype (Aa) and 'q^2' the frequency of the homozygous recessive genotype (aa). The conditions to maintain the Hardy-Weinberg equilibrium are: no mutation, no gene flow, large population size, random mating, and no natural selection. The Hardy-Weinberg equilibrium can be disrupted by deviations from any of its five main underlying conditions

The equilibrium gets disturbed due to genetic drift which refers to the changes in allele frequencies of a population occurring by chance. The change in allele frequency may be so different that the population becomes a different species, the original population becomes founders and such an effect is called founder effect

ANSWERS TO DIAGRAM BASED QUESTIONS

1. i. a. CH4 b. NH3 c.H2O d. H2 (The order of gases may interchange)

ii. E is the condensed liquid which contains organic molecules like amino acids.

iii. The experiment proves some of the steps suggested by chemical evolution theory of Oparin and Haldane. The formation of organic compounds from primitive gases was proved in the experiment.

2. These organs represent Homologous organs. Homologous organs are organs with same basic structure and origin but different appearance and function. All these organs have same kind of bones like humerus, radius, ulna, carpals, metacarpals and phalanges but have different appearance due to different functions they perform. Homologous organs are resulted from divergent evolution.

3. The diagram is a representation of Industrial melanism which is considered as a classic example of evolution by natural selection. It explains the evolution of dark coloured body by some organisms in response to the pollution caused by industrialization. The black-coloured body was selected by nature as it was easily blending with the dark background caused by excessive carbon emission from various industries.

4. Adaptive radiation is the rapid diversification of a single species into many species

that inhabit a variety of environments or use a variety of resources. Evolution of placentals in Australia, evolution of Darwin finches is also considered as examples for adaptive radiation.

5. These birds are Darwin's finches. Darwin observed that there were many varieties of

finches in the same island. All the varieties he came across had evolved on the island itself. They were originally adapted with seed-eating features. From these many other forms evolved with altered beaks depending on the food habit. This enabled them to become insectivorous, vegetarian finches etc. The evolution of Darwin's finches is considered as an example for adaptive radiation. The observation also helped Darwin to form his theory of natural selection.

6. The diagram represents convergent evolution of Australian marsupials and Australian placentals. The independent evolution of Australian marsupials is an example of adaptive radiation. Evolution of Australian placentals also considered as an example for adaptive radiation. If more than one adaptive radiation takes place in an isolated geographic area, it is considered as an example of convergent evolution. Convergent evolution is the independent evolution of similar features or traits in unrelated species to suit with similar environmental needs.

7. The diagram is a representation of three types of natural selection.

1. Stabilizing selection.: a type of natural selection in which genetic diversity decreases as the population stabilizes on a particular trait value. If natural selection favours an average phenotype by selecting against extreme variation, the population will undergo stabilizing selection.

2. Directional selection. a mode of natural selection in which a single phenotype is favoured, causing the allele frequency to continuously shift in one direction. When the environment changes, populations will often undergo directional selection, which selects for phenotypes at one end of the spectrum of existing variation.

3. Disruptive / Diversifying selection. Both extreme phenotypes are more fit than those in the intermediate phenotypes. Sometimes natural selection can select for two or more distinct phenotypes that each have their advantages. This type of selection often drives speciation.

8. The diagram illustrates the theory of inheritance of acquired characteristics, commonly referred to as Lamarckism as it was suggested by the naturalist, Jean Lamarck. This idea states that modifications in an individual are caused by its environment, or the use or disuse of a structure during its lifetime, and that these

changes can be inherited by its offspring, bringing about change in a species. According to Lamarckism, the ancestors of giraffe had small neck and forelimbs. They were residing in places with no surface vegetation, therefore, they had to stretch their neck and forelimbs to take the leaves for food. The longnecked giraffes evolved because of stretching of necks over many generations by short necked giraffes.

10. The diagram represents Genetic drift. Genetic drift is the change in the frequency of an allele in a population due to random sampling (random selection). Genetic drift occurs in all populations but its effects are strongest in small populations. Genetic drift includes the founder effect. The founder effect occurs when a portion of the population (i.e., “founders”) separates from the old population to start a new population with different allele frequencies

Contributions

1. *Ms. Vidya Unnikrishnan*

PGT Biology

K V Ottapalam

2. *Ms Bindu*

PGT Biology

K V Ottapalam

3. *Ms.Sreekala Ravindran*

PGT Biology

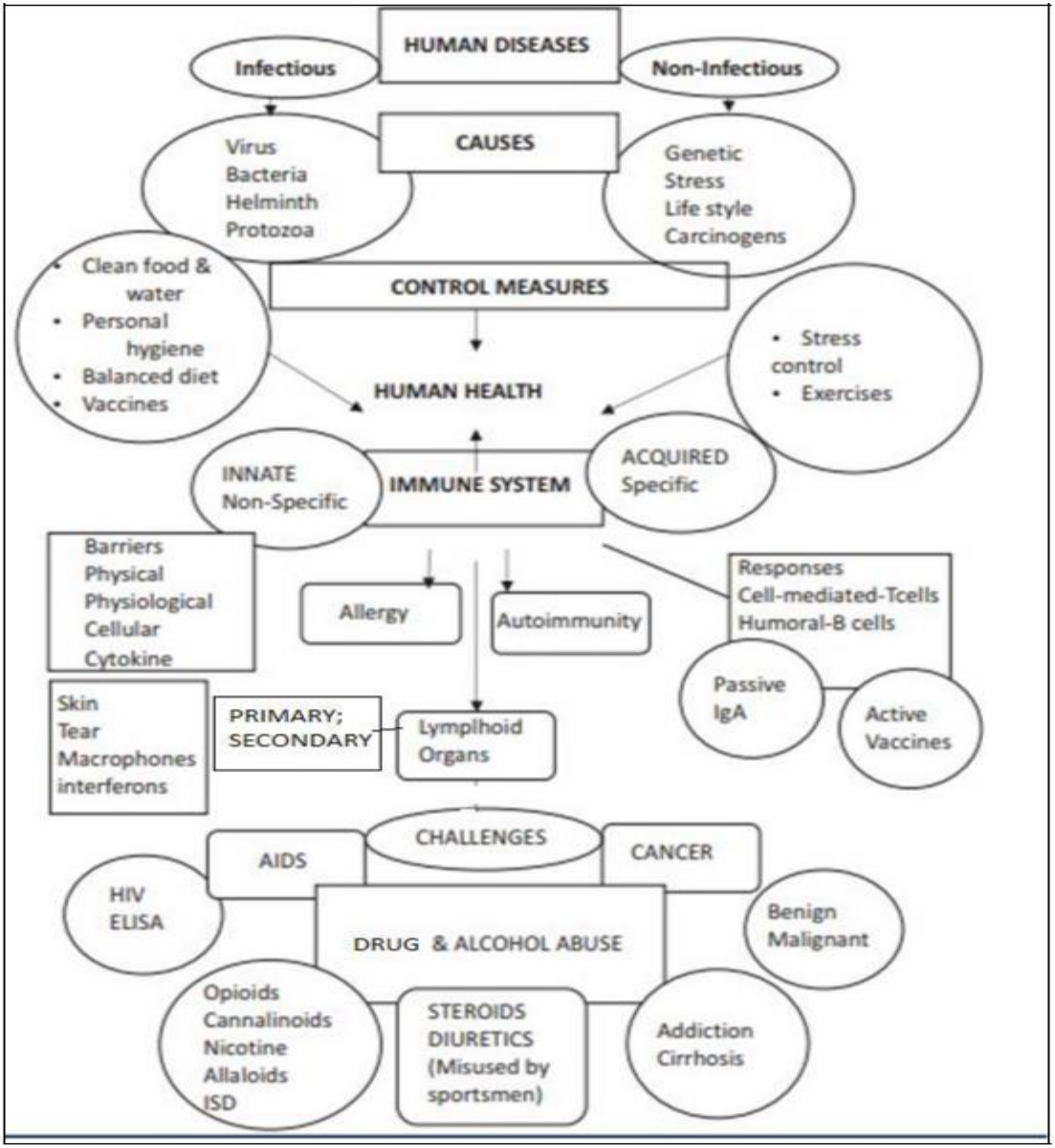
K V Ramavarmapuram

4. *Mr Jafar Sadik K*
   PGT Biology
   K V NAD Aluva

CHAPTER 8

HUMAN HEALTH AND DISEASES

CONCEPT MAP



COMMON DISEASES IN HUMANS:

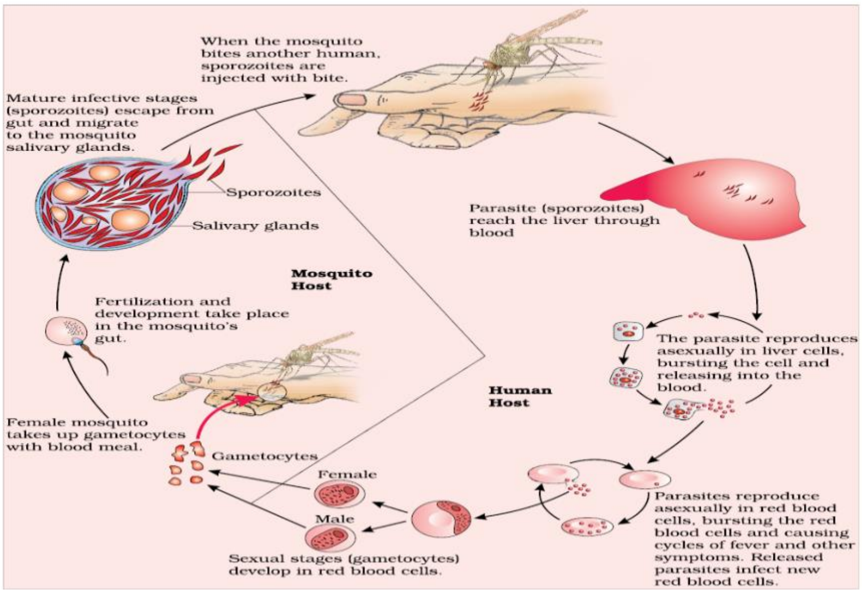
NAME OF DISEASE	CAUSATIVE ORGANISM	MODE OF TRANSMISSION	SYMPTOMS
TYPHOID	*Salmonella typhi*	Contaminated food and water	Fever(39 to 40 c),weakness, stomach pain, constipation, headache, loss of appetite
PNEUMONIA	*Stretococcus pneumoniae, Haemophilus influenzae*	Inhaling the droplets/aerosols released by an infected person or sharing glasses and utensils with n infected person	Fever, chills, cough, headache. In severe cases the lips and finger nails turn gray to bluish in color
COMMON COLD	*RHINO* VIRUSES	Droplets resulting from cough or sneezes of an infected person are either inhaled directly or transmitted through contaminated objects such as pens, books, cups, door knobs, etc.	Nasal congestion and discharge, sore throat, hoarseness, cough, headache, tiredness, etc. which lasts for 3-7 days
MALARIA	*Plasmodium vivax, P.falciparum, P.ovale, P.malaria*	By female Anopheles mosquito bite	Chill, high fever recurring every 3-4 days due to rupture of RBC Heamozoin released blood
AMOEBIASIS (AMOEBIC DYSENTRY)	*Entamoeba histolytica*	Houseflies act as mechanical carriers. Drinking water and food contaminated by faecal matter are the main source of infection	Constipation, abdominal pain and cramps, stools with excess mucous and blood clots

ASCARIASIS	*Ascaris lumbricoides*	By consuming contaminated water, vegetables, fruits, etc.	Internal bleeding, muscular pain, fever, anemia & blockage of internal passage
ELEPHANTIASES, FILARIASIS	*Wuchereria bancrofti, Wuchereia malayi*	Through the bit by the female *Culex* mosquito.	The filarial worm lives in lymphatic vessels for several years. Chronic inflammation of organs, specially lower limbs, genital organs affected
RINGWORMS	*Microsporum, Trichophyton, Epidermophyton*	They are acquired from soil or by using towels, clothes or even the comb of infected individuals.	Appearance of dry, scaly lesions on various parts of the body such as skin nails and scalp. The lesions are accompanied by intense itching heat and moisture help these fungi to grow, which make them thrive in skin folds such as those in the groin or between the toes

DENGUE	*Dengue virus*	is transmitted by the bite of *Aedes aegypti* caused by the dengue virus.	severe joint and muscle pain, swollen lymph nodes, headache, fever, exhaustion, and rash. The presence of fever, rash, and headache (the "dengue triad") is characteristic of dengue fever.
CHIKUNGUNYA	Chikungunya virus	Transmitted by two species of mosquito of the genus *Aedes*: *A. albopictus* and *A. aegypti*. Animal reservoirs of the virus include monkeys, birds, cattle, and rodents.	the symptoms of Chikangunaya are fever, arthritis, headache, chills, etc.

Life cycle of plasmodium:

Plasmodium enters the human body as small sporozoites through the bite of infected female anopheles mosquito and multiplies within the lever cells. Later attacks the RBCs resulting the rapture with release of toxic substance, haemozoin, which is responsible for high fever and chill recurring every three to four days. Malarial parasite requires two hosts, human and anopheles mosquito to complete their life cycle. Female anopheles is vector of this disease to human beings.



II. **IMMUNITY**:

- Ability of the host to fight the disease-causing organisms, conferred by the immune system is called immunity.

- **Innate Immunity:**

Innate immunity is a non-specific ***type*** of defense, -present at the time of birth. Innate immunity consists of **four types** of barriers. These are —

a. Physical barrier- skin, mucus coating of epithelium lining the respiratory, gastrointestinal and urogenital tract.

b. Physiological barrier- acid in stomach and saliva in mouth.

c. Cellular barrier- leucocytes, neutrophils, monocytes.

d. Cytokine barriers- virus infected cells secrete protein called interferon.

- **Acquired Immunity**
  - Pathogen specific defence characterised by memory.
  - When our body encounters a pathogen first time produces a response called primary response of low intensity. Subsequent encounter by same pathogen produce highly

    intensified response called secondary response or anamnestic response due to memory of first encounter.
  - Primary and secondary responses are carried out with the help of B-lymphocytes and T-lymphocytes. B-lymphocytes produce army of protein called antibodies each having two light and two heavy chains.

- B lymphocytes: Show humoral immune response (HI)
- T lymphocytes: Show cell mediated immunity (CMI)

- B-lymphocytes produce an 'army' of proteins called antibodies Immunoglobins or γ - globulins) to fight pathogens in our blood.

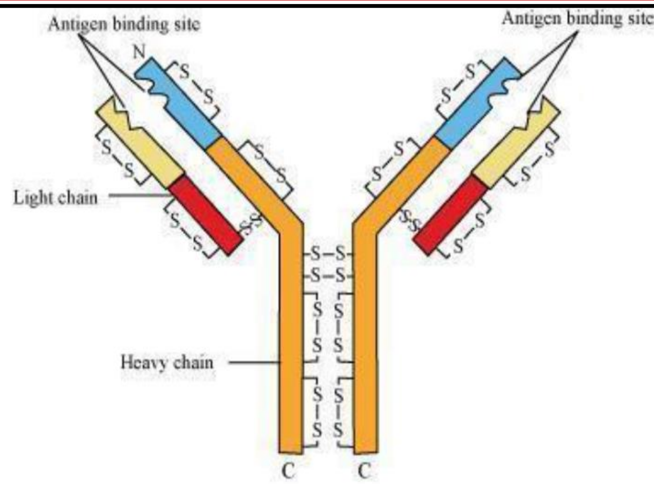
- The T-cells themselves do not secrete antibodies -but 'help' B cells to produce them. Each antibody molecule has four peptide chains -<u>two</u> are <u>small peptide chains</u> called light chains and <u>two</u> are <u>longer peptide chains</u> called heavy chains. Represented as H_2L_2.

- Different types of antibodies are produced in our body. IgG, IgE, IgD, IgM and IgA are some of them.
- As these antibodies are found in the blood, the response is also called as Humoral Immune response. This is one of the two types of our acquired immune response – Antibody Mediated response.
- The second type is called Cell-Mediated Immune response or cell-mediated immunity (CMI).
- The T-lymphocytes mediate CMI – 'Tissue/ Organ Rejection'. Grafts from just anysource

  – an animal, another primate, or any human beings cannot be made since the grafts would be rejected.

- Tissue matching and blood group matching -essential before undertaking any graft/transplant -and even after this, the patient has to take immuno– suppressants all his/her life -else the patient's life may deteriorate.

- The body is able to differentiate 'self' and 'oneself' and the cell-mediated immune response is responsible for the graft rejection.



Structure of an antibody molecule

- **Active and Passive Immunity:**

Antigens (**"*Antibody generating*"**) **-**may be in the form of living or dead microbes or other proteins, - 'Antibodies' are produced in the host body in response to the antigen that has entered the host body produces

Active Immunity:

When the host body produces Antibodies in response to Antigens entering the host body. ❖ Active immunity is slow.

❖ It takes time to give its full effective response.

❖ Injecting microbes deliberately during immunization or infectious organisms entering the body -during natural infection induce 'active immunity'.

Passive Immunity:

'Ready-made antibodies' (*pre-formed antibodies* or *antibodies produced by other animals*) - directly injected into our body to protect our body against foreign pathogenic agents it is called passive immunity.

Give reason as to why breast feeding is very important to an infant than weaning the infant on artificial substitute? *Why is mother's milk is considered very essential for the new born infant*?

- The yellowish fluid colostrum secreted by mother during the initial days of lactation has abundant antibodies (IgA) to protect the infant from many diseases.

- The foetus also receives some antibodies from their mother, through the Placenta (IgG) during pregnancy.

- **Vaccination and Immunization:**

  - It is based on the property of 'memory' of the immune system.

  - A vaccine is a preparation of antigenic proteins of pathogen or inactivated/weakened pathogen introduced into the body.

- The antibodies produced in the body by the host (active immunity) against these antigens, would neutralize the pathogenic agents during actual infection.

- The vaccines also generate memory – B and T-cells that recognise the pathogen quickly on subsequent exposure and overwhelm the invaders with a massive production of antibodies.

- It has been made possible to prepare -in large quantities, the antigenic polypeptides of pathogens, by cloning those genes of the pathogen, in bacteria or yeast (‘*suitable hosts*’ for gene transfer during rDNA technique). Vaccines are produced in a large scale and hence easily available for immunization, e.g., hepatitis B vaccine produced with the help of yeast.

- **ALLERGIES:**

▪ **Allergy** -an exaggerated response of the immune system to certain antigens present in the environment.

▪ **Allergens** -anything that causes allergic/ immune response - pollen, mites, food, dust, animal dander, etc.

▪ The antibodies produced to these are of IgE type.

▪ Allergy is due to the release of chemicals like histamine and serotonin from the mast cells.

▪ Determining the cause of allergy:

Use of drugs -anti-histamine, adrenalin and steroids quickly reduce the symptoms of allergy.

Auto Immunity:

Memory-based acquired immunity -based on the ability to differentiate foreign organisms (e.g., pathogens) from ‘self-cells’.

Rheumatoid arthritis is an auto-immune disease.

\

Immune System in the Body:

Components of our Immune system:

● Lymphoid organs -Bone marrow, Thymus, Spleen, Tonsil. ● Tissues -Lymph nodes, mucous membranes,

● Cells -Macrophages and

● Soluble molecules -Antibodies.

Lymphoid organs: Are the organs where origin and/or maturation and proliferation of lymphocytes occur.

Primary lymphoid organs –
❖ **Bone marrow** and **Thymus.**

- Here, immature lymphocytes differentiate into antigen-sensitive lymphocytes.

Secondary lymphoid organs –

❖ Spleen, lymph nodes, tonsils, Peyer's patches of small intestine and appendix.

- The bone marrow -main lymphoid organ = all blood cells including lymphocytes are produced.

- The thymus is quite large at the time of birth but keeps reducing in size with age.
- At puberty, thymus reduces to a very small size.

- Both bone-marrow and thymus provide micro-environments for the development and maturation of T-lymphocytes.

- The spleen is a large bean shaped organ. It mainly contains lymphocytes and phagocytes.
- Spleen filters blood by trapping blood-borne microorganisms.
- Spleen also acts as a large reservoir of erythrocytes.

- The lymph nodes are small solid structures located at different points along the lymphatic system.

- Lymph nodes serve to trap micro-organisms or other antigens that enter the lymph.

- Antigens trapped in the lymph nodes are responsible for the activation of lymphocytes present there and cause the immune response.

Mucosa Associated Lymphoid Tissue (**MALT**) -lymphoid tissue located within the lining of the major tracts (respiratory tract, digestive tract and urogenital tract).

● It constitutes about 50 % of the lymphoid tissue in human body.

AIDS:

AIDS =Acquired Immuno Deficiency Syndrome (not a congenital disease).

Causative organism: HIV =Human Immuno deficiency Virus (Retro virus -RNA virus) 'Syndrome' =means a group of symptoms.

(a) sexual contact with infected person

(b) by transfusion of contaminated blood and blood products

(c) by sharing infected needles as in the case of intravenous drug abusers and

(d) From infected mother to her child through placenta.

(i) individuals who have multiple sexual partners

(ii) drug addicts who take drugs intravenously

(iii) individuals who require repeated blood transfusions and

(iv) Children born to an HIV infected mother.

❖ Very important -please note -HIV/AIDS is not spread by mere touch or physical contact.

❖ It spreads only through body fluids.

❖ It is, imperative (of vital importance), that HIV/AIDS infected persons are not isolated from family and society for their physical and psychological well-being.

❖ Time-lag between infection and appearance of AIDS symptoms -varying from a few months to many years (usually 5-10 years).

The virus enters host body and attacks the macrophages.

The viral RNA genome replicates to form 'viral DNA' with the help of the enzyme reverse

transcriptase.

This viral DNA integrates into host cell's DNA and directs the infected cells to produce virus particle.

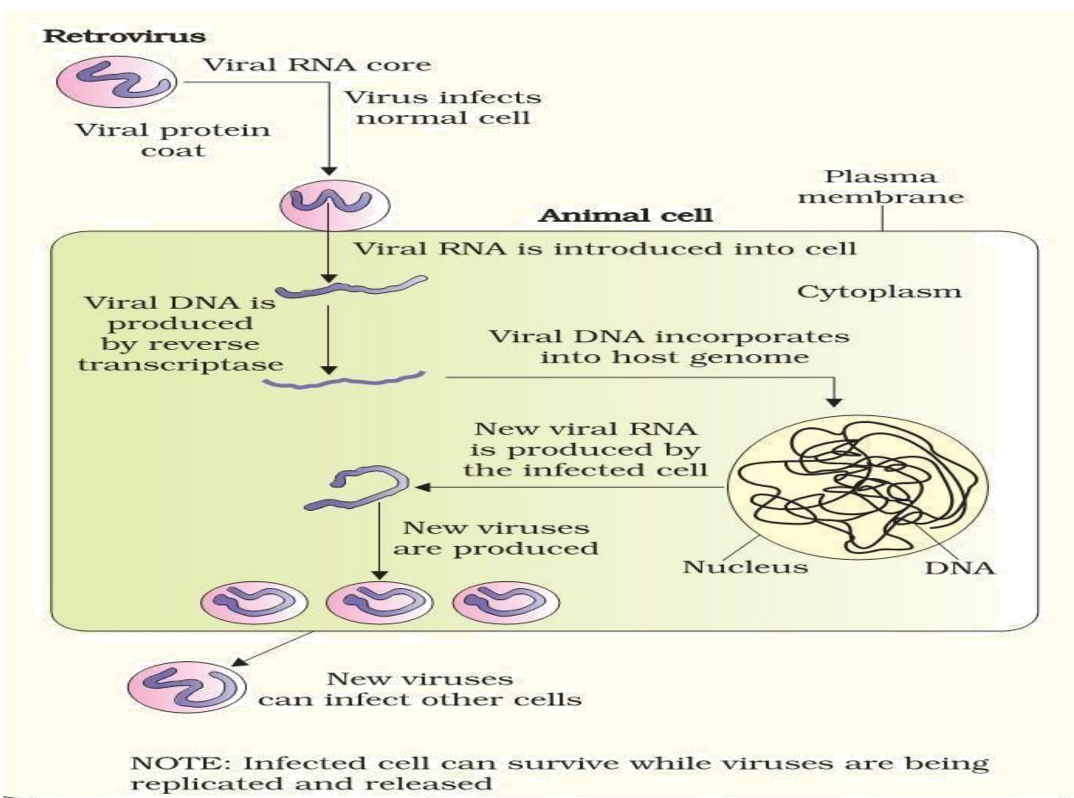


Figure 8.6 Replication of retrovirus

- The macrophages (act as '*HIV factories*') continue to produce more virus.

  Simultaneously, HIV enters helper T-lymphocytes (TH), replicates and produce more viruses.

- The progeny viruses released in the blood attack other helper T-lymphocytes.

- This leads to a progressive decrease in the number of helper T-lymphocytes.

- Now, the person suffers from bouts of fever, diarrhea and weight loss.

- Decrease in the number of helper T lymphocytes, the person starts suffering from infections by bacteria especially *Mycobacterium*, viruses, fungi and even parasites like *Toxoplasma*.

- The patient becomes very much immuno-deficient that he/she is unable to protect himself/herself against these infections.

- Diagnostic test for AIDS is Enzyme Linked Immuno-Sorbent Assay (ELISA). Treatment of AIDS with anti-retroviral drugs is only partially effective. They can only prolonglife of the patient but death inevitable

---

Prevention of AIDS:

AIDS has no cure. Prevention is the best option.

HIV infection, more often, spreads due to conscious behavior patterns and does not happen inadvertently (accidentally) -like pneumonia or typhoid -but in certain it maybe inadvertent (accidental), infection from improperly screened blood products transfused in patients, new-borne (from HIV infected mothers) etc., due to poor monitoring.

The only excuse may be ignorance and it has been rightly said – "don't die of ignorance".

National AIDS Control Organisation (**NACO**) and other non-governmental organization (NGOs) are doing a lot to educate people about AIDS.

A number of Programs (by WHO) to prevent the spreading of HIV infection.

- Making blood (from blood banks) safe from HIV.
- Ensuring the use of only disposable needles and syringes in public and private hospitals and clinics.
- Free distribution of condoms.
- Controlling drug abuse.
- Advocating safe sex and
- Promoting regular check-ups for HIV in susceptible populations.

AIDS/ HIV Infection should not be hidden – as, the infection will spread.

HIV/AIDS-infected people need help and sympathy -do not shun them from society.

III. <u>**CANCER**</u>**:**

Cancer cells -there is breakdown of regulatory mechanisms – ‘contact inhibition’ -which ‘Normal cells’ show.

Cancerous cells just continue to divide giving rise tumors.

Tumors are of **two types:**

Benign Tumor	Malignant Tumor
1. It remains confined to the affected organ.	**1. It also spreads to other organs of the body.**
2. Rate of growth is usually slow.	**2. Rate of growth is usually rapid.**
3. There is no latent stage.	**3. There is latent stage.**
4. It causes limited damage to the body.	**4. The cancer cells migrate to other sites of the body.**
5. There is no metastasis.	**5. There is metastasis.**
6. It is non-cancerous.	**6. It is cancerous.**

<u>**Causes of cancer**</u>**:**

Transformation of normal cells into cancerous neoplastic cells.

Carcinogens -agents that cause cancer.

Carcinogens -physical, **chemical** or **biological** agents.

- Ionising radiations like X-rays and gamma rays and UV (non-ionizing radiations) cause DNA damage leading to neoplastic transformation.
- The chemical carcinogens present in tobacco smoke have been identified as a major cause of lung cancer.
- Cancer causing viruses called oncogenic viruses have genes called viral oncogenes. Several genes called cellular oncogenes (*c-onc*) or proto-oncogenes have been

identified in normal cells get activated under certain conditions, lead to oncogenic transformation of the cells

Cancer detection and diagnosis:

- Cancer detection is based on biopsy and histopathological studies of the tissue and blood and bone marrow tests for increased cell counts in the case of leukemias.

- **What is Biopsy?** - (Histopathological studies) -a piece of the suspected tissue cut into thin sections is stained and examined under microscope by a pathologist.

TECHNIQUES TO DETECT CANCERS OF THE INTERNAL ORGANS:

- **Radiography** (**use of X-rays**).

- **CT** (**computed tomography**) - uses X-rays to generate a three-dimensional image of the internal organs -and

- **MRI** (**Magnetic Resonance Imaging**) - uses strong magnetic fields and non-ionizing radiations to accurately detect pathological and physiological changes in the living tissue.

- Antibodies against cancer-specific antigens are also used for detection of certain cancers.

- Techniques of molecular biology -can be applied to -

  - Detect genes in individuals with inherited susceptibility to certain cancers, which predispose an individual to certain cancers helpful in prevention of cancers.

  - Such individuals -advised to avoid exposure to particular carcinogens to which they are susceptible (e.g., tobacco smoke in case of lung cancer).

Treatment of cancer:

1. Surgical – cancerous tissues are surgically removed.
2. Radiotherapy – tumor cells are irradiated lethally by radiation.
3. Chemotherapy – drugs are used to kill cancerous cells, but shows side effects like hair loss, anaemia, etc.
4. Immunotherapy – patients are given with alpha-interferon which activate their immune system and help in destroying the tumor

IV. <u>DRUGS AND ALCOHOL ABUSE</u>:

NAME OF DRUG	COMMON NAME	SOURCE	EFFECT
OPIODS	Morphine, Smack, (Chemical Name:Diacetyl Morphine)	latex of poppy plant *Papaver somniferum*	Affects CNS, Depressant
CANNABINOIDS	Hashis, Charas, Ganja	inflorescences of the plant *Cannabis sativa*	Affects cardiovascular system
COCA ALKALOID	Cocaine, coke or crack	*Erythroxylum coca*	Interferes with the transport of the neuro-transmitter dopamine. It has a potent stimulating action on central nervous system, producing a sense of euphoria and increased energy. Excessive dosage of cocaine causes hallucinations.

Other well-known plants with hallucinogenic properties are *<u>Atropa belladona</u>* and *<u>Datura</u>*.

DRUGS NORMALLY USED AS MEDICINES.

barbiturates, amphetamines, benzodiazepines, lysergic acid diethyl amides (LSD)

used as medicines to help patients cope with mental illnesses like depression and insomnia, Morphine - effective sedative and painkiller, and is very useful in patients who have undergone surgery

Smoking also paves the way to hard drugs.

- Tobacco is smoked, chewed or used as a snuff.
- Tobacco contains a large number of chemical substances including nicotine, an alkaloid.
- Nicotine stimulates adrenal gland to release adrenaline and nor-adrenaline into blood circulation, both of which raise blood pressure and increase heart rate.
- Smoking is associated with increased incidence of cancers of lung, urinary bladder and throat, bronchitis, emphysema, coronary heart disease, gastric ulcer, etc.
- Tobacco chewing is associated with increased risk of cancer of the oral cavity.

- Smoking increases carbon monoxide (CO) content in blood and reduces the concentration of haem bound oxygen. This causes oxygen deficiency in the body.
- When one buys packets of cigarettes one cannot miss the statutory warning that is present on the packing which warns against smoking and says how it is injurious to health. Yet, smoking is very prevalent in society, both among young and old.

Adolescence and Drug/Alcohol Abuse:

The period between 12-18 years of age may be thought of as adolescence period. In other words, adolescence is a bridge linking childhood and adulthood.

Adolescence is accompanied by several biological and behavioral changes.

Common causes -Curiosity, need for adventure - excitement and experimentation -motivates youngsters towards drug and alcohol use.

A child's natural curiosity motivates him/her to experiment.

Further complications – 'effects' that might be perceived as benefits, of alcohol or drug use. First use of drugs or alcohol may be out of curiosity or experimentation - the child later starts

using these to escape facing problems.

Stress, from pressures to excel in academics or examinations, persuade the youngsters to try alcohol and drugs.

The perception among youth that it is 'cool' or 'progressive' to smoke, use drugs or alcohol - another major cause for youth to start these habits.

Television, movies, newspapers, internet also help to promote this perception.

Unstable or unsupportive family structures and peer pressure -promote drug and alcohol abuse among adolescents.

Addiction: A psychological attachment to certain effects –such as euphoria and a temporary feeling of well-being –associated with drugs and alcohol.

It drives people to take them even when not needed, or even when their use becomes self-destructive.

Repeated use of drugs, increases tolerance level of the receptors present in our body.

Hence, the receptors respond only to higher doses of drugs or alcohol leading to greater intake and addiction. the person gets addicted and becomes dependent on their use.

Dependence -tendency of the body to manifest a characteristic and unpleasant withdrawal syndrome if regular dose of drugs/alcohol is abruptly discontinued.

Symptoms of dependence: Anxiety, shakiness, nausea and sweating, which may be relieved when use is resumed again.

Withdrawal symptoms: can be severe and even life threatening and the person may need medical supervision.

Dependence makes patient to ignore all social norms in order to get sufficient funds to satiate his/her needs. These result in many social adjustment problems.

- Reckless behavior, vandalism and violence.
- Excessive doses of drugs may lead to coma and death due to respiratory failure, heart failure or cerebral hemorrhage.
- A combination of drugs or their intake along with alcohol generally results in overdosing and even deaths.

MISUSE OF DRUGS BY SPORTSPERSONS

- They (mis)use narcotic analgesics, anabolic steroids, diuretics and certain hormones in sports to increase muscle strength and bulk and to promote aggressiveness and as a result increase athletic performance.
- The **side-effects of the use of anabolic steroids in females** include
    - masculinization (features like males),
    - increased aggressiveness,
    - mood swings, depression,
    - abnormal menstrual cycles,
    - excessive hair growth on the face and body,
    - Enlargement of clitoris, deepening of voice

The side-effects of the use of anabolic steroids in males

- acne,
- increased aggressiveness,
- mood swings,

- depression,
- reduction of size of the testicles,
- decreased sperm production,
- potential for kidney and liver dysfunction,
- breast enlargement,
- premature baldness,
- Enlargement of the prostate gland**.**

(i) **Avoid undue peer pressure** –

- Respect and nurture every child by his/her own choice and personality.
- A child should not be pushed unduly to perform beyond his/her threshold limits - be it studies, sports or other activities.

(ii) **Education and counselling** –

- Educating and counselling him/ her to face problems and stresses, and to accept disappointments and failures as a part of life.
- It would also be worthwhile to channelize the child's energy into healthy pursuits like sports, reading, music, yoga and other extracurricular activities.

(iii) **Seeking help from parents and peers** –

- Help from parents and peers should be sought immediately so that they can guide appropriately.
- Help may even be sought from close and trusted friends –(a) for proper advice to sort out their problems, (b) helps the young to vent their feelings of anxiety and guilt.

(iv) **Looking for danger signs** –

- Alert parents and teachers -look for and identify ‘danger signs.
- ‘Friends’, should not hesitate reporting incidence of someone using drugs or alcohol - parents or teacher in the best interests of the drug/ alcohol addict.
- Appropriate measures to diagnose the malady and the underlying causes.

v)Seeking professional and medical help –

- Seek help form of highly qualified psychologists, psychiatrists.
- De-addiction and rehabilitation programs.
- Affected individual -with sufficient efforts and will power, can get rid of the problem completely and lead a perfectly normal and healthy life.

MULTIPLE CHOICE TYPE QUESTIONS

The substance produced by a cell in viral infection that can protect the other cells from further infection is:

(a) Serotonin

(b) Colostrum

(c) Interferon

(d) Histamine

2. The antibodies present in colostrum which protect the new born from certain diseases is of:

(a) IgG type

(b) IgA type

(c) IgD type

(d) IgE type.

3. Which form of the pathogen is used in to formulate vaccine?

(a) Activated and strong pathogenic antigens

(b) Inactivated and weakened pathogenic antigens

(c) Hyperactive and strong pathogen

(d) Preformed antibodies

4. ……… is a CNS stimulant as it interferes with the transport of the neuro-transmitter ………

(a) Cocaine, acetylcholine

(b) Barbiturate, glutamate

(c) Cocaine, dopamine

(d) Barbiturate, glycine

5.The substance given to the cancer patients in order to activate their immune system and to destroy the tumor is-

(a) Histamine

(b) Interleukin

(c) a-interferon

(d) Morphine.

6. Wuchereria worm causes Filariasis in human being. It belongs to--------------

(a) Protozoa

(b) Bacteria

(c) Virus

(d) Helminth

7. ‘Smack’ is a drug that is obtained from-----

(a) Latex of *Papaver somniferum*

(b) Leaves of *Cannabis saliva*

(c) Flowers of Datura

(d) Fruits of *Erythroxylum coca*.

8. Which one of the following sets includes bacterial diseases?

(a) Tetanus, tuberculosis, measles

(b) Diphtheria, leprosy, plague

(c) Cholera, typhoid, mumps

(d) Malaria, mumps, poliomyelitis

9. If you suspect major deficiency of antibodies in a person, to which of the following would you look for confirmatory evidences:

(a) Serum albumin

(b) Serum globulin

(c) Haemocytes

(d) Fibrinogen in plasma

10. AIDS is caused by HIV. Among the following, which one is not a mode of transmission of HIV?

(a) Transfusion of contaminated blood.

(b) Sharing the infected needles.

(c) Shaking hands with infected persons.

(d) Sexual contact with infected persons.

11. Anti-venom against the snake poison contains: -

(a) Antigens

(b) Antigen-antibody complexes

(c) Antibodies

(d) Enzymes

12. Which of the following gland is large sized at birth but reduces in size with ageing?

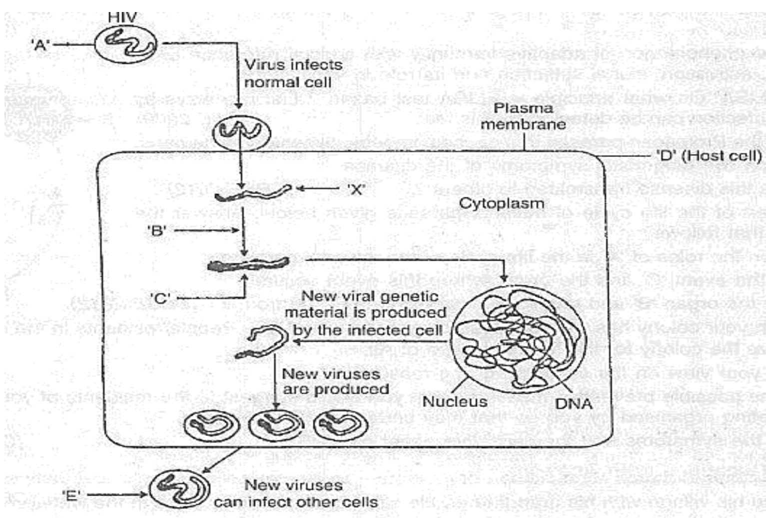
(a) Pineal

(b) Pituitary

(c) Thymus

(d) Thyroid

13. Study the given diagram, and identify the marked part X and C

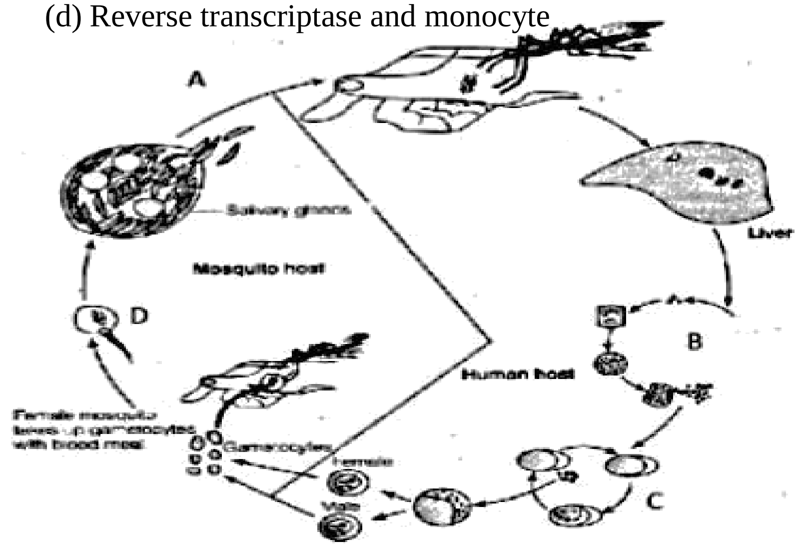


(a) Virus and Viral DNA

(b) Viral RNA and Viral DNA

(c) Viral DNA and Viral RNA

(d) Reverse transcriptase and monocyte



14. Study the life cycle of malarial parasite given below and answer the questions:

1. Fertilization of malarial parasite takes place:

(a) Human body

(b) Intestine of malarial female anopheles mosquito (c)Salivary gland of female anopheles mosquito (d)Red blood cells of man

2. Infectious stage of malarial parasite to man is-

(a) Gametocyte
(b) Sporozoite
(c) Plasmozoite
(d) None

3. The toxin haemozoin is produced by the malarial parasite is in:

(a) Human liver
(b) Human blood
(c) Salivary gland of mosquito
(d) Gut of mosquito

4. Malarial parasite needs……… host to complete the life cycle:

(e) 5
(f) 4
(g) 2
(h) 1

15. Identify the image given below:

(a) Papaver somniferum

(b) Erythroxylum coca

(c) Marijuana

(d) Ganja

16.The diagnosis of cause of allergy is done by-:

(a) Inoculation of small doze of steroids

(b) Inoculation of small doze of substances that cause allergy

(c) Inoculation of small doze of adrenalin

(d) Inoculation of small doze of noradrenalin

17.High fever, Constipation, Fatigue, Rashes, Dry cough, Stomach pain are the symptoms of:

(a) Cholera

(b) Tuberculosis

(c) Typhoid

(d) Malaria

18. Proto oncogene means ----------------:

(a) Virus that cause cancer

(b) Bacteria that cause cancer

(c) Certain cells that contains cancer causing genome under certain conditions

(d) Carcinogenic substances that seen around us

19. The Symptoms of this disease includes Internal bleeding, Muscular pain, Fever, Anemia and Blockage of the intestinal passage: - ---------------

(a) Typhoid

(b) Cholera

(c) Malaria

(d) Ascariasis

20. Different types of antibodies are produced in our body. IgA, IgM, IgE, IgG etc. These antibodies are found in the blood, this kind of immune response in our body is called ………

(a) Cell mediated immunity

(b) Humoral immunity

(c) Passive immunity

(d) Auto immunity

21. Recombinant DNA technology has allowed the production of antigenic polypeptides of pathogen in bacteria or yeast. Vaccines produced using this approach allow large scale production and hence greater availability for immunization. Most prominent r DNA vaccine is………

(a) Hepatitis vaccine from bacteria

(b) Hepatitis vaccine from yeast

(c) Hepatitis vaccine from bacteriophage

(d) Hepatitis vaccine from mouse

22. These organs provide the sites for interaction of lymphocytes with the antigen, which then proliferate to become effector cells:

(a) Bone marrow

(b) Thymus gland

(c) Spleen and lymph node

(d) Heart and aorta

23. This is a large bean shaped organ. It mainly contains lymphocytes and phagocytes. It acts as a filter of the blood by trapping blood-borne micro-organisms. It also has a large reservoir of erythrocytes:

(a) Kidney

(b) Gall bladder

(c) Spleen

(d) Lymph nodes

24.uses strong magnetic fields and non-ionizing radiations to accurately detect pathological and physiological changes in the living tissue.

(a) CT scan

(b) MRI scan

(c) X-ray

(d) Biopsy

25.Are a group of chemicals, which interact with the receptors present principally in the brain.

(a) Opioids

(b) Cannabinoids

(c) Coca alkaloids

(d) Marijuana

26. Drugs like barbiturates, amphetamines, benzodiazepines, and other similar drugs, that are normally used as medicines for………

(a) Sedative and pain killer

(b) Diuretics

(c) Depression and insomnia

(d) Analgesics

27. Habit of using .... is associated with increased incidence of cancers of lung, urinary bladder and throat, bronchitis, emphysema, coronary heart disease, gastric ulcer, etc.

(a) Alcohol
(b) Smoking Tobacco
(c) Use of Opioids
(d) Use of Cannabinoids

28.Means both 'a period' and 'a process' during which a child becomes mature in terms of his/her attitudes and beliefs for effective participation in society.

(a) Childhood
(b) Adolescence
(c) Youth
(d) None

29. Blood cancer is ------------ type of tumor

(a) Benign tumor
(b) Malignant tumor
(c) Both
(d) None

30. The Human Baby receives Passive immunity from ....

(a) Placenta
(b) Colostrum
(c) Placenta and colostrum
(d) Stem cells

31. Lysozyme that is present in perspiration, saliva and tears, destroys

(a) certain types of bacteria (b) all viruses (c) most virus-infected cells (d) certain fungi

32. The substance produced by a cell in viral infection that can protect other cells from further infection is

(a) serotonin (b) colostrum

(c) interferon (d) histamine

33. Transplantation of tissues/organs to save certain patients often fails due to rejection of such tissues/organs by the patient. Which type of immune response is responsible for such

rejections?

(a) Auto-immune response (b) Humoral immune response

(c) Physiological immune response (d) Cell-mediated immune response

34. Which of the following are the reason(s) for rheumatoid arthritis? Choose the correct option.

(i) The ability to differentiate pathogens or foreign molecules from self-cells increases.

(ii) Body attacks self-cells

(iii) More antibodies are produced in the body

(iv) The ability to differentiate pathogens or foreign molecules from self-cells is lost

(a) (i) and (ii) (b) (ii) and (iv) (c) (iii) and (iv) (d) (i) and (iii)

35. Tobacco consumption is known to stimulate secretion of adrenaline and nor-adrenaline. The Component causing this could be

(a) Nicotine (b) tannic acid

(c) curamin (d) catechin

ASSERTION REASON TYPE

QUESTIONS Answer these questions selecting the appropriate option given below: -

A. Both A & R are True and R is the correct explanation of A.

B. Both A & R are True and R is not the correct explanation of A.

C. A is True but R is False.

D. A is False but R is True.

1. Assertion (A) - Genetic disorders are infectious.

Reason (R) - Genetic disorders are inherited from parents to their children.

2. Assertion (A) - Pneumonia causes severe respiratory problems. Reason

(R) - Due to infection, alveoli of lungs get filled with fluid.

3. Assertion (A) - Female Anopheles mosquito is the pathogen for Malaria.

Reason (R)- Mosquito can transmit plasmodium.

4.Assertion (A) - Asexual reproduction of plasmodium takes place in the Gut of Mosquito.

Reason (R) - Sporozoites are formed in the Gut of Mosquito.

5. Assertion (A) - Virus infected cells secrete proteins called interferons which protect non-infected cells from further viral infection.

Reason (R) - It is a case of physiological barriers.

6. Assertion (A) - Anamnestic responses are highly intensified.

Reason (R) - Secondary response are due to memory of the first encounter.

7. Assertion (A) - Colostrum is secreted by mother during the initial days of lactation.

Reason (R)- Colostrum provides active immunity.

8. Assertion (A) - Many children in metro cities of India suffer from allergies.

Reason (R) -This could be because of the protected environment provided early in the life.

9. Assertion (A) - Small children have more immunity

Reason (R)- Thymus is quite large at the time of birth.

10. Assertion (A) - In host cell, viral DNA is produced by reverse transcription.

Reason (R)- Retrovirus has DNA genome.

11. Assertion (A) - *C-onc* are cells that can cause cancer.

Reason (R) - *C-onc* are cellular organisms.

12. Assertion (A) - Heroin is an opioid.

Reason (R) - Heroin is obtained from poppy plant.

13. Assertion (A) - Cannabinoids can affect cardiovascular system of body.

Reason (R)- Ganja is a cannabinoid.

14. Assertion (A) - Smoking causes raise in blood pressure and increases heart rate.

Reason (R)- Nicotine stimulates adrenal gland to release adrenaline and nor-adrenaline.

15. Assertion (A) - Peer pressure is necessary for better performance.

Reason (R)- Undue pressure can lead to consumption of alcohol and drugs.

16. Assertion (A) - AIDS and Hepatitis-B are viral diseases.

Reason (R) - These diseases are transferred from one person to another by sharing of infected needles and syringes.

17. Assertion (A) - Using morphine for medical purpose is a case of drug abuse.

Reason (R) - Morphine is a very effective sedative and painkiller.

18. Assertion (A) - α-interferon is a biological response modifier.

Reason (R) - α-interferon activates immune system and helps in destroying the tumor.

19. Assertion (A) - Excessive dosage of cocaine causes hallucinations.

Reason (R) - *Atropa belladona* and Datura have hallucinogenic properties.

20. Assertion (A) - Rheumatoid arthritis is an auto-immune disease.

Reason (R) - Here, body attacks self-cells.

SHORT ANSWER TYPE QUESTION (2 mark)

1. **N**ame and explain 4 lymphoid organs present in humans.
2. What is an autoimmune disease? Give an example.
3. Name the causative organism of the disease Amoebiasis. List three symptoms of this disease.
4. What would happen to the immune system, if thymus gland is removed from our body?
5. What is the role of histamine in inflammatory response? Name two drugs which reduce the symptoms of allergy.
6. Write the events that take place when a vaccine for any disease is introduced into the human body.
7. Why is a person with cuts and bruises following an accident administered tetanus antitoxin? (Give reason)
8. Write the source and effect on the human body of the following drugs.

   1.Cocaine 2.opioids
9. Differentiate between innate immunity and acquired immunity.
10. How are morphine and heroin related? Mention the effect each one of them has on the human body?
11. Explain the relationship between B-lymphocytes and T-lymphocytes in developing an immune response?
12. Why is tobacco smoking associated with rise in blood pressure and emphysema (oxygen deficiency in the body)? Explain.
13. Why an immunosuppressive agent is taken after an organ transplant?
14. In the metropolitan cities of India, many children are suffering from allergy/asthma. What are the main causes of this problem? Give some symptoms of allergic reactions.
15. Differentiate between benign and malignant tumours?
16. Name the plant source of the drug popularly called “smack’. How does it affect the body of the abuser?
17. What is colostrum? Why is it important to be given to the newborn infants?
18. What are interferons? Mention their role.
19. A farmer while working on his farm was bitten by a poisonous snake. The workers in the farm 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?
20. If a regular dose of drugs or alcohol is not provided to an addicted person, he shows some withdrawal symptoms. List any four such withdrawal symptoms.

SHORTANSWER TYPE QUESTION (3 Marks)

1. Name the form of Plasmodium that enters the human body. Explain the different stages of its lifecycle in the human body .

2. (a)Name and explain giving reasons the type of immunity provided to the new born by colostrum and vaccinations

   (b)Name the type of antibody

   1. Present in colostrum
   2. Produced in response to allergens in human body.

3. (a)Differentiate between benign & malignant tumors. (b)Why is colostrum a boon to new born baby?

4. What is innate immunity Write the 4 types of barriers which protect the body from the entry of the foreign agents

5. Name the disease in which immune system of a person is suppressed. Name the causal organism and diagnostic technique of this disease.

6. A farmer while working on his farm was bitten by a poisonous snake. The workers in the farm immediately rushed him to the nearby health center. The doctor right away gave him an injection to save his life. What did the doctor inject and why? Explain

7. a). It is generally observed that the children who had suffered from chicken pox in their childhood may not cause the same disease in their adulthood. Explain giving reasons the basis of such immunity in an individual. Name the kind of immunity.

   b) What is interferon? Mention their role

8. a). Why is there a fear amongst the guardians that their adolescent wards may get trapped in drug /alcohol abuse?

   b) Explain addiction and dependence in respect of drug/alcohol abuse in youth

9. How does the HIV break down the immune system of the AIDS patients?

10. With the help of diagram explain structure of antibody molecule.

11. During a school trip to ‘Rohtang Pass’, one of your classmates suddenly developed ‘altitude sickness’. But, she recovered after sometime.

(a) Mention one symptom to diagnose the sickness.

(b) What caused the sickness?

(c) How could she recover by herself after sometime

12.(a) All human beings have cellular oncogenes but only a few suffer from cancer disease. Why?

(b) How is a malignant tumour different from a benign tumour?

13. Prior to a sports event, blood and urine samples of sports persons are collected for drug tests.

(a) Why is there a need to conduct such tests?

(b) Name the drugs the authorities usually look for.

(c) Write the genetic names of two plants from which these drugs are obtained.

14. When someone buys packets of cigarettes, cannot miss the statutory warning that is present on the packing which warns against smoking and says how it is injurious to health. Yet, smoking is very prevalent in our society, both among young and old. Advise the adolescents about the importance of avoiding smoking.

15. (a) Why is there a fear amongst the guardians that their adolescent wards may get trapped in drug/alcohol abuse

(b) Explain ‘addiction’ and ‘dependence’ in respect of drugs/alcohol abuse in youth

<u>LONG ANSWER TYPE QUESTIONS (5 marks)</u>

1. Briefly describe the life history of malarial parasite.
2. Give an account of the following diseases (i) Ascariasis (ii) Filariasis (iii) Ring worms
3. Describe the lymphoid organs of the body and their role.
4. Trace the events that occur in the human body to cause immune deficiency, when HIV enters the body.
5. What is the basic principle of vaccination? How do vaccines prevent microbial infections?

   (b) Name the organism from which Hepatitis b vaccine is produced.
   (c)Differentiate between B -cells and T- cells
6. What are the methods of cancer detection? Describe the common approaches for treatment of cancer?
7. Mention one application for each of the following
   a) Passive immunization
   b) Antihistamine
   c) Colostrum
   d) Cytokine barrier

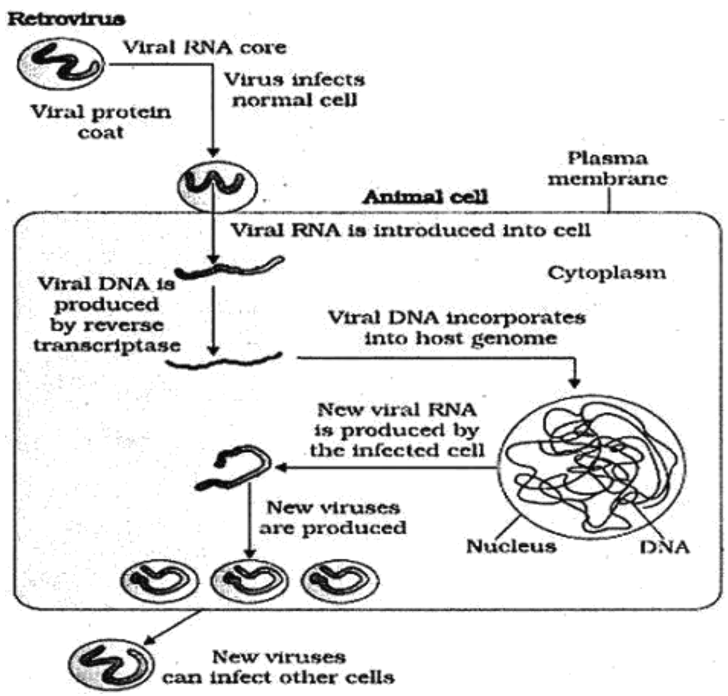
e) ELISA

8. Define drug addiction. Give sources and harmful effects of some drugs derived from different plant sources?
9. What are opioids. Describe briefly about the various products obtained from opioids?

10. Tobacco addiction is due to nicotine present in it. Mention some effects of nicotine on human body.
11. List some factors which compel the people to take drugs.
12. How can alcohol or drugs abuse be avoided among adolescents?

Case/ Diagram Based Questions

1. OBSERVE THE FIGURE



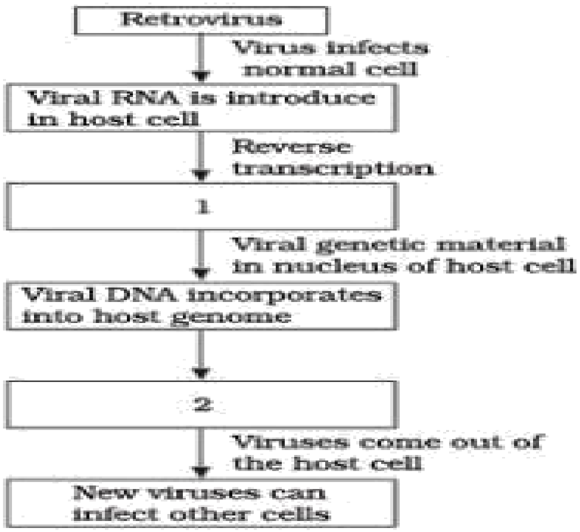
The diagram shows replication of the retrovirus in the host. Note and answer the following questions.

(a) Fill in the missing data in boxes labelled 1 & 2.

(b) Why is it named as retrovirus?

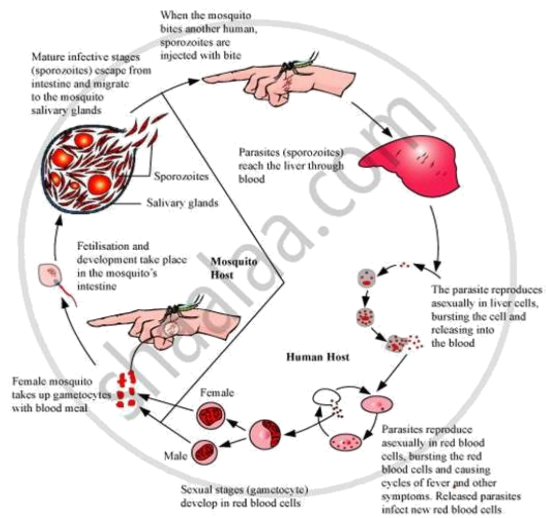
(c) While the virus is being replicated and released, does the infected cell survive?

(d) Why does immunity of an HIV infected person decrease even though the viral infected cell survives?



2. OBSERVE THE FIGURE

Life cycle of plasmodium



A. Diagram represent the life cycles of three eukaryotic parasitic protistans. Give the scientific names of those organisms? Among those which one is responsible for malignant malaria? Why it is called so?

B. It has a sexually reproducing phase and an asexually reproducing phase which is distinct and restricted to a specific host. In which host asexual method of reproduction taking place? What is the method?

C. i. Name the host in which sexual reproduction is taking place? ii.What is the site of fertilization and development?

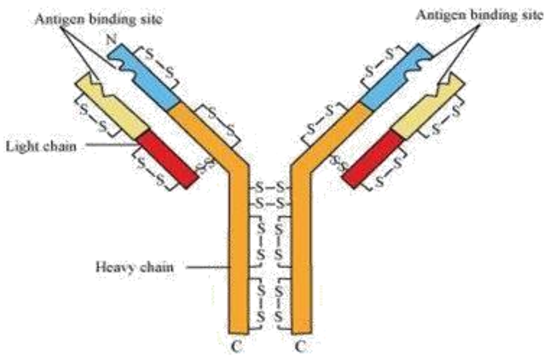
iii.What is the role of salivary gland playing for the reproduction of plasmodium? iv What is the period and reason for high fever and chillness of malarial patient?

D. Name the stage of plasmodium infecting.

a. Man

b. Female Anopheles mosquito.

3. OBSERVE THE FIGURE



Structure of an antibody molecule

I.A biomolecule represented by our immune system is represented as H2L2.

a. Identify by the molecule.

b. Why it is represented as H2L2

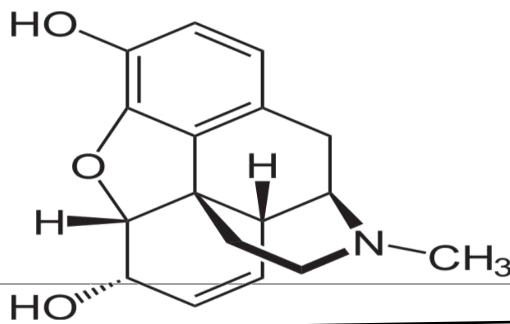
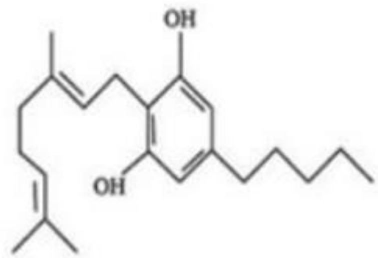
c. What is the source of it?

II. There are different pathways for antibody production. What are they?

III. Production of antibody is memory based. What is the advantage of this feature of humoral immune response?

IV There are different types of protective protein produced by our immune system. What are they? How they are represented.

4. OBSERVE THE FIGURE

Figure. A	Figure.
	

a. Identify Figure A and Figure B.

b. Write the scientific name of source organisms of these biomolecules.

c. ‘A’ on acetylation produce a drug. Name the drug?

d. Name the part of plant from which they are produced.

e. What is the common name of the substances? Which among this affect: - 1) Gastrointestinal tract 2) Cardiovascular system?

Our mind and mental state can affect our health. Of course, health is affected by- (i) genetic disorders – deficiencies with which a child is born and deficiencies/defects which the child inherits from parents from birth;

(ii) infections and (iii) life style including food and water we take, rest and exercise we give to our bodies, habits that we have or lack etc. When the functioning of one or more organs or systems of the body is adversely affected, characterised by appearance of various signs and symptoms, we say that we are not healthy, i.e., we have a disease. Diseases can be broadly grouped into infectious and non-infectious.

Diseases which are easily transmitted from one person to another, are called infectious diseases. Infectious diseases are very common and every one of us suffers from these at some time or other. Some of the infectious diseases like AIDS are fatal. Among non-infectious diseases, cancer is the major cause of death. Drug and alcohol abuse also affect our health adversely.

Que. 1) Which of the following thing mainly affects health?

(a) Life style

(b) Education

(c) Genetic disorder

(d) Both (a) and (b)

Que.2) When the child is born with some deficiencies then it is ………………………

(a) Heart disease

(b) Genetic disorder

(c) Obesity

(d) Infections

Que. 3) If a person’s organ or organ system is affected then the symptoms will appear. And the person can say ……………………………………………………………….

(a) I am healthy.

(b) I am in good state.

(c) I am unhealthy.

(d) I am resting.

Que. 4) Define the term 'Infectious disease' and write an example.

Que. 5) Identify 'B'

Disease	Examples
1. Infectious disease	AIDs
2. Non-infectious disease	'B'

Case Study 2:

A wide range of organisms belonging to bacteria, viruses, fungi, protozoans, helminths, etc., could cause diseases in man. Such disease-causing organisms are called pathogens. Most parasites are therefore pathogens as they cause harm to the host by living in (or on) them. The pathogens can enter our body by various means, multiply and interfere with normal vital activities, resulting in morphological and functional damage. Pathogens have to adapt to life within the environment of the host. For example, the pathogens that enter the gut must know a way of surviving in the stomach at low pH and resisting the various digestive enzymes. A few representative members from different groups of pathogenic organisms are discussed here along with the diseases caused by them. Preventive and control measures against these diseases in general, are also briefly described. Salmonella typhi is a pathogenic bacterium which causes typhoid fever in human beings. These pathogens generally enter the small intestine through food and water contaminated with them and migrate to other organs through blood. Sustained high fever (39° to 40°C), weakness, stomach pain, constipation, headache and loss of appetite are some of the common symptoms of this disease. Intestinal perforation and death may occur in severe cases.

Typhoid fever could be confirmed Widal test : A classic case in medicine, that of Mary Mallon nicknamed Typhoid Mary, is worth mentioning here. She was a cook by profession and was a typhoid carrier who continued to spread typhoid for several years through the food she prepared. Que. 1) In a classic case, who was spreading typhoid by cooking?

(a) Mary Mallon

(b) Typhoid Cook

(c) Classic Mallon

(d) Mary Classic

(a) *Plasmodium vivax*

(b) *Salmonella typhi*

(c) *Entamoeba histolytica*

(d) *Aedes Aegypti*

Que. 3) The organisms like viruses, helminths, protozoa and bacteria which are responsible for causing disease in man are known as ……………………………………………………………………………………….

(a) Non-Infectious

(b) Enzymes

(c) Typhoid

(d) Pathogens

Que. 4) Write the name of pathogenic bacteria that causes typhoid and its symptoms.

Que. 5) Why most of parasites are pathogens?

Case Study 3:

Bacteria like Streptococcus pneumoniae and Haemophilus influenzae are responsible for the disease pneumonia in humans which infects the alveoli (air filled sacs) of the lungs. As a result of the infection, the alveoli get filled with fluid leading to severe problems in respiration. The symptoms of pneumonia include fever, chills, cough and headache. In severe cases, the lips and finger nails may turn gray to bluish in colour. A healthy person acquires the infection by inhaling the droplets/aerosols released by an infected person or even by sharing glasses and utensils with an infected person. Dysentery, plague, diphtheria, etc., are some of the other bacterial diseases in man. Many viruses also cause diseases in human beings. Rhino viruses represent one such group of viruses which cause one of the most infectious human ailments – the common cold. They infect the nose and respiratory passage but not the lungs.

The common cold is characterised by nasal congestion and discharge, sore throat, hoarseness, cough, headache, tiredness, etc., which usually last for 3-7 days. Droplets resulting from cough or sneezes of an infected person are either inhaled directly or transmitted through contaminated objects such as pens, books, cups, doorknobs, computer keyboard or mouse, etc., and cause infection in a healthy person.

Que. 1) which organ in the humans get affected by pneumonia disease?

(a) Stomach

(b) Heart

(c) Lungs

(d) Bladder

Que. 2) Rhino virus can infect ………………………………………… in the humans.

(a) Hand

(b) Nose

(c) Ear

(d) Hairs

Que. 3) By which of the following reason, an healthy person can acquire pneumonia disease?

(a) By exhaling droplets of non-infected person.

(b) By headache or leg pain.

(c) By eating fast food.

(d) By inhaling droplets of infected person.

Que. 4) How long does common cold last?

Que. 5) Write any two symptoms of common cold and pneumonia.

Case Study 4:

Ascaris, the common round worm and Wuchereria, the filarial worm, are some of the helminths which are known to be pathogenic to man. Ascaris, an intestinal parasite causes ascariasis. Symptoms of these disease include internal bleeding, muscular pain, fever, anemia and blockage of the intestinal passage. The eggs of the parasite are excreted along with the faeces of infected persons which contaminate soil, water, plants, etc. A healthy person acquires this infection through contaminated water, vegetables, fruits, etc. Wuchereria (W. bancrofti and W. malayi), the filarial worms cause a slowly developing chronic inflammation of the organs in which they live for many years, usually the lymphatic vessels of the lower limbs and the disease is called elephantiasis or filariasis. The genital organs are also often affected, resulting in gross deformities. The pathogens are transmitted to a healthy person through the bite by the female mosquito vectors.

Many fungi belonging to the genera Microsporum, Trichophyton and Epidermophyton are responsible for ringworms which is one of the most common infectious diseases in man. Appearance of dry, scaly lesions on various parts of the body such as skin, nails and scalp are the main symptoms of the disease.

Que. 1) If a person is having dry and scaly lesions on various parts of the body, then the person is infected by ………………………………………………………………. Disease.

(a) Ringworm

(b) Roundworm

(c) Filarial worm

(d) Earthworm

Que. 2) A healthy person can have infection of Ascaris

through ……………………………………………………………………………….

(a) Moisture

(b) Mosquito

(c) Gases

(d) Contaminated food and water

Que. 3) The disease filariasis can transmit to a healthy person

through …………………………………………………………………………….

(a) Through fungi

(b) Through round worm

(c) Through female mosquito bite

(d) Through ringworms

Que. 4) Name any two genera of the fungi which are responsible for causing ringworms.

Que. 5) Give an example of filarial worm and round worm.

Case Study 5:

Every day we are exposed to large number of infectious agents. However, only a few of these exposures result in disease. Why? This is due to the fact that the body is able to defend itself from most of these foreign agents. This overall ability of the host to fight the disease-causing organisms, conferred by the immune system is called immunity.

Immunity is of two types: (i) Innate immunity and (ii) Acquired immunity. Innate Immunity Innate immunity is non-specific type of defence, that is present at the time of birth. This is accomplished by providing different types of barriers to the entry of the foreign agents into our body. Innate immunity consist of four types of barriers. These are — (i) Physical barriers: Skin on our body is the main barrier which prevents entry of the micro-organisms. Mucus coating of the epithelium lining the respiratory, gastrointestinal and urogenital tracts also help in trapping microbes entering our body. (ii) Physiological barriers: Acid in the stomach, saliva in the mouth, tears from eyes–all prevent microbial growth. (iii) Cellular barriers: Certain types of leukocytes (WBC) of our body like polymorpho-nuclear leukocytes (PMNL-neutrophils) and monocytes and natural killer (type of lymphocytes) in the blood as well as macrophages in tissues can phagocytose and destroy microbes. (iv)Cytokine barriers: Virus-infected cells secrete proteins called interferons which protect non-infected cells from further viral infection.

Que. 1) A skin barrier that protects our body from entering micro-organisms is a ………………… barrier.

(a) Cellular barrier

(b) Physical barrier

(c) Physiological barrier

(d) Both (a) and (c)

(a) Innate immunity

(b) Acquired immunity

(c) Pathogen specific

(d) PMNL

Que. 3) When the host is able to fight against disease-casing organisms, then the ability is known as ……………………………………………………………………………….

(a) Microbial growth

(b) Immunity

(c) Barriers

(d) Interferon

Que. 4) what is meant by cellular barriers?

Que. 5) which type of barrier include interferon that protects non-infected cells from further viral infection?

ANSWER KEY

HUMAN HEALTH AND DISEASES

I. MCQ-ANSWER KEY

1	C	11	C	18	C	28	B
2	B	12	C	19	D	29	B
3	B	13	b	20	B	30	C
4	C	14-1	B	21	B	31	a
5	C	14-2	B	22	C	32	c
6	D	14-3	B	23	C	33	d
7	A	14-4	c	24	B	34	b
8	B	15	B	25	B	35	a
9	B	16	B	26	C		
10	c	17	c	27	B		

II. ANSWERFOR ASSERTION – REASON QUESTIONS

1.D	**2.A**	**3.D**	**4.D**	**5.C**
6.A	**7.C**	**8.A**	**9.A**	**10.C**
11.D	**12.B**	**13.B**	**14.A**	**15.D**
16.B	**17.D**	**18.A**	**19.B**	**20.A**

III. ANSWER KEY (2Marks)

III. ANSWER KEY (2Marks)

1.Primary lymphoid organs- bone marrow and thymus gland-immature lymphocyte differentiate into antigen sensitive

lymphocytes (1). Secondary lymphoid organ-spleen and lymph nodes-provide sites for interaction of lymphocytes

with antigen (1)

2.When body attacks self-cells (1) Rheumatoid arthritis (1)

3.Entamoeba histolytica (1/2) Symptoms-constipation, abdominal pain, cramps, stool with blood clots/excess mucous. Any three 1/2x3=11/2

4.T lymphocytes produced from bone marrow and migrate to thymus gland for maturation (1)

If thymus gland is removing that will result in weak immune system (1)

5.Histamine is produced by mast cells which acts as allergy mediator which cause blood vessels to dilate (1) Anti-histamines, adrenalin, steroids quickly reduce the symptoms (1)

6.Antibodies are produced in the bodies against the antigens of the disease, which would neutralize the antigens during actual infection (1) Cause production of B cells and T cells that recognize the pathogen quickly on subsequent exposure (1)

7.Tetanus is caused by deadly bacterium; quicker response is required (1). So, performed antibodies / antitoxin is administered, to neutralize the effect of bacterial toxin (1)

8.Cocaine –from coca plant (Erythroxylum coca) (1/2)

It acts on central nervous system producing sense of euphoria and increased energy (1/2)

opioids-from poppy plant (Papaver somniferum) (1/2)

Affect central nervous system, depressant and slows down body functions (1/2)

9. Innate immunity -nonspecific type of defense, present from the time of birth (1/2+1/2=1)
Acquired immunity- pathogen specific, acquired after birth, due to disease or vaccination (1)

10. Heroin is obtained by acetylation of morphine which is obtained from the latex of poppy plant (1) Effect-slows down body functions, depression (1)

---

11. B-lymphocytes produce antibodies to fight pathogen. (1)

T lymphocytes help B cells to produce them. They can also destroy pathogen quickly. (1)

12. Tobacco has nicotine that stimulates the release of adrenaline and noradrenaline which raise

blood pressure. (1) Smoking tobacco releases carbon monoxide which reduces the concentration of haem-bound oxygen. This causes emphysema. (1)

13. Our immune system is capable to differentiate between ‘self’ and ‘non-self’ cells/tissues. (1)

The graft (grafting) is a non-self-tissue which may be rejected by our immune system. So, to Prevent the rejection, immunosuppressants are taken after the transplant. (1)

14. Allergy is the exaggerated response of the immune system to certain antigens present in the environment. (1/2) In metropolitan cities lifestyle is responsible in lowering of immunity and Sensitivity to allergens. (1/2) More polluted environment increases the chances of allergy in children. Some symptoms of allergic reactions are sneezing, watery eyes, running nose and

Difficulty in breathing. (1/2+1/2)(Any two symptoms)

15.

Benign Tumour	Malignant Tumour
1. It remains confined to the affected organ.	1. It also spreads to other organs of the body.
2. Rate of growth is usually slow.	2. Rate of growth is usually rapid.
3. There is no latent stage.	3. There is latent stage.
4. It causes limited damage to the body.	4. The cancer cells migrate to other sites of the body.
5. There is no metastasis.	5. There is metastasis.
6. It is non-cancerous.	6. It is cancerous.

Any four points (1/2*4=2)

16. Plant source of 'smack' is Papaver somniferum or poppy. (1)

Smack is a depressant and slows down body functions. (1)

` 17. The milk that comes out of the mammary glands during initial days of lactation is called colostrum. (1)

It contains several antibodies (IgA most abundantly), absolutely essential for developing resistance in The newborn babies (1).

18. These are glycoproteins which protect non-infected cells from further viral infection. (1) It is a type of innate immunity (cytokine barrier) (1)

19. The doctor injected an antivenom. (1)

The antivenom contains preformed antibodies which when

Injected act on the pathogen immediately provide protection by providing passive immunity. (1)

20. The withdrawal symptoms are:

(a) Anxiety (b) Shakiness

(c) Nausea (d) Sweating (1/2*4=2)

ANSWER KEY (3 Marks questions)

1. Sporozoites (1/2)

Sporozoites reach the liver through blood (1/2)

The parasites reproduce asexually in liver cells (1/2) Parasites reproduces asexually in RBC (1/2)

Bursting RBC and enter into blood (1/2) Gametocytes develop in RBC (1/2)

2. Passive immunity (1/2)

When readymade antibodies are directly given to protect the body against foreign agents (1/2)

Active immunity- (1/2)

When a host is exposed to antigens which may be forms of living or dead microbes or other protein are produced in the host body (1/2)

b)1. IgA (1/2)

2. IgE (1/2)

3. Benign tumor-remains confined to the original location. (1/2)
Does not spread to other parts of the body (1/2)

Malignant tumor-mass of proliferating cells that invade and damage surrounding tissues. (1/2)
Spread to different parts of the body (metastasis) (1/2)

4. Innate immunity is nonspecific type of defense that is present at the time of birth. (1)

a) Physical barriers, physiological barriers, cellular barriers, cytokine barriers(1/2x4=2)

5. AIDS-Acquired Immuno Deficiency Syndrome (1)

Caused by HIV-Human Immuno Deficiency Virus (1)

ELISA-Enzyme Linked Immuno Sorbant Assay (1)

6. Antitoxin/antivenoms/performed antibodies (1)

Quick response is required 1)

To neutralize snake venom quickly passive immunity is provided (1)

7 a). First infection produce primary response and antibodies are generated against chickenpox
virus encounter subsequently with the same virus elicits a highly intensified secondary response
Due to the memory cells formed during the first encounter, Active immunity (1/2x4=2)

b) Proteins secreted by viral infected cells which protects non-infected cells from viral infection/When alpha interferon is given to cancer patients (it activates immune system) destroys tumor (1)

8. a) Adolescents are easily affected by peer pressure/adventure/curiosity/excitement /experimentation
(any two) (1/2+1/2=1)

b). Addiction-psychological attachment to certain effects such as euphoria/temporary feeling of wellbeing (1)

Dependence-tendency of body to show withdrawal syndrome/symptoms if regular doses of drug /alcohol is abruptly discontinued (1)

9. Virus enters in macrophages.

RNA genome replicates to form viral DNA with the help of reverse transcriptase Viral DNA gets in corporated in to host cell's DNA to produce virus particles. HIV enters into helper T cells and produce Progeny virus. These are released into the blood and attack other T helper cells. The no. of T helper Cells decreases and the person starts suffering from infections (loss of immunity) (1/2x6=3)

10. Labelled diagram (2) Structure (1)

11.(a) Nausea/fatigue/heart palpitation (1)

(b) The sickness was caused due to low atmospheric pressure at high altitude because of which the body was deprived of oxygen. (1)

(c)The body compensates low oxygen availability by increasing RB

production decreasing the (Any two points) binding capacity of haemoglobin and by increasing breathing rate. (1/2*2)

12. All humans have cellular oncogenes or proto-oncogenes, but only a few suffer from cancer

because cancer only occurs on activation of oncogenes. This activation is induced by carcinogens which can be physical, chemical or biological. The chemical carcinogens present in tobacco and smoke have been identified as a major cause of lung cancer. (2)

Refer to the answer key 15 of two marks questions. (Any two points)

13. (a) Such tests are conducted to detect drug abuse to ensure fair game (1).

(b) The authorities look for cannabinoids, cocaine, coca alkaloid, coke, crack, hashish, charas,ganja and hemp plant extract.(1)

(c) These drugs are obtained from Cannabis, Atropa, Erythroxylum, and Datura. (1)

14. (i) Tobacco in cigarettes contains a large number of chemical substances including nicotine, an alkaloid. Nicotine stimulates adrenal gland to release adrenaline and nor-adrenaline into blood circulation, both of which raise blood pressure and increase heart rate.

(ii) Smoking is associated with increased incidence of cancers of lung, urinary bladder, throat and oral cavity.

(iii) It is responsible for bronchitis and emphysema.

(iv)It is associated with increased risk of coronary heart disease, gastric ulcer, etc.

(v) Smoking increases carbon monoxide (CO) content in blood and reduces the concentration of haem-bound oxygen.

(vi)This causes oxygen deficiency in the body. (1/2*6=3)

15.(a) Adolescents are easily affected by (or are vulnerable to) peer pressure. Curiosity, need for adventure and excitement, and experimentation constitute common causes for motivation. A Child’s natural curiosity motivates him/her to experiment. Television, movies, newspapers, Internet also promote drug use.1/2*2=1)

(b) Addiction is the psychological attachment to certain effects such as euphoria or temporary feeling of well-being. (1)

(c) Dependence is the tendency of the body to show withdrawal syndrome or symptoms if regular doses of drug/alcohol are abruptly discontinued. (1)

IV.Long Answer Question

1.

i. Ascariasis:

Pathogen: Caused by *Ascaris lumbricoides*

Symptoms: Blockage of intestinal passage, anemia, abdominal /muscular pain, internal bleeding, nausea and headache.

Modes of transmission: Infection is through contaminated vegetables, fruits and water as eggs of parasites excreted by the infected persons contaminate soil, plants and water.

ii. Filariasis/Elephantiasis

Pathogen: *Wuchereria bancrofti* and *W. malay*i

They normally cause the inflammation of the organs in which they live for many years. They normally affect the lymph vessels of the lower limbs (causing them to swell) Genital organs may also affect.

Transmission: Female Culex mosquito is the vector.

iii. Ringworm infection

Pathogen-fungi like Microsporum, Epidermophyton and Trichophyton

Symptoms: Dry scaly lesions on the skin,nails and scalp. Lesions are accompanied by itching

---

2.

i. Malarial parasite completes life cycle in two hosts. i.e, man and female anopheles' mosquito.

ii. Sporozoites are the infective stage.

iii. The sporozoites enter the body, reach the liver cells through blood and multiply within the liver cells.

iv. Such liver cells burst and release the parasites into blood.

v. Then they attack RBCs, multiply and cause their rupture.

vi. The rupture of RBCs is associated with the release of toxin called haemozoin, which is responsible for the high recurring fever and the chill and cause malaria.

vii. Sexual stages (gametocytes) develop in the red blood cells

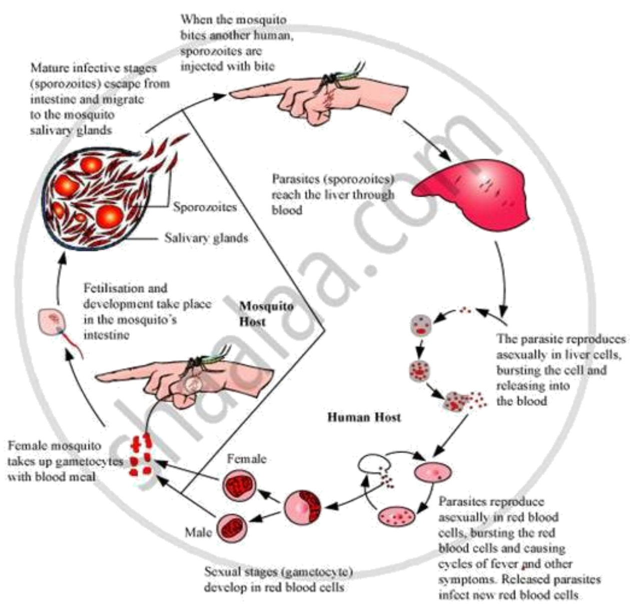
viii. The parasite then enters the female Anopheles mosquito along with blood when it bites an infected person.

ix. Further development occurs in the stomach wall of mosquito.

x. The gametes fuse to form zygote.

xi. The zygote undergoes further development in the body of the mosquito and form sporozoites.

xii. Sporozoites are transported to and stored in the salivary glands of mosquitoes and are transferred to a human body during the bite of mosquito.



3.

- These are the organs where origin and/or maturation and proliferation of lymphocytes occur.

- The primary lymphoid organs are bone marrow and thymus where immature lymphocytes differentiate into antigen sensitive lymphocytes.

  i) Bone marrow: Bone marrow present in the bones is the main lymphoid organ where all

blood cells including lymphocytes are produced. Bone marrow provides the micro environment for the development and maturation of B lymphocytes.

ii) Thymus: Thymus is located beneath the breastbone. Thymus is quite large at the time of birth but keeps reducing with age. It Provides microenvironment for the development and maturation of T lymphocytes.

<u>Secondary lymphoid organs</u>: The lymphocytes after maturation migrate to secondary lymphoid organs like spleen, lymph nodes, tonsils,Peyer's patches of small intestine and appendix. Secondary lymphoid organs provide sites for interaction of lymphocytes with antigen, which then proliferate to become effector cells.

i. Spleen: Spleen mainly contains lymphocytes and phagocytes. It acts as a filter of the blood by trapping blood borne microorganisms. Spleen has a large reservoir of erythrocytes.

ii. Lymph nodes: Lymph nodes are small solid structures located at different points along the lymphatic system. Lymph nodes serve to trap the microorganisms or other antigens, which happens to get into lymph.

iii. MALT- Mucosal associated lymphoid tissue. Lymphoid tissue located within the lining of major tracts (respiratory, digestive, urogenital) is called MALT.

iv. Lymphoid tissue associated with the gut is called peyer's patches.

4.

- HIV enters into macrophages where it synthesizes viral DNA from RNA genome, with the help of enzyme reverse transcriptase.

- This viral DNA gets incorporated into the host cell’s DNA and direct the infected cells to produce viral particles.

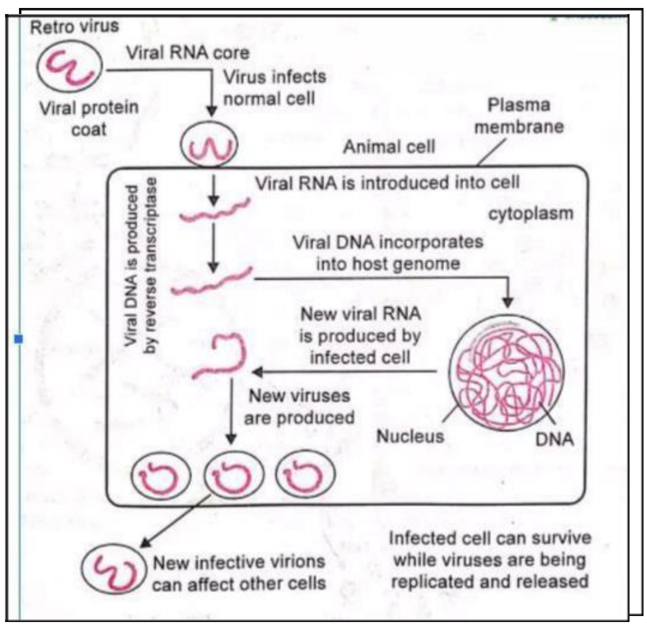
- The macrophages continue to produce viruses and in this way acts like an HIV factory.

- HIV enters into helper T-lymphocytes, replicates and produce progeny viruses.

- The progeny viruses released in blood attack other helper T lymphocytes in the body of the infected person.

- Due to decrease in the number of T lymphocytes, the person starts suffering from infections due to bacteria such as Mycobacterium, viruses, fungi and even parasite Toxoplasma.

- The patient becomes so immunologically deficient and unable to fight against such infections.



5.

a) Principle of vaccination is based on the property of memory of immune system. In vaccination, a preparation of antigenic proteins of pathogens or inactivated /live but weakened pathogens is introduced into the body. The antigens generate primary immune response by producing antibodies along with formation of memory B cells and T cells. When the vaccinated person attacked by the same pathogen, the existing

Memory B cells and T cells recognize the antigen and overwhelm the invaders with massive production of lymphocytes and antibodies.

b) Hepatitis B vaccine is produced from Yeast.

B-cells	T-cells
i. They are produced in bone marrow and remain there and later migrate to lymphoid tissue ii. Produce plasma cells, once triggered by the antigens iii. They are part of humoral immune system	i. They are produced in bone marrow and migrate to thymus and get differentiated there. ii. T cells are responsible for recognizing specific antigen and attack it by secreting chemicals iii. They are part of cell mediated immune response

6. <u>Detection of cancer:</u>

- Biopsy of affected tissue
- Histopathological studies
- Techniques such as radiography (x rays) CT scan, and MRI

<u>Treatment:</u>

- Surgery: Removal of entire cancerous tissue
- Radiation: Exposure to X rays which destroy rapidly growing cells without harming the surrounding tissues.
- Chemotherapy: administration of anti-cancerous drugs.

- Treatment by combination of surgery, drugs and radiation therapy.
- Patients are given substances such as biological response modifiers such as alpha interferon, which enables the immune system in detection and destruction of cancer cells.

7.

a) Provide preformed antibodies / anti-toxins for quick response in case of infection by deadly microbes (eg : tetanus) or snake bite

b) Reduces symptoms of allergy

c) Provides passive immunity / antibodies / Ig A to new born

d) Protection of non-infected cells from further viral infection

e) Enzyme Linked Immuno Sorbent Assay- Diagnostic test for AIDS

8. The prolonged use of drugs may lead the physical and mental dependence of the body on them.

This is called as drug addiction.

(i) Heroin: -

Source - Poppy plant (Papaver somniferum)

effects - Depressant, slows down body functions.

(ii) Cocaine: -

Source - Coca plant (Erythroxylum coca)

Effects - Potent stimulating action on CNS, producing a sense of euphoria and increased energy. Excessive

dose cause hallucinations.

(iii) Marijuana,Hashish, Charas, Ganga : -

Source - Cannabis plant (Cannabis sativa)

Effects: - Effects on cardiovascular system.

9.These are the drugs, which are obtained from the latex of poppy plant (Papaver somniferum). The exudate of these plants is air dried and is used as opium. Opium is a pain killer drug that acts on CNS. Opium yields the following alkaloids: -

(a) Morphine. It is the main constituent of opium. It is kept in slaked lime and ammonium chloride and then it is filtered to remove impurities and to obtain Morphine. It is a strong analgesic and has sedative and calming effect. It suppresses brain functions and relieves

intense pain during fractures, burns & surgery. Brown sugar or smack is diacetyl morphine hydrochloride which is highly analgesic than morphine.

(b) Heroin. It is a white odourless, bitter crystalline powder obtained from morphine on acetylation (diacetyl morphine). It is about three times more potent than morphine and is used as potent pain killer. It is taken by snorting and injection. It reduces anxiety and tension, lowers blood pressure and breathing rate.

(c) Methadone. It is a synthetic opiate which acts as analgesic, respiratory depressant and constipating agent like morphine.

(d) Codeine. It is a natural opiate, occurs in the form of methyl - morphine. It acts as mild analgesic and used as an ingredient of many medicines and cough syrups.

(e) Pethidine (Meperidine). It is a synthetic opiate and acts somewhat similar to Morphine.

10. Tobacco contains nicotine (an alkaloid) which is a powerful toxin. It has a number of effects on

human body. These are

(i) Nicotine stimulates adrenal gland to release adrenaline and nor-adrenaline in to blood circulation, both of which raise blood pressure and increase heart rate.

(ii) It causes lung cancer,bronchitis, emphysema,coronary heart disease, cancer of urinary bladder and throat,gastric ulcer etc.

(iii) Tobacco chewing causes cancer of the oral cavity.

(iv) Smoking increases CO content in blood and reduces the concentration of haem bound oxygen.

This causes oxygen deficiency in the body.

11.People generally take drugs on the basis of the following factors:

(a) People take drugs to escape from the realities of life, to overcome frustrations and depressions.

(b) Drugs act as a motivation factor for pleasure, fun, curiosity, adventure and to experience different kind of awareness.

(c) People consume drugs under the influence of peer group

(d) People use drug as a result of apathy arising from race,sex and age etc. They start consuming depressant in order to overcome the prophecy of defeat and powerlessness.

(e) They take drug to do more physical or mental work or to get relief from severe pains.

12. (i) Avoid undue peer pressure: Every child has his / her own choice and personality, which should be respected and nurtured. A child should not be pushed unduly to perform beyond his / her threshold limits: be in sports or other activities.

(ii) Education & counselling: The child should be properly counselled to face problems and stresses and to accept disappointments and failure as part of Life.

(iii) Seeking help from Parents and peers: The parents and peers should guide youth and adolescents appropriately for sorting out their problems.

(iv) Looking for danger signs: Friends and teachers should not hesitate to bring it to the notice of their parents if their wards are consuming drugs or alcohol.

(v)Seeking professional and medical help: Lot of help is available in the form of highly qualified psychologists, psychiatrists and de-addiction and rehabilitation programs to help the individuals who have unfortunately become drug abuser.

V DIAGRAM BASED QUESTION ANSWERS

1. (a) – 1. Viral DNA is produced by reverse transcriptase. 2 – New viral RNA is produced by the infected cell.

(b) Retrovirus belongs to the family retroviridae.

(c) An infected cell can survive while viruses are being replicated and released.

(d) Infected cell (T lymphocyte) instead of producing antibodies produces only viral particles.

2. **A.** Plasmodium vivax, plasmodium malaria, *Plasmodium . falciparum* causes malignant malaria and it is more serious and can even fatal

B. Asexual reproduction takes place in the human Liver cells and RBC.

Multiple fission is the method.

C i. Female Anopheles mosquito.

Ii .Fertilisation and development occur in the stomach of mosquito.

iii. Developed embryo mature into infective stage called sporozoa in the salivary gland of mosquito and stored there.

iv.A toxin called haemozoin is released from the infected RBC when it rupture to release the multiplied cells of plasmodium.High fever and chillness recurring every three to four days. d)a.Man - Sporozoite

b. Female Anopheles- Gametocytes.

3. a. Antibody molecule

b. It is made up of two heavy peptide chain and two light peptide chain.

c. B- Lymphocyte of our immune system produce it.

II. Vaccination and infection by an antigen.

III. Subsequent encounter with the same pathogen elicit a highly intensified secondary or anamnestic response

IV.

Name of protein	Symbol
Immunoglobin A	IgA
Immunoglobin M	IgM
Immunoglobin E	IgE
Immunoglobin G	IgG

4.I. a. Figure A chemical structure of morphine.

Figure B Skeletal structure of Cannabinoid molecule.

b. A obtained from Papaver somniferum

B obtained from Cannabis sativa.

c. Opioid drugs

d. A obtained from latex of the poppy plant and B is obtained from inflorescence of Cannabis plant.

e. A is commonly called morphine and B is commonly called Cannabinoids.

f.1)Opioid drugs 2)Cannabinoid drugs.

CASE STUDY QUESTION ANSWERS

1

1) (d) Both (a) and (b)

2) (b) Genetic disorder

(c) I am unhealthy.

4) Transmission of the diseases from one person to another is called as Infectious diseases. AIDs is an example of infectious disease.

5)

Disease	Examples
1. Infectious disease	AIDs
2. Non-infectious disease	Cancer

2.

1)(a) Mary Mallon.

2) (b) *Salmonella typhi*.

3) (d) Pathogens.

4) Answer: A pathogenic bacterium that causes typhoid fever in humans is *Salmonella typhi*. *Salmonella typhi* causes typhoid by entering small intestine. The common symptoms of typhoid disease are weakness, high fever, and loss of appetite, constipation, and headache.

5) Parasites live in or on the host and causes harm to the host. Hence, most of parasites are pathogens.

3.

1).(c) Lungs

2) (b) Nose

3) (d) By inhaling droplets of infected person.

4) Answer: Common cold usually last for three to Seven days.

5) Answer: Common cold manly infects respiratory passage and pneumonia mainly infects alveoli. Symptoms of common cold are sore throat, cough and headache etc., and symptoms of pneumonia are fever, cough and chills etc. Fingers and lips turn gray to bluish colour in severe cases.

4.

1)(a) Ringworm.

2) (d) Contaminated food and water

3) (c) Through female mosquito bite.

4) Answer: *Epidermophyton* and *Microsporum* are the two genera of fungi which are responsible for causing ringworms.

5) Answer: Example of filarial worm is *Wuchereria* and an example of round worm is Ascaris.

5.

1)(b) Physical barrier.

2) (a) Innate immunity.

3) (b) Immunity.

4) Answer: An Innate immunity which has specific types of leukocytes (Like monocytes, polymorpho-nuclear leukocytes, and natural killer macrophages in tissue and in the blood) that can phagocytose and destroy microbes in our body, this is known as Cellular barriers.

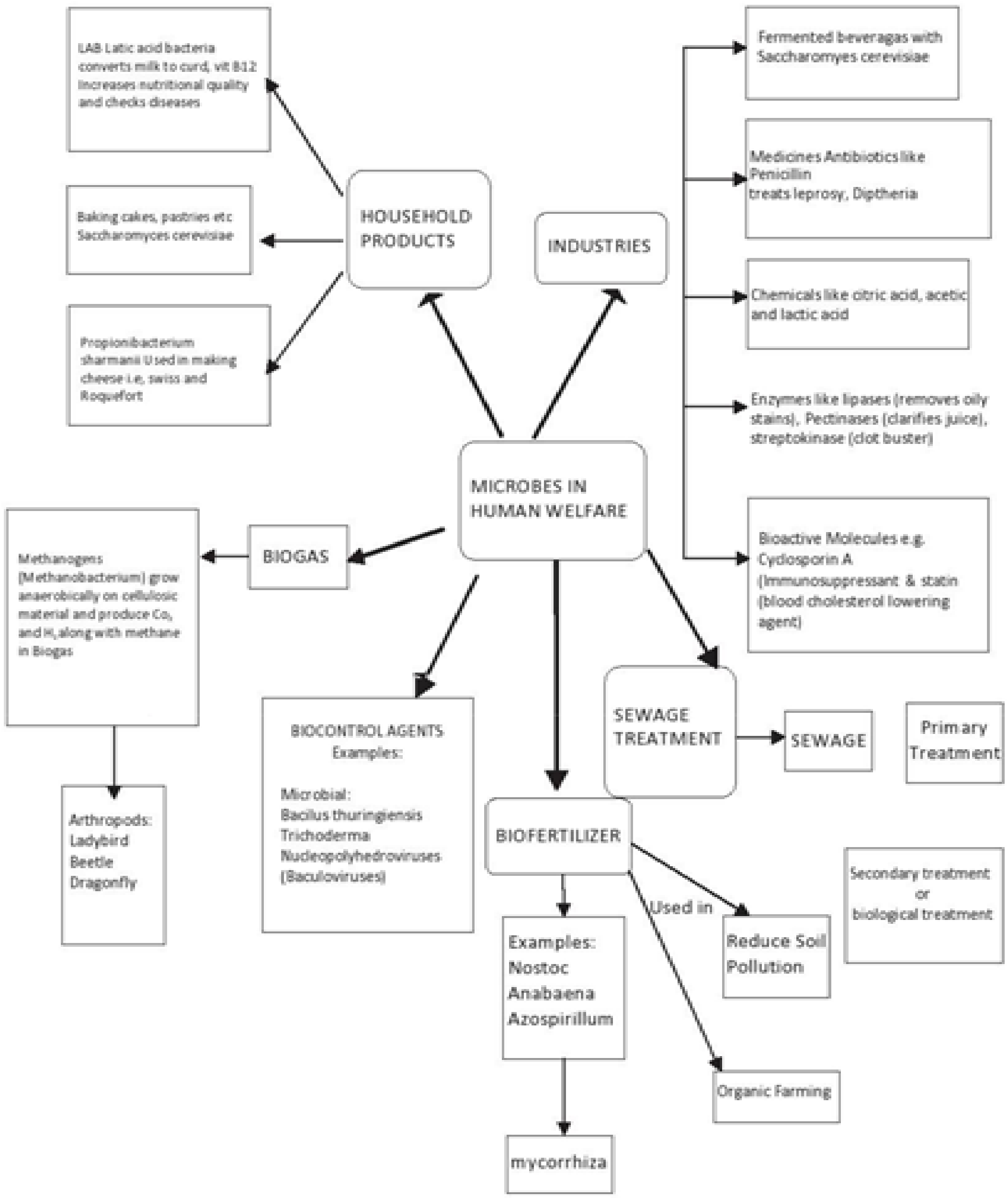
5) Answer: Cytokine is a type of barrier which include interferons to protect non-infected cells from further viral infection.

Prepared by:

1) ***Mrs. Muthulakshmi M, PGT Biology, KV No.1 Palakkad***
2) ***Mrs. Sajeena H, PGT Biology, KV No.1 Palakkad***
3) ***Mrs. Savithanath K S, PGT Biology, KV Ezhimala***

CHAPTER: 10 MICROBES IN HUMAN WELFARE

(CONCEPT MAP)



GIST OF THE MAJOR & MINOR CONCEPTS

I. Microbes in Household products:

A common example is the production of curd from milk. Micro-organisms such as Lactobacillus and others commonly called Lactic Acid Bacteria (LAB) grow in milk and convert it to curd. During growth, the LAB produces acids that coagulate and partially digest the milk proteins. It also improves its nutritional quality by increasing vitamin B12. In our stomach too, the LAB play very beneficial role in checking disease causing microbes.

The dough, which is used for making bread, is fermented by using baker's yeast (Saccharomyces cerevisiae).

"Toddy", a traditional drink of some parts of southern India is made by fermenting sap from palms.

Microbes are also used to ferment fish, soya bean and bamboo-shoots to make

foods. Cheese, is one of the oldest food items in which microbes were used. The large holes in 'Swiss cheese' are due to production of a large amount of CO_2 by a bacterium named Propionibacterium sharmanii. The 'Roquefort cheese' is ripened by growing a specific fungus on them for a particular flavour.

J,Microbes in Industrial products:

Production on an industrial scale requires growing microbes in very large vessels called Fermenters.

a) Fermented Beverages:

The yeast Saccharomyces cerevisiae used for bread making and commonly called

brewer's yeast, is used for fermenting malted cereals and fruit juices to produce ethanol. Wine and beer are produced without distillation whereas whisky, brandy and rum are produced by distillation of the fermented broth.

b) Antibiotics:

Antibiotics are chemical substances, which are produced by some microbes and can kill or retard the growth of other disease-causing microbes.

Pencillin was the first antibiotic to be discovered and it was a chance discovery. Alexander Fleming while working on Staphylococci bacteria, once observed a mould growing in one of his unwashed culture plates around which Staphylococci could not grow. He found out that it was due to a chemical produced by the mould and he named it Pencillin after the mouldPencillium notatum. Later, Ernest Chain and Howard Florey made its full potential effective antibiotic.

c) Chemicals, Enzymes and other Bioactive Molecules:

Chemicals:

Aspergillus niger (fungus) – Citric acid

Acetobacter aceti (bacterium) – Acetic acid

Clostridium butylicum (bacterium) – Butyric acid
Lactobacillus (bacterium) – Lactic acid
Saccharomyces cerevisiae – Ethanol

Enzymes:

Lipase – used in laundry detergents

Pectinase and protease – used in bottled juices

Streptokinase (Streptococcus bacterium) – used as clot buster (to remove clots)

Bioactive molecules:

Cyclosporin A (Trichoderma polysporum fungi) – used as immunosuppressive agent (for organ transplant patients).

Statins (Monascuspurpureus yeast) – used as blood cholesterol lowering agents.

- **Microbes in Sewage Treatment:**

Treatment of waste water is done by heterotrophic microbes naturally present in the sewage. This treatment is carried out in two stages;

Primary treatment / Physical treatment: It involves physical removal of particles from the sewage through filtration and sedimentation.

Sequential filtration – to remove floating debris
Sedimentation – to remove grit (soil and small pebbles)

All solids that settle form the primary sludge, and the supernatant forms the effluent.

The effluent from the primary settling tank is taken for secondary treatment.

Secondary treatment / Biological treatment:

The primary effluent is passed into large aeration tanks, this allows vigorous growth of aerobic microbes into flocs. While growing, these microbes consume the major part of the organic matter in the effluent. This significantly reduces the BOD (biochemical oxygen demand) of the effluent. BOD is a measure of the organic matter present in the water. The greater the BOD of waste water, more is its polluting potential.

Once the BOD of sewage water is reduced significantly, the effluent is then passed into a settling tank where the bacterial 'flocs' are allowed to sediment. This sediment is called Activated sludge.A small part of this sludge is pumped back into the aeration tank to serve as theinoculum.The remaining major part of the sludge is pumped into large tanks called anaerobicsludge digesters.During this digestion, bacteria produce a mixture of gases such as methane, hydrogensulphide and carbon dioxide. These gases form biogas.

The effluent from the secondary treatment plant is generally released into natural water bodies like rivers and streams.

IV. <u>Microbes in Production of Biogas</u>:

Biogas is mixture of gases produced by the microbial activity and which may be used as

fuel. Certain bacteria, which grow anaerobically on cellulosic material, produce large amount of methane along with CO_2 and H_2. These bacteria are collectively called Methanogens (Methanobacterium).

These bacteria are also present in the rumen of cattle. A lot of cellulosic material

present in the food of cattle is also present in the rumen. In rumen, these bacteria help in the breakdown of cellulose and play an important role in the nutrition of cattle. Thus, the excreta (dung) of cattle, commonly called Gobar, is rich in these bacteria. Dung can be used for generation of biogas commonly called gobar gas.

Biogas Plant:

The technology of biogas production was developed in India mainly due to the efforts of Indian Agricultural Research Institute (IARI) and Khadi and Village Industries Commission (KVIC).

The biogas plant consists of a concrete tank in which bio-wastes are collected and slurry

of dung is fed.A floating cover is placed over the slurry, which keeps on rising as the gas is produced inthe tank due to the microbial activity.

The biogas plant has an outlet, which is connected to a pipe to supply biogas to nearby houses.The spent slurry is removed through another outlet and may be used as fertilizer. The biogas thus produced is used for cooking and lighting.

p **<u>Microbes as Biocontrol Agents</u>:** Biological control of pests and diseases: Lady bird – to control aphids

Dragon fly – to control mosquitoes

Bacillus thuringiensis (Bt Cotton) – to control wide range insects Trichoderma (fungi) – protects root system and control plant pathogens. Baculoviruses (Nucleopolyhedrovirus) – to attack insects and other arthropods.

VI. **<u>Microbes as Biofertilisers</u>:** Biofertilizers are organisms that enrich the nutrient quality of the

soil. The main sources of biofertilisers are bacteria, fungi and cyanobacteria.

Bacteria:

Symbiosis – Rhizobium with root nodules of leguminous plants Free living (in the soil) – Azotobacter and Azospirillum.

Fungi:

Symbiosis – Mycorrhiza with root system of genus Glomus and absorb phosphorus and water from the soil for the plant growth.

Cyanobacteria:

Symbiosis – Anabaena in Azolla

Free living – Nostoc, Oscillatoria and Blue green algae.

MULTIPLE CHOICE QUESTIONS

1.Big holes in Swiss cheese are made by ---------- .

(a).a fungus that releases carbondioxide.

(b).a bacterium that produces methane gas.

(c).Yeast

(d).a bacterium that produces large amount of carbondioxide.

2.The events of sewage treatment is given below

(a). Filtration (b).Chlorination (c). Biological treatment (d).Sedimentation

Which one is the correct sequence of steps involved in sewage treatment?

(a)Steps A, B, C and D (b). Step B C, A, and D (c). Steps A, D, C and B (d). Steps A, D, B and C

3.Identify the organism which cannot fix atmospheric nitrogen.

(a).Nostoc (b).Oscillatoria, (c).Anabaena(d).Spirogyra.

4.Activated sludge formed in STP is used in :

(a). Aeration tank to serve as inoculums

(b)Anaerobic sludge digester

p Used in aeration tank as well as anaerobic sludge digester (d)Used in sedimentation tank.

5.Match the following list of microbes and their commercially important products:

Microbe **Product**

A).Aspergillusniger i)Lactic acid B).Lactobacillus ii)Citric acid C).Acetobacteraceti iii)Butyric acid D).Clostridium butylicum iv)Acetic acid (a). A-ii, B-i, C-iii, D-iv (b). A-ii, B-iii, C-i, D-iv, (c.)A-ii, B-iv, C-i, D-iii (d).A-ii, B- i, C-iv, D-iii

6.The spent slurry from the biogas plant is used as ………. .

(a).cooking fuel, (b).biofertiliser, (c).manure, (d).inoculum.

7.The use of biocontrol agents in farming will greatly reduce our dependence on….. .

(a).Fertilisers, (b).manure, (c).chemical pesticides(d).weedicides.

8.Which of the following is/are used in organic farming?

(a). Anabaena, (b).Azospirillum, (c).Trichoderma, (d).All

9.Baculoviruses are pathogens that :

(a.) Attack viruses and bacteria, (b).attack insect pests,

(c). kill useful insects, (d). Kill nucleopolyhedrovirus.

10.Identify the wrong pair:

(a). Statin : Monascus, (b).Cyclosporin : Trichoderma

(c.) Penicillin : Staphylococci, (d.)Ethanol : Yeast

11.The vitamin whose content increases following the conversion of milk into curd by lactic acid bacteria is :

(a).Vitamin E, (b).Vitamin B_{12} ,(c) Vitamin C , (d).Vitamin D

12.Which of the following alcoholic drink is produced without distillation?

(a). Whisky , (b). Brandy , (c).Rum , (d).Wine

13.Which of the following is immediately given to a patient brought to a hospital with myocardial infarction?

(a).Streptokinase, (b).Statin, (c).Penicillin, (d).Cyclosporin –A

14.Identify the process involved in making " Toddy" .

(a).Lactic acid fermentation, (b).Alcoholic fermentation

(c).Distillation, (d).All the above

15.Bottled juices are clarified by the use of ……… and ……… .

(a).Pectinase and lipase, (b).Protease and lipase,

(c).Protease and amylase, (d).Protease and pectinase.

ASSERTION –REASON TYPE QUESTIONS

16.Answer these questions selecting the appropriate option given below: -

(a)..Both A and R are true and R is the correct explanation of A

(b).Both A and R are true but R is not the correct explanation of A.

(c).A is true but R is false.

(d).A is false but R is true.

17.Assertion(A) : Statins produced by Monascus is used for lowering blood cholesterol.

Reason (R) : Statins stimulate the enzyme responsible for synthesis of cholesterol.

18.Assertion(A): Methanogens are present in the rumen of cattle.

Reason (R) :The break down of cellulosic materials in the rumen is carried out by methanogens.

19.Assertion (A) : Cyanobacteria like Nostoc and Anabaena are used as biofertilisers.

Reason (R) :Cyanobacteria absorb phosphorus from soil and passes it to crop.

20. Assertion (A) :Dough used for making dosa and idli is fermented by bacteria.

Reason (R)) :The puffed-up appearance of dough is due to production of lactic acid.

21.Assertion (A): Bacillus thuringiensis and Trichoderma are used as biocontrol agents by organic farmers.

Reason (R) : The use of biocontrol agents helps to reduce pollution caused by excessive use of fertilizers.

22.Assertion (A) : *Saccharomyces cerevisiae* is used for making bread.

Reason (R) : Fermentation carried out by Yeast enzymes produces CO_2 .

Assertion (A) : *Azospirillum* can enrich nitrogen content in the soil.

Reason (R) : Ammonia is converted into free nitrogen by *Azospirillum* .

SHORT ANSWER TYPE QUESTIONS

23.Alexander Fleming while working on *Staphylococci* bacteria, once observed a mould growing in one of his unwanted culture plate around which *Staphylococci* could not grow. Which was the mould that contaminated his culture plate. Mention the significance of this observation. 2

24.Suggest an eco-friendly and pollution free alternative source of energy for rural areas which is dependent on microbial activity. Name the microbe involved in the production of this cooking fuel and mention the chemical composition of it. 2

25.Organ-transplant patients need a medicine called cyclosporine. How is it useful for the patient? 2

26.An organic farmer added fungal genus Glomus in his crop field. How does it help in improving the yield? 2

27.What are flocs in STP? Mention the role of flocs in STP. 2

28.How are the following microbes useful to us?

a.Trichodermapolysporum b.Monascuspurpureus 2

29.The excessive use of chemical pesticides causes soil pollution and adversely affect human health. An alternative to pesticide is use of biocontrol agents. Name a bacterium and a virus which are used as biocontrol agents and mention their action. 3

30.a) What is activated sludge ?

b) Explain the fate of activated sludge in the sludge digester. 3

31.a) Name two photosynthetic biofertilisers. How do they improve soil fertility?

b) How is it different from mycorrhizae ? 3

32.As a part of Swatch Vidyalaya programme, the Panchayath has donated a biogas plant and a single burner stove. The Panchayath authorities instructed to add 10 bags of cow dung initially in the biogas plant.

a.Mention the main constituents of biogas.

b.What is the use of spent slurry?

c.Give reason for adding cow dung in the biogas plant. 3

LONG ANSWER TYPE QUESTIONS

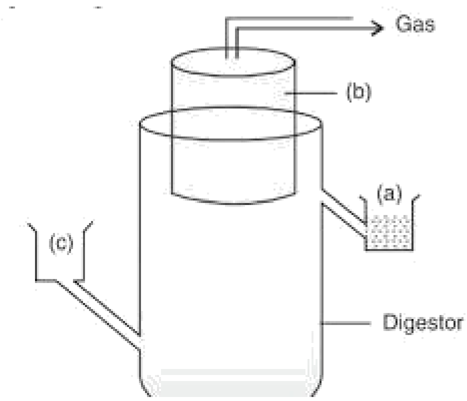
33.a) Secondary treatment of the sewage is also called ‘Biological treatment’. Justify the statement and explain the process. 5

34.a) Differentiate between biofertilisers and chemical fertilizers?

b) Explain the three types of biofertilisers. 5

DIAGRAM BASED / CASE BASED QUESTIONS

35.Observe the given diagram and answer the questions :



a).What is a and how is it useful to us?

b).Name the main gases collected in b.

c).Name the microbes present in the digester part. 3

36.The given diagram shows the root system of a leguminous plant.

a.Name the microbe present inside the root nodule and mention the role of it.

b.How is this microbe differ from Nostoc? (2)

c The application of fertilizers and pesticides has improved our food production. But excessive use of these agrochemicals have adverse effect on environment and human health. So many

farmers are moving away from the use of agrochemicals and started practicing organic farming.

37.Organic farmers use a number of microbes for crop protection from pests.

a.Mention one benefit of microbial biocontrol method over pesticides.

b.Name a fungus and a bacteria which act as biocontrol agents.2

38.Sewage treatment plants are compulsory for all newly constructed residential apartments with many family accommodations. Sewage treatment aims to remove contaminants from sewage to produce an effluent that is suitable for discharge to the surrounding environment or can be reused for watering plants. Untreated sewage discharged into water bodies adversely affect the quality of water. The presence of high amount of organic matter in water increases the BOD. The two stages in sewage treatment are physical treatment and biological treatment. The secondary / biological treatment requires the action of aerobic and anaerobic microbes. The flocs formed in the aeration tank help to reduce the BOD. The biogas generation is also possible through STPs.

a)The effluent from the primary settling tank is taken to --------

i.Anaerobic sludge digester, ii.Aeration tank ,

iii.Natural water bodies , iv.Biogas plant

b)Name two major categories of microbes which consume organic matter in the aeration tank. c)Give reason for pumping a part of activated sludge in to aeration tank? d)Where is activated sludge formed in STP?

ANSWER KEY

MCQ

1.d, 2.c, 3.d , 4.c , 5.d , 6.c, 7. c, 8.d , 9.b, 10.c , 11.b , 12.d , 13.a , 14.b , 15.d ,

REASON ASSERTION

16.c, 17.a, 18.c, 19.c, 20.c, 21.a, 22.c

SHORT ANSWER

23.*Penicillium notatum* , The chemical produced by the mould (Penicillium) inhibited the growth of Staphylococci. This led to the discovery of antibiotic – penicillium. 1+1=2

24.Biogas plant, Methanogens/ methanobacterium, Methane, carbondioxide, Hydrogen etc. 2

25.Cyclosporin is used as an immunosuppressant, It prevent the rejection of transplanted organ.

1+1=2

26.Glomus forms mycorrhiza , It helps to absorb phosphorus from the soil and pass it to plant, resistant to root borne pathogen, tolerance to salinity and drought. 2

27.Masses of bacteria associated with fungal filaments to form mesh like structures in aeration tank. These microbes consume the major part of the organic matter in the effluent and reduces the BOD. 2

28.Trichoderma polysporum is the source of Cyclosporin which is used as immunosuppressive agent. Monascuspurpureus is the source of statins which is used for lowering cholesterol. 2

29.Bacterium –Bacillus thuringiensis, Toxin released by his bacterium kill the pest larvae.

Virus _ Baculoviruses/Nucleopolyhedrovirus attack insects and other arthropods.

30.a)The effluent from aeration tank is passed into a settling tank where the bacterial flocs are allowed to sediment. This sediment is called activated sludge. 1+2=3

b)A small part of it is passed into aeration tank to serve as inoculums. The remaining part is pumped into anaerobic sludge digester.Here, the anaerobic bacteria digest bacteria and fungi in the sludge and forms methane, hydrogen sulphide and carbondioxide. These gases form biogas.

- a)Anabaena, Nostoc, Oscillatoria (Any two), Fix atmospheric nitrogen- also add organic material to the soil.

b)Mycorrhizae are symbiotic association between fungi and roots of higher plants. Photosynthetic biofertilisers are free living or symbiotic.

1+1+1=3

32. a)Methane, hydrogen sulphide, carbondioxide, hydrogen.

b)Used as manure.

c)Cow dung is rich in methanogens which help to produce biogas. 1+1+1=3

LONG ANSWER

33. Aerobic and anaerobic microbes used in secondary treatment.

Primary effluent is passed into aeration tank- constantly agitated mechanically and air is pumped into it-Flocs formation- these microbes consume major part of the organic matter in the effluent- reduces BOD – Effluent is passed into settling tank – forms activated sludge- small part is pumped back into aeration tank – major part is passed into anaerobic sludge digester – Anaerobic bacteria digest flocs into mixture of gases (methane, carbondioxide, hydrogen etc) forms biogas –Effluent from the secondary treatment plant is released into natural water bodies. (10x.5 =5)

34. a)Any two differences – biofertilisers are organisms/ but fertilizers are chemicals produced in factories, Use of biofertilisers do not cause pollution/ but excessive use of fertilizers causes pollution.

b)i.Bacteria – symbiotic (Rhizobium) fix atmospheric nitrogen.

Free living nitrogen fixers – Azospirillum and Azotobacter.

ii)Mycorrhizae –symbiotic association of fungi with roots of higher plants –any one role (absorb Phosphorus and pass it to plant, resistant to root borne pathogens, tolerance to salinity and drought.

- Cyanobacteria – Nostoc,Anabaena, Oscillatoria –can fix atmospheric nitrogen.2+3=5

DIAGRAM BASED/CASE BASED

35. a)Spent slurry/ sludge, used as manure.

b) CH_4 , CO_2 , H_2S , H_2

c)Methanogens / Methanobacterium (1+1+1=3)

36. a)Rhizobium, Can fix atmospheric nitrogen.

b)Rhizobium is symbiotic nitrogen fixer, But Nostoc is photosynthetic free living

37.a)No pesticide pollution, No impact on health

Fungus- Trichoderma , Bacterium: Bacillus thuringiensis

38.a) Aeration tank b) Bacteria and fungi

c) It acts as inoculums d) In settling tank. (4x1=4)

Prepared by:

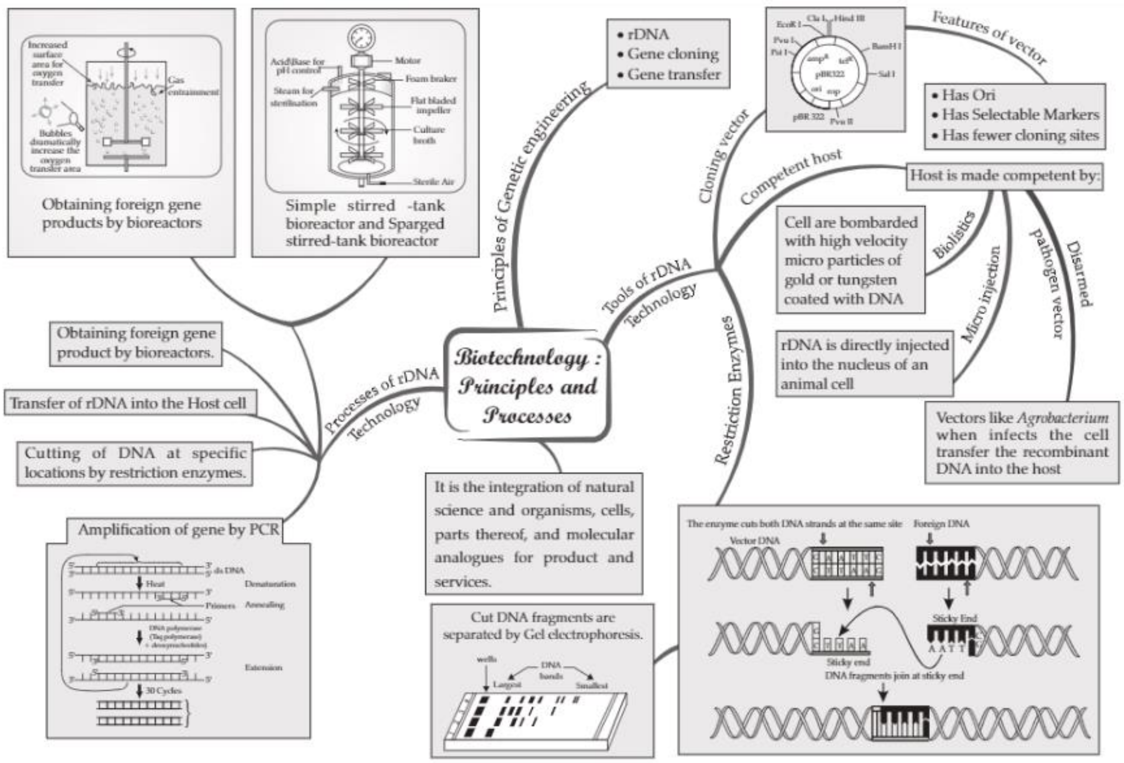
1) Mrs.Lathakumary P K, PGT Biology, KV RB Kottayam

2) ***Mr. Gopalan T, PGT Biology, KV No.2 Kasaragod***

3) ***Mrs. Savithanath K S, PGT Biology, KV Ezhimala***

CHAPTER 11

BIOTECHNOLOGY: PRINCIPLES AND PROCESSES



Biotechnology deals with techniques of using live organisms or enzymes from organisms to produce products and processes useful to humans.The European Federation of Biotechnology (EFB) defines biotechnology as follows:

'The integration of natural science and organisms, cells, parts thereof, and molecular analogues for products and

services.

PRINCIPLES OF BIOTECHNOLOGY

TWO CORE TECHNIQUES THAT ENABLED THE BIRTH OF MODERN BIOTECHNOLOGY

GENETIC ENGINEERING: TECHNNIQUES TO ALTER THE CHEMISTRY OF DNA AND RNA

MAINTENANCE OF STERILE AMBIENCE IN CHEMICAL ENGINEERING PROCESSES TO ENABLE GROWTH OF ONLY THE DESIRED MICROBE/EUKARYOTIC CELL IN LARGE QUANTITIES SO THAT THE PROCESS YIELDS ANTIBIOTICS, VACCINES, ENZYMES, ETC.

TRADITIONAL HYBRIDISATION Vs GENETIC ENGINEERING

Traditional hybridization procedures very often lead **to inclusion and multiplication of undesirable genes along with the desired genes.**

Genetic engineering allows us to isolate and **introduce only one or a set of desirable genes without introducing undesirable genes into the target organism.**

GENETIC ENGINEERING INVOLVES

- Creation of **recombinant DNA**
- Use of **gene cloning**
- **Gene transfer**

The likely fate of a piece of DNA, which is somehow transferred into an alien organism :

- Most likely, this piece of DNA would **not be able to multiply** itself in the progeny cells of the organism
- But, when **it gets integrated into the genome** of the recipient, it **may multiply** and be inherited along with the host DNA. This is because the alien piece of DNA has become part of a chromosome, which has the ability to replicate. In a chromosome there is a specific DNA sequence called the **origin of replication**, which is responsible for initiating replication. Thus, an **alien DNA is linked with the origin of replication, so that, this alien piece of DNA can replicate** and multiply itself in the host organism. This can also be **called as cloning** or making multiple identical copies of any template DNA.

CONSTRUCTION OF THE FIRST ARTIFICIAL RECOMBINANT DNA MOLECULE

The construction of the first recombinant DNA was accomplished by **Stanley Cohen and Herbert Boyer in 1972 .**They adopted the following procedure.

- They isolated antibiotic resistance gene by cutting out a piece of DNA from the plasmid .
- The cutting of DNA at specific locations was done with the help of **restriction enzymes** popularly called as **'molecular scissors**.
- The cut piece of DNA with antibiotic resistance gene was then linked with the plasmid DNA of Salmonella typhimurium acting as **vector** with the help of the **enzyme DNA ligase**.
- This **new autonomously replicating DNA** created **in vitro** with linked fragment of antibiotic resistant gene is called **recombinant DNA**
- Recombinant DNA was then transferred into Escherichia coli, where it could **replicate** using the new **host's DNA polymerase enzyme.** The ability to multiply copies of antibiotic resistance gene in E. coli was called **cloning of antibiotic resistance gene in E. coli.**

3 BASIC STEPS IN GENETICALLY MODIFYING AN ORGANISM

1

IDENTIFICATION OF GENES WITH DESIRABLE GENES

2

INTRODUCTION OF DESIRABLE GENE INTO THE HOST

3

MAINTENANCE OF INTRODUCED DNA IN THE HOST AND ITS TRANSFER TO PROGENY

TOOLS OF RECOMBINANT DNA TECHNOLOGY :

The **key tools** are

- **restriction enzymes**
- **polymerase enzymes**
- **ligases**
- **vectors**
- **the host organism**

Restriction Enzymes:

- Restriction enzymes belong to a larger class of enzymes called nucleases.
- These are of two kinds; **exonucleases and endonucleases**.

Exonucleases **remove nucleotides** from the **ends of the DNA** whereas, endonucleases **make cuts** at specific positions **within the DNA so** that single stranded free ends called '**sticky ends'** project from each fragment of DNA duplex.

- In 1963 two restriction enzymes responsible for restricting the growth of bacteriophage in Escherichia coli were isolated. One of these added methyl groups to DNA, **while the other cut DNA. The later was called restriction endonuclease.**

The first restriction endonuclease–Hind II was isolated and characterised in1968. It cuts DNA molecules at a particular point by recognising a specific sequence of six base pairs. This specific base sequence is known as the recognition sequence for Hind II.

<u>Naming of restriction endonucleases</u> is done as per the following conventions.

- **First letter** of the name comes from the **genus of** prokaryotic cell from which they were isolated. It is written in capital letters.
- **Second two letters** come from the **species** of the prokaryotic cell from which they were isolated. They are written in small letters.
- **The fourth letter** of the name represents the **first letter of the strain**.

- **The Roman number** written at the end of the name indicates **the order in which the enzyme was isolated** from that strain of prokaryotic cell.
-

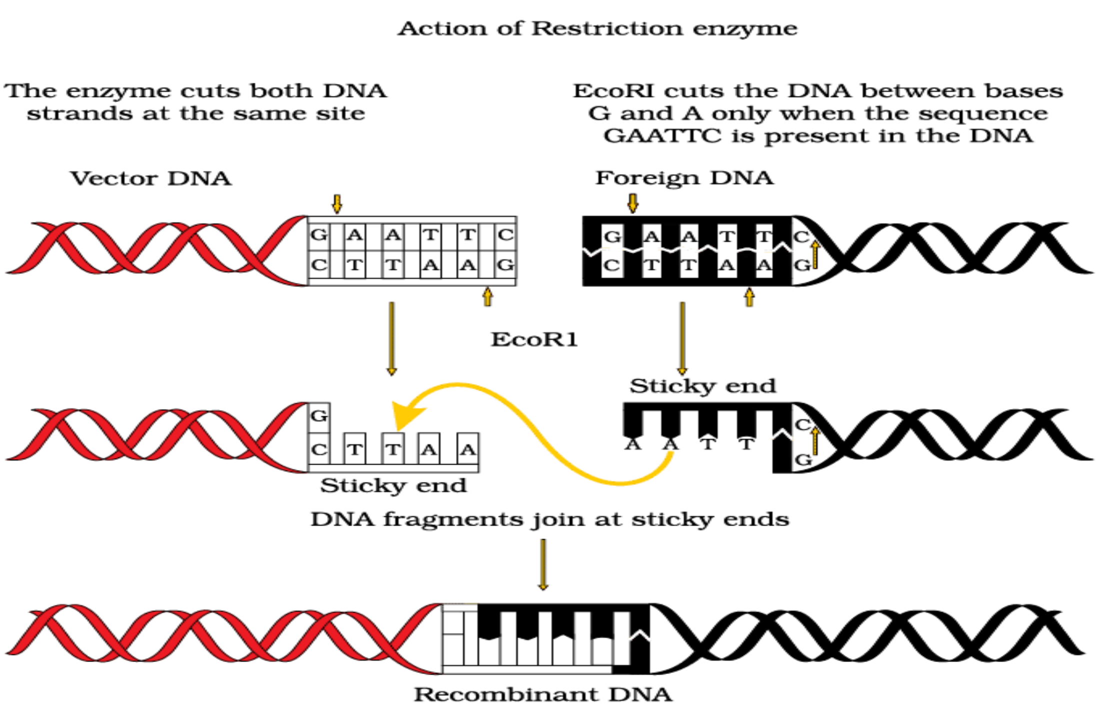
e.g **Naming of Restriction endonuclease EcoRI**

- The capital letter comes from genus Escherichia of E. coli.
- Co comes from coli, the species of E. coli
- The letter R comes from RY 13 strain of E. coli.
- Roman number I indicates, it was the first enzyme isolated from bacterium E. coli.

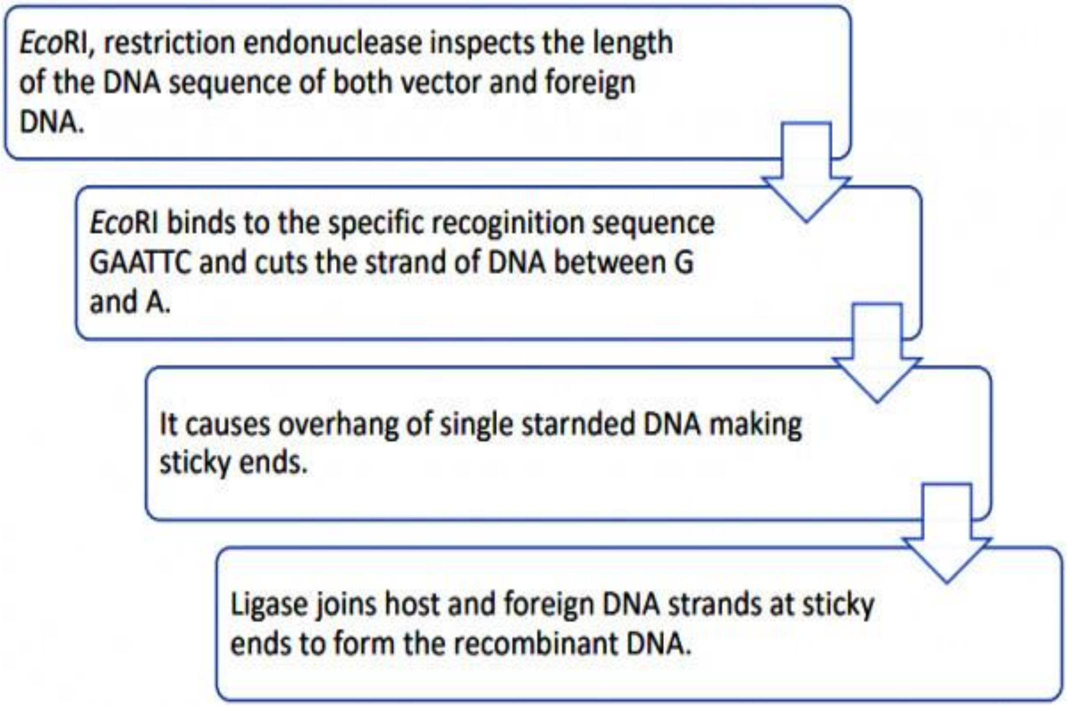
<u>FUNCTIONING OF RESTRICTION ENDONUCLEASE</u>

- Each restriction endonuclease functions by **'inspecting' the length of a DNA sequence**.
- Once it finds its specific **recognition sequence,** it will bind to the DNA and cut each of the two strands of the double helix **at specific points in their sugar-phosphate backbone**.
- The **recognition sequence** of each restriction endonuclease consists of a definite number of specific base pairs in DNA double helix called **palindromic nucleotide sequence**. Palindromes are groups of letters that form the same words when read both forward and backward.

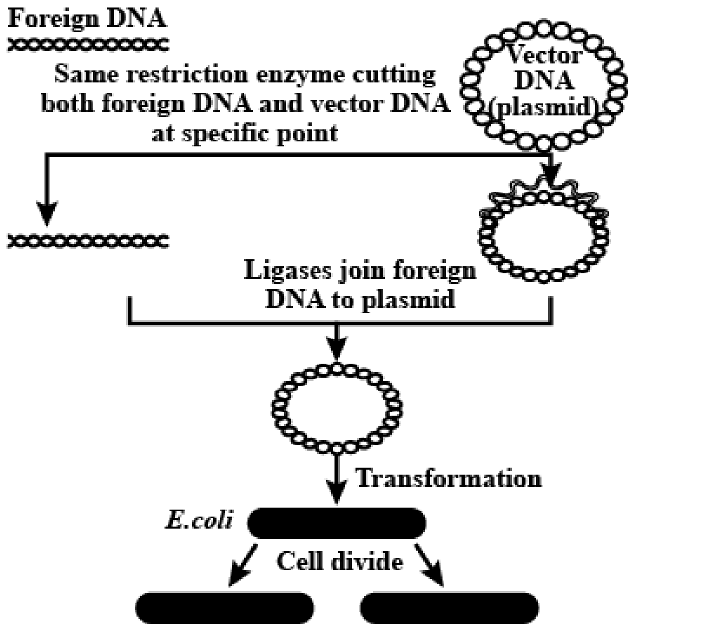
Steps in the formation of recombinant DNA by the action of restriction endonuclease enzyme – EcoR1



FLOW CHART SHOWING ACTION OF EcoR1:



SUMMARY OF RECOMBINANT DNA TECHNOLOGY



Diagrammatic representation of recombinant DNA technology

- -The restriction enzyme cuts both the vector DNA and the foreign DNA at the same site. It cuts each of the two strands of the DNA double helix **at specific points in their sugar-phosphate backbone**.

- This leaves overhanging sticky ends in foreign DNA and vector DNA.
- Sticky ends form hydrogen bonds with their complementary cut counterparts. This stickiness of the end facilitates the action of enzyme DNA ligase.

- -Thus **Recombinant DNA** is formed.

- The recombinant DNA is now shifted to the suitable host to get expressed and yield choice product.

Separation and isolation of DNA fragments: [GEL ELECTROPHORESIS]

-Gel electrophoresis is the technique used for separating DNA fragments.

PRINCIPLE OF GEL ELECTROPHORESIS:

DNA fragments are negatively charged. When an electric field is applied in a medium containing DNA, the DNA tend to move towards the positive electrode anode

PROCEDURE:

-The medium used in gel electrophoresis is agarose gel which is a natural polymer extracted from seaweeds.

-The DNA fragments are transferred to the agarose gel matrix and an electric field is applied.

-Under the electric field, the DNA fragments move according to their size through the seaving effect of agarose gel

-Smaller the size of the DNA fragment, the faster is the rate of movement of it and farther is the distance covered by it.

-The separated DNA fragments can be visualized by staining with ETHIDIUM BROMIDE followed by its exposure to UV radiations.

-The DNA appear in bright orange coloured bands in the gel

-The separated DNA bands can be cutout from the agarose gel and extracted from the gel. This step is known as ELUTION.

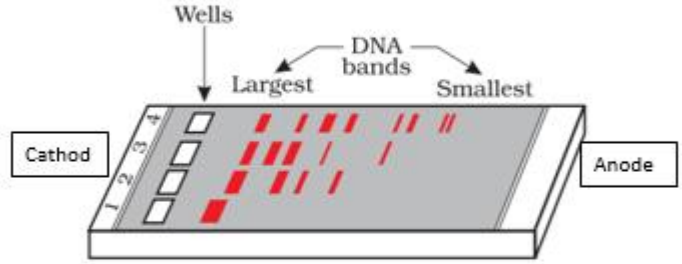


Figure 11.3 A typical agarose gel electrophoresis showing migration of undigested (lane 1) and digested set of DNA fragments (lane 2 to 4)

Cloning vectors

Cloning vectors are the DNA molecules that can carry a foreign DNA segment into the host cell.

(i) The vectors used in recombinant DNA technology can be:

(a) Plasmids Autonomously replicating circular extra-chromosomal DNA.

(b) Bacteriophages Viruses infecting bacteria.

(c) Cosmids Hybrid vectors derived from plasmids which contain cos site of X phage.

(ii) Copy number can be defined as the number of copies of vectors present in a cell.

(iii) Bacteriophages have high number per cell, so their copy number is also high in genome.

(iv) Plasmids have only one or two copies per cell.

(v) Copy number can vary from 1-100 or more than 100 copies per cell.

(vi) If an alien piece of DNA is linked with bacteriophage or plasmid DNA, its number can be multiplied equal to the copy number of the plasmid or bacteriophage.

Features Required to Facilitate Cloning into Vector

(a) Origin of replication (Ori)
(b) Selectable marker
(c) Cloning sites
(d) Vectors for cloning genes in plants and animals.

Origin of replication

Origin of replication(Ori) is a sequence from where replication starts.

• Any piece of DNA when linked to this sequence can be made to replicate within the host cells.

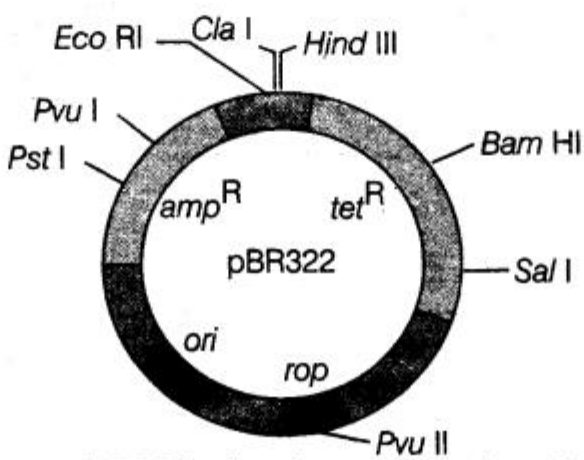
The sequence is also responsible for controlling the copy number of the linked DNA.

(ii) Selectable marker helps in identifying and eliminating non-transformants and selectively permitting the growth of the transformants.

• Transformation is a process through which a piece of DNA is introduced in a host bacterium.

Selectable marker

• The genes encoding resistance to antibiotics such as ampicillin, chloramphenicol, tetracycline or kanamycin, etc, are some useful selectable markers for E. coli.



E. coli cloning vector pBR322 showing restriction sites (*Hind* III, *Eco* RI *Bam* HI, *Sal* I, *Pvu* II, *Pst* I, *Cla* I), *ori* and antibiotic resistance genes (*amp*^{R} and *tet*^{R}). *rop* codes for the proteins involved in the replication of the plasmid.

• Ligation of alien DNA is carried out at a restriction site present in one of the two antibiotic resistance genes. Example is ligating a foreign DNA at the Bam HI site of tetracycline resistance gene in the vector pBR322.
-» The recombinant plasmids will lose tetracycline resistance due to insertion of foreign DNA. But, it still can be selected out from non-recombinant ones by plating the transformants on ampicillin containing medium.

-» The transformants growing on ampicillin containing medium are then transferred on a medium containing tetracycline.

-» The recombinants will grow in ampicillin containing medium but not on that containing tetracycline.

The non-recombinants will grow on the medium containing both the antibiotics.
In this example, one antibiotic resistance gene helps in selecting the transformants whereas, the other antibiotic resistance gene gets 'inactivated due to insertion' of alien DNA and helps in selection of recombinants.

* Selection of recombinants due to inactivation of antibiotics is a cumbersome procedure, so alternative selectable markers are developed which differentiate recombinants from non-recombinants on the basis of their ability to produce colour in the presence of a chromogenic substrate.
-» In this method, a recombinant DNA is inserted within the coding sequence of an enzyme J3-galactosidase.

-» This results into inactivation of the enzyme, B-galactosidase (insertional inactivation).

-> The bacterial colonies whose plasmids do not have an insert, produce blue colour, but others do not produce any colour, when grown on a chromogenic substrate.

Cloning Site
Cloning sites are required to link the alien DNA with the vector.
• The vector requires very few or single recognition sites for the commonly used restriction enzymes.
• The presence of more than one recognition sites within the vector will generate several fragments leading to complication in gene cloning.

(d) Vectors for cloning genes in plants and animals are many which are used to clone genes in plants and animals.

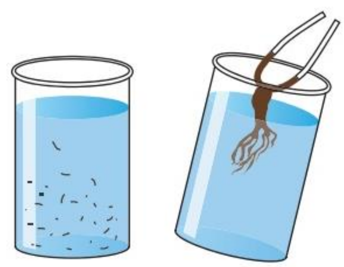
• In plants, the Tumour inducing (Ti) plasmid of Agrobacterium tumefaciens is used as a cloning vector.
-» Agrobacterium tumefaciens is a pathogen of several dicot plants.
-» It delivers a piece of DNA known as T-DNA in the Ti plasmid which 1 transforms normal plant cells into tumour cells to produce chemicals
required by pathogens.
• Retrovirus, adenovirus, papillomavirus are also now used as cloning vectors in animals because of their ability to transform normal cells into cancerous cells.

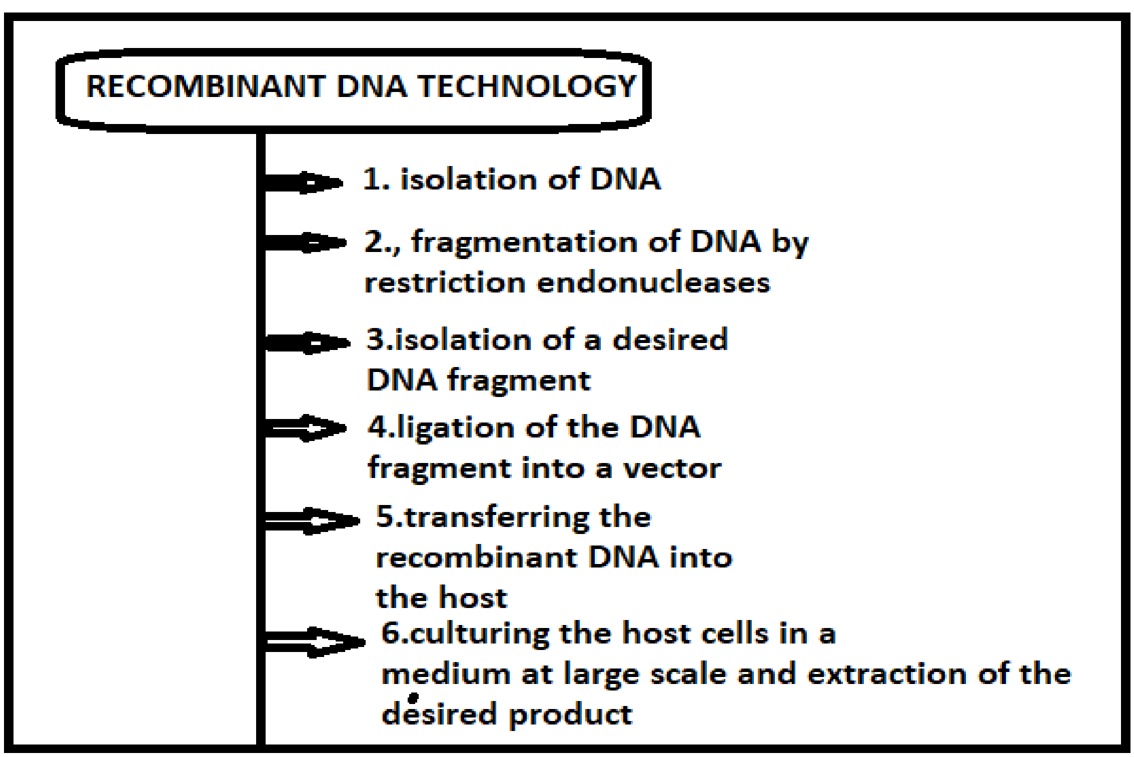
Competent host organism
Competent host for transformation with recombinant DNA is required because DNA being a hydrophilic molecule, cannot pass through cell membranes, Hence, the bacteria should be made competent to accept the DNA molecules or Competency is the ability of a cell to take up foreign DNA.

Methods to make a cell competent are as follows.
(a) Chemical method in this method, the cell is treated with a specific concentration of | a divalent cation such

as calcium to increase pore size in cell wall.
The cells are then incubated with recombinant DNA on ice, followed by placing them briefly at 42°C and then putting it back on ice. This is called heat shock treatment.
• This enables the bacteria to take up the recombinant DNA.
(b) Physical methods In this method, a recombinant DNA is directly injected into the nucleus of an animal cell by microinjection method.
• In plants, cells are bombarded with high velocity microparticles of gold or tungsten coated with DNA called as biolistics or gene gun method.
(c) Disarmed pathogen vectors when allowed to infect the cell, transfer the recombinantDNA into the host.

ISOLATION OF THE GENETIC MATERIAL(DNA)





<u>**Isolation of the Genetic Material (DNA)**</u>

- **RNA** is removed by treatment with **ribonuclease**

- **Proteins** are removed by treatment with **Protease**
- The purified DNA is precipitated by adding chilled ethanol.
- The Bacterial/Plant /Animal cell is broken down by enzymes to release DNA, along with RNA,proteins ,polysaccharides and lipids.
- **Bacterial cell** is treated with enzyme **Lysozyme**
- **Plant cell** is treated with enzyme **Cellulase.**
- **Fungal cell** is treated with **Chitinase.**

Cutting DNA at specific locations

Using the restriction enzymes to cut target DNA and the vector DNA so that the sticky ends can be complimentary and linking can be done by ligase.

Amplification of Gene of Interest using PCR

Polymerase chain reaction (PCR) is the process in which the amplification of the gene of interest is carried out with two sets of primers and a thermostable DNA polymerase enzyme Taq polymerase. It was developed by Kary Mullis in 1985. The process involves the following steps:

Denaturation: The double-stranded DNA is heated up to 94^0 C which causes the hydrogen bonds to break and the two strands get separated.

Annealing: The two sets of primers are added which bind to the appropriate complementary segment of the DNA strand at 54oC.

Extension: The Taq polymerase enzyme polymerizes the nucleotide chain using the nucleotides provided in the medium and by using the template strand at 72^0 C.

Insertion of recombinant DNA into the host cell/organism.

There are several methods of introducing the ligated DNA into recipient cells.

Recipient cells after making them ‘competent’ to receive, take up DNA present in its surrounding.

If a recombinant DNA bearing gene for resistance to an antibiotic (e.g., ampicillin) is transferred into E. coli cells, the host cells become transformed into ampicillin-resistant cells.

Selectable marker-An antibiotic resistance marker is a gene that produces a protein that provides cells expressing this protein with resistance to an antibiotic.

Bacteria that have been subjected to a procedure to introduce foreign DNA are grown on a medium containing an antibiotic, and those bacterial colonies that can grow have successfully taken up and expressed the introduced genetic material.

Normally the genes encoding resistance to antibiotics such as ampicillin, chloramphenicol, tetracycline or kanamycin, etc., are considered useful selectable markers.

Obtaining the foreign gene product

In recombinant technologies, the desired genes for administration is selected, followed by selecting a perfect vector into which the desired gene has to be integrated and recombinant DNA formed.

Once this foreign DNA is inserted, it is multiplied and ultimately desirable protein is produced.

And at last, it has to be maintained in the host and carried forward to the offspring.

For the production of the desired protein, the gene encodes for it needs to be expressed.

This happens only under optimized conditions.

The target protein has to be expressed and produced on a large scale.

The recombinant cells can be multiplied in large scale using a continuous culture system.

Here the cells are cultured in a large vessel and the medium is refreshed on a regular interval to maintain the optimum conditions.

This helps to culture a large mass of the desired protein. This was achieved by the development of bioreactor.

Recombinant protein is the protein encoding gene expressed in a heterologous host
Bioreactors are vessels in which raw materials are biologically converted into specific products using microbial, plant or animal cells.
Bioreactor is designed to meet several requirements such as pH and temperature control, aeration and agitation, drain or overflow and sampling facility.
Regular monitoring for physical, chemical and biological parameters is done through control systems of the bioreactor.

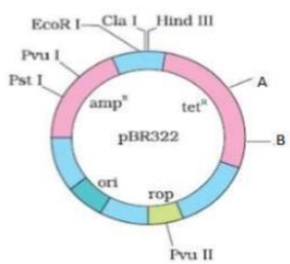
TYPES OF BIOREACTOR:
(a) Simple stirred-tank bioreactor;
(b) Sparged stirred-tank bioreactor.

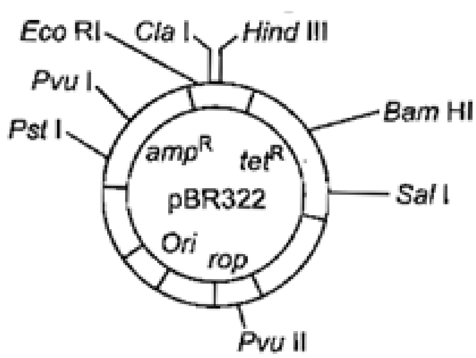
Downstream Processing.

Downstream Processing: The process of formulation, separation and purification of rDNA products made in Bioreactors.
Downstream processing is a sequential step in which the isolation, purification, preservation of final products are done before it is marketed.
In this stage, the final product is formulated with additives like preservatives, colors, etc, followed by clinical trials.
Strict quality control testing for each product is also required

	BIOTECHNOLOGY: PRINCIPLES AND PROCESSES MCQ	
1	Plasmid has been used as vector because a) both its ends show replication. b) it can move between prokaryotic and eukaryotic cells. c) it is circular DNA which have capacity to join to eukaryotic DNA. d) it has antibiotic resistance gene.	1
2	The first restriction endonuclease reported was a) Hind II b) EcoRI c) Hind III d) BamHI	1
3	Restriction endonuclease - Hind II always cuts DNA molecules at a particular point by recognizing a specific sequence of a) six base pairs b) five base pairs c) four base pairs d) seven base pairs	1
4	DNA fragments generated by the restriction endonucleases in a chemical reaction can be separated by a) polymerase chain reaction b) electrophoresis c) restriction mapping d) centrifugation	1
5	In agarose gel electrophoresis, DNA molecules are separated on the basis of their a) Size only b) Charge to size ratio c) All of the above d) Charge only	1
6	The most important feature in a plasmid to be used as a vector is: a) Origin of replication (ori) b) Presence of a selectable marker c) Presence of sites for restriction endonuclease d) Its size	1
7	The EcoR-1 enzyme is obtained from (a) Virus (b) Salmonella (c) E.Coli (d) Penicillium	1
8	Which of the following is not a feature of the plasmid? (a) Single stranded (b) Independent replication (c) Circular structure (d) Small, circular double-stranded	1
9	A foreign DNA and plasmid cut by the restriction endonuclease can be joined to form a recombinant plasmid using______________ (a) Eco RI	1

	(b) Taq polymerase (c) Ligase (d) Polymerase II	
10	The construction of the first recombinant DNA was by linking of a gene encoding antibiotic resistance with the native plasmid of (a) Salmonella typhimurium (b) Agrobacterium tumefaciens (c) Entamoeba histolytica (d) Streptococcus pneumoniae	1
11	Identify a character that is not desirable in a cloning vector (a)an inactive promoter (b) an origin of replication site (c)selectable markers such as genes for antibiotic resistance (d)one or more unique restriction endonuclease site	1
12	A cloning vector has two antibiotic resistance genes- for tetracycline and ampicillin. A foreign DNA was inserted into the tetracycline gene. Non-recombinants would survive on the medium containing (a)ampicillin but not tetracycline (b)tetracycline but not ampicillin (c)both tetracycline and ampicillin (d)neither tetracycline nor ampicillin	1
13	A host cell normally does not take up a foreign DNA until it has been made competent to do so. This is because: (a)DNA is a hydrophilic molecule (b)DNA is a very large molecule (c)there are no receptors for DNA on the cell membrane (d) DNA is an inert molecule	1
14	Which of the following restriction sites is located within the gene for tetracycline resistance in the plasmid pBR322? (a) BamHI (b)Psti (c)Clal (d)Pvull	1
15	The technique not used for transformation of plant cells in recombinant procedures is: (a)Biolistic (b)Agrobacterium mediation (c)Use of viruses (d) Micro-injection	1
16	In the screening process during rDNA experiments, clones that metabolize β-gal turn: (a) Colourless (b)Blue	1

	(c)Yellow (d)Green	
17	Microinjection is suitable for a. Injecting an ovum into the sperm in IVF b. Transforming animal cells c. Injecting very small sized drug particles into neurons d. Conferring antibiotic resistance to a certain strain of bacteria	1
18	The plasmid pBR322 does not contain a. An origin of replication site b. A gene that encodes for restrictor of plasmid copy number c. Gene for Ampicillin and Streptomycin resistance d. Sites for many restriction enzymes	1
19	A and B in the pBR 322, shown in the diagram given below, respectively represent recognition sequences of  a. BamH I and Sma I b. Hind II and Sma I c. BamH I and SaI I d. SaI I and Hind II	1
20	A gene, whose expression helps to identify transformed cells is known as a. selectable marker b. vector c. plasmid d. structural gene	1
21	The DNA molecule to which the gene of interest is integrated for cloning is called a. Transformer b. Vector c. Template	1

	d. Carrier	
22	The colonies of recombinant bacteria appear white in contrast to blue colonies of non-recombinant bacteria because of a. Non-recombinant bacteria containing β galactosidase b. Insertional inactivation of α-galactosidase in non-recombinant bacteria c. Insertional inactivation of β-galactosidase in recombinant bacteria d. Inactivation of glycosidase enzyme in recombinant bacteria	1
23	The figure below is the diagrammatic representation of the E.Coli vector pBR 322. Which one of the given options correctly identifies its certain components (s)?  a. Ori-original restriction enzyme b. rop-reduced osmotic pressure c. Hind III, Eco RI -selectable markers d. amp^R, tet^R-antibiotic resistance genes	1
24	The linking of antibiotic resistance gene with the plasmid vector became possible with d. amp^R, tet^R-antibiotic resistance genes b. endonucleases c. DNA polymerase d. exonucleases	1
25	A tumor inducing plasmid widely used in the production of transgenic plants is that of a. Escherichia coli b. Bacillus thuringiensis c. Staphylococcus aureus d. Agrobacterium tumefaciens.	1
26	Which of the following is a cloning vector? a. DNA of Salmonella typhimurium b. Ti plasmid c. Amp' and Tet' loci	1

	d. Ori minus PBR322	
27	Plasmid vector in DNA recombinant technology means a. a virus that transfers gene to bacteria b. extra-chromosomal autonomously replicating circular DNA c. sticky end of DNA d. any fragment of DNA carrying desirable gene	1
28	Which organism is used to transfer T-DNA? a. Streplomyceshygroscopicus b. Agrobacterium tumefaciens c. Salmonella typhi d. Escherichia coli	1
29	Biolistic (gene gun) is suitable for a. disarming pathogen vectors b. transformation of plant cell c. constructing recombinant DNA by joining with vectors d. DNA fingerprinting	1
30	Which is a natural genetic engineer of the plants? a. E. coli b. *Agrobacteriumtumefaciens* c. Rhizobium d. Pseudomonas	1
31	Biolistic method makes use of microparticles coated with DNA bombarded at cells to be transformed. These particles are made up of a. Zinc or tungsten b. Silicon or gold c. Tungsten or gold d. Selenium or Platinum	1
32	Insertional inactivation of the *lac Z* gene forms- a. Blue recombinant colonies b. Colourless recombinant colonies c. Fluorescent green colonies d. There is no relation between the lac Z gene and colour of the colony.	1
33	Which is not a component of the vector pBR322? a. Chloramphenicol selectable marker b. Replication proteins c. Origin of replication d. Cloning site for BamHI enzyme	1
34	Which of the following would you choose as the safest and least cumbersome selectable marker-? a. Ampicillin resistance gene b. Tetracycline resistance gene	1

	c. Kanamycin resistance gene d. b Galactosidase gene	
35	Which enzyme is used to isolate DNA from fungal cells for biotechnology experiments? A) Lysozyme B) Chitinase) C)Cellulase D) Ligase.	1
36	Suggest a technique to a researcher who needs to separate fragments of DNA? A) PCR B) Gel electrophoresis. C)Centrifugation D) X-ray diffraction.	1
37	Which enzyme is used to isolate DNA from a plant cell? A) Chitinase B) DNA Polymerase C) Cellulase d) Amylase.	1
38	. While isolating DNA from bacteria, which of the following enzyme is not used? A) Deoxyribonuclease B) Lysozyme C) Ribonuclease D) Protease.	1
39	The purified DNA is precipitated by adding A) Deoxyribonuclease B) Chilled ethanol C) Acetone D) Ethidium Bromide.	1
40	Which of the following is incorrectly matched? A) RNA-Ribonuclease B) Proteins –Protease C) Fungus-Chitinase D) Plants –Lysozyme	1
41	Plants in comparison to animals are more rapidly manipulated by genetic engineering. Select out the most probable reason for this.	1

	A) Totipotency shown by plant cells. B) Single somatic cell can regenerate a whole plant body. C) Genetic engineering is supplemented with plant tissue culture techniques. D) All of the above	
42	The PCR technique was developed by__________. (a) Kohler (b) Altman (c) Milstein (d) Kary Mullis	1
43	Which of the following statements is accurate for the PCR – polymerase chain reaction? (a) Automated PCR machines are called thermal cyclers (b) A thermostable DNA polymerase is required (c) Millions to billions of desired DNA copies can be produced from microgram quantities of DNA (d) All of the above	1
44	Thermus aquatics is the source of __________. (a) Vent polymerase (b) Primase enzyme (c) Taq polymerase (d) Both a and c	1
45	Which of the following is the basic requirement of PCR reaction? (a) Two oligonucleotide primers (b) DNA segment to be amplified (c) A heat-stable DNA polymerase (d) All of the above	1
46	Which of the following steps are catalysed by Taq polymerase in a PCR reaction? (a) Denaturation of template DNA (b) Annealing of primers to template DNA (c) Extension of primer end on the template DNA (d) All of the above	1
47	Which one of the following steps is the first and the most important in the polymerase chain reaction? (a) Annealing (b) Primer extension (c) Denaturation (d) None of the above	1
48	What is the process of binding of primer to the denatured strand called? (a) Annealing	1

	(b) Renaturation (c) Denaturation (d) None of the above	
49	Denaturation is the process of __________. (a) Heating between 72°C (b) Heating between 40 to 60°C (c) Heating between 90 to 98°C (d) None of the above	1
50	Which of the following statements are true regarding PCR? (a) Primer extension occurs at 72°C (b) Denaturation involves heating at 90 to 98°C (c) Annealing involves the binding of primer between 40 to 60C°C (d) All of the above	1
51	Polymerase used for PCR is extracted from ______________ . (a) Homo sapiens (b) Thermus aquaticus (c) Escherichia coli (d) Saccharomyces cerevisiae	1
52	How many DNA duplexes are obtained from one DNA duplex after 4 cycles of PCR? (a) 8 (b) 4 (c) 32 (d) 16	1
53	Primers used for the process of polymerase chain reaction are __________. (a) Single-stranded RNA oligonucleotide (b) Single-stranded DNA oligonucleotide (c) Double-stranded RNA oligonucleotide (d) Single-stranded DNA oligonucleotide	1
54	At what temperature does annealing of DNA and primer take place? (a) 54°C (b) 96°C (c) 42°C (d) 74°C	1
55	Reverse transcription PCR uses __________. (a) RNA as a template to form DNA (b) mRNA as a template to form cDNA (c) DNA as a template to form ssDNA (d) All of the above	1
56	A device in which large volume of living cells are cultured in order to get a specific product is called (a) PCR (b) agitator (c) bioreactor (d) assimilator	1
57	Which of the following gene helps in identifying transformed cells? (a) plasmid (b) selectable marker	1

	(c) structural gene (d) vector	
58	Antibiotics are used in genetic engineering. They are useful (a) to keep culture free of microbial infections (b) to select healthy vectors (c) to identify replication start sites (d) as selectable markers	1
59	Which of the following is not a component of downstream processing? a. Expression b. Preservation c. Purification d. Separation	1
60	Recombinant proteins are a) proteins synthesized in animals b) proteins synthesized by transgene in host cell by rDNA technology c) proteins synthesised in cells that are produced by protoplast fusion d) proteins synthesized in mutated cell lines	1
61	How the plasmid clones can be screened? a) By selectable markers b) By bacterial resistance gene c) For restriction site d) By ARS sequence	1
62	What does continuous culture mean? a) Where DNA and protein getting expressed continuously. b. Where the used medium is drained out while fresh medium is added from another side. c. Where cells are producing protein for one week continuously. d. Where the production of recombinant DNA is continuing without interference.	1
63	Continuous culture has cells in a) their physically active phase b.) Lag phase c)Exponential phase d. Both a and b.	1
64	The cylindrical or curved base of a bioreactor actually facilitates: a. The handling and maintenance of bioreactor. b. Mixing c)Better oxygen transport d)More accumulation of product	1
65	A selectable marker is used to: a. help in eliminating the non-transformants so that the transformants can be regenerated. b. Identify the gene for a desired trait in an alien organism. c. Select a suitable vector for transformation in a specific crop. d. mark a gene on a chromosome for isolation using restriction enzyme.	
	BIOTECHNOLOGY: PRINCIPLES AND PROCESSES ASSERTION-REASON QUESTIONS	

	In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as: (a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion. (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion. (c) If Assertion is true but Reason is false. (d) If both Assertion and Reason are false.	
1	Assertion: Restriction endonucleases are also called 'molecular scissors'. Reason: When fragments generated by restriction endonucleases are mixed, they join together due to their sticky ends	1
2	Assertion: Foreign DNA and vector DNA are cut with the help of ligase. Reason: Ligase act on sugar phosphate backbone of DNA.	1
3	Assertion: In gel electrophoresis, DNA fragments are separated. Reason: DNA is negatively charged, so it moves towards anode under electric field.	1
4	Assertion: Genetic engineering can overcome the drawbacks of traditional hybridization. Reason: Genetic engineering can create desired DNA sequences to meet specific requirements	1
5	Assertion: A piece of DNA inserted into an alien organism generally does not replicate if not inserted into a chromosome. Reason: Chromosomes have specific sequences called 'ori' region where DNA replication is initiated.	1
6	Assertion: The uptake of DNA during transformation is an active, energy requiring process. Reason: Transformation occurs in only those bacteria, which possess the enzymatic machinery involved in the active uptake and recombination.	1
7	**Assertion:** *Agrobacterium tumefaciens* is popular in genetic engineering because this bacterium is associated with the roots of all cereal and pulse crops. **Reason:** A gene incorporated in the bacterial chromosomal genome, gets automatically transferred to the crop with which the bacterium is associated.	1
8	**Assertion: Plasmids** are extra chromosomal DNA. **Reason:** Plasmids are found in bacteria and are useful in genetic engineering	1

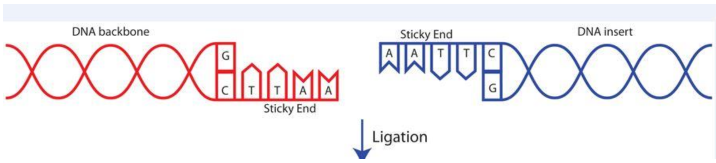
9	Assertion: E. coli having pBR322 with DNA insert at Bam HI site cannot grow in medium containing tetracycline. Reason: Recognition site for Bam HI is present in tetR region of pBR32	1
10	As**sertion:** Insertion of recombinant DNA within the coding sequence of β-galactosidase results in colourless colonies. **Reason:** Presence of insert results in inactivation of enzyme β-galactosidase known as insertional inactivation.	1
11	Assertion: To extract DNA from tomato cells, first it must be treated with chitinase, protease and then deoxyribonuclease. Reason: Deoxyribonuclease will digest Proteins While RNA will be intact.	1
12	Assertion: Chitinase is used to isolate DNA from bread Mould Reason: Chitinase is an enzyme that degrades chitin, which is a chief constituent of fungal cell walls.	1
13	Assertion: In the annealing step of PCR, primers are added at free 3' end of the target DNA and are catalyzed at a temperature of 60-50^0 C. Reason: The extension step is catalysed by Taq polymerase enzyme at a temperature of 72^0 C.	1
14	Assertion: In PCR, primers are used which are single stranded RNA fragment 100-200 nucleotides in length. Reason: The primers get attached to 5' site of the target sequence.	1
15	Assertion: the double-stranded DNA is denatured by subjecting it to high temperature of 94^0 C for 15 seconds. Reason: One of the separated strands of the DNA is destroyed during denaturation and the other act as a template.	1
16	Assertion: Selectable markers helps in identifying and eliminating non-transformants and selectively permitting the growth of transformants Reason: If a recombinant DNA bearing gene for resistance to ampicillin is transferred into E. coli cells, the host cells become transformed into ampicillin-resistant cells	1
17	Assertion: The genes encoding resistance to antibiotics are considered as useful selectable markers for E. coli Reason: The normal E. coli does not carry resistance against any of the antibiotics.	1
18.	Assertion: Cloning vector should have selectable marker. Reason: Selectable marker helps in identifying and eliminating non – transformants and selectively permitting the growth of transformants.	1
19.	Assertion: It is essential to have few cloning sites in a cloning vector.	1

	Reason: It helps in identifying and eliminating non – transformants and selectively permitting the growth of transformants.	
20.	Assertion: In a bioreactor, temperature, pH, substrate, salts, vitamins, and oxygen are maintained. Reason: They are added to maintain the proper growth of the organism and to achieve desired product optimally.	1
21.	Assertion: The most commonly used bioreactors are of stirring type. Reason: The stirrer facilitates even mixing & oxygen availability throughout the bioreactor.	1
22	Assertion: Bioreactors are used for the large-scale production of the desired products. Reason: Bioreactor designing only needs complete information of biological systems.	1
23	Assertion: The recombinant cells are multiplied in a continuous culture system Reason: It is to maintain the cells in their physiologically most active log/exponential phase	1
24.	Assertion: The process including separation & purification of product are collectively referred as downstream processing Reason: The downstream processing & quality control testing are same for all type of products.	1
25.	Assertion: The stirred-tank is well suited for large scale production of microorganisms under aseptic conditions. Reason: In sparged stirred tank bioreactor, surface area for oxygen transfer is increased.	1

MULTIPLE CHOICE QUESTIONS

SHORT ANSWER QUESTIONS

	SA 1 (2 MARK QUESTIONS)	
1	**Identify the recognition sites in the given sequences at which E.coRI will cut and make sticky ends.** **5´-GAATTC-3´** **3´-CTTAAG-5´**	**2**
2	What is the role of ‘Ori’ in any plasmid?	2
3	What are the two core techniques that enabled the birth of biotechnology?	2
4	Make a list of tools of recombinant DNA technology	2
5	Why is it not possible for an alien DNA to become part of chromosome anywhere along its length and replicate?	2

6	What is EcoRI? How does EcoRI differ from an exonuclease?	2
7	How are ‘Sticky ends’ formed on a DNA strand? Why are these so-called?	2
8	Study the given diagram and answer the questions  A] Name the restriction enzyme that recognises this palindrome. B] Name the enzyme that link the DNA fragments.	2
9	Name the first plasmid used as vector.	2
10	Why is it not possible for an alien DNA to become part of a chromosome anywhere along its length and replicate normally?	2
11	Name two commonly used vectors in genetic engineering.	2
12	An extra chromosomal segment of circular DNA of a bacterium is used to carry gene of interest into the host cell. What is the name given to it?	2
13	Name the commonly used vector for trans formation in plant cell?	2
14	Differentiate between plasmid DNA and chromosomal DNA?	2
15	What is the role of Ori for cloning vector?	2
16	Why is it essential to have selectable marker in a cloning vector?	2
17	The gene of interest is cloned at which position in plasmid PBR322 to facilitate quick selection?	2
18	State what happens when an alien gene is ligated at Sal I site of pBR322 plasmid.	2
19	Name the host cells in which microinjection technique is used to introduce an alien DNA.	2
20	Name the enzyme used as an alternate selectable marker.	2
21	Explain any two methods of vector less gene transfer?	2
22	Name the source organism from which Ti plasmid is isolated. Explain the use of this plasmid in biotechnology	2
23	Why is Agrobacterium tumefaciens considered as a good cloning vector? Explain.	2
24	Why is ‘Origin of replication’ (Ori) required to facilitate cloning into a vector?	2
25	Why is Agrobacterium mediated genetic transformation describe as natural genetic engineering in plants?	2
26	DNA being hydrophilic cannot pass through cell membrane of a host cell. Explain how does recombinant DNA get introduced into the host cell to transform the later?	2
27	Which enzymes are used for releasing macromolecules (DNA) from cell envelope?	2
28	Name the enzymes used in Bacteria, Plants and fungus for isolating DNA?	2
29	What are the other macromolecules associated with DNA?	2
30	Name the enzyme used to cut DNA?	2

31	Why is the enzyme cellulase needed for isolating genetic material from plant cells and not from animal cells?	2
32	Give the full form of PCR. Who developed it?	2
33	How many PCR cycles are adequate for proper amplification of DNA segment?	2
34	Name the source of the DNA polymerase used in PCR technique.	2
35	Why we prefer the usage of Taq polymerase in PCR technique?	2
36	Name the bacterium that yields thermostable DNA polymerase.	2
37	Name the technique used for amplification of DNA?	2
38	Biotechnological techniques can help to diagnose the pathogen much before the symptoms of the disease appear in the patient. Suggest any two such techniques	2
39	Why is the primer required in PCR added at the 3' end of DNA template?	2
40	What are selectable markers? What is their use in genetic engineering?	2
41	Name two main steps which are collectively referred to as down streaming process. Why is this process significant?	2
42.	What are recombinant proteins? How do bioreactors help in their production?	2
43.	How does a simply stirred tank bioreactor to differ from sparged stirred – tank' bioreactor?	2
44.	How is a continuous culture system maintained in a bioreactor?	2
	SA II (3 MARK QUESTIONS)	
1	Explain the work carried out by Cohen and Boyer that contributed immensely to biotechnology.	3
2	With the help of diagrams show the different steps in the formation of recombinant DNA by the action of restriction endonuclease.	3
3	How are restriction endonuclease enzymes named? Write examples.	3
4	How are DNA segments separated by gel electrophoresis be visualised and isolated?	3
5	List 6 recombinant proteins which are used in medical practice? Find where they are used as therapeutics.	3
6	How do bioreactors help in the production of recombinant proteins?	3
7	Sketch the two types of bioreactors. What is the utility? Which is the common type of bioreactors?	3
8	Besides better aeration and mixing properties, what other advantages do stirred tank bioreactors have over shake flasks?	3
9	What are the components of a bioreactor?	3

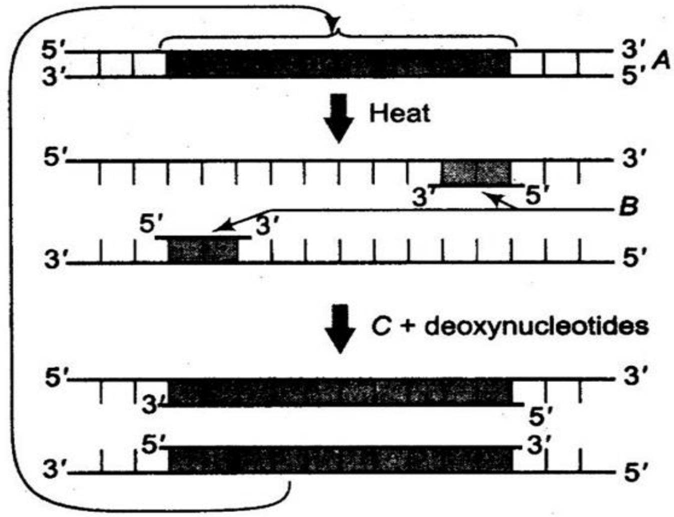
<u>LONG ANSWER QUESTIONS</u>

1	With the help of diagrams enumerate the different steps in recombinant DNA technology.	5
2	With the help of a neat labelled sketch, explain the formation of recombinant DNA by action of restriction endonuclease enzyme EcoR1.	5

3	a) Why are engineered vectors preferred by biotechnologists for transferring the desired genes into another organism? (b)Explain how do "*ori*" selectable markers" and" cloning sites" facilitate cloning into a vector?5	5
4	List the steps involved in rDNA technology	5
5	Any recombinant DNA with a desired gene is required in billion copies for commercial use. How is the amplification done? Explain.	5
6	How is the bacterium Thermus aquaticus employed in recombinant DNA technology?	5
7	What is bioreactor? Draw a labelled diagram of a sparged stirred bioreactor. Explain its functioning.	5
8	What is downstream processing? Describe the steps in downstream processing.	5
9	Sequentially state the process you would adopt for getting a recombinant protein?	5
10	Describe the parts of a Simple stirred-tank bioreactor.	5
11	Draw well labelled diagrams of simple stirred tank bioreactor and sparged stirred tank bioreactor. distinguish between simple stirred tank bioreactor and sparged stirred tank bioreactor.	5

DIAGRAM BASED QUESTIONS

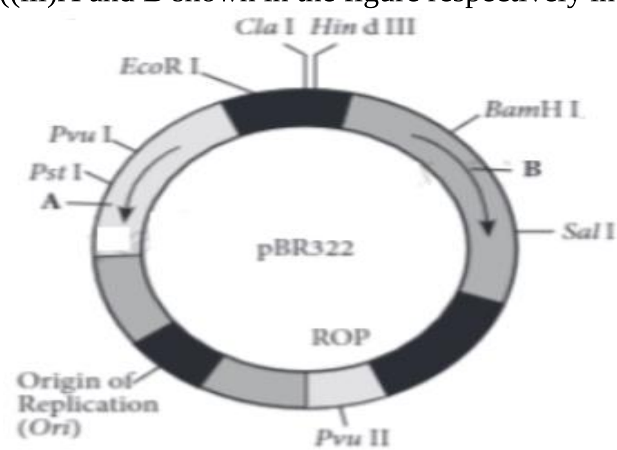
1.	A schematic representation of Polymerase Chain Reaction (PCR) up to the extension stage is given below. Answer the questions that follow:	2

	 (i) Name the process - A. (ii) Identify B. (iii) Identify C and mention its importance in PCR.	
2	A schematic representation of Polymerase Chain Reaction (PCR) up to the extension stage is given below. Identify A, B C & D:	2

CASE BASED QUESTIONS

CASESTUDY-I

Read the following and answer any four questions from (i) to (v) given below 'The vectors are DNA molecules that can carry a foreign DNA segment and replicate inside the host cell. Vectors may be plasmids, bacteriophages (viruses that attack bacteria), cosmids, yeast artificial chromosomes (YACs), Bacterial artificial chromosomes (BACs) and viruses. The most widely used, versatile, easily manipulated vector PBR 322 is an ideal plasmid vector. Features that are required to facilitate cloning into a vector includes origin of replication (Ori) which is a specific sequence of DNA bases responsible for initiating replication, selectable marker genes and cloning sites.	

(i) p in pBR 322 denotes that it is a (a) plasmid (b) prokaryote (c) protist (d) plant cell.	1
(ii) Ori is a specific DNA sequence that help in (a) attachment of primers (b) initiation of replication (c) extension of DNA base (d) initiation of denaturation.	1
((iii)A and B shown in the figure respectively indicates  (a) Pvu II and Cla I (b) ROP and Sal l (c) amp^R and tet^R (d) tet^R and amp^R.	1
(iv) Selectable markers in vector (a) are responsible for replication (b) help in selecting transformants from non-transformants (c) code for proteins involved in the replicating plasmids (d) contain unique recognition sites.	1
(v) Plasmid vectors are (a) dsDNA molecule (c) present in bacteria and yeast (b) extra-chromosomal (d) all of these.	1

CASE STUDY -II

2. *Read the following and answer any four questions from (i) to 8(v) given below:* Rajat is a student of biotechnology. His professor tells him that for	

transformation with recombinant DNA the bacterial cells must be made capable of taking up DNA as DNA do not pass through membrane. While doing experiment in the lab, Rajat noticed that bacterial cells were not taking up the foreign DNA even after treating it with sodium ion. He asked his professor, the reason behind this. His professor explained that he should check the valency and charge of the ion that he is using for the treatment.	
(i) It is difficult for DNA to pass through the membrane as (a) it is a hydrophilic molecule (b) it is a hydrophobic molecule (c) it is a circular molecule (d) it changes its shape when it comes in contact with host cell	1
(ii) What type of ions are used for DNA mediated gene transfers? (a) Divalent anions (b) Divalent cations (c) Monovalent cations (d) Monovalent anions	1
(iii) rDNA stands for (a) reduced DNA (b) red DNA (c) recombinant DNA (d) related DNA.	1
(iv) Which of the following statements with regard to DNA is correct? (a) DNA is a positively charged molecule having two polynucleotide chains. (b) Nitrogen bases of two polynucleotide chain form complementary pairs. i.e., A opposite G and T opposite C. (c) Backbone of DNA chain is built up of alternate deoxyribose sugar and phosphate group. (d) Both (a) and (c)	1
(v) Assertion: Competent host is essential for transformation with rDNA. Reason: Transfer of DNA in a prokaryotic cell is called transfection. (a) Both assertion and reason are true and reason is the correct explanation of assertion. (b) Both assertion and reason are true but reason is not the correct explanation of assertion. (c) Assertion is true but reason is false. (d) Both assertion and reason are false.	1

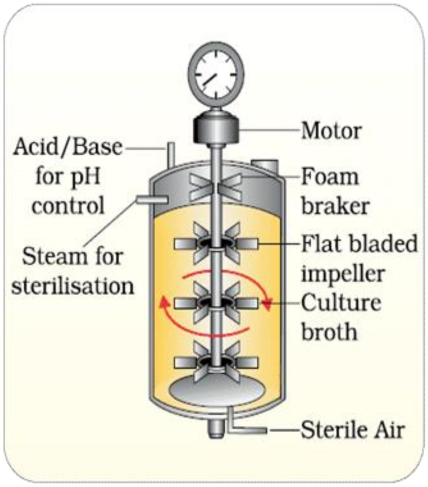
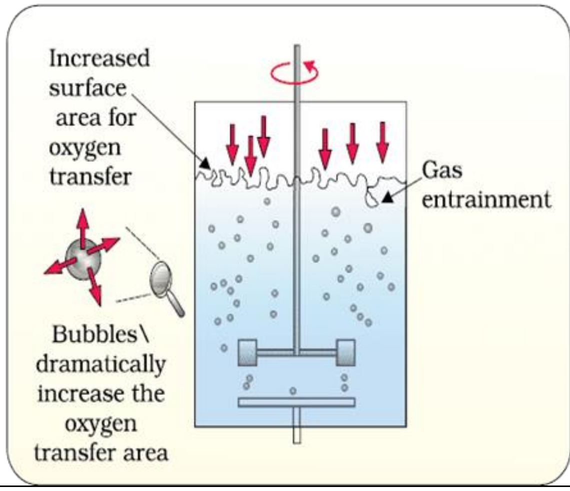
CASE STUDY -III

When you insert a piece of alien DNA into a cloning vector and transfer	

it into a bacterial, plant or animal cell, the alien DNA gets multiplied. In almost all recombinant technologies, the ultimate aim is to produce a desirable protein. Hence, there is a need for the recombinant DNA to be expressed. The foreign gene gets expressed under appropriate conditions. The expression of foreign genes in host cells involve understanding many technical details. After having cloned the gene of interest and having optimised the conditions to induce the expression of the target protein, one has to consider producing it on a large scale. Can you think of any reason why there is a need for large-scale production? If any protein encoding gene is expressed in a heterologous host, it is called a recombinant protein. The cells harbouring cloned genes of interest may be grown on a small scale in the laboratory. The cultures may be used for extracting the desired protein and then purifying it by using different separation techniques.	
i. Which of the following should be chosen for best yield if one were to produce a recombinant protein in large amounts? (a) A continuous culture system b) A stirred-tank bioreactor without in-lets and out-lets c) Laboratory flask of the largest capacity d)None of the above	1
ii. The process of separation and purification of expressed protein before marketing is called (a) upstream processing (b) downstream processing (c) bioprocessing (d) postproduction processing	1
iii. Genetically engineered bacteria is used for the production of: a. Thyroxine b. Human insulin c growth hormone d. None of the above	1
iv. Construction of recombinant DNA involves: a. cleaving and joining of DNA segments with endonuclease b. cleaving DNA segments with endonuclease and re-joining with ligase c. cleaving and re-joining DNA segments with ligase d. cleaving DNA segments with ligase and re-joining with endonuclease	1
v. Any DNA molecule that has the ability to replicate in an appropriate host cell, to which the desired gene are integrated for cloning: a. Plasmid b. Linker c. Vector d. adapter	1

1. **CASE STUDY-IV**

The cells can also be multiplied in a continuous culture system wherein the used medium is drained out from one side while fresh medium is added from the other to maintain the cells in their physiologically most active log/exponential phase. A stirred-tank reactor is usually cylindrical or with a curved base to facilitate the mixing of the reactor contents. The stirrer facilitates even mixing	

and oxygen availability throughout the bioreactor. Alternatively, air can be bubbled through the reactor. If you look at the figure closely you will see that the bioreactor has an agitator system, an oxygen delivery system and a foam control system, a temperature control system, pH control system and sampling ports so that small volumes of the culture can be withdrawn periodically.  	
i. Micro-organisms can be grown in the bioreactors by (a) Support growth system (b) Agitated growth system (c) Suspended. growth system (d) Both (a) and (c)	1
ii. The components of a bioreactor are: (a) An agitator system (b) An oxygen delivery system (c) A foam control system (d)All of these	1
iii. The bioreactor is not capable of: a) Producing aseptic conditions b) Meeting containment regulations c) Controlling pH d) Produce electricity	1
iv. The small-scale bioreactors have volume of: a) 5-10 litres b) 10-20 litres c) 1-10 litres d) 1-20 litres	1
v. Sparger in stirred tank bioreactor helps in: a. Proper gas distribution b. Proper mixing of medium c. Measuring temperature of medium d. Better sterility	1

ANSWER KEY

MULTIPLE CHOICE QUESTIONS

1	c	34	d
2	a	35	b
3	a	36	b
4	b	37	c
5	a	38	a
6	a	39	b
7	c	40	d
8	a	41	a
9	c	42	d
10	a	43	d
11	a	44	c
12	c	45	d
13	a	46	c
14	a	47	b
15	a	48	a
16	b	49	c
17	b	50	d
18	b	51	b
19	c	52	d
20	a	53	b
21	b	54	a
22	c	55	b
23	d	56	c
24	b	57	b
25	d	58	d
26	b	59	a
27	b	60	b
28	b	61	a
29	b	62	b
30	b	63	c
31	c	64	b
32	b	65	a
33	b		

ANSWER KEY-ASSERTION -REASON TYPE QUESTIONS

1	b	14	d
2	d	15	c
3	a	16	b
4	a	17	c
5	a	18	a
6	c	19	c
7	a	20	a
8	b	21	a
9	b	22	b
10	a	23	a

11	d	24	c
12	a	25	b
13	b		

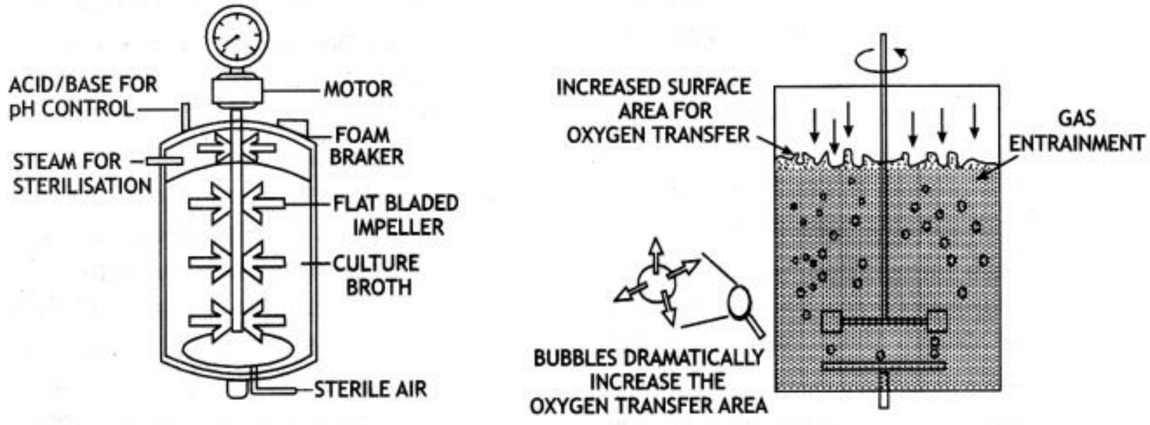
ANSWER KEY- SHORT ANSWER QUESTIONS

	SA 1 (2 MARK QUESTIONS)	
1	**ans. 5'−G↓AATTC-3'** **3'−CTTAA↑G-5'**	2
2	Ori is a nucleotide sequence in plasmid vector which makes any piece of DNA linked to this sequence replicate with in host cells. Ori also determines the copy number of linked DNA	2
3	The two core techniques that enabled the birth of modern biotechnology are: Genetic engineering techniques to alter the chemistry of genetic material (DNA and RNA), so that it can be introduced to host organisms to change the phenotype of the host organism. Maintenance of sterile ambience in chemical engineering processes to enable the growth of only the desired microbe/eukaryotic cell in large quantities for the manufacture of biotechnological products like antibiotics, vaccines, enzymes, etc.	2
4	Key tools of recombinant DNA technology: Restriction enzymes Polymerase enzymes Ligases Vectors Host organism.	2
5	For multiplication of any alien DNA, it needs to be a part of a chromosome which has a specific sequence known as 'origin of replication'	2
6	EcoRI is an endonuclease restriction enzyme which cut both the stands of palindromic DNA at a specific position of nitrogen base sequence (GAATTC) while exonuclease removes nucleotides from terminals of DNA strands.	2
7	1. Restriction enzymes cut the 2 strands of DNA a little away from the centre of palindrome site, but between the same two bases on opposite strands. As a result, single-stranded over hanging stretches of DNA called sticky ends are left at each end. 2. The Sticky ends are named so because they form hydrogen bonds with their complementary cut counterparts. The stickiness helps in the action of DNA ligase.	2
8	A] EcoR1 B] DNA ligase	1+1
9	pBR322.	2
10	Alien DNA must be linked to ori or origin of replication site to start replication.	2
11	Plasmid and Bacteriophage.	2
12	Plasmid.	2
13	Agrobacterium tumefaciens.	2

14	Plasmid DNA is extranuclear DNA, found in protoplasmic whereas chromosomal DNA is the nuclear or genetic DNA which is found within the nucleus.	2
15	Ori: It is a genetic sequence that acts as the initiation site for replication of DNA. Any fragment of DNA, when linked to the ori region, can be initiated to replicate	2
16	Selectable markers are essential to identify and eliminate non-transformants (no recombinant DNA), and selectively permitting the growth of the transformants (host cells bearing recombinant DNA).	2
17	The gene of interest is inserted at restriction enzyme site located in any one of the antibiotic resistance genes or selectable marker gene. The restriction sites are Hind III, EcoR I, BamH I, Sal I, Pvu I, Pst I, Cla I and the selectable markers are ampR and tetR.	2
18	If an alien gene is ligated at Sal I site of tetracycline resistance gene in the vector pBR322, the recombinant plasmid will lose its tetracycline resistance.	2
19	The microinjection technique to introduce alien DNA is usually carried out in animal cell, i.e. directly into the nucleus.	2
20	β --Galactosidase.	2
21	.(i)Microinjection-In this method rDNA is directly injected into the nucleus of an animal cell (ii) Biolistics or gene gun-In this the target cells are bombarded with high velocity particles of gold or tungsten coated with DNA	2
22	(i)Agrobacterium tumefaciens (ii)The desired gene or segment of DNA can be ligated to this plasmid, and it is then used as a vector to introduce gene into the host plant.	2
23	i)Agrobacterium tumefaciens is a soil bacterium which causes diseases in many dicot plants? (1) (ii)It is able to deliver a piece of DNA known as T-DNA, to transform the normal cells into tumour cells and direct these tumour cells to produce to chemicals required by the pathogen. (1)	2
24	Ori is a sequence from where replication starts and any piece of DNA to replicate in the host cell needs to be linked to it. (1) * It also controls the copy number of the linked DNA. (1)	2
25	(i) Agrobacterium tumefaciens pathogen of dicot plants is able to deliver a piece of DNA known as T-DNA to transform normal plant cell into tumour. (ii) Ti plasmid of Agrobacterium tumefaciens has been modified into a cloning vector, which is no more pathogenic to the plant but still able to use the mechanism to deliver genes into a variety of plants. iii. Since this process occur without human intervention, it is described as natural genetic engineering.	2
26	(i)Chemical and heat shock method -the bacterial cells are treated with specific concentration of divalent cation such as calcium, rDNA is forced into such cells by incubating rDNA on ice, followed by placing them briefly at 420c and placing them back on ice. .(i)Microinjection-In this method rDNA is directly injected into the nucleus of an animal cell (ii)Biolistics or gene gun-In this the target cells are bombarded with high velocity particles of gold or tungsten coated with DNA	2
27	Lysozyme for bacteria, cellulase for plant cell and chitinase for fungus.	2
28	Lysozyme for bacteria, cellulase for plant cell and chitinase for fungus.	2
29	RNA, proteins, polysaccharides and also lipids	2
30	restriction enzymes,	2
31	The enzyme cellulase breaks down cellulose which is present in cell walls of plants but absent in animal cells.	2

32	PCR is a polymerase chain reaction. It was developed by Kary Mullis in 1985.	2
33	20-30 cycles.	2
34	The DNA polymerase used in PCR is Taq polymerase extracted from the bacterium Thermus aquaticus.	2
35	It is a thermostable enzyme that can withstand high temperature used in the denaturation and separation of DNA strands. Hence, it can be used for a number of cycles in amplification.	2
36	The thermostable DNA polymerase can be produced with the help of a bacterium which is named Thermus aquaticus.	2
37	The DNA amplification can be done by the technique named the Polymerase Chain Reaction.	2
38	1. PCR – Polymerase chain reaction 2. ELISA – Enzyme-linked immunosorbent assay	2
39	The dna polymerase can catalyse polymerisation reaction in 5' to 3' direction only. The free 3' end of the primer will provide linking site for new nucleotides.	2
40	A gene or other identifiable portion of DNA whose inheritance can be followed and used in the process of selection of transformed cells from non-transformed ones is called selectable marker. A selectable marker is a gene inserted into a cell, in particular a bacterium or a cultured cell, which confers a trait appropriate for artificial selection.	2
41.	Separation and Purification. This process is essential because before reaching into market, the product has to be subjected for clinical trial and quality control.	2
42.	Any protein encoding gene is expressed in a heterologous host, is called recombinant protein. Bioreactors help in the production of recombinant proteins on large scale. A bioreactor provides optimal conditions for achieving the desired recombinant protein by biological methods.	2
43.	In the simply stirred tank bioreactor the stirrer facilitates the even mixing and the oxygen availability throughout the process, whereas for proper mixing throughout the reactor in the case of sparged stirred-tank bioreactor the air is found to be bubbled.	2
44.	In a continuous culture system, the used medium is drained out from one side while the fresh medium is added from the other to maintain the cells in their physiologically most active log/exponential phase. The continuous culture method produces larger biomass leading to a higher yield of the desired protein.	2
	SA II (3 MARK QUESTIONS)	
1	They isolated antibiotic resistance gene by cutting out a piece of DNA from the plasmid. The cutting of DNA at specific locations was done with the help of **restriction enzymes** popularly called as **'molecular scissors**. The cut piece of DNA with antibiotic resistance gene was then linked with the plasmid DNA of Salmonella typhimurium acting as **vector** with the help of the **enzyme DNA ligase**. This **new autonomously replicating DNA** created **in vitro** with linked fragment of antibiotic resistant gene is called **recombinant DNA** Recombinant DNA was then transferred into Escherichia coli, where it could **replicate** using the new **host's DNA polymerase enzyme.** The ability to multiply copies of antibiotic resistance gene in E. coli was called **cloning of antibiotic resistance gene in E. coli.**	3
2	Fig 11.1 steps in the formation of recombinant DNA by action of restriction endonuclease enzyme ECoRI Page 196 NCERT TEXT	3
3	The naming of restriction enzymes is as follows:	3

	The first letter of the name comes from the genus and the next two letters from the name of the species of the prokaryotic cell from which they are isolated. The next letter comes from the strain of the prokaryote. The roman numbers following these four letters indicate the order in which the enzymes were isolated from that strain of the bacterium. eg.EcoR I is isolated from Escherichia coli RY 13	
4	-The separated DNA fragments are visualised after staining with ethidium bromide followed by exposure to UV light. -The bright orange-coloured bands of DNA appears when ethidium bromide-stained gel is exposed to UV light. -The separated bands of DNA are cut out from the gel piece and extracted from the gel piece. This is known as elution.	
5	<table><tr><td>RECOMBINANT PROTEIN</td><td>THERAPEUTIC USE</td></tr><tr><td>1INSULIN</td><td>For treatment of diabetes mellitus</td></tr><tr><td>2.HUMAN GROWTH HORMONE</td><td>For treatment of dwarfism</td></tr><tr><td>3.INTERFERONS</td><td>For the treatment of viral diseases, cancer and AIDS</td></tr><tr><td>4STREPTOKINASE</td><td>For treating thrombosis</td></tr><tr><td>5.INTERLEUKINS</td><td>For treating sepsis and cancer</td></tr><tr><td>6.HEPATITIS -B SURFACE ANTIGEN</td><td>Vaccine against hepatitis B</td></tr></table>	3
6	Small volume cultures cannot yield appreciable quantities of products. To produce these products in large quantities the development of 'bioreactors' was required where large volumes of (100-1000 L) of cultures can be processed. Thus, bioreactors can be thought of as vessels in which raw materials are biologically converted into specific products, using microbial, plant, animal, or human cells or individual enzymes. A bioreactor provides the optimal conditions for achieving the desired product by providing optimum growth conditions like temperature, pH, substrate, salts, vitamins and oxygen.	3

<table>
<tr><td>7</td><td>

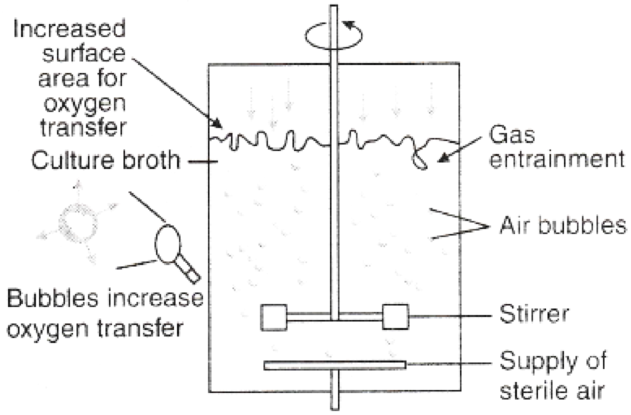
(a) Simple stirred-tank bioreactor (b) Sparged stirred-tank bioreactor through which sterile air bubbles are sparged.
A bioreactor provides the optimal conditions for achieving the desired product by providing optimum growth conditions (temperature, pH, substrate, salts, vitamins, oxygen).
One of the most commonly used bioreactors is of stirring type.
A stirred tank reactor is cylindrical or a container with a curved base which facilitate the mixing of the reactor contents. The stirrer facilitates even mixing and oxygen availability throughout the bioreactor. Alternatively, air can be passed through the reactor. It consists of agitator system, an oxygen delivery system, a foam control system, a temperature control system, pH control system and sampling ports so that small volumes of the culture can be withdrawn periodically.</td><td>3</td></tr>
<tr><td>8</td><td>Shake flasks are used for growing and mixing the desired materials on a small scale in the laboratory. A large scale production of desired biotechnological product is done by using ‘bioreactors’. Besides better aeration and mixing properties, the bioreactors have following advantages
(i) Small volumes of cultures are periodically withdrawn from die reactor for sampling.
(ii) It has a foam control system, pH control system and temperature control system.
(iii) Facilitates even mixing and oxygen availability throughout the bioreactor.</td><td>3</td></tr>
<tr><td>9</td><td>The bioreactor has the following components:
• An agitator system.
• An oxygen delivery system.
• A foam control system.
• A temperature control system.
• pH control system and
• Sampling ports.</td><td>3</td></tr>
</table>

ANSWER KEY-

	LONG ANSWER QUESTION 5 MARKS	
1	• Isolation of genetic material which has the gene of interest. • Cutting of gene of interest from genome and vector with the same restriction endonuclease enzyme. • Amplifying gene of interest (PCR). • Ligating gene of interest and vector using DNA ligase forming rDNA. • Transformation of rDNA into the host cell. • Multiplying host cell to create clones.	5

	• Figure 11.2 Diagrammatic representation of recombinant DNA technology page 197 NCERT text book	
2	DIAGRAM –Refer Page 196 Fig 11.1NCERT text Restriction endonuclease recognizes a specific palindromic nucleotide sequence in the DNA. -The recognition site for EcoRI - 5' - G A A T T C - 3' 3' - C T T A A G - 5' -Restriction enzymes cut the strand of DNA a little away from the centre of the palindromic sites, but between the same two bases on the opposite strands: -The enzyme cuts both the vector DNA and the foreign DNA at the same site. EcoRI cuts the DNA between bases G and A only when the sequence GAATTC is present in the DNA. -This leaves single-stranded portions at the end which are overhanging stretches called sticky ends. -sticky end form hydrogen bonds with their complementary cut counterparts. This stickiness of the end facilitates the action of enzyme DNA ligase. -Thus, Recombinant DNA is formed.	5
3	.(a)Engineered vectors are preferred because they help easy linking of foreign DNA and selection of recombinants from non-recombinants. (b)(i) Origin of replication (Ori) -It is the sequence of DNA from where replication starts. -Any piece of alien DNA linked to it is made to replicate within the host cell -It also decides the copy number of linked DNA (ii)Selectable marker -The selectable marker is a gene in the vector, which helps in selecting the transformant/recombinant cells from the non-recombinants. Eg. the genes encoding resistance to antibiotics. (iii)Cloning sites -The vector should have very few, preferably single recognition sites to link the alien/foreign DNA.	5

4	• Isolation of a desired DNA fragment. • Ligation of the DNA fragment into a vector. • Transferring the recombinant DNA into the host. • Culturing the host cells in a medium at large scale and extraction of the desired product.	5
5	Ans. Amplification of gene is done using polymerase Chain Reaction (PCR). it is carried out in the following steps: (i) Denaturation The double stranded DNA is denatured by applying high temperature of 95°C for 15 seconds. Each separated strand acts as a template. (ii) Annealing Two sets of primers are added, which anneal to the 3′ end of each separated strand. (iii) Extension DNA polymerase extends the primers by adding nucleotides complementary to the template provided in the reaction. Taq polymerase is used in the reaction, which can tolerate heat. All these steps are repeated many times to get several copies of the desired DNA.	5
6	Ans. Thermus aquaticus, a bacterium yields DNA polymerase used in PCR in recombinant DNA technology. (i) This enzyme remains active during the high temperature applied in the denaturation of double stranded DNA. (ii) It extends the primers using the nucleotides provided in the reaction and the genomic DNA as template. (iii) Repeated amplification is achieved by this enzyme. The amplified fragments, if desired can be used to ligate with a vector for further cloning.	5
7	Bioreactors are vessels in which raw materials are biologically converted into specific products using microbial, plant or animal cells. A bioreactor provides the optimal conditions for achieving the desired product by providing optimum growth conditions like temperature, pH, substrate, salts, vitamins and oxygen. In a sparged stirred-tank bioreactor, the sterile air is sparged through the reactor. Sparged stirred-tank bioreactor has increased surface area for oxygen transfer than simple stirred-tank.	5

	 Sparged stirred tank bioreactor	
8	The process of formulation, separation and purification of rDNA products made in Bioreactors is called downstream processing. Steps in downstream processing. i)Separation of biomass: the (microbial cells are separated from the culture medium. If the product is biomass then it is recovered for processing and spent medium is discarded. Cell mass is separated from the fermented broth by centrifugation or ultracentrifugation. When there is no aeration and agitation some of the microbial cells settle down in the fermentor. Ii)Cell disruption: if desired product is intracellular the cell biomass can be disrupted so that the product is released. iii)concentration of broth: The spent medium is concentrated if the product is extracellular. iv)Initial purification of metabolites: methods for recovery of product from the clarified fermented broth -precipitation, solvent extraction, ultrafiltration, ion exchange chromatography, adsorption and solvent extraction. v)Metabolite specific purification: Specific purification methods are used when desired metabolite is purified to a very high degree. vi)De watering: When a low amount of product is found in very large volume of spent medium, volume is reduced by removing water to concentrate the product.it is done by vaccum drying or reverse osmosis. vii) Polishing of metabolites: Final step of making the product to 98%-100% pure. Purified product is mixed with excipients. The formulated product is packed and sent to the market for the consumers.	5
9.	i) Isolation of DNA (enzymes used), cutting the DNA, ii)Separation of fragments, iii)PCR,	5

	iv)introducing into host cell, v)obtaining gene product in the Bioreactor, vi)downstream processing	
10	i)An agitator system ii). oxygen delivery system iii)Foam control system iv)temperature control system v) pH control system vi) Sampling ports vii) Cleaning and sterilization system. viii). A sump and dump line for emptying of the reactor.	5
11	. i) There is increased surface area for oxygen transfer in the Sparged Stirred bio reactor, whereas there is less surface area as compared to Sparged tank for oxygen area in Simple Stirred bio reactors. ii). Bubbles increase the oxygen transfer area in Sparged whereas there is absence of oxygen bubbles in Simple stirred	5

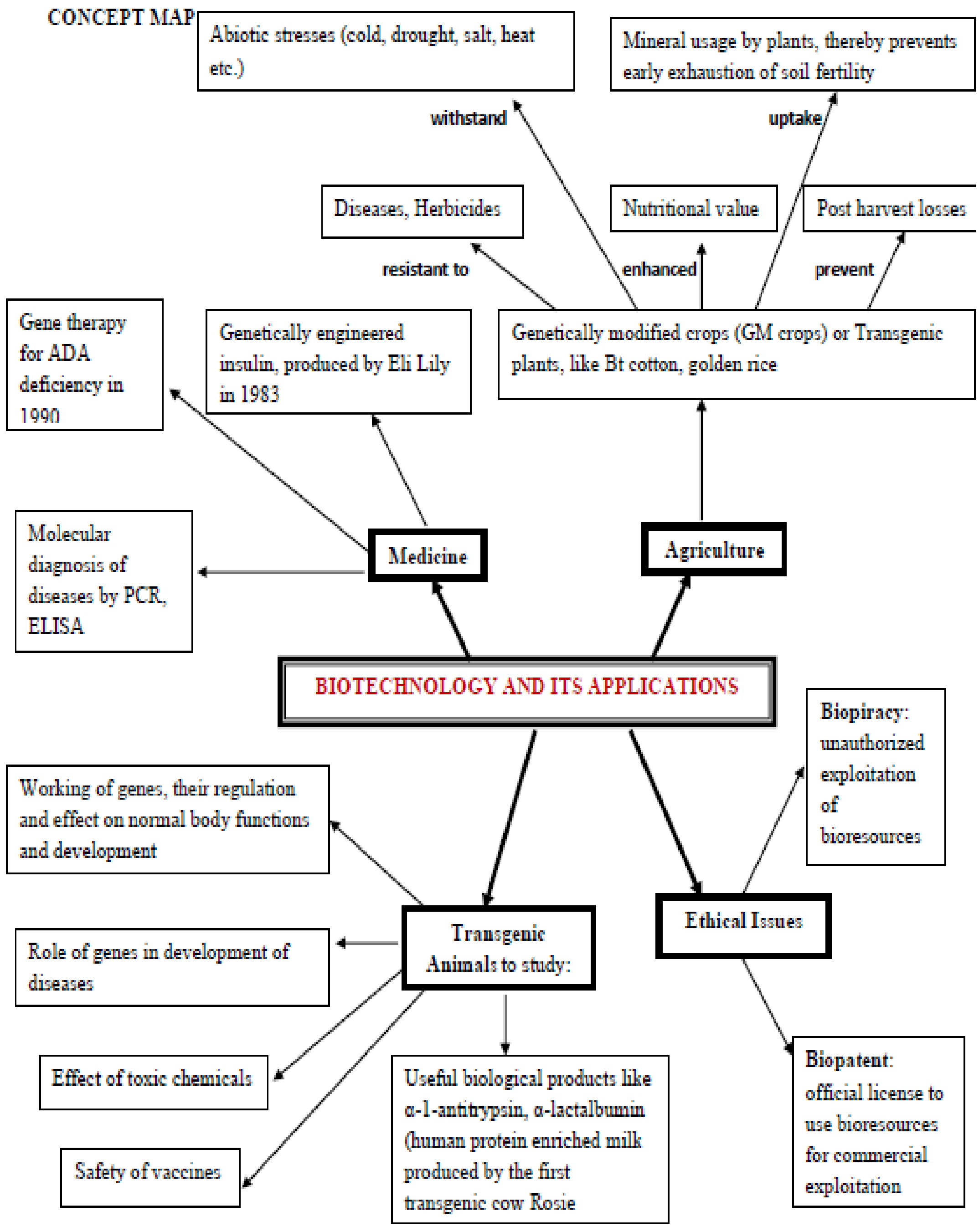
ANSWER KEY- DIAGRAM BASED QUESTIONS

1	(i) A-Denaturation of the double stranded DNA. (ii) B-Primers (iii) C-DNA polymerase or Taq polymerase. Importance in PCR: It extends the primers using the nucleotides provided in the reaction medium and the genomic DNA as the template. Taq polymerase is thermostable and withstands the high temperature used in denaturation process.	3
2	A - Heat B - Primers C - Deoxynucleotides D - 30	2

ANSWER KEY- CASE BASED QUESTIONS

CASE 1	CASE 2	CASE 3	CASE 4
i) a ii) b iii) c iv) b v) d	i) a ii) b iii) c iv) c v) c	1. a 2. b 3. b 4. b 5. c	1. d 2. d 3. d 4. a 5. a

CHAPTER 12: BIOTECHNOLOGY & ITS APPLICATIONS



GIST OF THE MAJOR & MINOR CONCEPTS

- Deals with industrial scale production of bio pharmaceuticals and biological products using genetically modified microbes.

- Applications include:-
    - Therapeutics
    - Diagnostics
    - Genetically modified crops for agriculture.
    - Processed food
    - Bioremediation
    - Waste treatment
    - Energy production
- 3 Critical research areas
    1. Providing best catalyst (improved organisms/microbes/pure enzyme)
    2. Creating optimal condition for catalytic action
    3. Downstream processing technologies to purify protein/ organic compound.

BIOTECHNOLOGICAL APPLICATION IN AGRICULTURE

Three Options:-

- Agro-chemical based agriculture.
- Organic agriculture
- Genetically engineered crop-based agriculture.

- Green revolution has tripled the food supply.
- Agrochemicals are often too expensive
- Further increase not possible using conventional breeding.
- Use of chemicals and fertilisers are harmful
- These problems can be solved by using GMO.

GENETIC MODIFICATION HAS MADE

- Crops more tolerant to abiotic stresses.
- Reduced use of chemical pesticides.
- Reduce post harvest losses.
- Increased efficiency of mineral usage.
- To enhance nutritional value of food.

BT COTTON

- *Bacillus thuringiensis* produce proteins crystals.
- These protein crystals kills certain group of insects.
- Crystals contain- toxic insecticidal protein.
- These protein does not kill bacteria as it exists as inactive pro toxins.
- When ingested by insects, it is converted to active form due to the alkaline pH of gut, which solubilises the crystals.
- Active toxins binds to the surface of midgut epithelial cells and create pores, which causes swelling and lysis, which leads to death.
  NOTE: Bt toxins are insect group specific

Eg: toxins is coded by gene cry/AC (cry genes) and cry II Ab controls boll worms. cry/Ab controls corn borer.

PEST RESISTANT PLANTS:

- A nematode *Meloidegyne incognitia* infects the roots of tobacco plants.
- This causes reduction in yield.
- RNA interference (RNAi) a cellular defense used in eukaryotic organisms prevents this infestation.
- This method involves silencing of mRNA where complementary ds RNA that binds and prevents translation of mRNA.
- The complementary RNA could be from an infection by viruses.
- Agrobacterium vectors, nematode specific genes introduced into the host plant.
- The DNA produced both sense and antisense RNA.
- The two RNA being complimentary form dsRNA thus silenced the specific mRNA of nematode.
- Therefore parasite cannot survive in a transgenic host.

BIOTECHNOLOGICAL APPLICATION IN MEDICINE

- GENETICALLY ENGINEERED INSULIN
  - Earlier insulin for diabetes was extracted from slaughtered cattle and pigs, this patients developed allergies/ other reaction in response to foreign protein.
  - Development of biotechnology, the process became easy.
  - Insulin has two short polypeptide chains (A and B).
  - These chains are linked by disulphide bond.
  - Insulin synthesised as prohormone (contains extra C peptide).
  - C peptide removed during maturation.
  - In rDNA technology the assembling of mature, insulin became challenging.
  - Eli Lily, an American company prepared 2 DNA sequences for A and B chain, introduced into plasmids of E.coli, which was extracted and creating by disulphide bonds.
- GENE THERAPY
  - It is a collection of methods that allows correction of a gene defect.
  - Genes are inserted into a person’s cells and tissues to treat a disease.
  - Here normal genes are delivered to take over the functions of non-functional gene.
  - First clinical gene therapy given in 1900- to a 4 year old girl with adenosine deaminase (ADA) deficiency.
  - ADA is crucial for immune system to function.
  - The disorder is due to deletion of ADA gene.
  - It can be treated by
    - Bone marrow transplantation
    - Enzyme replacement therapy
      - Both are not completely curative
  - The lymphocytes of patient grown in a culture is introduced with a functional ADA cDNA(using retroviral vector) and returned.
  - Since these cells are not immortal, the patient requires periodic infusion.

NOTE: Permanent cure is possible if ADA gene from bone marrow is introduced into cells at embryonic stage.

- ❖ MOLECULAR DIAGNOSIS
  - ➢ For effective treatment early diagnosis is important
  - ➢ Some diagnostic techniques:-
    - rDNA technology
    - Polymerase Chain Reaction(PCR)
    - *Enzyme linked Immuno-Sorbent Assay* (ELISA)
  - ➢ Presence of pathogens is suspected when symptoms are produced, by this time the concentration of pathogen is high.
  - ➢ Very low concentration of pathogens can be detected by amplification of the nucleic acid by PCR.

    NOTE: PCR is a powerful technique to identify:-
    - ▪ HIV in suspected AIDS patients.
    - ▪ Mutation in genes in suspected cancer patients.
  - ➢ Single stranded DNA/RNA probe is allowed to hybridise to its complementary DNA in a clone of cells. The clone with mutated gene will not appear in the photographic film autoradiography as the probe will not have complementary with the mutated genes.
  - ➢ ELISA is based on principle of antigen-antibody interaction. Infection can be detected by the presence of antigens or by detecting the antibodies synthesised.
- ❖ TRANSGENIC ANIMALS

  Are those which who have DNA manipulated to possess and express a foreign gene.

  Reasons to create Transgenic Animals:
  - Study normal physiology and development.
  - Study of diseases.
  - Production of biological products.
  - Vaccine safety testing.
  - Chemical safety testing.

ETHICAL ISSUES

- Ethical standards are required to evacuate the mortality of human activities.
- Genetic modifications can have unpredictable results when introduced into ecosystem.
- GEAC (Genetic Engineering Approval Committee) by Indian Government will validate the GM research and its safety of introducing GM organisms for public services.
- Patency is granted for products and technologies that make use of the genetic materials/plants that have been used for farmers /indegenous
- Bio piracy is used to refer to the use of bio-resources by multinational companies and other organisations.
- Traditional knowledge related to bio-resources from the underdeveloped world by the industrial nation with poor biodiversity.

MULTIPLE CHOICE QUESTIONS

1. *Bacillus thuringiensis* forms protein crystals which contain insecticidal protein. This protein:-

(a) Binds with epithelial cells of mid gut of the insect pest ultimately killing it

(b) Is coded by several genes including the gene *cry*

(c) Is activated by the acid pH of the foregut of the insect pest

(d) Does not kill the carrier bacterium which is itself resistant to this toxin

2. Human insulin is being commercially produced from a transgenic species of

(*a) Rhizobium*

(b) Saccharomyces

(c) Escherichia

(d) Agrobacterium

3. RNA interference involves

(a) Synthesis of cDNA and RNA using reverse transcriptase

(b) Silencing of specific *m*RNA due to complementary RNA

(c) Interference of RNA in synthesis of DNA

(d) Synthesis of *m*RNA from DNA

4. The proteins encoded by the genes *cry*IAc and *cry*IIAb control

(a) Cotton bollworms

(b) Corn borer

(c) Budworms

(d) Butterflies

5. What is the source of Ti (Tumor inducing) plasmid which is modified and used as a cloning vector to deliver the desirable genes into plant cells?

(a) *Bacillus thuringiensis*

(b) *Meloidogyne incognita*

(c) *Thermus aquaticus*

(d) *Agrobacterium tumefaciens*

6. Genetic engineering has been successfully used for producing

(a) Transgenic models for studying new treatments for certain disease

(b) Transgenic mice for testing safety of polio vaccine before use in humans

(c) Animals like bulls for farm work as they have super power

(d) Transgenic cow Rosie which produces high fat milk for making ghee

7. The illegal and unlawful development of biomaterials without payment to the inhabitants of their origin is called

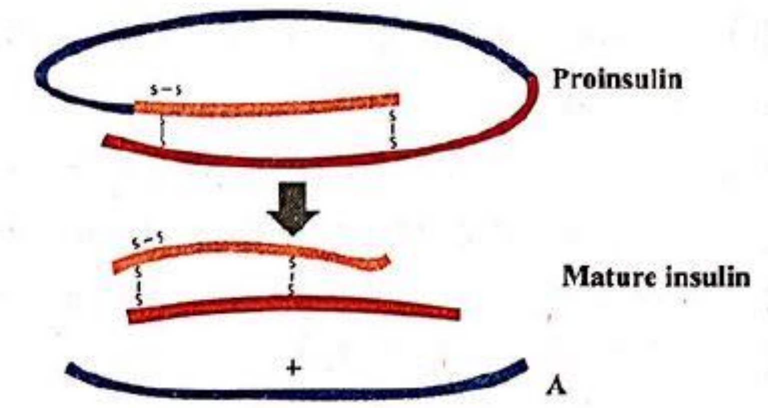
(a) bio patent

(b) bio war

(c) bio piracy

(d) biotechnology

8. Given figure represents the maturation of pro-insulin into insulin. Identify the product A.



(a) polypeptide cghain A

(b) polypeptide chain B

(c) polypeptide chain C

(d) pro-hormone

9. Golden rice is a genetically modified crop plant where the incorporated gene is meant for biosynthesis of

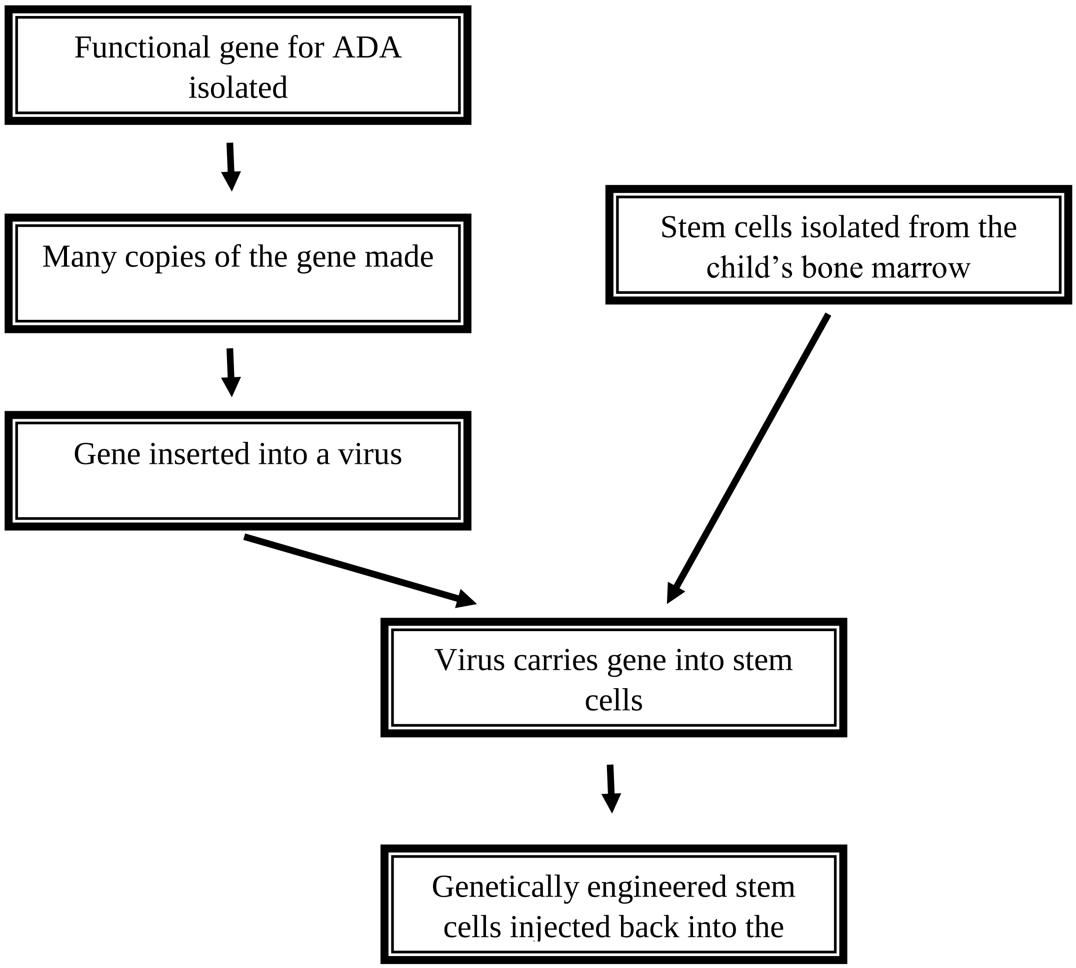
(a) vitamin E

(b) vitamin K

(c) vitamin D

(d) vitamin A

10. Children with Severe Combined Immunodeficiency Disorder(SCID) cannot produce the many types of white blood cells that fight infections. This is because they do not have the functional gene to make the enzyme Adenosine Deaminase (ADA). Some children with SCID have been treated with stem cells as shown in the given flow chart.



Why stem cells are used in this treatment?

(a) Stem cells are capable of dividing for long periods to generate replacements for cells that are unable to produce ADA.

(b) The stem cells used here belong to the child and there will be no triggering immune response

(c) Stem cells are unspecialized and can differentiate to specialized cell types such as white blood cells to fight infection

(d) All of these

II. ASSERTION REASON TYPE QUESTIONS

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

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

(c) Assertion is true, reason is false

(d) Assertion is false, reason is true

1. **Assertion**: Biopiracy is the practice of commercially exploiting naturally occurring biochemical or genetic material especially by obtaining patents that restricts its future use while failing to pay fair compensation to the community from which it originates.

Reason: US patented turmeric and neem which ios a case of biopiracy.

2. **Assertion**: A novel strategy was adopted to prevent nematode infestation which was based on the process of RNA interference (RNAi).

Reason: RNAi takes place in all prokaryotic organisms as a method of cellular defense

3. **Assertion**: Organisations like GEAC are necessary to monitor GM researches and test the safety of introducing GM organisms for public services.

Reason: GM researches can have unpredictable results which can be disastrous when genetically modified organisms are introduced into the ecosystem

4. **Assertion**: Transgenic animals are used to study the physiology and development of an organism.

Reason: Transgenic animals are specifically designed to allow the study of regulation of genes

5. **Assertion**: To cure ADA deficiency, erythrocytes from the blood of the patient are grown in a culture outside the body.

Reason: A functional ADA cDNA (using a retroviral vector) is then introduced into these lymphocytes, which are subsequently returned to the patient.

SHORT ANSWER TYPE QUESTIONS

1. What do you mean by biopiracy ? Give an example.

2. Why is pro insulin so called? How is insulin different from it?

3. **How is ' Rosie' considered different from a normal cow? Explain.**

4. (i) Mention the cause and the body system affected by ADA deficiency in humans.

(ii) Name the vector used for transferring ADA-DNA into the recipient cells in humans. Name the recipient cells.

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

6. A bacterium *Bacillus thuringiensis* produces a toxic protein named 'cry protein' that is lethal to certain insects but not to bacterium

(i) Why this toxin does not kill the bacteria?

(ii) What type of changes occur in the gut of insects on consuming this protein?

(iii) How man has exploited this protein for his benefit?

7. **Name the host plant and its part that *Meloidogyne incognita* infects. Explain the role of *Agrobacterium* in the production of dsRNA in the host plant.**

8. **Name the source and the types of cry genes isolated from it for incorporation into crops by biotechnologists. Explain how have these genes brought beneficial changes in genetically modified crops.**

9. Compare and contrast the advantages and disadvantages of producing genetically modified organisms.

10. Why is *Agrobacterium* mediated genetic transformation described as natural genetic engineering in plants?

LONG ANSWER TYPE QUESTIONS

1. (i) Name the source from which insulin was extracted earlier. Why this insulin no more in use by diabetic people?

(ii) Explain the process of synthesis of insulin by EH Lilly company. Name the technique used by the company.

(iii) How is the insulin produced by human body different from the insulin produced by the above mentioned company?

2. (i) Name the insect that attacks cotton crops and causes lot of damage to the crop. How have Bt cotton plants overcome this problem? Explain.

(ii) Write the role of gene *cry* I Ab.

Case 1: Monopoly over indigenous resources

Read the following and answer the questions that follows:

Turmeric is one of the most famous plants that is known to miraculously cure almost all health problems and is known to be used by Indians for thousands of years due to its immense health benefits and anti-inflammatory properties. The University of Mississippi applied for a patent on the use of turmeric for wound healing properties and the patent was granted to them in 1994. The university claimed that the turmeric was mainly used in India for curing sprains and for anti-inflammatory applications but there was no proof on the use of turmeric for treating external wounds. The Indian Council for Scientific and Industrial Research disputed the patent by submitting relevant records and Sanskrit tests, including a research that showed the use of turmeric in treating wounds which was published in 1953. On the basis of submitted proofs, the U.S patent and trademark office revoked the patent which was given to the Mississippi University on the use of turmeric for healing external wounds.

(i) Suggest the term for the unauthorized use of bio resources by multinational companies and organizations, without approval of a nation or its related people

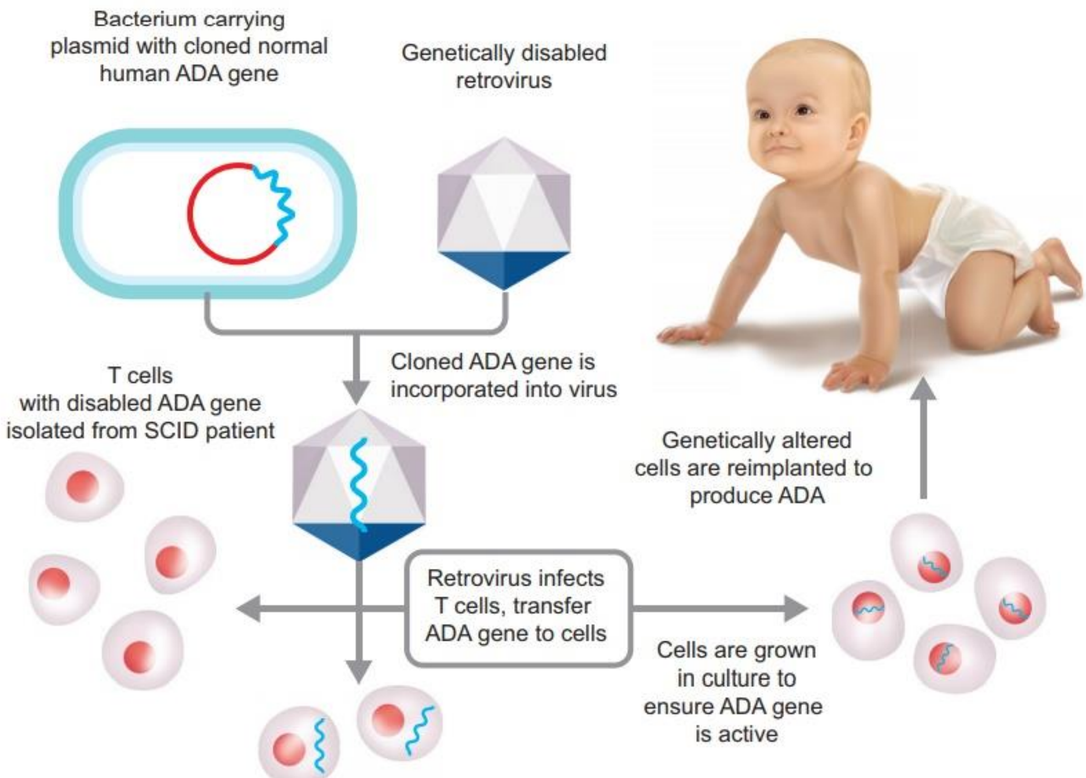
(ii) Give any two examples of plants for which patent has been revoked.

(iii) What are the three criteria to obtain a patent?

(iv) State any two drawbacks of patents.

Case 2: Gene Therapy

Read the following and answer the questions that follows:



Human gene therapy seeks to modify or manipulate the expression of a gene or to alter the biological properties of living cells for therapeutic use.Gene therapy is a technique that modifies a person's genes to treat or cure disease. Gene therapies can work by several mechanisms:

- Replacing a disease-causing gene with a healthy copy of the gene
- Inactivating a disease-causing gene that is not functioning properly
- Introducing a new or modified gene into the body to help treat a disease

(i) In gene therapy, the gene defects are cured in a child or in ……………. stage.

(a) adulthood

(b) adolescent

(c) old age

(d) embryonic

(ii) In 1990 the first gene therapy was given to treat which deficiency?

(a) Adenosine deaminase

(b) phenylketonuria

(c) Phenylalanine

(d) tyrosine

(iii) …………… is an alternative method to cure ADA deficiency

(a) Cloning

(b) Bone marrow transplantation

(c) Hybrdization

(d) Southern blotting

(iv) Introduction of gene isolate from bone marrow producing ADA should be introduced at what age to permanently cure ADA?

(a) adulthood

(b) adolescent

(c) old age

(d) embryonic

(v) What kind of disease can be cured with the help of gene therapy?

(a) acute diseases

(b) physiological diseases

(c) hereditary diseases

(d) infectious diseases

ANSWERS

MULTIPLE CHOICE QUESTIONS

1. a	**2. c**	**3. b**	**4. a**	**5. d**
6. b	**7. c**	**8. c**	**9. d**	**10. d**

ASSERTION REASON TYPE QUESTIONS

1. b	**2. c**	**3. a**	**4. a**	**5. d**

SHORT ANSWER TYPE QUESTIONS

1. Biopiracy refers to the use of bioresources by multinational companies and other organizations without proper authorizations from the countries and people concerned. For example, Basmati rice grown in India is distinct for its unique flavor and aroma but an American company got patent rights on Basmati through US patent.

2. Proinsulin contains an extra stretch called C-peptide that needs to be removed to become fully mature insulin, therefore it is called proinsulin (prohormone). The mature functional insulin contains only A and B-peptide chain

3. The transgenic cow, Rosie, produced human protein-enriched milk (2.4 gm/L). It contained the human α -lactalbumin and was nutritionally more balanced product for human babies than natural cow's milk.

4. (i) ADA is caused due to deletion of gene for adenosine deaminase. Immune system of the body is affected due to this.

(ii) Retroviral vector is used to transfer ADA-DNA into the recipient cells of human. Recipient cells are the lymphocytes.

5. GEAC – Genetic Engineering Approval Committee. Objectives of GEAC as below:(i) To make decisions regarding validity of GM research.
(ii) Safety of introducing GMO for public use.

6. (i) Produced in inactive form as prototoxin

(ii) 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.
(iii) 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.

7. The nematode *Meloidogyne incognita* infects the roots of tobacco plants. The *Agrobacterium* are used as vectors carrying nematode specific genes to be introduced in host plant. These genes when expressed inside host plant produces sense and anti-sense RNA strands, complementary to nematode's functional mRNA. This binding results in formation of double stranded RNA and inhibiting or silencing the translation of RNA specified. This process is called RNA interference.

8. The source is *Bacillus thuringiensis*. Types of cry genes are *cry*IAc, *cry II*Ab, *cryI*Ab. The cry genes code for certain crystal proteins that have Bt toxin. Bt toxin exists as inactive protoxin and gets converted into active form (toxin) in the alkaline pH of the gut of the insect.
The activated toxin binds to the epithelial cells lining the epithelial surface of the midgut and creates pores leading to swelling and lysis of the cells and ultimately cause death of the insect. This way GM crops show resistance against insect pests.

9. ADVANTAGES OF PRODUCING GMOs:

(i) GM crops produce desired phenotypic traits in crop plants

(ii) The genes responsible for production of specific proteins are inserted into GM crops. These crops then produce that specific protein.

(iii) Transgenic crops synthesizes new end product of specific biochemical pathway.

(iv) These crops also help in preventing expression of existing native gene.

DISADVANTAGES OF PRODUCING GMOs:

(i) Transgenic crops may endanger wild & native species.

(ii) GM crops may cause health problems by supplying allergens

(iii) GM crops may damage the natural environment.

10. *Agrobacterium tumefaciens,* a natural pathogen of several dicot plants is able to deliver a piece of DNA known as "t – DNA" to transform normal plant cell into a tumor & direct gene transfer transform tumor cells to produce chemicals required by pathogen. The tumor inducing (Ti) plasmid of *Agrobacterium tumefaciens* has now been modified into a cloning vector which is no more pathogenic to plant but is still able to use the mechanism to deliver gene of our interest into a variety of plants. Since *Agrobacterium tumefaciens* has the natural ability to donate a part of its DNA to the plant during infection, this property of *Agrobacterium* is exploited and a gene of interest is ligated into T-DNA so that it automatically gets transformed into plant cell thus, *Agrobacterium tumefaciens* is known as "Natural Genetic Engineer" of plants.

LONG ANSWER TYPE QUESTIONS

1. (i) Insulin was extracted earlier from pancreas of slaughtered pigs and cattle animals. Insulin obtained from these sources caused some allergy or some other reactions to the foreign protein.

(ii) DNA sequences corresponding to the two polypeptide, A and B- chains of insulin are synthesized in vitro. They are introduced into plasmid DNA of E. coli. This bacterium is cloned under suitable conditions. The transgene is expressed in the form of polypeptides A and B, secreted into the medium. They are extracted and combined by creating disulphide bridge to form human insulin.

(iii) Differences between insulin produced by rDNA and insulin produced by pancreas are:

Proinsulin	Insulin
Non functional, inactive form of insulin	Functional insulin produced by pancreas
Along with two polypeptide chains, it contains an extra stretch called C peptide	It is made up of two short polypeptide chains A and B linked by disulphide bridges

2. (i) Cotton bollworm larvae that attacks cotton crops. Bt cotton plants are GMO containing active *cry* gene from *Bacillus thuringiensis* which form protein crystals during a particular phase of their growth. These crystals contain toxic insecticidal protein which is present in inactive form, but becomes active toxin in the

alkaline pH of the insect gut. The activated toxin binds to the midgut epithelial cells and creates pores that cause cell swelling and lysis and eventually cause the death of the insect. Most Bt toxin genes are insect specific, and the toxin is coded by a gene named *cry*.

(ii) The protein coded by *cry*IAb controls corn borer

Case 1: Monopoly over indigenous resources

(i) Biopiracy

(ii) Neem and Basmati

(iii) Novelty, Non-obviousness and Utility

(iv) Biopiracy and patenting of indigenous knowledge is a double theft because first it allows theft of creativity and innovation, and secondly, the exclusive rights established by patents on stolen knowledge steal economic options of everyday survival on the basis of our indigenous biodiversity and indigenous knowledge. Overtime, the patents can be used to create monopolies and make everyday products highly priced.

Case 2: Gene Therapy

1. d	**2. a**	**3. b**	**4. d**	**5. c**

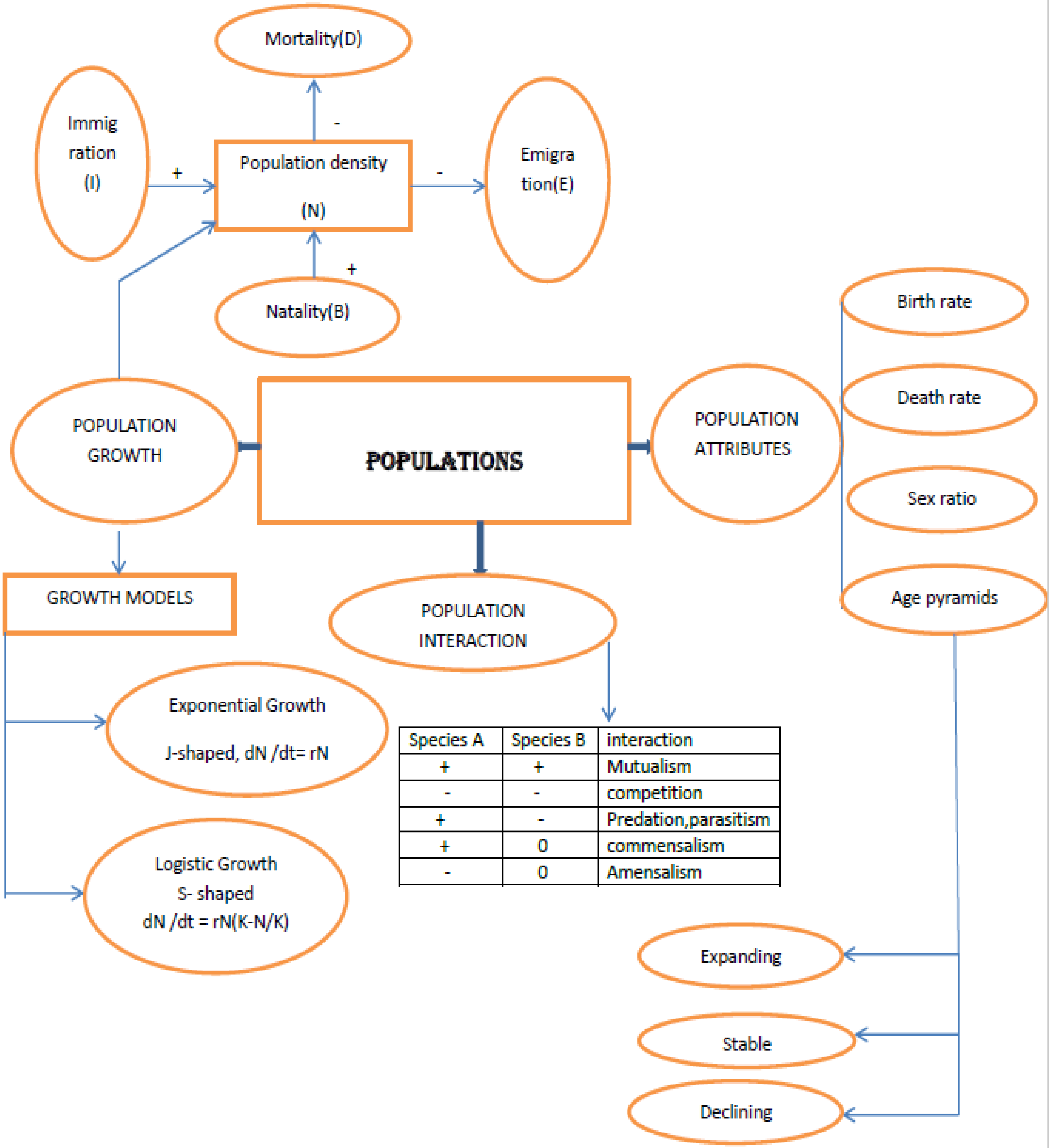
Prepared by

1. M. Jayaseelan ***2. Mridula Gokuldas***

KV No.1 Calicut ***KV No.1 Calicut***

CHAPTER 13. ORGANISMS AND POPULATIONS

CONCEPT MAP



Species A	Species B	interaction
+	+	Mutualism
-	-	competition
+	-	Predation,parasitism
+	0	commensalism
-	0	Amensalism

GIST OF MAJOR & MINOR CONCEPTS:

ECOLOGY- Deals with the interaction among organisms , between organisms and its physical environment.

POPULATION ATTRIBUTES

BIRTH RATE- Number of individuals born per thousand per year.

DEATH RATE- Number of individuals die per thousand per year.

SEX RATIO- Ratio of male and female in the populations.

POPULATION DENSITY- The number of individuals organisms per unit area [it is an appropriate measure - total number sometimes difficult to determines or meaning less because 4 factors like N **[NATILITY] + I [IMMIGRATION + M [MORTALITY + E [EMIGRATION]** are concerned with respect to habitat is concerned.

AGE PYRAMIDS-It is a graphical illustration of the distribution of a population by age groups and sex.

Three ecological age pyramids are recognised.

[1] PRE- REPRODUCTIVE [2] REPRODUCTIVE and [3] POST REPRODUCTIVE.

High proportion of Pre-Reproductive individuals occur in EXPANDING Population.

Pre-Reproductive individuals are uniform in STABLE Population.

Pre-Reproductive individulas are less in DECLINING Population.

REPRESENTATION OF AGE PYRAMIDS FOR HUMAN POPULATION.

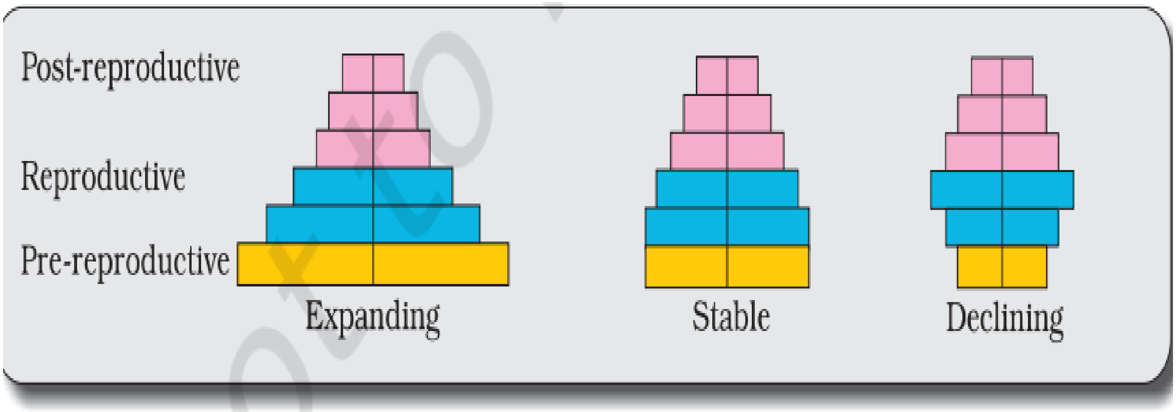


Figure 13.4 Representation of age pyramids for human population

POPULATION GROWTH. [Growth Models]

1. EXPONENTIAL GROWTH-

$$dN/dt = (b - d) \times N$$

Let $(b–d) = r$, then

$$dN/dt = rN$$

2.**LOGISTIC GROWTH[Verhulst-Pearl Logistic Growth]**

□ □ $$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

Where

N = Population density at time t

r = Intrinsic rate of natural increase

K = Carrying capacity

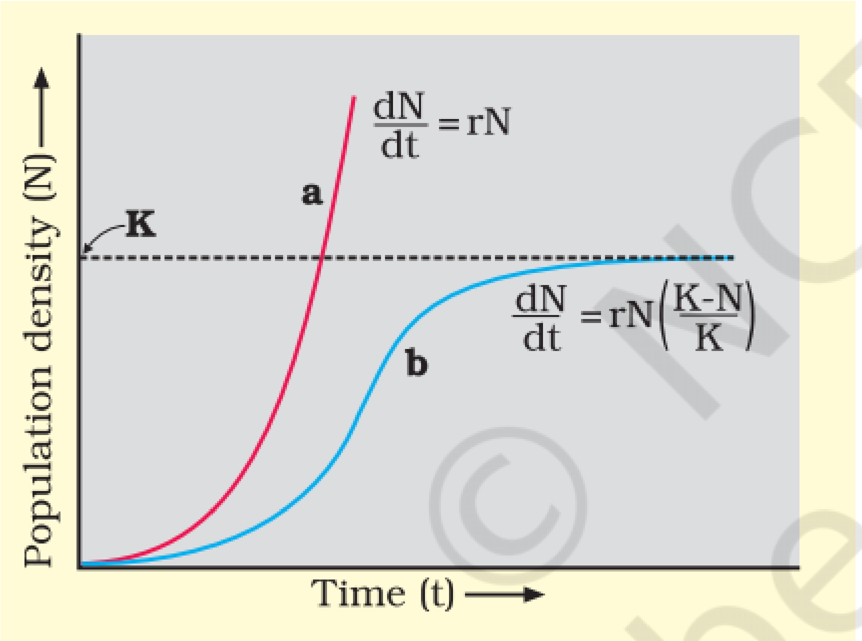


Figure 13.6 Population growth curve **a** when responses are not limiting the growth, plot is exponential, **b** when responses are limiting the growth, plot is logistic, **K** is carrying capacity

#Factors that affect the size of population are

[1] FOOD AVAILABILITY

[2] WEATHER

[3] PREDATION PRESSURE

[4] COMPETITION

DENSITY of population at any time at a given place depends on …

[1]NATALITY [2] MORTALITY [3] EMIGRATION [4] IMMIGRATION

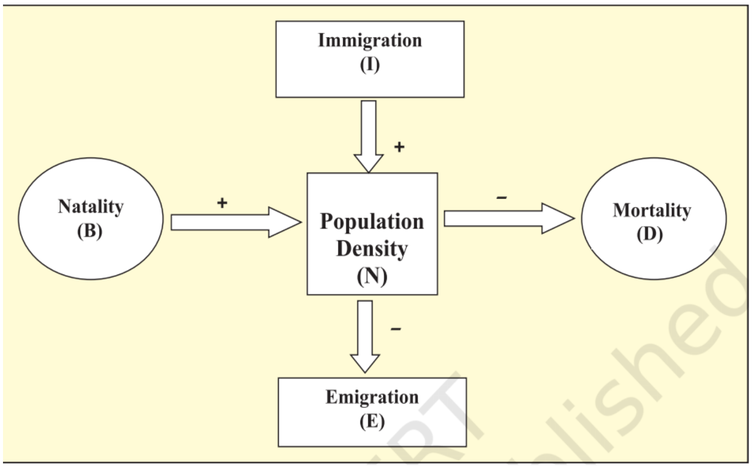
FACTORS THAT AFFECT POPULATION DENSITY.

#.**1.NATALITY.**[B]-Individuals added[+ve]

2.IMMIGRATION[I]-Individuals added[+ve]

3.EMMIGRATION[E]Individuals will left[-ve]

4.MORTALITY[D]-Individuals will die[-ve]



The characteristics of a populations are shaped by the interactions between individuals and their environment

population s have size and geographical boundaries.

The DENSITY of a population is measured as the number of individuals per unit area.

The DISPERSION of a population is the pattern of spacing among individuals within the geographic boundaries.

MEASURING OF POPULATION DENSITY.

Population will grow if B+ I+ > D+ E

Population will shrink if B+I < D+E

Population will be in equilibrium if B+ I= D+ E

MEASURING THE SIZE OF A POPULATION-

Status of the population in a habitat.

#Outcome of competition with others.

Impact of predators or pesticides.

#increase or decrease population size

The percentage cover is more meaningful measure of population size than mere numbers-

Ex. When 1 Banyan tree is compared with 100 Partthenium plants .The population of banyan in terms of number is very much low as compared to parthenium.But in terms of percentage cover to biomass, the banyan provides a much larger cover in comparison to 100 parthenium plants.

POPULATION- In an ecological sense , it is a group of organisms , of the same species, which roughly occupy the same geographical area at the same time.

POPULATION SIZE-

A Population's size depends on how the population is defined

If a population is defined in terms of some degree of reproductive isolation , then the population size is the SIZE OF THE GENE POOL.

If a population is defined in terms of some geographical range , then   that population ‘s size is   the NUMBER OF INDIVIDUALS LIVING IN THE DEFINED AREA.

POPULATION DENSITY.

Given that a population is defined   in terms of some natural or arbitrarily defined geographical range , then population density may be defined as   THE NUMBER OF INDIVIDUAL ORGANISMS   PER UNIT AREA.

PATERNS OF POPULATION DISPERSION.

Individuals members of a populations may be distributed over a geographical area in different ways.

[1] CLUMPED DISTRIBUTION[ATTRACTION]

[2] UNIFORM DISTRIBUTION[REPULSION]

[3] RANDOM DISTRIBUTION[MINIMUM INTERACTION]

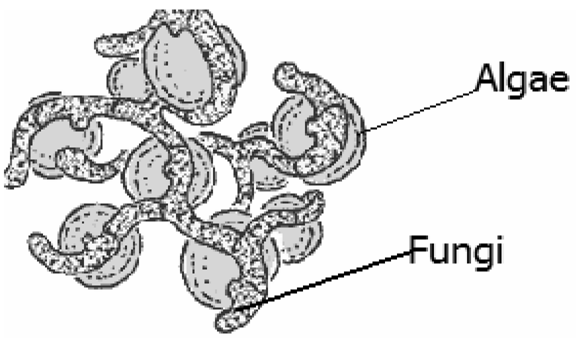
TYPES OF POPULATION INTERACTIONS.

INTERACTION	**SPECIES a**	**SPECIEC b**
Mutualism	+	+
Predation	+	-
Parasitism	+	-
Competition	-	-

Mutualism
Both the species get benefited.
Lichens Relationship between Non-photosynthetic Fungus and photosynthetic Algae or Cyanobacteria.
Mycorrhiza Asociation between Fungui and Higher Plants like Pinus.
Plants and insects for pollination
Orchid ophrys and male bee a good example for co-evolution of plants and Animals.
Bees and Bumble bees

PREDATION
One species get benefited and the other harmed.
Tiger and Deer
Snake and Frog
Herbivores and plants
Pisaster [starfish] and invertbrates of American pacific .

Competition



Both the species are harmed.
Flammingoes and resident fishes compete for the common food zooplankton in
South American lakes.
Abington Tortoise and goats in Galapagos Islands for food.
Gouse‘s Competitive Exclusion Principle -Two closely related species competing for the same resource cannot co-exist indefinitely and the competitively inferior one will be eliminated eventually.

Parasitism

One species gets benefit and the other is harmed.

Adaptations of parasites

#

Parasites

Endoparasites ectoparasites brood parasites

Liver fluke, plasmodium lice, ticks koel

Loss of sense organs

Presence of adhesive organs or suckers

Loss of digestive system

High reproductive capacity.

****

<u>1 MARK QUESTION</u>

1.When two species of *Paramoecium(P. caudatum and P. aurelia* were grown together in the laboratory, at first both the species grow in number,eventually however, *P. caudatum* declines in number while *P. aurelia* continues to increase in number.-Which type of animal interaction can substantiate the above phenomenon?(competition)

2.Plants like beech, Oak and Pine gain amino acids from fungal associationship , while the fungi in return receive carbohydrates and vitamins from the tree-What type of interaction can be inferred from this?(Mutualism)

3.In the stomach of ruminants huge number of Cellulolytic bacteria are present which help the herbivores to digest the plant material, in turn, the bacteria receive Nitrogen that has been secreted or ingested into the rumen in the form of urea-Name the type of interaction

<u>Short answer type questions (2marks)</u>

1.List the important attributes that a population possess**.**

2.Write the importance of measuring the size of a population in a habitat .

3. Explain with anexample how the percentage cover is a more meaningfull measure of population size than numbers.

4.List any three ways of measuring population density of a habitat.

5.Mention the essential information that can be obtained by studying the population density of an organism.

6.Explain ‘ birth rate’ in a population by taking a suitable example.

7.Write thecharacteristics which only a ppulation shows but an individual cannot

8.Name two basic types of competition found amongst organisms.Which one of them is more intense and why?

9.What is Guase’s competitive exclusion principle ? Explain with an example.

10.Explain Verhulst- Pearl Logistic Growth of a population.

11.Predation is usually referred to as a detrimental association .State any three positive role that a predator plays in an ecosystem.

12.Explain brood parasitism with the help of an example.

Short answer type questions (3 marks)

1. What is brood parasitism? Give an example. What adaptation has evolved in this phenomenon?

Ans. One species lays eggs in the nest of another bird, lets the host incubate them. e.g. Cuckoo lays eggs in the nest of a crow.

The Eggs of the parasite resemble the eggs of the host in colour, size. Reduce chances of the host bird detecting the foreign eggs and ejecting them from nest.

2. Name and explain the kind of interaction in the following.

Ans. 1. Algae and Fungi in Lichens
2. Head Louse Humans
3. Hermit Crab and Sea Anemone

(i) Interaction of mutualism where the two species are equally benefited. Fungus provides protection, helps in absorption of water and minerals, Algae provide food for the Fungus.

(ii) This is case of Parasitism where the louse is an ectoparasite. Parasite takes shelter on humans and also derives nutrition.

(iii) It is commensalisms where one species is benefited and the other is neither benefited nor affected. Sea Anemone is benefited as it does not have to move to places rich in nutrients, while hermit crab is neither benefited nor harmed.

3. How does Ophrys get pollinated by bees?

Ans.1. Sexual deceit.
2. One petal resembles female.
3. Male pseudocoupulates with the flower.
4. Pollen grain transferred from one flower to another.

4. Biomass is a more meaningful measure of population size. Explain with an example.

Ans. (i) Population large Total number is not an easily adoptable measure. Counting takes long time or practically impossible

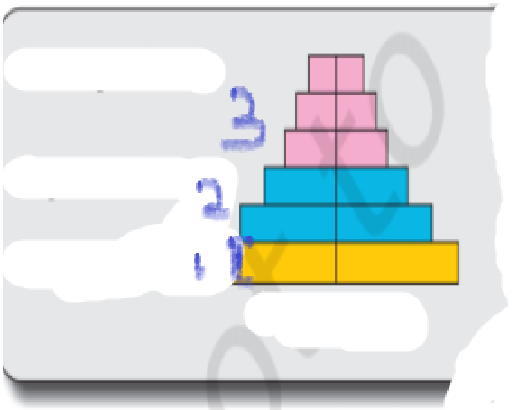
(ii) There is no need to know the absolute population size for some investigations.

(iii) Number may sometimes be misleading e.g. In a given area there are 200 *Parthenium* plants and a single banyan tree. Here biomass size of the banyan tree is much more than those of 200 *Parthenium* plants.

5.. What is interference competition? Define competitive exclusion principles.

Ans. (i) Feeding efficiency may be reduced due to interference of another species. E.g. –Tiger and deer.

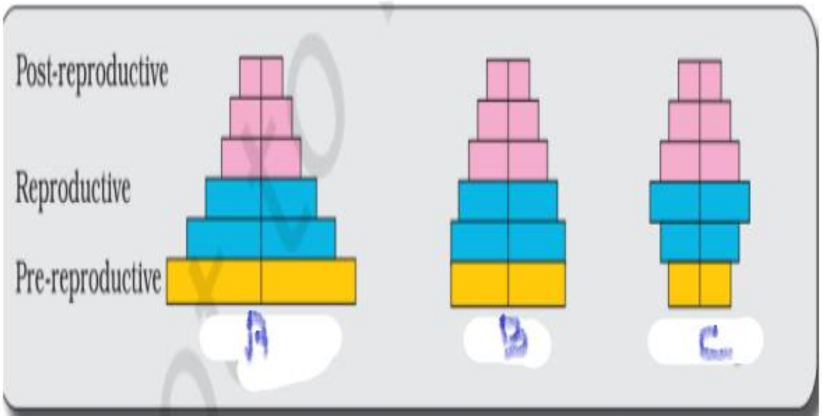
(ii)Two closely related species need same resource can not co-exist indefinitely.



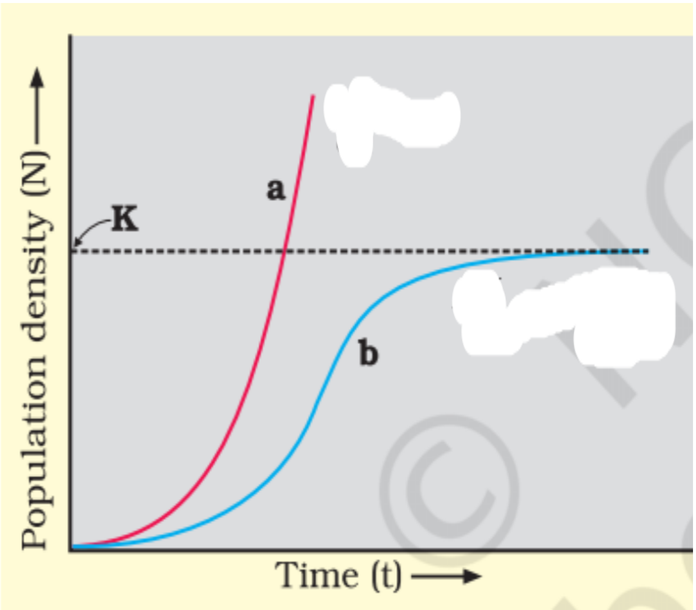
6.[a] Label the three tiers 1.2..3 given in the above pyramid.

[b] What type of population growth is represented by above age pyramid?

7.Study the three different age pyramids for human population given below and answer the questions below:

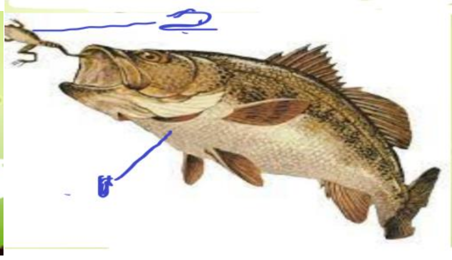


[a]write the names given to each of these age pyramids.
[b] Mention the one which is ideal for human population and why?
8.Study the population growth curves in the graph given below and answer the questions that fallows?



[i] Identify the growth curves 'a' and 'b'.
[ii] Which one of them is considered a more realistic one and why?
[iii] What does K stand for?

9[a].Why are herbivores considered similar to predators in the ecological context ? Explain.
[b] Differentiate between the followinginter specific interactions in a population
[i] Mutualism and competition.
10.In the given picture what is the relationship between [1] and [2] with respect to population interaction and between [3] and [4] with respect to trophic levels?



11.Explain co-evolution with reference to parasites .
12.What is mutualism? Mention any two examples where the organisms involved are commercially exploited in agriculture.

(5 Marks) Questions:

1.What are the different types of population growth pattern? Mention their differences.
Ans: a. Logistic and Exponential growth
b. S Shaped curve, J shaped curve. Limiting Factors, No-limiting Factors
2.With the help of age pyramids explain the nature of a population.
Ans: a. Pre-reproductive/ re-productive/ post-reproductive
b. increasing population/ stable population/ declining population

MULTIPLE CHOICE QUESTIONS.

1. Maximum growth rate occurs in

[a] Senescent phase [b] Lag phase [c] Exponential phase [d] Stationary phase.

2. The ability of venus fly trap to capture insects is dueto

[a] Specialised 'muscle - like 'cells [b] Chemical stimulation by the prey [c] A passive process requiring no special ability on the part of the plant. [d]A rapid turgur pressure changes.

3. Geometric representation of age structure is a characteristics of ..

[a] Population [b] Land scape [c] Ecosystem [d] Biotic community

4. Plant species having a wide range of genetical distribution evolve into a local population known as..

[a] Ecotype [b] Biome [c] Ecosystem [d] population [e] Ephemerals

5. If in a population , natality is balanced by mortality then there will be …

[a] Decrease in population growth [b] Zeroppulation growth [c] Increase in population growth [d] over population.

6. A population has more young individuals compared in the older individuals .What would bre the status of the population after some years?

[a] It will decline [b] It will stabilize [c] It will increase [d] It will first decline and then stabilise.

7. The tendency of population to remain in genetic equlibrium may be disturbed by…

[a] Lack of migration [b] Lack of mutations[c] lack of random mating [d] Randam mating

8. In an area , a population with large size individuals having long life span , more parental care and slow development was present.This type of population curve will be …

9. [a] S-shape [b] J-shaped [c] Z-shaped [d] All of these.

10.The density of a population in a habitat per unit area is measured in different units .Write the unit of measurement fish population ..

[a] Biomass/ area [b] Numbers/area [c] Coverage/area [d] weight/area

The following questions consists of two statements each.Assertion[A] and Reason[R] .To answer these questions ,Mark the correct alternativeas directed below.

ASSERTION-REASON TYPE QUESTIONS

A. If both A and R are true and R is the correct explanation of A

B. If both A and R are true but R is not the correct explanation of A

C. If a is true but R is false

D. If both A and R are false.

1. Assertion: Population are said to be sympatric when

Reason : Two populations share the same environment but cannot inter breed.

[A] [B] [C] [D]

2.Assertion: The human population is represented by sigmoid population durve.

Reason : Two population share the same environment but cannot inter breed.

[A] [B] [C] [D]

3. Assertion: A high density of elephant population in an area can result in intra specific competition .

Reason : It plays an important role in supporting other species.

[A] [B] [C] [D]

4. Assertion: The shape of age pyramid reflects the growth status of population

Reason :The decling age profile is ideal for population , it givess an idea that in future the population will decline.

[A] [B] [C] [D]

CASE BASED QUESTIONS

1. The size of population for any species is not a static parameter.It keeps changing with time , depending on various factors including food availability ,predation pressure and adverse weather.In fact , it is these changes in population density that give us some idea of what is happening to the population, whether it is flourishing or declining .Whatever might be the ultimate reasons, the density of a population in a given habitat during a given peroid, fluctuates due to changes in four basic process , two of which[Natality and Immigration] contribute to an increase in population density and two [mortality and emigration] to a decrease.

[1] Natality refers to the number of births during a given period in the population that are added to the initial density

[2] Mortality is the number of deaths in the population during a given period

[3] Immigration is the number of individuals of the same species that have come into the habitat from elsewhere during the time periods under consideration

[4] Emigration is the number of the population who left the habitat and gone else where during the time period under consideration.

Questions[1] For anyspecies ,size of ------------------------ is not a static parameter

[A] Population [B] Area [C] Temperature [D] Soil

[B] Question[2] Which of the followings are responsible for the fluctuation of density of population.

[A] Mortality [B] Natality [C] Emigration [D] All of these

Question[3] In the population , the number of death during a given period is known as ------------

[A] Immigration [B] Mortality [C] Natality [D] Emigration

Question[4] Define the following terms.

[i] Mortality [ii] Immigration.

Question[5] Whch two basic process can decrease population density.

ECOSYSTEM – CONCEPT MAP

ECOSYSTEM FUNCTIONS

PRODUCTIVITY | DECOMPOSITION | ENERGY FLOW | NUTRIENT CYCLING

PRODUCTIVITY

- Productivity- Rate of production of biomass or energy.
- Primary productivity – It is the biomass or organic matter produced per unit area over a time period by plants during photosynthesis.
  A. Gross Primary Productivity – Rate of production of organic matter during photosynthesis
  B. Net Primary Productivity (NPP) – Gross primary productivity minus respiration losses (R), is the net primary productivity.
- Secondary productivity – At the level of consumers.

$NPP = GPP - R$

DECOMPOSITION

- FRAGMENTATION
- LEACHING
- CATABOLISM
- HUMIFICATION
- MINERILAISATION

DECOMPOSITION - CONTROLLING FACTORS

A. CLIMATIC FACTORS- TEMPERATURE & SOIL MOISTURE

B. CHEMICAL COMPOSITION OF DETRITUS

ENERGY FLOW

- Flow of energy through organisms of different trophic levels.
- Laws related to energy flow
  A. First law of thermodynamics
  B. Second law of thermodynamics
  C. 10 % law
- Energy flow occurs through food chain & food web.
- Grazing food chain begins from producers.
- Detritus food chain begins from detritivores.
- Inner connected food chains are food webs.

ECOLOGICAL PYRAMID

- Concept was introduced by Elton.
- It is the graphical representation of ecological parameters like number, energy and biomass.
- Base of the pyramid is occupied by producers and apex by tertiary consumers.
- It may be upright or inverted.
- Pyramid of number and pyramid of biomass may be upright or inverted but pyramid of energy is always upright.

STANDING CROP AND STANDING STATE

- Each trophic level has a certain mass of living material at a particular time called as the standing crop.
- The amount of nutrients, such as carbon, nitrogen, phosphorus, calcium, etc., present in the soil at any given time, is referred to as the standing state.

LIMITATIONS OF ECOLOGICAL PYRAMIDS

- It does not consider the same species belonging to two or more trophic levels.
- It assumes a simple food chain, something that almost never exists in nature; it does not accommodate a food web.
- saprophytes are not given any place in ecological pyramids even though they play a vital role in the ecosystem

ECOSYSTEM

GIST OF THE MAJOR & MINOR CONCEPTS

An Ecosystem is a functional unit of nature, where living organisms interact among themselves and also with the surrounding physical environment.

- Terrestrial ecosystems: Forest, grassland and desert.
- Aquatic ecosystems: pond, lake, wetland, river and estuary.
- Man-made ecosystems: Crop fields and an aquarium.

ECOSYSTEM – STRUCTURE AND FUNCTION

35. Species composition: Plant and animal species of an ecosystem
36. Stratification: Vertical distribution of different species occupying different levels is called stratification. For example, trees occupy top vertical strata or layer of a forest, shrubs the second and herbs and grasses occupy the bottom layers.

The components of the ecosystem are seen to function as a unit when you consider the following aspects:

i) Productivity (ii) Decomposition (iii) Energy flow (iv) Nutrient cycling.

Pond as an example of aquatic ecosystem.

Abiotic components

- Water -dissolved inorganic and organic substances and the rich soil deposit at the bottom of the pond.
- The solar input, the cycle of temperature, day-length and other climatic conditions regulate the rate of function of the entire pond.

Biotic Components

- The autotrophic components include the phytoplankton, some algae and the floating, submerged and marginal plants found at the edges.
- The consumers are represented by the zooplankton, the free swimming and bottom dwelling forms.
- The decomposers are the fungi, bacteria and flagellates especially abundant in the bottom of the pond.

Functions

- Conversion of inorganic into organic material with the help of the radiant energy of the sun by the autotrophs, consumption of the autotrophs by heterotrophs,
- Decomposition and mineralisation of the dead matter to release them back for reuse by the autotrophs.
- There is unidirectional movement of energy towards the higher trophic levels and its dissipation and loss as heat to the environment.

PRODUCTIVITY

Primary production: It is defined as the amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis. It is expressed in terms of weight (gm^{-2}) or energy ($kcal\ m^{-2}$).
Productivity: The rate of biomass production. It is expressed in terms of $gm^{-2}\ yr^{-1}$ or $(kcal\ m^{-2})\ yr^{-1}$

Gross primary productivity (GPP): Gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis. A considerable amount of GPP is utilised by plants in respiration.

Net primary productivity (NPP) Gross primary productivity minus respiration losses (R), is the net primary productivity (NPP). GPP – R = NPP is the available biomass for the consumption to heterotrophs (herbivores and decomposers).

Secondary productivity is defined as the rate of formation of new organic matter by consumers. **DECOMPOSITION**

Decomposers break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients and the process is called decomposition.

Detritus: Dead plant remains such as leaves, bark, flowers and dead remain of animals, including faecal matter which is the raw material for decomposition.

The important steps in the process of decomposition:

B **Fragmentation**: Detritivores (e.g., earthworm) break down detritus into smaller particles. This process is called fragmentation.

X **Leaching**: Water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.

Δ **Catabolism**: Bacterial and fungal enzymes degrade detritus into simpler inorganic substances. This process is called as catabolism.

E **Humification**: leads to accumulation of a dark coloured amorphous substance called humus that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate. Being colloidal in nature it serves as a reservoir of nutrients.

Φ **Mineralisation**: The humus is further degraded by some microbes and release of inorganic nutrients occur by the process known as mineralisation.

Factors affecting Decomposition

- Decomposition is largely an oxygen-requiring process.
- The rate of decomposition is controlled by chemical composition of detritus and climatic factors.
- In a particular climatic condition, decomposition rate is slower if detritus is rich in lignin and chitin, and quicker, if detritus is rich in nitrogen and water-soluble substances like sugars.
- Temperature and soil moisture are the most important climatic factors that regulate decomposition through their effects on the activities of soil microbes.
- Warm and moist environment favour decomposition whereas low temperature and anaerobiosis inhibit decomposition resulting in build-up of organic materials.

ENERGY FLOW

- Flow of energy is unidirectional from the sun to producers and then to consumers.
- The green plant in the ecosystem are called producers.
- All organisms are dependent for their food on producers, either directly or indirectly.
- In a terrestrial ecosystem, major producers are herbaceous and woody plants.
- In an aquatic ecosystem are phytoplankton, algae and higher plants.
- All animals depend on plants (directly or indirectly) for their food needs.
- They are hence called consumers and also heterotrophs.

Primary consumer

- The primary consumers will be herbivores.
- Some common herbivores are insects, birds and mammals in terrestrial ecosystem and molluscs in aquatic ecosystem.

Secondary consumers

Animals eating other animals.

The consumers that feed on herbivores are carnivores, or more correctly primary carnivores.

Those animals that depend on the primary carnivores for food are labelled secondary carnivores.

Grazing food chain (GFC)

Grass (Producer) ➡ Goat (Primary Consumer) ➡ Man (Secondary consumer)

The detritus food chain (DFC)

Dead organic matter ➡ Decomposers (fungi and bacteria).

Food chain

Series of organisms linked by the process of eating and being eaten meant for energy flow

Food web

The natural interconnection of food chains.

Trophic level

- Organisms occupy a specific place in the food chain based on the source of their nutrition or food.
- Producers belong to the first trophic level, herbivores (primary consumer) to the second and carnivores (secondary consumer) to the third.

Energy flow through different trophic levels

- The amount of energy decreases at successive trophic levels.
- When any organism dies it is converted to detritus or dead biomass that serves as an energy source for decomposers.
- Organisms at each trophic level depend on those at the lower trophic level for their energy demands.

Standing Crop

- Each trophic level has a certain mass of living material at a particular time called as the standing crop.
- The standing crop is measured as the mass of living organisms (biomass) or the number in a unit area.
- The biomass of a species is expressed in terms of fresh or dry weight.

- The number of trophic levels in the grazing food chain is restricted as the transfer of energy follows 10 per cent law – only 10 per cent of the energy is transferred to each trophic level from the lower trophic level.

- **<u>Ecological Pyramids</u>**

- The base of each pyramid represents the producers or the first trophic level while the apex represents tertiary or top-level consumer.

- The three types of ecological pyramids
  - Pyramid of number;
  - Pyramid of biomass and
  - Pyramid of energy
- A given species may occupy more than one trophic level in the same ecosystem at the same time. For example, a sparrow is a primary consumer when it eats seeds, fruits, peas, and a secondary consumer when it eats insects and worms.

- In most ecosystems, all the pyramids, of number, of energy and biomass are upright, i.e., producers are more in number and biomass than the herbivores, and herbivores are more in number and biomass than the carnivores.

- Energy at a lower trophic level is always more than at a higher level.
  <u>There are exceptions to this generalisation</u>

- The number of insects feeding on a big tree.

- The pyramid of biomass in sea is generally inverted because the biomass of fishes far exceeds that of phytoplankton.

- Pyramid of energy is always upright, can never be inverted, because when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step

- **<u>Limitations of ecological pyramids</u>**

- It does not consider the same species belonging to two or more trophic levels.

- It assumes a simple food chain, something that almost never exists in nature;

- It does not accommodate a food web.

- Saprophytes are not given any place in ecological pyramids even though they play a vital role in the ecosyst

Net primary productivity (NPP) Gross primary productivity minus respiration losses (R), is the net primary productivity (NPP). GPP – R = NPP is the available biomass for the consumption to heterotrophs (herbivores and decomposers).

Secondary productivity is defined as the rate of formation of new organic matter by consumers. **DECOMPOSITION**

Decomposers break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients and the process is called decomposition.

Detritus: Dead plant remains such as leaves, bark, flowers and dead remain of animals, including faecal matter which is the raw material for decomposition.

The important steps in the process of decomposition:

Γ **Fragmentation**: Detritivores (e.g., earthworm) break down detritus into smaller particles. This process is called fragmentation.

H **Leaching**: Water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.

I **Catabolism**: Bacterial and fungal enzymes degrade detritus into simpler inorganic substances. This process is called as catabolism.

ϑ **Humification**: leads to accumulation of a dark coloured amorphous substance called humus that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate. Being colloidal in nature it serves as a reservoir of nutrients.

K **Mineralisation**: The humus is further degraded by some microbes and release of inorganic nutrients occur by the process known as mineralisation.

Factors affecting Decomposition

- Decomposition is largely an oxygen-requiring process.
- The rate of decomposition is controlled by chemical composition of detritus and climatic factors.
- In a particular climatic condition, decomposition rate is slower if detritus is rich in lignin and chitin, and quicker, if detritus is rich in nitrogen and water-soluble substances like sugars.
- Temperature and soil moisture are the most important climatic factors that regulate decomposition through their effects on the activities of soil microbes.

- Warm and moist environment favour decomposition whereas low temperature and anaerobiosis inhibit decomposition resulting in build-up of organic materials.

ENERGY FLOW

∉ Flow of energy is unidirectional from the sun to producers and then to consumers.

∉ The green plant in the ecosystem are called producers.

∉ All organisms are dependent for their food on producers, either directly or indirectly.

∉ In a terrestrial ecosystem, major producers are herbaceous and woody plants.

∉ In an aquatic ecosystem are phytoplankton, algae and higher plants.

∉ All animals depend on plants (directly or indirectly) for their food needs.

∉ They are hence called consumers and also heterotrophs.

MULTIPLE CHOICE QUESTIONS

1.Which of the following is a man-made ecosystem

(a. Forest b. Aquarium c. River d. Desert)

2.Vertical distribution of different species occupying different levels represents:

(a. Productivity b. Standing crop c. Stratification, d. Trophic level)

5. -------------and his colleges have very recently tried to put price tags on Nature's life support services.

(a. Robert Constanza b. Robert May c. Paul Erlich d. Alexander Von Humbolt)

4.Based on the source of their nutrition or food, organisms occupy a specific place in the food chain is known as ---------.

(a. Trophic level b. Biomass c. Ecological pyramid d. None of these)

5.Pyramid of -------------- is always upright, can never be inverted.

(a. Biomass b. Numbers c. Energy d. None of these)

6.------------- are not given any place in ecological pyramids even though they play an important role in the ecosystem.

(a. Saprophytes b. Producers c. Consumers d. Abiotic factors)

7.In a particular climatic condition, decomposition rate is slower if detritus is rich in -----------

(a. Nitrogen and sugar b. Lignin and chitin c. Sugar and chitin d. None of these)

8.If we completely remove the -----------from an ecosystem, their functioning will be adversely affected because Mineral movement will be blocked.

(a. Grass b. carnivores c. Decomposers d. Herbivores)

9.Approximately how much of the solar energy that falls on the leaves of a plant is converted to chemical energy by photosynthesis?

(a. Less than 1% b. 30 % c 2-10 % d.50%)

10.Gross primary productivity of an ecosystem is the rate of production of organic matter by ---------------

(a, Respiration b. Decomposition c. Photosynthesis d. None of these)

ASSERTION-REASON TYPE QUESTION

Directions

In the following questions, a statement of assertion is followed by a statement of reason.

Mark the correct choice as:

A If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C If Assertion is true but Reason is false.

D If both Assertion and Reason are false.

1. Assertion: Both agriculture and aquaculture are man – maintained ecosystems.
   Reason: All biotic and abiotic factors are managed by humans in these ecosystems.
2. Assertion: Most of an ecosystem's production is eventually consumed by detritivores and decomposers.
   a. Reason: Energy is said to flow through, not cycle within the ecosystem.
3. Assertion: Most food chains and webs have only about four or five trophic levels.
   Reason: Trophic efficiencies are generally only about 10% in different ecosystems.
4. Assertion: Net primary productivity is higher in warm climates than cold ones.
   a. Reason: The limit on a community's productivity is determined ultimately by the amount of sunlight it receives.
5. Assertion: Some aquatic ecosystems have inverted biomass pyramids.
   Reason: The pyramid of energy is also inverted in such cases.
6. Assertion: Saprophytes play a vital role in ecosystem.
   a. Reason: Saprophytes are accorded the highest trophic levels in a food chain or food web.
7. Assertion: There is no limitation of the number of trophic levels in a detritus food chain.
   a. Reason: The transfer of energy between successive trophic levels in a detritus food chain does not follow 10% rule.
8. Assertion: Strongly vertically stratified habitats are very stable ecosystems. Reason: Through the formation of different layers a given habitat is better utilized.
9. Assertion: Ecological pyramids of biomass are generally inverted in sea
   a. Reason: Biomass of fishes far exceeds that of phytoplankton.

10. Assertion: Pyramid of biomass is always upright for tree ecosystem.

    a. Reason: Total biomass of a tree in a specific area is more than that of herbivores

11. Assertion: Stratification helps in accommodation of a large number and types of plants in the same area. Reason: It is the occurrence of horizontal zonation in the ecosystem.

SHORT ANSWER TYPE QUESTIONS

2 Mark Questions

2 It is possible that a species may occupy more than one trophic level in the same ecosystem at the same time. Explain with the help of one example.

3 Construct a pyramid of biomass starting with phytoplankton. Label-3 trophic levels. Is the pyramid upright or inverted? why?

4 State the difference between the first trophic levels of the detritus food chain and grazing food chain.

5 What are the limitations of ecological pyramids in the study of ecosystem?

6 How does the chemical composition of detritus affect the rate of decomposition in a particular climatic condition?

3 Mark Questions

(b) Citing Lake as an example of a simple aquatic ecosystem, interpret how various functions of this ecosystem are carried out.

(c) a) What does secondary productivity in an ecosystem indicate?

b) Primary productivity varies in different types of an ecosystem why?

(d) Explain the steps of decomposition which operates simultaneously on the detritus.

4.Why is the length of a food chain in an ecosystem generally limited to 3 -- 4 trophic levels? Explain with an example.

b a) What do you mean by standing crop?

(a) In a food chain a trophic level represents a functional level not a species. Explain.

LONG ANSWER TYPE QUESTIONS

(d) a) Taking an example of a small pond, explain how the four components of an ecosystem function as unit? b) Name the type of food chain that exists in a pond.

(e) What is primary productivity? Give brief description of factors that affect primary productivity.

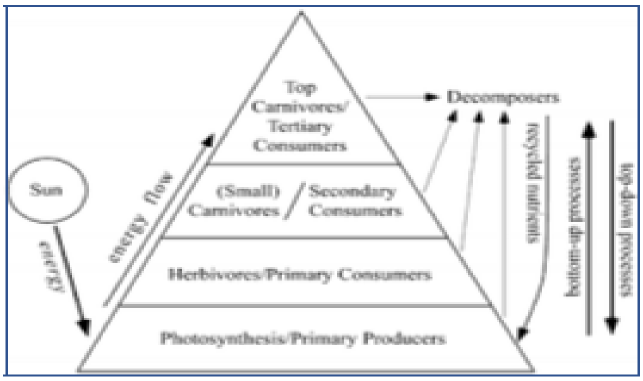
OR

Primary productivity varies from ecosystem to ecosystem. Explain.

3. What is an ecological pyramid? Compare the pyramid of energy, pyramid of biomass and pyramid of number.

DIGRAM BASED & CASE BASED QUESTIONS

2 Organisms in an ecosystem acquire energy in a variety of ways, which is transferred between trophic levels as the energy flows from the bottom to the top of the food web, with energy being lost at each transfer. The efficiency of these transfers is important for understanding the different behaviours and eating habits of warm-blooded versus cold-blooded animals. Modelling of ecosystem energy is best done with ecological pyramids of energy, although other ecological pyramids provide other vital information about ecosystem structure.

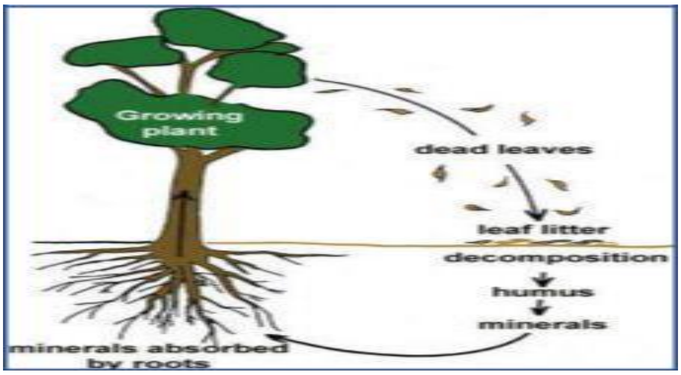


A. ‘Pyramid of energy is always upright’. Substantiate this statement.

B. The essence of second law of thermodynamics is ‘no form of energy can fully convert into another form of energy’. Analyse this statement with reference to energy flow.

C. Construct a pyramid of energy in aquatic ecosystem consisting of 4 members. (Net primary productivity is 10000 J

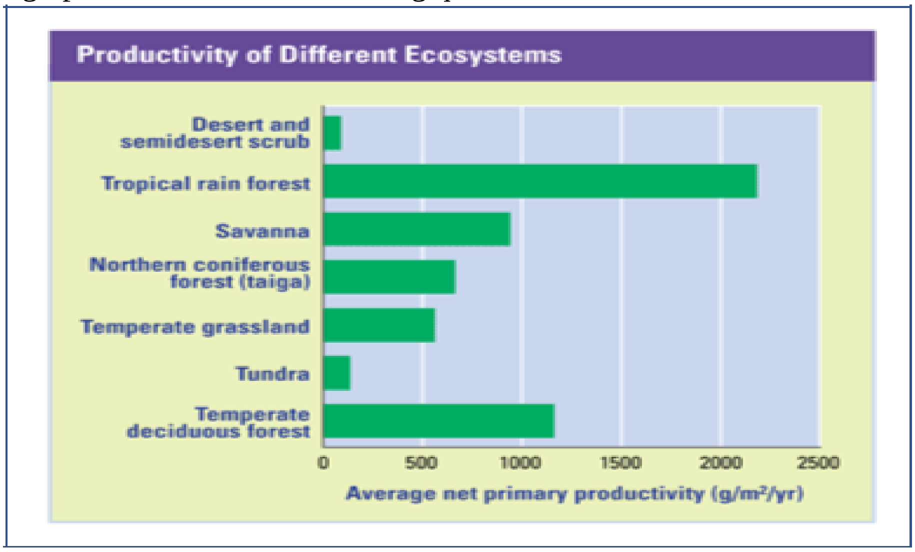
2. Observe the diagram and answer the following questions



A. List out the stages in decomposition.

B. Shell of a prawn and a piece of wood are undergoing decomposition. Compare their rate of decomposition. C. How temperature and moisture content influence decomposition?

3. Analyse the graph and answer the following questions



A. List out the reasons for the variations in productivity in different ecosystems.

B. Despite occupying about 70 percent of the surface, the productivity of the oceans are only 55 billion tons. Analyse the reason.

C. How GPP and NPP is related with respiration?

ANSWERS

MULTIPLE CHOICE QUESTIONS

1.b. Aquarium

2 c. Stratification

3 a. Robert Constanza

4 a. Trophic level

5. c. Energy

6.a. Saprophytes

19. b. Lignin and chitin

20. c. Decomposers

21. c 2-10 %

22. c. Photosynthesis

ASSERTION-REASON TYPE QUESTIONS

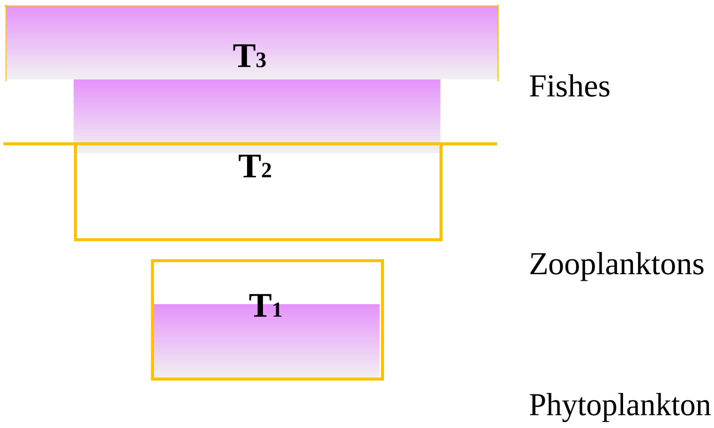
Q. No	Answer	Q. No	Answer	Q. No	Answer
1	**a**	6	**c**	11	**c**
2	**b**	7	**d**		
3	**a**	8	**a**		
4	**a**	9	**a**		
5	**c**	10	**a**		

SHORT ANSWER TYPE QUESTIONS

2 Marks (Answer)

21. For example, sparrow is an omnivore. When it eats seeds fruits or any other plant product it occupies a primary trophic level where as when it eats worms and any other insect it occupies the secondary trophic level thus it occupies more than one trophic level in the same ecosystem

22. .



The pyramid is inverted because the biomass of fishes is more than that of the phytoplankton.

3)

S No	First Trophic Level of Detritus Food Chain	First Trophic Level of Grazing Food Chain
(i)	Decomposers are the first trophic level.	Producers are the first trophic level.
(ii)	They break down the complex organic matter into simpler form by secreting enzymes.	They prepare complex organic molecules from simple inorganic material with the help of sunlight

2 The ecological pyramid assumes a simple food chain and does not accommodate food webs. Thereby, it does not consider the fact that species may belong to two or more tropic levels at a time. Also, saprophytes despite their vital role in ecosystem are given no place in the ecological pyramid.

3 The rate of decomposition is slower if the detritus is rich in lignin and chitin and quicker if the detritus is rich in nitrogen and water-soluble substances like sugar

3 Marks (Answer)

1) i) productivity: conversion of inorganic into organic material with the help of solar energy by the autotrophs.

23. energy flow: unidirectional moment of energy towards higher trophic level. iii) decomposition: fragmentation, leaching, catabolism, humification, mineralisation by bacteria fungi.

2 nutrient cycling: decomposition of dead matter to release the nutrient back to be used by the autotrophs.

24. a) The rate of assimilation and formation of new organic matter by consumers is called secondary productivity.

b) Primary productivity depends on the plant species in habiting a particular area, it also depends on the variety of environment factors, availability of nutrients and photosynthetic capacity of a plants. Therefore, it varies from one ecosystem to another ecosystem.

25. The steps of decomposition which operate simultaneously on detritus are fragmentation, leaching and catabolism.

(a) Fragmentation: the process of breaking down of the detritus in the smaller particles is called fragmentation.

(b) Leaching: the process by which water soluble in organic nutrients go down into the soil and get precipitated as unavailable salt.

(c) Catabolism: the enzymatic process by which degraded detritus is converted into simple inorganic substance is called catabolism.

26. The amount of energy flow decreases with successive trophic levels as only 10% of energy is transferred from one trophic level to the next successive trophic level. The energy is lost in the form of respiration and other vital activities to maintain life. If more trophic levels are present the residual energy will be limited and decreased to such an extent that it cannot further support any trophic level by the flow of energy. so, the food chain is generally limited to 3-- 4 trophic levels only.

27. a) The standing crop is measured as the mass of living organisms or the number in a unit area

b A given species may occupy more than one trophic level in the same ecosystem at a given time, if the function of the mode of nutrition of species changes it position shall change in the trophic levels. The same species can be at primary consumer level in one food chain and at secondary consumer level in another food chain in the same ecosystem at the given time.

LONG ANSWER TYPE QUESTIONS

(e) **a) Pond ecosystem:** Pond is an example of an aquatic ecosystem, it is fairly a self-sustainable unit. A pond is a shallow water body in which all the four basic components of an ecosystem are well exhibited.

α The **abiotic component** is the water with all the dissolved inorganic and organic substances and the rich soil deposits at the bottom of the pond. The solar input, the cycle of temperature, day-length and other climatic conditions regulate the rate of function of the entire pond.

β The **autotrophic biotic components** include the phytoplankton, some algae and the floating submerged and marginal plants found at the edges.

χ The **consumers** are represented by the zooplankton, the free swimming and bottom dwelling forms.

δ The **decomposers** are the fungi, bacteria and flagellates especially abundant in the bottom of the pond.

This system performs all the functions of any ecosystem and of the biosphere as a whole. ie, conversion of inorganic into organic material with the help of radiant energy of the sun by the autotrophs, consumption of the autotrophs by heterotrophs, decomposition and mineralization of the dead matter to release them back or reuse by the autotrophs etc These events are repeated over and over again. There is unidirectional movement of energy towards higher trophic levels and its dissipation and loss as heat to the environment.

b) Grazing food chain.

2 Primary productivity is the rate of synthesis of biomass by producers per unit time per unit area through the process of photosynthesis.

Factors affecting primary productivity:

This varies from ecosystem to ecosystem. This is due to various factors that listed below:

i)The plant species inhabiting a particular area.

ii)Various environmental factors also contribute in affecting primary productivity. They are,

2 Light: Sunlight is the ultimate source of energy. Due to the less availability of light in an aquatic ecosystem, here productivity is less than terrestrial ecosystem. Maximum light is available in tropics and poles receives the minimum light. Therefore, productivity is comparatively low on poles.

3 Temperature: It regulates the activity of an enzyme, so optimum temperature is required for proper functioning of an enzyme.

1 Moisture: Rain/humidity increases the productivity of the ecosystem, but it tends to decrease with the scarcity of water. So, deserts have the lowest primary productivity as soil is deficient in moisture.

4 Nutrients availability: Nutrients are essential for the growth of producers. Thus, higher the nutrients, greater the primary productivity.

28. Photosynthetic efficiency of plants (producers): C_4 plants are more productive as compared to C_3 plants because some plants have more efficiency to trap sunlight.

29. The relation between producers and consumers in an ecosystem can be graphically represented in the form of a pyramid is called **ecological pyramid.**

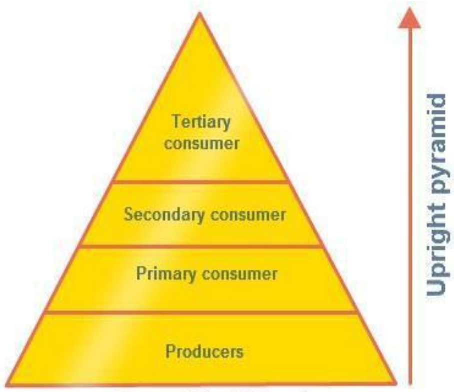
Ecological pyramids are of 3 kinds

(c)Pyramid of number

(d) Pyramid of biomass

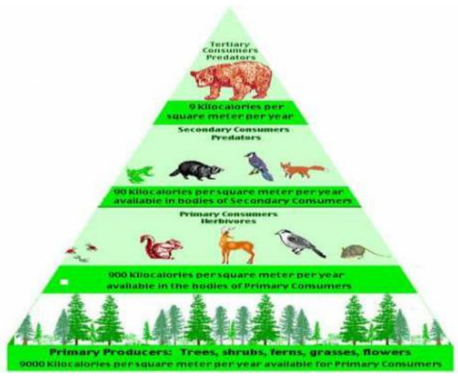
c)Pyramid of energy.

Pyramid of number: The relationship between producers and consumers in an ecosystem can be represented in the form of a pyramid in terms of number is called pyramid of number.

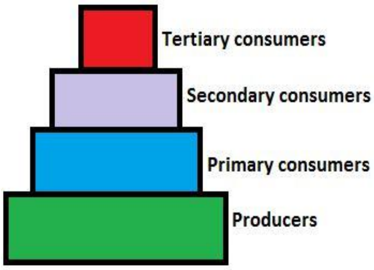


Pyramid of Number

Pyramid of biomass: The relationship between producers and consumers in an ecosystem can be represented in the form of pyramid in terms of biomass is called pyramid of biomass. It can be upright or inverted.



Pyramid of energy: The relationship between producers and consumers in an ecosystem can be represented in the form of pyramid in terms of flow of energy called pyramid of energy. It is always upright as energy is lost as heat at each step.

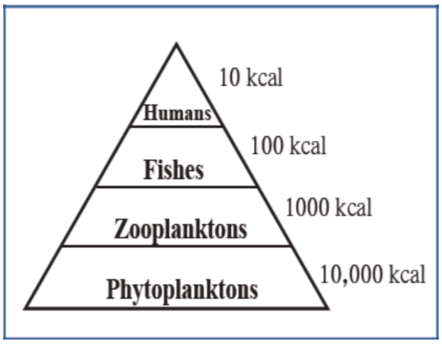


Pyramid of energy

DIGRAM BASED & CASE BASED QUESTIONS

2 A. Pyramid of energy is always upright, can never be inverted, because when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step.

B. During energy flow some amount of energy is lost in the form of heat. C.



32. A. The stages in decomposition are, a. Fragmentation

b. Leaching c.

Catabolism d.

Humification e.

Mineralisation

B. Shell of prawn is composed of chitin but wood predominantly contains cellulose. So, rate of decomposition is lower i shell of prawn.

C. Warm and moist environment favour decomposition whereas low temperature and anaerobiosis inhibit decomposition resulting in build-up of organic materials.

3. A. Primary productivity depends on,

a. The plant species inhabiting a particular area.

b. Environmental factors.

c. Availability of nutrients.

d. Photosynthetic capacity of plants.

B. The various reasons include,

33. Non-uniformity in the availability of sunlight.

34. Non-availability of sufficient minerals.

35. Photosynthetic capability of producers.

36. Size of producers.

C.NPP=GPP–R

TEAM MEMBERS

MS K SHERLI - KV KELTRON NAGAR

MS KUMARI OMANA - KV KELTRON NAGAR

MS NINU V JOY - KV CHENNEERKARA

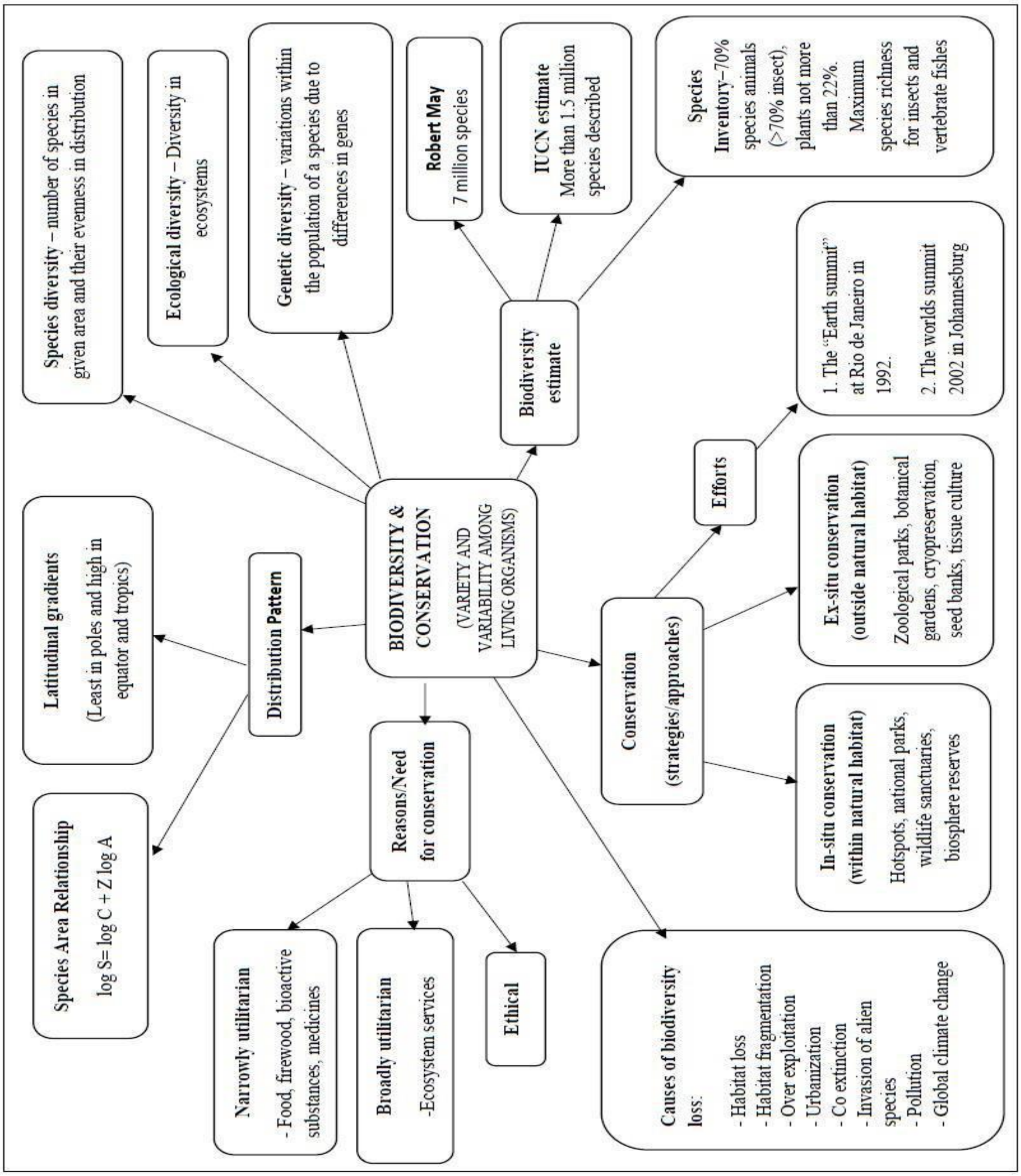
MS MINI ANILKUMAR - KV PANGODE

MS INDIRA T K - KV KAVARATTI

MR PRAMOD B - KV PANGODE

CONCEPT MAP

Biodiversity and Conservation (Concept Map)



GIST OF MAJOR AND MINOR CONCEPTS

Biodiversity refers to the variety and variability that exists among organisms.

J. This term was coined by **Edward Wilson**. The vast array of species of micro- organisms, algae, fungi, plants and animals occurring on the earth either in the terrestrialor aquatic habitats and the ecological complexes of which they are a part comprises biodiversity .

K. Diversity ranges from macromolecules to biomes.

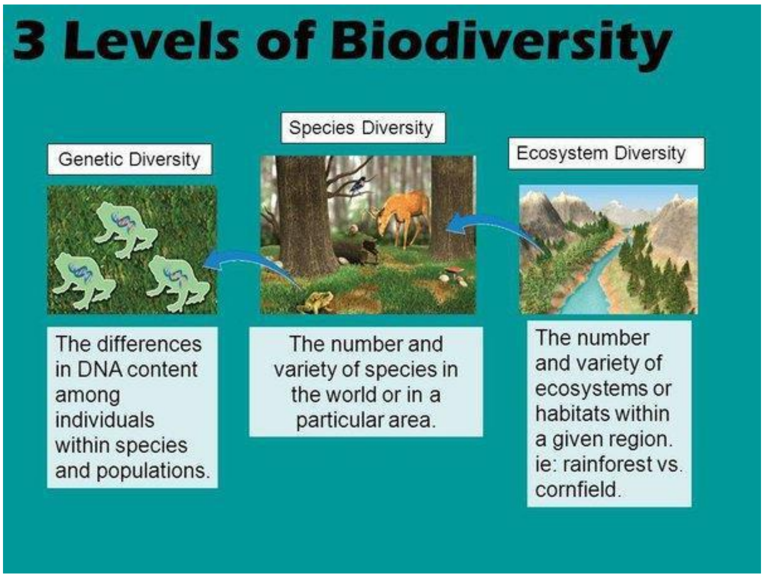
The important diversity at the levels of biological organization are-

Genetic Diversity- a single species might show high diversity at the genetic level over itsdistributional range. *Rauwolfia vomitoria* shows genetic variation in terms of concentration and potency of chemical reserpine India has more than 50,000 genetically different strains of rice and 1000 varieties of mango.

Species Diversity- diversity at species level for example, the Western Ghats have more amphibian species diversity than the Eastern Ghats.

Ecological Diversity- deserts, rain forests, mangroves, coral reefs, wetlands, estuaries and alpine

meadows are types of ecological diversity.



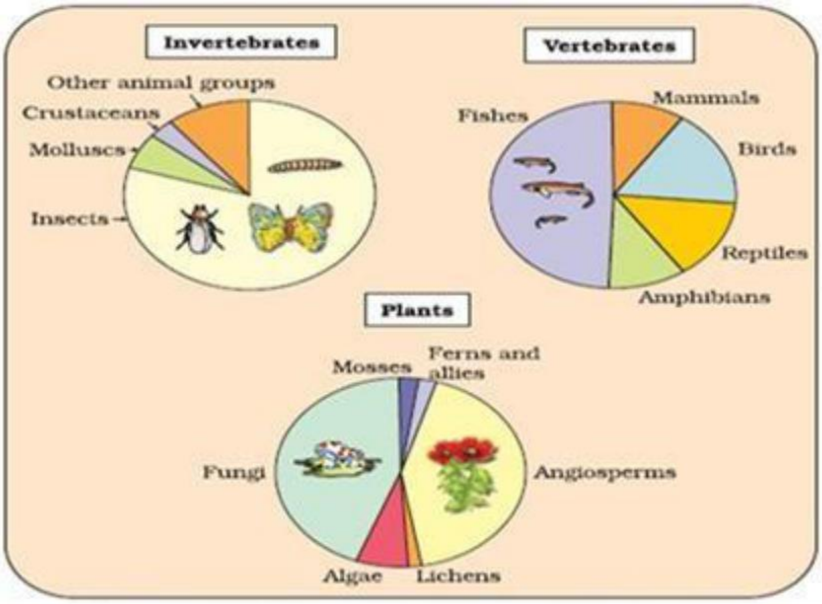
GLOBAL SPECIES DIVERSITY

Biodiversity and its conservation are vital environmental issues of international concern as more and more people around the world begin to realize the critical importance of biodiversity for survival and well-being on this planet.

JJ. According to the IUCN, the total number of plant and animal species described so far is about 1.5 million but still many species are yet to discovered and described.

- More than 70% of all the species recorded are animals while rest are plants including algae, fungi, bryophytes, gymnosperms and angiosperms. Among animals, 70% of total are insects.

q The number of fungi species in the world is more than the combined total of the species of fishes, amphibians, reptiles and mammals.


Invertebrates
Other animal groups
Crustaceans
Molluscs
Insects
Vertebrates
Fishes
Mammals
Birds
Reptiles
Amphibians
Plants
Mosses
Ferns and allies
Fungi
Angiosperms
Algae
Lichens

BIODIVERSITY IN INDIA

q India is one of the twelve mega biodiversity countries of the world.

r India has only 2.4% of the land area of the world, it has 8.1% of the global species biodiversity.

s There are about 45,000 species of plants and about 90,000-1,00,000 species of animals.

t New species are yet to be discovered and named.

u Applying Robert May's global estimate, only 22% of the total species have been recorded, India has probably more than 1,00,000 species of plants and 3,00,000 species of animals to be discovered and described.

Patterns of Biodiversity

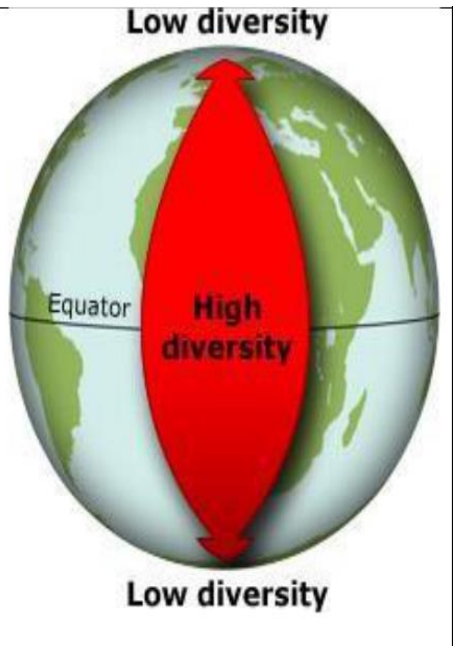
p **Latitudinal gradients-**

The diversity of plants and animals is not uniform throughout the world and shows uneven distribution.

This distribution pattern is along the latitudinal gradient in diversity.

Species diversity decreases as we move away from the equator towards the poles.

Tropics harbor more species than temperate or polar areas. Amazonian Rainforest has the greatest biodiversity on earth. It has more than 40000 species of plants, 1,25,000 species of insects, 300 species of fish, 427 of amphibian and 378 of reptiles, 1300 species of birds and 427 of mammals



Why tropics have greater Biodiversity?

• Speciation is a function of time unlike temperate regions subjected to frequent glaciation in past, tropical latitudes have remained relatively undisturbed for millions of years and thus had long evolutionary time for species diversification

• Tropical environments unlike temperate ones are less seasonal and more constant and predictable which promote niche specialization and lead to a greater species diversity.

c)There is more solar energy available in the tropics which contribute to higher productivity this in turn contribute indirectly to greater diversity.

SPECIES-AREA RELATIONSHIPS

37. During his pioneering and extensive explorations in the wilderness of South American jungles, the great German naturalist and geographer Alexander von Humboldt observed that within a region species richness increased with increasing explored area, but only up to a limit.

38. In fact, the relation between species richness and area for a wide variety of taxa (angiospermic 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

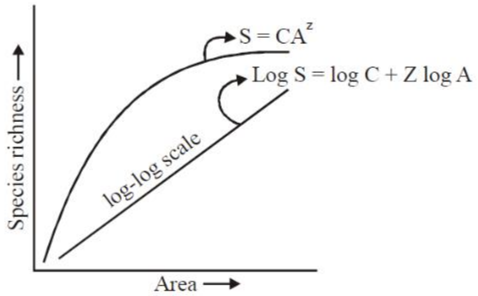


Fig. : Showing species area relationship

Note that on log scale the relationship becomes linear

where S = Species richness,

A= Area

Z = slope of the line (regression coefficient)

C = Y-intercept

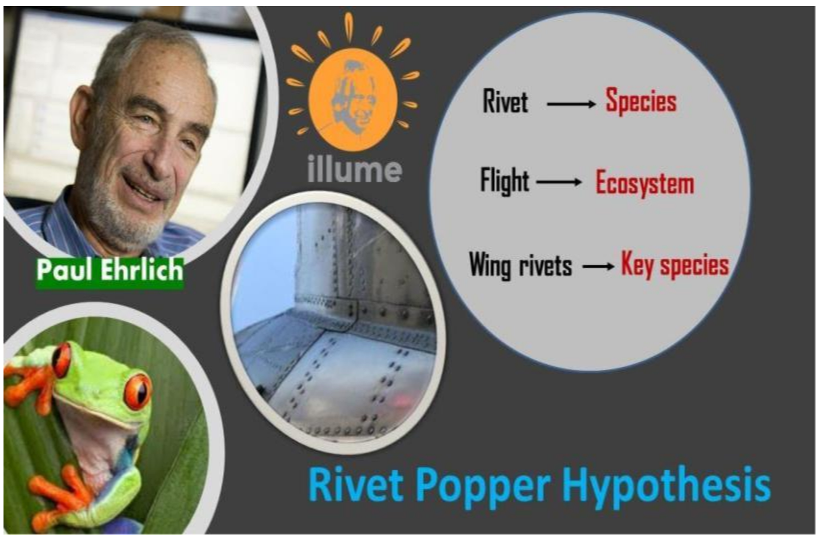
Ecologists have discovered that the value of Z lies in the range of 0.1 to 0.2, regardless of the taxonomic group or the region.

The importance of Species Diversity to the Ecosystem

8. The communities with more species are generally more stable than those with less species. A stable community should not be show too much variation in productivity fromyear to year.

9. Rich biodiversity is essential for ecosystem health and imperative for the very survival ofhuman race on this planet.

Rivet popper hypothesis – given by Paul Ehrlich. In an airplane (ecosystem) all parts are joined together using thousands of rivets (species). If every passenger travelling in it starts popping a rivet to take home (causing a species to become extinct), it may not affect flight safety (proper functioning of the ecosystem) initially, but as more and more rivets are removed, the plane becomes dangerously weak over a period of time. Furthermore, which rivet is removed may also be critical. Loss of rivets on the wings (key species that drive major ecosystem functions) is obviously a more serious threat to flight safety than loss of a few rivets on the seats or windows inside the plane.



Loss of Biodiversity

The biological wealth of our planets have been declining rapidly due to three factors – Population, Urbanisation and Industrialisation. The IUCN Red List (2004) documents the extinction of 784 species (including 338 vertebrates, 359 invertebrates and 87 plants) in the last 500 years. Some examples of recent extinctions include the dodo (Mauritius), quagga (Africa), thylacine (Australia), Steller's Sea Cow (Russia) and three subspecies (Bali, Javan, Caspian) of tiger. In last 20 years, 27 species have been disappeared. In general, loss of biodiversity in a region may lead to

Decline in plant population

Lowered resistance to environmental perturbations, drought, and flood

Increased variability in ecosystem processes such as productivity, water use, and pest and disease cycles.

LOSS OF BIODIVERSITY

4) The colonisation of tropical Pacific Islands by humans is said to have led to the extinction of more than 2,000 species of native birds. The **IUCN Red List (2004)** documents the extinction of 784 species (including 338 vertebrates, 359 invertebrates and 87 plants) in the last 500 years. Some examples of recent extinctions include the dodo (Mauritius), quagga (Africa), thylacine (Australia), Steller's Sea Cow (Russia) and three subspecies (Bali, Javan, Caspian) of tiger.

5) The last twenty years alone have witnessed the disappearance of 27 species.

TYPES OF EXTINCTION

Species become extinct through three types of extinction processes:

NATURAL EXTINCTION

It is the extinction of species slowly from the earth due to changes in environmental conditions. Some species disappear and the others which are more adapted to changed conditions, take their place.

MASS EXTINCTION

It refers to the extinction of a large number of species due to catastrophe.

ANTHROPOGENIC EXTINCTION

They are extinctions abetted by human activities like settlements, hunting, over exploitation and habitat destruction.

CAUSES OF BIODIVERSITY LOSSES

HABITAT LOSS AND FRAGMENTATION

Expanding population and development require more industrial area, extension of present towns and cities, more area for agriculture, new roads, canals, dams etc. **Habitat fragmentation** is the breaking of a large habitat into smaller patches due to the development of agriculture, water body and other changes.

OVER-EXPLOITATION

Over exploitation of any particular species reduces the size of its population so that it becomes vulnerable to extinctions, e.g., hunting of animals, collection of medicinal plants.

ALIEN SPECIES INVASIONS

Any new species entering in a geographical region are known as exotic or alien species.

It may cause disappearance of native species through changed biotic interaction, like - Nile perch, where a large predator fish was introduced in Lake Victoria of South Africa. It led to a threat to the entire freshwater ecosystem by feeding on small herbivorous and carnivorous cichlid fish species which were endemic to the aquatic system.

CO-EXTINCTION

When a species becomes extinct, the plant and animal species associated with it also become extinct. Example, in a coevolved plant-pollinator mutualism, extinction of one always leads to the extinction of the other.

BIODIVERSITY CONSERVATION

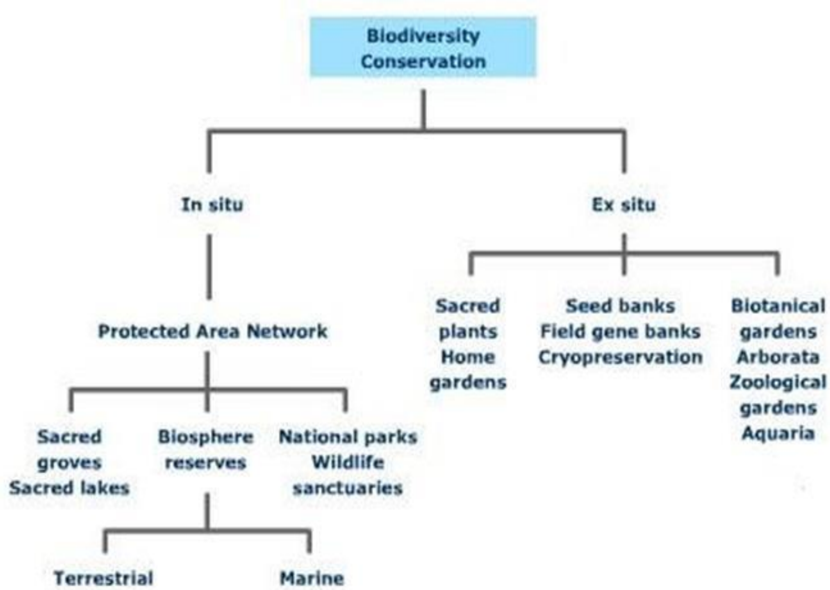
(e) The reasons for conserving biodiversity are narrowly utilitarian, broadly utilitarian and ethical.

(f) **Narrowly utilitarian** reason for conserving biodiversity are fairly apparent. According to most people, biodiversity is a reservoir of resources for the manufacture of food, pharmaceutical and cosmetic products.

(g) **Broadly utilitarian** reveals that biodiversity plays a main role in many ecosystem services that nature provides.-oxygen, pollination etc.

(h) **Ethical reasons** relates to what we owe to millions of plant, animal and microbe species with whom we share this planet.

(i) The International Union for Conservation of Nature and Natural Resources (IUCN), having its headquarters at Morgis in Switzerland, maintains a Red Data Book providing a record of animals and plants which are known to be in danger.



In situ (on site) conservation:

Conservationists have identified for maximum protection certain

(ii) 'Biodiversity hotspots' regions with very high levels of species richness and high degree of endemism, species found in that region and not found anywhere else.

There are 34 biodiversity hot spots in the world. These hotspots are also regions of accelerated habitat loss. India has 14 biosphere reserves, 90 national parks and 448 wildlife sanctuaries.

India has also a history of religious and cultural traditions that emphasised protection of nature.

In many cultures, tracts of forest were set aside, and all the trees and wildlife within were venerated and given total protection.

❖ Sacred groves:

Khasi and Jaintia Hills in Meghalaya,

Aravalli Hills of Rajasthan,

Western Ghat regions of Karnataka and Maharashtra

and the Sarguja, Chanda and Bastar areas of Madhya Pradesh.

❖ In Meghalaya, the sacred groves are the last refuges for a large number of rare and threatened plants.

Ex situ (off site) conservation:

In this method, threatened animals and plants are taken out from their natural habitat and placed in special setting when they be protected and given special care.

Zoological parks, Botanical Gardens and wildlife safari parks are used for this purpose.

- Advanced methods of ex-situ conservation:

Gametes of threatened species can be preserved in viable and fertilecondition for long periods of time using cryopreservation technique.

The historic convention on Biological Diversity (The Earth Summit) held in Rio de Janeiro in 1992,called upon all nations to take appropriate measures for conservation of biodiversity andthe World Summit on sustainable development held in 2002 in Johannesburg, South Africa, 190 countries pledged their commitment to achieve by 2010, a significant reduction in the current rate of biodiversity loss at global, regional and local levels.

MULTIPLE CHOICE QUESTIONS

1. Which one of the following is an example of ex situ conservation?

(a) Wildlife sanctuary

(b) Seed bank

(c) Sacred groves

(d) National park

2. Which one of the following is not observed in biodiversity hot spots?

(a) Lesser inter-specific competition

(b) Species richness

(c) Endemism

(d) Accelerated species loss

3. Which one of the following pairs of organisms are exotic species introduced in India?

(a) Lantana camara, water hyacinth

(b) Water hyacinth, Prosopis cinereria

(c) Nile perch, Ficus religiosa

(d) Ficus religiosa, Lantana camara

5. Biodiversity of a geographical region represents

(a) Endangered species found in the region

(b) The diversity in the organisms living in the region

(c) Genetic diversity in the dominant species of the region

(d) Species endemic to the region

7. Which of the following countries has the highest biodiversity?

(a) South America

(b) South Africa

(c) Russia

(d) India

8. Which of the following is not a cause for loss of biodiversity?

a) Destruction of habitat

(b) Invasion by alien species

(c) Keeping animals in zoological parks

(d) Over-exploitation of natural resources

9. Which of the following is not an invasive alien species in the Indian context?

(a) Lantana

(b) Cynodon

(c) Parthenium

(d) Eichhornia

10. The enormous number of varieties of mango in India represents

(a) Genetic diversity

(b) Species diversity

(c) Ecological diversity

(d) hybridisation programmes

11. Which one of the following is not a major characteristic feature of biodiversity hot spots?

(a) Large number of species

(b) Abundance of endemic species

(c) Mostly located in the tropics

(d) Mostly located in the Polar Regions

12. Match the animals given in column I with their location in column II.

Column I Column II

A. Dodo (i) Africa

B. Quagga (ii) Russia

C. Thylacine (iii) Mauritius

D. Stellar's sea cow (iv) Australia

Choose the correct match from the following.

(a) A-(i), B-(iii), C-(ii), D-(iv)

(b) A-(iv), B-(iii), C-(i), D-(ii)

(c) A-(iii), B-(i), C-(ii), D-(iv)

(d) A-(iii), B-(i), C-(iv), D-(ii)

13. What is common to the following plants: Nepenthes, Psilotum, Rauwolfia and Aconitum?

(a) All are ornamental plants

(b) All are phylogenic link species

(c) All are prone to over exploitation

(d) All are exclusively present in the Eastern Himalayas.

14. Select the ex-situ conservation technique from the following

(a) Wildlife sanctuaries

(b) Biosphere reserves

(c) Cryopreservation

(d) national parks.

15. Amongst the animal groups given below, which one appears to be more vulnerable to extinction?

(a) Insects

(b) Mammals

(c) Amphibians

(d) Reptiles

16. Which one of the following is an endangered plant species of India?

(a) Rauwolfia serpentina

(b) Santalum album (Sandal wood)

(c) Cycas beddonei

(d) All of the above

17. What is common to Lantana, Eichhornia and African catfish?

(a) All are endangered species of India.

(b) All are keystone species.

(c) All are mammals found in India.

(d) All the species are neither threatened nor indigenous species of India.

18. Keystone species deserve protection because these

(a) are capable of surviving in harsh environmental condition

(b) indicate presence of certain mineral in the soil.

(c) have become rare due to overexploitation.

(d) play an important role in supporting other species.

19. Which of the following statements is correct?

(a) Parthenium is an endemic species of our country.

(b) African catfish is not a threat to indigenous catfishes.

(c) Steller's sea cow is an extinct animal.

(d) Lantana is popularly known as carrot grass.

20. Among the ecosystem mentioned below, where can one find maximum biodiversity?

(a) Mangroves

(b) Desert

(c) Coral reefs

(d) Alpine meadows

21. Genetic diversity in agricultural crops is threatened by

(a) Intensive use of pesticides

(b) Extensive intercropping

(c) Intensive use of fertilisers

(d) Introduction of high yielding varieties.

22. Which of the following forests is known as the 'lungs of the planet Earth'?

(a) Taiga forest

(b) Tundra forest

(c) Amazon rainforest

(d) Rainforests of North East India

23. The active chemical drug reserpine is obtained from:

(a) Datura

(b) Rauwolfia

(c) Atropa

(d) Papaver

24. Which of the following group exhibit more species diversity?

(a) Gymnosperms

(b) Algae

(c) Bryophytes

(d) Fungi

25. The historic convention on Biological Diversity held in Rio de Janeiro in 1992 is known as

(a) CITES Convention

(b) The Earth Summit

(c) G-16 Summit

(d) MAB Programme

26. What is common to the techniques (i) in vitro fertilisation, (ii) Cryopreservation and (iii) tissue culture?

(a) All are in situ conservation methods.

(b) All are ex situ conservation methods.

(c) All require ultra-modern equipment and large space.

(d) All are methods of conservation of extinct organisms.

27. The extinction of passenger pigeon was due to

(a) Increased number of predatory birds.

(b) Over exploitation by humans.

(c) Non-availability of the food

(d) Bird flu virus infection.

28. Which of the below mentioned regions exhibit less seasonal variations?

(a) Tropics

(b) Temperate

(c) Alpines

(d) Both (a) and (b)

29. Biosphere reserves differ from National Parks and Wildlife Sanctuaries because in the former

(a) Human beings are not allowed to enter.

(b) People are an integral part of the system.

(c) Plants are paid greater attention than animals

(d) Living organisms are brought from all over the world and preserved for prosperity

30. The species confined to a particular region and not found elsewhere is termed as :

a) Rare

b) Keystone

c) Alien

d) Endemic

ASSERTION REASONING QUESTIONS

In each of the questions given below, there are two statements marked as Assertion (A) andReason (R). Mark your answer as per the codes provided below:

a. Both assertion and reason are true and the given reason is the correct explanation

b. Assertion and reason both are true but given reason is not the correct explanation

c. Assertion is true, reason is false

d. Assertion is false, reason is true

1. Assertion: The variation in Rauwolfia growing in different Himalayan ranges might be in terms of the potency and concentration of the active chemical (reserpine) that the plant produces.

Reason: A single species might show high diversity at the genetic level over its distributional range.

2. Assertion: Island ecosystems are generally prone to invasion by introduced species.

Reason: Invasion is common when the introduced ecosystem is not similar to the one in which the invader evolved.

3. Assertion: Diversity observed in the entire geographical area, is called gamma diversity.

Reason: Bio-diversity decreases from high altitude to low altitude.

4. Assertion: Communities that comprise of more species tend to be more stable.

Reason: A higher number of species results in less variation in total biomass.

5. Assertion: If the species-area relationships are analyzed among very large areas like the entire continents, the value of Z i.e., slope of line lies in the range of 0.1 to 0.2.

Reason: The value of Z i.e., slope of line of species area relationships lies in the range of 0.6 to 1.2 when analysis is done among small areas.

6. Assertion: Speciation is a function of time and tropical regions had got a long evolutionary time for species diversification as compared to temperate regions.

Reason: Temperate regions have undergone frequent glaciations in the past whereas tropical regions have remained relatively undisturbed for millions of years.

7. Assertion: Endemic organisms with limited range are the least affected by habitat destruction.

Reason: These organisms are not found anywhere else within the world and hence have more chance of recovering.

8. Assertion: The process of evolution is random and slow.

Reason: Any species that cannot adapt to its environment will not survive.

9. Assertion: Biodiversity is declining at an alarming rate.

Reason: exotic species are a major cause of species extinction.

10. Assertion: Tropical rain forests are disappearing fast from developing countries.

Reason: No value is attached to these forests as they are poor in biodiversity.

SHORT ANSWER QUESTIONS

1.What is Mass extinction?

2.State the use of Biodiversity in modern agriculture.

3. List the features that make a stable biological community.

4. Why certain regions have been declared as biodiversity "hot spots" by environmentalists of the world? Name any two "hot spot" regions of India.

5. Explain co- extinction with a suitable example.

6. List any four factors which may lead to loss of biodiversity.

7. Why are sacred groves highly protected?

8. Alien species are a threat to native species. Justify taking examples of an animal and a plant alien species.

9. Suggest two practices giving one example of each, that help to protect rare or threatened species.

10. The following graph shows the species-area relationship. Answer the following questions asdirected.

a.Name the naturalist who studied the kind of relationship shown in the graph. Write

theobservations made by him.

b. Write the situations as discovered by the ecologists when the value of 'Z'

(slope of theline) lies between

(1) 0.1 and 0.2

(2) 0.6 and 1.6

c. When would the slope of the line `b' become steeper?

11. Amazonian rain forest has the greatest biodiversity on earth. List any two hypotheses that are proposed by the biologists to account for the greater biological diversity.

Giving reasons, explain why there is more species biodiversity in tropical latitudes than in temperate ones.

12. Enlist the three levels of biodiversity with the help of suitable examples.

13. What are the three basic arguments put forward regarding conservation of biodiversity?

14.Differentiate between in-situ and ex-situ approaches of conserving biodiversity.

15. List six advantages of "ex-situ" approach to conservation of biodiversity.

16. Many plant and animal species are on the verge of their extinction because of loss of

forestland by indiscriminate use by the humans. As a biology student what method would you suggest along with its advantages that can protect such threatened species from getting extinct?

17. What is biodiversity? How is it a matter of concern now?

18. List the features that makes a stable biological community.

LONG ANSWER QUESTIONS

1. Name and explain the 3 interrelated hierarchical levels of biodiversity?

2. Explain the efforts for the conservation of biodiversity at international level.

3. What are the two types of desirable approaches to conserve biodiversity? Explain with examples bringing out the difference between the two types.

4. (a) Biologists are not sure about how many prokaryotic species there might be. Give reasons.

(b) Would Western Ghats ecosystems be less functional if one of its tree frog species is lostforever? Substantiate your answer in the light of the hypothesis proposed by Paul Ehrlich.

5. How is biodiversity important for ecosystem functioning?

6. What are the major causes of species losses in a geographical region?

7.Why is there a need to conserve biodiversity?

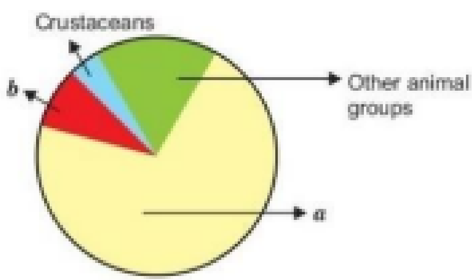
8.(a) What is IUCN red list? Give any two uses of this list.

(b) Why are conventional methods not suitable for the assessment of biodiversity of bacteria?

DIAGRAM BASED/ CASE BASED QUESTIONS

When this catfish was introduced into Indian rivers, it posed a threat to Indian catfish. Name the fish. Give the specific term for such event.

2. Name the unlabelled area 'a' and 'b' of the pie chart representing the global biodiversityof invertebrates showing the proportionate number of species of major taxa.



3. Identify the plant and write the scientific name. What was the result of introduction of this plant?

4. Name the type of biodiversity represented by the Rauwolfia vomitoria growing in different regions of Himalayas.

4. Read the following and answer any four questions from 3(i) to 3(v) given below:

IUCN maintains a Red Data Book or Red List which is a catalogue of taxa facing risk of extinction. The IUCN Red List (2004) documents the extinction of 784 species in the last 500 years. Some examples of recent extinctions include the dodo, quagga, thylacine and Steller's sea cow. The last twenty years alone have witnessed the disappearance of 27 species. Red List has eight categories of species.

(i) Dodo, an extinct taxon, belongs to which country?

(a) Mauritius

(b) Africa

(c) Australia

(d) Russia

(ii) To which of the following categories of IUCN, *Berberis nilghiriensis* belongs?

(a) Extinct

(b) Extinct in wild

(c) Endangered

(d) Critically endangered

(iii) Steller's sea cow and passenger pigeon became extinct due to

(a) Alien species invasion

(b) Over-exploitation

(c) Coextinctions

(d) Intensive agriculture.

(iv) Bali, Javan and Caspian are

(a) Species of tiger

(b) Species of cheetah

(c) Subspecies of cheetah

(d) Subspecies of tiger.

(V) Select the correct term for the following definitions (i, ii, iii, iv).

(i) The taxon is liable to become extinct if not allowed to realise its full biotic potential by providing protection from exotic species/human exploitation/habitat deterioration/depletion of food.

(ii) The taxon has been completely eliminated or died out from earth. Eg.Dodo

(iii) The taxon is facing a high risk of extinction in the wild in the near future due to decrease in its habitat, excessive predation or poaching.

(iv) They are species with naturally small populations, either localised or thinly scattered, which are always at risk from pests/pathogens/ predators/exotic species.

(i) (ii) (iii) (iv)

(a) Threatened extinct Endangered Rare

(b) Endangered Extinct Threatened Rare

(C)Extinct Rare Threatened Endangered

(d) Threatened Extinct Rare Endangered

5. Read the following and answer any four questions from (i) to (v) given below

Sacred groves of India are forest fragments of varying sizes, which are communally protected, and which usually have a significant religious connotation for the protecting community. Hunting and logging are usually strictly prohibited within these patches. Other forms of forest usage like honey collection and deadwood collection are sometimes allowed on a sustainable basis. Sacred groves did not enjoy protection via federal legislation in India. Some NGOs work with local villagers to protect such groves. Indian sacred groves are often associated with temples, monasteries, shrines or with burial grounds. Generally, sacred groves are a tract of virgin forest, harbouring rich biodiversity and protected traditionally by the local communities as a whole. The area of scared groves ranges from few square meters to several hectares. Till today, there exist some fascinating example of forest patches harbouring native vegetation, which has been intertwined with the various aspects of indigenous, cultural and religious practices along with the associated taboos. A Sarpakkavu or Snake Grove is a kind of holy grove found in Kerala. Kavu is the traditional name given for Sacred groves across the Malabar Coast in Kerala, South India

(i) Sacred groves are

A. sacred areas B. temples C. burial grounds d. protected natural habitats

(ii) Sacred groves of Palakkad are

a. Pathirikunnath mana b. Anthimahakali temple kavu c. Athippakamana kavu d . all the above

(iii) Based on the article GIVEN answer the following

Sacred groves are neglected today due to

a. Lack of public interest in traditions

b. Encroachment

c. Increased population pressure

d. Exploitation by money makers

e. All the above

(iv) Sacred groves are especially useful in

(a) Preventing soil erosion

(b) Year-round flow of water in river

(c) Generating environmental awareness

(d) Conserving rare and threatened species

(v)All of the following are included in ex-situ conservation except_______

(a) Botanical gardens

(b) Sacred groves

(c) Wildlife safari parks

(d) Seed banks

6. Read the following and answer any four questions from 4(i) to 4(v) given below:

Wetlands are called Ramsar sites because the first international convention on their conservation was held in Ramsar in Iran in 1971. Wetlands or Ramsar sites are low lying marshy areas which get filled up during rains due to runoff and overflow from other water bodies. They are often considered to be waste lands which are used as dumping areas and filled up to recover land for various constructions activities. As a result, a large number of wetlands have disappeared.

(i) Select the incorrect match of wetland and its location.

Wetland Location

(a) Harike Punjab

(b) Chandra Tal H.P.

(c) Bhoj M.P

(d) Ashtamudi Odisha

(ii) Migratory bird flamingo breeds in which of the following wetlands?

(a) Bhitarkanika Mangroves

(b) Rann of Kutch

(c) Harike

(d) Chandra Tal

(iii) Which of the following is not an importance of wetlands?

(a) They are an important source of recharging groundwater.

(b) They provide protection from floods.

(c) They are good source of siltation and purification of water.

(d) None of these

(iv) Which of the following wetland ecosystem is highly acidic and has a accumulation of decomposed plants known as peat?

(a) Bog

(b) Mangrove

(c) Estuary

(d) Watershed

(v) The mangroves of Bhitarkanika are famous for

(a) Rare migratory waterbirds

(b) Nesting sites for endangered olive ridley turtles

(c) Prawn cultivation

(d) all of these.

ANSWER KEY

MULTIPLE CHOICE QUESTIONS

1. (b) 2. (a) 3. (a) 6. (b) 7. (a) 8. (c) 9. (b) 10. (a) 11. (c) 12. (d) 13. (c) 14. (c) 15. (c) 16. (d) 17. (d) 18. (d) 19. (c) 20. (c) 21. (d) 22. (c) 23. (b) 24. (d) 25. (b) 26. (b) 27. (b) 28. (a) 29.(b) 30.(d)

ASSERTION- REASONING QUESTIONS

1. A 2. C 3. C 4. A 5. D 6. A 7. D 8. B 9. B 10. C

SHORT ANSWER QUESTIONS

1. A large number of species become extinct due to natural calamities like volcanic eruptions,prolonged drought, heavy rain,earthquakes etc which is called mass extinction.

2. Biodiversity is a source of hybrids, GM plants, biopesticides, organic farming,biofetilisers, disease resistant plants etc.

3. Hot spots of biodiversity are the regions with very high levels of species richness and high degree of endemism. Environmentalists are in the opinion that the protection of hot spots couldreduce the ongoing mass extinction by almost 30 per cent.

Two hot spot regions of India are: Western Ghats and Sri Lanka, and Indo-Burma.

4. Co-extinction refers to the disappearance of a species with extinction of another species ofplant or animal with which it was associated in an obligatory way.

Eg: Extinction of a plant species, when its pollinator species become extinct.

5. (1) Habitat loss and fragmentation
(2) Over- exploitation of natural resources.
(3) Alien species invasions, which compete with the native species and cause theirextinction.
(4) Co-extinction of associated species in an obligatory way.
6.Sacred groves are highly protected - because of religious and cultural traditions, refuges for large number of rare and threatened plants / ecologically unique and biodiversity rich regions
7. - The introduction of Nile Perch into Lake Victoria in East Africa, led to the extinction Of more than 200 species of cichlid fish in the lake.
- Parthenium (carrot grass) introduced to our country have become invasive and caused environmental damage, and posing a threat to the native species.
8. (1) In situ conservation, biodiversity hotspot / biosphere reserve / national parks /sanctuaries /Ramsar sites / sacred groves (Any one)
(2) Ex situ conservation, Zoological parks / botanical garden / wild life safari parks /cryopreservation techniques / Tissue culture / seed bank / pollen banks (Any one)
9. (a) Alexander Von Humboldt. He observed that with in a region species richness Increased with increasing explored area, but only up to a limit.
(b) (1) Explored area is very small.
(2) Explored area is very large.
(c) When the area exhibit species richness.
10.(1) Temperate regions have undergone frequent glaciations in the past which killed most ofthe species. But species continued to flourish and evolve undisturbed for several years in thetropical regions as no such disturbances occurred there.
(2) Tropical environments are less seasonal, relatively more constant and predictable, suchenvironment promote niche specialisation and lead to a greaterspecies diversity.
(3) As more solar energy is available in the tropics, which contributes to higher productivityand biodiversity in the tropics.
11. i) Genetic diversity: It is the variations in the gene and their alleles in the same species. Eg. India has more than 50,000 genetically different strains of rice and 1000 varieties of mango.
(ii) Species Diversity: It is the variation in the number and richness of the species of a region.Eg: Amphibian species are rich in number in Western Ghats than in the Eastern Ghats.
(iii) Ecological diversity: It is the variety in the types of ecosystems in a region.Eg: Deserts, Rain forests, Wetlands etc.
12. Narrow Utilitarian Aspect – Human derive direct benefit from nature in the form of

food,firewood, medicine etc

Broad Utilitarian Aspect- Biodiversity plays a major role in the ecosystem services that Nature provides - oxygen availability, pollination, aesthetic pleasure etc.

Ethical Aspect- Each species has its own intrinsic value. It is our moral duty to take care of well-being of plants and animals. We must conserve the present for the future of our children.

13. In-situ conservation- It is an approach of conservation and protection of the whole ecosystem and

its biodiversity at all levels in order toprotect the threatened species. Endangered species is protected in itsnatural habitat.

E.g. National parks, Wild life sanctuaries, Biosphere reserves etc.

Ex-situ conservation- It is an approach of protecting the endangered species of plants and animals by removing it from the threatened habitat and placing under human care.

The endangered species is protected in places outside their natural habitats,

E.g. Botanical gardens, Zoological parks, Seed banks etc.

14. An endangered / threatened species can be conserved

1. genetic strains of commercially important plants can be preserved for a long time (seedbanks)
2. biodiversity loss is reduced
3. gametes of threatened species can be preserved in a viable and fertile condition for long periods (using cryopreservation)
4. eggs can be fertilized in -vitro
5. plants can be propagated using tissue culture
6. economically beneficial / conserve large number of species
7. aesthetic value (Any six points)

15. Ex-situ conservation

Threatened animals and plants are taken out from their natural habitat and placed in special setting where they can be protected and given special care

Botanical garden / tissue culture / micro propagation / seed bank /Zoological Park / wild life safari park / cryopreservation

16. Biodiversity refers to the totality of genes, species and ecosystem of a region. It is a matter of concern because the biodiversity is important for our survival and well-being of the planet

17. A stable community does not show too much of variation in productivity from year to year.

(2) A stable community is either resistant or resilient to occasional disturbances (natural or manmade)

(3) It must be resistant to invasion by alien species.

LONG ANSWER QUESTIONS

1. The 3 levels of biodiversity are:

a) Genetic diversity

It is the measure of variety/diversity in genetic information contained in theorganisms/single species

It enables the population to adapt to its environment

For example, medicinal plant Rauwolfia vomitoria growing in Himalayan ranges showsvariation in potency and concentration of the active chemical reserpine that it produces.

There are more than 50000 different strains of rice and 1000 varieties of mango.

b) Species diversity

Diversity at species level and their relative abundance present within a region.

For example, the Western Ghats have a greater amphibian species diversity than the Eastern Ghats.

c) Ecological diversity

Diversity at community and ecosystem level

For example, ecological diversity is greater in India due to presence of large number of ecosystems like deserts, rain forests, coral reefs, wetlands, estuaries and alpine meadows

2. The earth summit was held at Rio de Janeiro (Brazil) in which representatives of more than 170 countries were present. The summit promoted the Convention on Biological Diversity(CBD). India became a signatory to this convention in May 1994.

The major objectives were

a) Finding and supporting various methods to conserve biological diversity

b) Use of biodiversity only up to sustainable limit

c) The benefits derived from the use of genetic resources should be fairly and equitably shared.

A second world summit on biological diversity was held in 2002 in Johannesburg, South Africa, In the summit, 190 countries pledged to reduce the current rate of biodiversity loss at global, regional and local levels by 2010.

3. Biodiversity can be conserved by protecting the whole ecosystem.

There are 2 basic approaches for conservation of biodiversity.

(I) In situ conservation (Onsite conservation)

This approach involves protection of species in their natural habitat.

a) Biodiversity hotspots

These are regions of high levels of species richness and high degree of endemism

There are 34 hotspots in the world

In India, the 3 hot spots are, Western ghats, Indo-Burma and Himalaya

Protecting these reduce mass extinction by 30%

b) Protected areas

India has 14 biosphere reserves, 90 national parks and 448 wildlife sanctuaries

c) Ramsar sites

Ramsar sites are wetlands which are considered to be of international importance

Ramsar convention is an international treaty for the conservation and sustainable utilisation of wetlands

There are 26 Ramsar sites in India. Some of these are Ashtamudi wetland, Sambhar Lake,Rudra Sagar Lake etc.

d) Sacred groves

These are forest patches set aside for worship. All the trees and wildlife within are given total protection by tribal people

Large number of rare and threatened plants can be found in these regions

Some of the sacred groves in India are as follows: Khasi and Jaintia Hills in Meghalaya,Aravalli hills of Rajasthan, Sarguja, Chanda and Bastar areas of Madhya Pradesh etc.

(II) Ex-situ conservation (Off-site conservation)

This approach involves placing threatened animals and plants in special care units for their protection.

India has 35 botanical gardens and 275 zoological parks where animals which have become extinct in wild are maintained

By using cryopreservation technique, sperms, eggs, animal cells, tissues and embryos can be stored for long period in gene bank, seed bank etc

Plants are propagated in vitro using tissue culture methods (micropropagation)

It is the desirable approach when urgent measures are required

4. Biologists are not sure about the number of prokaryotic species because

(i) The conventional taxonomic methods are not sufficient for identifying these Microbial species

(ii) Many of the species cannot be cultured under laboratory conditions.

(iii) Biochemical and molecular biology techniques would put their diversity in to millions

b)According to the hypothesis proposed by Paul Ehrlich, “the rivet popper hypothesis”, each species is essential in the balance of nature. If one is lost that much imbalance is caused in the ecosystem

5. Importance of biodiversity for ecosystem functioning:

a) Stability: biodiversity is an important aspect for stability of an ecosystem.
Ecologists believes that communities with more species tend to more stable than those with less species

b) Productivity: ecosystems with higher biodiversity show more productivity than ecosystems with lower biodiversity. David Tilman's long term ecosystem experiments using outdoor plots provides confirmation

c) Ecosystem health: rich biodiversity is not only essential for ecosystem health but imperative for the survival of the human race on earth. Species are interlinked and so, killing or disappearance of one would affect the others also.

d) Resilience: increased biodiversity provides resilience of the ecosystem against natural orman-made disturbances.

6. There are 4 major causes of biodiversity loss. These are also known as the 'Evil Quartet'.

a) Habitat loss and fragmentation

Destruction of habitat is the primary cause of extinction of species

The tropical rainforests initially covered 14% of the land surface of earth, but now Covers only 6% of the land area

The Amazon rainforest is being cut and cleared for cultivation of soya beans and for conversion in to grasslands for raising beef cattle

When large sized habitats are broken or fragmented due to human settlements, building of roads, digging of canals etc. the population of animals requiring large territories and some animals with migratory habits decline.

b) Over-exploitation

When biological system is over exploited by man for natural resources, it results in degradation and extinction of the resources

For example steller's sea cow, passenger pigeon and many marine fishes

c) Alien species invasions

Some alien (exotic) species when introduced unintentionally or deliberately, Become invasive and cause harmful impact, resulting in extinction of the

indigenous species.

Nile perch, a large predator fish when introduce to lake Victoria(East Africa) caused the extinction of an ecologically unique species of Cichlid fish in the lake

Invasive weed species like Parthenium (carrot grass) , Lantana and Eichornia (Water hyacinth)caused environmental damage and posed threat to our native species

Introduction of African catfish *Clarias gariepinus* for aquaculture purposes posing a Threat to the indigenous cat fishes of Indian rivers

d) Co-extinctions

When a species becomes extinct, the plant and animal species associated with it in anobligatory manner, also become extinct.
For example if the host fish species becomes extinct, all those parasites exclusively dependent on it, will also become extinct; in plant-pollinator mutualism also, extinctionof one results in the extinction of the other.
7. There are 3 main reasons for conserving biodiversity which have been classified in to thefollowing categories.
a) Narrowly utilitarian arguments
Human beings derive direct economic benefits from nature like food, firewood, fibre,construction material, industrial products (resins, gums, tannins etc.) and medicinally important products
More than 25% of the drugs are derived from plants and about 25000 species of plants Are used by native people as traditional medicines
b) Broadly utilitarian arguments
Biodiversity plays a major role in maintaining and sustaining supply of goods and Service sfrom various species as well as ecological systems
The different ecological services provided are:
Amazon forest is estimated to contribute 20% of the total oxygen in the atmosphere on earth
Ecosystems provides pollinators like bees , bumble bees, birds and bats which Pollinate plants to form fruits and seeds
Aesthetic pleasures like bird watching, spring flowers in full bloom, walking through the thick forest, waking up to a bulbul's song etc. are some other benefits of the ecosystem
c) Ethical reasons
There are thousands of plants, animals and microbes with whom we share this planet. Every species has some intrinsic value even if it is not of any economic value to us. It is therefore our moral duty to ensure the well-being of all the living creatures and passon our biological legacy in good order to future generations
8. (a) IUCN red list is a catalogue os species and subspecies that are facing the risk of extinction.
The two uses of this list are:
-provides information and develops awareness about the importance of the threatened species.
- Identification and documentation of endangered species
(b) Many bacteria are not culturable under normal condition in the laboratory. This becomes a problem in studying their morphological, biochemical and other

characterisations which are useful for their assessment. Thus conventional methods are not suitable.

DIAGRAM BASED/ CASE BASED QUESTIONS

1. African catfish (Clarias gariepinus). Alien species invasions
2. a. Insects, b. Mollusca.
3. Eichhornia (Water hyacinth). It posed threat to the indigenous cat fishes of Indian
4. (i)a (ii) d (iii)b (iv)d (v) a
5. (i)d (ii) d (iii)e (iv)d (v)b
6. (i) d (ii)b (iii)d (iv)a (v)b

Prepared by:

SELVI PRIYA S

KV, KALPETT

BIOLOGICAL TERMS (ALL CHAPTERS)

UNIT-VI CHAPTER : 2 SEXUAL REPRODUCTION IN FLOWERING PLANTS

S.No	Term	Explanation
1	Syncarpous	Fused pistils
2	Megasporogenesis	Formation of megaspores from the mega spore mother cell
3	Monosporic development	Embryo sac formation from a single megaspore
4	Pollination	Transfer of pollen grains from anther to the stigma of a pistil
5	Autogamy	Transfer of pollen grains from the anther to the stigma of the same flower.
6	Geitonogamy	Transfer of pollen grains from the anther to the stigma of another flower of the same plant
7	Xenogamy	Transfer of pollen grains from anther to the stigma of a different plant
8	Artificial hybridisation	Crossing different species to combine desirable characters to produce superior varieties
9	Emasculation	Removal of anthers from flower bud before the anther dehisces
10	Bagging	Covering emasculated flowers with a bag to prevent contamination of its stigma with unwanted pollen
11	Syngamy	Fusion of male and female gamete
12	Triple fusion	Fusion of three haploid nuclei

13	Double Fertilisation	Two types of fusions syngamy and triple fusion that takes place in an embryo sac
14	Post fertilization events	Events of endosperm ,embryo development ,maturation of ovule into seed, ovary into fruit
15	Free –nuclear endosperm	The stage of endosperm development wherein PEN undergoes successive nuclear divisions to give rise to free nuclei
16	Dormancy of seed	Embryo enter a state of inactivity
17	False fruit	Thalamus contributes to fruit formation
18	True fruit	Fruits develop from the ovary
19	Parthenocarpic fruits	Fruits develop without fertilisation
20	Apomixis	Production of seeds without fertilisation
21	Polyembryony	More than one embryo in a seed
22	Filament	Long slender stalk of stamen
23	Anther	Bi lobed structure of stamen
24	Dithecous	Two theca in each lobe
25	Tapetum	Innermost wall layer of microsporangia
26	Sporogenous tissue	Compactly arranged homogenous cells in the centre of microsporangia
27	Microspore tetrad	Cluster of four microspores
28	Pollen grains	Male gametophyte
29	Exine	Hard outer layer of pollen grain
30	Sporopollenin	Most resistant organic material of exine
31	Germ pore	Apertures in pollen grain
32	Intine	Inner wall of the pollen grain
33	Generative cell	Cell floats in the cytoplasm of vegetative cell
34	Moncarpellary	Single pistil
35	Multicarpellary	More than one pistil

36	Microsporogenesis	Formation of microspores from a PMC through meiosis
37	Apocarpous	Free pistils
38	Stigma	Landing platform of pollen grains
39	Style	Elongated slender part beneath the stigma
40	Ovary	Basal bulged part of pistil
41	Ovule	Megasporangia
42	Funicle	Stalk of ovule
43	Hilum	Region ,the body of the ovule fuses with funicle
44	Integuments	Protective envelopes of ovule
45	Micropyle	Small opening in the ovule
46	Chalaza	Basal part of the ovule
47	Embryo sac	Female gametophyte
48	Egg apparatus	Three cells at the micropylar end with two synergids and one egg cell
49	Antipodals	Three cells at the chalazal end
50	Cleistogamous flower	Flowers which do not open at all
51	Zygote	Diploid cell resulting out of fertilisation
52	Primary endosperm cell	Central cell after triple fusion becomes PEC
53	Embryogeny	Embryo development
54	Epicotyl	Portion of embryonal axis above the level of cotyledons
55	Hypocotyl	Portion below the level of cotyledons
56	Scutellum	Cotyledon of grass family situated towards one side of embryonal axis
57	Coleorrhiza	Undifferentiated sheath that encloses radical and root cap
58	Coleoptile	Hollow foliar structure that encloses a shoot apex and a few leaf primordia
59	Non-albuminous seed or ex-albuminous	No residual endosperm as it is completely consumed during embryo development
60	Albuminous	Retain a part of endosperm as it is not completely used up during embryo development
61	Perisperm	Residual persistent nucellus
62	Pericarp	Wall of the fruit

UNIT VI - CHAPTER 3: HUMAN REPRODUCTION

S.NO	TERM	Explanation
1	Spermatogenesis	The immature male germ cells produce sperms that begins at puberty
2	Spermiogenesis	The process of transformation of spermatids into sperm
3	Spermiation	Release of sperms from seminiferous tubule
4	Oogenesis	Process of formation of a mature female gamete initiated during embryonic development
5	Ovulation	The process during which the Graafian follicle ruptures to release the secondary oocyte (ovum) from the ovary
6	Menarche	The first menstruation that begins at puberty
7	Menstrual cycle	Cycle of events starting from one menstruation till the next one
8	Menopause	Ceasation of menstrual cycle around 50 years of age
9	Cleavage	The mitotic division the zygote undergoes when it moves toward uterus and forms blastomeres
10	Implantation	Embedding of blastocyst in the endometrium of the uterus
11	Parturition	Vigorous contraction of the uterus at the end of pregnancy causing expulsion/delivery of the foetus
12	Foetal ejection reflex	Mild uterine contractions induced by the signals for parturition from the fully developed foetus and the placenta
13	Lactation	The process by which the mammary glands
14	GnRH	Gonadotropin releasing hormone
15	LH	Luteinising hormone
16	FSH	Follicle stimulating hormone

17	hCG	Human chorionic gonadotropin
18	hPL	Human placental lactogen

UNIT VII CHAPTER : 6 MOLECULAR BASIS OF INHERITANCE

S.No	TERM	Explanation
1	Transcription-	copying of genetic material from DNA to RNA
2	Purines –	adenine and thymine
3	Pyrimidine –	cytosine , thymine and guanine
4	Nucleotide –	consists pentose sugar phosphate group and nitrogenous base
5	Nucleoside –	consists of nitrogenous base and pentose sugar
6	DNA ligase -	joins the discontinuously synthesized fragments
7	Exons –	coding sequence
8	Introns –	intervening sequence
9	Polynucleotide chain –	consists sugar and phosphate
10	Splicing –	introns are removed in this process
11	Capping –	an unusual nucleotide is added to 5' end of the RNA
12	Codon –	formed by 3 nitrogen bases on mRNA that codes an amino acids
13	Anticodon –	has bases complementary to the code
14	Lac operon –	conversion of lactose to glucose and galactose
15	Bioinformatics –	associated to Human Genome Programme
16	Polymorphism –	variation at genetic level
17	Repetitive DNA –	small stretches of DNA
18	Satellite DNA –	forms small peaks

19	Translation –	polymerization of amino acid to form a polypeptide
20	Tailing –	adenylate residues are added to the 3’ end of hnRNA
21	HGP	Human Genome Project
22	ESTs	Expressed Sequence Tags
23	BAC	Bacterial artificial chromosome
24	YAC	Yeast artificial chromosome
25	SNPs	single nucleotide polymorphism
26	VNTR	variable number of tandem repeats
27	UTR	untranslated regions
28	sRNA	soluble RNA
29	hnRNA	heterogeneous nuclear RNA
30	snRNA	small nuclear RNA
31	RNA	ribonucleic acid
32	DNA	deoxyribonucleic acid
33	Proteases	protein digesting enzyme
34	RNase	RNA digesting enzyme
35	DNase	DNA digesting enzyme
36	NHC	Non histone chromosome
37	EM	electron microscope

UNIT VIII - BIOLOGY IN HUMAN WELFARE

CHAPTER: 8 HUMAN HEALTH & DISEASES

S.No.	Term	Explanation
1	**PMNL**	Polymorpho-Nuclear Leukocytes
2	**CMI**	Cell Mediated Immunity
3	**ELISA**	Enzyme Linked Immunosorbent Assay
4	**MALT**	Mucosal Associated Lymphoid Tissue
5	**SCID**	Severe Combined Immuno Deficiency
6	**NACO**	National AIDS Control Organisation
7	**MRI**	Magnetic Resonance Imaging
8	**HLA**	Human Leukocyte Antigen
9	**Carcinogens**	Cancer causing agents. e.g., gamma rays. UV rays, dyes and lead.
10	**Immunity**	Resistance to infection or antigen
11	**Immuno Suppressant**	The chemical which supress the immunity response to antigen.
12	**Interferon**	The glycoproteins produced by our body cells in response to a viral infection.
13	**Incubation Period**	The time period between infection and the appearance of symptoms.
14	**Metastasis**	The property in which the cancer cells spread to different sites through blood and develop secondary tumours.

15	**Oncogene**	Viral genome which causes cancer
16	**Retrovirus**	A virus having RNA as genetic material and forms DNA by reverse transcription and then replicate e.g., Human Immunodeficiency Virus (HIV).
17	**Syndrome**	Collection of disease symptoms responsible for a disorder or a disease.
18	**Vaccination:**	Inoculation of a vaccine to stimulate production of antibodies and provide immunity for one or more disease

CHAPTER:10 MICROBES IN HUMAN WELFARE

S.NO	Term	Explanation
1.	BOD	Biochemical Oxygen Demand
2.	GAP	Ganga Action Plan
3.	YAP	Yamuna Action Plan
4.	KVIC	Khadi and Village Industries Commission
5.	LAB	Lactic Acid Bacteria
6.	Baculovirus	Pathogens that attack insects and other arthropods
7.	Effluent	The product of primary treatment of sewage
8.	Fermentors	A very large vessel where microbes are grown on an industrial scale.

9.	Flocs	mass of mesh like structure formed by Bacteria and fungi
10.	Prions.	The proteinaceous infectious agent
11.	Methanogens -	Bacteria producing methane
12.	STPs	Sewage Treatment Plants
13.	IARI	Indian Agricultural Research Institute
14.	IPM	Integrated Pest Management

Unit – IX CHAPTER : 11 BIOTECHNOLOGY PRINCIPLES & PROCESSES

S.No	Term	Explanation
1	rDNA	Recombinant DNA
2	Gene cloning	DNAtechnologyusedtoproducemultiple,exactcopiesofasinglegeneorothe rsegmentofDNAtoobtainenoughmaterialforfurtherstudy.
3	Gene transfer	Incorporation of newDNA into anorganism's cells, usually by a vector such aasmodifiedvirus. Used in gene therapy. *See also:*mutation,genetherapy,vector
4	Genetic Engineering	Alteringthegeneticmaterialofcellsororganismsto enable themtomakenew substancesorperformnewfunctions
5	ORI	The specific sequence of bases in a DNA which initiates replication.

6	Restriction enzymes	They are molecular scissors capable of cutting DNA at specific site. These are enzymes present in bacteria which prevent the multiplication of bacteriophages in their cells.
7	Plasmid	Autonomously replicating extrachromosomal circular DNA molecules, distinct from the normal bacterial genome and non essential for cell survival under non selective conditions. Some plasmids are capable of integrating into the host genome.A n umber of artificially constructed plasmids are used as cloning vectors
8	Cloning Vectors	Vectors that introduce foreign DNA into host cells,where the DNA can be reproduced in large quantities. Examples are plasmids, cosmids, and yeast artificial chromosomes
9	Endonuclease	Protein thatrecognizesspecific,shortnucleotidesequencesandcutsDNAatthosesites within the molecule.
10	Nucleases	Enzymes that are specific to nucleic acids
11	Exonucleases	An enzyme that cleavesnucleotidessequentiallyfromfreeends of a linear nucleicacid substrate.
12	Palindromic Sequences	The sequence of base pairs that reads the same on both the strands when read in the same orientation (ie 5’ to 3’ in both the strands)
13	Gel Electrophoresis	A method ofseparating large molecules (such as DNA fragments or proteins)from a mixture of similar molecules.An electric current is passed through amediumcontainingthemixture,andeachkindo A method of separating large molecules (such as DNA fragments or proteins)from a mixture of similar molecules.An electric current is passed through a medium containing the mixture,and each kind of molecule travels through the medium at different rate,depending on its electrical charge and size .Agarose and acrylamide gels are the media commonly used for electrophoresis of proteins and nucleic acids

14	Elution	The extraction of separated fragments of DNA from the electrophoresis gel
15	Auto-Radiography	A technique that uses X-Ray film to visualize radioactively labeled molecules or fragments of molecules, used in analyzing length and number of DNA fragments after they are separated by gel electrophoresis.
16	Transformation	Most common method to introduce DNA into living cells.In this procedure, bacterial cells take up DNA from the surrounding environment. Many hos t cell organisms such as, E.coli,yeast and mammalian cells do not readily take up foreign DNA and have to be chemically treated to become competent to do so.
17	Selectable markers	A gene or other identifiable portion of DNA whose inheritance can be followed and used in the process of selection of transformed cells from non transformed ones.
18	Insertional Inactivation	The process by which a gene encoding a protein is inactivated by the insertion of a foreign DNA within the coding sequence of the protein.
19	Ti Plasmid	Tumour inducing Plasmid in *Agrobacterumsp*.causingtumour in plant cells
20	Tumour	Uncontrolled growth of cells in the body of plants or animals.
21	Microinjection	The process of introducing rDNA into animal cells using a micropipette.
22	Biolistics/gene gun	Adirectgenetransfermethodfordeliveringforeigngenesintoanytissuesand cellsorevenseedlings. • The foreignDNAiscoatedorprecipitatedontothesurfaceofminutegoldortungstenparticles • Itisbombardedorshotontothetargettissueorcellsusingthegenegun.
23	Embryonic stem(ES)cells	An embryonic cell having totipotency that can replicate indefinitely,transform into other types of cells ,and serve as a continuous source of new cells.These cells are derived from inner cell mass of the blastocyst or the 4-8cell stage of embryo.
24	Lysosyme	The enzyme that digests the cell wall of bacteria
25	Cellulase	The enzyme that digests cellulose of plant cell walls.

26	Chitinase	The enzyme that can digest cell walls of fungi containing chitin.
27	Polymerase Chain Reaction (PCR)	Polymerase Chain Reaction where DNA can be amplified in a short time to produce multiple copies of DNA (can be made in vitro)
28	Recombinant protein	Protein encoding gene expressed in a heterologous host
29	Bioreactors	Are vessels in which raw materials are Biologically converted into specific products using microbial,plant or animal ells

30	Downstream Processing	The process of formulation,separation and purification of rDNA products made in Bioreactors.
31	Spooling	The method of separating DNA precipitates in chilled ethanol ,after its isolation from the other cell contents
32	Disarmed pathogens	Some bacteria orviruses,whichareused to transfer recombinantDNA carrying the gene of interest the host'scells. .
33	Retrovrus	RNA virus containing reverse transcriptase and can be used to transfer the gene of interest into the host chromosome.
34	Ligases	Enzymes that can join fragments of DNA
35	Vector	DNAmolecule,capableofreplicationinahostorganism,intowhichagene is insertedtoconstruct a recombinantDNAmolecule.
36	Competant Host Cell	A cell which has been chemically treated to take up rDNA from its surroundings by causing pores in its cell wall.
37	Amplification	Anincreaseinthenumberofcopiesofaspecific DNAfragment; canbeinvivoorin vitro.
38	Sticky ends	Single stranded overhanging ends of DNA formed by the restriction enzymes cutting the strands of DNA at specific palindromic sequences.
39	Denaturation	Double stranded DNA is separated by applying high temperature of $95^{o}C$
40	Annealing	Primers bind to the 3’ends of the separated DNA strands
41	Extension	DNA polymerase extends the primers by adding complementary nucleotides .Taq polymerase is used here

42	Taq Polymerase	DNA polymerase obtained from bacteria *Thermusaquaticus*, which is thermostable.

CHAPTER : 12 BIOTECHNOLOGY & ITS APPLICATIONS

S.No	Term	Explanation
1	Green Revolution	The increased production of food production by use of improved varieties of crops,better agricultural practices and use of Agrochemicals
2	GMO	Genetically Modified Organisms-organisms in which the genes are manipulated or foreign gene introduced into
3	Bt	*Bacillus thuringienesis,a bacteria producing an insecticidal protein.*
4	Bt Cotton	Cotton plant with Bt gene thereby made resistant to Bollworm insects
5	Insecticidal protein	Protein toxin that kills insect pests
6	cry gene	Gene coding for insecticidal toxin
7	RNA interference	Process which interferes with the translation of mRNA of the parasite in the host plant/cell (in
8	ds RNA	Double stranded RNA formed to prevent the translation of the mRNA of the parasite DNA in the host cell
9	C peptide	The peptide which is part of the Pro-insulin and removed before maturation of Insulin.

10	Transgenic animals	Animalswithmanipulatedgenesoraforeigngene that can be expressedarecalledastransgenicanimals.
11	GEAC	Genetic Engineering Approval Committee –checks the validity and safety of GM reaearchand GM oroganisms
12	Biopiracy	Unauthorised use of Bioresources of one Nation by another without proper compensation being given
13	Gene therapy	The procedure by which a genetic disorder is treated by introduction of a functional gene in the body through cultured cells carrying the functional gene in children or embyo.

14	ADA	Adenosine Deaminase –an enzyme required for the functioning of the immune system.
15	c DNA	DNA which is made complementary to the mRNA
16	α1-antitrypsin	Human protein (made from transgenic animals)used in the treatment of Emphysema.
17	ELISA	Enzyme Linked Immuno Sorbent Assay-a test based on detection of antibody produced against the pathogen using specific antigen–antibody reaction used It is used for diagnosis of diseases like AIDS.
18	***Agrobactetrium vectorsa***	The bacteria *Agrabacteriumtumifaciens* (used in transferring rDNA to plant cells)has the natural ability to transfer genes to plant cells.
19	Indian Patents Bill	A Bill passed by the Indian Parliament which takes issues such as terms for patent ,research and development initiatives etc.
20	***Meloidegyneincognitia***	The nematode that affects roots of tobacco plants and reduce their yield,RNA interference is used against the nematode to protect tobacco plants.
21	cryIAb	Gene coding for protein that controls corn borer.
22	cryIAc and cry IIAb	Genes coding for protein that controls Bollworm insects

S.No	Term	Explanation
10	Pseudocopulates	Male bee is attracted to what it perceives as female&pseudocopulates" with the flower..e.g.Mediterraneam orchid-ophrys-sexual deceit —pollinated-bees, Bunblebees.-co-evolution-operates.; (petal similar to female bee)
11	Brood parasitism	Cuckoo/koel lays its eggs(resembles the egg of host)in the nest of crow & lets the host incubate them.
12	Competitive release '	A species whose distribution is restricted to a small geographical area because of the presence of a competitively superior species, is found to expand its distributional range when the competing species is removed.(Connell's elegant field experiments —rocky sea coasts of Scotland-larger competitively superior barnacle *Balanus*dominates, & excludes smaller barnacle *Chathaarrialus)*, Abingdon Tortoise eliminated by goat due to greater grazing efficiency.

19	Mutualism	Interaction in which both species are benefited.
20	Amensalism	Interaction between 2 different species —one harmed &the other neither benefitted nor harmed.
21	Predators	Interspecific interaction where an animal —predator kills & consumes the other weaker animal-prey.
22	Competition	Both the species suffer & it may exist between some sps.(interspecific competition) or between individuals of different species(intraspecific competition)
23	Gause's Principle	'Competitive exclusion principle' states that two closely related species competing for the same resource cannot coexist indefinitely & the competitively inferior one will be eliminated eventually by the superior one.
24	Resource partitioning, co-existance. .	Phenomenon- in which species facing competition might evolve mechanisms that promote co-existence rather than exclusion.MacArthur showed that 5 closely related warblers living on the same tree were able to avoid competition &co-exist due to behavioural differences in their foraging activities.
25	Parasitism	One sps. depends(parasite) on other sps.(host) for food, shelter, and in the process host is damaged.
26	Endoparasite	Parasite live inside the host's body. E.g.*Plasmodium*
27	EctoParasite	Parasite feed on the external surface of the host organism for food &shelter-lice, copepods, ticks, *Cuscuta*.

CHAPTER: 14 ECOSYSTEM

S. No	Term	Explanation
1	Photosynthetic efficiency	Some plants have more efficiency to trap sunlight-sugarcane.
2	Ecosystem	The unit including biotic and abiotic components and their interactions .Coined-SirA. G. Tansley1935
3	**Abiotic**	Non-living (ex. Temperature ,light, water, nutrients)
4	**Biotic:**	Livingorganisms (calledbiota)
5	Functional Components of Ecosystem	1.Productivity, 2. Decomposition 3. Energy flow 4. Nutrient cycling .
6	Primary Production	Amount of biomass or organic matter produced per unit area.over a time period by plants during photosynthesis, expressed in terms of weight(e) or energy (kcal m^{-2}).
7	Productivity	Rate of biomass production-expressed in terms of $g^{-2}yr^{-1}$ or (kcal m^{-2})yr^{-1}
8	Gross primary productivity Net primary productivity	rate of production of organic matter during photosynthesis-GPP GPP- respiratory loss(R)=NPP- available biomass to heterotrophs(herbivore & decomposers)

	Secondary productivity	Rate formation of new organicmatter by consumers.
9	Decomposition	Decomposers break down complex organic matter into inorganic substances like carbon dioxide, water & nutrients.
10	Detritus	Dead plant remains such as leaves, bark flowers & dead remains of animals, including faecal matter -raw material for decomposition, found above & below the ground.
11	Decomposition	Includes Fragmentation, leaching, catabolism, humification&mineralisation.
12	Detritivores	Earthworm-breakdown detritus into smaller particles — fragmentation.
13	Process of Decomposition	Fragmentation- Earthworm-breaks down detritus into smaller particles Leaching--Water soluble inorganic nutrients go down into soil horizon, get precipitated as unavailable salts Catabolism-Bacterial & fungal enzymes convert degraded detritus into Inorganic substances(Simpler) Humification-Occur during decomposition in the soil, lead to accumulation of dark coloured amorphous substance resistant to microbial action, undergoes decomposition at extremely slow rate.(Humus)' Mineralisation- Humus degradbd by microbes & release inorganic-nutrient.
14	PAR	Photosynthetically Active Radiation
15	Producers	Autotrophs-produce organic matter from inorganic matter (producing chemical energy in the form of organic matter)

16	Consumers	Heterotrophs-herbivore-carnivore / that depend on producers or other consumers for food.
17	Decomposers	Fungi & bacteria-heterotrophic organisms that break down(decompose)detritus
18	Saprotrophs ,	Sapro meaning decompose; decomposers secrete digestive enzymes that breakdown dead & waste materials into simple, inorganic material-subsequently absorbed by them.
19	Food chain	Transfer of energy from producers to top consumers through a series of organisms, one organism holds only one position in the chain,thereby transferring matter/energy from one level to the next.
20	Food web	No. of food chain interconnected with each other like a web, one organism holds more than one position.,there are series of branching lines, competition among different members of different trophic levels.(complexnetworkofmanyinterconnectedfoodchainsandfeeding relationships)
21	Standing crop	Each trophic level with certain mass of living material at a particular time
33	Energy flow	Solar energy 100%-->plants 2-10%—>consumers; Energy is transferred in an ecosysystem& in each step food is degraded & major portion lost as heat energy at each step.
34	Lindeman's 10% Law	At each step of food chain when food energy is transferred from one trophic level to the next only 10% of energy is passed on to next level.-(1942).
35	Ecological pyramid ...,	The relation between producers & consumers in an.ecosystem — graphically represented in the form of pyramid.
36	Pyramid of	Relationship between producers &consumers in an ecosystem

	Number	represented in the form of a pyramid in terms of number.- upright(except tree ecosystem-inverted)
37	Pyramid of Biomass	Relationship between producers & consumers in an ecosystem represented in the form of a pyramid in terms of biomass.(biomass in sea-inverted)
38	Pyramid of energy	Relationship between producers & consumers in an ecosystem represented in the form of a pyramid in terms of flow of energy.- always upright never inverted
41	Biome	Anyoftheworld'smajorecosystems,classifiedaccordingtothe predominantvegetationandcharacterizedbyadaptationsoforganismstothat environment.Terrestrialregionsinhabitedbycertaintypesoflife,especiallyve getation. eg. Deserts, grassland andforests
42	Carryingcapacity (K)	-maximumpopulationofaparticularspecies thatagiven habitat can supportover a given period oftime.
43	Competition	Two ormoreindividualorganismsofasinglespecies(intraspecific competition)ortwoormoreindividualsofdifferentspecies(interspecificcomp etition) attemptingto use the samescarceresourcesinthesameecosystem.
44	Consumer	Organismthatcannotsynthesizetheorganicnutrientsitneedsand getsitsorganicnutrientsbyfeedingonthetissuesofproducers orofother consumers;generallydividedintoprimaryconsumers(herbivores),secondary consumers(carnivores),tertiary(higher-level)consumers,omnivores,and detritivores (decomposers anddetritusfeeders
45	**Deforestation**	. removal oftreesfromaforestedareawithoutadequatereplanting
46	**Desert**	-biomewhereevaporationexceedsprecipitationandtheaverageamountof precipitationislessthan25centimeters(10inches)ayear.Suchareashavelittle vegetation or have widelyspaced,mostlylow vegetation.
47	**Desertification**	Depletionordestructionofapotentiallyrenewableresourcesuch as soil,grassland,forest, or wildlifebyusingit at a faster ratethan it is naturallyreplenished. Ifsuch use continues, the resourcecan become

		nonrenewable on ahuman time scaleor nonexistent (extinct).
48	**Ecologicalniche**	-totalwayoflifeorroleofaspeciesinanecosystem.Itincludes allphysical,chemical,andbiologicalconditions a speciesneedstoliveand reproduce inanecosystem.
49	**Environmental degradation**	- conversionofrangeland,rain-fedcropland,orirrigatedcropland to desertlikeland,withadropinagriculturalproductivityof10%ormore.Itisusuallycausedbyacombinationofovergrazing,soilerosion,prolonged Drought,andclimatechange.
50	**Extinction**	-completedisappearanceofaspeciesfromtheearth.Thishappenswhenaspeciescannot adaptandsuccessfullyreproduceundernewenvironmental conditions or when itevolves into on Ormorenewspecies (speciation).
51	**Forest**	-biomewithenoughaverageannualprecipitation(atleast76centimeters,or30inches)tosupport growthofvariousspeciesoftreesandsmaller forms of vegetation
52	**Grassland**	biomefoundinregionswheremoderateannualaverageprecipitation (25to76centimeters,or10to30inches)isenoughtosuppor the growthofgrass and smallplants, but not enoughtosupport large trees.
53	**Habitat**	placeortypeofplacewhereanorganismorapopulationoforganisms live
54	**Keystonespecies**	Speciesthatplayrolesaffectingmanyotherorganismsinan ecosystem.
55	**Limitingfactor**	singlefactorthatlimitsthegrowth,abundance,ordistributionofthepopulation of a species in an ecosystem
56	**Native species**	**-**species that normallylive and thrive in a particular ecosystem.
61	**Stratification**	**:** Stratification in an ecosystem refers to the vertical distribution of different species occupying different levels.

CHAPTER:15 BIODIVERSITY AND CONSERVATION

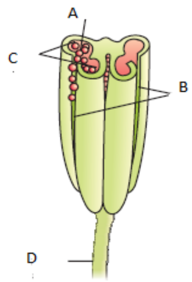
S.No	Term	Explanation
1	**Biodiversity**	refers to the sum total of diversity that emits all levels of biological organization
2	**Genetic diversity**	a single that shows high diversity at the genetic level over its disributional range
3	**Species diversity**	the diversity at the species level
4	**Ecological diversity**	the diversity at the ecosystem level
5	**Bioprospecting**	exploring molecular , genetic and species level diversity for product of economic importance
6	**Sacred grooves**	tracts of forests were set aside and all the trees and wildlife within were venerated and given total protection
7	**Evil Quartet**	Sobriquet use to describe 4 major causes of species exinction=Habitat loss &Fragmentation ,Over exploitation ,Alien species invasion &Coextinctions
8	**Insitu Conservation**	Conservation of species in their natural habitat that is on site conservation
9	**Exsitu Conservation**	Conservation of threatened species in special settings where they are protected & given special care that is off site conservation .Eg-zoological parks ,Botanical gardens ,etc.
10	**Biodiversity Hotspots**	Regions with very high levels of species richness
11	**Sacred Groves**	Tracts of forests where all trees & wild life within are venerated & given total protection

12	**The Earth Summit**	Meeting of several nations at Rio de Janeiro in 1992 to discuss appropriate measures for conservation of Biodiversity
13	**World Summit on Sustainablde Development**	Meeting of several nations In Johannesburg,South Africa in 2002 to reduce the rate of biodiversity loss
14	**Endemism**	Species confined to a region & not found elswhere

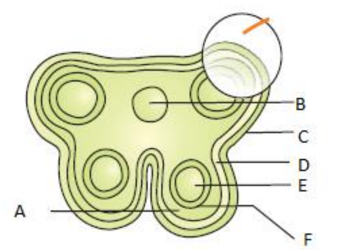
CHAPTER: 2 SEXUAL REPRODUCTION IN FLOWERING PLANTS

Label the following diagrams:

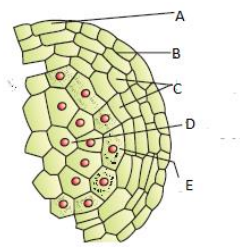
1. Three-dimensional cut section of an anther



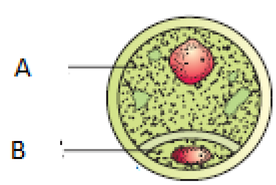
2. Transverse section of a mature anther



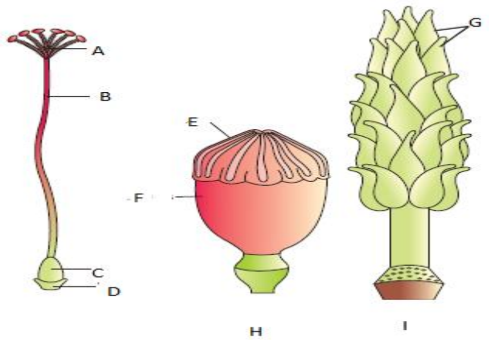
3. Enlarged view of one microsporangium



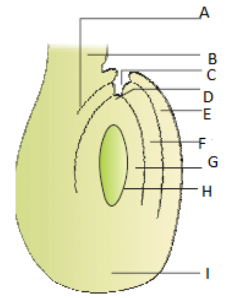
4. Pollen Grain



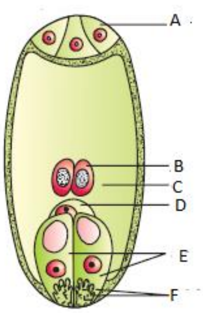
5. Pistil of Hibiscus,Papaver,Michelia



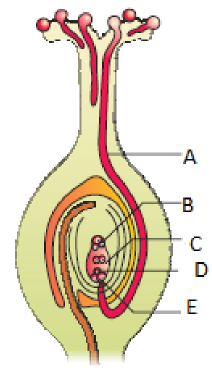
6.A typical anatropous ovule



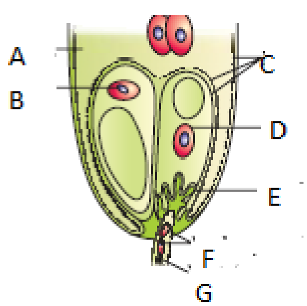
7. Mature embryo sac



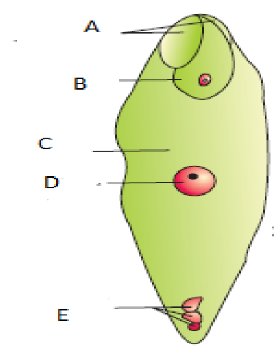
8. LS of flower showing growth of polleNtube



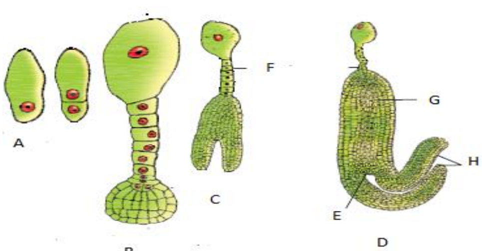
9. Enlarged view of egg apparatus entry of pollen tube into synergid



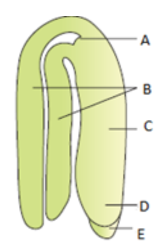
10.Fertilised embryo sac showing zygote and PEN



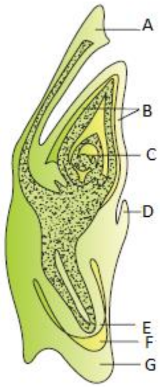
11.Stages in embryo development

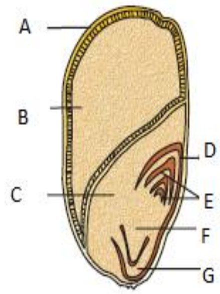


12. Dicot embryo

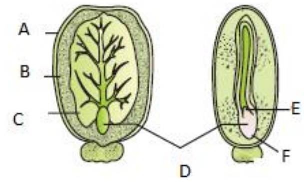


13. Monocot embryo

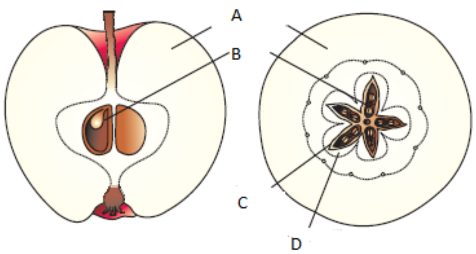




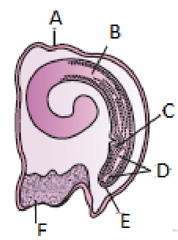
14 . Monocot seed ,Dicot Seeds



15. False fruit



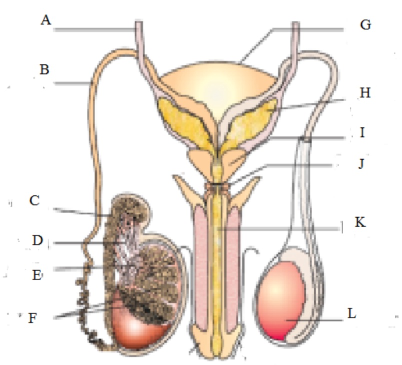
16. Seed



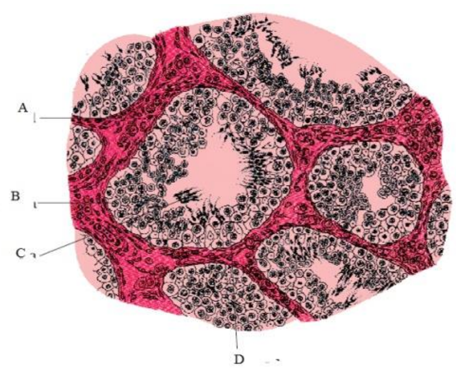
CHAPTER 3 : HUMAN REPRODUCTION

Label the following diagrams:

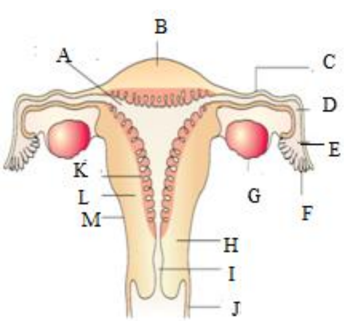
1. Male reproductive system



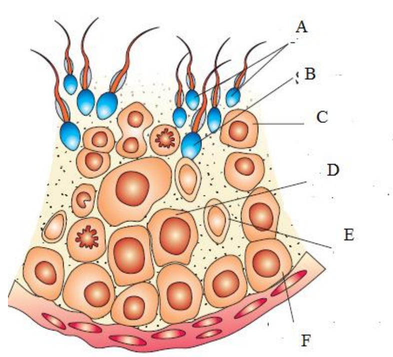
2. Diagrammatic representation of Seminiferous tubule



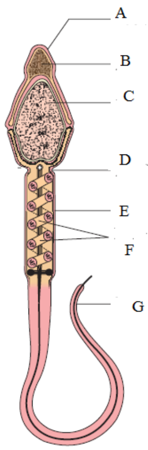
3. Female reproductive system



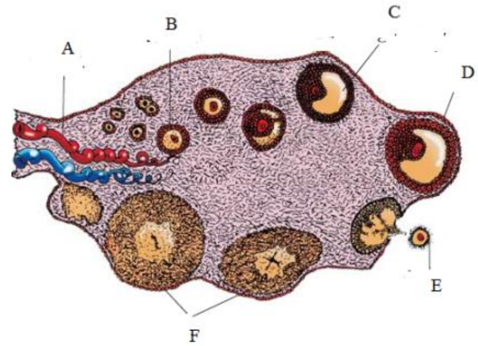
4. Seminiferous tubule enlarged



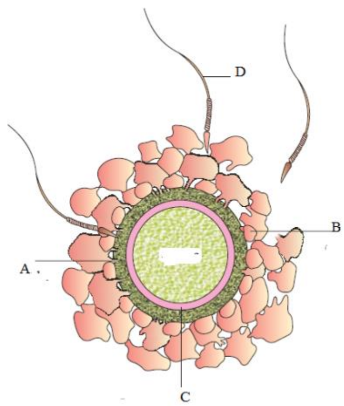
5. Human Sperm



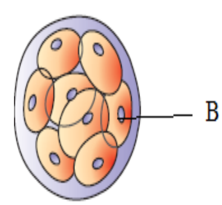
6. Sectional view of ovary



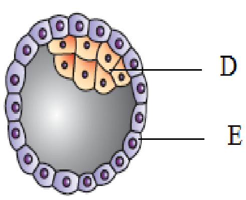
7. Ovum



8. Identify the given diagram A and B and label the parts

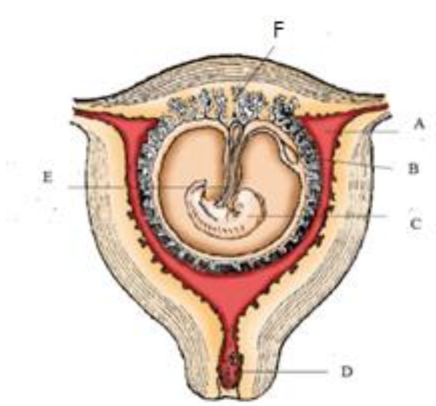


A

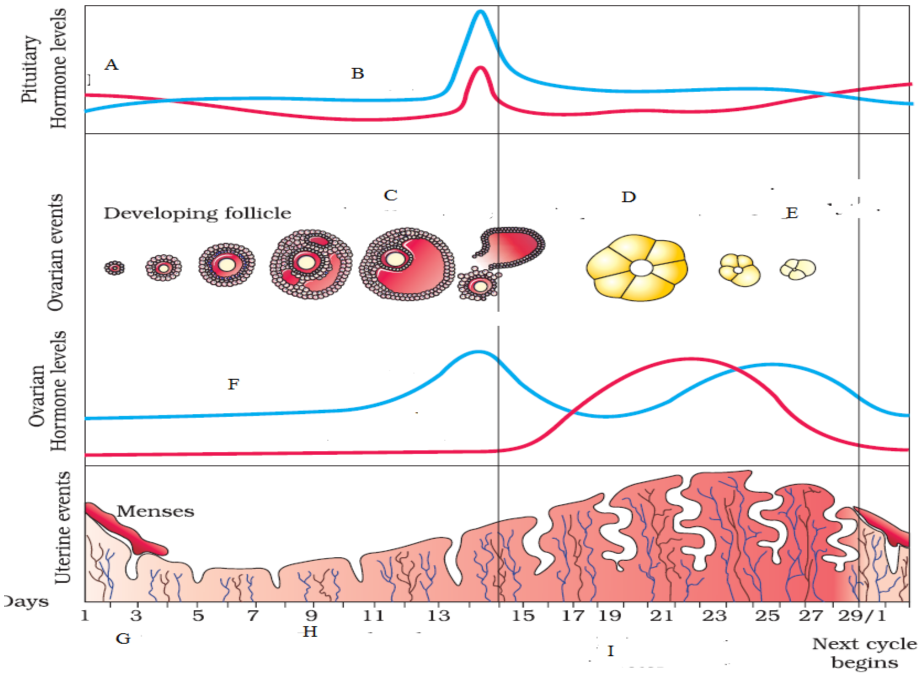


C

9. Human foetus within the uterus

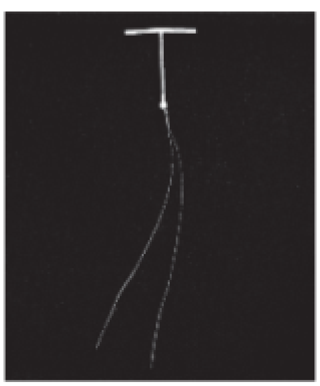


10 . Various events during a Menstrual Cycle

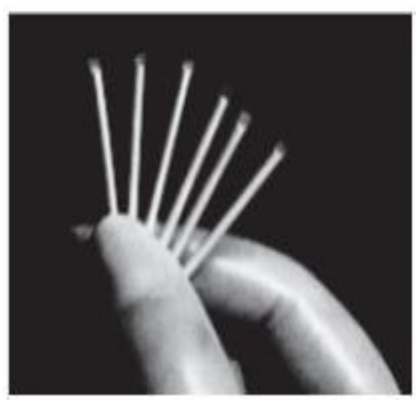


CHAPTER : 4 REPRODUCTIVE HEALTH

1. Identify the following contraceptives A and B:

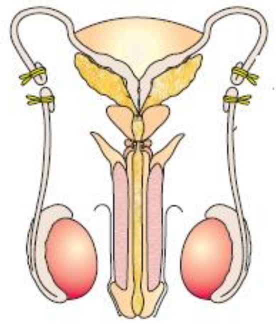


A

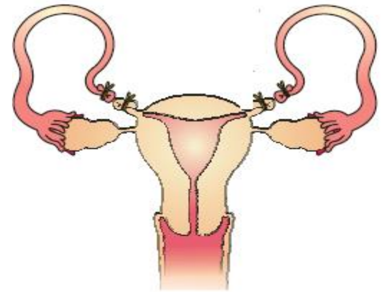


B

2. Identify the technique involved in the following diagrams A and B :



A

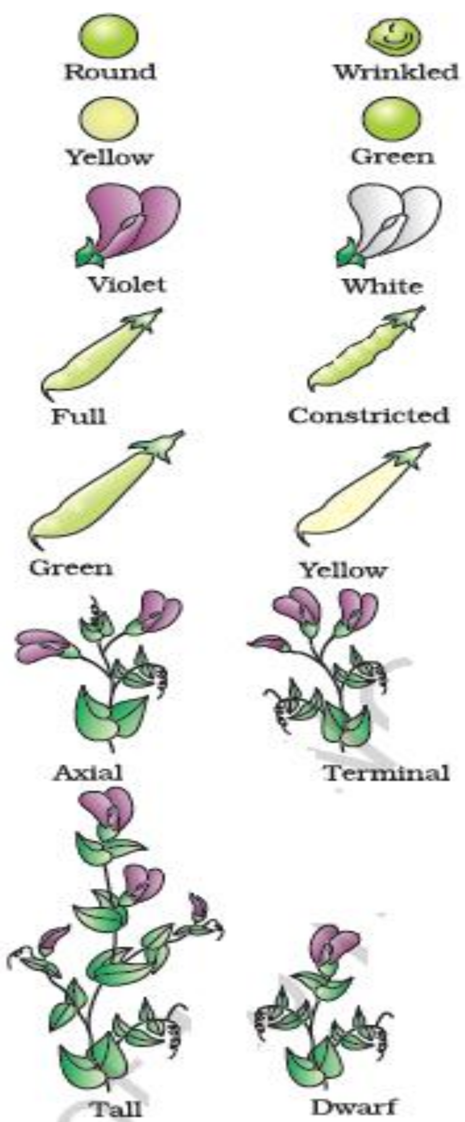


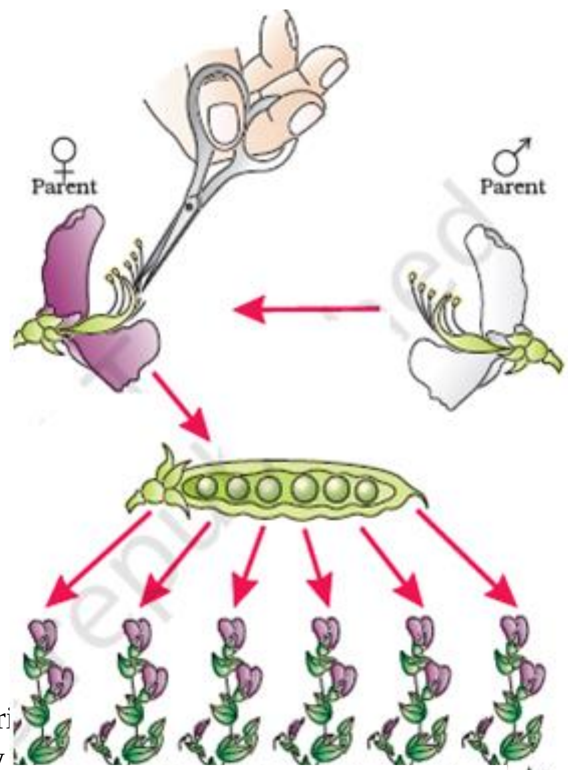
B

CH – 5 PRINCIPLES OF INHERITANCE AND VARIATION

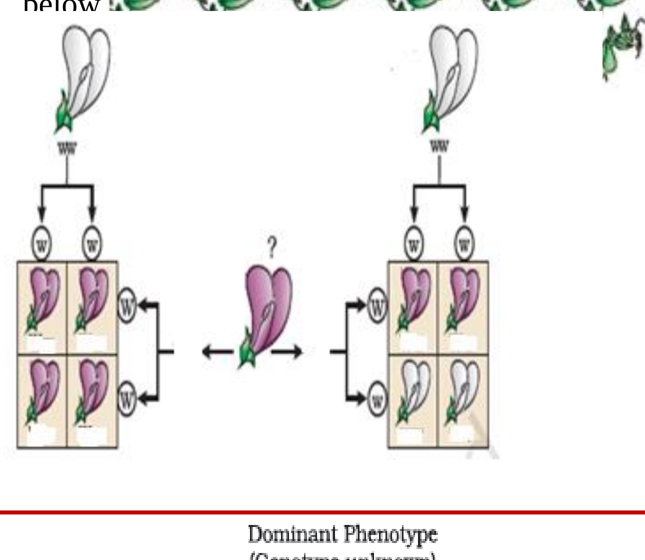
a. Identify the dominant and recessive traits

b. Name the steps in making a Cross in Pea

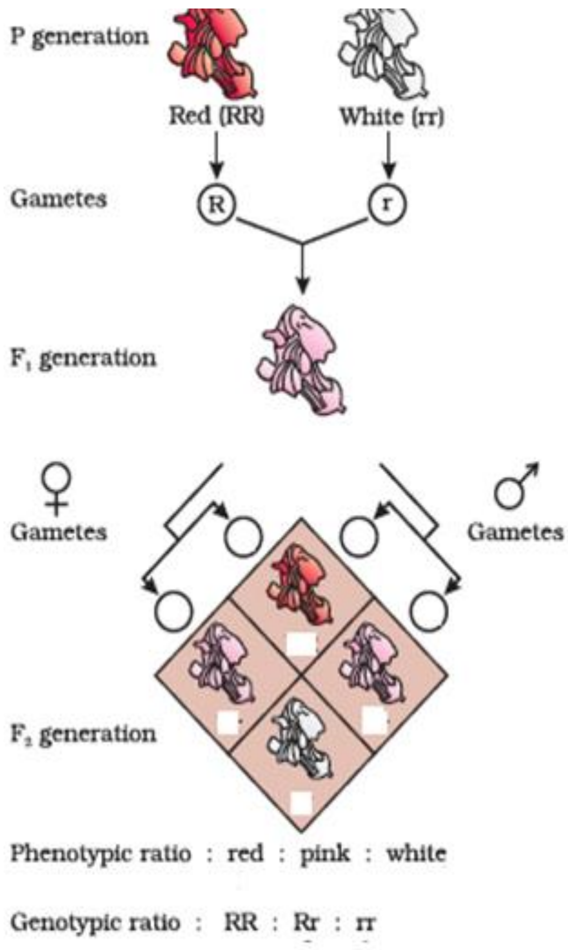




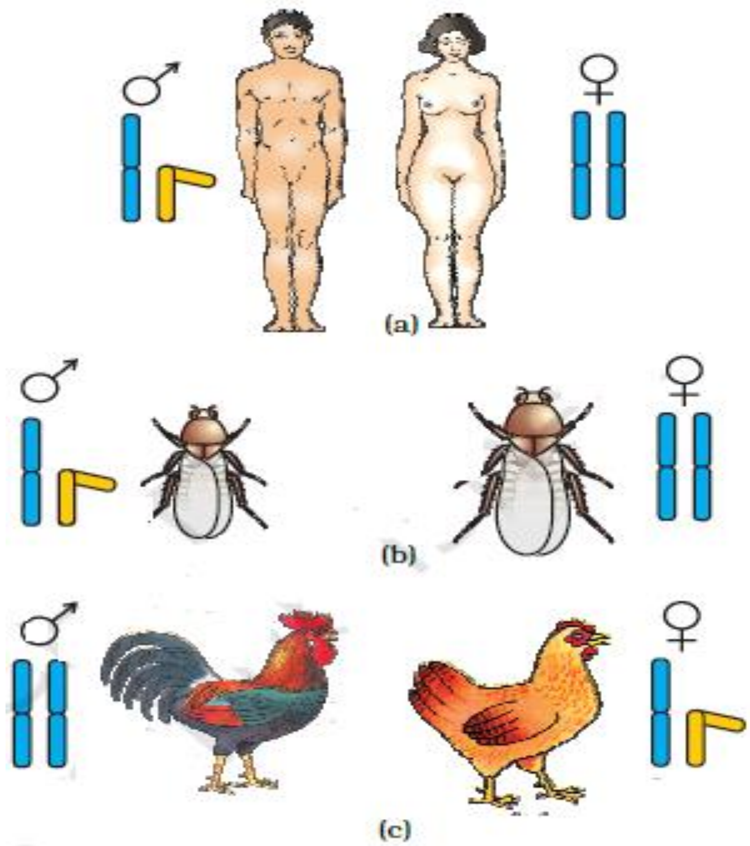
c. Wri
below



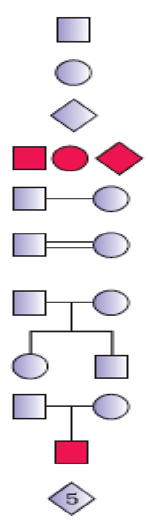
d. Write the genotype and ratio of F2 in the cross. shown in Mirabilis sp.



e.Write the sex determining mechanism



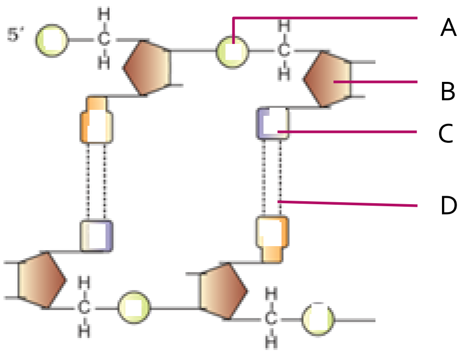
f. Label the symbols used in pedigree charts.

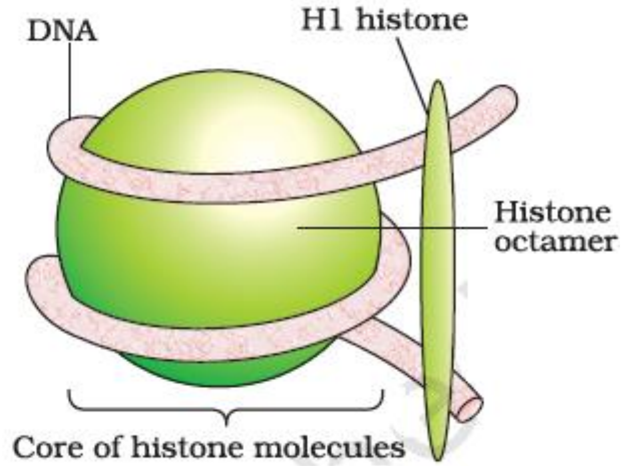


g. Label the symptoms shown in Down's syndrome

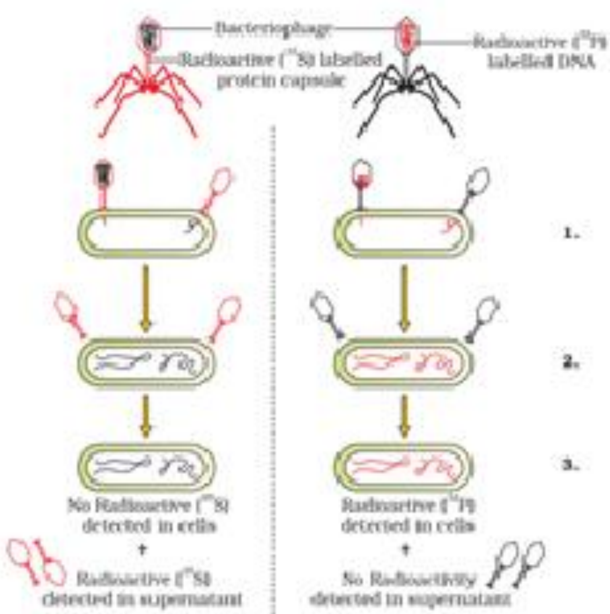
CHAPTER :6   MOLECULAR BASIS OF INHERITANCE

1. Poly nucleotide chain

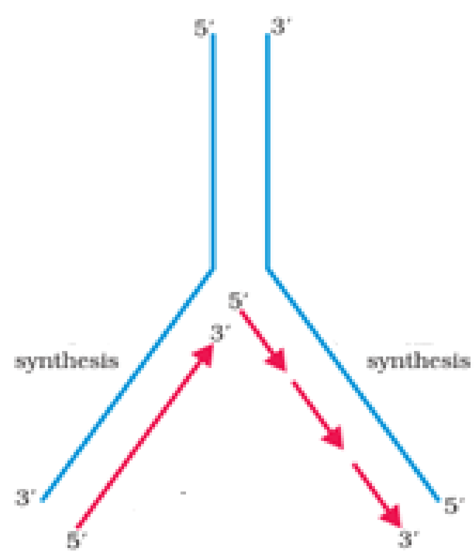




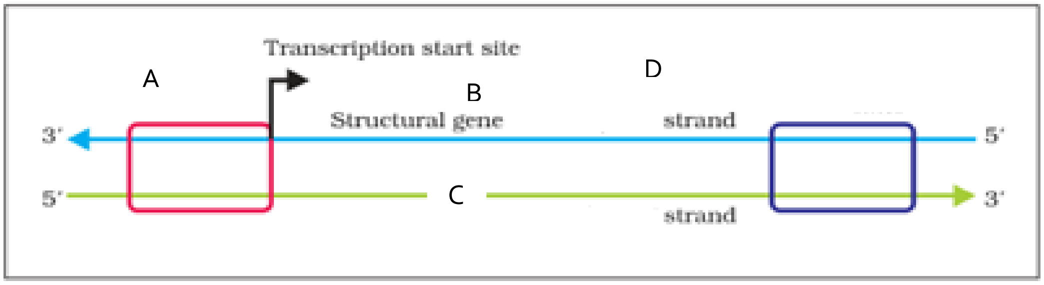
2. LABEL THE STEPS 1, 2 and 3 in given Hershey-Chase experiment



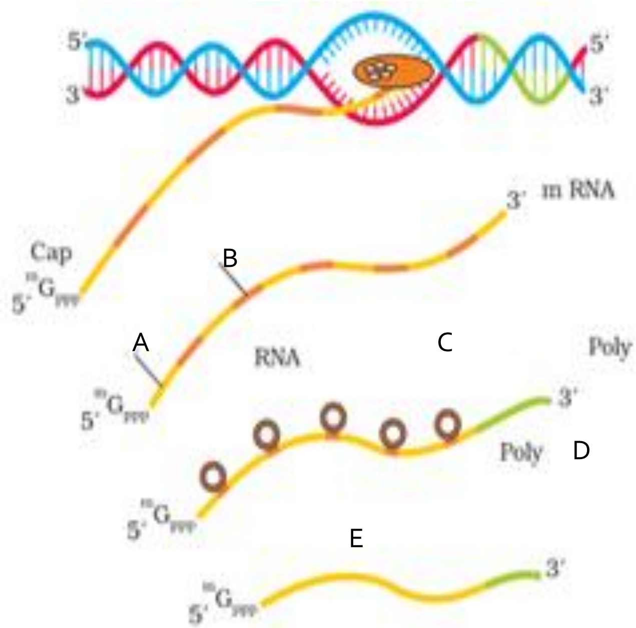
1. Identify the diagram and label the parts



4.Label A,B, C, D in the given Schematic structure of a transcription unit

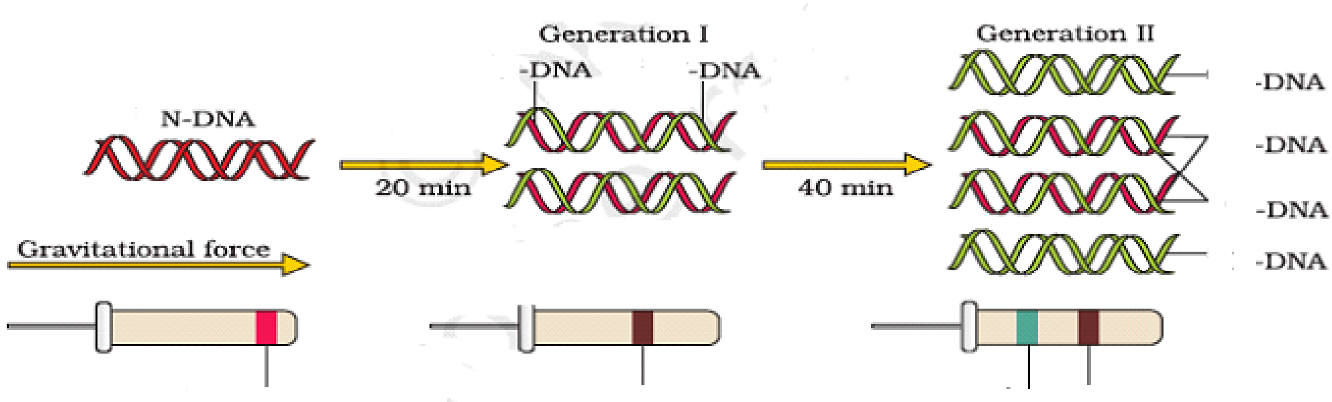


2. Process of Transcription in Eukaryotes - Label A,B, C, D & E



Label the state the nature of DNA in all three generations

5.MESELSON & STAHL'S EXPERIMENT

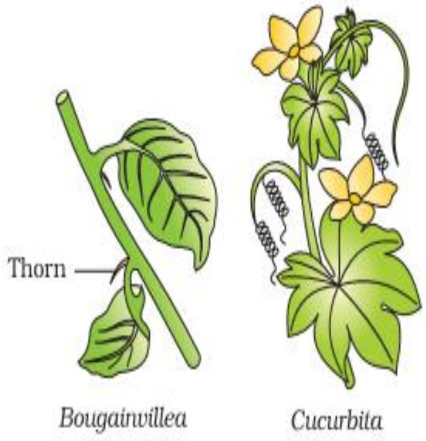


(Separation of DNA by Centrifugation)

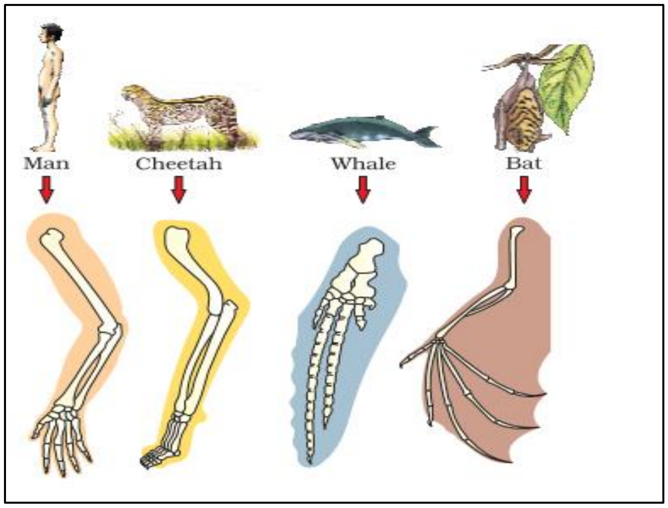
CHAPTER :7 Evolution

1. Mention the type of Evolution

   a)

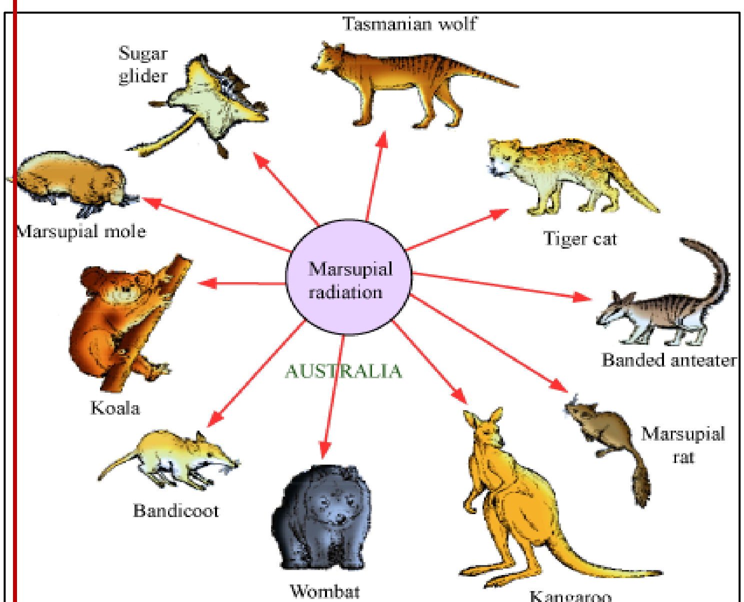


   b)



2. Based on the Diagram answer the following questions :

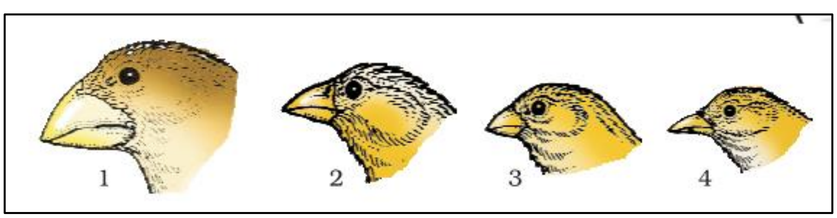
   Mention the specific geographical region where these organisms are found.



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

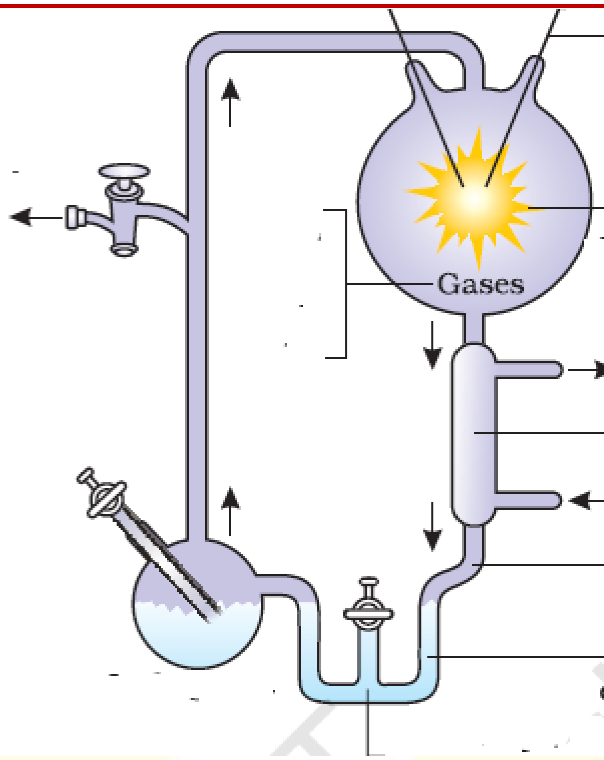
   2) Explain giving reasons the reasons of existence of placental wolf and Tasmanian wolf sharing the same habitat.

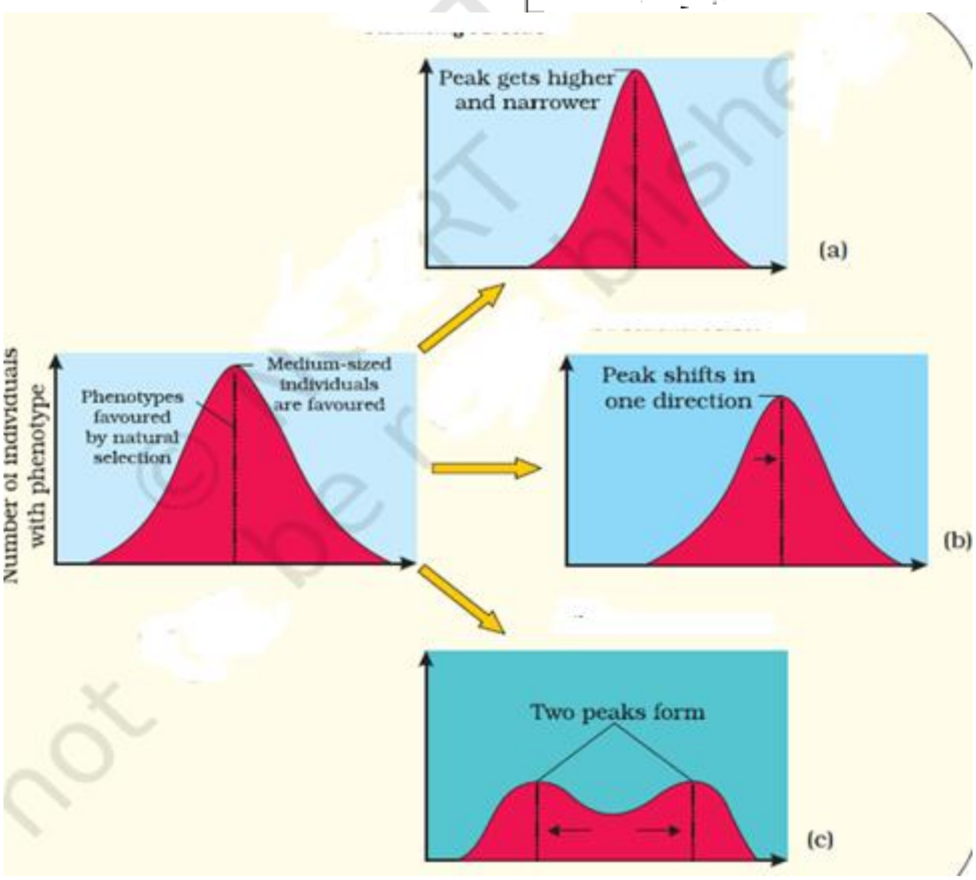
3. Diagram based question:



   1) Write your observations on the variation seen in Darwin's finches shown above.
   2) How did Darwin explain the existence of different varieties of finches on Galapagos Island?

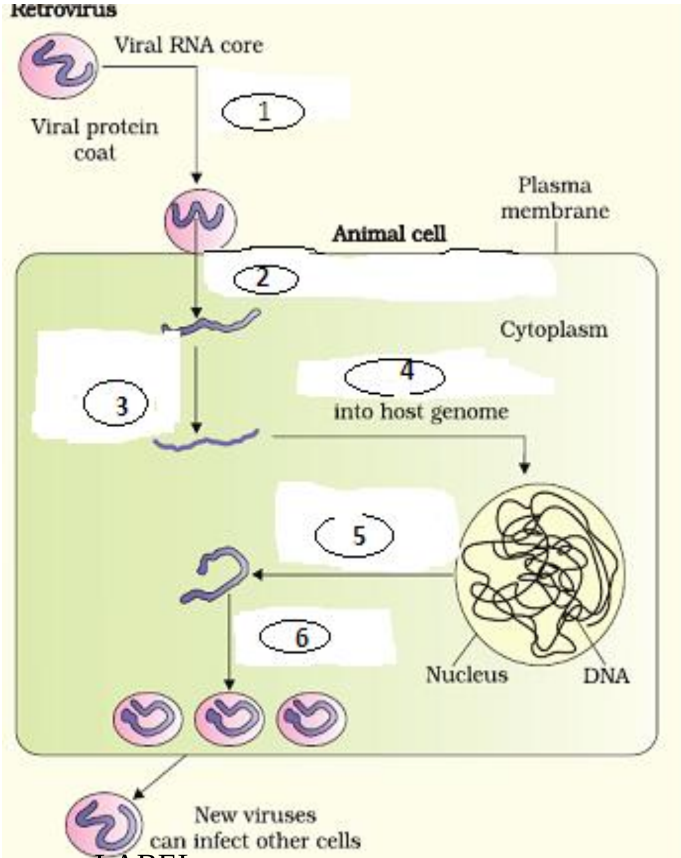
Label the set up


Gases

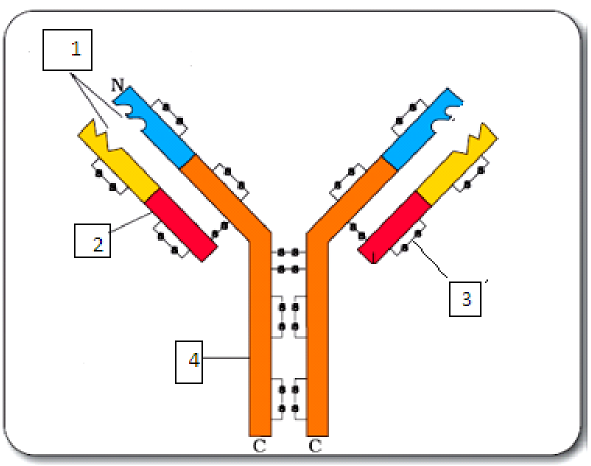

Peak gets higher
and narrower
(a)
Number of individuals
with phenotype
Phenotypes
favoured
by natural
selection
Medium-sized
individuals
are favoured
Peak shifts in
one direction
(b)
Two peaks form
(c)

CH – 8 HUMAN HEALTH & DISEASES

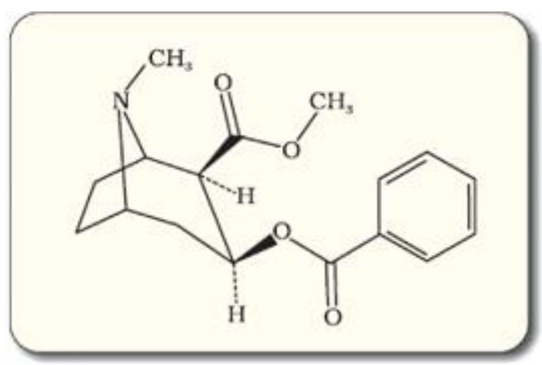
Label the stages 1, 2, 3,4,5,6 in the given diagram of the life cycle of HIV

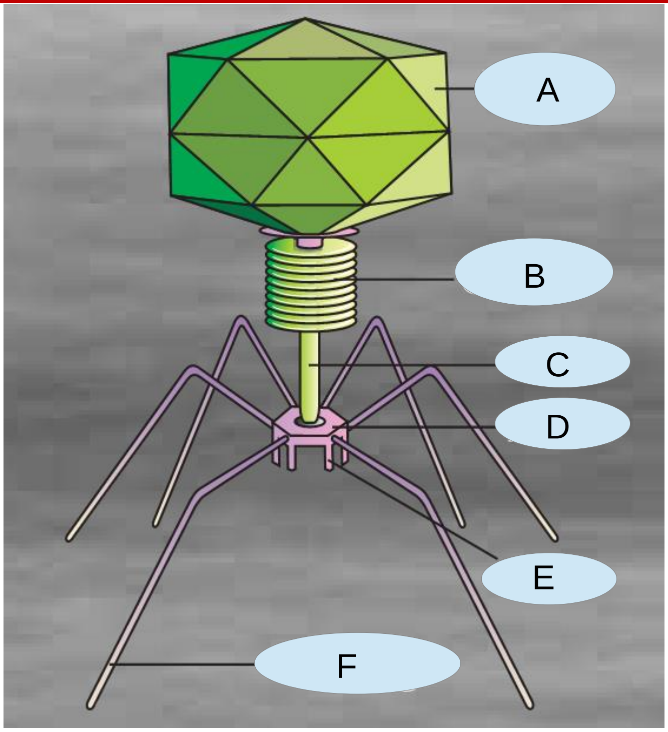


LABEL



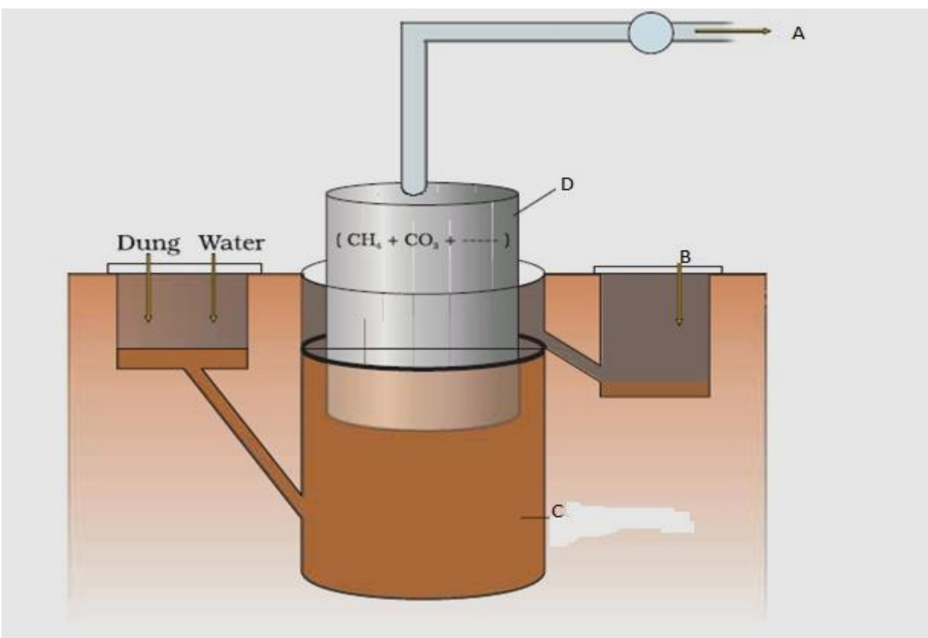
Identify the molecule, abused as a drug





(1) Label the above diagram (A-F).

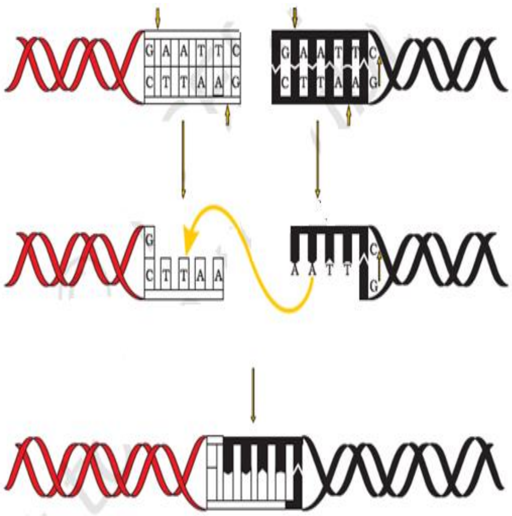
(2)Label A, B, C, D. in the given diagram of a biogas plant



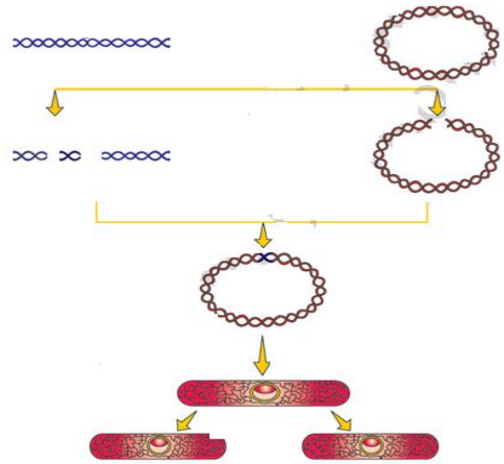
CHAPTER – 11 BIOTECHNOLOGY-PRINCIPLES & PROCESSES

LABEL THE DIAGRAMS AND THE PROCESSES INDICATED

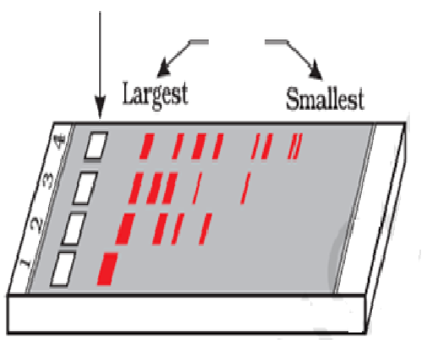
1.



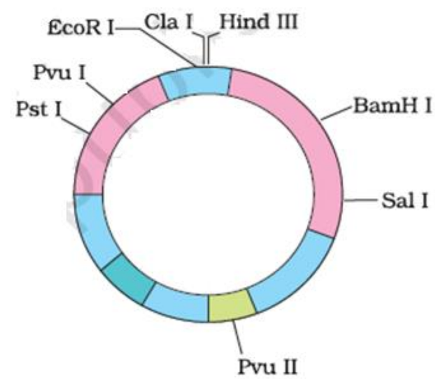
2.



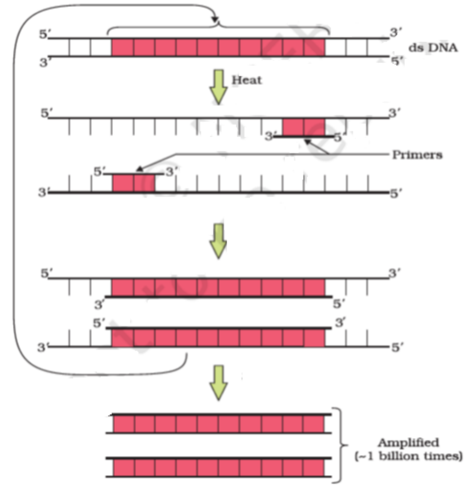
3. Name the process indicated and label the diagra



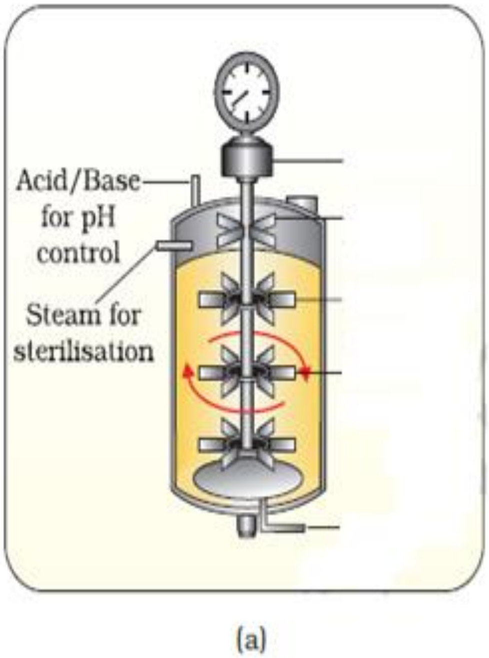
4. Label the major markers in pBR322

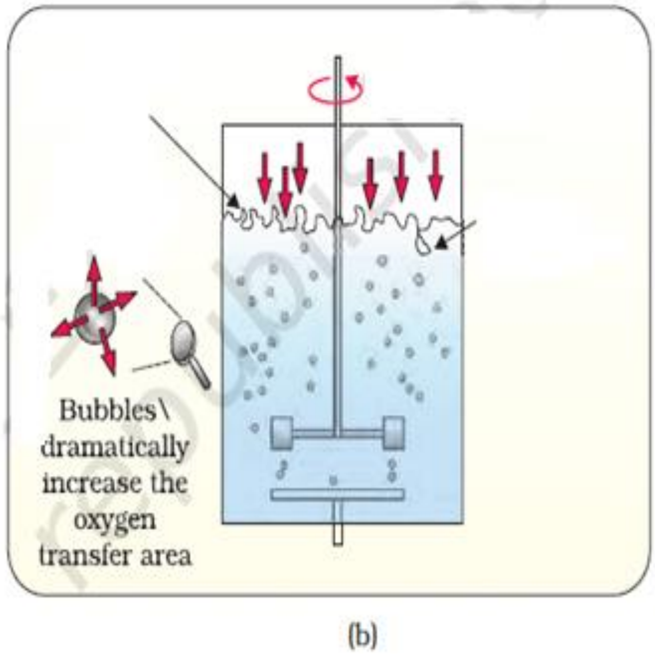


5. Name the process and complete the labelling.



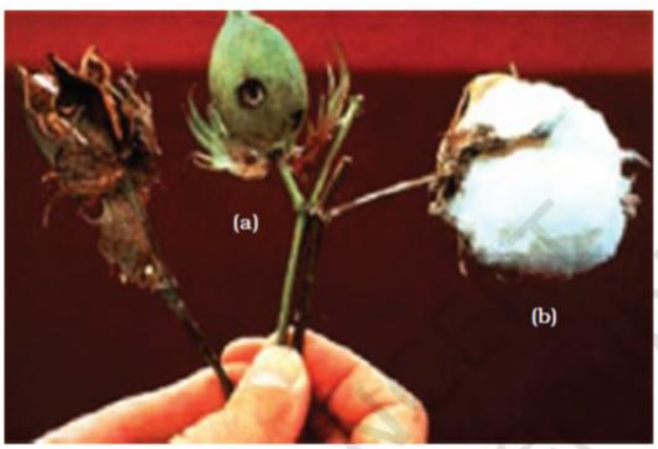
6.





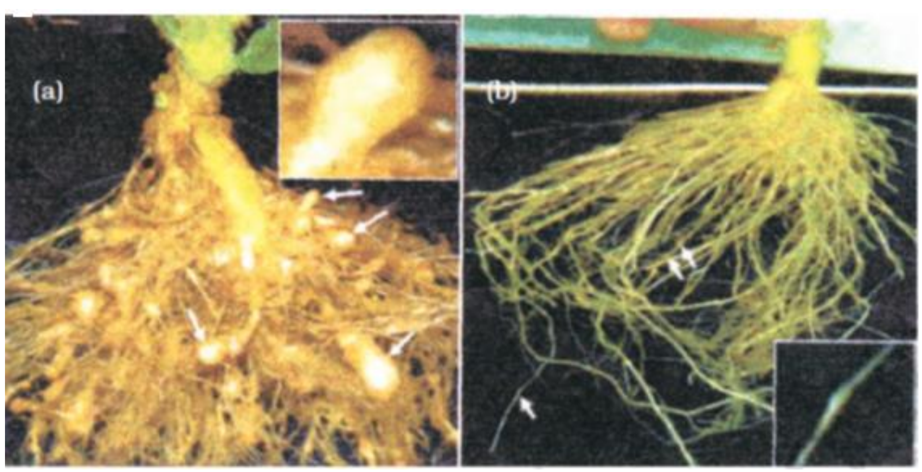
CHAPTER – 12 BIO TECHNOLOGY AND ITS APPLICATIONS

1.



How are a) and b) different?

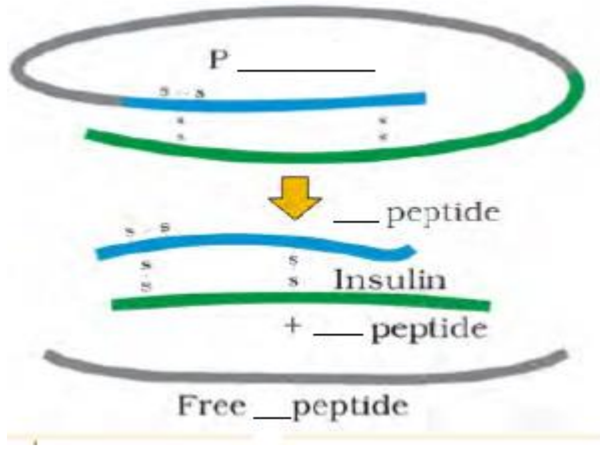
2.



What is a) and b)

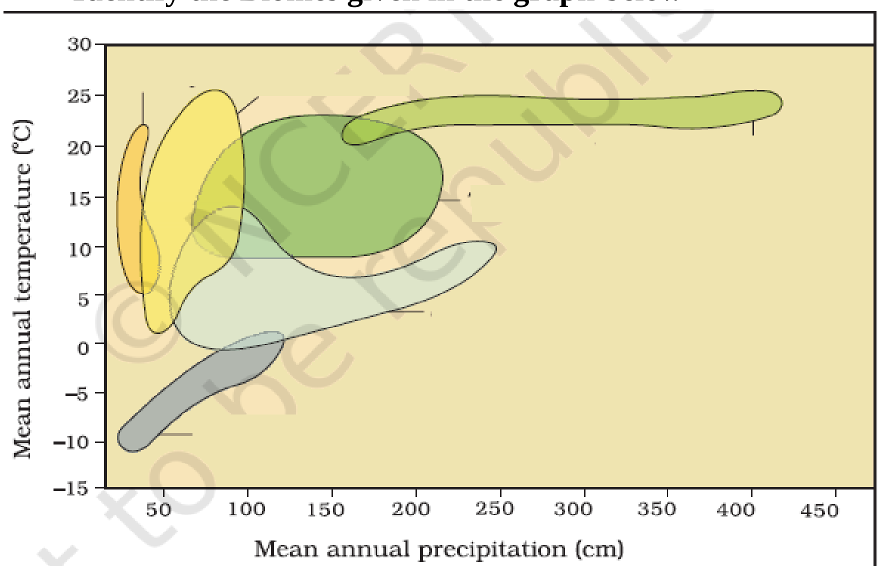
3. Fill in the 4 blanks indicated in the diagram.

What do the diagrams represent?

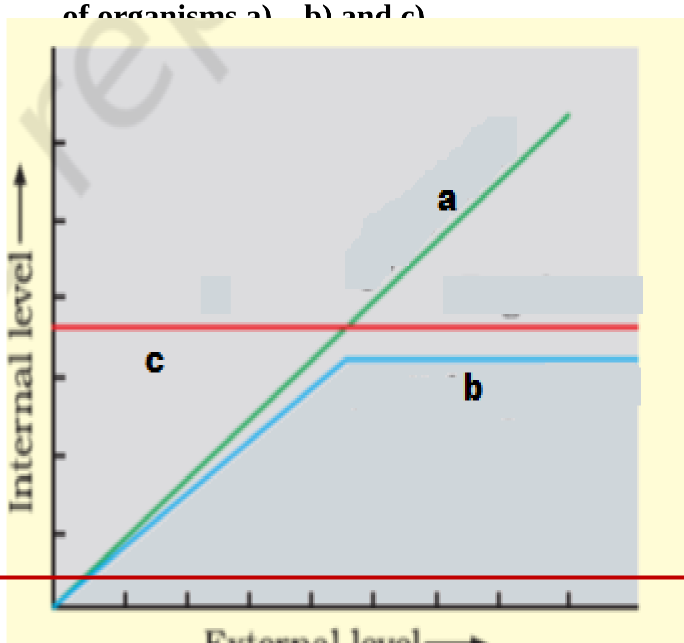


CHAPTER – 13 ORGANISMS & POPULATIONS

1. **Identify the Biomes given in the graph below**

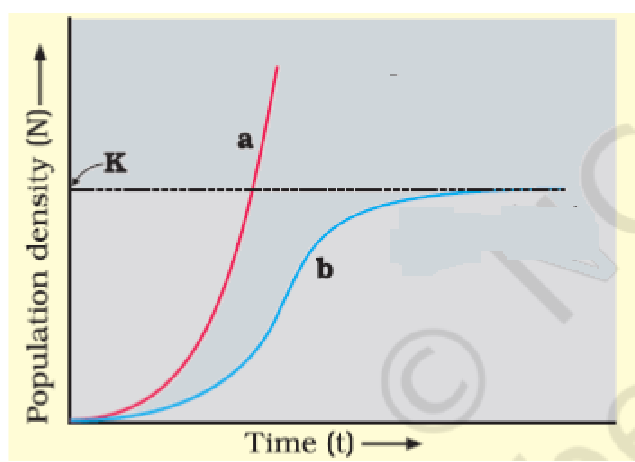


2.The figure shows the response of organisms to changes in abiotic levels. Identify the type of organisms a) , b) and c)

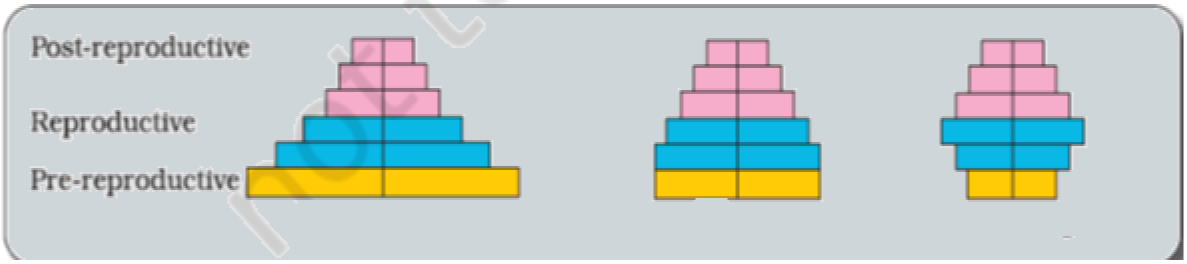


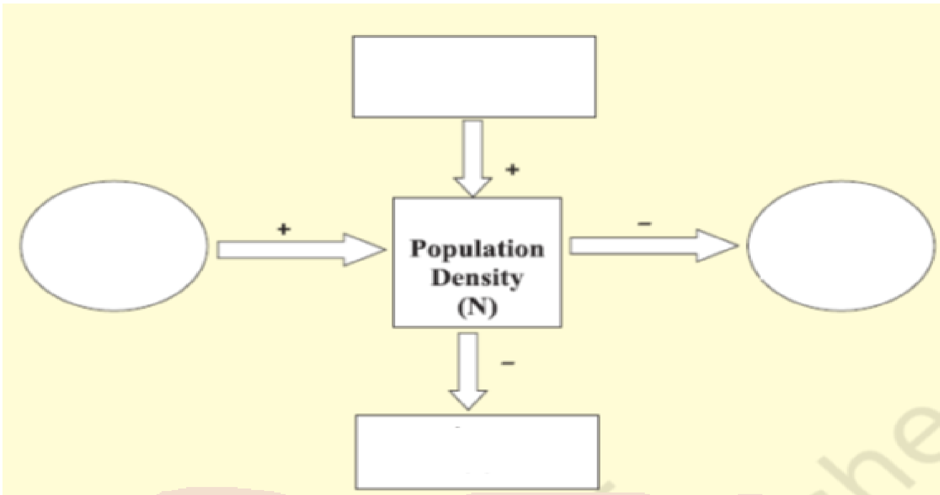
mids

3.



Write the equations for the growth curves

5. 



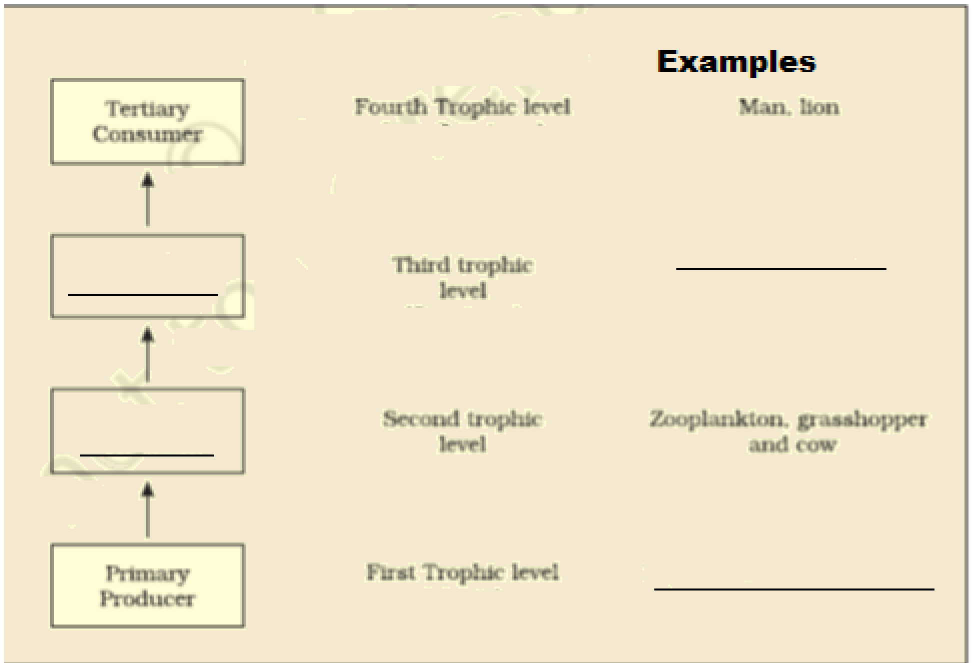
Identify the 4 factors affecting Population Density

6. Identify the Interspecific interaction illustrated below. Name the organisms and the reasons for the interaction

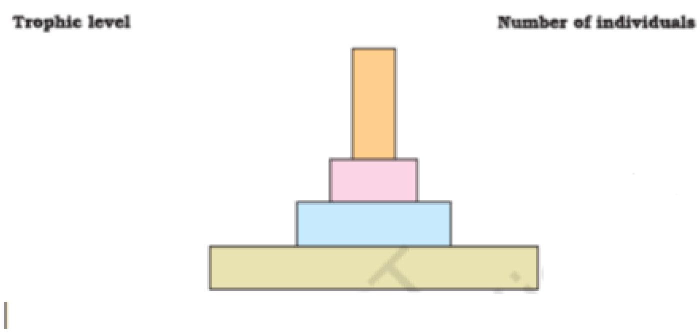
(a) (b)

CHAPTER – 14 ECOSYSTEM

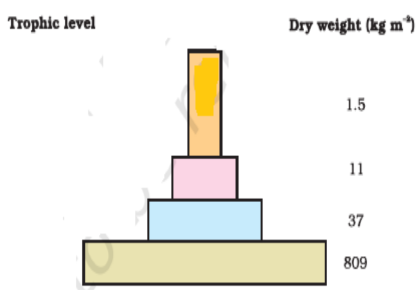
1.Fill in the blanks



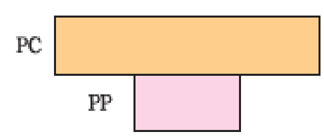
2. Name the different trophic levels and number of individuals at each level. Name the pyramid.



3. Identify the trophic levels

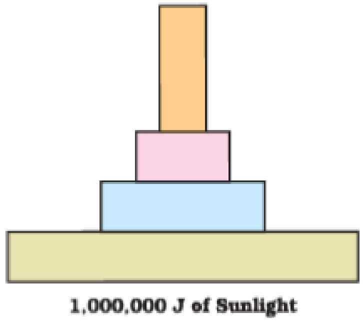


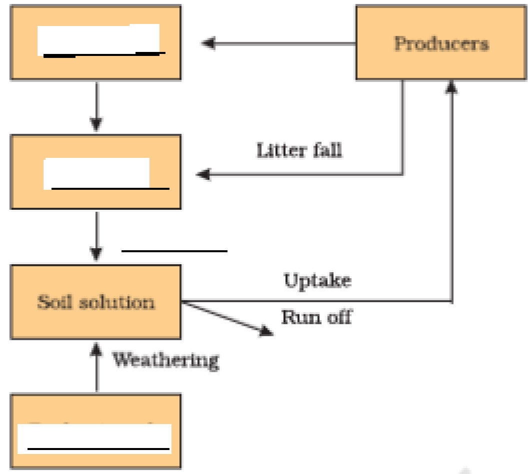
4.Identify the pyramid .Give examples of the trophic levels indicated



5.Show how energy flows through the trophic levels in the Energy pyramid

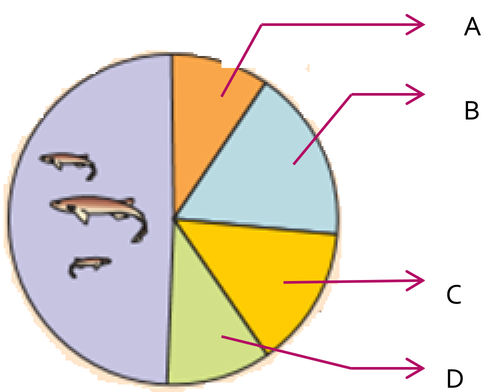
6. Fill in the blanks in the phosphorus cycle



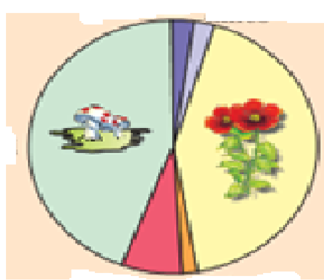


CHAPTER : 15 BIODIVERSITY AND CONSERVATION

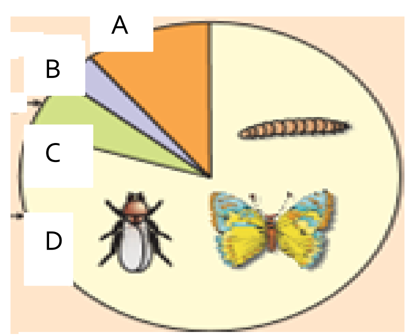
1. Identify the regions with the organisms



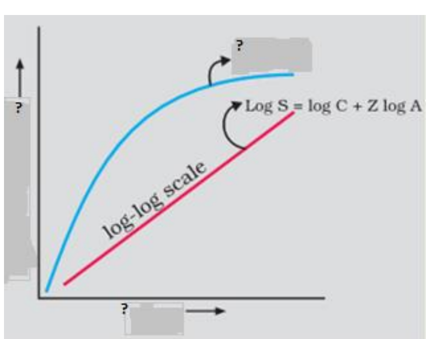
2. IDENTIFY THE PLANT BIODIVERSITY



IDENTIFY THE ANIMAL GROUPS FROM THE GIVEN CHART



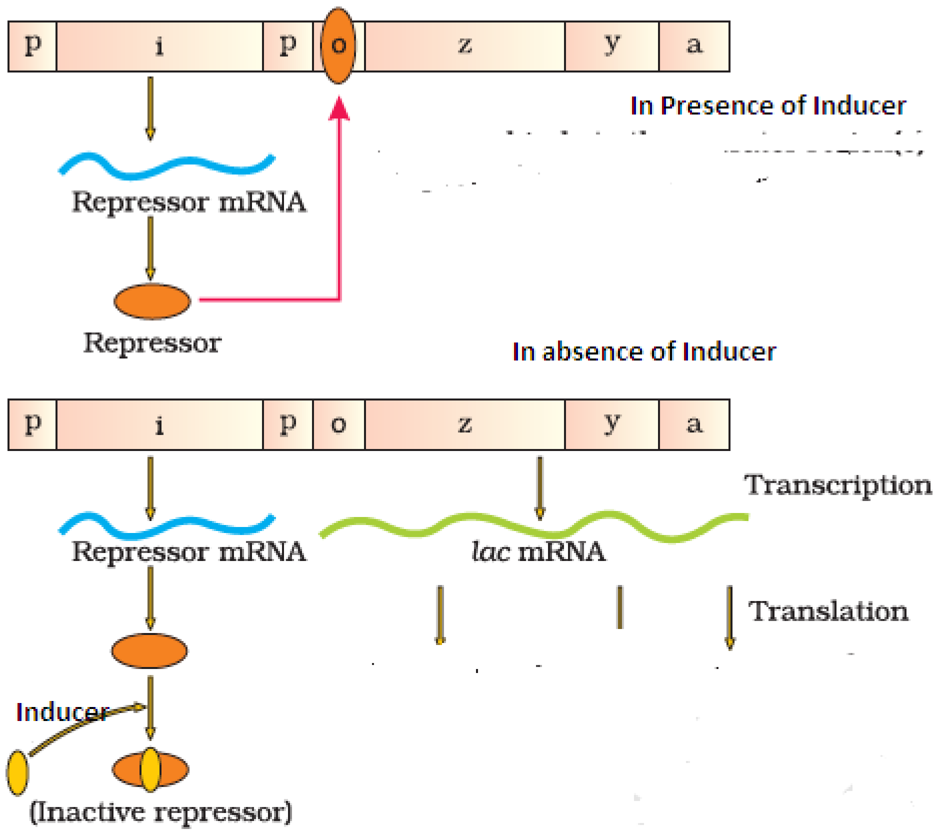
3. IDENTIFY **A,B,C AND D**, STATE THE RELATION



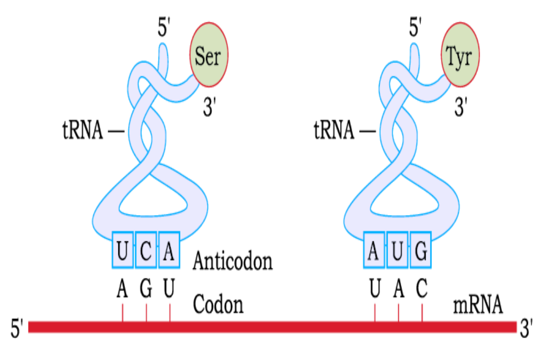
C A

ADDITIONAL DIAGRAMS

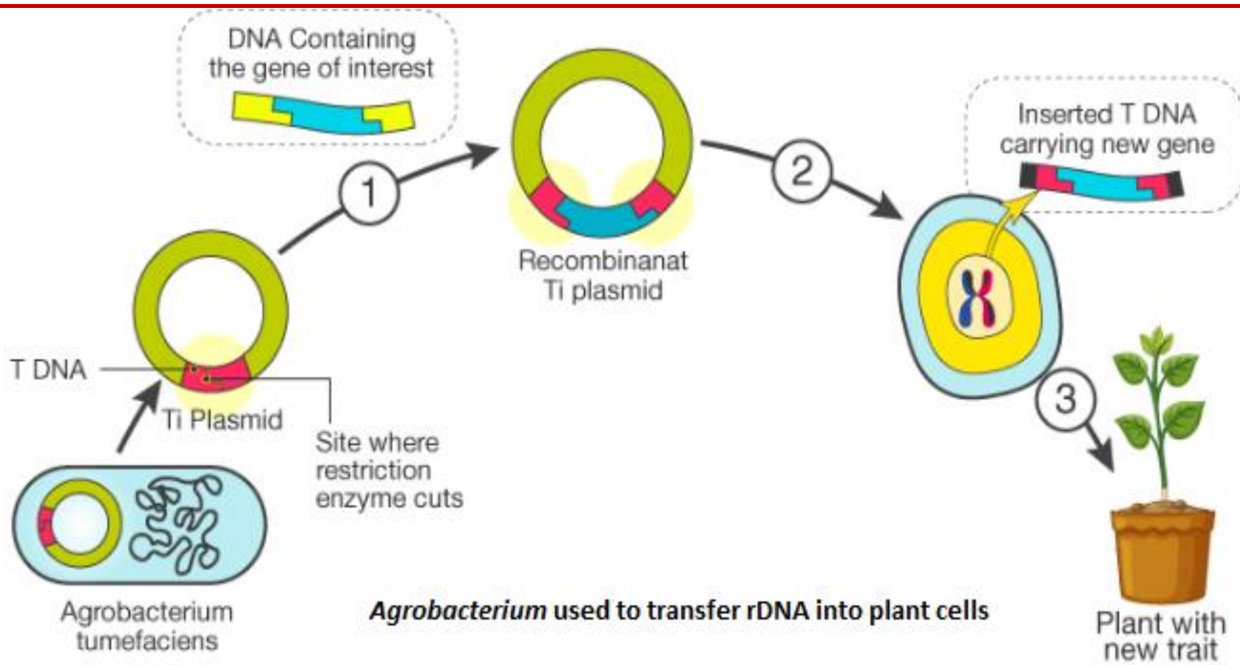
LAC OPERON –



tRNA

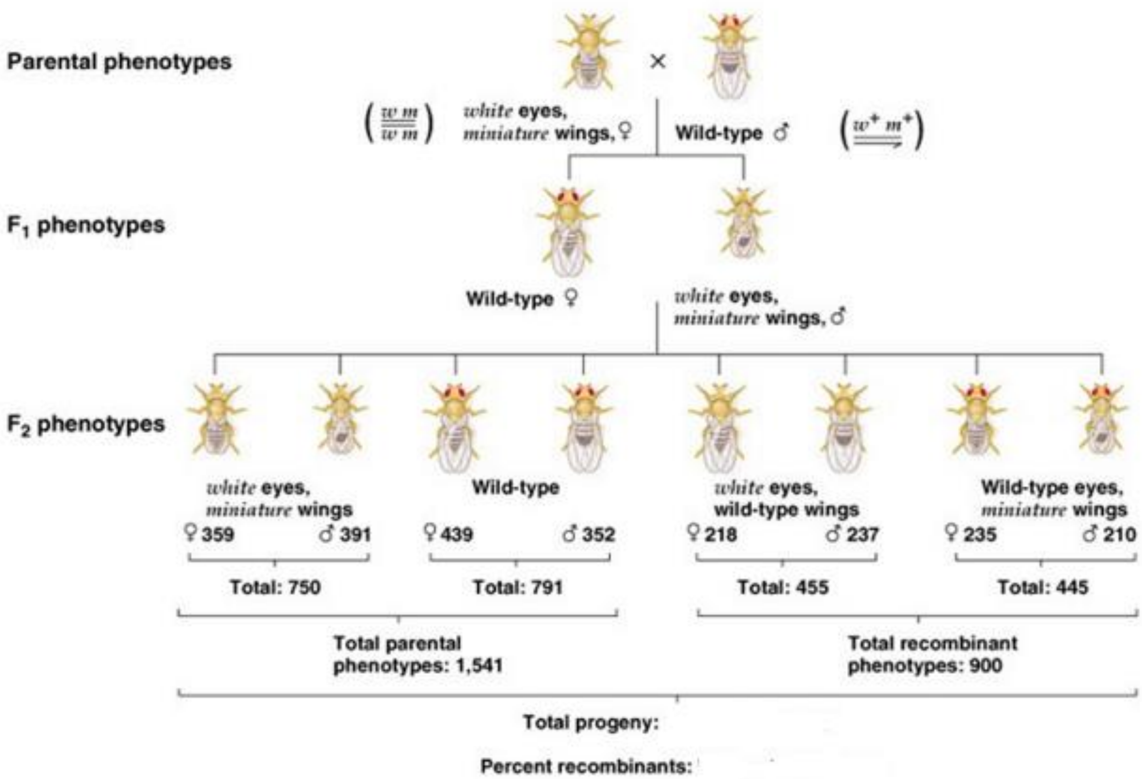


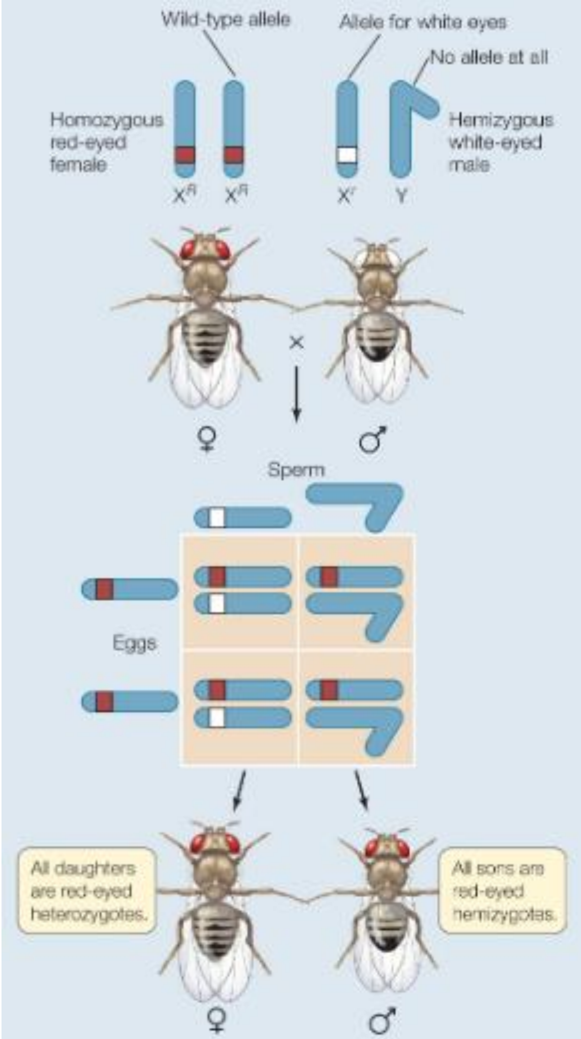
.



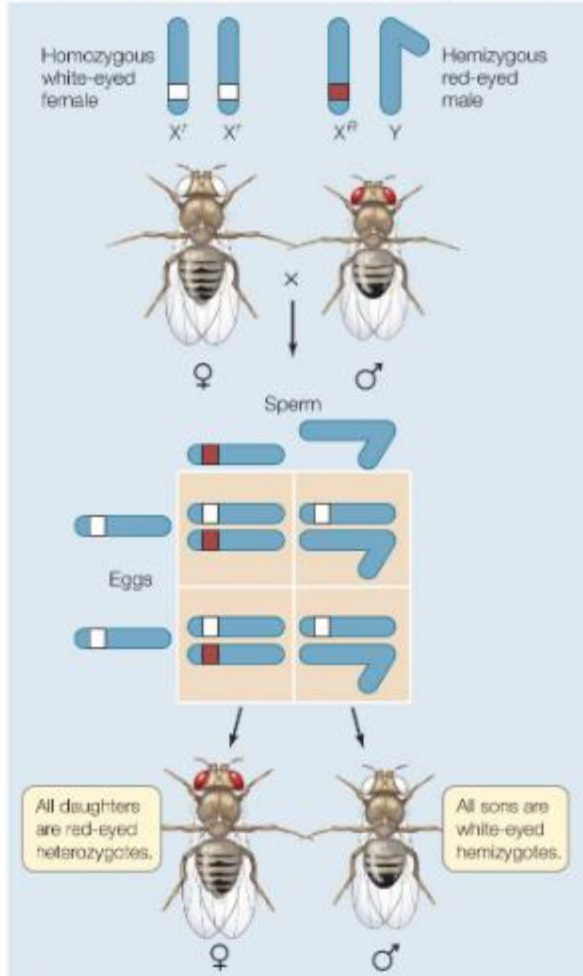
***Agrobacterium* used to transfer rDNA into plant cells**

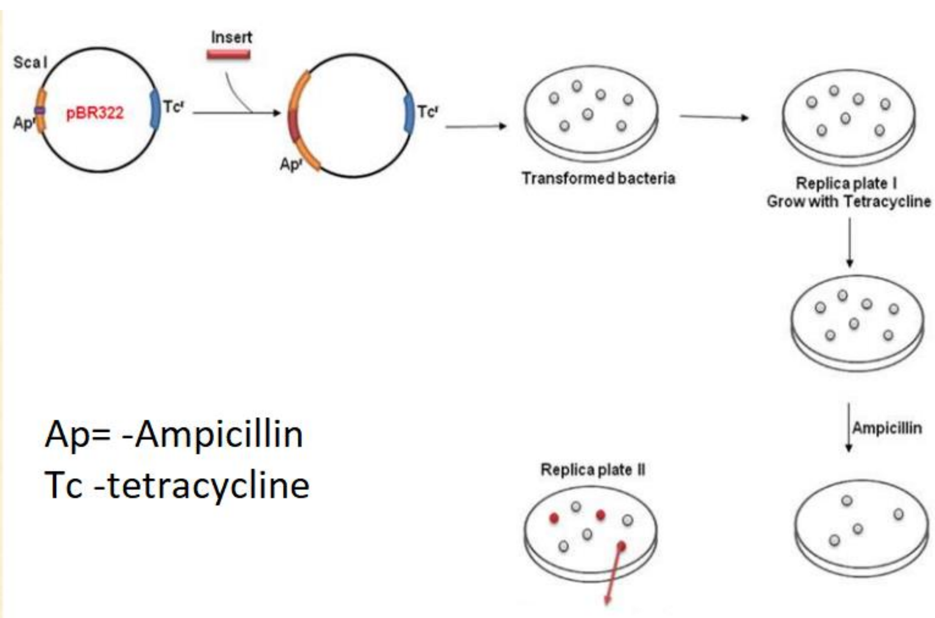
Morgan's experimental cross of white-eyes and miniature wings.





Gene for eye colour seen on X chromosome.





Ap= -Ampicillin
Tc -tetracycline

Describe the steps and objective of the Biotechnological process depicted.

RNA interference

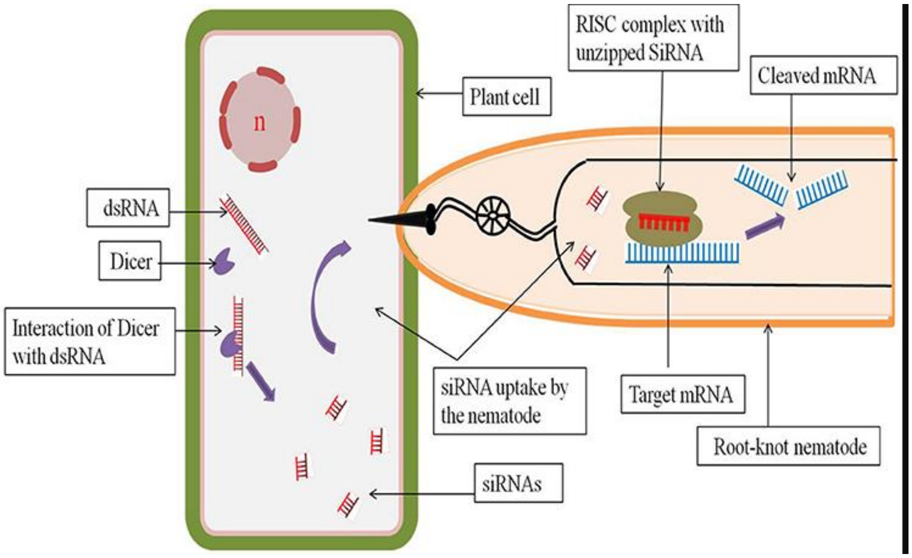


FIGURE 1. HOST GENERATED RNAI THROUGH INTERACTION BETWEEN HOST PLANT CELL AND ROOT-KNOT NEMATODE. The dsRNA introduced into the host plant is recognized by the cellular RNAse III type enzyme dicer, which cuts the dsRNA into shorter fragments of 20–25 nucleotides called siRNAs. During infection into the host, the nematode ingests the siRNAs through its stylet. These host derived siRNAs are then processed by the nematode RNAi machinery where the unzipped siRNAs bound to the RISC complex cleaves the target mRNA in a sequence specific manner and inhibits further translation of the target mRNA.

Explain the process depicted above and its application in agriculture.

Explain the steps of gel electrophoresis , depicted in the diagrams.