केंद्रीय विद्यालय संगठन, क्षेत्रीय कार्यालय, राँची

Kendriya Vidyalaya Sagathan Regional Office, Ranchi

CLASS XII

Biology (044)

STUDY MATERIAL

Session: 2023-2024

BIOLOGY

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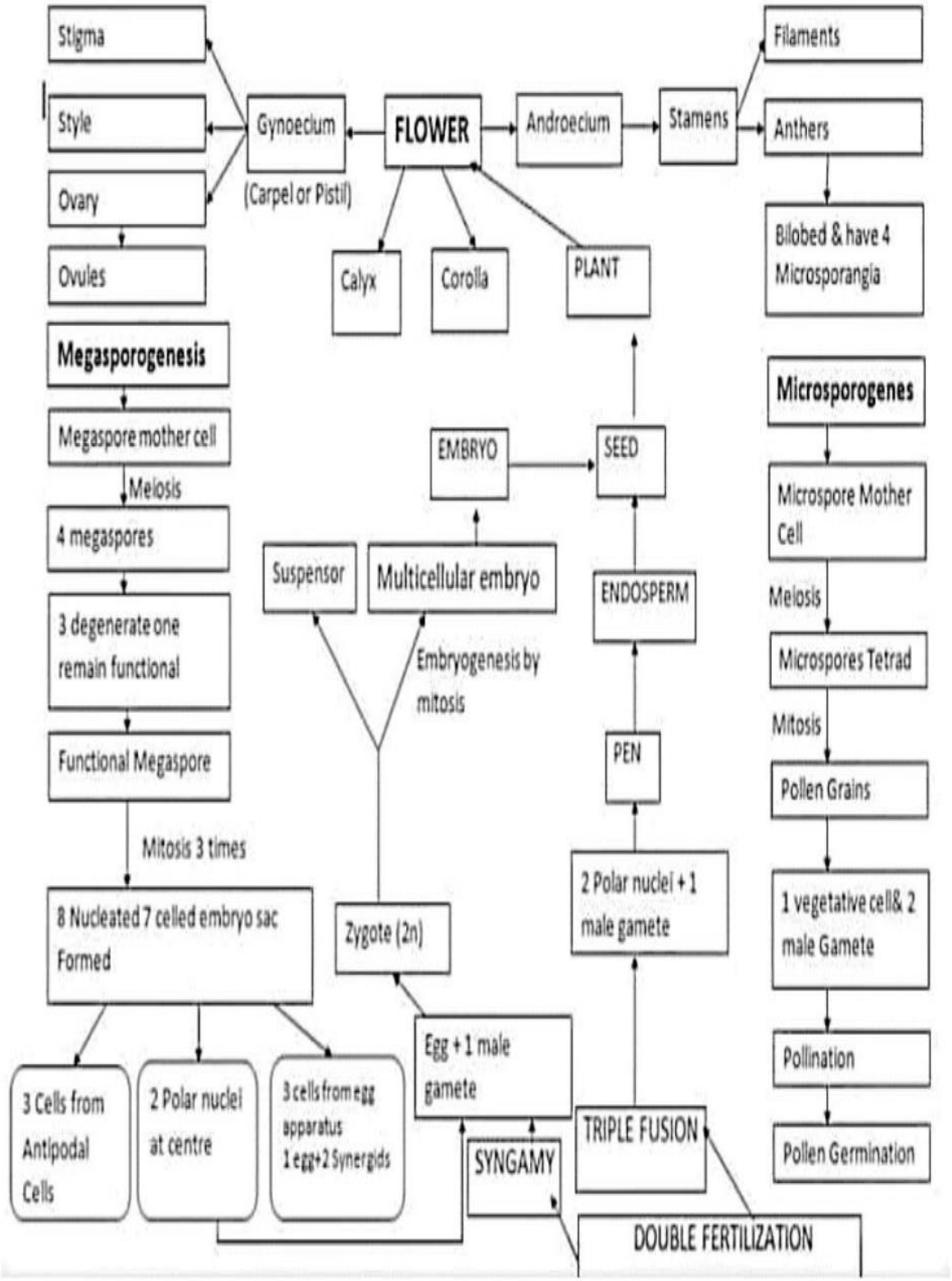
CHAPTER – 1

Concept Map:



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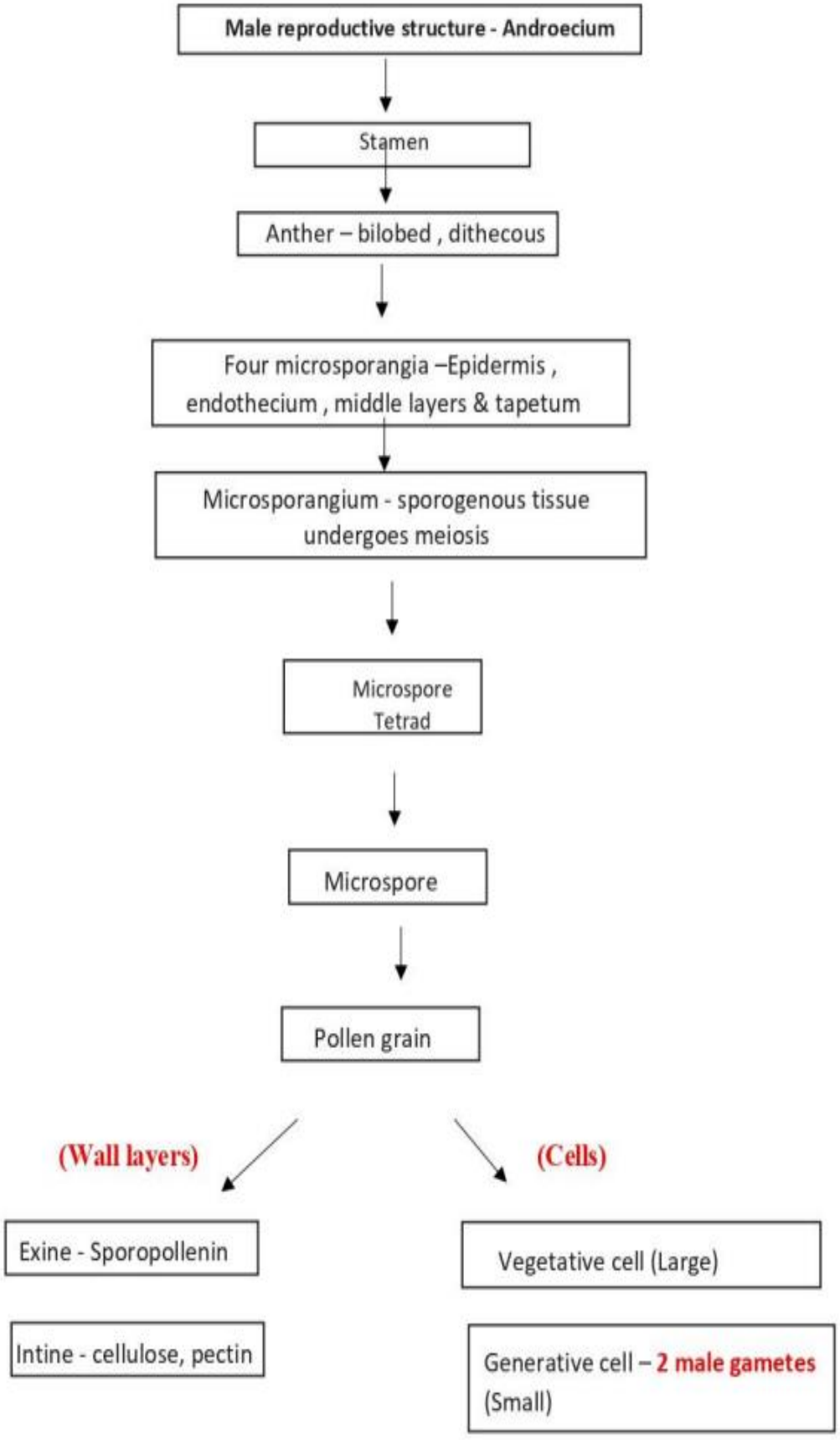
FLOW CHARTS :

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



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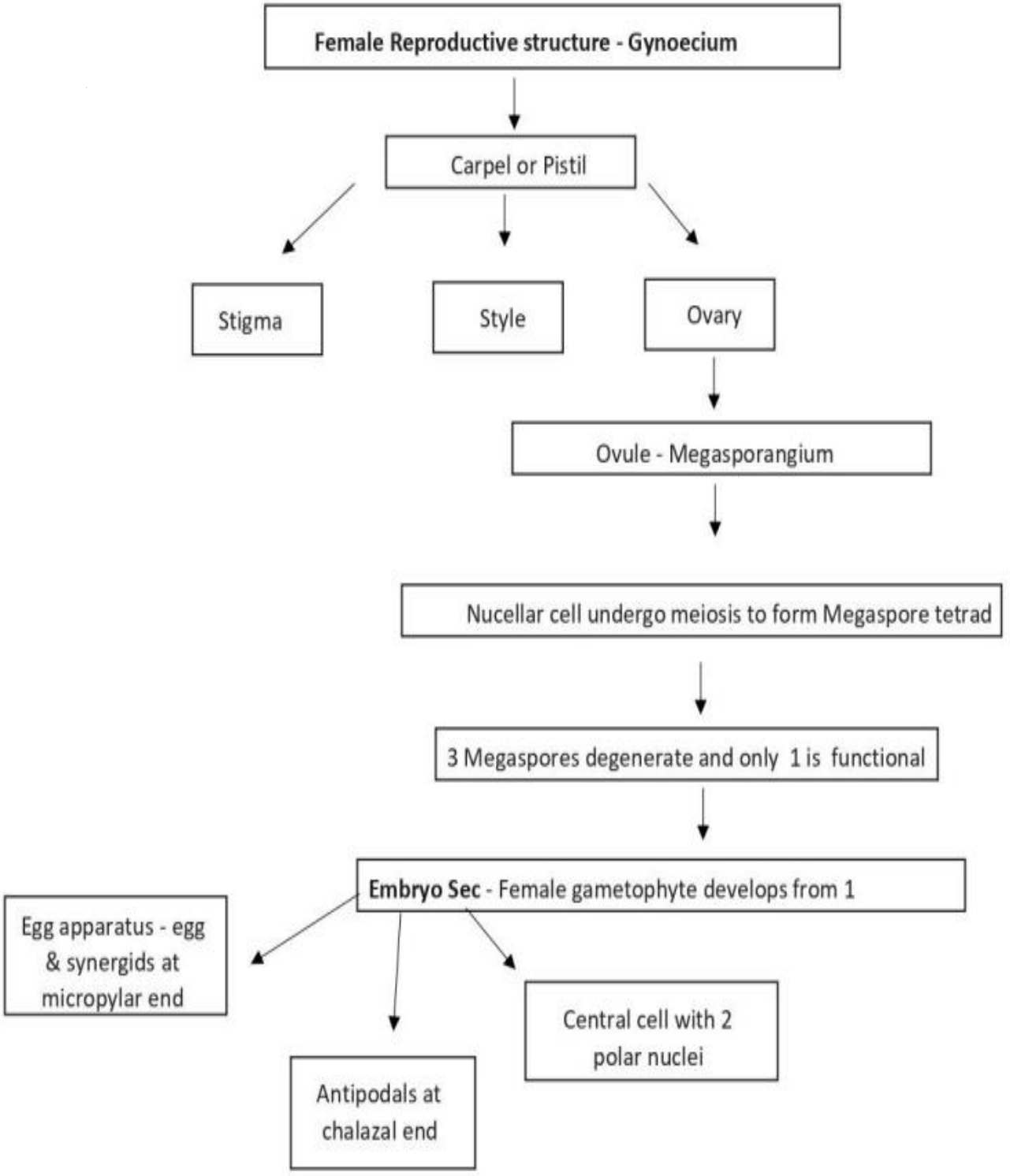
SEXUAL REPRODUCTION IN FLOWERING PLANTS

2. Development of Female gametophyte and Egg from Megasporangium.



Monosporic Development
Mature embryo sac is 7 celled structure.

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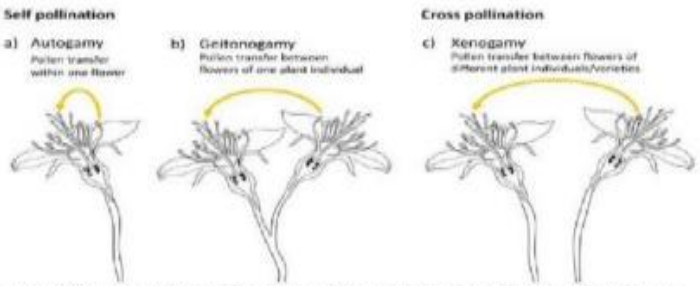
3.Pollination - Types.

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 .

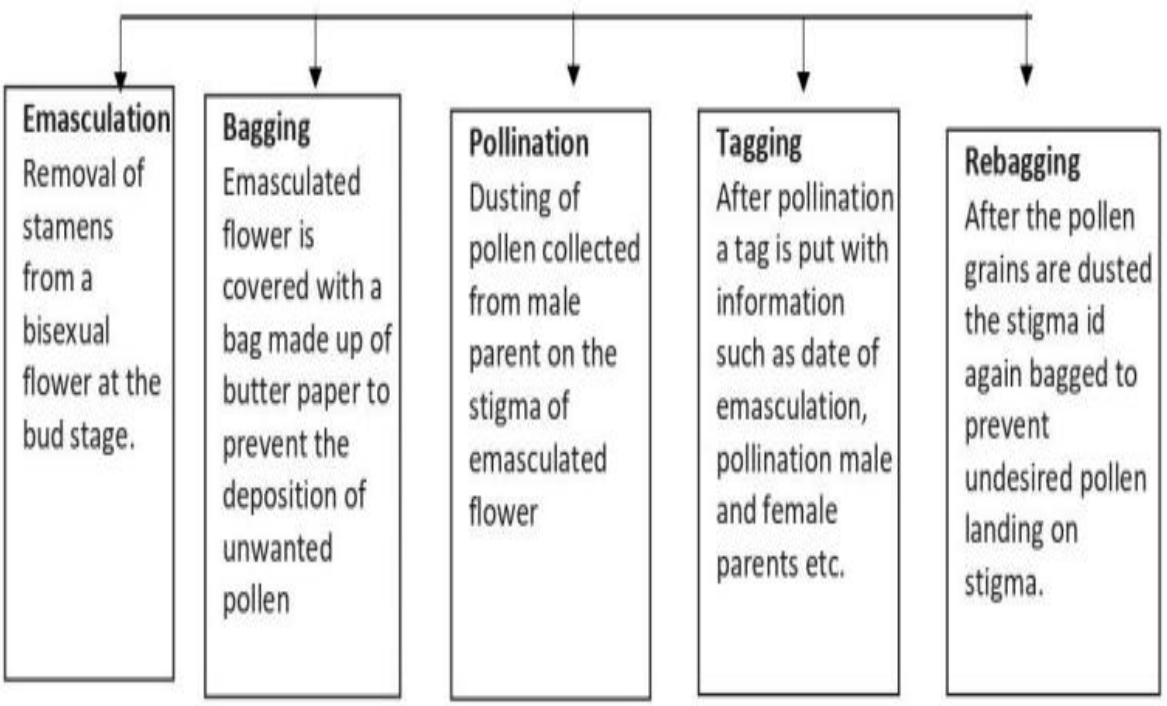
Water
Pollen grains produced in large number, mucilaginous covering, long and ribbon like.

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

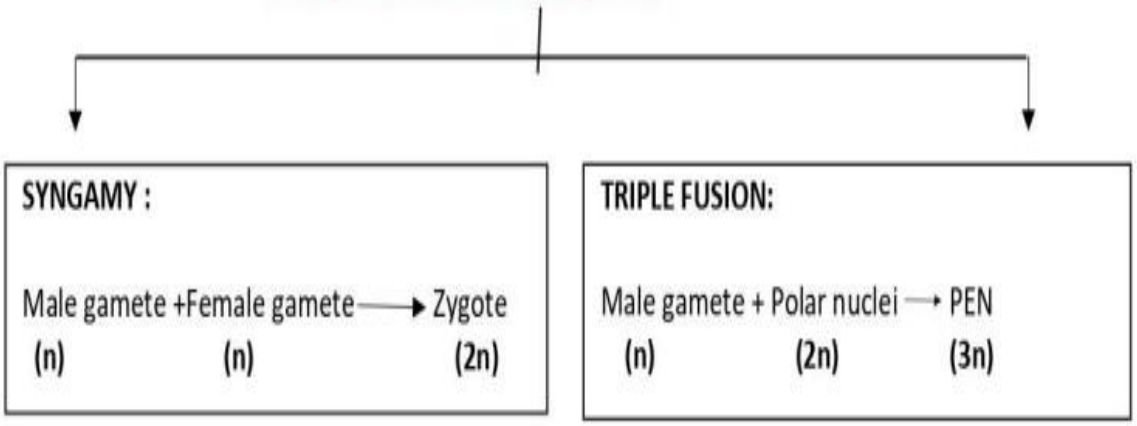
5.Outbreeding devices:

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:



7. Double fertilisation (Unique event to flowering plants)



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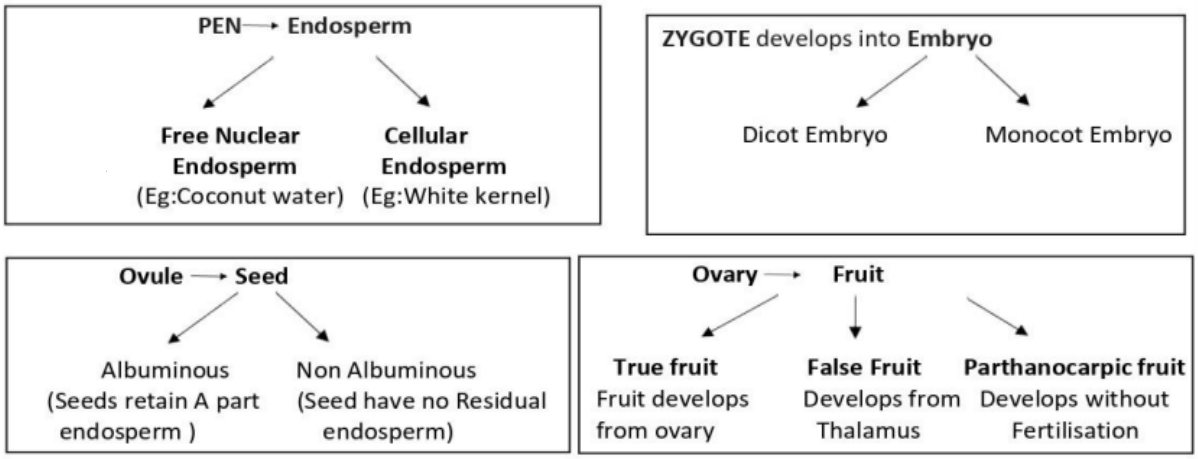
8. Post Fertilisation- Structures and events :



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.

<u>SHORT ANSWER QUESTIONS:</u>

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

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

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

4. Mention the ploidy of the different types of cells present in the female gametophyte of an Angiosperm.

5. Gynoecium of a flower may be apocarpous or syncarpous. Explain with the help of an Example each.

<u>SHORT ANSWER QUESTIONS (3-MARKS):</u>

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1. Explain the different modes of pollination that can occur in a chasmogamous flower.

2. Differentiate between parthenocarpy and parthenogenesis. Give one example of each.

3. In plant breeding experiments, pistillate flowers are not emasculated, but are still bagged. Explain.

4. 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.

5. Write the differences between wind-pollinated and insect pollinated flowers. Give examples of each type.

ASSERTION-REASON 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: 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.
2. Assertion: Ovule after fertilization forms the fruit.
   Reason: The fruit contains diploid endosperm.

3. 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.

4. Assertion: Megaspore mother cell undergoes meiosis to produce four megaspores.
   Reason: Megaspore mother cell and megaspores both are haploid.

CASE-BASED QUESTIONS:

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.

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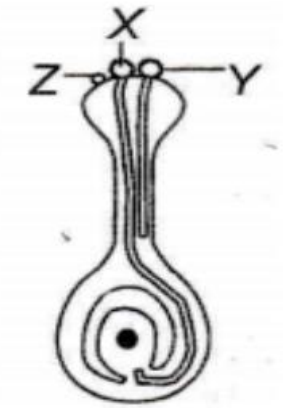


i. The given diagram shows the carpel of an insect pollinated flower. What is the most likely reason for the non-germination of pollen grain Z?

(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

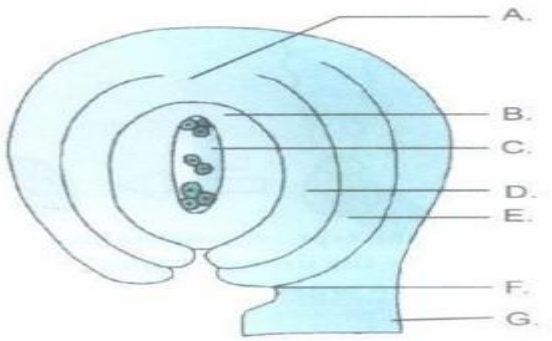
a. 1 b.2 c. 3 d. 4

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 below.



(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.

ANSWERS:

SHORT ANSWER QUESTIONS:

1. 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.

2. 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.

3. 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.

4. (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

5. 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.

SHORT ANSWER QUESTIONS (3-MARKS):

1. (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.

2. 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.

3. (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.

4. 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

5. 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.

ASSERTION-REASON TYPE QUESTIONS:

1. C.
2. D.
3. C.
4. C.

CASE-BASED QUESTIONS:

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

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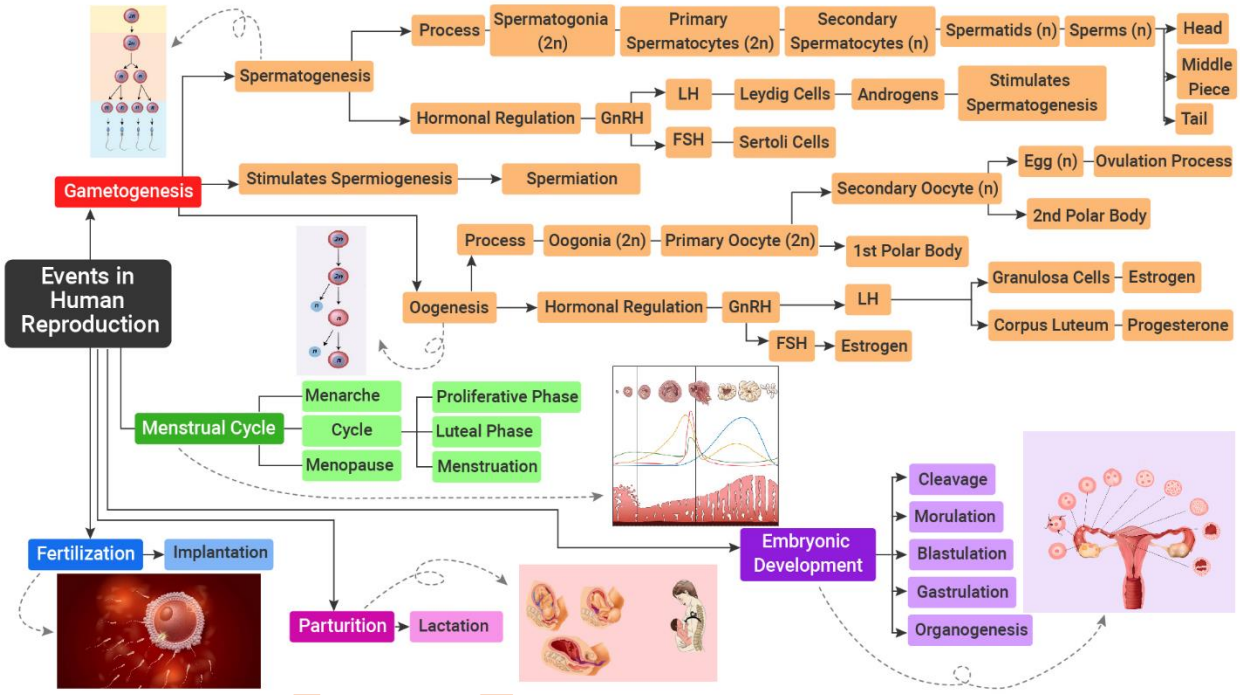
CHAPTER – 2

HUMAN REPRODUCTION

MIND MAPPING



SPERMATOGENESIS

- Spermatogenesis is the process of formation of mature sperm cells through a series of mitotic and meiotic divisions along with metamorphic changes in the immature sperm cell.
- In mammals, this takes place in the seminiferous tubules of the male reproductive system.
- It begins in the seminiferous tubules within testes and then continues into the epididymis where maturation of the male gamete occurs, and they are further stored under ejaculation.
- Spermatogenesis begins in male after puberty and it is continued throughout life.

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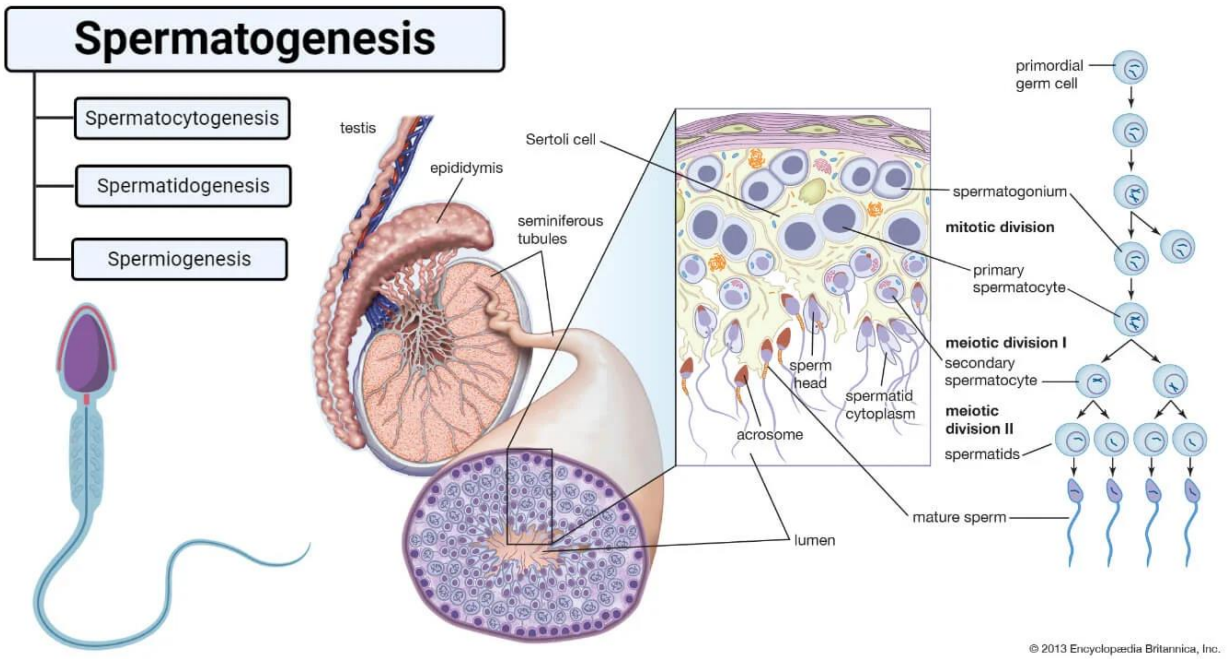


A. Spermatocytogenesis
Site –Seminiferous tubule of testes
Male germ cells divide mitotically to form a large number of spermatogonia

- Some of the spermatogonia called primary spermatocytes periodically undergo meiosis to form two equal haploid cells called secondary spermatocytes.
- The undergo the second meiotic division to produce four equal haploid spermatids.
- The spermatids are transformed into spermatozoa (sperms) by the process called spermiogenesis.

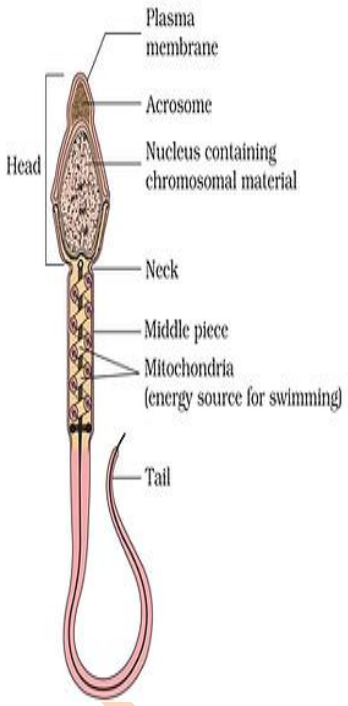
FLOW CHART SPERMATOGENESIS

SCROTUM → TESTIS → TESTICULAR LOBULES → SEMINIFEROUS TUBULES → MALE GERM CELLS (SPERMATOGONIA) → PRIMARY SPERMATOCYTES → MEIOSIS I → SECONDARY SPERMATOCYTES → MEOSIS II → SPERMATIDS → SPERMATOZOA (SPERMS)

Hormonal control of spermatogenesis

- Gonadotropin-releasing hormone(GnRH) from the hypoyhalamus stimulates the anterior pituitary to secrete luteining hormone,FSH.
- LH acts at Leydig cells and stimulates the secretion of androgens help in spermatogenesis.

- FSH act on the sertoli cells and secrete two factors –androgen binding protein and inhibin which helps in spermatogenesis.



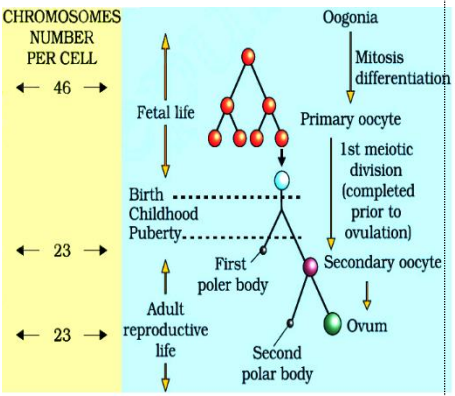
STRUCTURE OF SPERM

- Head: contains the nucleus with densely coiled chromatin fibers, surrounded anteriorly by a thin, flattened sac called the acrosome, which contains enzymes used for penetrating the female egg. It also contains vacuoles.
- Middle Piece: The contain many mitochondria which provides energy for vigrous movement of sperm.
- Tail: It helps in swimming of a sperm

OOGENESIS:

The process of formation of a mature female gamete is called oogenesis

- Oogenesis starts during embryonic stage, 25th week of the fetal age.
- Germinal epithelium of ovary divided mitotically to produce millions of gamete mother cell or **oogonia.**
- No oogonia formed or added after birth.
- Oogonia enters into meiosis-I and proceeds upto diakinesis of Prophase-I and get suspended, at this stage called **primary Oocytes.**
- Each primary oocyte surrounded by layers of granulose cells and then called **primary follicle.**
- At puberty only **60,000 to 80,000** primary oocytes are left in each ovary.
- After puberty primary follicles get surrounded by more layers of granulosa cells and a new theca to form **secondary follicles.**
- The secondary follicle transformed into **tertiary follicle**, characterized by a fluid filled cavity called **antrum.**
- The theca layers organized into an inner theca interna and outer theca externa.
- During the growth of primary follicle into tertiary follicle during puberty, the primary oocyte restarts its first meiotic division and completes it within tertiary follicle resulting **two unequal haploid cells.**



- Large haploid cell is called **secondary oocyte.**
- A tiny cell called **first polar body.**.
- The secondary oocyte retains bulk of the nutrient rich cytoplasm of primary oocyte.
- The tertiary follicle having secondary oocyte further changes into **Graafian follicle.**
- The **secondary oocyte** surrounded by a new membrane, **zonapellucida.**
- The secondary oocyte undergoes second meiotic division continued upto **metaphaseII** and get suspended until entry of sperm.
- At this stage Graafian follicle releases secondary oocyte from the ovary by the process called **ovulation.**

- On entry of a sperm into the secondary oocytes stimulates it to complete meiosis-II and there is formation of a haploid **ovum** and a **second polar body (n)**

MENSTRUAL CYCLE:

- Reproductive cycle of female primates is called **menstrual cycle.**
- The first menstruation begins at puberty is called **Menarche.**
- Menstrual cycle repeated at an average interval of 28/29 days.
- One ovum is released in the middle of each menstrual cycle.

Menstrual cycle has following phases:

Menstrual phase:

- 1st phase of menstrual cycle.
- Menstrual flow occurs.
- Lasts for 3-5 days.
- Breakdown of endometrial lining and blood vessel.
- Mucus and blood comes out through vagina.
- It occurs only when ovum released but no fertilization.
- Lack of menstruation is the indication of pregnancy.

Follicular phase:

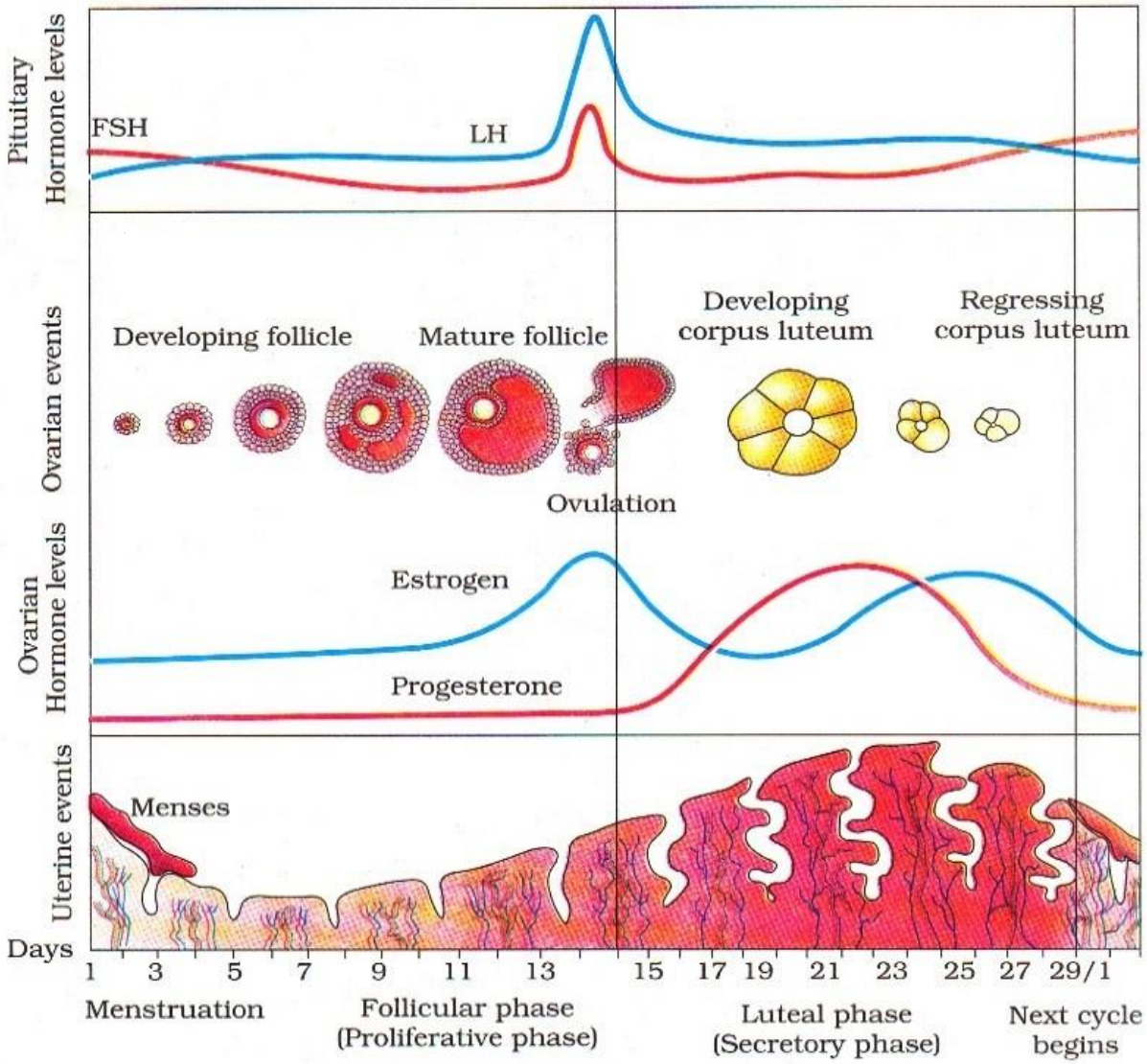
- Menstrual phase followed by follicular phase.
- Primary follicle becomes Graafian follicle.
- Regeneration and proliferation of uterine endometrium.
- LH and FSH level increases gradually in follicular phase.
- Level of estrogen increases as it is secreted from growing follicle.
- It lasts for 5-13 days.

Ovulatory phase:

- FSH and LH attain peak level in this period (14^{th} day).
- This is called **LH surge**, which induces rupture of Graafian follicle and release of ovum from the ovary called **ovulation.**

Luteal phase:

- Remaining part of Graafian follicle transformed into **corpus luteum.**
- Corpus luteum produces large amount of **progesterone.**
- Progesterone maintains the uterine endometrium, and prepares it for implantation.
- Thickness of uterine endometrium increase in many folds, due to proliferation.
- If there is fertilization, corpus luteum grows further and pregnancy continued, menstrual cycle stopped.
- In the absence of fertilization corpus luteum degenerates.
- Disintegration of endometrium leading to menstruation.
- Menstrual cycle ceases around 50 years of age, called **menopause.**



FERTILIZATION AND IMPLANTATION:

- During copulation (coitus) semen is released by the penis into the vagina is called **insemination.**
- The motile sperm swim rapidly, pass through cervix, uterus and finally reach the junction of isthmus and ampulla **(ammpullary-isthmic junction).**
- The ovum released from the ovary also transported to ampullary isthmic junction where fertilization takes place.
- Fertilization only takes place if both sperm and ovum reach ampullary – isthmic junction simultaneously.
- The process of fusion of a sperm and ovum is called **fertilization.**
- Acrosome of sperm secretes enzymes helps in penetration into the ovum
- Once a sperm comes contact with the zonapellucida of ovum and induces the changes in the membrane that blocks the entry of additional sperms.
- That ensures **monospermy** and prevents **polyspermy.**
- Only one sperm fertilize with one ovum.
- Entry of sperm into the ovum induces the ovum to complete its second meiotic division of secondary oocyte.
- Meiosis-II is also unequal cytokinesis resulting production of one large **ovum (ootid)** and one small **second polar body**.
- Haploid nucleus of sperm fused with the haploidnucleus of ovum to form a **diploid zygote**

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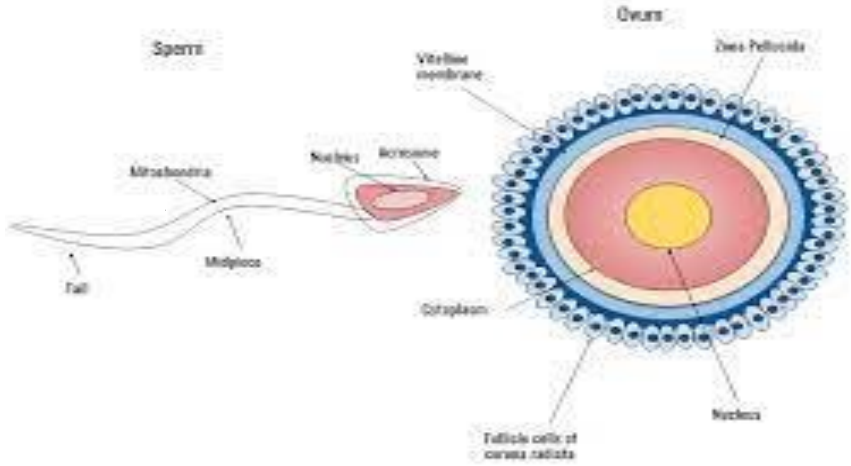

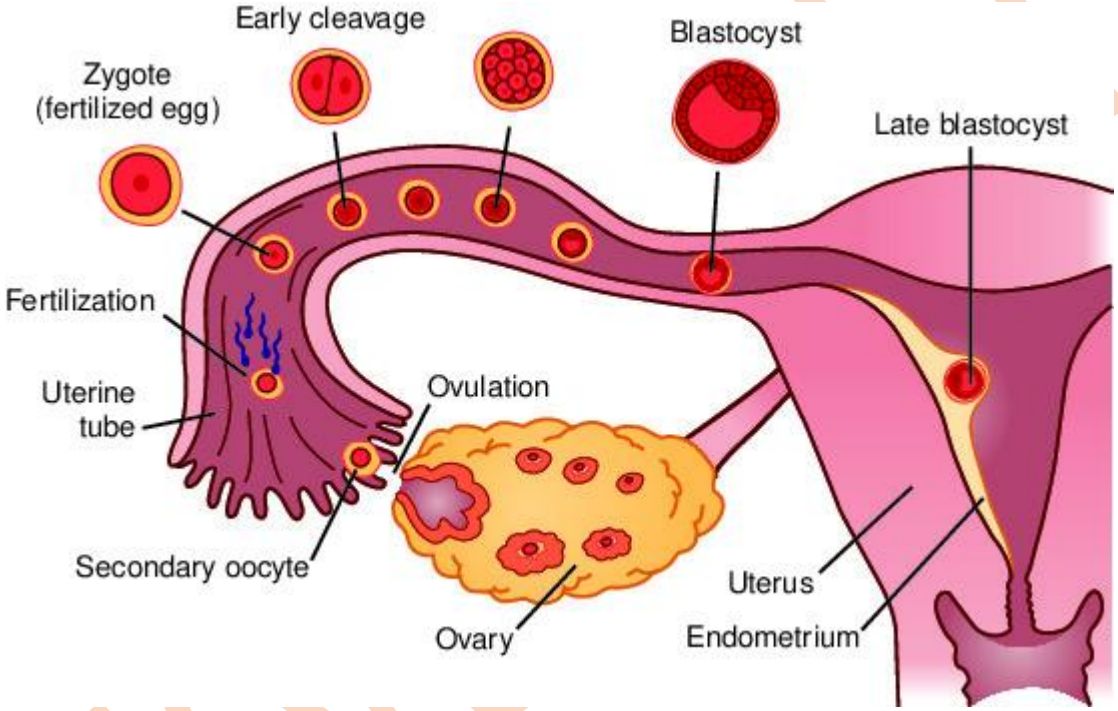

PREGNANCY AND EMBRYONIC DEVELOPMENT

The placenta is an organ that develops in the uterus during pregnancy. This structure provides oxygen and nutrients to a growing baby. It also removes waste products from the baby's blood. The placenta attaches to the wall of the uterus, and the baby's umbilical cord arises from it.

Its principal function is to supply the fetus, and in particular, the fetal brain, with oxygen and nutrients. The placenta is structurally adapted to achieve this, possessing a large surface area for

exchange and a and fetal circulations.thin interhaemal membrane separating the maternal

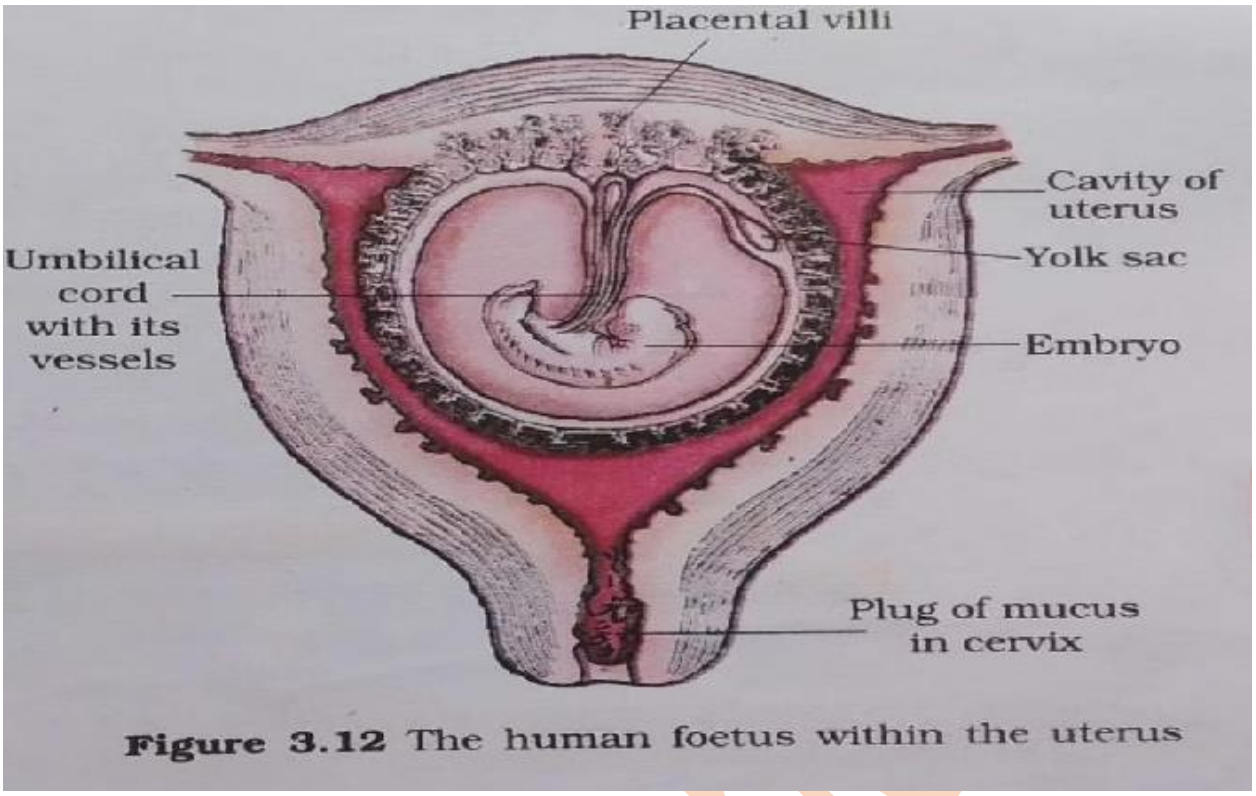

Figure 3.12 The human foetus within the uterus

PARTURITION

Gestation period-The average duration of human pregnancy is 9 months.

The process of delivery of the foetus is called parturition.

It is the endocrine mechanism.The signals for parturition originate from the fully developed foetus and placenta which induces mild contractions called foetal ejection reflex.Due to this oxytocin hormone is released from the maternal pituitary which causes stronger uterine contractions,which inturn stimulates further secretion of oxytocin.Continous secretion of oxytocin causes stronger and stronger contractions.This leads to expulsion of the baby out of the uterus through the birth canal.

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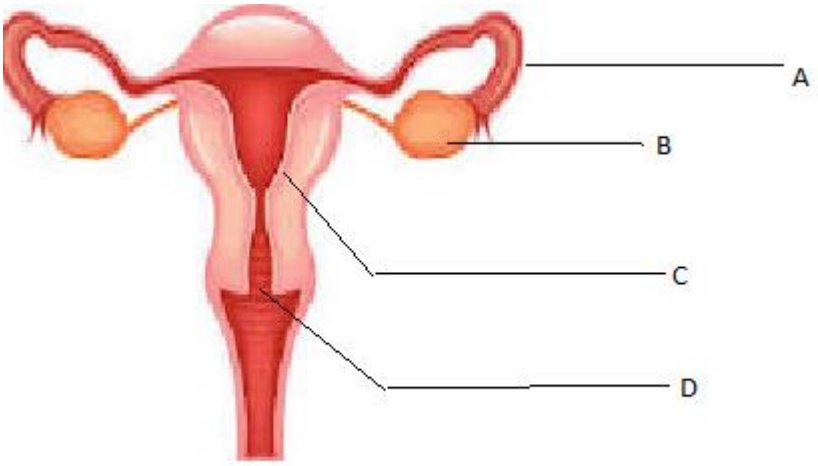
COMPETENCY BASED QUESTION

1.In the given diagram ,label it correctly

A	B	C	D
Ovary	endometrium	cervix	Ampulla



Ans-A-ovary,B-Ampulla,C-Endometrium,D-Cervix

2.Given below are structural details of a human mammary gland:

(i)The glandular tissue in the breast has 15-20 clusters of cells called alveoli.

(ii)The milk is stored in the lumen of alveoli.

(iii)The alveoli join to form the mammary ducts.

(iv)Mammary ampulla is connected to lactiferous ducts.

Choose the option that gives the correct detail of human mammary gland.

(a) (i) and (ii) (b) (ii) and (iii)

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

Ans (c)

3. The secondary sexual characters develops in females because of

(a)estrogen (b)androgen (c)absence of estrogen (d)absence of androgen

Ans-a

4.The cleavage division in human is

(a)holoblastic,equal and indeterminate (b)holoblastic,unequal and indeterminate

(c)holoblastic equal and determinate (d)holoblastic ,unequal and determinate

Ans-c

5. Each seminiferous tubule is line on its inside

(a) spermatogonia (b) Primary spermatocytes

(c) Sertoli cells (d) Both (a) and (b)

Ans-d

6. What causes the onset of puberty in males?

(a)Increase in secretion of testosterone by testis (b) Decrease in secretion of testosterone by the testis

(c) Increase in secretion of GnRH by the hypothalamus (d) Decrease in secretion of GnRH by the hypothalamus

Ans-c

7. The spermatids are transformed into spermatozoa by the process:

(a)Spermiation (b)Spermatocytogenesis

(c) Spermiogenesis (d)Spermatolysis

Ans-c

8. Penetration of the sperm in the ovum is followed by:

(a) formation of first polar body (b)completion of meiosis II

(c) First meiosis (d) formation of second polar body

Ans-d

9. An accessory genitalia of man is:

(a)prostate gland (b)seminal gland

(c) Cowper's gland (d) All of these

Ans-d

10.The uterus is single and it is also called

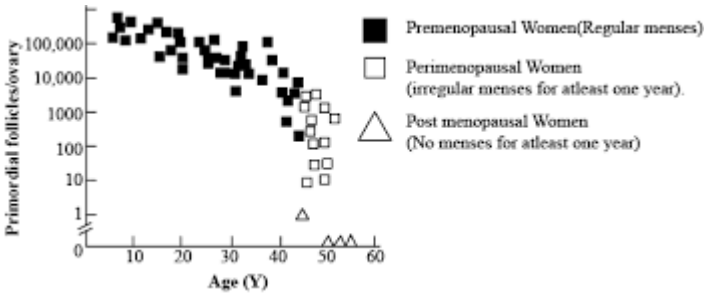
(a)fimbria (b)isthmus (c)ampulla (d)womb

Ans-d

2 MARKS QUESTION

1. The graph given below shows the number of follicles per ovary in women at different ages. Study the graph and answer the questions that follow

BIOLOGY



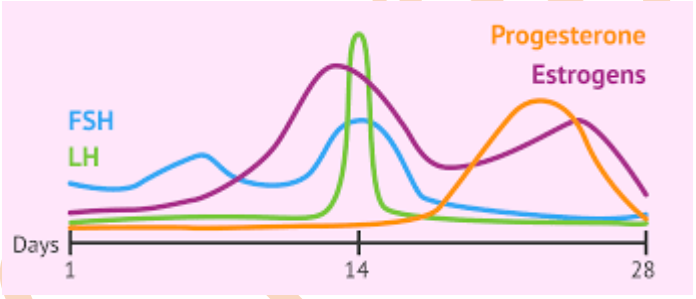
(a)What is the average age of the women at the onset of menopause?

(b)At what the maximum primordial follicles present in the ovary, according to the given graph?

Ans-(a)45-55 years age

(b) The pool of primordial follicles present in the female ovary reaches its maximum number around 20 weeks of gestational age and then decreases in a logarithmic fashion throughout life until complete depletion occurs around the age of the menopause.

2. In the figure given below, it show the level of hormones which influence the menstrual cycle.



Study the figure and answer the questions that follow:

(a) Name the organs which secrete the hormones represented in parts A and B.

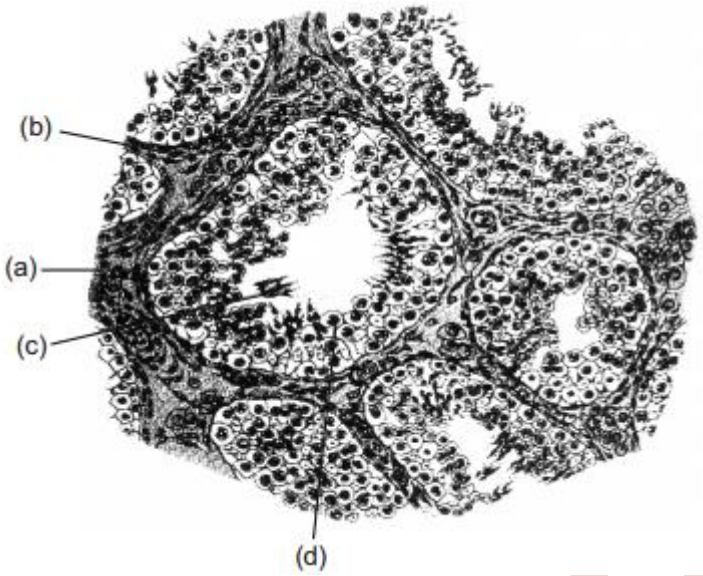
(b) State the impact of the hormones on the uterus of the human female during 6 to 15 days of menstrual cycle?

Ans(a)-A-Estrogen-Placenta B-Progesterone-Corpus luteum

(b) The rise in the level of estrogen stimulates the thickening of the endometrium in the uterus. LH is secreted by the pituitary gland which causes ovulation. The rise in LH level is followed by the rise in the progesterone which is responsible for developing the follicles into corpus luteum.

3. Study the sectional view of human testis showing seminiferous tubules given below.Answer the questions that follow:

BIOLOGY



(i)Identify a,b,c,and d.

(ii)Write the functions of a and d

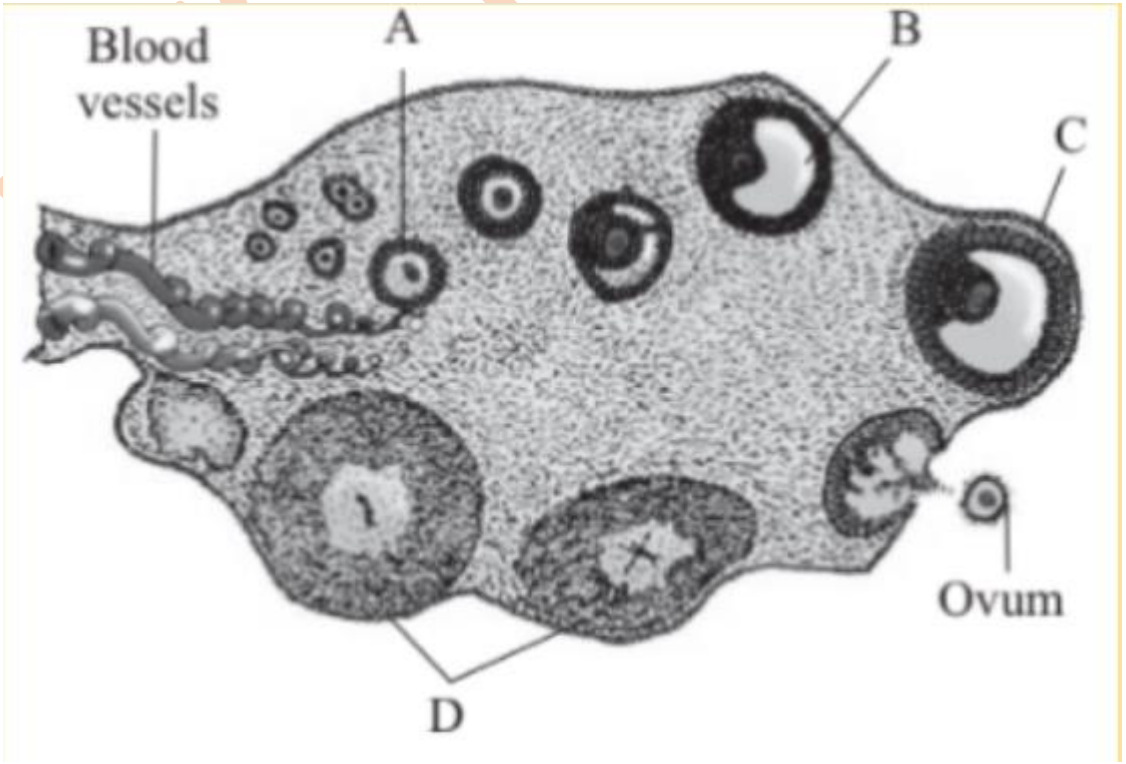
Ans-(i)a-Spermatogonia b-Interstitial cells c-Spermatozoa d-Sertoli cells

(ii)Functions:

a-Spermatogonia-or germ cells-it undergo meiotic divisions leading to sperm formation.

d-Sertoli cells-provide nutrition to germ cells.

4.Identify the diagram and do labelling.



Ans-A-Primary follicles B-Tertiary follicles C-Graafian follicles D-Corpus luteum

5. Name the hormones influencing

(i) Ovulation (ii) development of corpus luteum

Ans-(i) Ovulation Gonatropins like LH and FSH and estrogen

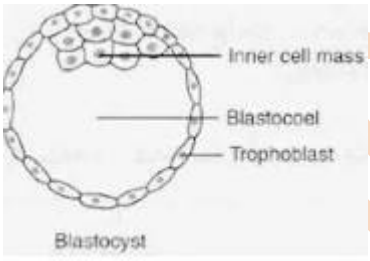
(ii)Development of corpus luteum-LH and progesterone

6. Justify how placenta acts as endocrine tissue?

Ans-Placenta produces several hormones like HCG,HPL oestrogens and progesterone that are essential to maintain pregnancy.This way placenta acts as endocrine tissue.

7. Draw a labelled diagram of human blastocyst. How does it get implanted in the uterus?

Ans-diagram of human blastocyst



The trophoblast layer of the blastocyst gets attached to the cells of the endometrium and the inner cell mass gives rise the embryo.

8. Why are male testis located outside the abdominal cavity? Or Failure of testis to descend from abdominal cavity leads to sterility. Why?

Ans- The testicles make sperm. To do this, the temperature of the testicles needs to be cooler than the inside of the body. This is why the scrotum is located outside of the body. If the testes do not descend into the scrotum, the sperms produced would get killed by the high abdominal temperature, causing sterility in the male.

9. How many sperms will be produced from 10 primary spermatocytes and how many eggs will be produced from 10 primary oocytes?

Ans-40 sperms and 10 ovum

10. Name the substances present in the sperm acrosome and which help in sperms entry into egg?

Ans- Hyaluronidase is the enzymes that helps in dissolving membrane of ovum.

3 MARKS QUESTION

1. Explain the functions of the following structures in the human male reproductive system.

(a) Scrotum

(b) Leydig cells

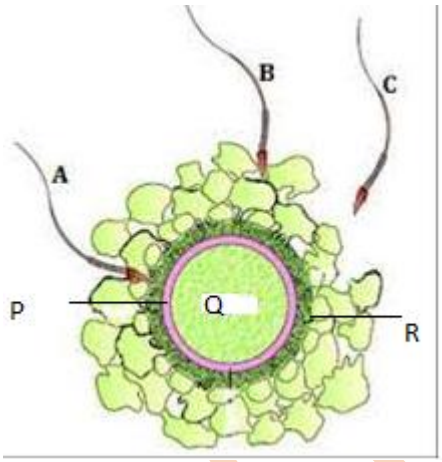
(c) Male accessory glands

BIOLOGY

2. The figure given below shows 3 sperms A, B and C.(3)

a) Which one of the three sperms will gain entry into the ovum?

b) Describe the associated changes induced by it on P and Q.



Ans-a) Sperm A [0.5]

b) In the figure given, Sperm 'A 'has come in contact with the zona pellucida layer (P) of the ovum (Q), it will induce changes in the membrane that will block the entry of additional sperms (B and C). Thus, it ensures that only one sperm can fertilise the ovum. [0.5]

The secretions of the acrosome of sperm A will help it to enter into the cytoplasm of the ovum (Q) through the zona pellucid (P) and the plasma membrane, this will induce the completion of the meiotic division of the secondary oocyte (Q). [1]

The second meiotic division in Q being unequal will result in the formation of a second polar body and a haploid ovum. Then, the haploid nucleus of the sperm 'A' and that of the ovum (Q) will fuse together to form a diploid zygote.

3. Explain the phases in embryonic development from the morula stage till the establishment of pregnancy in a human female.(3)

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

The morula continues to divide and transforms into blastocyst as it moves further into the uterus.

The blastomeres in the blastocyst are arranged into an outer layer called trophoblast and

An inner group of cells attached to trophoblast called the inner cell mass.

The trophoblast layer then gets attached to the endometrium and the inner cell mass gets

differentiated as the embryo.

After attachment, the uterine cells divide rapidly and covers the blastocyst.

As a result, the blastocyst becomes embedded in the endometrium of the uterus. This is

called implantation and it leads to pregnancy.

4. What is hymen .Why is it considered that the presence or absence of hymen is not an indication of virginity?

Ans- Hymen is the membrane that partially covers the vaginal opening. The hymen gets torn during the first coitus. But it can also be torn by active participation in sports like horse-riding, cycling, or by a sudden fall or jolt and insertion of vaginal tampon; so, its presence or absence cannot indicate virginity

5. Medically it is advised to all young mothers that breast feeding is the best for the new-born babies. Do you agree? Give reason in support of your answer.

Ans-The milk produced during initial days of lactation is called colostrum. Breastfeeding is important for newborn babies because breast milk has valuable immunoglobulin which improves the immune power of the newborn. It has a good amount of Ig A initially along with water, fat, carbohydrates, protein, vitamins and minerals, amino acids, enzymes, and white cells. It is the most hygienic food for the baby and it also develops a bond between mother and child.

6. Describe the post embryonic development of a zygote up to its implantation in humans.

Ans-The process of embryonic development a zygote is as follows:

(i)Zygote divides rapidly by mitotic division and cleavage and as a result 2,4,8,and 16 daughter cells are produced which are termed as blastomeres.

(ii)Embryo with 8-16 blastomeres is called morula.

(iii)The morula changes into large mass of cells called blastocyst which passes further into the uterus.

(iv)Blastomeres in the blastocyst are arranged into an outer layer called trophoblast and an inner group of cells attached to trophoblast called inner cell mass.

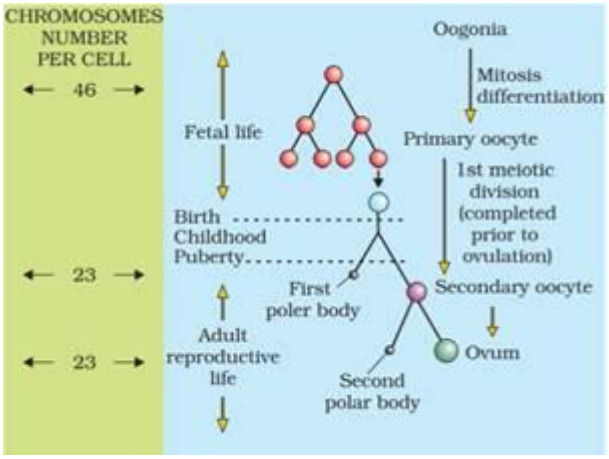
(v)The trophoblast layer and the inner cell mass gives rises to the embryo.

(vi) The cells of endometrium divide rapidly and cover blastocyst.

So the blastocyst gets embedded in the endometrium of the uterus called implantation leading to pregnancy.

7.Construct a flowchart exhibiting sequential events of oogenesis.

Ans-The process of formation of mature female gamete is called oogenesis.The flowchart showing sequential events of oogenesis is as given:

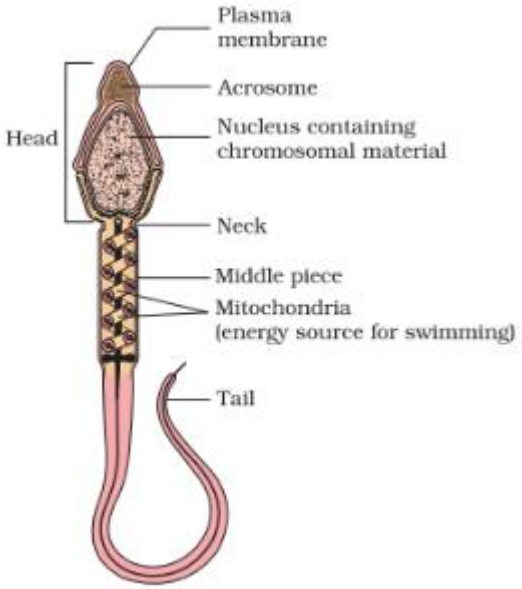


8. Mention the targets cells of luteinizing hormone in human males and females. Explain the effect and the changes which the hormone induces in each case.

Ans- The target cells of luteinising hormone in males are the Leydig cells and in females are the mature growing follicles. LH in males stimulates the Leydig cells interstitial cells of testes to synthesise and secrete androgens which in turn stimulate the process of spermatogenesis. LH in females stimulate the ovulation release of ovum transformation of Graafian follicle into corpus luteum to secrete progesterone which prepares the endometrium to receive and implant blastocyst.

9. Draw a labelled diagram of a mature human sperm. Label any three parts and write their functions.

Ans-



Plasma membrane-It is an envelope of the sperm

Acrosome-It is filled with enzyme that helps in fertilization of ovum.

Nucleus-It contains chromosomal material.

10. When and where do choronic villi appear in human? State their function.

Ans- After implantation, finger-like projections appear on the trophoblast called chorionic villi which are surrounded by the uterine tissue and maternal blood. It becomes inter digitated with uterine tissue to form the placenta and increases the surface area for exchange of materials between the mother and the embryo.

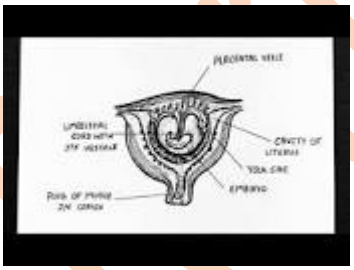
5 MARKS QUESTION

1(i).Explain the formation of placenta after the implantation in a female. (3)

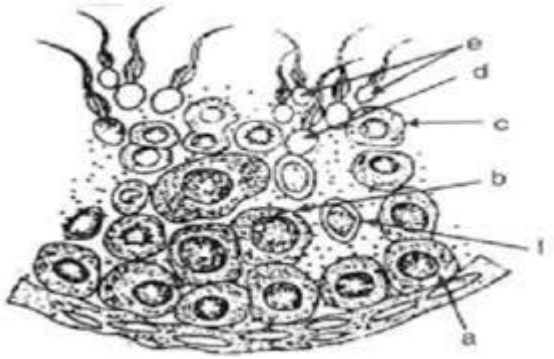
(ii)Draw the diagram showing human foetus within the uterus and label any four parts in it.(2)

Ans(i) The placenta is formed gradually during the first three months of pregnancy, while, after the fourth month, it grows parallel to the development of the uterus. Once completed, it resembles a spongy disc 20 cm in diameter and 3 cm thick. The placenta is an organ found in the mammals only during the development of the foetus. After around 12 weeks of pregnancy, the chorionic villi and uterine tissue become interdigitated with each other and together form a structural and functional unit between developing embryo (foetus) and maternal body called placenta. A tough cord called umbilical cord is also formed during this time which connects the embryo to the uterus through the placenta. Placenta provides nutrients to the embryo.

(ii)



2.Study the given figure:



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

(ii)Name ‘a’ and ‘b’ cells .What is the difference between them with reference to the number of chromosomes?

(iii)Pick out and name the motile cells.

(iv)What is ‘f ‘cells .Mention its function.

(v)Name the structure of which the given diagram is a part.

Ans-(i) d-spermatids

(ii)a-spermatogonium b-primary spermatocyte

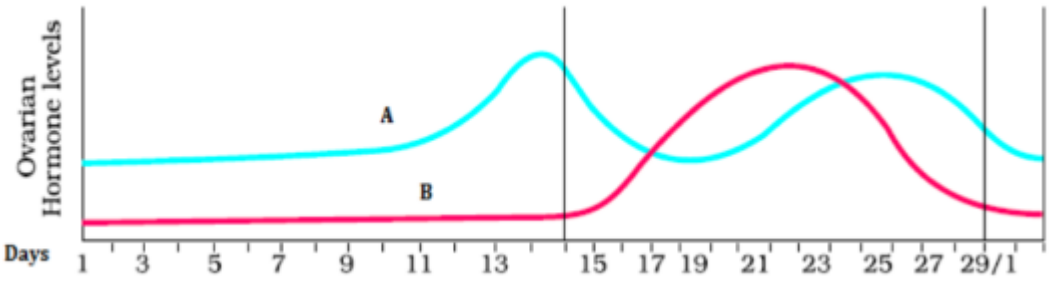
They both are diploid and have 46 chromosomes each

(iii)e-spermatozoa

(iv) f-sertoli cells it provides nutrition to germ cells

(v)Seminiferous tubule

3.



Read the graph given above and correlate the uterine events that take place according to the hormonal levels:

(i)Specify the name of hormones mentioned in the graph.

(ii) (a) 6-15 days

(b) 16-25 days

(c) 26-28 days (if the ovum is not fertilized

Ans-(i)A-Estrogen B-Progesterone

(ii) (a) Oestrogen first icrease and then decrease but progesterone almost remains constant. There is regeneration of endometrium.

(b)In 16-25 days, progesterone increases but estrogen remains constant. Uterus gets highly vascularized and gets ready for embryo implantation.

(c) In 26-28 days-progesterone decrease and oestrogen increases. There is disintegration of the endometrium leading to menstruation.

4. Describe the structure of mammary glands of a human female.

Ans- Mammary glands are paired structures which contain glandular tissue and variable amount of fat.

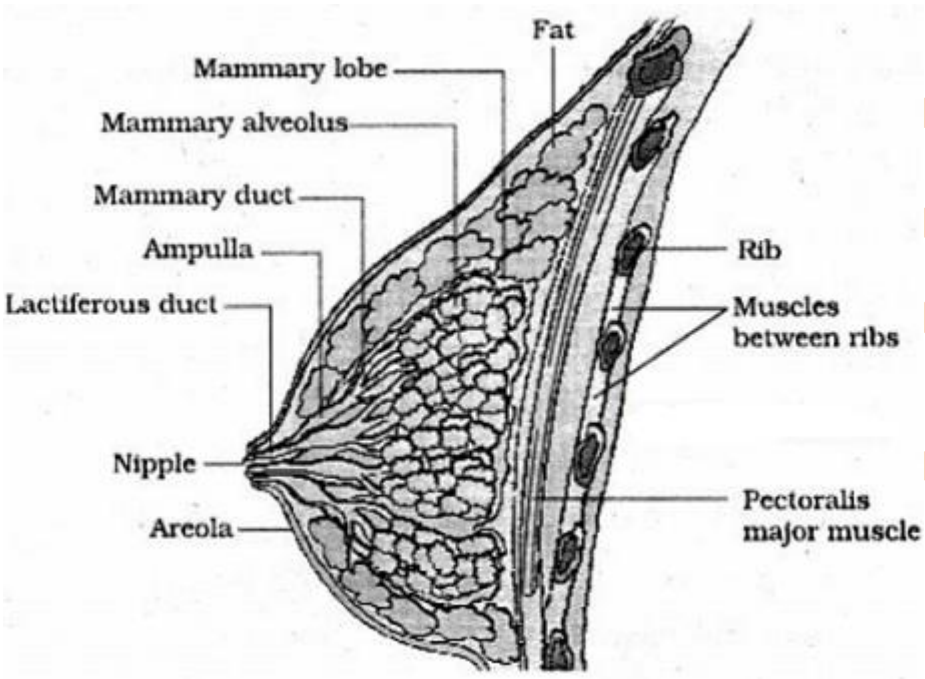
∗ In each breast, glandular tissue is divided into 15 - 20 mammary lobes. These lobes have clusters of cells called alveoli.

∗ The cells of alveoli secrete milk which is stored in the cavities (lumens) of alveoli. The alveoli open in mammary tubules.

∗ Tubules from each lobe join to form a mammary duct.

∗ Many mammary ducts join to form a wider mammary ampulla.

∗ A mammary ampulla is connected to the lactiferous duct. Milk is sucked out through the lactiferous duct.



5.(i)Explain menstrual cycle in human females.

(ii)How can the scientific understanding of the menstrual cycle of human females help as a contraceptive measure?

Ans-(i) See page no. 49 -51 of NCERT book

(ii) The scientific understanding of the menstrual cycle of human females helps as a contraceptive measure in the following ways:

1) Prevents pregnancy by monitoring the fertile periods during the menstrual cycle

2) Allows women to avoid sexual intercourse or use alternative contraceptive methods during the fertile stages of their menstrual cycle

ASSERTION AND REASONING

1. Assertion: The female external genitalia include the mons pubis, labia majora, and labia minora.

Reason: The glandular tissue of each breast is divided into 5-10 mammary lobes.

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

b- Both assertion and reason are true and the reason is not a correct explanation of the reason.

c- Assertion is true but the reason is false

d- Both assertion and reason are false

Ans-B

2. Assertion: in the testes, sperm production occurs in the seminiferous tubules and androgen secretion takes place in the interstitial cells.

Reason: testosterone is a type of androgen that brings about secondary sexual characteristics.

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

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

c- Assertion is true but the reason is false

d- Both assertion and reason are false

Ans: B

3. - Assertion: The testes are situated outside the abdominal cavity within the scrotum.

Reason: Muscles in the scrotum helps to maintain low the temperature of the testes, necessary for spermatogenesis.

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

b- Both assertion and reason are true and the reason is not a correct explanation of the assertion.

c- Assertion is true but the reason is false

d- Both assertion and reason are false

Ans: B

4. Assertion: Seminiferous tubule is lined by male germ cells and sertoli cells.

Reason: Seminiferous tubule is structural and functional unit of testes.

Ans-B

5. Assertion: Testes are situated outside the abdominal cavity of human male.

Reason: Ovaries are situated inside the abdominal cavity of the female.

Ans B

6. Assertion-Large number of mitochondria is present in middle piece of sperm.

Reason-Numerous mitochondria in the middle piece of sperm produce energy which is required for their movement.

Ans-A

7. Assertion-Oxytocin helps in parturition.

Reason-Oxytocin acts on uterine muscle and causes expulsion of the foetus.

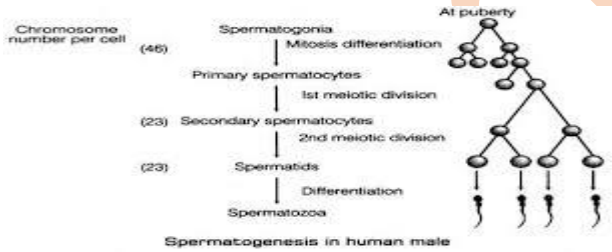
Ans-A

8. Assertion-The gamete formed in males determine the sex of the offspring.

Reason-Sex determination in human being depend upon the cumulative effect of some gene Of X and Y chromosome.
Ans-c
9. Assertion-The secretory phase in the human menstrual cycle is also called the luteal phase.
Reason-During the luteal phase the development of corpus luteum and secretion of progesterone occurs.
Ans-A
10. Assertion-Sperm formation continues in old man.
Reason-Ovum formation ceases in women around the age of 50 years.
Ans-B

Case Based Question

1. Spermatogenesis is the production of sperms from male germ cells (spermatogonia) inside the testes (seminiferous tubule). This process begin at puberty. Observe the following flow diagram and answer the questions that follows-



Spermatogenesis in human male

(i) This happens during spermatogenesis

(a) Meiosis (b) Mitosis

(c) Meiosis and mitosis (d) None of these

Ans-c

(ii) The process of spermatogenesis is induced by

(a) TSH (b) FSH

(c) MSH (d) ACTH

Ans-b

(iii) The number of spermatozoa, a single primary spermatocyte finally produced in spermatogenesis is

(a) 2 (b) 4

(c) 6 (d) 8

Ans-b

(iv) In spermatogenesis, the phases of maturation involve

(a) formation of spermatids from primary spermatocyte through meiosis

(b) growth of spermatogonia into primary spermatocytes

(c) formation of spermatogonia from gonocytes through mitosis

(d) formation of oogonia from spermatocyte through meiosis

Ans-a

(v) The correct sequence of cell stage in spermatogenesis is
(a) spermatocyte → spermatids → spermatogonia → spermatozoa
(b) spermatogonia → spermatids → spermatocyte → spermatozoa
(c) spermatocytes → spermatogonia → spermatid → spermatozoa
(d) spermatogonia → spermatocytes→ spermatids → spermatozoa

Ans-d

CHAPTER – 3 CHAPTER: 4 REPRODUCTIVE HEALTH

- The term reproductive health simply refers to healthy reproductive organs with normal functions.
- According to the World Health Organisation (WHO), reproductive health means a total well-being in all aspects of reproduction, i.e., physical, emotional, behavioural and social.
- The programmes called 'family planning' were initiated in 1951
- The purpose of introduction of sex education in schools is to provide right information to the young and to discourage children from believing in myths and having misconceptions about sex-related aspects.
- **Amniocentesis**: A fetal sex determination test based on the chromosomal pattern in the amniotic fluid surrounding the developing embryo.

POPULATION EXPLOSION AND BIRTH CONTROL

- Increased health facilities, better living conditions are the cause of population explosion.
- A rapid decline in death rate, maternal mortality rate (MMR) and infant mortality rate (IMR) as well as an increase in number of people in reproducible age are probable reasons for this.
- The most important step to overcome this problem is to motivate smaller families by using various contraceptive methods.
- An ideal contraceptive should be user-friendly, easily available, effective and reversible with no or least side-effects.

BIRTH CONTROL METHODS:

- A wide range of contraceptive methods are presently available which could be broadly grouped into the following categories

BIOLOGY

1. NATURAL METHODS:

(i) Periodic abstinence

(ii) Withdrawal or coitus interruptus

(iii) Locational amenorrhea

2. BARRIER METHODS:

In barrier methods, ovum and sperms are prevented from physically meeting with the help of barriers such Condoms diaphragms, cervical caps and vaults.

3. INTRA UTERINE DEVICES (IUDs).

These devices are inserted by doctors or expert nurses in the uterus through vagina. IUDs increase phagocytosis of sperms within the uterus and the Cu ions released suppress sperm motility and the fertilizing capacity of sperms.

4. CHEMICAL METHODS:

Oral administration of small doses of either progestogens or progestogen–estrogen combinations is another contraceptive method used by the females. They are used in the form of tablets and hence are popularly called the pills.

5. SURGICAL METHODS:

Surgical methods, also called sterilisation, are generally advised for the male/female partner as a terminal method to prevent any more pregnancies. Surgical intervention blocks gamete transport and thereby prevent conception.

(a) Vasectomy: Sterilisation procedure in the male is called 'vasectomy'. In vasectomy, a small part of the vas deferens is removed or tied up through a small incision on the scrotum.

(b) Tubectomy: In tubectomy, a small part of the fallopian tube is removed or tied up through a small incision in the abdomen or through vagina.

MEDICAL TERMINATION OF PREGNANCY

- Intentional or voluntary termination of pregnancy before full term is called medical termination of pregnancy (MTP) or induced abortion.
- MTPs are considered relatively safe during the first trimester, i.e., upto 12 weeks of pregnancy.

SEXUALLY TRANSMITTED DISEASES:

- Infections or diseases which are transmitted through sexual intercourse are collectively called sexually transmitted infections (STI) or venereal diseases (VD) or reproductive tract infections (RTI).
- Gonorrhoea, syphilis, genital herpes, chlamydiasis, genital warts, trichomoniasis, hepatitis-B and HIV leading to AIDS are some of the common STIs.

- One could be free of these infections by following the simple principles given below:

(i) Avoid sex with unknown partners/multiple partners.

(ii) Always try to use condoms during coitus.

(iii) In case of doubt, one should go to a qualified doctor for early detection and get complete treatment if diagnosed with infection.

INFERTILITY:

- The couple unable to produce children in spite of unprotected sex.
- The reason of infertility may be:-

Physical, Congenital Diseases, Drugs, Immunological or **psychological.**

- Problems of infertility may be in male or female.
- Infertility clinic can diagnose and correct the cause of infertility.
- In case there no corrections are possible, some special technologies used to have children called **assisted reproductive technologies. (ART)**

Assisted reproductive technologies:

(a) In vitro fertilization:

- Fertilization outside the body in the laboratory.
- Condition created in laboratory similar to the body.

(b) Embryo transfer:

- Popularly known as **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- Intra Uterine transfer** (embryo with more than 8 blastomeres).
- Further development taken place within the female body.
- Embryo formed by **in-vivo fertilization** can also be transfer to assist those female 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 female can provide suitable environment for fertilization and development.

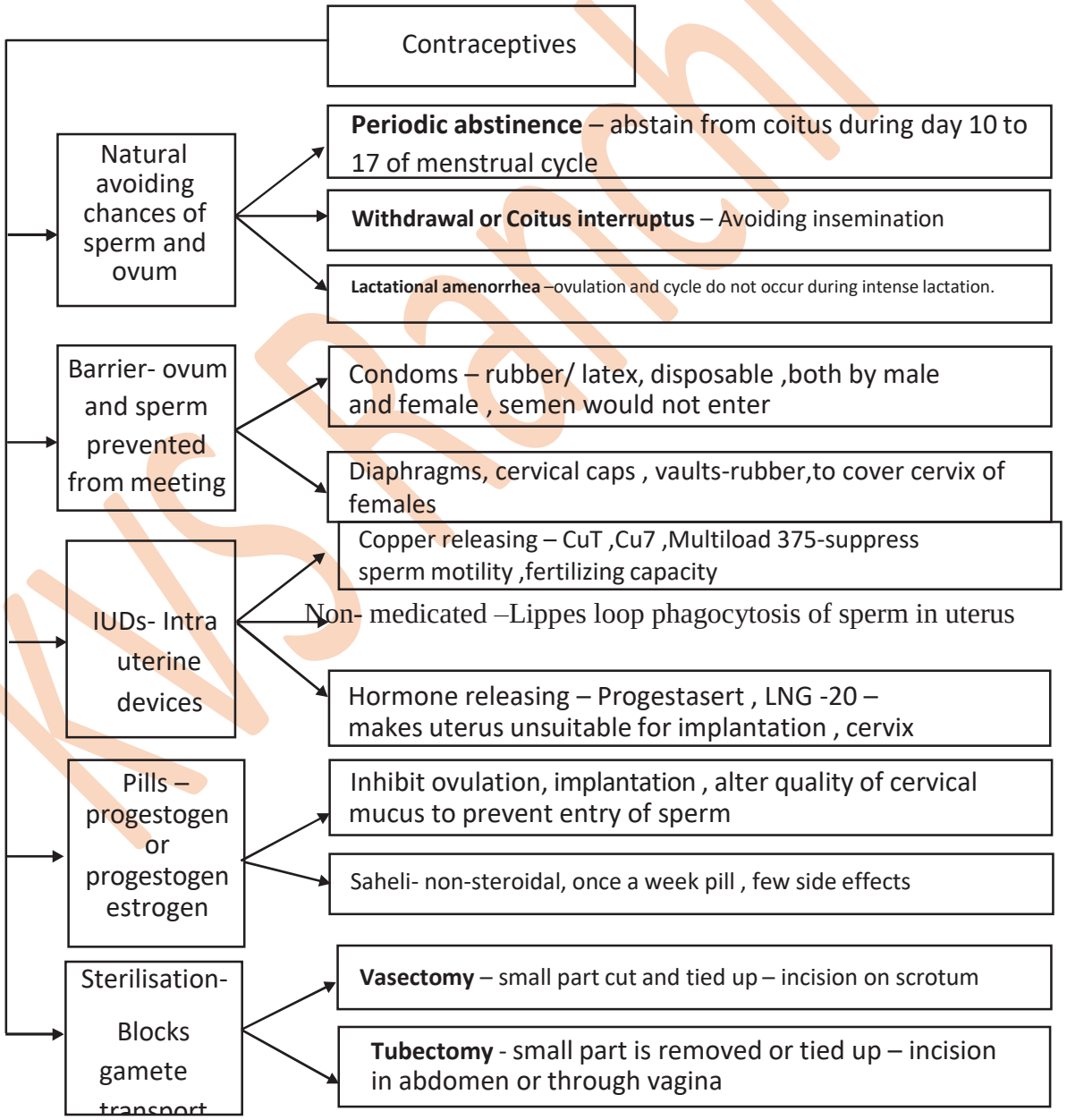
(d) Intra cytoplasmic sperm injection (ICSI):

- 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 is artificially introduced into vagina or into the uterus (**IUI-intra uterine insemination**) of the female.
- Such technology is useful in cases either the male partner unable to inseminate the female or very low sperm counts in the ejaculation.

MIND MAP



(2) MTP- Medical termination of pregnancy → Safe during first trimester

(3) STD/VD/RTI - Sexually transmitted diseases → Gonorrhoea, syphilis, genital herpes, chlamydiasis,genital warts, trichomoniasis, hepatitis –B,AID

Symptoms –itching , fluid discharge, slight pain ,swelling in the genital region

(4) **ART** - Assisted Reproductive Technologies

- **ZIFT** - Zygote or embryos upo 8 blastomers transferred into fallopian tube
- **IUT** - embryos with more that 8 blastomeres into uterus
- **IVF** - fertilisation outside the body followed by embryo transfer - test tube baby programme / In vivo fertilization
- **GIFT** - transfer of ovum into fallopian tube who cannot produce but can provide environment for fertilisation
- **ICSI** - intra cytoplasmic sperm injection - sperm is directly injected
- **AI** - Artificial insemination - inability to inseminate / low sperm count

BIOLOGY

CHAPTER: 4 REPRODUCTIVE HEALTH (QUESTION BANK)

MCQ

1. An infertile couple was advised to undergo in vitro fertilization by the doctor. Out of the options given below select the correct stage for zygote transfer to the fallopian tube for successful results?

(a) Zygote only (b) Zygote or early embryo upto 8 blastomeres.

(c) Embryos with more than 8 blastomeres (d) Blastocyst stage

2. Given below are four contraceptive methods and their modes of action. Select the correct match:

Method		Mode of Action	
(a)	Condom	(i)	Ovum not able to reach fallopian tube
(b)	Vasectomy	(ii)	Prevents ovulation
(c)	Pill	(iii)	Prevents sperms reaching the cervix
(d)	Tubectomy	(iv)	Semen contains no sperms

Options:

(A) (a) – (i), (b) --- (ii) , (c) – (iii), (d) – (iv) (B) (a) – (ii), (b) --- (iii) , (c) – (iii), (d) – (i)

(C) (a) – (iii), (b) --- (iv) , (c) – (ii), (d) – (i) (D) (a) – (iv), (b) --- (i) , (c) – (iii), (d) – (ii)

3. Match the assisted reproductive technique given in column A with their description given in column B.

Column A		Column B	
(a)	GIFT	(i)	Transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce one
(b)	ZIFT	(ii)	It is used when blockage in uterine tube prevents the normal binding of sperm to egg
(c)	ICSI	(iii)	A single sperm is injected directly into each egg to carry out fertilization.
(d)	IUI	(iv)	It involves placing sperm inside a women's uterus to facilitate fertilization

Options:

(A) (a) – (i), (b) --- (ii) , (c) – (iii), (d) – (iv) (B) (a) – (ii), (b) --- (iii) , (c) – (i), (d) – (iv)

(C) (a) – (iii), (b) --- (ii) , (c) – (iv), (d) – (i) (D) (a) – (iv), (b) --- (i) , (c) – (ii), (d) – (iii)

4. Which of the following is hormone releasing?

(a) Multiload 375 (b) LNG-20

(c) Lippes loop (d) Cu 7

5. Which among the following is commonly called withdrawal method?

(a) Lactational amenorrhoea (b) Coitus interruptus

(c) Periodic abstinence (d) Rhythm method

6. 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.

7. The method of directly injecting a sperm into ovum in assisted reproductive, technology is called

(a) GIFT (b) ZIFT

(c) ICSI (d) ET

8. ZIFT is transfer of

(a) zygote into fallopian tube. (b) a mixture of sperms and ova into the fallopian tube.

(c) a mixture of sperms and ova into the uterus. (d) embryo into the uterus.

9. Which of the following cannot be detected in a developing foetus by amniocentesis?

(a) Jaundice (b) Down's syndrome

(c) Cystic fibrosis (d) Colorblindness

10. RCH stands for

(a) routine check-up of health (b) reproduction cum hygiene

(c) reversible contraceptive hazards (d) reproductive and child health care.

ASSERTION AND REASONING TYPE OF QUESTIONS

These questions consist of two statements each, printed as Assertion and Reason. While answering these questions of the following four responses.

A . If both Assertion and Reason are true and the Reason is correct explanation of the Assertion. B. If both Assertion and Reason are true but the Reason is not a correct explanation of the Assertion.

C. If Assertion is true but the Reason is false.

D. If both Assertion and Reason are false

11. Assertion: Use of condom is a safeguard against AIDS and sexual diseases besides checking pregnancy.

Reason: Certain contraceptives are planted under the skin of the upper arm to prevent pregnancy 12.

Assertion: Amniocentesis is often misused.

Reason: Amniocentesis is meant for determining the genetic disorders in the foetus, but is being misused to determine female foetus may be aborted.

13. Assertion: Mother should not be blamed for the birth of girls in the family.

Reason: Father is responsible for the sex of the child.

Two Marks Questions

14. List one drawback of surgical methods of birth control.

15. What are the measures one has to take to prevent from contracting STDs?

16. Mrs. X was blamed for being childless though the problem was due to low sperm counts in the ejaculates of her husband. Suggest a technique which could help the couple to have a child.

Three Marks Questions

17. Describe the three different practices under natural methods of birth control.

18. What are barrier methods of birth control? Explain.

19. Expand IUDs. Explain the various methods of IUDs.

20. What is sterilization? Explain the various methods.

21. How do oral contraceptives function? What is the advantage of Saheli?

22. What is an ideal contraceptive for women and explain its contraceptive role?

23. Explain the various methods of Assisted Reproductive Technologies.

CASE BASED QUESTIONS (5)

24. MTPs are considered relatively safe during the first trimester, i.e., up to 12 weeks of pregnancy. Second trimester abortions are much more risky. One disturbing trend observed is that a majority of the MTPs are performed illegally by unqualified quacks which are not only unsafe but could be fatal too. Another dangerous trend is the misuse of amniocentesis to determine the sex of the unborn child. Frequently, if the foetus is found to be female, it is followed by MTP- this is totally against what is legal.

(a) What is MTP?

(b) Which period of pregnancy is safer for MTP?

(c) How amniocentesis is misused?

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MARKING SCHEME

Q.N	ANSWER	MARKS
1	(b) Zygote or early embryo up to 8 blastomeres	1
2	(c) (a) – (iii), (b) --- (iv) , (c) – (ii), (d) – (i)	1
3	(A) (a) – (i), (b) --- (ii) , (c) – (iii), (d) – (iv)	1
4	(b) LNG-20	1
5	(b) Coitus interruptus	1
6	(d) all of the above	1
7	(c) ICSI	1
8	(a) Zygote into fallopian tube.	1
9	(a) Jaundice	1
10	(d) Reproductive and child health care.	1
11	B	1
12	A	1
13	A	1
14	It is irreversible	2
15	Avoiding multiple partner, use of condom	2
16	IUI	2
17	Withdrawal, Lactational amenorrhea, Periodic abstinence	3
18	Use of Condoms, Diaphragms, cervical caps and vaults	3
19	Intra Uterine Devices See page No. 60 of NCERT Book	3
20	See page No. 61 of NCERT Book	3
21	See page No. 61 of NCERT Book	3
22	An ideal contraceptive should be user-friendly, easily available, effective and reversible with no or least side-effects. See page No. 43 of NCERT Book	3
23	See page No. 64 of NCERT Book	3
24	(a)Medical termination of pregnancy, (b) MTPs are considered relatively safe during the first trimester, i.e., up to 12 weeks of pregnancy (c) It is misused for determination of sex of unborn child and female foeticide	5

BIOLOGY

Chapter-4

PRINCIPLES OF INHERITANCE AND VARIATION

Genetics is the study of principles and mechanism of heredity and variation. Gregor Mendel is known as "Father of genetics".

Inheritance – It is the process by which characters are passed on from parent to progeny. It is the basis of heredity.

Variation – It is the degree by which progeny differ from their parents. Variation may be in terms of morphology, physiology, cytology etc.

Variation arises due to following reasons: -

i. Reshuffling of gene/chromosomes
ii. Crossing over or recombination
iii. Mutation and effect of environment

Mendel's law of Inheritance

Mendel conducted hybridization experiment on garden pea (Pisum Sativum) for seven years and proposed the law of inheritance.

Reasons for selecting pea plant

i. Pea has many distinct contracting characters.
ii. Life span of pea plant is short
iii. Flowers show self – pollination
iv. It is easy to artificially cross- pollinate the pea flowers. The hybrids produced are fertile.

Mendel's Working Method

- He studied only one character at a time.
- He used all available technique to avoid cross-pollination by undesirable pollen grains.
- He applied mathematics and statistics to analyses the results obtained by him.
- Mendel selected 7 contracting characters of garden pea for his hybridization.

Characters	Contracting character (Dominant/ Recessive)
• Stem height	Tall/dwarf
• Flower colour	Violet/White
• Flower position	Axial/Terminal
• Pod shape	Inflated/constricted
• Pod colour	Green/Yellow
• Seed shape	Round/Wrinkled
• Seed colour	Yellow/Green

Mendel's Monohybrid cross: - Inheritance of one gene.

- Mendel crossed tall and dwarf pea plant and collected all the seeds obtained from this cross.
- He grew all the seeds to generate plants of first hybrid generation (F1).
- He observed that all the plants were tall. Similar observation was also found in other pair of traits.

BIOLOGY

- Mendel self-pollinated F1 plants and found that in F2 generation some plants were also dwarf.
- The proportion of dwarf plant is $1/4^{th}$ and tall plants of $3/4^{th}$.

P — Pure *Tall* x Pure *Dwarf*

(Genotypes) — TT tt

Types of gametes — T t

F_1 — Monohybrid Tt Hybrid *Tall*

Types of gametes by F_1 — T t

Selfing/ Inbreeding

F_2

Female gametes → / Male gametes ↓	T	t
T	TT *Tall*	Tt *Tall*
t	Tt *Tall*	tt *Dwarf*

F_2 — *Punnet's square* or *Checker board*

Phenotypic ratio
3 *Tall* : 1 *Dwarf*
75% : 25%

Genotypic ratio in F_2
Pure *Tall* : Hybrid *Tall* : Pure *Dwarf*
1 TT : 2 Tt : 1 tt

- Mendel called the "factors" that passes through gametes from one generation to next generation. Now a day factors are called genes.
- Genes that code for a pair of contracting traits are known as alleles.

TEST CROSS

It is the cross between an individual with dominant trait and a recessive parent in order to known whether the dominant trait is homozygous or heterozygous.

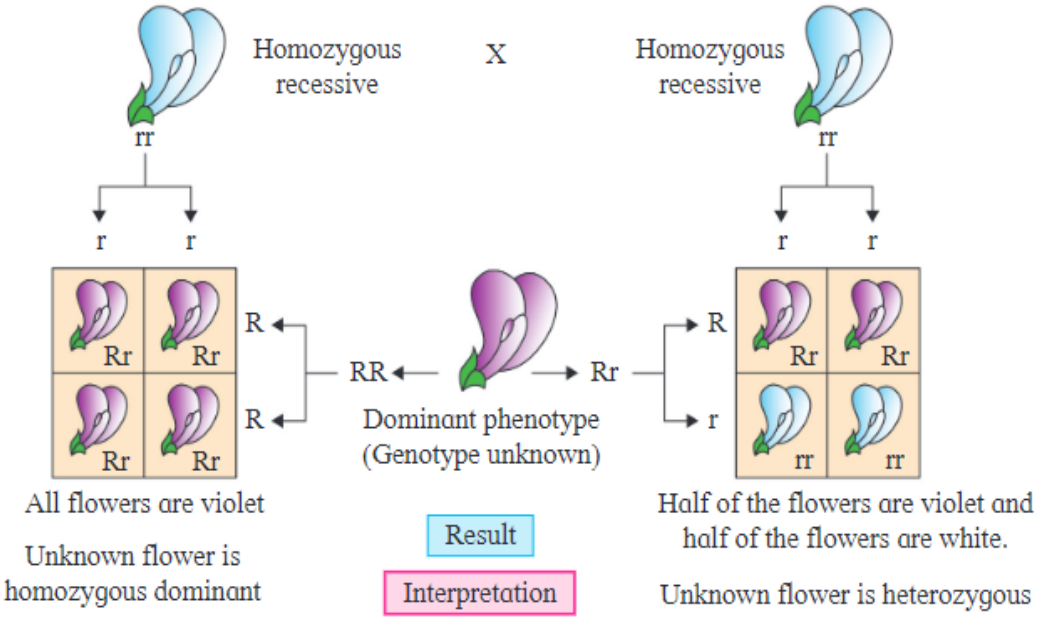


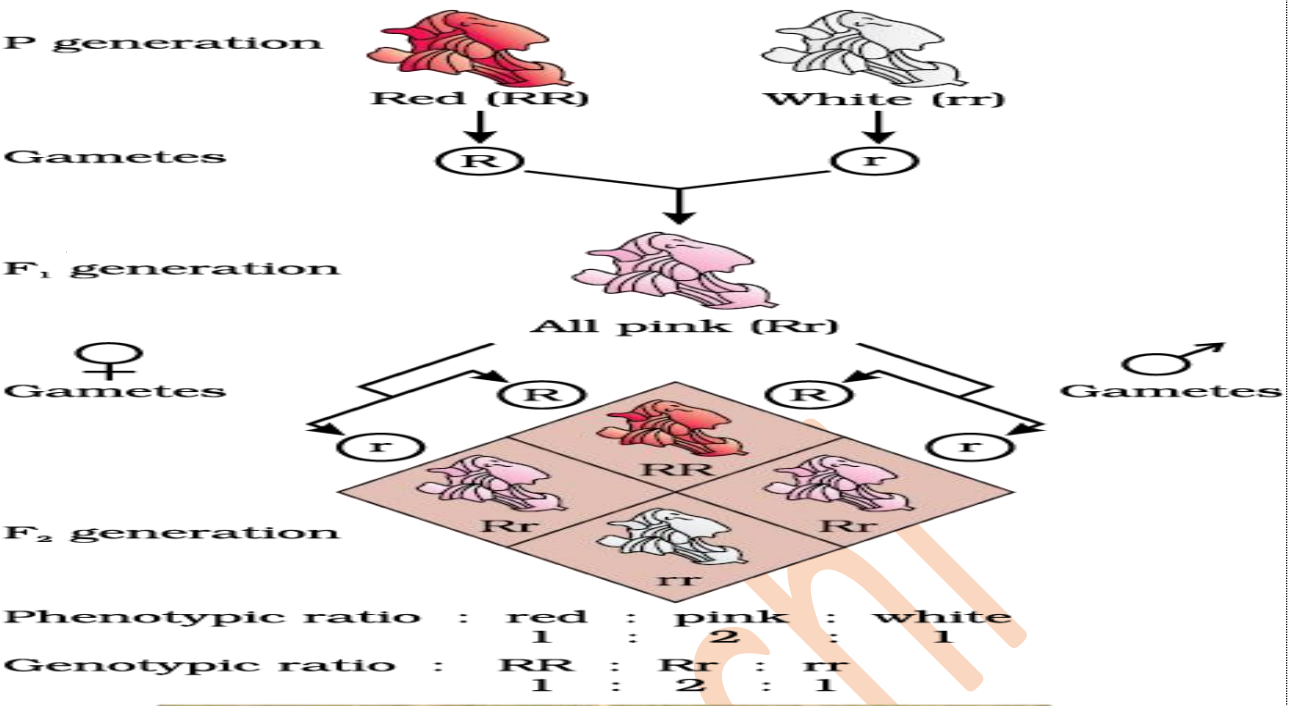
Fig.- diagrammatic representation of test cross

Principles / Laws of Inheritance (Based on monohybrid cross)

1. **Law of Dominance: -**
   - i. Characters are controlled by descrete 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).
2. **Law of Segregation: -**
   - i. Alleles do not blend and both the character are recovered during gamete formation as in F2 generation.
   - ii. Though the parents contain two alleles, during gamete formation, the factors or alleles of a pair segregate from each other such that a gamete receives only one of the two factors.
   - iii. Homozygous produce similar kinds of gametes but heterozygous produce two different kinds of gametes with different traits.

INCOMPLETE DOMINANCE

- It is a post Mendelian discovery. Incomplete dominance is the phenomenon of neither of the two alleles being dominant so that F1 is a fine mixture or intermediate between the expression of two alleles.
- Example – In snapdragon or Antirrhinum sp. (dog flower) there are two types of pure breeding plants, red flowered and white flowered.
  On crossing the two, F1 plants possesses pink flowers. On selfing them F2 generation has **1red:2pink:1white**.
- The pink flower in F1 is due to incomplete dominance.



Co-Dominance

- It is the phenomenon of two alleles lacking dominant – recessive relationship and both expressing themselves in the organism.
- Human being, ABO blood grouping is controlled by I gene. The gene has three alleles I^A, I^B and i.
- Any person contains any two of three alleles. I^A, I^B are dominant over i.
- The plasma membrane of RBC has sugar polymers that protrude from its surface and the kind of sugar is controlled by the gene.
- When I^A and I^B are present together, both express their own types of sugar because of co-dominance.

Table Showing the Genetic Basis of Blood Grouping in Human Population			
Allele from Parent 1	Allele from Parent 2	Genotype of Offspring	Blood-types of Offspring
I^A	I^A	$I^A I^A$	A
I^A	I^B	$I^A I^B$	AB
I^A	*i*	I^A i	A
I^B	I^A	$I^A I^B$	AB
I^B	I^B	$I^B I^B$	B
I^B	*i*	I^B i	B
i	*i*	*ii*	O

Multiple Alleles

- ABO blood group is a good example of multiple alleles.
- In this case there are more than two i.e three alleles, governing the same character. In an individual only two alleles can be present, multiple alleles can be found only when population studies are made.

Pleiotropy – Single gene exhibit multiple phenotypic expressions. Pleiotropic gene affects the metabolic pathways, resulting in different phenotypes.
For example: -

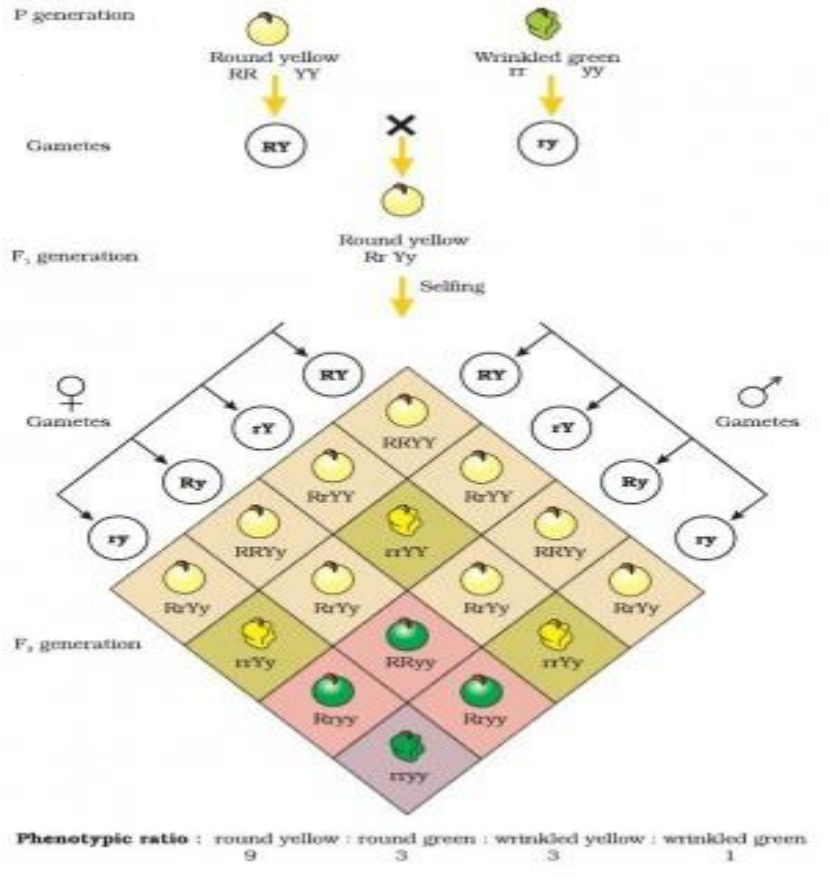
i. In Drosophila, gene for wing size influences nature of balancers, colour of eye, dossal bristles, fertility and longevity
ii. Phenylketonuria is caused by mutation in the gene, coding for the enzyme phenylalanine hydroxylase. The affected individuals show mental retardation as well as reduction in hair and skin pigmentation.

- **Polygenic inheritance-** – A trait is controlled by three or more genes.
- For example, human skin colour. Suppose 3 genes A, B and C control skin colour with A, B, C being dominated responsible for dark skin colour and a, b, c being recessive alleles responsible for light skin colour.
- The genotype with all dominant alleles (AABBCC) will have the darkest skin colour and that with all the recessive alleles (aabbcc) will have the lightest skin colour.
- The genotype with three dominant alleles and three recessive alleles will have an intermediate skin colour.
- The F2 generation will have varied skin tones, with each type of allele in the genotype determining the darkness or lightness of the skin.

Inheritance of Two gene (Dihybrid Cross)

- It is the cross between plants differing in two traits. In this, cross is done to study simultaneous inheritance of two pairs of mendelian factors or genes.

- In this Mendel crossed pea plants that differed in two characters.
- He made a cross between a pea plant that has seeds with yellow colour and round shape with seeds of green colour and wrinkled shape.
- Yellow colour was dominant over green and round shape dominated over wrinkled.



Law of independent assortment (based on Mendel's dihybrid cross)-

This law states that two pairs of traits are combined in a hybrid, segregation of one pair of characters is independent of the other pair of characters.

Chromosomal Theory of Inheritance

- It was proposed independently by Walter Sutton and Theodore Boveri in 1902.
- They stated that behaviour of chromosome was parallel to behaviour of genes and used chromosomal movement to explain Mendel's law.

According to this Theory: -

i. The heredity factors are carried in nucleus.
ii. Like the Mendelian alleles, chromosomes are also found in pairs.
iii. The sperm and egg have haploid (n) set of chromosomes fuse to re-establish the diploid state.
iv. Two alleles of a gene pair are located on homologous sites on homologous chromosomes in a linear order.
v. Homologous chromosomes synapse during meiosis and get separated to pass into different cells. This forms the basis of segregation and independent assortment.

vi. A gamete receives only one chromosome of each type and there has only one gene for a trait. This paired condition is restored by fusion of gametes.

GENE	CHROMOSOME
i. Occur in pairs. ii. Segregate at the time of gamete formation such that only one of each pair is transmitted to gamete. iii. Independent pair segregate independently of each other.	i. Occur in pairs. ii. Segregate at gemmate formation and only one of each pair is transmitted to a gamete. iii. One pair segregate independently of another pair.

LINKAGE AND RECOMBINATION

- **Linkage** – Physical association of genes on a chromosome.
- **Recombination** – Generation of non-parental gene combinations, arising from crossing-over between non-homologous chromosomes.
- T.H Morgan carried out several dihybrid crosses in Drosophila to study the genes that are sex-linked.
- He observed that when the two genes in a dihybrid cross are located on same chromosome, the proportion of parental gene combination in the progeny was much higher than the non-parental or recombination of gene.
- Morgan and his group found that when genes are grouped on the same chromosome, some genes are tightly linked and show little recombination.
- F2 generation ratio deviated from 9:3:3:1
- When the genes are loosely linked, they show high percentage of recombination.
- Morgan hybridized yellow body and white eyed females with brown bodied and red eyed males (wild type) and intercrossed their F1 progeny. The F2 phenotypic ratio deviated from Mendel's 9:3:3:1.

  The gene of eye colour and body colour are closely located on X-chromosome, showing linkage and therefore, are inherited together.

  Recombinants were formed due to crossing over but at low percentage.

Reason for selecting Drosophila melanogaster (Fruit Fly)

- They can be grown on simple synthetic medium in the laboratory.
- They complete their life cycle in two weeks.
- A single mating could produce a large number of progenies.
- Male and female flies are easily distinguishable.
- Has many types of hereditary variations that can be seen with low power microscope.

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SEX DETERMINATION MECHANISM

- **Male heterogamety**- male produce different types of gametes in terms of sex-chromosomes. It is of two types- XX-XY type and XX-XO type.
- **Female heterogamety**- female produce different types of gametes in terms of the sex-chromosomes. It is of two types- ZZ-ZW type and ZZ-ZO type.

1. **XX-XY TYPE-** seen in many insects and mammals, including humans, Drosophila melanogaster.

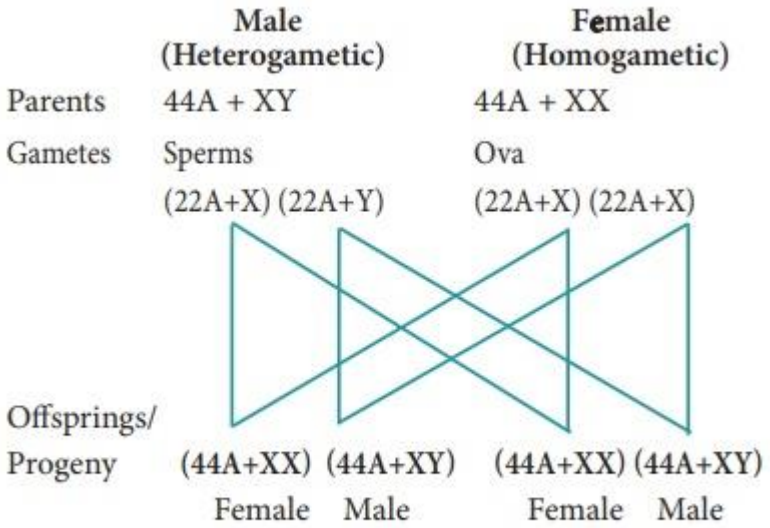
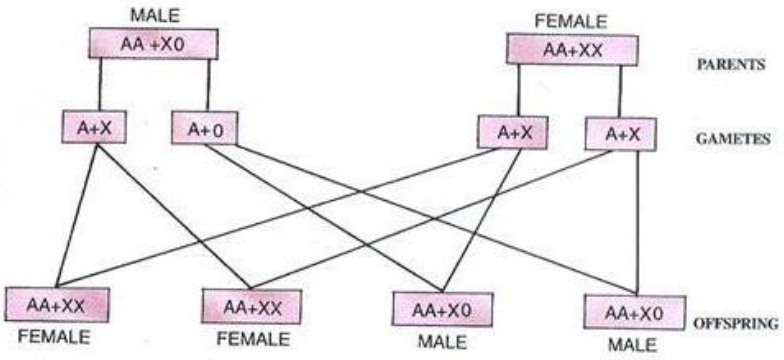
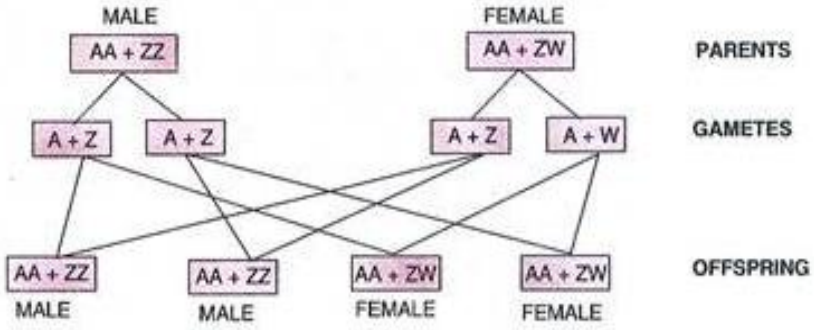


Fig. 4.6 Sex determination in human beings

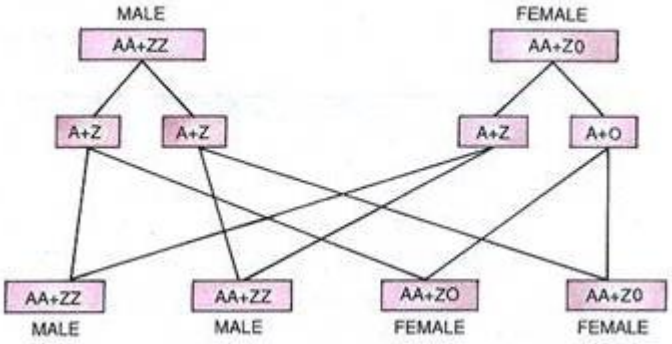
2. **XX-XO TYPE-** seen in grass hopper and cockroach.



3. **ZZ-ZW TYPE-** Seen in birds, fowl and fishes. Females have one Z and one W chromosome whereas males have a pair of Z chromosomes.

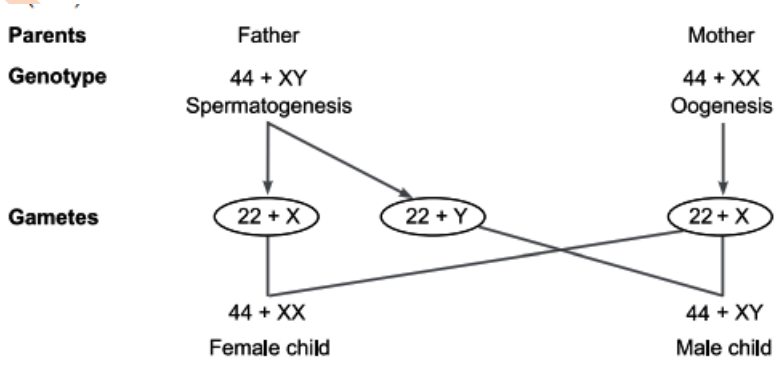


4. **<u>ZO-ZZ TYPE</u>**- Seen in butterflies and moths. Females have only one Z chromosome beside autosomes and males have a pair of Z chromosomes.



<u>Sex Determination in Human</u>

- Human show XY type of Sex-Determining mechanism
- Out of 23 pair of chromosomes, 22 are autosomes in both males and females.
- During spermatogenesis males produce gametes with combination either 22+X or 22+Y.
- During oogenesis, females produce only one type of gamete – 22+X
- An ovum fertilized by a sperm carrying X-chromosome develops into a female (XX) the sperm carrying Y- chromosome develops into a male (XY).



- **Hence, it is evident that genetic constitution of sperm determines the sex of the child.**

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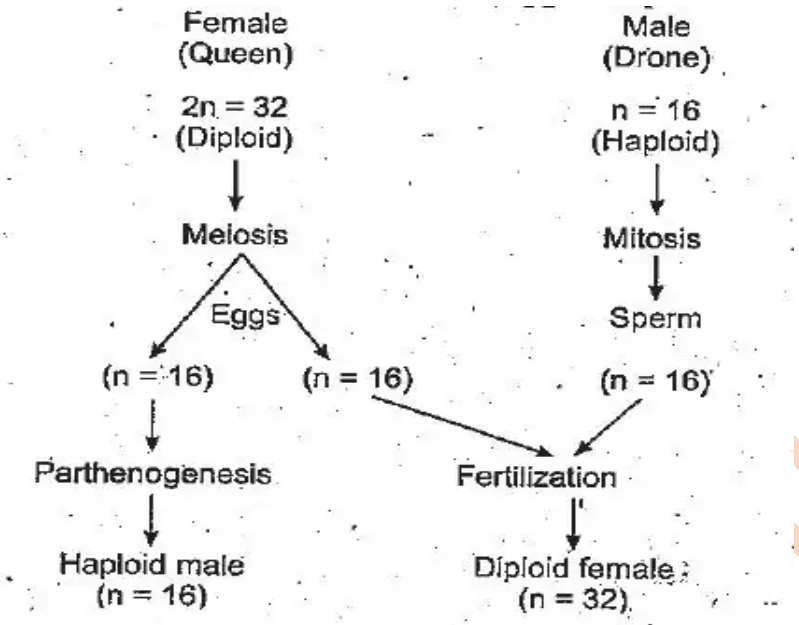
Sex determination in Honey bee- haplodiploidy sex determination system.



- Offsprigs formed from the union of a sperm and an egg develops as a female (Queen or worker) which are diploid, having 32chromoswomes.
- Unfertilised eggs developed by parthenogenesis form male (drone), which are haploid having 16 chromosomes.
- Males produce sperms by mitosis.

MENDELIAN DISORDERS-They occur due to alteration or mutation in single gene.

1. Hemophilia

- It is sex linked recessive disorder.
- In this disease patient continues to bleed even with a minor cut because of a defect in blood clotting.
- The gene for haemophilia is located on X-chromosome.
- Mostly males suffer from this disease as a single gene for the defect is able to express as males have only one chromosome. (X^CY-Diseased Male)
- X^CX- Carrier female
- X^CX^C - Diseased female (Female suffers from this disease only in homozygous condition)
- In this disease, a single protein that is a part of cascade of proteins involved in blood clotting is affected.

2. Colour Blindness

- Sex-linked recessive disorder.
- It occurs due to defect in either red or green cone of eye resulting in failure to discriminate between red and green colour.
- This defect is due to mutation in certain genes precent in X-chromosome.
- The gene for colour blindness is present on X-chromosome.
- It is observed more in male (X^CY) because of presence of only one X chromosome.

- Female is diseased only in homozygous condition (X^CX^C)
- X^CX- Carrier female.
- It occurs in about 8% males and 0.4 % females.

3. Sickle – cell anaemia

- It is an autosome- linked recessive trait.
- The disease is controlled by a single pair of alleles HBa and HBs
- Homozygous condition HbsHbs shows the diseased phenotype.
- Heterozygous individuals (HbsHba) are carriers.
- Due to point mutation, glutamic Acid (Glu) is replaced by Valine (Val) at the sixth position of β-globin chain of haemoglobin molecule.
- It occurs due to single base substitution at 6^{th} codon of β-globin gene from GAG to GUG.
- Mutated hemoglobin molecule undergoes polymerization under low oxygen tension causing the change in the shape of RBC from biconcave disc to elongated sickle-like structure.
- As a result, RBC cannot pass through narrow capillaries and blood capillaries are clogged and thus affect blood supply to different organs.

4. Phenylketonuria –

- It is an inborn error of metabolism and is inherited as autosomal recessive trait.
- The affected individual lack an enzyme called phenylalanine hydroxylase that converts the amino-acid phenylalanine into tyrosine in liver.
- Phenylalanine is accumulated and gets converted into phenyl pyruvic acid and other derivatives.
- This affects the brain, resulting in mental disorder.
- Phenylalanine is also excreted through urine due to its poor absorption by kidney.

5. Thalassemia

- It is an autosomal recessive disorder.
- It occurs due to either mutation or deletion resulting in reduced rate of synthesis of one of globin chains of haemoglobin.
- Anaemia is the characteristics of this disease.
- It is classified into two types: -
  a. α- Thalassemia – Production of α-globin chain is affected. It is controlled by closely linked genes HbA1 and HbA2 on chromosome 16. It occurs due to mutation or deletion of one or more of the four genes.

b. β- Thalassemia – Production of β-globin chain is affected. It occurs due to mutation in one or both HbB genes on chromosome 11.

Chromosomal Disorders

- It occurs due to excess, absence or abnormal arrangement of one or more chromosomes.
- **Aneuploidy** – Sometimes chromatids fail to segregate during cell division, resulting in gain or loss of a chromosome. This is called aneuploidy.

It is of two types

i. **Trisomy** – Additional copy of chromosome in an individual i.e (2n+1).

ii. **Monosomy** – Lack of copy of a chromosome in an individual i.e (2n-1).

- **Polyploidy**- Failure of cytokinesis after telephase stage of cell division resulting in an increase in whole set of chromosomes in an organism. It is called polyploidy. Mostly seen in plants.

1. **Down's Syndrome** –

- Cause: - Additional copy of chromosome number 21 or trisomy of chromosome 21.

Symptoms: -

1. Short statured with small round head.
2. Partially open mouth with protruding furrowed tongue.
3. Palm is broad with characteristic palm crease.
4. Physical, psychomotor and mental development retarded.

2. **Klinefelter's Syndrome** –

- Cause – Presence of an additional copy of X- chromosome resulting in the Karyotype 44+XXY i.e 47 chromosomes.
- Symptoms-

i. Sex of individual is masculine but possess feminine characters.
ii. Gynecomastia – i.e development of breasts.
iii. Poor beard growth and often sterile.
iv. Feminine pitched voice.
v. Tall stature.

3. **Turner's Syndrome**

Cause: - Absence of one X-Chromosomes, resulting in the Karyotype 44+XO i.e have 45 chromosomes.

Symptoms-

i. Sterile female with rudimentary ovaries.
ii. Lack of other secondary sexual characters.
iii. Poor development of breast.
iv. Underdeveloped feminine characters.
v. Short stature, small uterus, puffy fingers.

MULTIPLE CHOICE QUESTIONS

1. If a genetic disease is transferred from a phenotypically normal but carrier female to only some of the male progeny, the disease is
   a. Autosomal dominant
   b. Autosomal recessive
   c. Sex-linked dominant
   d. Sex-linked recessive

Ans. d. Sex-linked recessive

2. Person having genotype I^AI^B would show the blood group as AB. This is because of
   a. Pleiotropy
   b. Co-dominance
   c. Segregation
   d. Incomplete dominance

   Ans. b. Co-dominance

3. ZZ/WW type of sex determination is seen in
   a. Platypus
   b. Snails
   c. Cockroach
   d. Peacock

   Ans. d. Peacock

4. A cross between two tall plants resulted in offspring having few dwarf plants. What would be the genotypes of both the parents?
   a. TT and Tt
   b. Tt and Tt
   c. TT and TT
   d. Tt and tt

   Ans. b. Tt and Tt

5. Occasionally, a single gene may express more than one effect. The phenomenon is called
   a. Multiple allelism
   b. Mosaicism
   c. Pleiotropy
   d. Polygeny

   Ans. c. Pleiotropy

   ASSERTION – REASON QUESTIONS

   In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

   a. Assertion and reason both are correct statements and reason is correct explanation for assertion.
   b. Assertion and reason both are correct statements and reason is not correct explanation for assertion.
   c. Assertion is correct statement reason is wrong statement.
   d. Assertion is wrong statement reason is correct statement.

      1. Assertion: The law of independent assortment can be studied through dihybrid cross.
         Reason: Only those genes show independent assortment which are linked.

Ans. c

2. Assertion: There is expression of only one gene of the parental character in a Mendelian Monohybrid cross in F_1 generation.
   Reason: In a dissimilar pair of factors one member of the pair dominates the other.
   Ans. b
3. Assertion: ABO blood group system is a good example of pleiotropic genes.
   Reason: In ABO blood group system, when I^A and I^B alleles are present together, both express themselves.
   Ans. d
4. Assertion: Sickle-cell anemia is an autosome – linked recessive disorder.
   Reason: It appears only in human male which can be transferred to their grandson through carrier daughter.
   Ans. c
5. Assertion: All genetic disorders, Mendelian or chromosomal, are transmitted from one generation to the other.
   Reason: Genes are located on chromosomes.
   Ans. d.

CASE- BASED QUESTIONS

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

i. Turner's syndrome is an example of
   a. Aneuploidy
   b. Euploidy
   c. Polyploidy
   d. Autosomal abnormality
   Ans. a

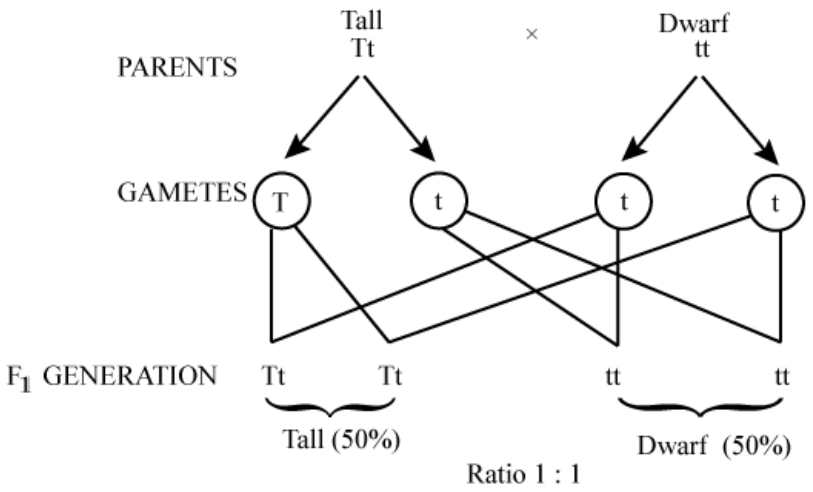
ii. In which disorder does a human male suffers as a result of an additional X- chromosome?
   a. Turner's syndrome
   b. Down's syndrome
   c. Klinefelter's syndrome
   d. Hemophilia
   Ans. c

iii. Which of the following statement regarding Turner's syndrome is not correct?
   a. It is a case of monosomy of sex chromosomes.
   b. The suffering individual is sterile female will one 'X' chromosome is missing in the cells.
   c. The problem can be cured by taking regular injection of female sex hormone after puberty.
   d. All the above
   Ans. c

BIOLOGY

SHORT ANSWER QUESTIONS: -(2 MARKS EACH)

1. During a monohybrid cross involving a tall pea plant with a dwarf pea plant, the offspring populations were tall and dwarf in equal ratio. Work out a cross and show how is it possible?



2. In Snapdragon, a cross between true-breeding red flowered (RR) plants and true breeding white flowered (rr) plants showed a progeny of plants with all pink flowers. (a) The appearance of pink flowers is not known as blending. Why?
   (b) what is this phenomenon known

   Ans: - (a) The appearance of pink flowers is not known as blending because the parental type appears in F2 generation.
   (b) This phenomenon is called as incomplete dominance.

3. Explain co-dominance with the help of one example.
   Ans- refer notes point co-dominance.

4. What is a test cross? How can it decipher the heterozygosity of a plant?
   Ans- A cross to analyse whether genotype of dominant individual is homozygous or heterozygous is called test cross.
   If the dominant-expressing organism is a homozygote, then all F_1 offspring will be heterozygotes expressing the dominant trait. Alternatively, if the dominant expressing organism is a heterozygote, the F_1 offspring will exhibit a 1:1 ratio of heterozygotes and recessive homozygotes.

5. Why are human females rarely haemophilic? Explain. How do haemophilic patients suffer?

Ans- Haemophilia is a sex- linked recessive disorder. In human females both the sex chromosomes are X chromosomes, so for haemophilia to be seen in females both the X chromosomes need to be affected. If only one X chromosome is affected then she will be a

carrier of the disease as she will be able to pass it to the future generations but will not show the symptoms of the disease.

In patients having haemophilia, the blood clotting factors are absent. Due to this, blood does not clot easily on injury.

LONG ANSWER QUESTIONS (3 MARKS EACH)

1. The F2 progeny of a monohybrid cross showed phenotypic and genotypic ratios as 1: 2: 1 unlike that of Mendel's monohybrid F 2 ratio. With the help of a suitable example, work out a cross and explain how it is possible.

Ans- this kind of cross is observed in Mirabilis Jalapa/ four o' clock plant/ dog flower.

(Refer to in-complete dominance portion of notes)

2. Explain how does trisomy of 21 chromosome occur in humans. List any four characteristics features in an individual suffering from it.

Ans- refer to point Down syndrome of notes.

LONG ANSWER QUESTIONS (5 MARKS EACH)

1. a) State the law of independent assortment.
   b) Using Punnet square demonstrate the law of independent assortment in a dihybrid cross involving two heterozygous parents.

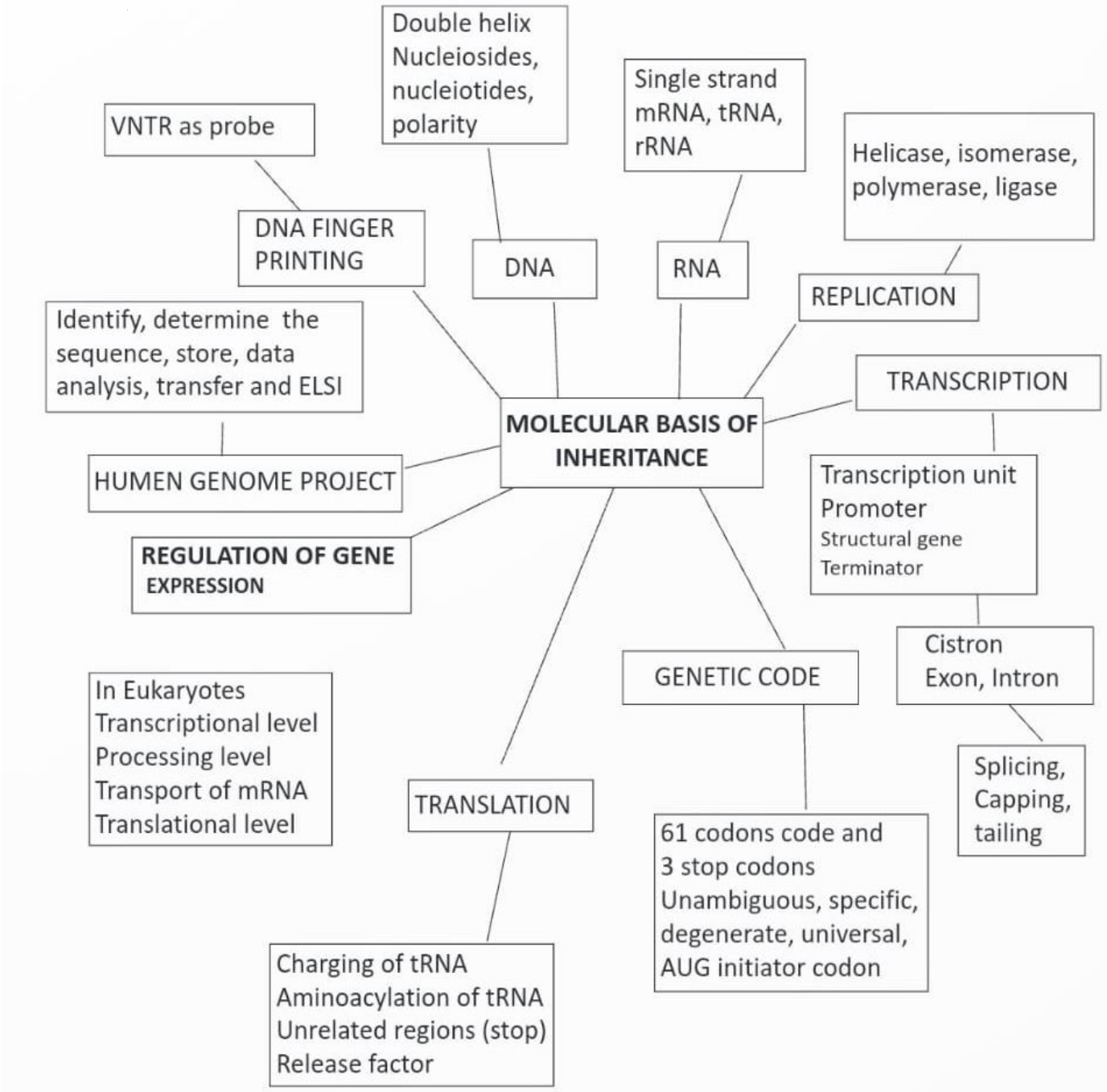
Ans- Refer to point Mendel's dihybrid cross of notes.

2. Thalassemia and haemophilia are both Mendelian disorders related to blood. Write the symptoms of the diseases. Explain with the help of the crosses the difference in the inheritance pattern of the two diseases.

Ans- Both are caused due to alteration or mutation, in a single gene and follow Mendelian pattern of inheritance. (Refer to point Mendelian disorder).

BIOLOGY

CHAPTER : 6 MOLECULAR BASIS OF INHERITANCE
(CONCEPT MAP)



BIOLOGY

POLYNUCLEOTIDE CHAIN

- ✓ DNA / RNA both are made of polynucleotide chain.
- ✓ In polynucleotides the nucleotides are joined with
- ✓ Phosphodiester bond. Nucleotides are made up of Nucleoside + Phosphoric acid
- ✓ Nucleosides consists of Nitrogenous
- ✓ bases+Pentose sugar Pentose sugar maybe

i- Deoxyribose(DNA)

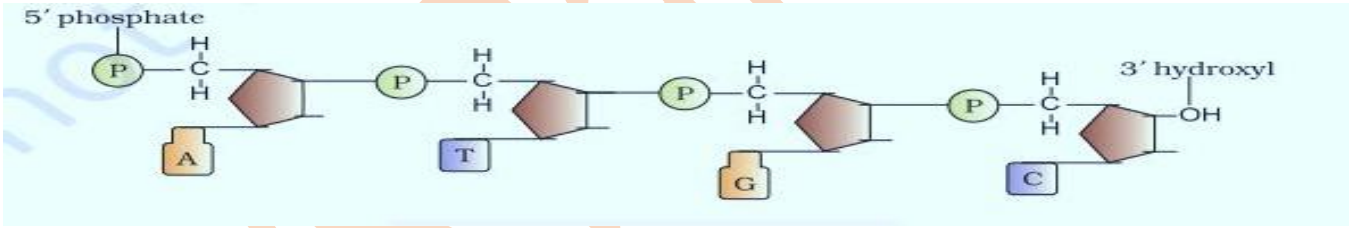
ii- Ribose (RNA)

- ✓
  - Nirogenous bases may be

Purine	Pyrimidine
Adenine and Guanine	Thymine (only in DNA), Cytosine and Uracil (only in RNA)

✓ A nitrogenous base is linked to the OH of 1'C pentose sugar through a N-glycosidic linkage to form a nucleosidee.g.-adenosine or deoxyadenosine,guanosine or deoxyguanosine,cytidine or deoxycytidine and uridineor deoxy thymidine

✓ Two nucleotides are linked through3'-5'phosphodiester linkage to form a dinucleotide.More nucleotides can be join together to form a polynucleotide chain.



THE DNA

- ✓ Friedrich Meischer in 1869 identify DNA as an acidic substance present in nucleus and as 'Nuclein' named it
- ✓ DNA is a long polymer of deoxyribonucleotides.
- ✓ The length of DNA is usually defined as number of nucleotides/ base pairs present in it.

Organism	Length of DNA
Bacteriophage ϕ ×174	5386 nucleotides
Bacteriophage lambda	48502 bp
Escherichia coli	4.6 × 106 bp
Human (haploid content)	3.3 × 109 bp

Double Helical Model of DNA

- ✓ James Watson and Francis Crick,based on the X-raydiffraction data produced

by Maurice Wilkins and Rosalind Franklin,proposed Double Helix model of DNA.The salient feature shows that model is as given below

- ✓ DNA is made of two polynucleotide chains where the backbone is constituted by sugar - phosphate.
- ✓ The two chains have anti-parallel polarity i.e.if one chain has the polarity 5'to3', the other has 3' to5'.
- ✓ The nitrogenous bases are held by hydrogen bond in between two
- ✓ polynucleotide chain. Adenineforms two hydrogen bonds with Thymine.Similarly,Guanine is bonded with Cytosine with threeH-bonds.
- ✓ The two chains are coiled in a right-
- ✓ handed fashion. The pitch of the helix is 3.4nm.
- ✓ There are roughly 10bp in each helix; consequently, the distance between a bp in a helixis approximately 0.34nm.

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- ✓

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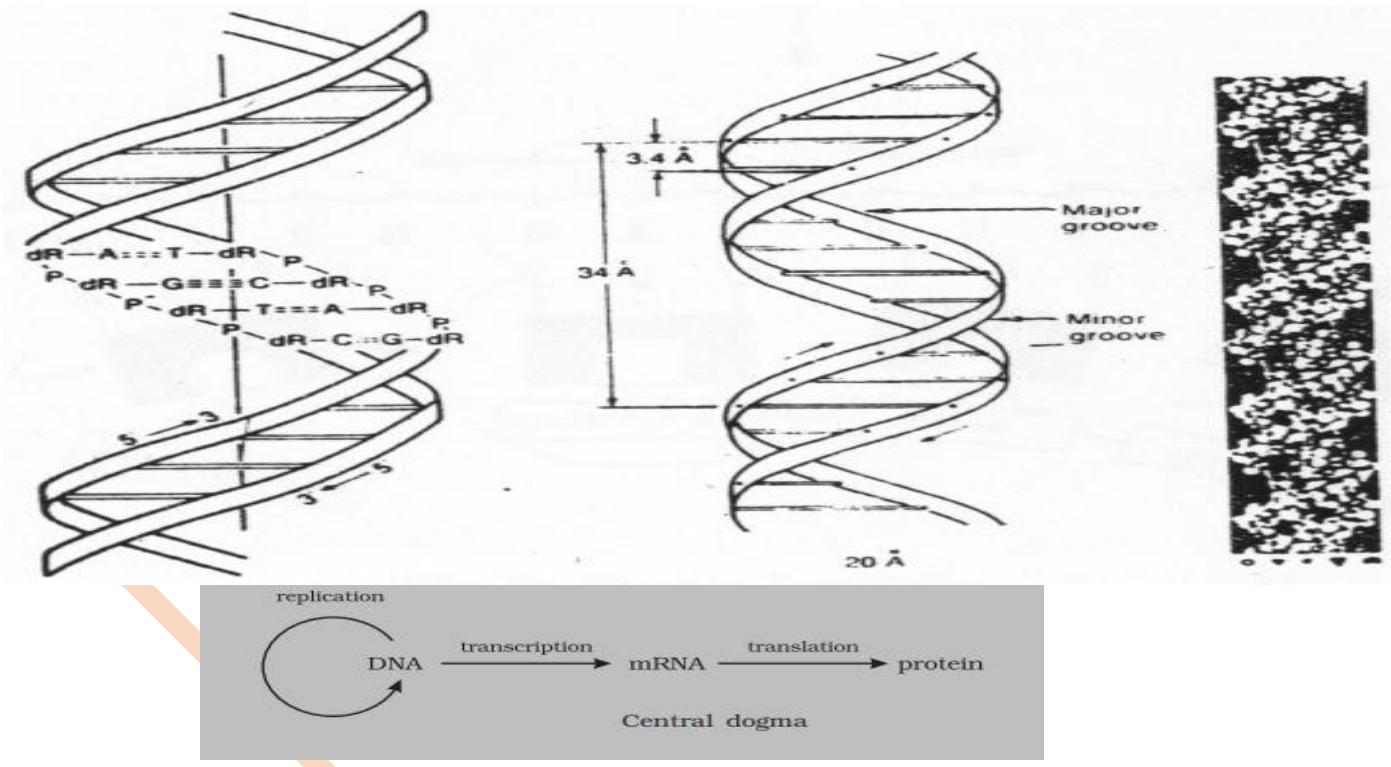
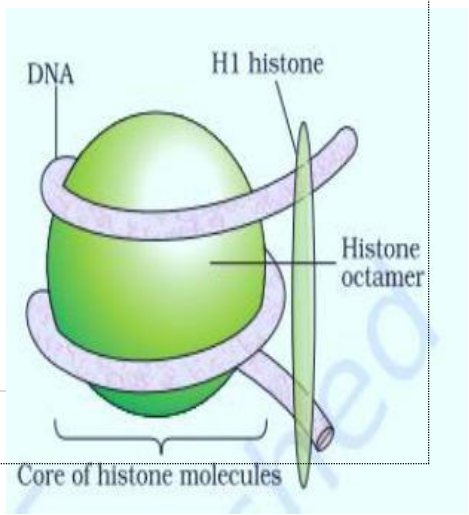
Erwin Chargaff
He found that in DNA, the ratios of adenine(A) to thymine(T)and guanine(G)to cytosine(C)are equal.
A= T and G=C
[A] + [G] = [T] + [C] or [A] + [G] / [T] + [C] =1



PACKAGING OF DNA HELIX

✓ The process of tightly packing the DNA molecule to fit into the nucleus of a cell is known as Packaging of DNA Helix.

✓ In eukaryotes a set of positively charged, basic proteins (histones) are present. The positive charge is due to



basic amino acids lysine and arginine.

- ✓ Histones are organised to form a unit of eight molecules called histone octamer.

. Histone octamer=2(H2a+H2b+H3+H4)

Linker DNA bears H1 protein

- ✓ The negatively charged DNA is wrapped around the positively charged histone octamer to form bead like structure called nucleosome.

A ✓typical nucleosome contains 200 bp of DNA helix.

THE SEARCH FOR GENETIC

MATERIAL **TRANSFORMING**

PRINCIPLE

It is proposed by Frederick Griffith in 1928.

He used mice &*Streptococcuspneumoniae*. Strepto coccus pneumoniae has 2strains: Smooth(S) strain (Virulent): Has polysaccharide mucus coat ,cause pneumonia.

Rough (R) strain (Non-virulent): No mucus coat, do not cause Pneumonia.

Experiment:

S- strain → Inject into mice → Mice die

R- strain → Inject into mice → Mice live

S- strain (Heat killed) → Inject into mice → Mice live

S-strain (Heat killed)+R-strain (live) → Inject into mice → Micedie

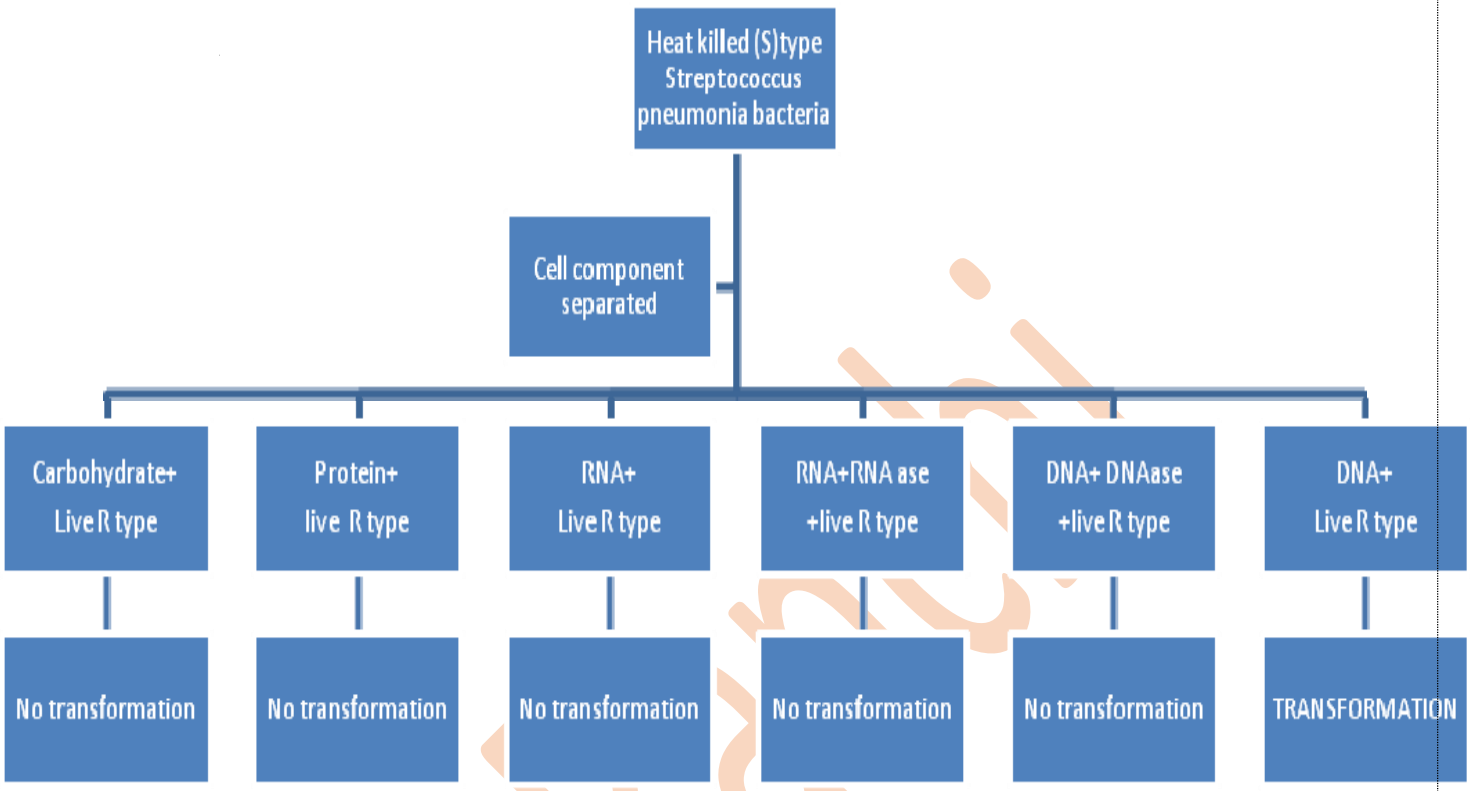
He concluded due to transfer of genetic materials one R strain bacteria transformed into S stain (Virulent).

BIOCHEMICAL CHARACTERIZATION OF TRANSFORMING PRINCIPLE

It is carried out by - Oswald Avery, Colin Macleod &Maclyn McCarty to determine the biochemical nature of 'transforming principle' in Griffith experiment.

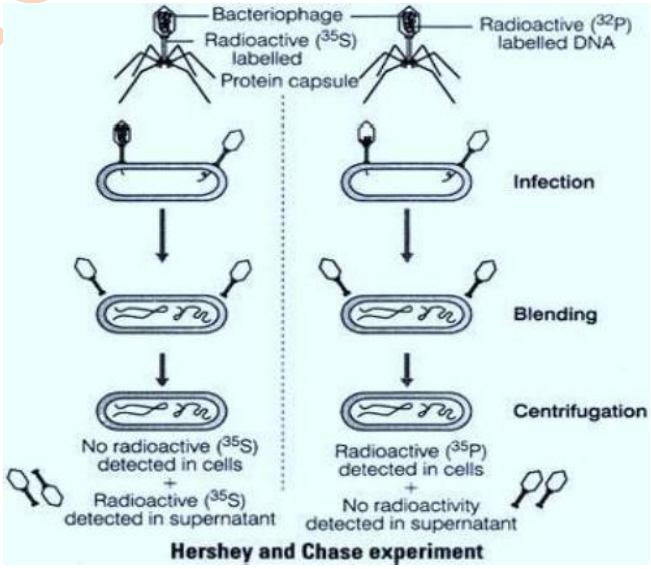
They purified biochemical (proteins, DNA, RNA etc.) from heat killed S cells using suitable enzymes. They discovered that digestion of protein and RNA (using Proteases and RNases) did not affect transformation .It means that the transforming substance was not a protein or RNA.

Digestion of DNA with DNase inhibited transformation. It means that DNA caused transformation of R cells to S cells. They concluded that DNA is the hereditary Material.



HERSHEY-CHASE EXPERIMENT

- It is carried by Alfred Hershey and Martha Chase (1952) to prove that DNA is Genetic material.
- They worked with viruses that infect bacteria called bacteriophages.
- They used two types of radioactive chemicals ^{32}P (present in DNA) and ^{35}S (present in protein)
- The viruses grown in ^{32}P medium has radioactive DNA while those grown in ^{35}S medium has labeled protein



coat.

- They infect one group of bacteria with ^{32}P labeled virus and other group with ^{35}S containing viruses.
- After blending and centrifugation they observed and concluded that bacteria infected with ^{32}P produces offspring labeled with ^{32}P while no of the progeny is radioactively labeled of ^{35}S labeled virus therefor DNA is main genetic material.

PROPERTIES OF GENETIC MATERIAL (DNA VERSUS RNA)

A molecule that can act as a genetic material must fulfill the following criteria:

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

(ii) It should be stable chemically and structurally.

(iii) It should provide the scope for slow changes (mutation) that are required for evolution.

DNA is more stable than.

(iv) It should be able to express itself in mendelian characters.

DNA is more stable than RNA because

- DNA is double stranded
- Thymine in DNA is less reactive than
- Uracil of RNA Mutation rate in RNA is more than DNA
- Absence of 2′ OH group in sugar in DNA makes its less reactive.

RNA WORLD

- RNA was the first genetic material.
- Essential life processes (such as metabolism, translation, splicing, etc.), evolved around
- RNA. RNA used to act as a genetic material as well as a catalyst.
- RNA can directly code for the protein synthesis, hence can easily express the characters. DNA is dependent on RNA for protein synthesis.

Types of RNA

Type	Explanation
m RNA	It contains messages of DNA in the form of codons. Eukaryotic mRNA undergo splicing before undergo translation process. Prokaryotic mRNA does not need to be processed.
r RNA	rRNA forms ribosomes along with protein. The ribosomes contain an exit (E), peptidyl (P), and acceptor (A) site to bind aminoacyl - tRNAs and link amino acids together to create polypeptides.
t RNA	It is also known as adapter RNA. They have a cloverleaf structure that consists of a 3′ acceptor site, 5′ terminal phosphate, D arm, T arm, and anticodon arm. The primary function of a tRNA is to carry amino acids to the ribosome

BIOLOGY

REPLICATION

"Process by which DNA produces daughter DNA molecules which are exact copies of the original DNA." In eukaryotes, DNA is double stranded. The two strands are complementary to each other because of their base sequences.

Semi-conservative method of DNA replication important points:

(i) Most common method of DNA replication.
(ii) Takes place in the nucleus where the DNA is present in the chromosomes.
(iii) Replication takes place in the S-phase (synthesis phase) of the interphase nucleus.
(iv) Deoxyribose nucleotides needed for formation of new DNA strands are present in nucleoplasm. At the time of replication, the two strands of DNA first separate. Each strand then acts as a **template** for the formation of a new strand.
(v) A new strand is constructed on each old strand, and two exactly identical double stranded DNA molecules are formed.
(vi) In each new DNA molecule, **one strand is old** (original) while the **other is newly formed**.
(vii) Hence, Watson and Crick described this method as **semi-conservative replication**. (A) An overall process of DNA replication showing replication fork and formation of new strands template and lagging template.

The various steps involved in this process are summarized as follows:

(i) Mechanism of replication starts at a specific point of the DNA molecule, called **origin**.

(ii) At origin, DNA strand breaks because of an **incision** (nick). This is made by an enzyme called **incision enzyme** (endonuclease).

(iii) The hydrogen bonds joining the two strands are broken by the enzyme.

(iv) The two strands start **unwinding**. This takes place with the help of a **DNA unwinding enzyme**

Helicases. Two polynucleotide strands are thus separated.

(v) The point where the two strands separate appears like a fork or a **Y-shape**. This is described as a **replicating fork**.
(vi) A new strand is constructed on each old strand. This takes place with the help of a small **RNA primer** molecule which is complimentary to the DNA at that point.
(vii) Each old DNA strand acts as a **template** (site) for the construction of new strand. The RNA primer attaches itself to the old strand and attracts the enzymes (**DNA polymerase III**) which add new nucleotides through ***base complementation***. The deoxyribose nucleotides are present in the surrounding nucleoplasm. New DNA strand is thus constructed opposite

to each old strand.

(viii) Formation of new complementary strand always begins at the 3' end of the template strand (original strand) and progresses towards the 5' end (ie in 3' - 5' direction). Since the new strand is ***antiparalle***l to the template strand. It is obvious that the new strand itself is always developed in the, 5'-3' direction. For this reason when the two original strands separate (then with respect to the origin of separation), one acts as 3'-5' template while the other acts as 5'- 3' template.

(ix) Of the two, the replication of 3'-5' template begins first. Hence the new strand formed on it is called the **leading strand**. The other template (5'-3') must begin replication at the fork and progress back toward the previously transcribed fragment. The new strand formed on it is called the **lagging strand.**

(x) Replication of the lagging strand takes place in small fragments called **Okazaki fragments**. These are then connected together by the enzyme **ligase**

(xi) Replication may take place in only one direction on the DNA helix (unidirectional) or in two directions (bidirectional).

(xii) At the end of the process, two double stranded DNA molecules are formed from the original DNA molecule.

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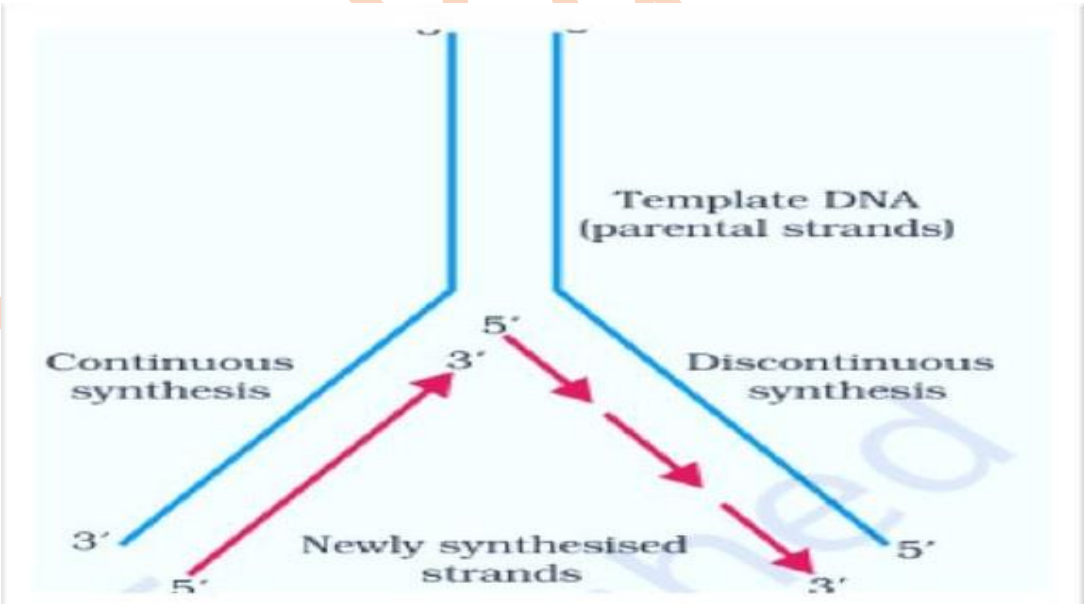
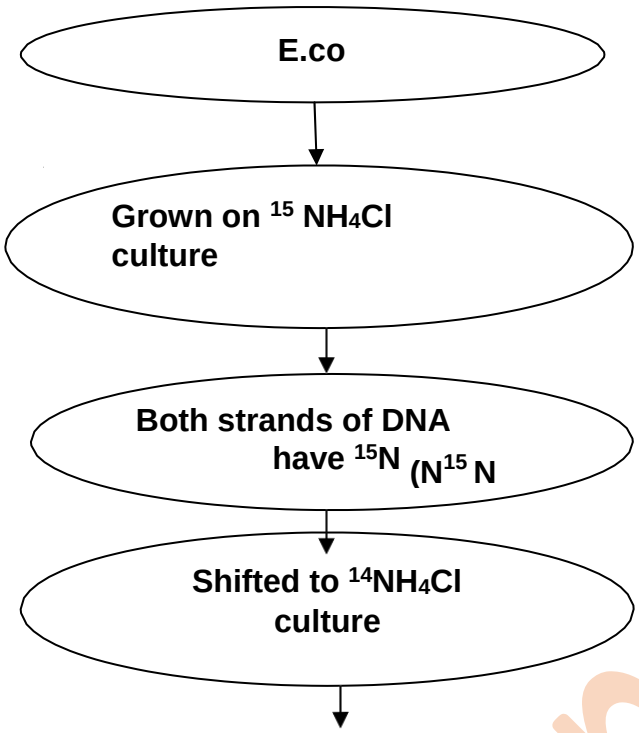


Flow Chart of Semiconservative Mode of Replication

BIOLOGY

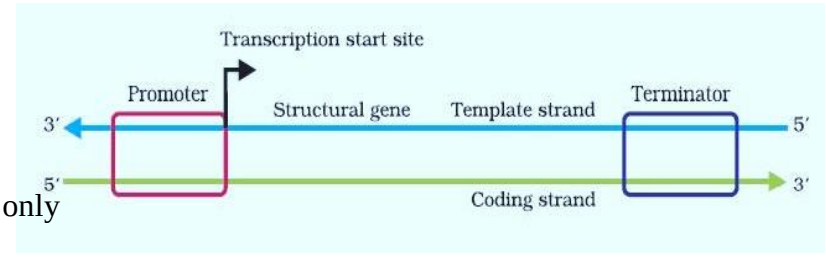


TRANSCRIPTION

- The process of copying genetic information from one strand of the DNA into RNA is termed as transcription.
- The main enzyme is DNA dependent RNA polymerase.
- In transcription only a segment of DNA and only one of the strands is copied into RNA.

A transcription unit in DNA consists of -

(i) A Promoter
(ii) The Structural gene
(iii) A Terminator



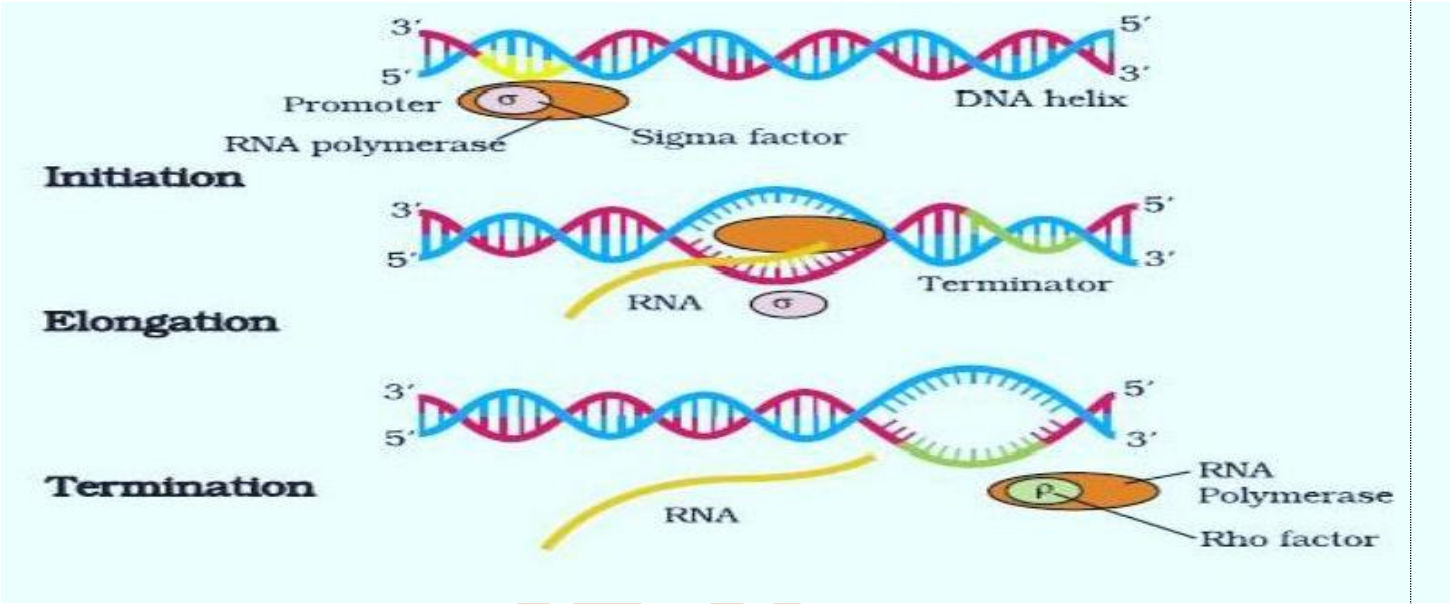
- Polymerization takes place only from 5′ end to 3′ end.
- The strand with 3′ to 5′ end polarity is known as template strand and other is known as codingstrand.

3′-ATGCATGCATGCATGCATGC-5′ Template Strand

5′-TACGTACGTACGTACGTACG-3′ Coding Strand

Structural gene is the region which is transcribed is flanked with promotor towards 5’ end and terminator towards 3’ end.

- Promoter provides binding site for RNA polymerase while at terminator the process of transcription stops.
- RNA polymerase binds to promoter and initiates transcription (Initiation) with the help of sigma factor. Polymerase uses nucleoside triphosphates as substrate for
- After completion of polymerization of structural gene the factor (ρ) terminate the transcription polymerization process.



Complexities in Eukaryotic Transcription

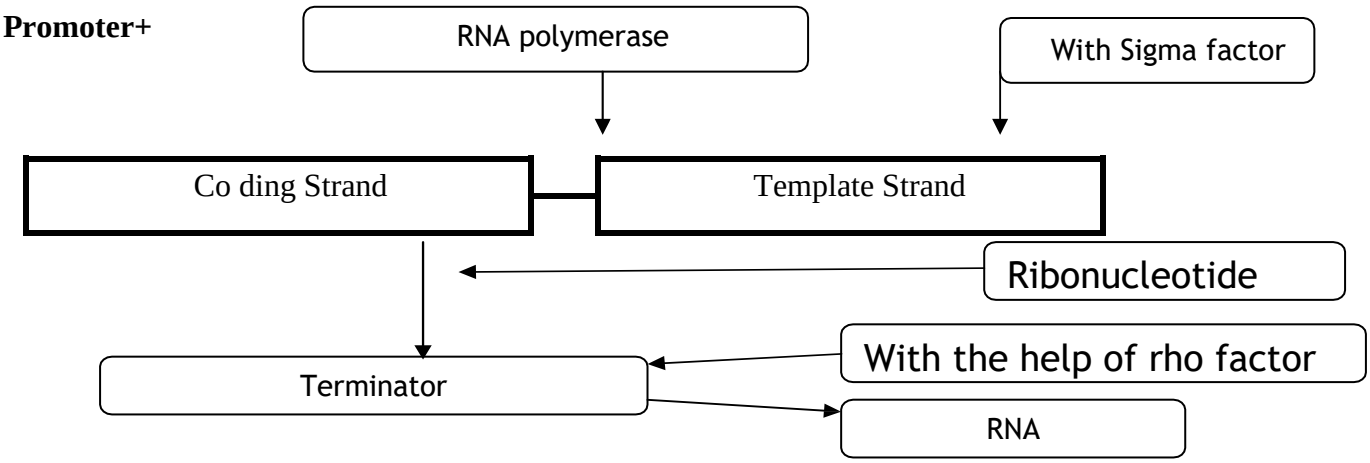
i- Three different RNA Polymerases

RNA polymerase I	Transcribes rRNAs (28S, 18S, and 5.8S),
RNA polymerase II	Transcribes mRNA, heterogeneous nuclear RNA (hnRNA)
RNA polymerase III	Transcribes of tRNA, 5srRNA, and snRNAs

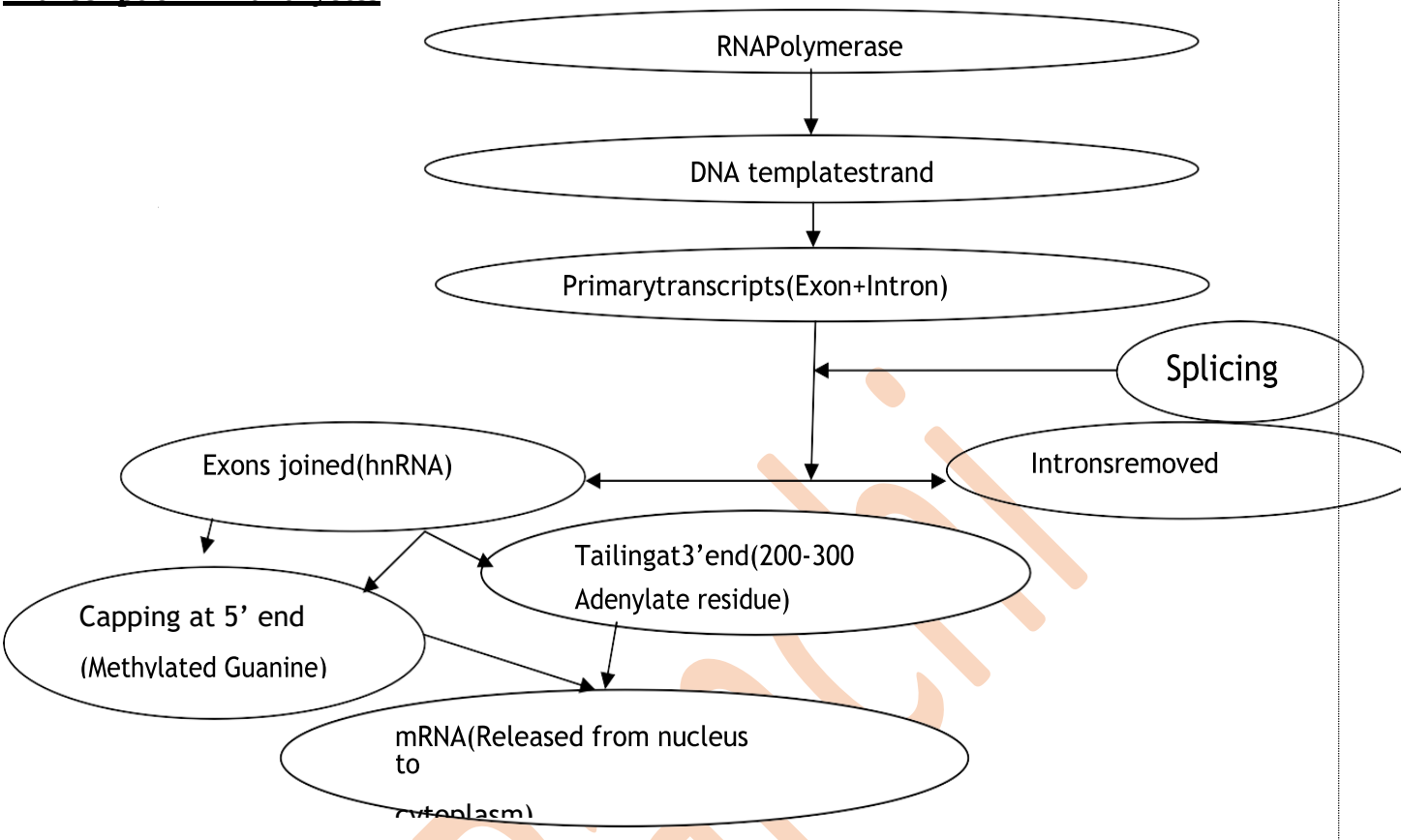
ii- Splicing Mechanism

Primary transcripts contain both the exons and the introns. Introns are removed by splicing process and exons are joined in a defined order.

Transcription in Prokaryotes



Transcription in Eukaryotes



GENETIC CODE

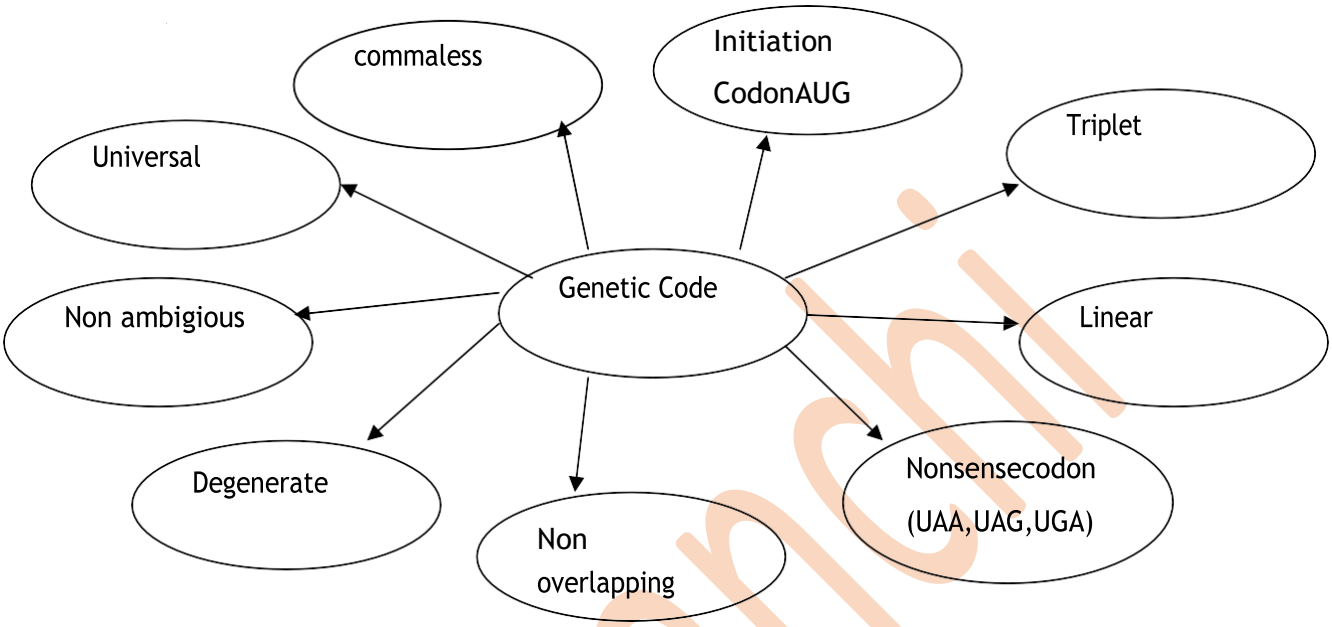
Genetic-code is sequence of codons on mRNA that contain information about aminoacids.

The salient features of genetic code areas follows:

- The codon is triplet.61codons code for aminoacids and 3 codons donot code for any aminoacids, hence they function as stopcodons.
- Some aminoacids are coded by more than one codon, hence the code is degenerate.
- The codon is read in mRNA in a contiguous fashion. There are no punctuations.
- The code is nearly universal e.g.from bacteria to human UUU would code for Phenylalanine. Some exceptions to this rule have been found in mitochondrial and some protozoancodons.
- AUG has dual functions. It codes for Methionine (met) and it also act as initiation codon.
- UAA, UAG, UGA are stop terminator codons.

First position	Second position U	Second position C	Second position A	Second position G	Third position
U	UUU Phe	UCU Ser	UAU Tyr	UGU Cys	U
	UUC Phe	UCC Ser	UAC Tyr	UGC Cys	C
	UUA Leu	UCA Ser	UAA Stop	UGA Stop	A
	UUG Leu	UCG Ser	UAG Stop	UGG Trp	G
C	CUU Leu	CCU Pro	CAU His	CGU Arg	U
	CUC Leu	CCC Pro	CAC His	CGC Arg	C
	CUA Leu	CCA Pro	CAA Gin	CGA Arg	A
	CUG Leu	CCG Pro	CAG Gin	CGG Arg	G
A	AUU Ile	ACU Thr	AAU Asn	AGU Ser	U
	AUC Ile	ACC Thr	AAC Asn	AGC Ser	C
	AUA Ile	ACA Thr	AAA Lys	AGA Arg	A
	AUG Met	ACG Thr	AAG Lys	AGG Arg	G
G	GUU Val	GCU Ala	GAU Asp	GGU Gly	U
	GUC Val	GCC Ala	GAC Asp	GGC Gly	C
	GUA Val	GCA Ala	GAA Glu	GGA Gly	A
	GUG Val	GCG Ala	GAG Glu	GGG Gly	G

Mind map of Genetic Code-



TRANSLATION

Translation refers to the process of polymerization of amino acids to form a polypeptide (protein).

- **1.Activation of aminoacids**
  - AA+ATP+E Mg^{2+} AA-AMP-E+PPi
  - AA-AMP-E+trna———→AA-tRNA+AMP+E

. 2. Initiation

- Small subunit (40s) of ribosome binds with mRNA.
- Charged tRNA specific for initiation codon reaches Psite.
- Larger subunit (60s) of ribosome now combines with 40s mRNA—t RNA^{met} Complex in the presence of Mg^{+2}.

3. Elongation-

- Second t-RNA charged with amino acid occupies Aside of ribosome.
- Peptide bond formation between methionine and second amino acids with the help of enzyme peptide transferase.
- Ribosomes moves over mRNA in5-------→3'.

4. Terminator

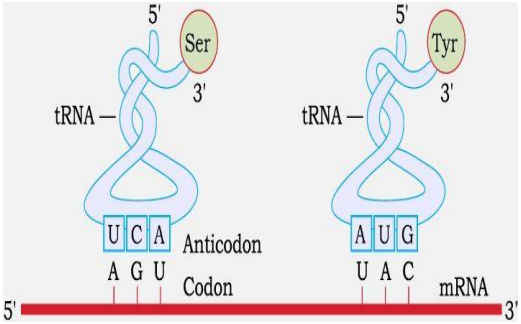
- Translation stops when non-sense codons (Stop codons) reached.
- Not-RNA for stop codons(UAA,UAG,UGA)

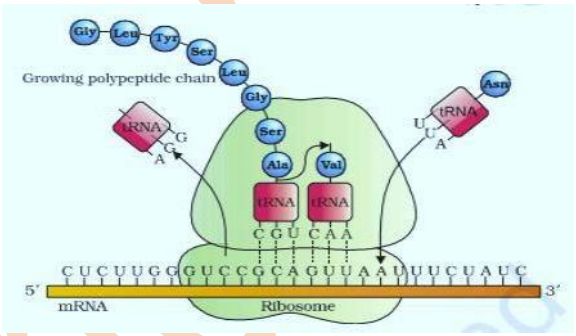
- Synthesized polypeptide is released with the help of release factor.

Important abbreviation's

- AA—Amino acid
- *ATP—Adenosine Triphosphate
- *E—Pyrophosphate
- AA—AMP-E-Amino acid adenylate enzyme complex AA—t RNA—Amino acyl-t RNA complex

UTR-these are untranslated region on mRNA. These are present at both 5'-end (before start codon)and at 3'-end(after stop codon).They are Required for efficient translation process.





REGULATION OF GENE EXPRESSION

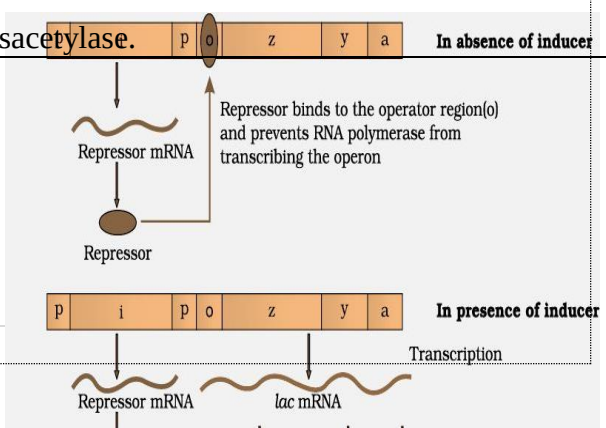
In eukaryotes, the regulation could be exerted at -
(i) Transcriptional level (formation of primary transcript),
(ii) Processing level (regulation of splicing),
(iii) Transport of mRNA from nucleus to the cytoplasm,
(iv) Translational level.

THE LAC OPERON

- Francois Jacob and Jacque Monod proposed Lac operon for lactose metabolism in
- E. coli Genes on Lac Operon

Regulator gene (i)	Codes for the repressor of the lac operon.
Promotor (p)	It is binding site for RNA Polymerase
operator gene (o)	It is binding site for repressor
structural genes (z, y, a)	The z gene (beta-galactosidase (β-gal) breakdown lactose into galactose and glucose. The y gene (permease)- increases permeability of the cell to β-galactosides. The a gene encodes a transacetylase.

- 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.

- When lactose is absent the regulator gene synthesizes repressor protein. The repressor protein binds on operator and prevents RNA polymerase from transcribing the operon.
- When lactose is present the repressor is inactivated by interaction with the inducer. This allows RNA polymerase access to the promoter and transcription proceeds.

HUMAN GENOME PROJECT

It is an international scientific project with the goal of determining the sequence of nucleotide base pairs human genome and its mapping.

Goals of HGP

- Identify all the approximately 20,000 -25,000 genes in human DNA.
- Determine the sequences of the 3 billion chemical base pairs that make up human DNA 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.

Methodologies

The methods involved two major approaches

- ESTs (Expressed sequence tags) - identifying all the genes that are expressed as RNA.
- Sequence Annotation- Sequencing the whole set of genome that contained all the coding and non-coding sequence.
- For sequencing, the total DNA from a cell is isolated, cleaved into smaller fragments and cloned/ amplify in suitable host using specialized vectors.
- The commonly used hosts were bacteria and yeast, and the vectors were called as BAC (bacterial artificial chromosomes), and YAC (yeast artificial chromosomes)
- The fragments were sequenced using automated DNA sequencers. (Frederick Sanger is credited to develop methodology of automatic sequencer.

SALIENT FEATURES OF HUMAN GENOME

- The human genome contains 3164.7 million base pairs and 30000 genes. 99.9 % nucleotide

bases are exactly the same in all people.

- The average gene consists of 3000 bases. Largest gene is of dystrophin (2.4 million bases).
- Function of 50 % gene is still unknown and Less than 2 % of the genome codes for proteins Repetitive sequences are stretches of DNA sequences that are repeated.
- Chromosome 1 has most genes (2968), and the Y has the fewest (231).
- There are about 1.4 million locations where single base DNA differences (SNPs single nucleotide polymorphism 'Snips') occurs in Humans.

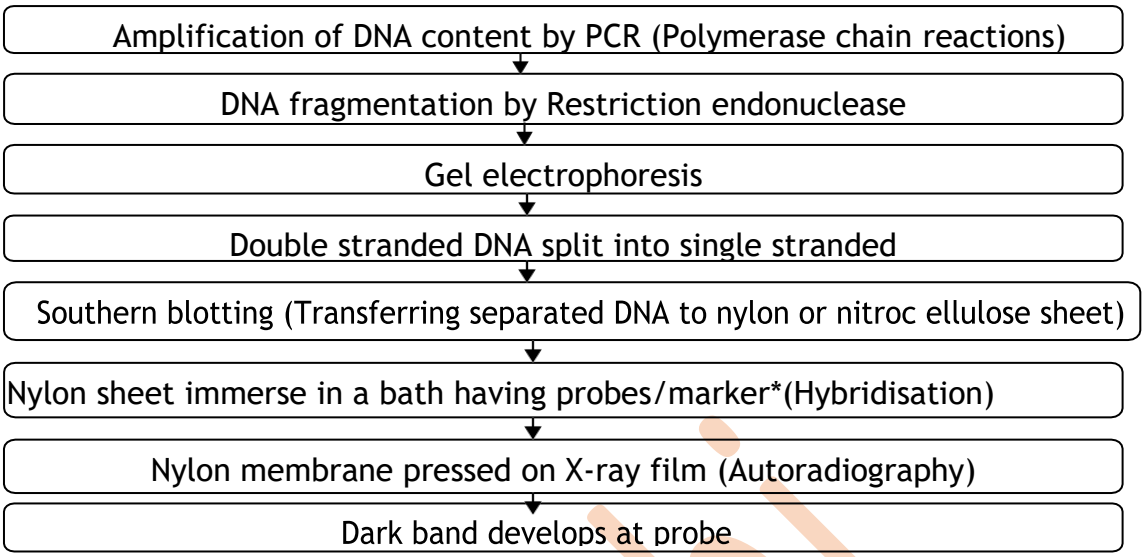
DNA FINGERPRINTING

- DNA fingerprinting is a technique of determining nucleotide sequences of certain areas (VNTRs) of DNA which are different in different individual.
- DNA fingerprinting involves identifying differences in repetitive DNA..Alec Jeffreys develops technique of DNA Fingerprinting. He used satellite DNA as probe that shows very high degree of polymorphism called as VNTRs (as Variable Number of Tandem Repeats).
- These sequences with high degree of polymorphism form the basis of DNA finger printing. The repetitive DNA are separated from bulk genomic DNA as different peaks during density gradient centrifugation.
- The bulk DNA forms a major peak and the other small peaks are referred to as satellite DNA (such as micro-satellites, mini-satellites etc. DNA Polymorphism (variation at genetic level) arises due to mutations. It is widely used in forensic science, paternity dispute etc
- **Steps of 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) Hybridization using labelled VNTR probe.
  (vi) Detection of hybridized DNA fragments by autoradiography.

Concept Map of DNA Fingerprinting-

DNA extraction from the cells in high speed refrigerated centrifuge



***Probes/ Markers are radioactive synthetic DNA complementary to VNTR**

IMPORTANT QUESTIONS

ONE MARK QUESTIONS

1. **The net electric charge on DNA and histones is**
(a) Both positive (b) Both negative
(c) Negative and positive, respectively (d) Zero.
Answer: (c) Negative and positive, respectively

2. **Which of the following statements is the most appropriate for sickle cell anaemia?**
(a) It cannot be treated with iron supplements. (b) It is a molecular disease.
(c) It conferes resistance to acquiring malaria. (d) All of the above.
Answer:
(d) All of the above.

3. **The first genetic material could be**
(a) Protein (b) Carbohydrates
(c) DNA (d) RNA.
Answer: (d) RNA.

4.**The human chromosome with the highest and least number of genes in them are respectively**
(a) Chromosome 21 and Y (b) Chromosome 1 and X
(c) Chromosome 1 and Y (d) Chromosome X and Y.
Answer: (c) Chromosome 1 and Y

5. **Who amongst the following scientist had no contribution in the development of the double helix model for the structure of DNA?**
(a) Rosalind Franklin (b) Maurice Wilkins
(c) Erwin Chargaff (d) Meselson and Stahl
Answer (b) Maurice Wilkins

6. Which of the following steps in transcription is catalysed by RNA polymerase?
(a) Initiation (b) Elongation
(c) Termination (d) All of the above
Answer: (d) All of the above

7. Control of gene expression takes place at the level of
(a) DNA-Replication (b) Transcription
(c) Translation (d) None of the above.
Answer: (b) Transcription

8. **Which was the last human chromosome to be completely sequenced?**
(a) Chromosome 1 (b) Chromosome 11
(c) Chromosome 21 (d) Chromosome X
Answer: (a) Chromosome 1

9.**If the sequence of initrogen bases of the coding strand of DNA in a transcription unit is: 5' – ATGAATG – 3', the sequence of bases in its RNA transcript would be**
(a) 5' – AUG A AUG – 3' (b) 5' – UACUU AC – 3'
(c) 5' – CAUUCAU – 3' (d) 5' – GUAAGUA – 3'.
Answer: (d) 5' – GUAAGUA – 3'.

10.**If the base sequence of a codon in mRNA is 5' – AUG – 3′ the sequence of tRNA pairing with it must be**
(a) 5' – UAC – 3' (b) 5' – CAU – 3'
(c) 5'-AUG – 3' (d) 5' – GUA – 3'
Answer: (b) 5' – CAU – 3'

11. To initiate translation, the with RNA first bind to
(a) The smaller ribosomal sub-unit (b) The larger ribosomal sub-unit
(c) The whole ribosome (d) No such specificity exists.
Answer: (a) The smaller ribosomal sub-unit

12. In E. coli, the lac operon gets switched on when
(a) Lactose is present and it binds to the repressor (b) Repressor binds to operator
(c) RNA polymerase binds to the operator (d) Lactose is present and it binds to RNA polymerase.
Answer: (a) Lactose is present and it binds to the repressor

Very Short Answer Type Questions

1. **By which method detection of hybridized DNA fragments is possible**.
   Ans: Autoradiography
2. **Who invented methodologies of automatic DNA sequencing and Lac operon?**
   Ans: Frederick Sanger, Alec Jefferys
3. **Give name of commonly used vectors in human genome project.**

   Ans: BAC (Bacterial artificial chromosome), YAC (yeast artificial chromosome)

4. What are two basic approach adapted as methodologies in HGP.

Ans: Expressed Sequence Tags (ESTs) and Sequence Annotation

5. What **are inducers in lac operon, give two examples of inducer.**

Ans : Inducer binds with repressor protein so that they can't bind on operator gene.

Example- Lactose and Allolactose.

6. What are untranslated regions (UTR)? Give their importance.

Ans: The UTRs are present at both5'-end (before start codon) and at 3'-end (afters top codon). They are required for efficient translation process.

7. What are initiator tRNA? How many tRNAs are present in cell for 20 different amino acid?

Ans: Initiator tRNA is for initiation of translation process. It always carries methionine amino acid.

There are 20 different tRNAs for 20 different amino acids.

8. What is dual nature of codon AUG?

Ans: It codes for amino acid methionine.

This is also known as initiation codon responsible for initiation of translation process.

9. What is the role of sigma factor and DNA ligase?

Ans: Sigma factor initiates the process of transcription. DNA ligase is to join adjacent nucleotides.

10. Name the bacteria used by Fredrik Griffith in his experiment. Also mention the types of Strain he used to prove the nature of genetic material.

Ans: Bacteria- Streptococcus pneumonia.

Strain- S strain (virulent) R strain (non- virulent).

Short Answer Type Questions

1. What do you mean by phosphodiester bond?

Ans: The bond which is formed between the 3'-OH of one deoxyribonucleotide and 5'-phosphate residue of an adjacent de-oxyribonucleotide.

2. What type of transcription is found in retrovirus? Name the enzyme.

Ans: in retrovirus the genetic information flows from RNA to DNA and is called reverse transcription while the enzyme involved is called reverse transcriptase.

3. What would happen if histones were to be mutated and made rich in

amino acids aspartic acid and glutamic acid in place of basic amino acids such as lysine and arginine?

Ans: If histone proteins were rich in acidic amino acids instead of basic amino acids then they would not have any role in DNA packaging in eukaryotes as DNA is also negatively charged molecule. The packaging of DNA around the nucleosome would not happen. Consequently, the chromatin fiber would not be formed.

4. Explain what happens in frameshift mutation. Name one disease caused by the disorder.

Ans: Mutation in which addition/insertion or deletion of one or two bases changes the reading frame from the site of mutation is called frameshift mutation. It may result in polypeptide with different sequences of amino acids.
Disease caused by frameshift mutation - sickle-cell anemia.

5.The sequence of the coding strand of DNA in a transcription unit is mentioned below

3′ TATAGCATCTATTAGG 5′

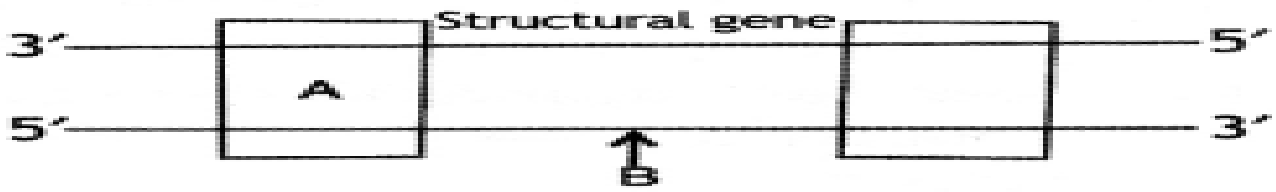
6.Write the sequence of RNA formed on this DNA.

Ans: 3′ UAUAGCAUCTAUUAGG 5′

7.Three codons on mRNA are not recognised by tRNA during translation process. Mention these codons? Write the importance of these in protein synthesis?

Ans: Stop codons- UAA, UAG and UGA
Help in termination of translation process and release of polypeptide into cytoplasm

8.Label the parts 'A' and 'B' of the transcription unit given below



Ans: A- Promoter B- Coding strand

Long Answer Type Questions

1. (a) What is DNA fingerprinting?

(b) What are the steps of DNA fingerprinting?

(c) Mention its application

Ans: 1. (a) DNA fingerprinting is a technique of determining nucleotide sequences of certain areas (VNTRs) of DNA which are different in different individual.

(b). Refer to study material & NCERT BOOK Page no-122.

(c) Paternity disputes can be solved by DNA fingerprinting.

It is useful in detection of crime and legal pursuits.

2.**(a) Differentiate between the genetic codes given below:**

(i) Unambiguous

(ii) Degenerate

(b) What is significance of Severo Ochoa enzyme?

Ans: a- (i) Unambiguous: one Condon code for only one amino acid.

(ii) -Degenerate: When an amino acid is coded by more than one codon

(b)- Severo Ochoa enzyme (polynucleotide phosphorylase) is useful in polymerizing RNA with defined sequences in a template independent manner (enzymatic synthesis of RNA)

3. (i) Write the stages at which Regulation of gene expression can be achieved in eukaryotes.

(ii) What is meaning of I, P and O in operon?

Ans: (i) Transcriptional level (formation of primary transcript), processing level (regulation of splicing), transport of mRNA from nucleus to the cytoplasm, translational level.

(ii) Regulator gene (i) Codes for the repressor of the lac operon, promoter (p) is binding site for RNA Polymerase and operator gene (o) It is binding site for repressor.

4.(i) Why is DNA molecule a more stable genetic material than RNA? Explain

(ii) Draw double helical diagram of DNA showing phosphodiester bond.

Ans- (i) The hydrogen between purine and pyrimidine provide stability to DNA.

The DNA lacks 2'OH group which makes it less reactive than RNA.

The thymine in DNA is less reactive than Uracil in RNA.

RNA mutates easily.

(ii)- Fig6.2, page 98 NCERT

5. Provide any five silent feature of human genome.

Ans: Refer to NECRT Page NO-120 (6.9.2)

The human genome contains 3164.7 million bp., The total number of genes is estimated at 30,000, Almost all (99.9 per cent) nucleotide bases are exactly the same in all people, The functions are unknown for over 50 per cent of the discovered genes, Less than 2 per cent of the genome codes for proteins, Chromosome 1 has most genes (2968), and the Y has the fewest (231), there are about 1.4 million locations where single base DNA differences (SNPs – single nucleotide polymorphism : 'snips') occur in humans.

CHAPTER - 6

EVOLUTION

Evolution is an orderly change from one form to another

Big Bang theory

Big Bang theory states that the universe originated about 20 billion years ago by a thermonuclear explosion.

The earth was formed about 4.5 – 5billion years ago.

Origin of life

Theories of origin of life

1.Abiogenesis – it states that life originated from decaying and rotting matter like straw, mud etc.

2.Biogenesis – it states that life originated from pre-existing life. It was proposed by Louis Pasteur.

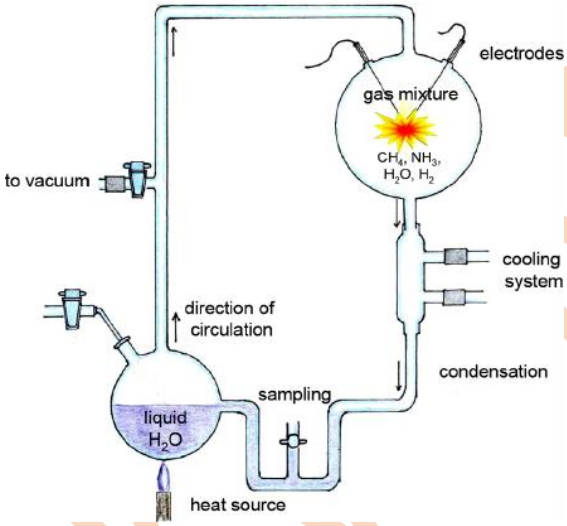
3.Cosmic or Panspermia theory – it states that units of life or spores were transferred from other planets.

4.Theory of special creation -- it states that living and non-living things are created by some supernatural power (God)

5.Theory of Chemical Evolution – Oparin and Haldane stated that the first life form of life was originated from non-living inorganic molecules such as CH4, NH3, H20, sugars, proteins, nucleic acids etc.

Miller and Urey experiment

Harold Urey and Stanley Miller tested the Oparin-Haldane theory and successfully produced organic molecule from some of the inorganic components.



Harold Urey and Stanley Miller for their experiment created a condition similar to that of primitive earth (high temperature, reducing atmosphere devoid of oxygen). They made electric discharge in a closed flask containing CH4, NH3, H2 and water vapour at 800.C

As a result, some amino acids were formed. In similar experiments sugars, nitrogen bases, fats were formed. They were the like first non-cellular parts RNA, proteins, polysaccharides, etc.

Evidences of evolution

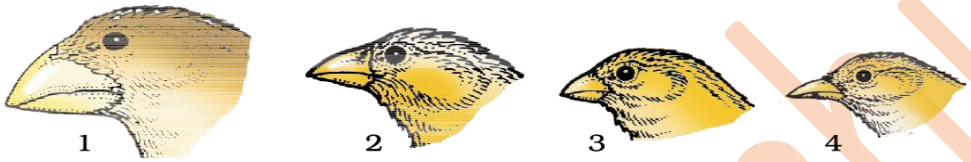
- **1.Palaeontological Evidences**– Fossils- the remains of life forms or past preserved in rocks, earth crust.
- **2.Morphological and Anatomical evidences**–(a)Homologous organs-are those having fundamental similarity in structure and origin but different in function. eg Human hand , Whale's flippers, Bats wings and Cheeta's foot(b)Analogous organs-are organs having similar function but different structure and origin. Eg Wings of insect and wings of birds , sweet potato and potato.
- **3.Adaptive radiation**– is the evolution of closely related species in a given geographical area. eg Darwin's finches.

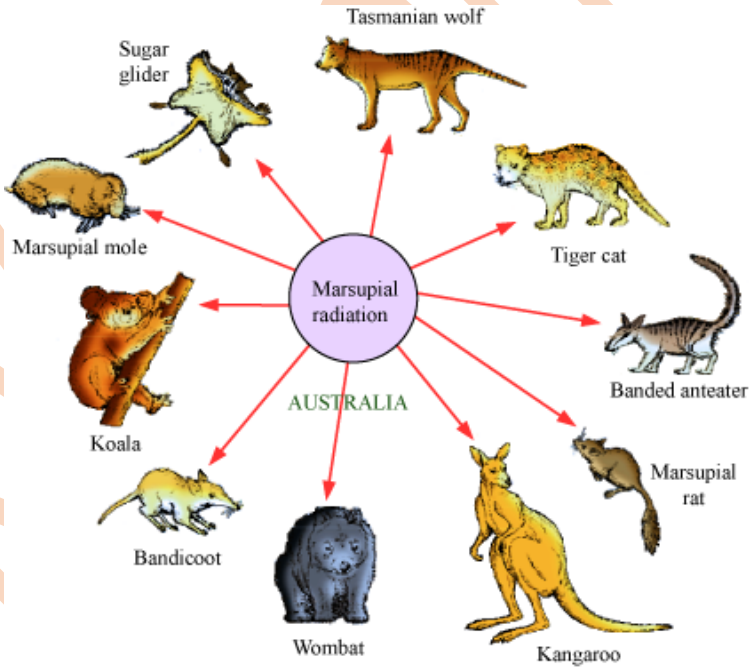
- **4.Biochemical evidences**– similarity in biomolecules and metabolism.eg similarity in proteins in genes
- **5.Evidences of evolution by Natural Selection**– the process by which the organisms that are best suited for the environment survive and reproduce.eg Industrial Melanism

Darwinism (Theory of Natural Selection)

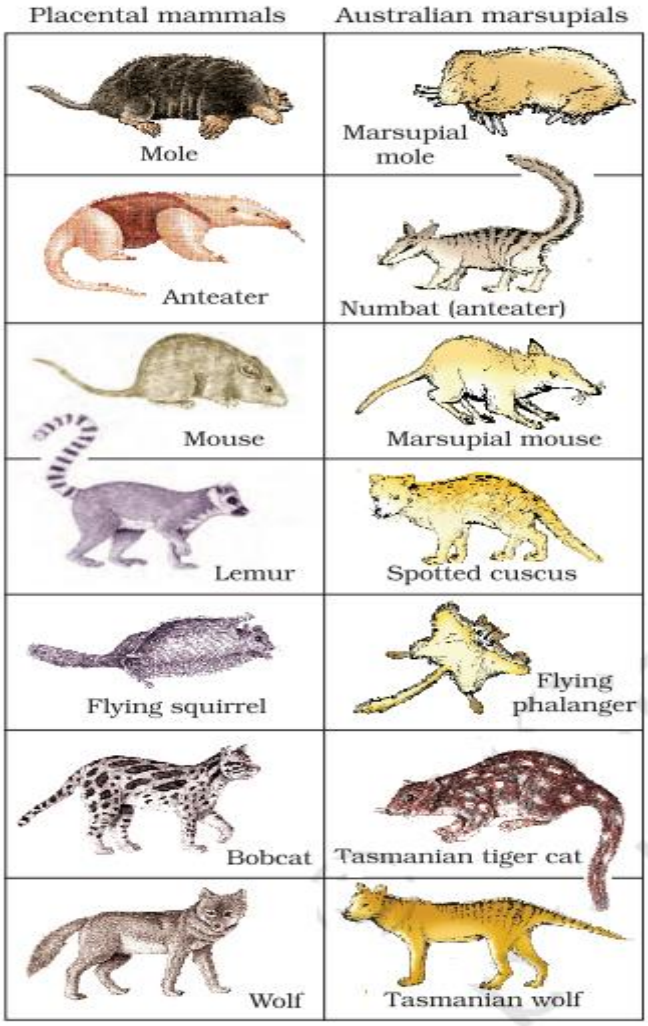
- The theory was proposed by Darwin in/hid book "The Origin of species" It is based on two key concepts–

(a) **Branching descent or Adaptive radiation**- it explains that all organisms are modified descendants of previous life forms. The process of evolution of different species starting from a point in a geographical area and finally radiation out to other areas.eg Darwin' finches, marsupials of Australia.





(b) **Natural Selection or Convergent evolution**- it is the evolutionary process where automatically different structures in different group of organisms evolve towards the same function.



Modern synthetic theory of evolution

The modern synthetic theory of evolution explains evolution as gene variants in a population that result in the establishment of a new species. It explains how genetic variations, breeding, geographical isolation, and natural selection all play a role in evolution.

The modern synthetic theory is also known as Neo-Darwinian theory which merges the theory of Darwin evolution with Mendelian genetics given by many evolutionary biologists such as Dobzhansky, Sewall Wright, G.I/Stebbins, Ernst Mayr.

This theory provide a new definition of evolution as " the change occurring in the allelic frequencies within the population"

Factors of modern synthetic theory:

Mutation
Genetic recombination
Gene drift
Natural selection
Isolation

Mechanisms of Evolution

- **Mutational theory** – Hugo de Vries proposed Mutational theory and believed that evolution takes place through mutation and not by minor variation.
- Evolution for Darwin was gradual while for de Vries it was sudden spontaneous process.

- Hugo de Vries believed mutation caused speciation and hence called it **Saltation** (single step large mutation)
- **Recombination,** the process by which DNA strands are broken and repaired, producing new combinations of alleles, occurs in nearly all multicellular organisms and has important implications for many evolutionary processes.
- Recombination by itself does not cause evolution to occur. Rather, it is a contributing mechanism that works with natural selection by creating combinations of genes that nature selects for or against.

Natural Selection

Natural selection is a mechanism of evolution. Organisms that are more adapted to their environment are more likely to survive and pass on the genes that aided their success. This process causes species to change and diverge over time.

Example -Galapagos finches have different types of beaks. During times of drought, the finches with the larger beaks survived better than those with smaller beaks. During rainy times, more small seeds were produced and the finches with smaller beaks fared better.

The mechanism that Darwin proposed for evolution is natural selection. Because resources are limited in nature, organisms with heritable traits that favor survival and reproduction will tend to leave more offspring than their peers, causing the traits to increase in frequency over generations.

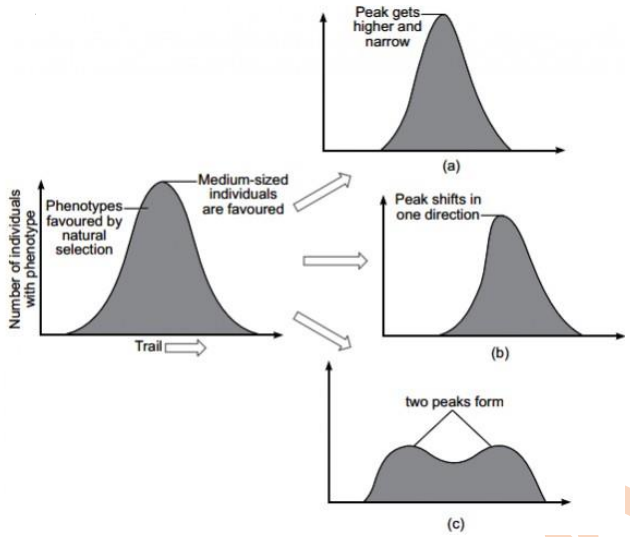
Hardy Weinberg Principle

- It states that the allele frequencies in a population are stable and constant from generation to generation.
- The gene pool the total genes their alleles in a population remain constant. This is called genetic equilibrium (Hardy Weinberg equilibrium)
- *p2+2pq+q2=1*. The sum total of all allelic frequencies=1
- In a diploid, p and q are the frequencies of alleles A & a respectively.
- The frequencies of *AA= p2* (i.e. the probability of an allele A with frequency p is the product of the probabilities , i.e. *p2*
- The frequency of *aa=p2*
- The frequency of *Aa= 2pq*
- Hence *p2+2pq+q2=1*. [binomial expansion of (p+q)2] The sum total of all allelic frequencies=1
- Change of frequency of alleles in a population causes disturbance in genetic equilibrium. This is due to evolution.

Factors affecting Hardy-Weinberg equilibrium

- **Gene Migration**- when gene flow from one population to another, occurs when migration happens multiple times
- **Genetic drift**-the accidental gene flow causing change in frequency. The original drifted population becomes founder and affect is called **founder effect.**
- **Mutation**- due to change in genetic material, new phenotypes are formed, which over few generations leads to speciation.
- **Genetic recombination**-it is the reshuffling of gene combinations during crossing over resulting in genetic variation.
- **Natural Selection**-It is a process occurring in nature that act over a number of generation slowly increase in number adapted to the environment due to their heritable characters. It isa major factor which adds variation in the population, change the gene frequencies in the gene pool resulting in the formation of new gene pool. There are three types of natural selection
  (a) Stabilising Selection: Here more individual acquire average character value and variation is reduced

(b) Directional Selection: Here, individuals of one extreme are more favoured.
(c) Disruptive Selection: Individuals of both the extreme are favoured. It produces two peaks that may lead to development of two different populations.



Origin and Evolution of Man

- (i)Dryopithecus and Ramapithecus(15 mya) – Fossils of man like bone found in Ethiopia and Tansmania. Man like primates, height up to 4 feet. Hairy body, walked like gorillas and chimpanzee. Dryopithecus: ape like. Ramapithecus: man like.
- (ii)Australopithecus(2 mya)-Inhabited the East African grasslands. Hunted with stones weapons, ate fruits.
- (iii)Homo habilis-First man like being. First human like being. Brain capacity 650-800 mya. Did not eat meat
- (iv) Homo erectus-They had large brain 900cc. Ate meat.
- (v)Neanderthal man:40,000-1 lakh years ago- Lived in East and Central Asia. Used hides to protect their body. Buried their dead.
- (iv)Homo sapiens(Modern man)- Evolution took place between 10,000 to 75,000 years ago. Pre historic cave art developed. Agriculture and settlements occurred 10,000 years ago

IMPORTANT QUESTIONS

	Very Short Answer Type Question (1 mark)
1	How did Charles Darwin express fitness?
Ans	The fitness according to Darwin is reproductive fitness
2	State the two principal outcomes of life that experiments conducted by Louis Pasture on origin of life.

Ans	Life comes from pre-existing life.
3	Mention one example each from plants animals exhibiting divergent evolution.
Ans	Thorns of Bougainvillea and tendrils of Cucurbita in plant and forelimbs of whales, bat, cheetah humans exhibit divergent evolution.
4	State a reason for the increased population of dark coloured moths with the loss of lichens during industrial period in England.
Ans	During industrialization period in England the lichens got wiped out due to air pollution and tree trunks became dark due to industrial smoke so that the dark colour moth could camouflage in dark background without any risk of predation. Thus they escaped predation , survived and therefore increased in population, where as white winged moth did not survive due to predation and industrial pollution.
5	State two postulates of Oparin and Haldane with reference to origin of life
Ans	(i) First form of life could have come from pre-existing non-living organic molecule such as RNA and protein. (ii) Formation of life was preceded by chemical evolution or organic molecule formed from inorganic molecule.
6	Write the probable difference between eating habits of Homo habilis and Homo erectus.
Ans	Homo habilis did not eat meat was vegetarian, while Homo erectus were probably meat eaters.
7	Rearrange the human activities mentioned below as per the order in which they developed after the modern Homo sapiens came into existence during ice age: (i) Human settlement (ii) Prehistoric cave art (iii) Agriculture
Ans	(i) Prehistoric cave art (ii) Agriculture (iii) Human settlement
8	Write the names of the following: (i) A 1.5 Mya primate that was ape-like (ii) A 2 Mya primate that lived in East African grassland
Ans	(i) Dryopithecus (ii) Australopithecus
9	According to De-Vries what is saltation?
Ans	Saltation is a single step large mutation which brings major change as speciation
10	What role does an individual organism play as per Darwin's theory of natural selection?
Ans	Individual with reproductive fitness passes on the useful gene to the next generation.
	Short Answer Type Question (1 mark)
1	Is sweet potato analogous or homologous to potato tuber? Give reasons to support your answer.
Ans	Sweet potato – root modification, potato tuber- stem modification are analogous. They are structurally different but both are functionally similar as they both store food.
2	Explain divergent evolution with two examples.
Ans	When the same structure in different animals, develop along different directions due to adaptation to different needs, the condition is called as divergent evolution. (i) Forelimbs of mammals like Whales, Bats, Cheetah and humans show homology as they share similarity in pattern of bones though perform different function. (ii) Vertebrates heart or brains.
3	Differentiate between analogous and homologous structures.

Ans	Analogous: Anatomically not similar though perform similar function is a result of convergent evolution. Homologous: Anatomically similar but perform different functions is a result of divergent evolution.
4	Explain with the help of an example the type of evolution homology is based on.
Ans	Homologous is based on divergent evolution. These have similar anatomical structures but perform different function. Examples: Thorns of Bougainvillea and tendrils of Cucurbita. Forelimbs of human and horse.
5	Select and write the analogous structures from the list given below. (a)wings of butterfly and bird (b)vertebrate hearts (c)tendrils of Bougainvillea and Cucurbita (d)tuber of sweet potato and potato
Ans	(i) Wings of butterfly and birds (ii) Tubers of sweet potato and potato.
6	How would the gene flow or genetic drift affect the population in which either of them happens to take place?
Ans	Results in changed frequency of genes in both populations, causing variation, leading to evolution and speciation.
7	Name the first human like hominid. Mention his food habit and brain capacity.
Ans	Homo habilis were first human hominid. They probably did not eat meat and there brain capacity were between 650-800cc.
8	Name the scientist who came to similar conclusion as Darwin. Where did he work?
Ans	Alfred Wallace came to similar conclusion as Darwin. He worked in Malay Archipelago
9	Around when did the thermonuclear explosion occur and what was formed as a result?
Ans	Big Bang theory state that the universe originated about 20 billon years ago by a thermonuclear explosion of dense entity.
10	State the significance of fossils.
Ans	(i) Fossils help us to know about the evolutionary history. (ii) Fossils help to study the connecting link between two groups of organisms. (iii) Fossils help to study about extinct animals.
	Short Answer Type Question (2 mark)
1	Explain Hardy Weinberg principle.
Ans	The frequency of occurrence of alleles of a gene is constant from generation to generation, it is expressed as p2+2pq+q2=1, p and q represents the frequency of different alleles.
2	Name the primate that lived 15 million years ago. List their characteristic features
Ans	Primates like Dryopithecus and Ramapithecus appeared about 14-15 million years ago. Characteristic features of Dryopithecus: (i) They are more ape-like (ii) Their body is hairy (iii) They ate soft fruits and leaves Characteristic features of Ramapithecus (i) They were more man like (ii) Their body is hairy (iii) They walked more erect
3	Where was the first mam -like animal found? When did modern Homo sapiens appear on this planet.
Ans	The first man-like animal was found in thee East Africa. Modern Homo sapiens arrived during the ice age between 75,000-10000 years ago
4	List four evidences of evolution

Ans	Four evidences of evolution are (i) Palaeontology evidences (ii) Morphological and anatomical evidences (iii) Biogeographical evidences (iv) Biochemical evidences
5	Explain any one of the types of evidence that help us understand the concept of evolution.
Ans	Palaeontology evidences: (a) The study of fossils is known as palaeontology. (b) Fossils are remains and impressions of life forms of the past preserved in sedimentary rocks or volcanic ash. (c) The study of fossils reveals the existence of life in the past and states its course of evolution of plants and animals. (d) Study of fossils in different sedimentary layers indicate the geological period in which they existed.
6	Different between divergent and convergent evolution.
Ans	

Divergent evolution	Convergent evolution
a) Same structure developed along different direction	a) Different structures evolving for the same function
b) Due to adaptation to different needs	b) Due to adaptation to meet similar needs
c) Examples: vertebrate heart and brain. Forelimbs of whale, bat, cheetah.	c)Examples: wings of bird and insect, potato and sweet potato.

7	What is founder effect?
Ans	Founder effect is the reduction of genetic variation when a small segment separates and develops into a new population set up. It may be quite different from the original population both in genotype and phenotype due to fixation of certain alleles, eliminating some alleles, new mutation and natural selection.
8	State and explain any two factors affecting allele frequency in a population.
Ans	Allele frequency in a population can change due to gene flow or gene migration, genetic drift , mutation, recombination and natural selection. (a) Gene flow or gene migration- It is change in allele frequency due to addition – immigration and reduction – emigration due to inward and outward migration of some population. (b) Natural selection- IT is survival of individual with useful variations and elimination of others with inferior genotype. The former reproduces and pass on the selected variation to the next generation. The same process occurs again in the next generation. Accumulation of variation leads to formation of new species or evolution.
9	The scientist believe that evolution is gradual. But extinction part of evolutionary story are sudden and abrupt and also group specific. Comment whether a natural disaster can be the cause of extinction of species.
Ans	Sudden, abrupt and group specific extinction have occurred in the past from time to time. They have been caused by (i) Competition from better evolved descendent (ii) Natural disaster (iii)Genetic degeneration.
10	Migration may enhance or blur the effects of selection. Comment
Ans	(i) Migration may enhance the effect of selection if it brings in more alleles being selected or take away alleles being rejected or take away the allele being selected. (ii) Migration may blur the effect of migration, if it brings in more alleles otherwise being rejected or take away
	Assertion and Reason(1 Mark)
	Question No 1 to 5 consists of two statement – Assertion(A) and Reason (R.) Answer these questions selecting the appropriate option below:

	A. Both A and R are true and R is the correct explanation of A. B. Both A and B 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: The scientific theory of evolution by natural selection was given by Charles Darwin Reason: Evolution refers to the changes in a population or species through time.
Ans	A. Both A and R are true and R is the correct explanation of A
2	Assertion: Fossils ae proof of evolution. Reason: Fossils are the preserved remains or traces of organisms from the distant past.
Ans	A. Both A and R are true and R is the correct explanation of A
3	Assertion: Wings of birds and bats are different in origin but similar in function Reason: Wings of birds and bats are examples of homologous structure
Ans	C.A is true but R is false
4	Assertion: Hugo de-Vries defined the mechanism of evolution as saltation. Reason: Saltation is a single step large mutation which brings major change as speciation
Ans	A. Both A and R are true and R is the correct explanation of A
5	Assertion: The most significant trend in evolution of Modern mam (*Homo sapiens*) is its cranial cavity Reason: The volume of the human brain has increased from about 600 cc in *Homo habilis* to 1400cc in modern man *Homo sapiens.*
Ans	A. Both A and R are true and R is the correct explanation of A
	Case Based Question (4 marks)
1	Population dynamics is the study of how and why population change in size and structure over time. Important factors in population dynamics include rates of reproduction, death and migration. A theoretical model of a community of species under selection of compatibility between nuclear and mitochondrial genome predicts patterns of species diversity, abundance, speciation and extinction and also suggests a link between metabolic demands and latitudinal variation in diversity. Among the three basic factors, gene and chromosomal mutation were regarded as the ultimate sources of biological changes and as raw materials for evolution. (i) Genetic drift is effective in population which are: (a) Small (b) Large (c) Densely populated (d) None of the above. (ii) Identify the accessory factors, which provide variability to the population (a) Migration (b) Hybridisation (c) Genetic drift (d) All of the above. (iii) The sources of biological changes and as raw materials are: (a) Gene (b) gene pool (c) chromosomal mutation (d) All of the above (iv) Population dynamics is affected by: (a) Death (b) Birth (c) Migration (d) All of the above
Ans	(i) (a) Small (ii) (d) All of the above (iii) (d) All of the above (iv) All of the above
2	The first cell appeared about 2000 million years ago on earth. Slowly these singled celled organisms become multicellular life forms and gradually evolved from less developed to more developed organisms. Life began in water and slowly life forms invaded the earth but the first organisms that invaded the earth were plants. The first evolved were small sized. After the extinction of major land reptiles, mammals, dominate the earth. Some mammals live wholly in water like whale's dolphins, seals and sea cows. (i) Eukaryotes developed around:

	(a) 3000 Mya (b) 4200 Mya (c) 1600 Mya (d) 3500 Mya (ii) Who proposed the theory of Origin of life? (a) T. Malthus (b) A. Wallace (c) Charles Darwin (d) Oparin (iii) When did the first mammals appeared around? (a) 450 million years back(b) 220 million years back (c) 1600 years back (d) 2000 million years back (iv) The first organisms that invaded earth was: (a) Animals (b) Plants (c) Both (d) None
Ans	(i) (c) 1600 Mya (ii) (d) Oparin (iii) (b) 220 million years back (iv) (b) Plants
	Long Answer Type Question
1	Name the law that states that allelic frequency in a population remains constant. What are the five factors that influence these values?
Ans	The Law – Hardy Weinberg principles states that – genetic variation in a population will remain constant or in equilibrium from one generation to the next remaining same till some disturbing factor tilts it. Factors which influence its value are – gene flow, genetic drift, mutation, recombination and natural selection.
2	What are the key concepts in the evolution theory of Darwin?
Ans	Two key concepts of evolution theory of Darwin are Natural Selection and Branching decent. Natural selection operates over variants produced in organisms and select the most suitable for survival and reproduction. Accumulation of variation produce new species which are modified descendent of original stock. Darwinism is based on five points: (i) High rate of reproduction (ii) Limitations of food and space (iii) Struggle for existence (iv) Variations (v) Natural Selection or survival of the fittest.
3	We are told that evolution is a continuing phenomenon for all living beings. Are human beings also evolving?
Ans	Evolution is a continuous phenomenon but it is slow as well not applicable to all situations. There are organisms which have remained unchanged for the past over hundred million years. Evolution occurs when there is stress on resources development of mutation and competition from better adapted organisms. Human beings have also faced such an evolution from Homo habilis, Home erectus and Homo sapiens. Presently only subspecies of Homo sapiens, called modern man or human beings is surviving all over the earth as it has the capability of overcoming natural stress and disasters and build its own comfortable environment.

Chapter no 7: HUMAN HEALTH AND DISEASES

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

Factors affecting Health:

Genetic Factors – e.g. Sickle cell anaemia

Life style-e.g. Obesity

Infections-e.g. Influenza

TYPES OF DISEASES:

I. Infectious (communicable) -e.g. Leprosy, common cold.

Transmitted by - air, water, physical contact, animals

Causative agents – viral, bacterial, fungal, worms, protozoan

Control methods – balanced diet, good personal hygiene, awareness about diseases, vaccination, hygienic food and water.

II. Non-Infectious (non-communicable) - e.g. High blood pressure, Cancer, Heart diseases.

Causes– stress, no/less physical activity, genetic, unsuitable diet, wrong life style, exposure to carcinogens.

Control measures – stress management, physical exercise, balanced diet, avoiding drugs, alcohol and tobacco.

Pathogenic diseases:

Disease	Causative Organism	Mode of Transmission	Control	Prevention
Malaria	Plasmodium	Bite of female Anopheles	Quinine	Breaking contact between female Anopheles and man, eliminating Anopheles
Diarrhea	Protozoan, bacteria, viruses	Contaminated food and water	ORS or salt-sugar solution	Proper sanitation, personal hygiene
Cholera	Vibrio cholerae	Contaminated food and water	Antibiotics, ORS or salt-sugar solution	Proper sanitation, vaccination
Typhoid	Salmonella typhi	Contaminated food and water	Use of antibiotics	Proper sewage system, using chlorinated or boiled water
Tuberculosis	Mycobacterium tuberculosis	Cough/sneeze droplets, contaminated milk	Use of antibiotics	Awareness to maintain cleanliness in public places and BCG vaccine for children
Hepatitis	Hepatitis viruses (A-G)	Contaminated food and water for some forms, through body fluids for others	Rest, antiviral injection, food rich in carbohydrates	Good sanitation, safe drinking water, use tested blood, disposables needles and syringes
Rabies	Rabies virus	Bite of infected animal	No cure after the diseases develops	Wash the wound antirabies serum, course of vaccine shots, pets should be vaccinated,
AIDS	Human immunodeficiency virus (HIV)	Infected blood, semen, breast milk, mother to fetus	No cure yet, a combination of drugs slows down progress of the diseases	Screening of blood and donors, use of disposable needles and syringes, not sharing blades and razors, safe sex practices.
Influenza	Myxovirus	Cough/sneeze droplets	No cure, bed rest, aspirin and fluids provide relief	Keeping away from infected person

Diseases Caused by Worms

Ascariasis

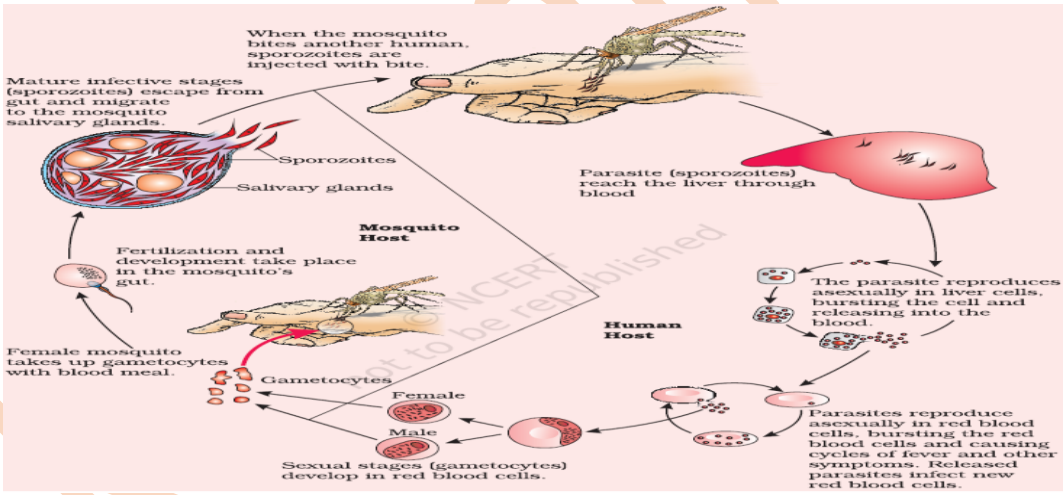
- **Pathogen** − Round worm, *Ascaris lumbricoides*
- **Spreads through** − Water, vegetables, fruits contaminated by faeces of infected person
- **Symptoms** − Internal bleeding, muscular pain, fever, anaemia, blockage of intestinal passage

Elephantiasis(filariasis)

- **Pathogen** − *Wuchereria (W. malayi and W. bancrofti)*
- **Spreads through** − Bite of female mosquito vector
- **Symptom** − Chronic inflammation of the organs, usually the lymphatic vessels of lower limb

Life Cycle of Plasmodium

- ✓ Plasmodium requires **two hosts** to complete its life cycle
- ✓ As female Anopheles mosquito bites a healthy human being, it releases Plasmodium, which lives in its body as sporozoite (infectious form).
- ✓ The parasites multiply (asexual reproduction) in the liver cells and finally burst the liver cells. Sporozoites are released in blood.
- ✓ Parasites enter RBCs and further multiply (asexual reproduction) here and finally burst RBCs also.
- ✓ Bursting of RBCs is accompanied by release of a toxic substance called **hemozoin** **(associated with fever and chills).**
- ✓ In the RBCs, only sporozoites change into gametocytes (sexual stage) Gametocytes multiply.
- ✓ When the diseased person is bitten by a female Anopheles mosquito, gametocytes are introduced into the mosquito.
- ✓ Gametocytes fertilise and develop inside the intestine of mosquito to form sporozoites.
- ✓ Sporozoites are stored in the salivary glands of mosquito and are released into the healthy person who is bitten by this mosquito.



Immunity-

The ability of body to fight the disease-causing organisms is called immunity.

Types of immunity

Immunity is of two types − innate immunity and acquired immunity.

Innate immunity− It is present from the time of birth. It is non-specific. It consists of 4 kinds of barriers.

- ☞ **Physical barriers** − Skin and mucus coating of respiratory, gastrointestinal, and urogenital tract prevent entry of microbes into body.
- ☞ **Physiological barriers** − Acid in stomach, saliva in mouth, tears from eyes

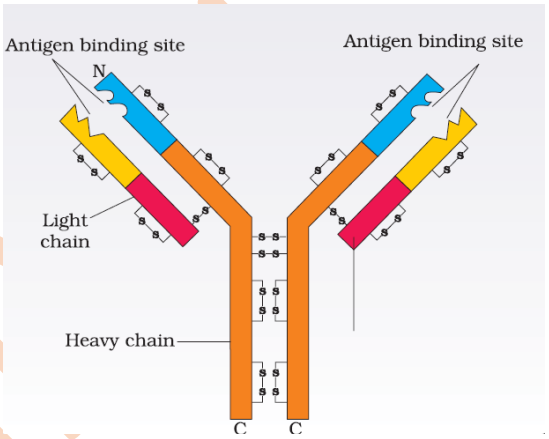
- ☞ **Cellular barriers** − Blood has leukocytes such as polymorph nuclear leukocytes, monocytes, etc. and tissue has macrophages which phagocytose the microbes.
- ☞ **Cytokine barriers** − Special proteins called interferons are secreted by virus infected cells that prevent the further spread of viral infection.

Acquired immunity − It is acquired, which means that it is produced in response to an encounter with a pathogen based on memory. It is pathogen specific.

If a pathogen for the first time infects a person, low intensity immune response is generated (**primary response**)-**Amnestic Response.**

If the same pathogen attacks again, intensified immune response in generated, thereby preventing the occurrence of disease (**secondary response**) **Anamnestic Response.**

Acquired immunity involves two types of cells - **B-lymphocytes and T- lymphocytes**.



B-lymphocytes − Secrete proteins called antibodies in response to pathogens Antibodies are specialized proteins with 4 peptide chains (2 light and 2 heavy), hence denoted as H2L2. IgA IgM,IgE, etc. are examples of some of the antibodies. They generate humoral immune response(found in blood).

T-lymphocytes − They help B-cells to produce antibodies. They generate cell -mediated immune response. This response helps the body to differentiate between 'self' and 'non-self' as occurs in case of graft rejection.

Active and Passive immunity.

Active Immunity	Passive Immunity
• This is the naturally acquired immunity produced in the host body in response to an antigen. • Immunization and body naturally getting immune to a microbe that had caused infection previously are examples of active immunity.	• When ready-made antibodies are provided to an individual to protect against foreign agents. • Colostrum present in mother's milk contain IgA. Also, the foetus gets antibodies from mother through placenta.

How does vaccination help?

● Vaccines are nothing but inactivated pathogens.

● These inactivated pathogens when introduced in the body produce a primary immune response and antibodies are produced against the pathogen.

● Memory B and T-cells are produced.

● Now when the pathogen again attacks the person, memory B and T-cells generate a massive immune response and the pathogen is killed.

Problems of immune system

Allergies

Exaggerated immune response to certain antigens present in environment
Allergens − Substances in response to which allergy is produced E.g., dust, pollen, etc.
Antibodies involved − IgE type

During allergic reactions, chemicals such as histamines and serotonins are released.
Symptoms − Sneezing, watery eyes, difficulty in breathing, etc.
Allergy test − Patient is injected with small doses of allergens to monitor his response.
Antihistamines, adrenalins, and **steroids** may be given so that the symptoms of allergy subside.

Auto immunity

- ✓ In autoimmunity, body generates immune response against its own cells.
- ✓ Reasons − Genetic and other unknown reasons
- ✓ Example − **Rheumatoid arthritis** is an autoimmune disease.

Human immune system

Lymphoid organs are of two types − primary lymphoid organs and secondary lymphoid organs.

● **Primary lymphoid organs** consist of bone marrow and thymus. Here, immature lymphocytes are differentiated to form antigen sensitive lymphocytes.

○ Bone marrow − Here, all blood cells including lymphocytes are produced.

○ Thymus − It is responsible for maturation of T-Lymphocytes. This lobed organ is situated near the heart and keeps on reducing in size as the age increases.

● **Secondary lymphoid organs** − Lymphocytes migrate here after attaining maturity. It includes spleen, lymph nodes tonsils, Peyer's patches, and appendix.

○ Spleen − Large bean shaped organ containing lymphocytes and phagocytes, which acts as a filter for blood.

○ Lymph nodes − Located at different points throughout the immune system, they trap the antigens present in lymph or tissue fluid, and these antigens cause activation of lymphocytes and generation of immune response.

● **MALT** (**Mucosal associated lymphoid tissue**) − Lines major tracts

(respiratory, digestive, urogenital, etc); constitutes 50% of lymphoid tissue in body.

AIDS (Acquired Immuno Deficiency Syndrome)

Caused by HIV **(Human Immunodeficiency Virus)** HIV is a retrovirus (RNA virus)]

Transmission of HIV occurs through:

○ Sexual contact with infected person

○ Sharing infected needles (as in case of intravenous drug abusers)

○ Transfusion of contaminated blood

○ Infected mother to child through placenta

● Time lag between infection and appearance of symptoms – Few months to many years (5-10 years)

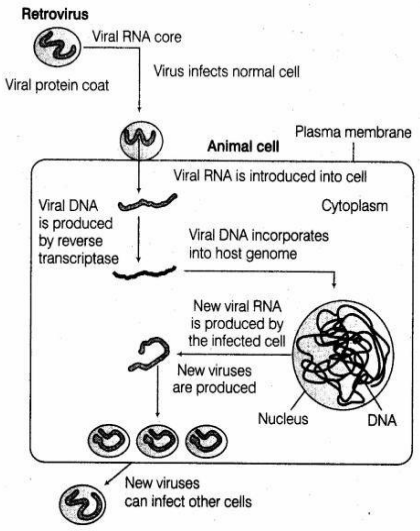
How does AIDS infection spread?

- ✓ Virus enters the body of a person and enters macrophages.
- ✓ Here, virus replicates (viral RNA reverse transcribes to viral DNA, which gets incorporated into hosts DNA and subsequently new viral particles are produced).
- ✓ Macrophages become a virtual HIV factory.
- ✓ Thereafter, HIV enters helper T- lymphocytes, replicates, and produces progenies.
- ✓ As the progenies are released, they attack other T- lymphocytes.
- ✓ Therefore, T- lymphocytes start decreasing in number and immune response of the person becomes weak.
- ✓ Even infections which could be overcome easily start aggravating.

● Diagnosis of AIDS − By **ELISA** (Enzyme Linked Immuno Sorbent Assay)● Treatment −No permanent cure; antiretroviral therapies can prolong the life of patient.

Prevention of AIDS

- ✓ Ensuring use of disposable syringes.
- ✓ Screening blood from blood banks.
- ✓ Advocating safe sex.
- ✓ NACO (National AIDS Control Organization) and many NGOs are doing a lot to create awareness among people.



Replication of Retrovirus inside an animal cell.

Cancer

● The process of development of cancer is called oncogenic transformation.

● Normal cells have the property of contact inhibition (stoppage of growth on coming in contact with other cells), but cancer cells lose this property.

● As a result, cancer cells divide continuously to give rise to mass of cells (tumours).

Tumours are of 2 types − **Benign and Malignant.**

● **Benign tumours** − Remain confined to their original location and do not spread

● **Malignant tumours**− These exhibit **metastasis** i.e., the cells sloughed from such tumours reach distant sites and wherever they reach, new tumour is formed.

● Malignant tumours actually represent cancer. The cells actively divide, grow, and starve the normal cells of vital nutrients.

Causes of cancer

○ Carcinogens − Physical, chemical, and biological agents that cause cancer , Example - ionizing radiations (X-rays and gamma rays), non-ionizing radiations (UV).

○ Oncogenic (cancer-causing) viruses− They have viral oncogenes (cancer-causing genes).

○ Sometimes normal genes in our body called proto-oncogenes get converted into cellular oncogenes that cause cancer.

Diagnosing cancer

○ Biopsy and histopathological studies
○ Biopsy− Suspected tissue is cut into thin sections and examined microscopically
○ Radiography, CT scan (computed tomography), and MRI (Magnetic resonance imaging) are techniques of diagnosing cancers.
○ C T Scan− 3-D imaging of internals of an organ is generated by X-rays.
○ MRI Scan− Pathological and physiological changes in a living tissue are detected by using magnetic fields and nonionizing radiations.
○ Immunological and molecular biological diagnostic techniques can all be used to detect cancers.
○ Identifying certain genes, which make an individual susceptible to cancers, can help to prevent cancers.

Treatment of cancer

Radiotherapy − Tumour cells are irradiated to death. Also, proper care is taken for protecting surrounding normal tissues.

Chemotherapy − Drugs specific for particular tumours are used to kill cancer cells. They have side effects such as hair loss, anaemia, etc.

Immunotherapy− Biological response modifiers such as α-interferons are used. They activate the immune system of patient and helps in destroying the tumour.

Commonly Abused Drugs

Name of the drug	Source	Part of the plant	Mode of intake	Effect	Ex.
Opioids	**Papaver somniferum**	Latex	Snorting/ injection	Binds with opioid receptors in the CNS & GI tract. Depressant –slows body function	Diacetyl morphine Heroin (smack)
Cannabinoids	**Cannabis sativa**	Inflorescence, flower tops, resins, leaves	Inhalation/ orally	- Affects Cardiovascular system. - Binds with receptors in the brain .	Marijuana Hashish
Coca Alkaloid	**Erythroxylum**		snorting	-Stimulates CNS	Coke/crack

	coca			-Sense of euphoria /Increased energy -Interferes with transport of neurotransmitter - dopamine -Excess- cause hallucinations	
Barbiturates, amphetamines, benzodiazepines, morphine				Cope up with mental illness like depression , insomnia	
Nicotine /alkaloid	Tobacco	leaves	Smoking, chewing	-Stimulates adrenal gland to release adrenaline and nor-adrenaline - Raises BP and heart rate -Increases risk of cancer of throat, lung, etc -Bronchitis, emphysema, CHD, - CO content in blood increases and reduces haem bound oxygen -Addictive	
LSD	FUNGI			HALLUCINATIONS	

Addiction and Dependence:

- Addiction is a psychological attachment to certain effects –such as euphoria and a temporary feeling of well-being – associated with drugs and alcohol.
- Withdrawal syndrome: if regular dose of drugs/alcohol is abruptly discontinued. This is characterised by anxiety, shakiness, nausea and sweating, which may be relieved when use is resumed again.

Prevention and Control

- **Avoid undue peer pressure**
- **Education and counselling**
- **Seeking help from parents and peers**
- **Looking for danger signs**
- **Seeking professional and medical help**

Revision through Question-Answer

BIOLOGY

2 marks Questions.

Q.N	Question and Answers
1.	**(a) Name the infective stage of Plasmodium which Anopheles mosquito takes in along with the blood meal from an infected human.** **(b) Why does the infection cause fever and recurrent chills in human**
Ans-	(a) The infective stage of Plasmodium which Anopheles mosquito takes in along with the blood meal from an infected human is gametocyte (b) Malaria is characterized by fever at intervals, sudden acute chillness accompanied by shivering followed by rise in temperature. Peak fever is 41.1°C which persists for 3-6 hours. After 2-4 hours of fever, there is profuse sweating which lowers the body temperature to near normal.
2	**Given below are the pathogens and the diseases caused by them. Which out of these pairs is not correct matching pair and why?** **(a) Wuchereria –Sleeping sickness** **(b) Microsporum -Ringworm** **(c) Salmonella -Common Cold** **(d) Plasmodium-Malaria**
Ans-	Wuchereria –Sleeping sickness is not a matching pair Salmonella : Common cold is not a matching pair
3	**Municipal corporation has deputed personnel to check for mosquito in your school.** **i) Which are the places they should check for mosquitoes & their larvae?** **ii) Name two diseases which are spread by mosquitoes and their larvae?**
Ans-	i) Places like water tanks, flower pots, stagnant water ii) Dengue, malaria, filariasis, chikungunya
4	**A boy of ten years had chicken-pox. He is not expected to have the same disease for the rest of his life. Mention how it is possible.**
Ans	He has developed memory and antibody for the chicken pox. It is an example of active immunity. Hence, he will not contract Chicken pox
5	**A young boy when brought a pet dog home started to complain of watery eyes and running nose. The symptoms disappeared when the boy was kept away from the pet.** **(a) Name the type of antibody and the chemicals responsible for such a response in the boy.** **(b) Mention the name of any one drug that could be given to the boy for immediate relief from such a response.**
Ans :	(a) Such a response in the boy is called allergy which occurs due to production of IgE antibodies and chemicals like histamine and serotonin from the mast cells. (b) Anti-histamine could be given to the boy for immediate relief from such a response

6 **Name the type of immunity that the colostrum provides to a new born baby. Write by giving an example where this type of immunity should be provided to a person.**

Ans- Colostrum provides passive immunity from a lactating mother to a new born baby.It contains the antibody IgA.

The insertion of antibodies or antitoxins directly produce quick immune responses e.g.,in tetanus preformed antibodies are directly injected.

7 **Name two drugs obtained from poppy plant. "These drugs are medically useful but are often abused. Taking the mentioned examples justify by giving reasons.**

Ans- Heroin / smack, morphine; morphine obtained from latex of unripe capsules of poppy plant (*Papaver somniferum*) is an effective pain killer and sedative. Heroin (a derivative of morphine) is used as drug.

If these drugs are taken for the purpose other than medicinal or taken in larger doses, that may impair the physical and mental state of a person, then it is said to be abused.

8 **(a) Name a drug used (i) as an effective sedative and painkiller (ii) for helping patients to cope with mental illnesses like depression, but often misused.**
(b) How does the moderate and high dosage of cocaine affect the human body?

Ans - (a) (i) Morphine (ii) Barbiturates
(b) Cocaine taken in low dose induces sense of well being and pleasure and delays fatigue, but in high dosage, it causes hallucinations.

9 **Answer the following with respect to Cancer.**
(a) How does a cancerous cell differ from a normal cell
(b) Benign tumor is less dangerous than malignant tumor. Why?

Ans-

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

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

10 **(i) Name the drug used**
(a) As an effective sedative & pain killer.
(b) For helping patients to cope with mental illness like depression but often misused.
(ii) How does the moderate and high doses of cocaine affect human body

Ans :

a) Morphine, which is obtained from the latex of the poppy plant is used as an effective sedative and pain killer.
(b) LSD (Lysergic acid dimethyl amide) or Barbiturates are used to help the patients to cope with mental illness like depression.
LSD is a hallucinogenic substance,
(ii) Cocaine is a powerful addictive stimulant drug. The source of cocaine is coca leaves (Erythroxylum coca). It can alter brain structure and function if used repeatedly.
Effect of moderate doses of cocaine:
1. Feeling of euphoria and increased energy.
2. Increased in heartbeat, respiration rate and blood pressure.
3. Dilated pupils.
4. Feeling of wellness and increased confidence.

3 marks questions

Qn.No.	Question and Answers
1	Two children, A and B aged 4 and 5 years respectively visited a hospital with a similar genetic disorder. The girl A was provided with enzyme replacement therapy and was advised to revisit periodically for further treatment. The girl B was, however, given a therapy that did not require revisit for further treatment. (a) Name the ailments the two girls were suffering from? (b) Why did the treatment provided to girl requires repeated visits? (c) How was the girl B cured permanently?
Ans-	a. Adenosine deaminase (ADA) deficiency (b) In Enzyme Replacement Therapy functional ADA is introduced to the patient (by injection), this therapy is not completely curative as enzyme can act only for a limited time period. (c) As there is no permanent cure at the age of Five.
2	If a patient is advised anti-retroviral drug, name the possible infection he/ she is likely to be suffering from. Name the causative organism. (b) How do vaccines prevent subsequent microbial infection by the same pathogen? (c) How does a cancerous cell differ from a normal cell?
Ans	a) AIDS is caused by the HIV (Human Immuno Deficiency Virus). (b) Vaccines prevent microbial infections by initiating production of antibodies against these antigens to neutralize the pathogenic agents during later actual infection. The vaccines also generate memory – B and T-cells that recognize the pathogen quickly on subsequent exposure. (c) Normal cells show a property called "contact inhibition" by virtue of which contact with other cells inhibits their uncontrolled growth. Cancer cells appear to have lost this property

3 **i**).It is generally observed that the children who had suffered from chickenpox in their childhood may not contract the same disease in their adulthood. Explain giving reasons on the basis of such immunity in an individual. Name this kind of immunity.

Ans ii) What are interferons? Mention their role.

(i) The first infection of chickenpox produces a primary response and antibodies are generated against the chickenpox virus, subsequent encounter with the same virus elicits a highly intensified secondary response, due to the memory cells formed during the first encounter, (active immunity).

(ii) Proteins secreted by virus infected cells, which protects non-infected cells from viral infection / when a – interferon is given to cancer patient (it activates immune system), destroys tumour.

4 Certain attributes of innate immunity are given in the table below. Identify A, B, C, D, E and F respectively in it

Sr. No.	Type of barrier	Example of the barrier	Function
(i)	**A**	**B**	Prevent microbial growth
(ii)	**C**	Polymorpho nuclear leucocytes	**D**
(iii)	Cytokine	**E**	**F**

Ans: A. Physiological barrier.
B. Acid in Stomach/Saliva in mouth/Tears.
C. Cellular Barrier.
D. Phagocytose / Destroy microbes.
E. Interferons.
F. Protect non-infected cells from virus attack

5 State the three characteristics of Acquired Immunity. List the different ways by which it can be attained by humans.

Ans: Characteristics of Acquired Immunity:
Pathogen specific / characterized by memory / Acquired after birth / are of two types: Active and passive/humoral and cell mediated/includes primary response and secondary response.
Way by which it can be attained by humans: Active Immunity by encountering a pathogen /virulent microbe/suffering from contagious disease.
Passive Immunity through immunization / readymade antibodies.

6 (a) List any two situations when a medical doctor could recommend injection of preformed antibodies into the body of a patient. Name this kind of immunization and mention its advantages.

(b) Name the kind of immunity attained when instead of antibodies, weakened

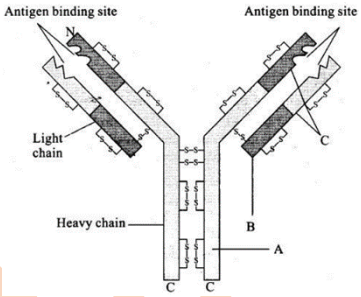
Ans: antigens are introduced into the body.

(a) If a person is infected with some deadly microbes to which quick immune response is required as in tetanus, we need to directly inject the preformed antibodies or antitoxin.

Even in the cases of snakes bites the injection which is given to the patients, contain preformed antibodies against the snake venom. This type of immunisation is called passive immunisation. It provides immediate relief.

(b) In vaccination, a preparation of antigenic proteins of pathogens or inactivated weakened pathogens are introduced into the body. This produces immune response and the type of immunity is called active immunity.

7 **Identify A, B and C in the schematic diagram of an antibody given above and answer the questions**



a) Identify the parts A,B,C.
(b) Name the cells that produce antibodies in humans.
(c) Mention the type of immune response provided by an antibody.

Ans: (a) A-Heavy chain ,B-Light Chain ,C-Antigen binding site.
(b) B-cells produce antibodies.
(c) Humoral immune response is an antibody mediated immune response.

8 **How does the HIV breakdown the immune system of the AIDS patients?**

Ans :
(i) Virus enters in macrophages.
(ii) RNA genome replicates to form viral DNA with help of reverse transcriptase.
(iii) Viral DNA gets incorporated into host cells DNA to produce virus particles.
(iv) HIV enters into helper 'T' lymphocytes and produces progeny virus.
(v) These are released in the blood and attack another helper 'T' lymphocytes.
(vi) This leads to progressive decrease in the number of helper 'T' lymphocytes and the person starts suffering from infections (loss of immunity)

9 During a school trip to 'Rohtang Pass', one of your classmates suddenly developed 'altitude sickness'. But she recovered after some time.
(a) Mention one symptom to diagnose the sickness.
(b) What caused the sickness?
(c) How could she recover by herself after some time?

Ans:

(a) Nausea / fatigue / heart palpitation.
(b) Low atmospheric pressure at high altitude,
body deprived of O_2
(c) Increase in RBC, decreases binding capacity
of hemoglobin, increased breathing rate, get acclimatized.

10 **(i) Name the type of lymphoid organs spleen and lymphoid nodes are. Explain the role played by them in causing immune response.**
(ii) Differentiate between innate immunity and acquired immunity.
(i) Spleen: They act as sites for interaction of lymphocytes with the antigen and cause immune response.
Function:
Spleen: Trap blood-borne micro-organisms and worn-out RBCs, thus filters blood.

Lymph nodes: Trap the micro-organisms / antigens (which happen to get into the lymph and tissue fluid). The trapped antigens activate lymphocytes and cause immune response.

ii.

Innate Immunity	Acquired Immunity
Non-specific type of response.	Pathogen-specific defence.
Present at the time of birth.	Acquired by the body after birth.
Provides a barrier to the entry of foreign agents into our body.	Characterised by memory.

Case Based Questions (5 marks)

Qn.No. Question and Answers

1 The process of development of cancer is called oncogenic transformation. Norma cells have the property of contact inhibition (stoppage of growth on coming i contact with other cells), but cancer cells lose this property.

● As a result, cancer cells divide continuously to give rise to mass of cells (tumours).Tumours are of 2 types − Benign and Malignant.

● Benign tumours − Remain confined to their original location and do not spread

● Malignant tumours− These exhibit metastasis i.e., the cells sloughed from such tumours reach distant sites and wherever they reach, new tumour is formed. Malignant tumours actually represent cancer. The cells actively divide, grow, and starve the normal cells of vital nutrients.

(a) Cancer is one of the most dreaded diseases of humans. Explain 'Contact inhibition' and 'Metastasis' with respect to the disease.
(b) Name the group of genes which have been identified in normal cells that could lead to cancer and how they do so?
(c) Name any two techniques which are useful to detect cancers of internal organs.
(d) Why are cancer patients often given α-interferon as part of the treatment?

Ans. (a) Contact inhibition is the property of normal cells in which contact with other cells inhibits their uncontrolled growth. Metastasis is the property in which tumour cells reach distant sites in the body, through blood.
(b) Proto oncogenes or Cellular oncogenes. These genes when activated under certain condition could lead to oncogenic transformation of the cells.
(c) Biopsy/radiography/CT/MRI (Any two)
(d) a-interferon activates immune system and destroys the tumour

2 You have attended a birthday party hosted by one of your classmates. You found some guests at the party sitting in a corner making a lot of noise and consuming 'something'. After a while one of the boys from the group started screaming, behaving abnormally and sweating profusely. On enquiry you found that the group members were taking drugs.

(a) Would you inform your parents/school authorities? Yes/No. Give reasons is support of your answer.

(b) Prepare a note to be circulated amongst the schoolmates about the sources and dangers of any two drugs.

(c) Write any two ways that you will suggest to your school principal so as to promote awareness amongst the youth against the use of these drugs.

Ans. (a) Yes, so that it does not become a habit by repeated use. Consumption of drugs may cause harmful effects.

b.

Drug	**Source**	**Danger**
Cocaine	Erythroxylum coca	Affects central nervous system and interferes with transport of dopamine.
Opioids/ Heroin/Smack	Latex of Papaver somniferum (poppy plant)	Slows down body functions.
Cannabinoids	Cannabis	sativa Affects cardiovascular system

(c). (c) Awareness can be promoted by organizing poster making competitions, street plays, talks by experts and interviews of experts.

CH-08 MICROBES IN HUMAN WELFARE

Microbes in Household products

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.

LAB play very beneficial role in checking disease causing microbes in Stomach.

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.

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.

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. Penicillin 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 Penicillin after the mould **Penicillium 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 (Monascus purpureus 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.

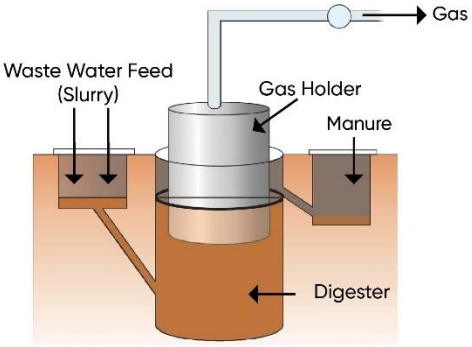
A small part of this sludge is pumped back into the aeration tank to serve as the inoculum. The remaining major part of the sludge is pumped into large tanks called anaerobic sludge digesters. During this digestion, bacteria produce a mixture of gases such as methane, hydrogen sulphide and carbon dioxide. These gases form biogas. The effluent from the secondary treatment plant is generally released into natural waterbodies like rivers and streams.

Microbes in Production of Biogas:

Biogas is mixture of gases produced by the microbial activity and which may be used as fuel. Certain Methanobacterium (present in gut of ruminants) which grow anaerobically on cellulosic material, produce large amount of methane along with CO_2 and H_2. A lot of cellulosic material present in the food of cattle is also present in the rumen. Cellulose is broken down and converted later into biogas. Thus, the excreta(dung) of cattle, commonly called Gober, is rich in these bacteria. Dung can be used for generation of biogas commonly called Gober gas.

Biogas Plant:

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 in the 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.

Microbes as Biocontrol Agents:

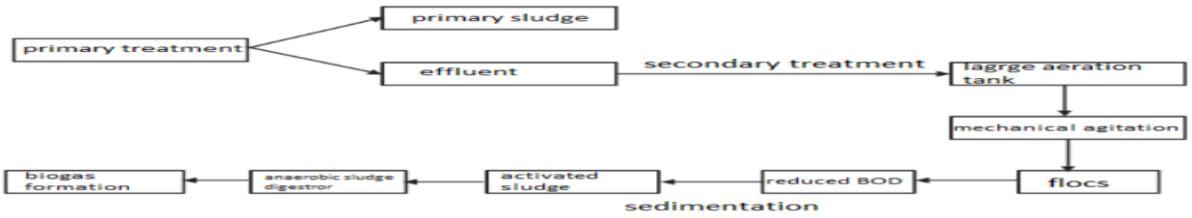
Biological control of pests and diseases:
Lady bird – **to control aphids**
Dragon fly – **to control mosquitoes**

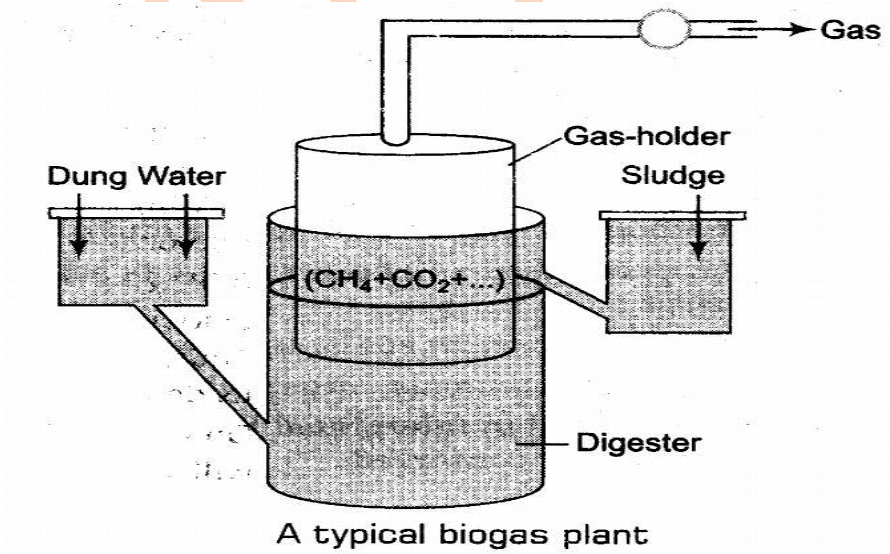
Bacillus thuringiensis (Bt Cotton) – **to control wide range insects**
Trichoderma (fungi) – **protects root system and control plant pathogens.**
Baculoviruses (Nucleopolyhedrovirus) – to attack insects and other arthropods.

Microbes as Biofertilizers:

Biofertilizers are organisms that enrich the nutrient quality of the soil. The main sources of biofertilizers are bacteria, fungi and cyanobacteria.
Bacteria:
Symbiotic Bacteria – 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.
Some important Diagram(s)

Sewage water treatment process





A typical biogas plant

Revision through Question-Answer

BIOLOGY

2 marks Questions

Q No. Question and Answers

1 Your advice is sought to improve the nitrogen content of the soil to be used for cultivation of a non-leguminous terrestrial crop.
(a) Recommend two microbes that can enrich the soil with nitrogen.
(b) Why do leguminous crops not require such enrichment of the soil?

Ans: a) *Azospirillum/ Azotobacter/ Anabaena/ Nostoc / Oscillatoria /Frankia* (Any two correct names of microbes).

(If cyanobacteria mentioned=½, but if along with cyanobacteria-a*nabaena / Nostoc / Oscillatoria* mentioned then no mark on cyanobacteria).
(b) They can fix atmospheric nitrogen, due to presence of *Rhizobium*/N2 fixing bacteria in their root nodules.

2 Name the microbes that help the production of the following products commercially:
(i) Statins
(ii) Citric acid
(iii) Penicillin
(iv) Butyric acid

Ans : (i) *Monascus purpureus*
(ii) *Aspergillus niger*
(iii) *Penicillium notatum*
(iv) *Clostridium butylicum*

3 **Name a genus of baculovirus. Why are they considered good biocontrol agents?**

Ans *Nucleopolyhedrovirus*
Species specific, narrow spectrum insecticidal application, no negative impact on non-target organisms

4 Mention a product of human welfare obtained with the help of each one of the following microbes.
(i) LAB
(ii) *Saccharomyces cerevisiae*
(iii) *Propionibacterium shermanii*
(iv) *Trichoderma polysporum*

Ans:
(i) Milk to curd
(ii) Bread / ethanol / alcoholic drinks / whisky / brandy/ beer/ rum
(iii) Swiss cheese
(iv) Cyclosporin A

5 **Distinguish between the roles of flocs and anaerobic sludge digesters in sewage treatments.**

Ans:

Sl. No.	Flocs	Anaerobic Sludge Digester
(i)	Breakdown organic matter aerobically.	Breakdown organic matter anaerobically.

(ii)	Breaks down organic matter present in primary effluent.	Breaks down organic matter present in secondary effluent.
(iii)	They do not produce biogas.	They produce biogas (mixture of methane, H_2S and CO_2)

MULTIPLE CHOICE QUESTIONS

1. Which of the following is a common biocontrol agent for the control of plant diseases?

(a) Baculovirus (b) Bacillus thuringiensis

(c) Glomus (d) Trichoderma

Ans. d

2. Among the following, which is a wrong match between a microbe and its industrial product, while the others are correct?

(a) Yeast – statins (b) *Acetobacter aceti* – acid

(c) *Clostridium butylicum* – lactic acid (d) *Aspergillus niger* – citric acid

Ans. (c)

3. Which of the following biogases is produced during sewage treatment?

(a) Methane, oxygen, hydrogen sulphide (b) hydrogen sulphide, methane, sulphur dioxide

(c) Hydrogen sulphide, nitrogen, methane (d)) methane, hydrogen sulphide, carbon dioxide

Ans. (d)

4. Some blue-green algae have the potential to be used as biofertilizers as they are?

(a) Photosynthetic (b) Surrounded by mucilage

(c) growing everywhere (d) Capable of fixing nitrogen

Ans. (d)

5. It was mainly due to the efforts of who in India that biogas production technology was developed?

(a) Indian Agricultural/ Research Institute (IARI) and Khadi and Village Industries Commission (KVIC)

(b) National Botanical Research Institute (NBR1) (c) Indian Council of Medical Research (ICMR) (d) Indian Council of Agricultural Research (ICAR)

Ans . (a)

6. BOD is measure of

(a) Organic material in water (b) Polluting potential of water

(c) Required oxygen to consume organic material (d) All of the above

Ans. (d)

7. Symbiotic nitrogen fixing bacteria
(a) *Rohizobium* (b) *Azospirillum*
(c) *Azetobacter* (d) Legume
Ans. (a)
8 . Which of the following is not a cyanobacteria
(a) *Anabaena* (b) *Nostoc*
(c) *Oscillatoria* (d) *Azetobacter*
Ans. (d)
9. Nucleopolyhedro virus are
(a) Biological control agents (b) Baculoviruses
(c) Narrow spectrum insecticidal viruses (d) All of the above
Ans. (d)
10. Ruminants
(a) have methanogens in their gut (b) Can digest cellulose with the help of certain bacteria
(c) can be used for pest control (d) (a) and (b) both
Ans. (d)

ASSERTION REASON TYPE QUESTION

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: *Lactobacillus* convert milk into curd.
   Reason: It increases Vitamin B12 in milk.
2. Assertion: Yeasts such as Saccharomyces cerevisiae are used in baking industry.
   Reason: Carbon dioxide produced during fermentation causes bread dough to rise by thermal expansion.
3. Assertion: An organ transplant patient if not provided with cyclosporin A may reject the transplanted organ. Reason: *Cyclosporin* A inhibits activation of T-cells and interferes with destruction of non-self-cells.
4. Assertion: *Saccharomyces* species are utilized for making alcoholic beverages.
   Reason: *Saccharomyces* is species of Yeast
5. Assertion: Secondary treatment of sewage is also called biological treatment while primary treatment is called physical treatment.
   Reason: Primary sewage treatment depends only upon sedimentation properties of materials present in sewage and filtration.

answers

1	2	3	4	5

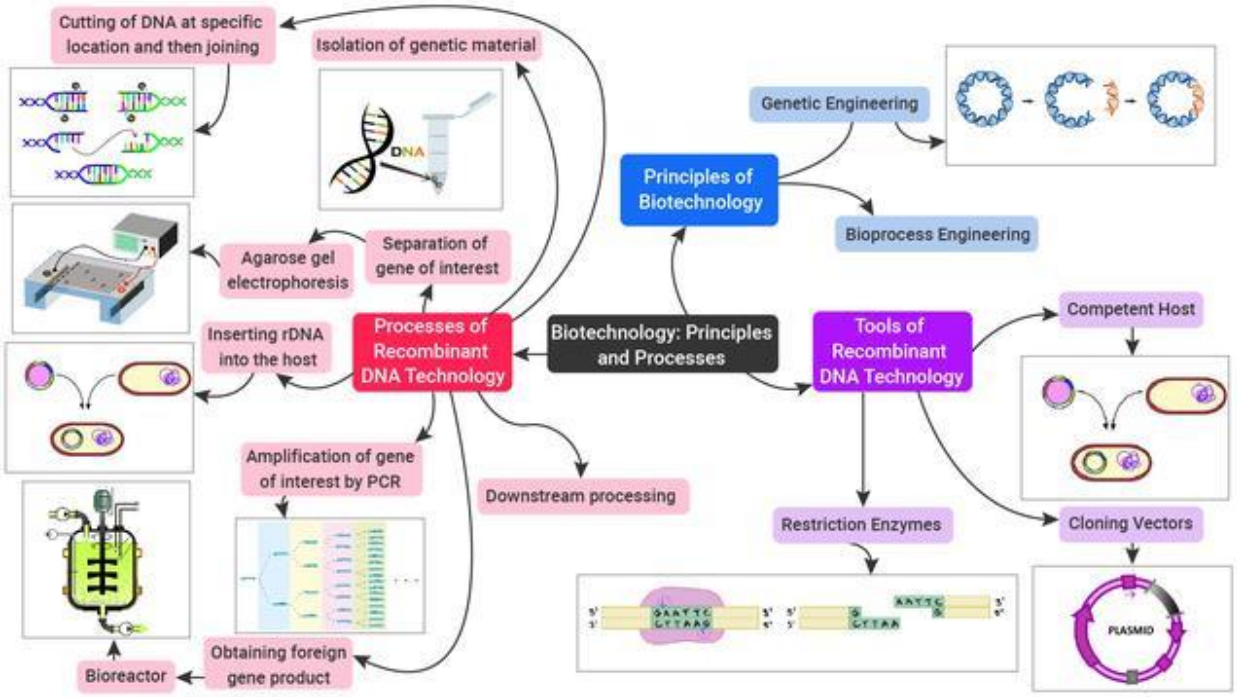
BIOLOGY

B	a	a	B	a

CHAPTER - 9 **BIOTECHNOLOGY: PRINCIPLES AND PROCESS**

Mind Map : The overall Idea

BIOLOGY

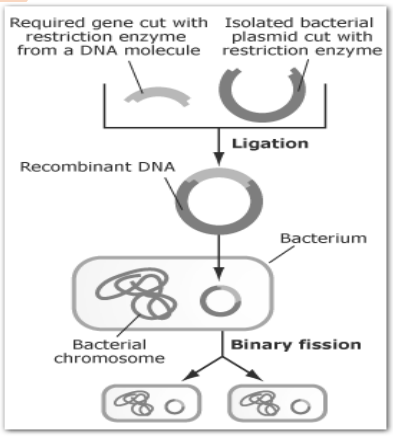


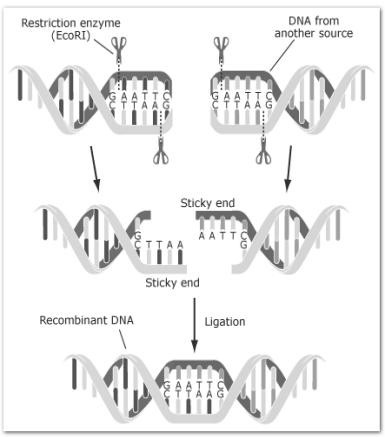
EFB (European Federation of Biotechnologist)defines Biotechnology as : 'The integration of natural science and organisms, cells, parts thereof, and molecular analogues for products and services'.

Two core techniques that enabled birth of modern biotechnology	
Genetic engineering	Techniques to alter the chemistry of genetic material (DNA and RNA), to introduce these into host organisms and thus change the phenotype of the host organism.
Chemical Engineering	Maintenance of sterile (microbial contamination-free) ambience in chemical engineering processes to enable growth of only the desired microbe/eukaryotic cell in large quantities for the manufacture of biotechnological products like antibiotics, vaccines, enzymes, etc.

Steps in producing recombinant

1. The required gene is cut from a DNA molecule using a Restriction enzyme.
2. A bacterial plasmid is isolated and cut with the same restriction enzyme. This ensures cut ends are complementary (same base sequence) to the ends of the required gene.
3. The required gene is joined to the plasmid using the enzyme DNA ligase in a process called ligation.
4. The resulting recombinant plasmid is returned to the bacterial cell.
5. The bacteria reproduce and the required gene is cloned.





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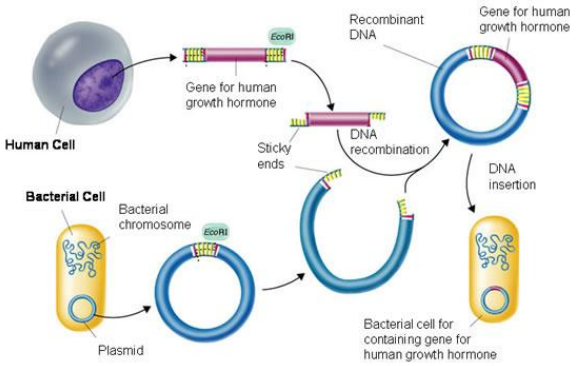


Recombinant DNA Technology

Procedure:

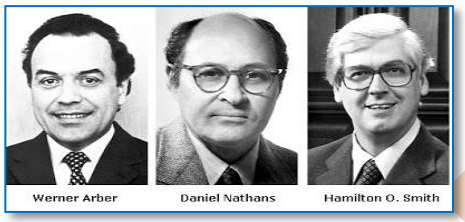
- Isolation
- Digestion
- Fractionation
- Purification of the TARGET fragment
- Cloning into vectors
- Transformation of host cell and selection
- Replication
- Analysis

Introduction of recombinant DNA into host cells:

Some commonly used procedures:

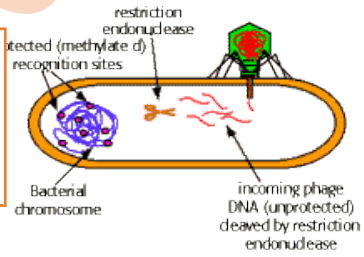
1. Transformation
2. Transfection
3. Electroporation
4. Biolistics or Genegun

***Agrobacterium* mediated gene transfer**



Discovery of a **first restriction enzyme** Hind II in the bacterium *Haemophilus influenza* by **Nathans, Arber & Smith** and award Nobel Prize.

Methyl groups are added to C or A nucleotides in order to protect the bacterial host DNA from degradation by its own enzymes



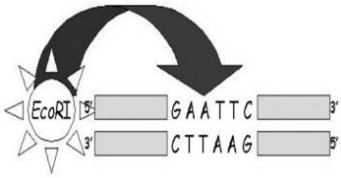
Restriction enzymes

Naming : EcoRI

E	co	R	I
Escherichia	coli	RY 13	1

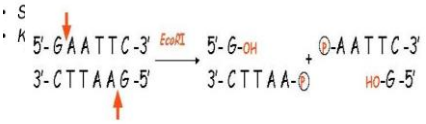
Restriction enzymes recognise specific short nucleotide sequence (

This is known as a Restriction Site The phosphodiester bond is cleaved between specific bases, one on each DNA strand



Why the funny names?

- *EcoRI – Escherichia coli* strain R, 1st enzyme
- *BamHI – Bacillus amyloliquefaciens* strain H, 1st enzyme
- *DpnI – Diplococcus pneumoniae*, 1st enzyme
- *HindIII – Haemophilus influenzae*, strain D, 3rd enzyme
- *BglII – Bacillus globigii*, 2nd enzyme
- *PstI – Providencia stuartii* 164, 1st enzyme
- S
- K



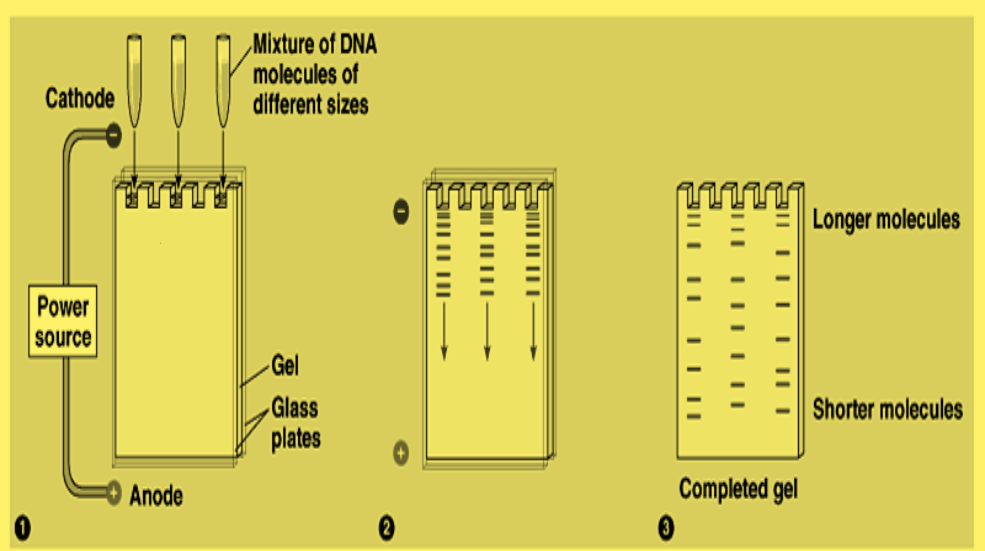
Types :

Exonucleases *remove nucleotides from the ends of the DNA whereas,*

Endonucleases *make cuts at specific positions within the DNA.*

DNA fractionation

Separation of DNA fragments in order to isolate and analyse DNA cut by restriction enzymes



GEL ELECTROPHORESIS :

Separation and isolation of DNA fragments:

(i) The cutting of DNA by restriction endonucleases results in the short fragments of DNA, which can be separated by a technique known as **gel electrophoresis**.

(ii) The DNA fragments are negatively charged and they can be separated by forcing them to move towards the anode under an electric field through a medium/matrix.

(iii) Commonly used matrix is agarose, which is a natural linear polymer of D-galactose and 3, 6-anhydro-L-galactose which is extracted from sea weeds.

(iv) The DNA fragments separate (resolve) out according to their size through sieving effect provided by the agarose gel. Hence, the smaller the fragment size, the farther it will move.

(v) The separated DNA fragments can be visualized after staining the DNA with **ethidium bromide** followed by exposure to UV radiation (orange band).

(vi) The separated bands of DNA are cut out and extracted from the gel piece, this step is called elution.

(viii) The purified DNA fragments are used to form recombinant DNA which can be joined with cloning vectors.

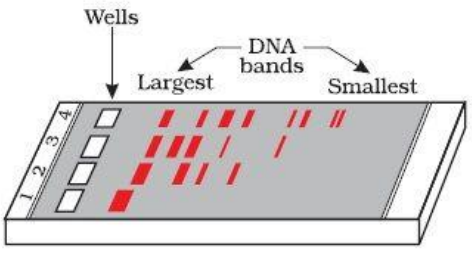
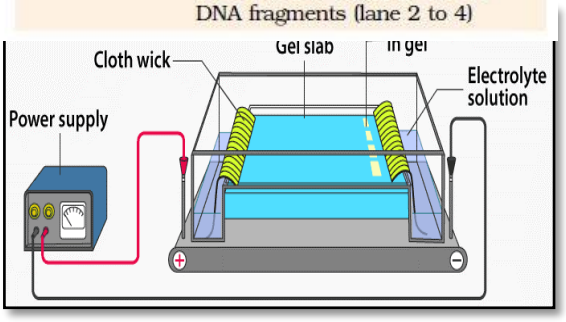


Figure 11.3 A typical agarose gel electrophoresis showing migration of undigested (lane 1) and digested set of DNA fragments (lane 2 to 4)



https://youtu.be/6mQGNDnOyH8

Recombinant DNA technology:

Recombinant DNA: Plasmids, cloning

What is DNA cloning?DNA *cloning is the isolation of a fragment or fragments of DNA from an organism and placing in a VECTOR that replicates independently of chromosomal DNA. The RECOMBINANT DNA is propagated in a host organism, the resulting CLONES are a set of genetically identical organisms which contain the recombinant DNA*

Three main purposes for cloning DNA
1) DNA sequencing
2) Protein production
3) Engineering animals/plants/proteins

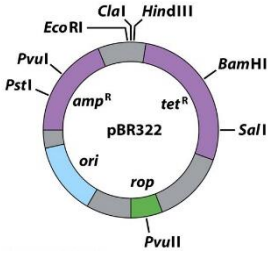
Cloning and Expression Vectors

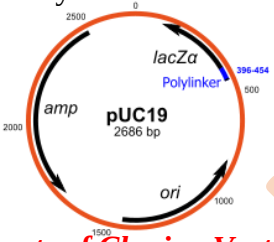
Isolated DNA is cloned into **VECTORS** for long term storage, propagation of the DNA and for production of protein from gene(s) encoded in the DNA

What are cloning vectors?

Cloning vectors are extra-chromosomal 'replicons' of DNA which can be isolated and can replicate independently of the chromosome.

- pBR322 has 4361 base pairs
- Origin of replication (*ori*)
- Antibiotic resistance genes *amp* and *tet*
- *Rop* gene regulates replication for ~20 copies of the plasmid per cell





Components of Cloning Vector

Commonly used vector systems
Bacterial plasmids
Bacteriophages
Cosmids
Yeast artificial chromosomes (YACs)
Ti plasmid (plants)
Eukaryotic viruses such as baculovirus (insect cells), SV40 virus and retroviruses.

Characteristics of a Cloning Vector

Origin of replication (ORI)	This process marks autonomous replication in vector. ORI is a specific sequence of nucleotide in DNA from where replication starts. When foreign DNA is linked to this sequence then along with vector replication, foreign (desirable) DNA also starts replicating within host cell.
Selectable Marker	***Characteristics of Selectable marker:*** A gene whose expression allows one to identify cells that have been transformed or transfected with a vector containing the marker gene. A **marker gene** is used to determine if a piece of DNA has been successfully inserted into the host organism. Gene usually encoding resistance to an antibiotic. A **selectable marker** will protect the organism from a **selective agent** that would normally kill it or prevent its growth.
Restriction sites	Allow cleavage of specific sequence by specific Restriction Endonuclease. Restriction sites in E.coli cloning vector pBR322 include HindIII , EcoRI , BamHI , SalI, PvuI, PstI, ClaI etc.

A Cloning Vector that Works with Plant Cells

Most commonly used plant cloning vector ***"Ti" plasmid,*** or tumor-inducing plasmid. Found in cells of the bacterium known as ***Agrobacterium tumefaciens***, normally lives in soil. Bacterium has ability to infect plants and cause a **crown gall**, or tumorous lump, to form at the site of infection.

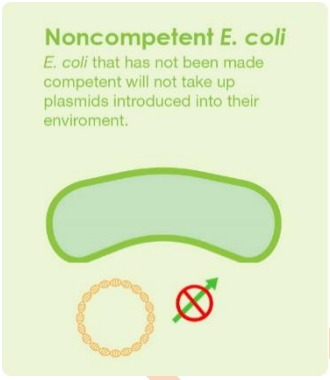
Ti plasmid - called T DNA - separates from the plasmid and incorporates into the host cell genome. This aspect of Ti plasmid function has made it useful as a ***plant cloning vector*** ***(natural genetic engineer).***

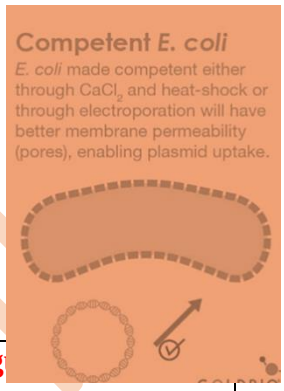
Competent Host (For Transformation with Recombinant DNA)

(i) **DNA** being a **hydrophilic molecule**, **cannot pass** through **cell membranes**.

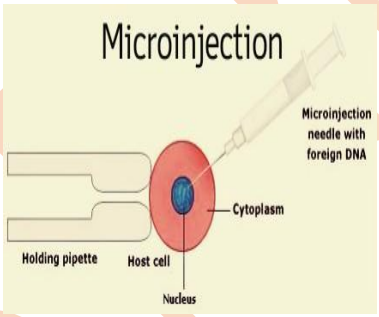
(ii) The bacteria should be made competent first, to accept the DNA molecules by treating them with a specific concentration of a divalent cation like calcium (Ca^{++}) which increases the efficiency with which DNA enters the cell through the pores in its cell wall.

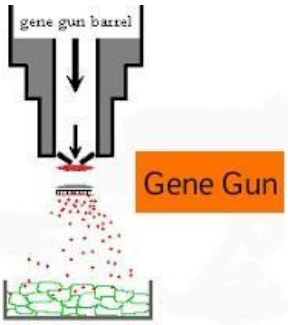
(iii) Recombinant DNA can be forced into such cells by incubating the cells on ice, followed by placing them briefly at 42°C **(heat shock)** and then putting them back on ice. This facilitates the entry of recombinant DNA in the bacterial cell.





Heat shock method	Micro-injection	Gene g
DNA is treated with a specific concentration of a divalent cation, such as calcium, which increases the efficiency with which DNA enters the bacterium through pores in its cell wall. The *r*DNA is forced into the cell by incubating the cell with *r*DNA on ice, followed by placing them briefly at 42°C (heat shock) and then putting them back on ice.	*r*DNA is directly injected into the nucleus of an animal cell.	cells are bombarded with high velocity micro-particles of gold or tungsten coated with DNA.





Isolation of DNA

1. Treating the bacterial cells/plant or animal tissue with enzymes such as **lysozyme** (bacteria), **cellulase** (plant cells), **chitinase** (fungus).
2. The RNA can be removed by treatment with **ribonuclease**.
3. Proteins can be removed by treatment with **protease**.
4. Other molecules can be removed by appropriate treatments
5. Purified DNA ultimately precipitates out after the **addition of chilled ethanol.**

This can be seen as collection of fine threads in the suspension

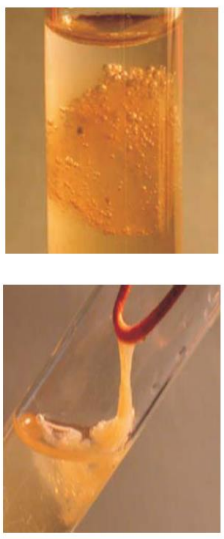
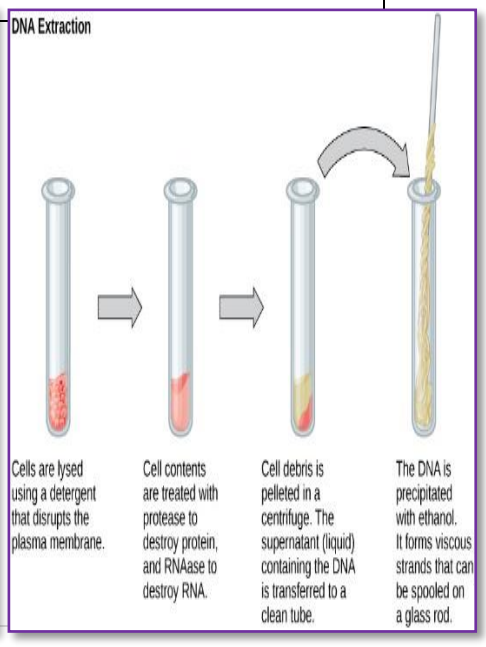
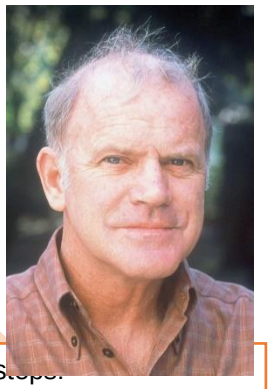


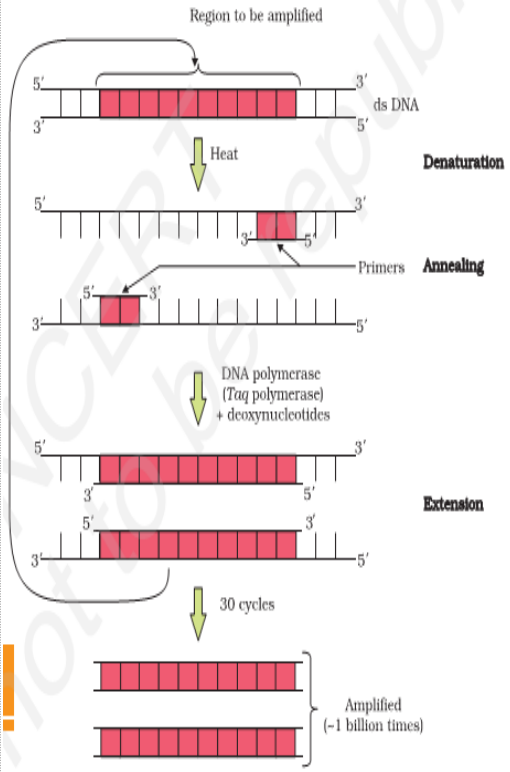
Figure 11.5 DNA that separates out can be removed by spooling



PCR (Polymerase Chain Reaction):



PCR is a technique for the ***in vitro amplification of a desired sequence of DNA***. PCR allows the generation of a large quantity of DNA product from only a few starting copies. It has been shown that PCR can be used to generate a detectable quantity of DNA from only one starting **target** (or **template**) molecule. PCR developed in the mid-**1986 by Kary Mullis**.



PCR is carried out in the following three steps:

(a) Denaturation

- ✓ The double-stranded DNA is denatured by applying high temperature of 95°C for 15 seconds. Each separated single stranded strand now acts as template for DNAsynthesis.

(b) Annealing

- ✓ Two sets of primers are added which anneal to the 3′ end of each separated strand.
- ✓ Primers act as initiators of replication.
- ✓ It is done at temperature of 62^0 C for around 20 s

(c) Extension (72^0 C for 20 s)

- ✓ DNA polymerase extends the primers by adding nucleotides complementary to the template provided in the reaction.
- ✓ A thermostable DNA polymerase (*Taq* polymerase) is used in the reaction which can tolerate the high temperature of the reaction.
- ✓ All these steps are repeated many times to obtain several copies of desired DNA.

Discovery of a thermostable DNA polymerase

The breakthrough came with the discovery of the thermostable DNA polymerase ***Taq* polymerase**, from the thermophilic bacterium, *Thermus aquaticus*, which lives in hot springs. ***Taq* polymerase** enzyme can resist **high temperatures** required to melt the template DNA apart without denaturation (loss of activity) and works best at **high temperatures (72°C).**

Bioreactor: It is a large vessel having many controls and is mainly used for :
(*i*) processing large volumes of culture
(*ii*) large scale production of recombinant proteins
(*iii*) biologically converting raw materials into specific products.

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.

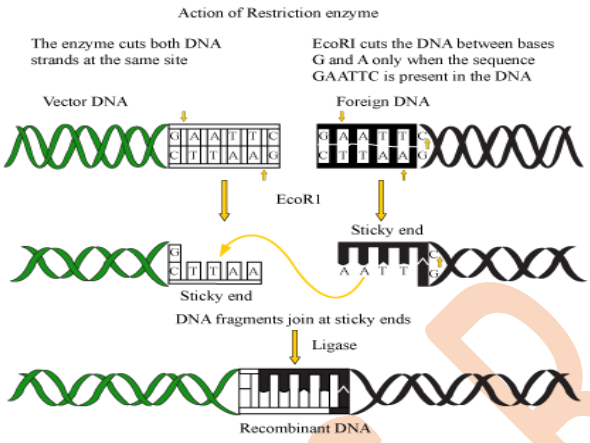
Downstream processing

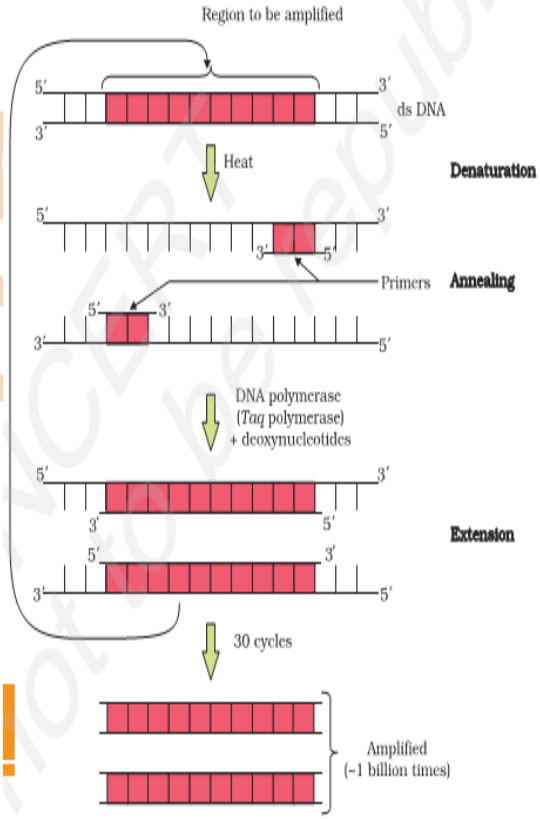
It refers to the recovery and purification of biosynthetic products, particularly pharmaceuticals, from natural sources such as animal or plant tissue or fermentation broth

Stages in Downstream Processing -A widely recognized heuristic for categorizing downstream processing operations divides them into four groups which are applied to bring a product from its natural state as a component of a tissue, cell or fermentation broth through progressive improvements in purity and concentration.

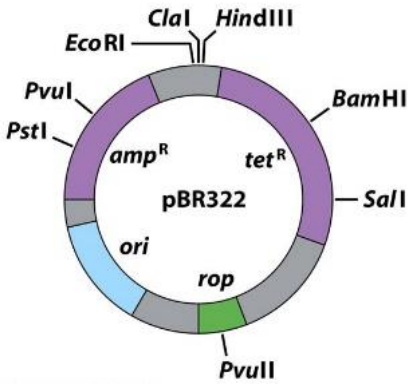
Removal of insolubles → Product Isolation → Product Purification → Product Polishing

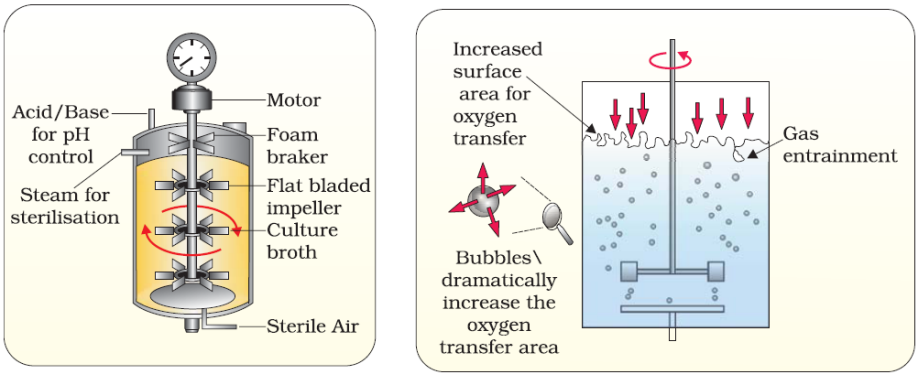
Some important Diagram(s)





- pBR322 has 4361 base pairs
- Origin of replication (*ori*)
- Antibiotic resistance genes *amp* and *tet*
- *Rop* gene regulates replication for ~20 copies of the plasmid per cell





igure 11.7 (a) Simple stirred-tank bioreactor; (b) Sparged stirred-tank bioreactor through which sterile air bubbles are sparged

Revision through Question-Answer

2 marks Questions

1 What are the two principal core techniques that gave rise to modern biotechnology?

Ans-
- Genetic Engineering
- Bioprocess Engineering

2 Name the technique that creates recombinant DNA? List the steps involved in it.

Ans- Genetic Engineering or Recombinant DNA Technology.

The Key Steps are:
- ✓ Creation of recombinant DNA
- ✓ Gene cloning
- ✓ Gene transfer into host organism

3 The first recombinant DNA was created by joint effort of Boyer and Cohen. How did they create the r-DNA?

Ans- Stanley Cohen and Herbert Boyer created rDNA in 1972 by isolating the antibiotic resistance gene by cutting out a piece of DNA from a plasmid using restriction enzymes. The cut piece of DNA was then linked with the plasmid DNA. These plasmid DNA act as vectors to transfer the piece of DNA attached to it.

4 **a. How can DNA be visualised after separation using gel electrophoresis?**

b. In the given process of separation and isolation of DNA fragments, some of the steps are missing, Complete the missing steps –

A: Digestion of DNA fragments using restriction endonucleases

↓

B: .....

↓

C: Staining with ethidium bromide

↓

D: Visualisation in U.V. light

↓

E: .....

↓

F: Purification of DNA fragments.

Ans- **a**. The DNA is stained with Ethidium Bromide is placed under UV Chamber (Transilluminator). The DNA is seen as orange band.

b. At step B the process of Gel Electrophoresis takes place while at step E the process of Elution occurs.

5 **What do you understand by Insertional inactivation?**

Ans- In recombinant DNA technology, insertional inactivation is a technique utilised. In this process, a bacteria carrying recombinant plasmids or a fragment of foreign DNA is made to insert into a restriction site inside a gene, causing the gene to become non-functional or inactivated and so resistant to antibiotics.

Or

The insertional inactivation is the process of insertion of the recombinant DNA into the coding Sequence of enzyme such as B– galactosidase leading to the inactivation of the enzyme. An example is when the insert is absent in the plasmid of bacteria then it will lead to the insertional inactivation leading to the production of colourless colonies instead of blue-colored colonies due to the presence of chromogenic substrate.

6 **Why is coding sequence of an enzyme Beta-Galactosidase a preferred selectable marker in comparison to antibiotic resistances (amp^R and tet^R) ?**

Ans- The selection of recombinants due to inactivation of antibiotics is a difficult process and requires simultaneous plating on two plates having different antibiotics. The enzyme β-galactosidase is preferred as a selectable marker as when the recombinant DNA is inserted into the coding sequence of the enzyme β-galactosidase, it leads to the inactivation of the enzyme and hence in the presence of a chromogenic substance the recombinants do not give coloured colonies, while the non-recombinants produce blue colonies. Thus, no separate plating is required.

7 **What will happen if there are many recognition sites in a cloning vector?**

Ans- If the restricition enzymes have more than one recognition site in a vector, then **the vector itself will get fragmented on treatment on treatment with the restriciton enzyme** . Restriction enzymes should not have more than one site of action in the cloning site of a vector.

8 **State what happens when an alien gene is inserted at Sal I and Pvu I site of pBR322 Plasmid?**

Ans- If an alien gene is ligated at the Pvu I site of ampicillin resistance gene in the vector pBR322 the **recombinant plasmids lose ampicillin resistance due to insertion for the foreign DNA**.

9 **Describe how is DNA isolated from a cell for recombinant DNA technology?**

Ans- Isolation of DNA from the organism:

i. The cells are lysed using detergent mixtures, which creates pores in the plasma membrane.
ii. Then the mixture of cell contents is treated with protease and RNAase enzymes. The enzyme protease destroys the proteins present in the mixture and the enzyme RNAase destroys the RNA molecules present in the mixture.
iii. Then the mixture is centrifuged and the supernatant containing the DNA is transferred into a clean test tube and ,
iv. the DNA precipitated with the addition of ethanol.

10 **Mention two classes of restriction enzymes. Suggest their respective roles.**

Ans- Ans: Exonucleases and endonucleases are two classes of restriction enzymes.
The function of Exonucleases is to remove the nucleotides from the ends of the DNA while the Endonucleases play a major role in cutting the DNA at specific sites between the ends of DNA.

3 marks Questions (10 questions)

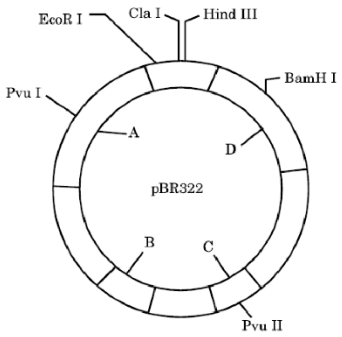
1 **An enzyme discovered from bacteria was found to cut the DNA of virus. What was the term used to for such Enzymes? How are these enzymes named? Explain using an example.**

Ans- Such Enzymes are called **Restriction enzymes.**
Naming : EcoRI

E	co	R	I
Escherichia	coli	RY 13	1
1st Letter of Genus in capital	**Two letters of species in lower case**	**First letter of Strain**	**Order in which the enzymes were isolated from that strain of bacteria.**

2

Study the figure of vector pBR322 given below.



Identify A,D, B and C and explain their roles in cloning a vector.

Ans- A- Ampicillin Resistance
B- ORI
C- ROP

D- Tetracycline Resistance

A, D- are used as selectable Marker in rDNA technology

B- ORI is a specific sequence of nucleotide in DNA from where replication starts. When foreign DNA is linked to this sequence then along with vector replication, foreign (desirable) DNA also starts replicating within host cell.

C- ROP - It codes for the proteins involved in the replication of the plasmid.

3 **What do you understand by down streaming process? Explain the steps involved in it and give its significance**.

Ans- **Downstream processing:** The processes include separation and purification are collectively referred to as downstream processing. It refers to the recovery and purification of biosynthetic products, particularly pharmaceuticals, from natural sources such as animal or plant tissue or fermentation broth.

Steps in Down streaming Process:

Removal of insoluble
Product Isolation
Product Purification
Product Polishing

The steps are necessary to make products ready for marketing as a finished product.

4 **A vector is engineered with three features which facilitate its cloning within the host cell. List the three features and explain each one of them.**

Ans- **Characteristic Feature of Cloning Vector:**

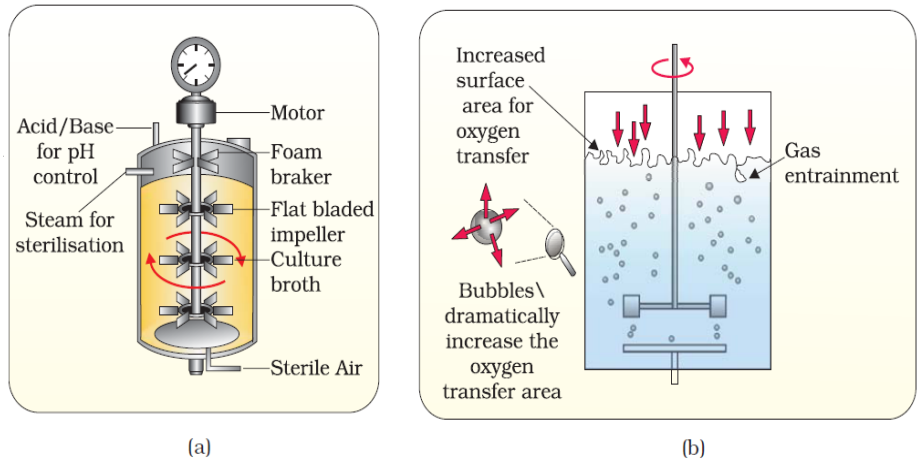
Origin of replication (ORI) :This process marks autonomous replication in vector. ORI is a specific sequence of nucleotide in DNA from where replication starts. When foreign DNA is linked to this sequence then along with vector replication, foreign (desirable) DNA also starts replicating within host cell.

Selectable Marker: A gene whose expression allows one to identify cells that have been transformed or transfected with a vector containing the marker gene. A marker gene is used to determine if a piece of DNA has been successfully inserted into the host organism. Gene usually encoding resistance to an antibiotic. A selectable marker will protect the organism from a selective agent that would normally kill it or prevent its growth.

Restriction sites : Allow cleavage of specific sequence by specific Restriction Endonuclease. Restriction sites in E.coli cloning vector pBR322 include HindIII , EcoRI , BamHI , SalI, PvuI, PstI, ClaI etc.

5 **What is a bioreactor? Draw a labelled diagram of a sparged stirred-tank bioreactor. How does simple stirred type bioreactor differ from sparged stirred tank bioreactor?**

Ans- Bioreactor: It is a large vessel having many controls and is mainly used for:



igure 11.7 (a) Simple stirred-tank bioreactor; (b) Sparged stirred-tank bioreactor through which sterile air bubbles are sparged

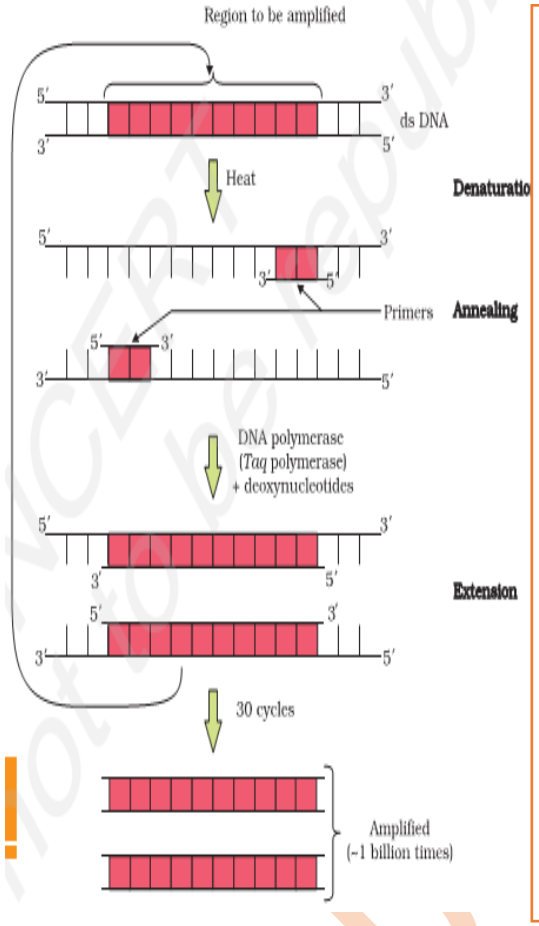
(i) processing large volumes of culture (ii) large scale production of recombinant proteins

(iii) biologically converting raw materials into specific products

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.

6 **Expand PCR. Mention its important steps.**

Ans-



PCR or **POLYMERASE CHAIN REACTION** is carried out in the following three steps:

(a) Denaturation

- ✓ The double-stranded DNA is denatured by applying high temperature of 95°C for 15 seconds. Each separated single stranded strand now acts as template for DNAsynthesis.

(b) Annealing

- ✓ Two sets of primers are added which anneal to the 3′ end of each separated strand.
- ✓ Primers act as initiators of replication.
- ✓ It is done at temperature of 62^0 C for around 20 s

(c) Extension (72^0 C for 20 s)

- ✓ DNA polymerase extends the primers by adding nucleotides complementary to the template provided in the reaction.
- ✓ A thermostable DNA polymerase (*Taq* polymerase) is used in the reaction which can tolerate the high temperature of the reaction.
- ✓ All these steps are repeated many times to obtain several copies of desired DNA.

7 **What are various ways to transfer Gene into host without using vector? Name a method that is used to transfer gene in Animal Cell.**

Ans- various ways to transfer Gene into host without using vector

I. Heat shock method: DNA is treated with a specific concentration of a divalent cation, such as calcium, which increases the efficiency with which DNA enters the bacterium through pores in its cell wall. The rDNA is forced into the cell by incubating the cell with rDNA on ice, followed by placing them briefly at 42°C (heat shock) and then putting them back on ice.

II. Micro-injection : rDNA is directly injected into the nucleus of an animal cell.

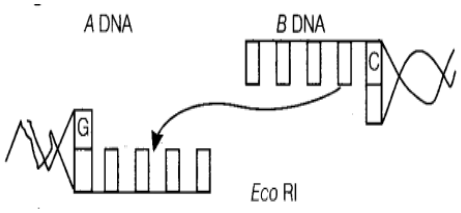
III. Gene gun/Biolistic : cells are bombarded with high velocity micro-particles of gold or tungsten coated with DNA.

Microinjection technique is used to transfer gene into Animal Cell.

8 The following Illustrates linking of DNA Fragments

(i) Write the name of A and B.

(ii) Complete the palindrome, which is



recognised by Eco RI.
(iii) Write the name of the enzyme that can link the two DNA fragments.

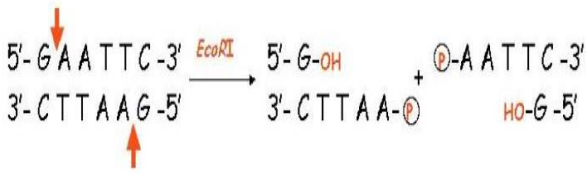
Ans- i. A-Vector DNA, B-Foreign DNA
ii. GAATTC(Pallindromic Recognition Sequence of Enzyme ECORI)
iii. DNA Ligase

9 Rearrange the following in correct sequence to accomplish an important biotechnological reaction
a). Invitro synthesis of copies of DNA of Interest
b).Chemically synthesised oligonucleotide
c).Enzyme-DNA Polymerase
d).Complementary region of DNA
e).Genomic DNA Template
f).Nucleotides provided
g).Primers
h)Thermostable DNA Polymerase from (Thermus aquaticus)
i).Denaturation of dsDNA**.**

Ans- The correct sequence of the steps involved in biotechnological reaction is
e. Genomic DNA template
i. Denaturation of ds-DNA
g. Primers
f. Nucleotides provided
h. Thermostable DNA polymerase (from Thermus aquaticus)
c. Enzyme DNA polymerase
b. Chemically synthesised oligonucleotides
d. Complementary region of DNA
a. In vitro synthesis of copies of DNA of interest

10 Observe the given sequence of nitrogenous bases on a DNA fragment and answer the following question
5′ - CAGAATTCTTA - 3′
3′ - GTCTTAAGAAT - 5′
(a) Name a restriction enzyme that can recognize this DNA sequence.
(b) Write the sequence after digestion.

Ans- Ans: a.EcoRI is the name of a restriction enzyme that helps in the recognition of various sequences of DNA.
b.



5 marks questions (Case Based Questions)

1 Some restriction enzymes break a phosphodiester bond on both the DNA strands, such that only one end of each molecule is cut and these ends have regions of single stranded

DNA. BamH1is one such restriction enzyme which binds at the recognition sequence, 5'-GGATCC- 3'and cleaves these sequences just after the 5'- guanine on each strand.

a. What is the objective of this action?

b. Explain how the gene of interest is introduced into a vector.

c. You are given the DNA shown below.

5' ATTTTGAGGATCCGTAATGTCCT 3'
3' TAAAACTCCTAGGCATTACAGGA 5'

If this DNA was cut with BamHI, how many DNA fragments would you expect? Write the sequence of these double-stranded DNA fragments with their respective polarity.

d. A gene M was introduced into E. coli cloning vector PBR322 at BamH1 site. What will be its impact on the recombinant plasmids? Give a possible way by which you could differentiate non recombinant to recombinant plasmids

Ans a. The two different DNA molecules will have compatible ends to recombine.
b. Restriction enzyme cuts the DNA of the vector and then ligates the gene of interest into the DNA of the vector.
c. 2 fragments
5' ATTTTGAG 3'5'GATCCGTAATGTCCT 3'
3' TAAAACTCCTAG 5'.3'GCATTACAGGA 5'
d. BamH1 site will affect tetracycline antibiotic resistance gene, hence the recombinant plasmids will lose tetracycline resistance due to inactivation of the resistance gene.
Recombinants can be selected from non-recombinants by plating into a medium containing tetracycline, as the recombinants will not grow in the medium because the tetracycline resistance gene is cut.

2 POLYMERASE CHAIN REACTION (PCR) stands for Polymerase Chain Reaction. In this reaction, multiple copies of the gene (or DNA) of interest are synthesised in vitro using two sets of primers (small chemically synthesised oligonucleotides that are complementary to the regions of DNA) and the enzyme DNA polymerase. The enzyme extends the primers using the nucleotides provided in the reaction and the genomic DNA as template. If the process of replication of DNA is repeated many times, the segment of DNA can be amplified to approximately billion times, i.e., 1 billion copies are made. Such repeated amplification is achieved by the use of a thermostable DNA polymerase (isolated from a bacterium, Thermus aquaticus), which remain active during the high temperature induced denaturation of double stranded DNA. The amplified fragment if desired can now be used to ligate with a vector for further cloning .

a. What are the three steps involved in PCR ?
b. How is it possible for DNA polymerase to work at high temperature in PCR ? What is the source of such thermostable DNA polymerase?
c. What are Primers? List its uses
.(a) The three steps involved in polymerase chain reaction (PCR):
(i) Denaturation of double stranded DNA (dsDNA) at high temperature.

(ii) Annealing of two sets of primers.
(iii) Extension of primers to form dsDNA by Taq polymerase and deoxynucleotides.
(b) Source of organism is the bacterium Thermus aquaticus. This enzyme is heat tolerant and repeatedly amplifies DNA at high temperatures.
(c). Primers are artificially synthesized oligonucleotide strand that are complementary to the regions of DNA. They anneal to both the strands of DNA which are then extended using nucleotides.

Multiple Type Questions

Choose and write the correct option in the following questions.

1. Restriction endonuclease
(a) synthesizes DNA (b) cuts the DNA molecules randomly
(c) cuts the DNA molecule at specific sites (d) restricts the synthesise of DNA inside the nuclease

2. The linking of antibiotic resistance gene with the plasmid vector became possible with
(a) DNA polymerase (b) exonucleases (c) DNA ligase (d) endonucleases

3. Stirred-tank bioreactors have been designed for
(a) addition of preservatives to the product (b) purification of the product
(c) ensuring anaerobic conditions in the culture vessel (d) availability of oxygen throughout the process 4. Given below is a sample of a portion of DNA strand giving the base sequence on the opposite strands. What is so special shown in it? 5′____GAATTC____3′ 3′____CTTAAG____5′
(a) Replication completed (b) Deletion mutation
(c) Start codon at the 5′ level (d) Palindromic sequence of base pairs

5. There is a restriction endonuclease called Eco RI. What does “co” part in it stand for?
(a) Colon (b) Coelom (c) Coenzyme (d) Coli

6. Agarose extracted from sea weeds is used in
(a) spectrophotometry (b) tissue culture (c) PCR (d) gel electrophoresis

7. An enzyme catalysing the removal of nucleotides from the ends of DNA is
(a) endonuclease (b) exonuclease (c) DNA ligase (d) Hind-II

8. The transfer of genetic material from one bacterium to another through the mediation of a viral vector is termed as:
(a) transduction (b) conjugation (c) transformation (d) translation

9. Which of the given statements is correct in the context of observing DNA separated by agarose gel electrophoresis?
(a) DNA can be seen in visible light
(b) DNA can be seen without staining in visible light
(c) Ethidium bromide stained DNA can be seen in visible light
(d) Ethidium bromide stained DNA can be seen under exposure to UV light

10. Which of the following is not a characteristic of the plasmids ?
(a) Extranuclear (b) Single-stranded (c) Independent replication (d) Circular DNA

Answers 1. (c) 2. (c) 3. (d) 4. (d) 5. (d) 6. (d) 7. (b) 8. (a) 9. (d) 10

In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
(c) Assertion is correct statement but reason is wrong statement.
(d) Assertion is wrong statement but reason is correct statement.

1. Assertion: Plasmids are single stranded extrachromosomal DNA.
Reason: Plasmids are found in eukaryotic cells.
2. Assertion: Plasmids are extrachromosomal DNA.
Reason: Plasmids are found in bacteria and are useful in genetic engineering.
3. Assertion: In recombinant DNA technology, human genes are often transferred into bacteria (prokaryotes) or yeast (eukaryote).
Reason: Both bacteria and yeast multiply very fast to form huge population which express the desired gene.
4. Assertion: Insertion of recombinant DNA within the coding sequence of beta-galactosidase results in colourless colonies.
Reason: Presence of insert results in inactivation of enzyme beta-galactosidase known as insertional inactivation.
5. Assertion: In recombinant DNA technology both ligase and nuclease play an important role.
Reason: Ligase cuts the DNA at specific sites and nuclease joins the DNA fragments.

Answers 1. (c) 2. (a) 3. (a) 4. (a) 5. (c) 6. (a) 7. (b) 8. (d) 9. (b) 10. (a)

BIOLOGY

CHAPTER – 10

BIOTECHNOLOGY AND ITS APPLICATION

- Biotechnology has many applications including biopharmaceuticals, therapeutics ,diagnostics ,genetically modified crops, processed food, bioremediation, waste treatment and energy production

Three Critical research areas of Biotechnology;-

- Providing the best catalyst in the form of an improved organism usually a microbe or enzyme
- Creating optimal condition through engineering for a catalyst to act .
- Downstream processing technologies to purify the protein / organic compound .

BIOTECHNOLOGICAL APPLICATION IN AGRICULTURE:-

Three way to increase food production are

- Agro-chemical based agriculture
- Organic agriculture
- Genetically engineered crop based agriculture.

ADVANTAGES OF GENETIC MODIFICATION IN PLANTS

- It makes crops more tolerant to abiotic stress (cold, drought, salt, heat etc.)
- Pest – resistant crops reduce the use of chemical pesticides.
- It reduces post – harvest losses.
- It increases plant mineral usage efficiency (it prevents soil fertility's early exhaustion).
- It enhances the nutritional value of food .E.g Golden rice(vitamin A enriched)
- To create tailor – made plants to supply alternative resources (starches ,fuels, pharmaceuticals etc.) to industries

Bt COTTON

- Bt cotton is created by using some strains of a bacterium, Bacillus thuringiensis (Bt is short form,).
- This bacterium produces proteins that kill certain insects such as lepidopterans (tobacco, budworm and armyworm), coleopterans (beetles) and dipterans (flies and mosquitoes).
- B. thuringiensis forms protein crystals during a particular phase of their growth. These crystals contain a toxic insecticidal protein.
- Bt toxin protein exist as inactive protoxins, but once an insect ingests the inactive toxin, it is converted into an active form of toxin due to the alkaline pH of the gut, which solublise the crystals.
- The activated toxin binds to the surface of midgut epithelial cells and create pores that cause cell swelling and lysis leading to death of an insect.
- Specific Bt toxin genes were isolated from Bacillus thuringiensis and incorporated into several crop plants as cotton.
- Most Bt toxins are insect-group specific. The toxin is coded by a gene named cry, e.g. the proteins encoded by the genes **cry IAc and cry IIAb** control the **cotton bollworms** and **cry IAb** controls corn **borer**.

COTTON BOLL INFECTED BY BOLLWORMS.

PEST RESISTANT PLANT

- 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.

ROOT KNOT DISEASE IN TOBBACO PLANT

BIOLOGY

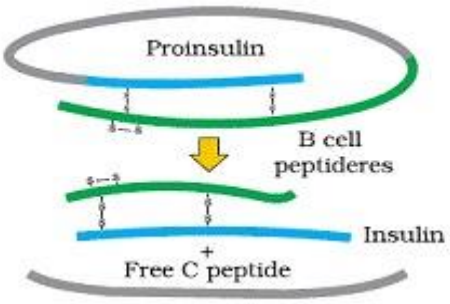
BIOTECHNOLOGICAL APPLICATION IN MEDICINE

- The rDNA technological processes have made immense impact in the area of healthcare by enabling mass production of safe and more effective therapeutic drugs. At present, about 30 recombinant therapeutics have been approved for human use the world over. In India, 12 of these are presently being marketed.

Genetically Engineered Insulin

- Diabetes can be controlled by taking insulin at regular intervals. The main source of this insulin was isolation of insulin from animals. Now a day's insulin can be obtained from bacterium using techniques of biotechnology.

- Insulin was earlier extracted from pancreas of slaughtered cattle and pigs but insulin from these sources develops allergy or other types of reactions to the foreign protein.
- Insulin consists of two short polypeptide chains-
  chain A and chain B, that are linked together by disulphide bridges.



- In humans, insulin is synthesised as a prohormone, which contains an extra stretch called C peptide, which is absent in mature insulin.
  The main challenge for production of insulin using rDNA technique was getting insulin assembled into a mature form.
- An American company, Eli Lilly in 1983 prepared two DNA sequence corresponding to A and B chain of human insulin and introduced them in plasmids of E.coli to produce insulin chain. Chain A and Chain B were produced separately, extracted and combined by creating disulphide bonds to form human insulin.

GENE THERAPY

- Gene therapy is a method that allows the correction of faulty gene by a correct and functional gene.
- **FIRST EVIDENCE** : In 1990 , a 4 year old girl with adenosine deaminase (ADA) enzyme deficiency which is caused due to the deletion of gene for adenosine deaminase . ADA enzyme is crucial for the immune system to function.

ADA deficiency can be cured by following methods:-

- **Lymphocyte culture**: Lymphocyte from the blood of the patient are grown in culture outside the body .A functional ADA gene is taken and using a retroviral vector, cDNA is

formed and then introduced into lymphocytes. These lymphocytes are subsequently returned to the patient.

- It is not a permanent method as lymphocytes are not mortal.

❖ **Enzyme replacement** :- ADA enzyme is given to patient by injection periodically

❖ **Bone marrow transplantation**: If the ADA gene from marrow cell is introduced into cell at early embryonic stages, it could be a permanent cure.

MOLECULAR DIAGNOSIS

a) It helps to solve the problem of early diagnosis and treatment of diseases.
b) Using conventional methods of diagnosis (serum and urine analysis), early detection of diseases is not possible.
c) To overcome this problem, some molecular diagnosis techniques were developed that provide early detection of diseases. These are as follows:

❖ **Polymerase Chain Reaction (PCR)** : A very low concentration of bacteria or virus can be detected by amplification of their Nucleic acid
PCR technique can be used for detecting HIV in suspected AIDS patients, genetic mutation in suspected cancer patients and in identifying genetic disorders.

❖ **Autoradiography: - To** find out mutated gene**.**
❖ **Enzyme Linked Immuno Sorbent Assay (ELISA**) : is based on the principle of antigen-antibody interaction.

TRANSGENIC ANIMAL

❖ Transgenic animals are animals with a modified genome. Their genome has been manipulated by using genetic engineering technology.

Example:- Transgenic plant :- Bt Cotton, Bt brinjal

Transgenic animals: - Rats, Rabbits, pigs, sheep, scow and fish

- ❖ Benefits of transgenic animals
- ❖ To study Normal physiology and development
- ❖ To study disease
- ❖ To obtain biological products Eg Human protein (1 antitrypsin) used to treat emphysema ,transgenic cow (ROSIE) produced human protein enriched milk (2.4 gram per litre)
- ❖ Testing for vaccine safety
- ❖ Chemical safety testing

ETHICAL ISSUES

- ❖ Ethical standards are required to evacuate the mortality of human activities.
- ❖ 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.

IMPORTANT QUESTION FOR PRACTICE-

Very short question Answer-

1) Which organism badly affects the crop of tobacco?

Ans:- Nematode meloidegnye incognitia

2) Which vector is used to create a pest resistant tobacco plant?

Ans ;- Agrobacterium tumifaciens vectors

3) Write name of gene that control cotton bollworms.

Ans ;- CryIAc and CryIIAb

. 4) Which is the first transgenic cow? Which gene was inserted into it?

The first transgenic cow was Rosie. The gene inserted was human alpha-lactalbumin.

5) How are 'cry' and 'CRY' different from each other?

Ans 'cry' is the gene that encodes for Bt toxin. 'CRY' is the protein coded by the 'cry' genes.

6) State the role of transposons in silencing of mRNA in eukaryotic cells.
Ans Mobile genetic elements, i.e. transposons are the possible source of RNA interference (RNAi) gene which is further involved in the silencing of the specific mftNA and prevents translation.

7) Name the technique based on the principle of antigen-antibody interaction used in the detection of HIV VIRUS.

Ans ;- ELISA

8) The development of a transgenic food crop may help in solving the problem of night blindness.Name this Crop plant

Ans:- Golden rice.

SHORT ANSWER TYPE

BIOLOGY

1) Why Bacterial toxin did does not kill the bacteria but only the insects?
   Ans. Bacterial toxin does not kill the Bacillus because. But toxic protein exist as inactive protoxin but once an insect ingest the inactive protoxin, it is converted into active form of toxin due to alkaline pH of gut which solubilise the crystal. The activated toxin binds to surface of midgut epithelial cells and create pores that cause cell swelling and lysis.

2) Give any two examples of products, how transgenic animals can be used to produce biological compounds?
   Ans. i) Alpha-1-antitrypsin – a protein that is used to treat emphysema.
   ii) Alpha – lactalbumin – protein – rich milk that is more nutritionally balanced product for human babies

3) GEAC is one of the organisation set up by Indian Government. Write its full form. Give its two objectives.

   Ans. 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.

4) What are the advantages of molecular diagnostic over conventional methods?

Ans. Following are some of the advantages of molecular diagnosis over conventional methods-

a) Using the conventional method, early diagnosis is not possible, but by using DNA technology and PCR early diagnosis is possible.
b) It is also used to detect mutations in patients suspected of cancer.
c) Molecular diagnostic is used to detect mutation in suspected cancer patients

5) Who was given the first gene therapy? Why does this treatment reoccur in nature?
   Ans: The first gene therapy was given to a four-year-old girl, on 14th September 1990, at the NIH Clinical Centre. She was suffering from a genetic disorder **Adenosine Deaminase deficiency**. The treatment is recurrent in nature because the genetically engineered lymphocytes used in the therapy are mortal and need to be administered periodically to the patient.

6) **LONG ANSWER QUESTION**

1) How has RNAi technique helped to prevent the infestation of roots in tobacco plant by a nematode Meloidegyne incognita?

Ans:- Nematode Meloidegyne incognitia infects the roots of tobacco plants and causes a great reduction in yield. RNA interference (RNAi) was used to stop this infestation. This method involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA (silencing). The source of this complementary RNA could be from an infection by viruses having RNA genomes or mobile genetic elements (transposons) that replicate via an RNA intermediate.

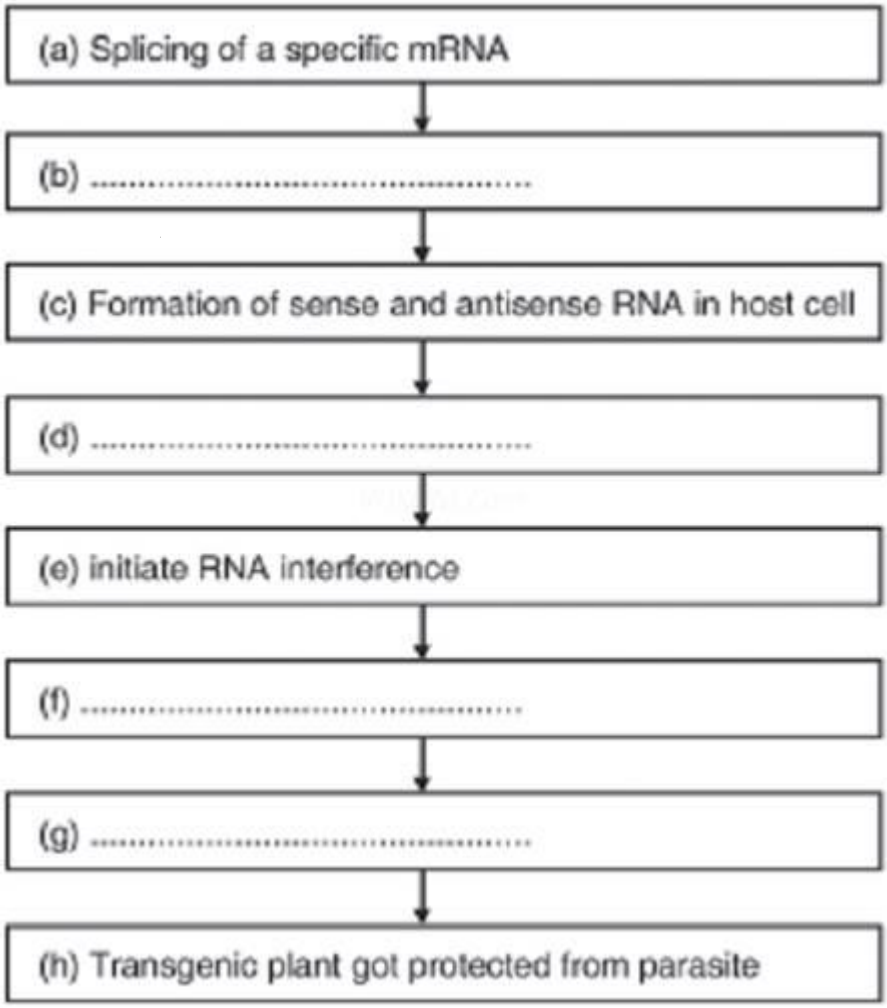
2) Mention any four applications of Biotechnology in the field of Agriculture
Ans. i) to maKe crops tolerant to abiotic stresses eg cold, drought, salt, heat.
ii) to reduce reliance on chemical pesticide by producing pest-resistant crops.
iii) increased efficiency of mineral usage by plants.
iv) enhanced nutritional value of food eg. Vit – A rich golden rice.

3) Some multinational companies and other organisations are using bioresources for commercial benefits, without proper authentication and compensation to concerned authorities.
(a) Give the term for this unauthorised act.
(b) Suggest any two ways to get rid of this.

4) **Ans. (a)** Biopiracy
(b) **(i)** Benefits of bioresources should be shared between developed and developing nations.
(ii) Laws should be developed to prevent unauthorised exploitation of them bioresources.

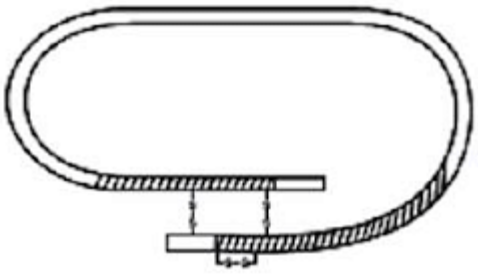
4) A bacterium Bacillus thuringiensis produces a toxic protein named 'cry protein' that is lethal to certain insects but not to bacterium
(a) Why this toxin does not kill the bacteria?
(b) What type of changes occur in the gut of insects on consuming this protein?
(c) How man has exploited this protein for his benefit?
Ans. (a) Produced in inactive form as Prototoxins.
(b) Prototoxin becomes active toxin in alkaline pH of gut of insects. Toxins bind to surface of midgut and cause perforation, swelling, lysis of cells ultimately leading to death.
(c) Specific Bt toxin genes isolated from Bacillus thuringiensis and incorporated into several crop plants such as cotton and corn which become pest resistant against certain insects.

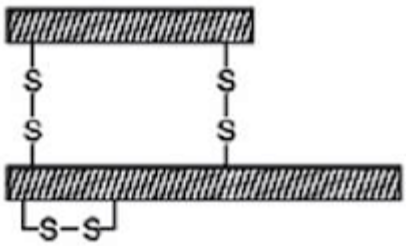
5) . Given below is an incomplete flow chart showing the process of production of nematode resistant tobacco plants based on RNAi technique?
(i) Write the missing steps in proper sequence
(ii) At which level RNAi silences the gene?



Ans. (i) (b) Using Agrobacterium as a vector, introduced into tobacco
(d) dsRNA (double stranded RNA)
(f) Silenced specific mRNA of the nematode
(g) Parasite could not survive.
(ii) RNAi silences the gene at translation level

6 In the given figure, Form (A) and Form (B) represent different forms of a proteinaceous hormone secreted by the pancreas in mammals.


Form 'A'



Form 'B'

(a) Explain what type of bonding is present between chains of this hormone.
(b) What are these forms (A) and form (B)? How do these firms differ from each other?
(c) How was this hormone produced by Eli Lilly using rDNA technology?

Ans. (a) The type of bonding is of Disulphide bond, between the chains of the **h**ormones

(b) Form (A) is proinsulin and form (B) is Mature nsulin. Proinsulin contains an extra stretch called c peptide which is absent in mature insulin.

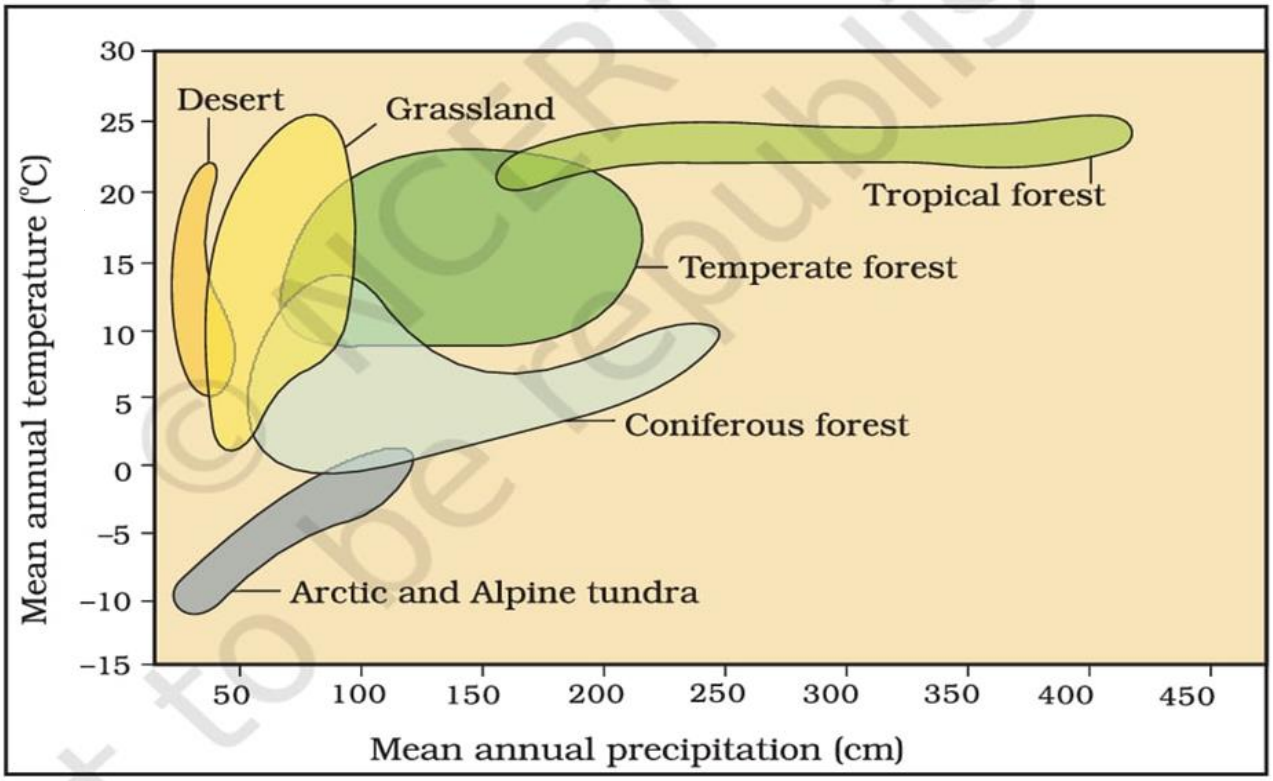
(c) The Eli Lilly company prepared two sequences that correspond to the A and B peptide chains of the human insulin and introduces them to the plasmid of E.coli to produce insulin chains, Chain A and B were produced separately .Then they were combined by creating a disulphide bonds to form human insulin.

BIOLOGY

CHAPTER – 11*:* *ORGANISM AND POPULATION*

- ***Terms to be known***

1. **Ecology**: Sustenance of life on earth depends upon constant interaction of organism and its environment and also among themselves. Study of these interactions is called ecology.
2. **Environment**: Surrounding of an organism.
3. **Ecosystem**: A system comprising living and non-living beings and their interactions builds an ecosystem.
4. **Biome**: It is the broader range of environment that can support life and life is there.
5. **Habitat**: Surrounding of an organism, which fulfils its basic needs of survival and which is suitable for a particular organism.
6. **Biotic and abiotic**: Living part of an ecosystem constitutes biotic and non-living part constitutes abiotic component.
7. **Adaptation**: The inherent tendency of organisms, which make their survival easier and supportive in a particular environmental condition, not by selection, but as outcome of natural random variations and their survival advantages.
8. **Species**: Naturally interbreeding group of individuals.
9. **Population**: Group of individuals belonging to same species.
10. **Community**: Group of population sharing same habitat.
11. **Parasite**: A kind of ecological relation between two organisms, where one is dependent upon the other living being for its nutritional requirement. (One drawing its nutrion from other living being and causing harm to that.)
12. **Diurnal**: Organisms active in day time.
13. **Foraging**: To move around actively for fulfilling biological needs.
14. **Topography**: Vertical layer of soil beneath the earth surface.
15. **Benthic**: Bottom area of waterbodies, where sunlight never reach.
16. **Population ecology**: Branch of ecology to link ecology to genetics and evolution of organisms.
17. **Camouflage**: ability of organism to mimic the color of surrounding to hide itself in surrounding.
18. **Conduits**: Phenomenon of becoming channel for conduction of energy from one tropic level to another.
19. **Prudent**: It is a kind of savior of another species by reducing competition among them. Predators keep check upon prey population by preying. Here prey must have higher multiplication rate than the predator.
20. **Phytophagous**: insects feeding upon plant cell sap.



1. ***Varied climatic condition and its causes.***
   Universe is outcome of organisation
   Sub atomic particles =atom=molecule=complex molecule=cell=tissue=organ=organ system=organism=species=population=community=biome.

- Surrounding of these organisms does not remain same all over the world and all through the year. It depends upon climatic variations caused by major climatic factors.

➢ **<u>Try answering following questions:</u>**

A) Why fish can't live in air and birds can't swim in water*? (Page no.-219)*
B) Why polar bear found in polar regions only*? (Page no.-219)*
C) Why do we not get mangoes in all seasons*? (Page no.-219)*
D) Why chirping sounds of birds differ?*(Page no.-219)*
E) Why night blooming flowers white in color?*(Page no.-219)*
F) How does honey bee knows where she will get nector?*(Page no.-219)*
G) How do migratory birds navigate during migration?*(Page no.-219)*
H) What are the climatic factors determining climate of a place?*(Page no.-221)*
I) Name major biomes of the earth and write down their features.*(Page no.-220)*
J) What are major biomes of India? Where are they located? Mark them in map of our country.*(Page no.- 220)*
K) What are the physical features of climatic variation?*(Page no.-220)*

L) What factors makes the habitat different?*(Page no.-221)*
M) Does habitat gets affected by biotic components also? Give one example.*(Page no.-221)*
N) What is the process of optimizing survival of organisms to new environmental condition called? Name the phenomenon. *(Page no.-221)*

2. Major abiotic factors affecting life of an organism.

- *Abiotic factors will include all physical factors like:*

i. **(Heat)Temperature**: The only natural source is sunlight. It depends upon the receptivity of the place like hight from sea level, kind of vegetation, kind of soil or rock etc.

A) Why temperature of earth from equator to poles decreases progressively? *(Page no.-221)*

B) How does some organisms survive in thermal vents where temperature is too high?*(Page no.-221)*

C) Does variation in temperature affects the oceanic currents? How?*(Page no.-222)*

D) What is the main threat to an organism moving to high temperature zone? How do they survive in extreme conditions of temperature?*(Page no.-222)*

E) What is meant by eurytherm and stenotherm? Which of these will be at greater threat in current scenario of global warming to survival and why? *(Page no.-222)*

ii. **Water**: Without water life is not possible. It is quality of water that matters a lot rather than quantity. Glaciers has tremendous amount of water but it causes cold desert. Sea water is too saline to live for fresh water organisms.

A) How does salinity of water affect life in it?*(Page no.-222)*
B) What do you mean by salanity of water? How is it measured?*(Page no.-222)*
C) Write down the difference between stenohaline and euryhaline? *(Page no.-222)*
D) Why not marine fishes survive in fresh water? What problems may be faced by fresh water fishes, if they are brought to sea?*(Page no.-222)*

iii. **Light**: availability of sunlight and its period of exposure determines the kind of vegetation in a particular area. In a forest we can easily observe the stratification and the kind of plants growing at different strata. Not only plants but animals' physiological behavior and is also dependent upon light.

A) What is the significance of canopy in a forest? *(Page no.-222)*
B) What do you mean by photoperiod? How does it affect flowering? *(Page no.-222)*
C) List out the activities of animals affected by quantity and quality of light. *(Page no.-222)*

D) How does light affect kinds of plants and animals found at different depth in water bodies? What is source of energy in deep seas, where sunlight can't reach directly?*(Page no.- 222)*

E) Why red algae found deepest in ocean? Which part of visible spectrum they use for photosynthesis? *(Page no.-222)*

iv) Soil: Soil is humified weathered rock particles becomes inhabited by wide range of microorganisms and contain moisture also. It provides base for plants to obtain nutrients and also for being rooted. Mineral composition ad topography of soil determines the kind of vegetation.

A) What is the study of soil called?*(Page no.-223)*

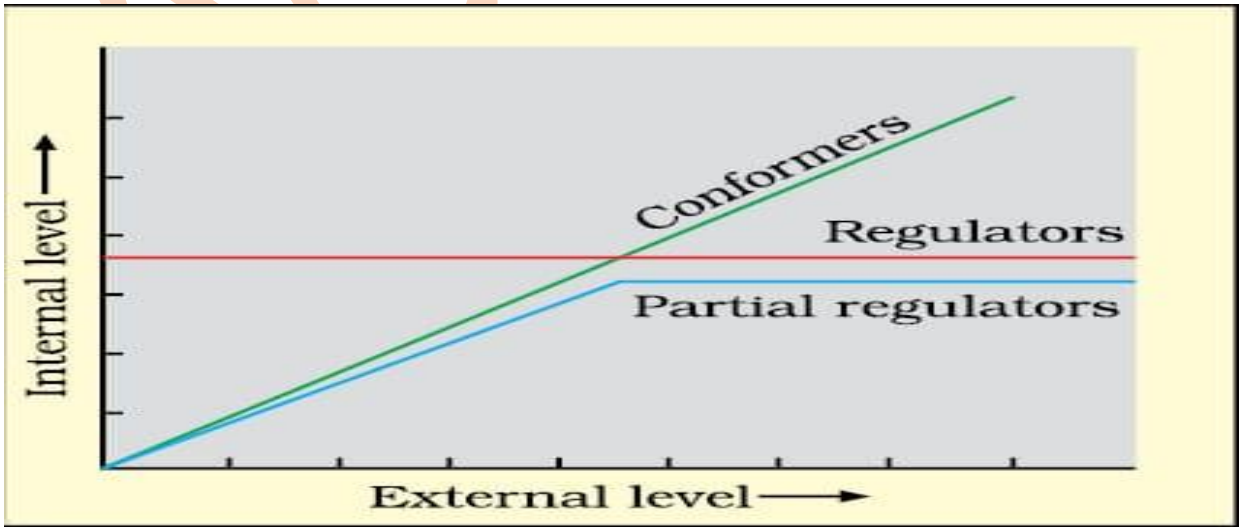
B) Mention the characteristics of soil.*(Page no.-223)*

C) How does soil characteristics affects the kind of vegetation it has?*(Page no.-223)*

D) How does soil quality affects the animal life in it? How does it determine the kind of benthic animals in aquatic medium?*(Page no.-223)*

3. Response behavior of an organism.

Being living means having ability to respond. Organisms respond to external environmental factors influencing them and also to the internal factors, called extrinsic and intrinsic factors. It may favour its survival or may sometimes put them into stressful condition. They develop skills or ways to escape from those stress, which is called stress tolerance. In a whole they try to maintain constant internal environment to cope up with the situation, called homeostasis. Some can easily achieve and some has to struggle littlie more and some find escape. (Regulators, partial regulators and conformers respectively).



1) **Regulators**: Birds and mammals are best example of this category which has natural ability to maintain homeostasis either by behaviour or by physiological adaptive abilities.

A) What makes mammals and birds efficient as thermoregulators?*(Page no.-224)*
B) How does sweating causes cooling of body? Is it behavioural or physiological tendency? *(Page no.-225)*

2) **Conformers**: don't have any control over constant internal environmental and it varies according to external environmental condition.

A) Why do very small animals are not found in polar region?*(Page no.-224)*

B) Why not all animals evolved for regulators?*(Page no.-224)*

C) What is the cost and benefits of being the regulators, mention few with one such example. *(Page no.-224)*

3)Partial regulators: Those which can regulate to certain extent but can't tolerate beyond that, they have two options left

a. **Migrate**: Moving away to the safer places temporarily to more hospitable environment. **E.g.,** some species of birds.

A) What may be the purpose of migration among marine fishes other than environmental?*(Page no.-225)*

b. **Suspend**: This is the temporary suspension of activities for survival. Most common in some plants, as seed becomes dormant for certain period of time. Also, in bacteria and fungi spores are produced to make them safe for next favourable condition.

A) How do animals cope up with the stressful environment, when they are not able to migrate? Explain. *(Page no.-225)*

B) How diapauses different from diurnals?*(Page no.-225)*

C) How to benthic animals like snails survive during the time of desiccation?*(Page no.-225)*

4) **Adaptation**: It is the ability of organism to cope up with the environment. It is randomly selected trait by the nature, which has survival benefit. It may be physiological, may be behavioural or morphological.

- Organisms living in extreme environment shows wide range of biochemical adaptations. They may possess different unique enzymes to help them cope up with varying environmental factors. They may have different biochemical pathway also. **Eg**, c. a. m. in succulent plants.

A) How do desert plants differ from aquatic plants?*(Page no.-225*)
B) What is the use of wax coating over the surface of leaves in cactus and in lotus? How to spines in desert plants help them to survive?*(Page no.-225)*

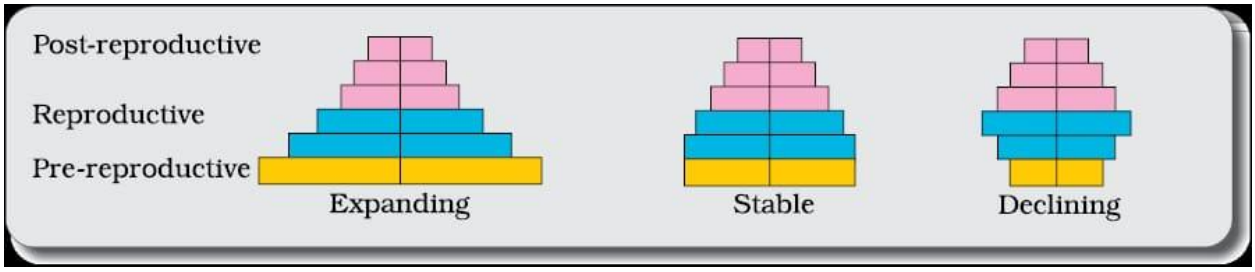
C) What are assumptions according to allen's rule?*(Page no.-226)*
D) What is meant by altitude sickness? Why it is caused? Mention any four symptoms of altitude sickness.*(Page no.-226)*
E) Why there is difference in haemoglobin count of people living in plains and on high altitude?*(Page no.-226)*
F) How do some bacteria are able to survive in very hot thermal vents?*(Page no.-226)*
G) Many fishes survive in antartic ocean water, where temperature goes below zero-degreecelcius? How their blood keeps moving in their blood vessels?*(Page no.-226)*
H) Mention adaptations in sea fishes living deep sea. What challenges they will face in such condition? What will be the impact of such condition on their morphology?*(Page no.-226)*
I) Categorise as morphological, physiological and behavioural adaptation.
Basking of reptiles, living underground in burrows, fish with flat body design, streamline body design, plants with different photosynthetic pathway, anaerobic respiration. *(Page no.-225)*

5) Population and population traits.

Individuals of same species sharing same geographical area and compete for same resource constitute population. Eg, population of sparrow living upon a banyan tree, population of dogs living in an area. Size of population is affected by birth and death in that population as well as immigrants and emigrants. Size of the population determines the kind of interaction among them as well as with others.

Individual traits are different from population traits, called population attributes. Birth and death apply to an individual, not the population.

A) What are birth rate and death rates? How it is expressed? *(Page no.-227)*
B) Sex ratio of a human population is 60percent, what does it mean?*(Page no.-227)*
C) What do you mean by age pyramid? What does they reflect?*(Page no.- 227)*
D) What is the significance of sex ratio in a population? *(Page no.-228)*
E) When we have to rely upon relative population densities rather than absolute population densities?*(Page no.-228)*
F) How will you measure population density of fish in a pond? *(Page no.-228)*
G) Give an example when population density cannot be determined in numbers. *(Page no.-228)*

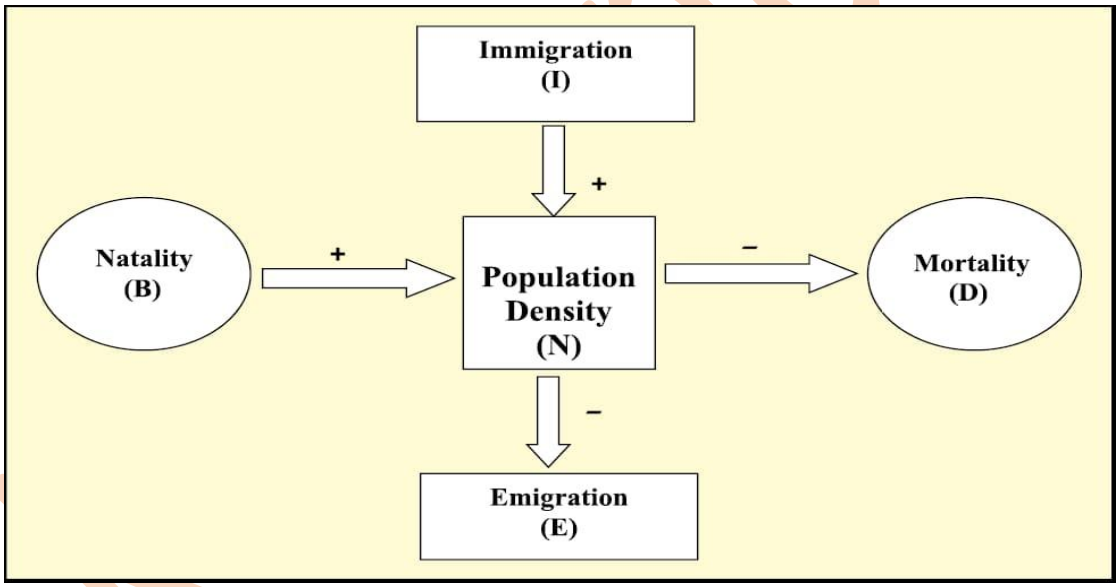


6) **<u>Growth and growth models:</u>** increase in volume, mass, and size of an organism is called growth. Growth in population is expressed in numbers or in mass, when are microscopic and can be expressed in terms of population growth rates. It depends upon various factors like food, shelter predators and interspecific intraspecific population interactions.

- When an animal dies, there will be sudden increase in bacterial population as there is plenty of food for them. But as soon as it is consumed, interspecific competition will increase and their number will start declining and it will show sudden drop. This was the example of exponential growth curve.

- Sometimes resource availability limits the number of consumers, therefore, though population size will not increase exponentially, but sustain in long run. Such growth model is called logistic growth curve.

- This is how population size in a community is regulated. In any population or community there will be these two kinds of growth models. Each represented by different equation.



A) When resources are limited in a population, which growth curve will be obtained in this condition?*(Page no.-230)*
B) Give an example of exponential growth curve. What threat will be there on such organisms following such patterns? Can dying individuals of such population becomes an opportunity for another group of population? *(Page no.-229)*
C) What is the difference between growth rate and intrinsic growth rate?*(Page no.-230)*

7) **Variation, its significance and evolution**: in any population if multiplication is there, there will be variation also. Such variations among species is useful for the population. It brings fitness of the species and makes its survival more effective in

diverse situations. Organisms have evolved in relation to the constrains imposed by abiotic and biotic components of the habitat in which they live.

A) What is meant by Darwinian fitness of species?*(Page no.-231)*
B) Why do some organisms give birth to many off springs at a time and some give birth to few ones? Is there any correlation with their body size and number of off springs produced?*(Page no.-232)*

8) Population interactions and its significance in creating harmony in nature and also disturbing the entropy.

No any population can exist single in a habitat, because they are interdependent upon one another. There are positive and negative interspecific orintyraspecific population interactions. **Eg**, flowers depend upon insects for pollination. Plants depend upon other organisms for their seed dispersal etc.

Plants manufacture their own food; can they survive on earth without animals or microbes?

Due to wild animals' forest is protected. So, they are serving each other.

Species A	Species B	Name of Interaction
+	+	*Mutualism*
–	–	*Competition*
+	–	*Predation*
+	–	*Parasitism*
+	0	*Commensalism*
–	0	*Amensalism*

It is the competition among species which provide them opportunity to evolve for their survival. It is done by developing morphological and chemical defense. Some of the chemicals like nicotine, caffine, opium etc. are manufactured in some plants as defensive chemicals.

A) Predators live upon their prey; still how do they help them to survive? In absence of predators what will happen to prey?*(Page no.-233)*

B) What is the impact of introduction of any exotic species to an existing population or a community?

Population a and b, living together in a community.

C is introduced to this as exotic one.

C becomes envassive as there is not any control over its population growth in absence of predator

It starts sharing resources of a and b

Slowly population size of a and b decrease and it may become extinct.*(Page no.-233)*

C) How do predators help in maintaining species diversity in a community?*(Page no.-233)*

D) What strategies prey adopt to protect themselves from predators? Mention few.
(Frog showing camouflage, Accumulation of distasteful chemical in the body of Monarch butterfly etc.)

E) How plants have evolved themselves for protecting themselves from herbivores?
(Page no.-234)

F) Give one example of morphological and chemical defence in plants. (Page no.-234)

G) Why predators called prudent?*(Page no.-235)*

H) What is meant by resource partitioning? What are the strategies behind this phenomenon? Give one such example. *(Page no.-235)*

- Competition is the kind of interaction between the individuals competing for same resources at same time in same habitat. More the competition, more will be variation.
- Gause competitive exclusion principle and competitive release: Resources limits the population, when two or more species compete for the same resource, the stronger eliminates the weaker one. It may result into complete elimination of one species, or resource portioning will will occur eg, extinction of Abingdon tortoise in Galapagos Island due to introduction of goat, as they were grazing much faster than them.

H) What is the difference between competitive exclusion and competitive release?
(Page no.-235)

Parasitism: It is the kind of interaction in which one organism is benefited and other is looser or being harmed by the first one. One which is residing upon other is parasite and one which is being used is host, so called host parasite relation. It is specific and selective. Parasite is evolving to adapt in host body, as per rejection response and host will evolve accordingly. this is called co- evolution.

A) What are parasitic adaptations? Give any four such adaptive features of parasite.
(Page no.-235)

B) What is the impact of parasites on host body? *(Page no.-236)*

C) Give an example of plant ectoparasite and an animal ectoparasite. *(Page no.-236)*

D) What is brood parasitism? Mention any two adaptive features of brood parasite.
(Page no.-236)

Commensalism: Interaction in which one species is benifited and other remain unaffected. E.g., cattle and egret bird.

BIOLOGY

A) How egret bird is benefited by cattle? *(Page no.-236)*

Mutualism: Interaction for mutual benefit of both the species. E.g., Lichen, algae and fungi living together as one entity for mutual benefit.

A) How do flower reward the pollinators visiting them? *(Page no.-237)*

B) What do mean by sexual deceit? How does it reflect the phenomenon of co evolution of flower as well as insect? *(Page no.-238).*

BIOLOGY

CHAPTER – 12

ECOSYSTEM

GIST OF THE MAJOR & MINOR CONCEPTS

An Ecosystem is a functional unit of nature, where living organisms interact among themselves and also withthe 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

Species composition: Plant and animal species of an ecosystem

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 offunction of the entire pond.

Biotic Components

The autotrophic components include the phytoplankton, some algae and the floating, submerged andmarginal 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 theautotrophs, 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 andloss as heat to the environment.

PRODUCTIVITY

Primary production: It is defined as the amount of biomass or organic matter produced per unit area over atime 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 oforganic 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 primaryproductivity (NPP). GPP – R = NPP is the available biomass for the consumption to heterotrophs (herbivoresand decomposers).

Secondary productivity is defined as the rate of formation of new organic matter byconsumers. **DECOMPOSITION**

Decomposers break down complex organic matter into inorganic substances like carbon dioxide, water andnutrients and the process is called decomposition.

Detritus: Dead plant remains such as leaves, bark, flowers and dead remain of animals, including faecalmatter which is the raw material for decomposition.

The important steps in the process of decomposition:

Fragmentation: Detritivores (e.g., earthworm) break down detritus into smaller particles. This processis called fragmentation.

Leaching: Water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.

Catabolism: Bacterial and fungal enzymes degrade detritus into simpler inorganic substances. Thisprocess is called as catabolism.

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.

Mineralisation: The humus is further degraded by some microbes and release of inorganic nutrientsoccur 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 decompositionthrough their effects on the activities of soil microbes.

Warm and moist environment favour decomposition whereas low temperature and anaerobiosis inhibitdecomposition 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 inaquatic 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 → Deer → Lion

BIOLOGY

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 weighThe number of trophic levels in the grazing food chain is restricted as the transfer of energy follows 10per cent law – only 10 per cent of the energy is transferred to each trophic level from the lower trophiclevel.

• Ecological Pyramids

The base of each pyramid represents the producers or the first trophic level while the apex representstertiary 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. Forexample, a sparrow is a primary consumer when it eats

seeds, fruits, peas, and a secondary consumerwhen it eats insects and worms.

- In most ecosystems, all the pyramids, of number, of energy and biomass are upright, i.e., producers aremore 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.

There are exceptions to this generalization

- 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 ofphytoplankton.
- Pyramid of energy is always upright, can never be inverted, because when energy flows from aparticular trophic level to the next trophic level, some energy is always lost as heat at each step
  - 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

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- 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
3. 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

4. Pyramid of ----------is always upright, can never be inverted.

(a) Biomass (b) Numbers (c) Energy (d) None of these

5. 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

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

ASSERTION REASON QUESTION

1. Assertion: Some aquatic ecosystem have inverted biomass pyramid
   Reason: The pyramid of energy is also inverted in such cases
2. Assertion: Saprophytes play a vital role in ecosystem.
   Reason: Saprophytes are accorded the highest trophic levels in a food chain or food web.
3. Assertion: There is no limitation of the number of trophic levels in a detritus food chain.
   Reason: The transfer of energy between successive trophic levels in a detritus food chain does not follow 10% rule.
4. Assertion: Strongly vertically stratified habitats are very stable ecosystems.
   Reason: Through the formation of different layers a given habitat is better utilized.
5. Assertion: Ecological pyramids of biomass are generally inverted in sea
   Reason: Biomass of fishes far exceeds that of phytoplankton

Ans: 1. (c) 2. (c) 3. (d) 4. (a) 5. (a)

SHORT ANSWER TYPE QUESTIONS

1. 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.

Ans: For example, sparrow is an omnivore. When it eats seeds, fruits or any other plant product, it occupies the primary trophic level. Whereas, 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.

2. Construct a pyramid of biomass starting with phytoplankton. Label-3 trophic levels. Is the pyramid upright or inverted? Why?

Ans: The pyramid of biomass starting with the phytoplankton is an inverted pyramid. This is because the biomass of fishes (SC) exceeds the biomass of Zooplanktons (PC) which in turn exceeds the biomass of phytoplankton (PP).See page 248 NCERT BOOK

3. State the difference between the first trophic levels of the detritus food chain and grazing food chain.

Ans: The grazing food chain releases energy into the ecosystem. The detritus food chain uses a large amount of energy from the environment. In the grazing food chain, green plants form the first trophic level. In the detritus food chain, the first trophic level is occupied by the decomposers.

4. What are the limitations of ecological pyramids in the study of ecosystem?

Ans: Limitations of Ecological Pyramid

More than one species may occupy multiple trophic levels as in case of the food web. Thus, this system does not take into account food webs. The saprophytes are not considered in any of the pyramids even though they form an important part of the various ecosystem.

5. How does the chemical composition of detritus affect the rate of decomposition in a particular climatic condition?

Ans: In a particular climatic condition, decomposition rate is slower if detritus is rich in nitrogen and water soluble compounds like sugars. All of the above. Warm and moist environments inhibit decomposition. Rate of decomposition is quicker if detritus is rich in lignin and chitin.

BIOLOGY

CHAPTER - 13

BIODIVERSITY AND CONSERVATION

- Biodiversity: Term coined by socio-biologist Edward Wilson(1992). Biodiversity refers to the sum total of diversity that exists at genetic, species and ecosystem level of biological organisation. Three inter-related levels of Biodiversity:
  -Genetic diversity: Diversity in the number and types of genes, as well as chromosomes present in different species and the variations in the genes and their alleles in the same species. It helps in speciation.
  -Species diversity: Varieties in the number and richness of the species of a region.
  -Ecological diversity: Variety in the types of ecosystems.

- IUCN (2004) has put the total number of known plants and animal species more than 1.5 million.

-India has: More than 50,000 genetically different varieties of rice; 1000 varieties of mango;

- India has 1,42,000 known species of plants and animals (Around 45,000 species of plants and rest of animals).

- India has 8.1% of share of global biodiversity.

- India is one of 12 Mega diversity countries of the world.

- Patterns of Biodiversity

-Altitudinal Patterns of Biodiversity In general, species diversity decreases as we move away from the equator towards the poles.

With very few exceptions, tropics (latitudinal range of 23.5° N to 23.5°S) harbour more species than temperate or polar areas.

Colombia located near the equator has nearly 1,4000 species of birds while New York at 41° N has 105 species and Greenland at 71° N only 56 species.

India has more than 1,200 species of birds.

The large tropical Amazonian rain forest in South America has the greatest biodiversity on the earth.
Reasons for greater biological diversity in tropics

(a) Tropical latitudes have remained relatively undisturbed for millions of years and thus had a long evolutionary time for species diversification.

(b) Topical environments are less seasonal, relatively more constant and predictable which promote niche specialisation and lead to greater species diversity.

(c) There is more solar energy available in the tropics, which contributes to higher productivity and indirectly leads to greater biological diversity.

-The importance of species diversity to the ecosystem

(1) Ecosystems with higher biodiversity are more productive than ecosystems with lower biodiversity. David Tilman showed in his experiments that increased diversity contributes to higher productivity.

(2) Biodiversity is essential for the stability of an ecosystem. Communities with more species are more stable than those with less species.

(3) Rich biodiversity is also essential to make an ecosystem more functional and survival of the human race on the earth. (Rivet popper hypothesis proposed by Paul Ehrlich).

2)Species-Area relationships

- German naturalist and geographer Alexander von Humboldt observed that within a region, species richness increases with increasing explored area, but only up to a limit.

-The relation between species richness and area for a wide variety of taxa (angiosperm plants, birds, bats, freshwater fishes) turns out to be a rectangular hyperbola. On a logarithmic scale, the relationship is a straight line described by the equation-

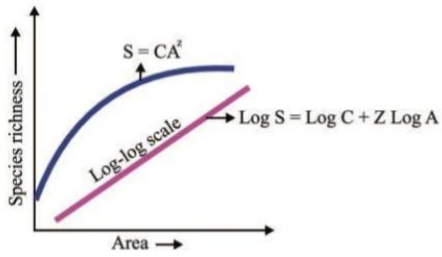
log S=log C+ Zlog A

Where S = Species richness, A = Area; Z= slope of the line (regression coefficient) C = Y-intercept.

-Value of Z lies in the range of 0.1 to 0.2, regardless of the taxonomic group or the region.

-The species-area relationships among very large areas like the entire continents has much steeper slope of the line (Z values in the range of 0.6 to 1.2).

Causes of Biodiversity Losses [The Evil Quartet]



i) Habitat loss and fragmentation: This is most important cause of plants and animals extinction. The Amazonian rain forest is called the lungs of the planet. It is being cut for cultivating soyabeans.

ii) Over exploitation: Many species extinctions are due to over exploitation by humans c.g. extinction of Steller's sea cow, passenger pigeon in last 500 years.

iii) Alien species invasions: When alien species are introduced in new habitat, some of them turn invasive and cause decline or extinction of indigenous species, e.g. Carrot grass (Parthenium), Lantana and water hyacinth (Eichhornia) posed threat to native species.

(iv) Co-extinctions: When a species becomes extinct, the plant and animal species associated with it in an obligatory way also become extinct. Example : In case of plant pollinator mutualism where extinction of one species leads to extinction of other species in nature.

- Reasons for Conservation of Biodiversity

1. Narrowly utilitarian: Humans derive countless direct economic benefit from nature food (cereals, pulses, fruits), firewood, fibre, construction material,industrial products (tannins, lubricants, dyes, resins, perfumes) and products of medicinal importance.

2. Broadly utilitarian: Biodiversity plays a major role in many ecosystem services that nature provides like oxygen, pollination, flood and soil erosion control.

3. Ethical: Every species has an intrinsic value, even if it may not be of any current economic value to us. We have a moral duty to care for their well-being .

Types of Conservation Strategies

In-situ conservation : Conservation and protection of the whole ecosystem and its biodiversity at all levels in order to protect the threatened species. Endangered species protected in natural conditions.

-Sacred Groves: Forest patches around the places of worship which are protected by tribal communities. e.g. some forest in Khasi and Jaintia hills in Meghalaya, Aravalli hills of Rajasthan.

- Biodiversity Hot Spots: An areas with high density of biodiversity or megadiversity (high level of species richness and high degree of endemism) e.g. Out of 34 hot spots in world, 3 occur in India, i.e., Western Ghats and Sri Lanka, Indo-Burma (North-East India) and Himalaya. Protected Areas: Ecological or Biogeographical areas where biological diversity with natural and cultural resources are protected. e.g. National parks, sanctuaries and Biosphere reserves.

National Parks: Areas reserved for wild life where they are able to obtain all the required natural resources and proper habitats. India has 90 national parks at present. Example Corbett national park, Kaziranga national park.

Sanctuaries: An area where animals are protected from all types of exploitation and habitat disturbance. India has 492 sanctuaries at present.

Biosphere Reserve: Large tracts of protected land with multiple use preserving the genetic diversity of the representative ecosystem by protecting wild life, traditional life styles of the tribals and varied plant and animal genetic resources. India has 14 biosphere reserves.

Ex-situ conservation : Conservation and protection of selected rare plants or animals in places outside their natural habitat.

-Offsite collections: Live collections of wild and domesticated species in Botanical gardens, Zoological parks etc.

-Gene Banks: Institutes which maintain stock of viable seeds, live growing plants, tissue culture and frozen germplasm with the whole range of genetic variability.

-Cryopreservation: Preservation of seeds, embryos etc. at -196°C in liquid nitrogen.

- Red Data Book: Record of threatened species of plants and animals maintained by IUCN. It has 8 categories → Extinct, Extinct in wild, critically endangered, Vulnerable, lowest risk, data deficient, Not evaluated.
- Important Wild Life Protection in India:

- Project tiger: Started in 1973 to check depletion in population of tiger. Jim Corbett National Park.

-Endemic Species: Species which are confined to a particular region and not found anywhere else.
-Exotic or Aliens Species: New species which enter a geographical regions.

-Bio prospective: Exploration of molecular, genetic and species level diversity for products of economic importance.

- International efforts for Biodiversity conservation:

-The Earth Summit: Historical convention on Biological diversity held in 1992 at Rio de Janeiro, Brazil.

-The World Summit on Sustainable Development: Held in 2002 in Johannesburg, South Africa to pledge to reduce biodiversity losses at global and local levels.

- The Biological Diversity Act, 2002:

The main objectives of the Act are:

1. Conservation of biological diversity.

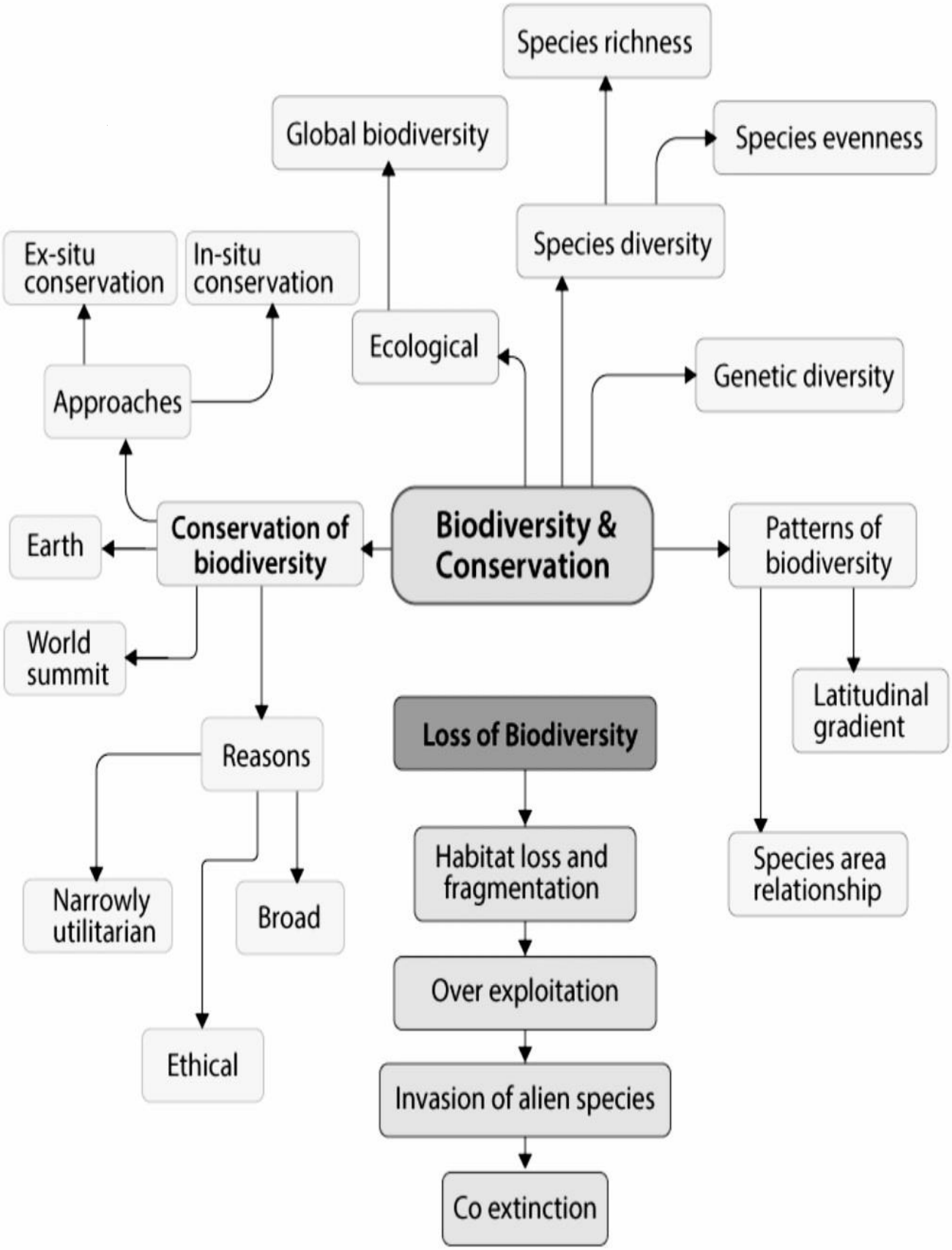
2. Sustainable use of its components

3. Fair and equitable sharing of the benefits arising out of utilisation of genetic resources.

-Ramsar sites Named after city Ramsar in Iran where the Ramsar convention was signed in 1971 to develop awareness about the importance of wetlands. These sites are mentioned for the conservation and sustainable utilisation of wetlands and recognising their ecological function, economic, cultural, scientific and recreational values.

BIOLOGY

CONCEPT MAP



BIOLOGY

MCQ

1. One of the ex situ conservation methods for endangered species is
(a) Wild life sanctuaries (b) Biosphere reserves
(c) Cryopreservation (d) National parks

2. Which group of vertebrates comprises the highest number of endangered species?
(a) Fishes (b) Reptiles (c) Birds (d) Mammals

3. Which of the following is not an invasive alien species in the Indian context?
(a) Lantana (b) Cynodon (c) Parthenium (d) Eichhomia

4. Among the ecosystem mentioned below, where can one find maximum biodiversity?
(a) Mangroves (b) Desert (c) Coral reefs (d) Alpine meadows

5. 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

6. Which of the following group exhibit more species diversity?
(a) Gymnosperms (b) Algae (c) Bryophytes (d) Fungi

7. 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.

8. What is common to Lantana, Eichhomia and African catfish?
(a) All are endangered species of India. (b) All are key stone species.
(c) All are mammals found in India.
(d) All the species are neither threatened nor indigenous species of India.

9. Which one of the following is not a characteristic feature of biodiversity hot spots?
(a) Large number of species (b) Abundance of endemic species
(c) Mostly located in the polar regions (d) Mostly located in the tropics

10. Which of the following countries has the highest biodiversity?
(a) Brazil (b) South Africa (c) Russia (d) India

Ans: 1-c , 2-d , 3-b, 4-c, 5-b 6-d, 7-c, 8-d, 9-c
10-a,

ASSERTION REASON QUESTIONS

In the following questions a statement of Assertion (A) is followed by statement of reason (R)
Select the correct answer to these questions from code A B C & D as 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) If A is true but R is false
(D) A is false but R is true

1. Assertion(A) : Genetic diversity within species increases with the increase in habitat variation.
Reason(R): It is essential for adaptation to varied environments.
(A) (B) (C) (D)

2. Assertion (A) : Pollen banks are part of in situ conservation.
Reason(R): They are one of the offsite collections
(A) (B) (C) (D)

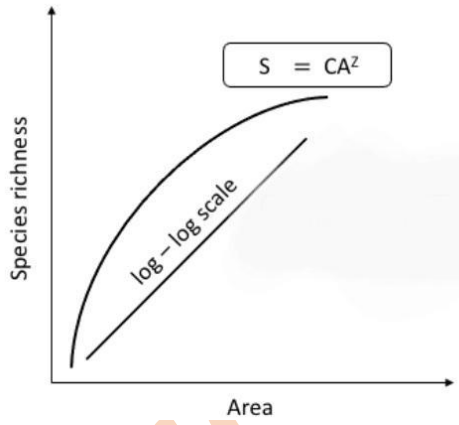
3.Assertion (A): Zoological parks have well managed captive breeding programme.

Reason(R): They are engaged in producing improved varieties of wildlife.
(A) (B) (C) (D)
4. Assertion (A):Now a days biodiversity is declining with an accelerated rate.
Reason(R): Exotic species are considered to be major cause of extinction of species.
(A) (B) (C) (D)
5. Assertion (A): Rate of extinction of wildlife has become rapid in the last hundred years.
Reason(R): Unplanned human activities like population explosion, deforestation, industrialization, hunting etc. have destroyed the natural habitats of many spp.of wildlife.
Answers 1-A 2- D 3- C 4- B 5-A

CASE STUDY QUESTIONS

Question 1.

Within a region species richness increases with increasing explored area but only up to a limit the given graph explain this relationship



i) What does the given figure shows
   a) Rivet popper hypothesis
   b) species area relationship
   c) proportionate number of species of major taxa
   d) a ecological diversity

ii) Equation for relationship(A) between species richness and area is
   a) log Si = log C + Z log A
   b) log C = log S + Z log A
   c) Z log A = log S + log C
   d) log S = log C + logA

iii) What is the value of slope of line or regression coefficient Z for frugivorous birds
   a) 0.1 - 0.2
   b) 1.15
   c) 0.01- 0.1
   d) 0.6 - 1.2

iv) The shape of curve for relationship between species richness and areas for a wide varietyof taxa is
a) straight line
b) parabola

c) rectangular hyperbol
d) bell shaped
v) Who gave this concept of increase in species richness with increasing area
a) Humboldt
b) Odum
c) Edward Wilson
d) Paul Ehrlich

Q.2. Read the given paragraph and answer any four questions from i– v given below :
Excessive exploitation of species whether a plant or animal reduces the size of its population so it becomes vulnerable to extinction such as Dodo and passenger pigeon have become extinct due to over exploitation by humans. Thus the world is facing accelerated rate of species extinctions largely due to human interference.

i) In which of the following course of biodiversity loss is not included evil quartet
a) Co extinction
b) b)pollution
c) alien species invasion
d) habitat loss and fragmentation

ii) Identify the species that have become extinct due to overexploitation
a) stellar sea cow
b) Yucca moth
c) Blatta orientalis
d) Nile perch

iii)Factors which make species suspectible to extinction are
a) large population size
b) lack of genetic variability
c) lower status of Trophic level
d) ability to switch over the alternate foods

iv) Assertion: Pollution reduces species biodiversity
Reason: Spillover oil in sea causes death of several marine animals.
a)Both Assertion and Reasons are true and reason is the correct explanation of assertion.
b)Both Assertion and Reasons are true but reason is not correct explanation of assertion.
c) Assertion is true but reason is false
d) Both assertion and reasons are false

v) ……. Is the first major cause of species extinction
a)Coextinction b) Overexploitation
c) Habitat destruction
d) Alien species invasion

Q3. Wetlands are calld Ramsar sites ibecause 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 wasteland which are usually as dumping area and filled up to b)recover lands for various constructions activities. As a result a large number of wetlands disappear.

i)Select the incorrect match of wetland and its location

Wetland	location
a)Harike	Punjab

b)Chandra taal H.P
c) Bhoj MP
d) Ashtamudi Odisha
ii) Migratory birds Flamingo breeds in which of the following wetlands?
a) Bhitarkanika b)Runn of kutch c)Harike
d)Chandratal
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 accumulation of decomposed plant known as peat?
a)Bog b) Mangrove c) Estuary d) Watershed
v) The Mangroves of Bhitarkanika is famous for
a) The migratory water birds
b) Nesting site endangered olive ridely turtles
c)Prawn cultivation
d)All of the above
Q4. The Kakapo is the world's largest and heaviest parrot, found only in New Zealand. It is unusual in that it is nocturnal, flightless and ground-dwelling. It is an excellent climber of trees has strong legs that allow it to "jog" several kilometres in a single trip, and has mossy green plumage mottled with brown and yellow. The Kakapo is also critically endangered as of now, there were only few known living individuals left.
a)Kakapo was only active in night when it's potential predator would not be out for hunting.
b)The kakapo would likely be well camouflaged among the forest foliage due to its greenish plumage.
c) It was effectively hunt for food in the night.
d) All of the above
ii) When humans started to settle in New Zealand, they took with them non-native animals, including mammals such as cats, dogs and stoats. By which of the following ways, human settlement likely contributed to a near decimation of Kakapo populations in New Zealand?
a)Habitat destruction
b)Alien species invasion
c)Pollution
d)Both a and b
(iii) All known survived Kakapo have been relocated by the New Zealand government to three predator-free islands, where they are monitored year round by staffs and volunteers to ensure that the birds are safe, healthy and well-fed. The extremely low population of Kakapo is a hurdle to the species becoming viable in the long term, despite such dedicated conservation efforts. This is because
a)the small population results in very small gene pool
b) there would be very limited genetic diversity among the resulting offspring.
c) of reduced capacity of the species to adapt and survive changes in the environment
d) All of these

iv) The reasons behind conserving biodiversity have been grouped into which of the following categories?

a) Narrowly utilitarian b)Broadly utilitarian
c)Ethical d) All of above

v) One of the ex situ conservation methods for endangered species is

a) Wildlife sanctuaries b) biosphere reserves
c) Cryopreservation d) National Park

Answers:

(1) i) b

ii) a On the logarithmic scale the relationship between species richness and area is straight line. It is described by the equation log S = log C + Z log A

iii) b The regression coefficient Z have a value of 1.15 for frugivorous birds and mammals of tropical forest of different continents

iv)c

v)a While exploring the wilderness of South America jungles Alexander von Humboldt found that within a region the species richness increased with increasing area but up to a certain limit.

Q2.Answers:

i) B ii) a iii) d iv) a v) c

Q3. i) d Ashtamudi is located in Kerala.

ii)b iii)d

iv)a The rate of peat formation is sufficiently high to create a bog in hydrosere. A bog is a permanently waterlogged raised site that receives all its water and nutrient inputs from rainfall or other precipitation.

v)b

Q4.i) d Kakapo is nocturnal.

ii) d) As human settled in New Zealand, they cleared the land for their needs

iii)d iv)d v) c

SHORT ANSWER QUESTIONS (2 Marks)

1. In the past which factor would have caused a mass extinction of species?

Answer: the following would have triggered for mass extinction

- temperature fluctuation ,meteorite asteroid, hitting the planet, emission of lethal hydrogen sulfide from the sea, the outburst of gamma radiations/ supernova/Nova, plate tectonics

2. In the IUCN Red List in 2004 what does red represen?

Answer: It refers to the taxa with highest risk of extinction.

3.What is the significance of genetic variation in the *Rauwolfia vomitoria* plant?

Answer: Refer to NCERT textbook 13.1 page no. 217

4. Habitat loss and fragmentation have caused severe damage to a particular type of ecosystem named it

Answer: Tropical rainforest

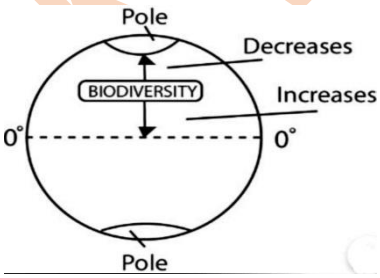
5. Which region is considered the one with the highest biodiversity on earth .what is the name given to such a region forest?

Answer The Amazon rainforest.

it is also called “lungs of the planet.”

6.What is a gene pool?
Answer: In a breeding population it refers to the sum total of all the genes of every individual.
7.State a difference between endemic and exotic species.
Answer: Exotic species are derived into a geographical area from another geographical area whereas and the big species are native species restricted to a particular geographical area.
8. How can the prevailing rate of species extinction be declined by 30% solely through the protection of biodiversity hotspots
Answer: Hotspots are species rich precisely those under human threat hence protecting them. They can preserved as sanctuaries and national parks.
9. Define cryopreservation. why is it useful in conserving biodiversity?
Answer: Cryopreservation is preserving material in liquid nitrogen at -196 °C.
It can be done to preserve threatened species in viable and fertile conditions for a long period.
10.Name the two most biodiversity rich zones of India.
Answer: The Western Ghats and the eastern Himalaya and the Eastern Himalaya.

SHORT ANSWER QUESTIONS (3 Marks)
1. List the important attributes of a stable community.
The following important attributes:
-It shall not show too many variations in the year to year productivity
- It must be either resistant or resilient to the disturbance occurring in season.
-It must be resistant to the invasion done by alien species.
2. Which type of conservation measures-in situ or ex-situ will help the larger number of species to survive? Explain.
Answer: In situ conservation will help the larger number of species to survive because it provides a natural environment four the growth and development of species.
3.What are sacred groves? What is their role in conservation.
Answer: Refer to NCERT textbook 13.2.2 page no. 225
4. "The Amazonian rainforest in South America has the greatest biodiversity on earth."justify the statement.
Answer: Refer to NCERT textbook 13.1.2 page no. 219
5. Study the diagram of earth given below. Give the name of the pattern of biodiversity therein. Suggest any two reasons for this type of occurrence.



Answer: Refer to NCERT textbook 13.1.2 page no. 220
6. In comparison to other animal groups why are amphibians more vulnerable to extinction?
Answer: it is because of the following
•habitat fragmentation
•habitat destruction or modification
•large scale climate change

7. Ecologists have discovered that the value of Z lies in the range of 0.1 20.2 regardless of taxonomic group or region when will the slope of the line be steeper in a species area relationship?

Answer: Refer to NCERT textbook 13.1.2 page no. 220

8. Differentiate between in-situ and ex-situ conservation?

Answer: Refer to NCERT textbook 13.2.2 page no. 224,225

9. Why is it necessary to conserve biodiversity?

Answer: Refer to NCERT textbook 13.2.1 page no. 223 ,224

10. i)"Stability of a community depends on its species richness." Write how did David Tillman show this experimentally.

Answer: Refer to NCERT textbook 13.1.3 page no. 221

ii)State the use of biodiversity in modern agriculture .

Answer: The use of biodiversity in agriculture is immense. It is a source of hybrids,GM plants, biopesticides ,organic farming, biofertilizer, improved varieties of plants disease resistant plants. It also promotes sustainable management of agricultural resources,conservation and farming of all wild and native varieties of plants.

LONG ANSWER QUESTIONS (5Marks)

1. Why is the sobriquet 'The Evil Quartet' used in the context of biodiversity? Name the members of this quartet. Why do we grieve for the genes when a species is lost?

Ans: The members of the quartet are:

i)Habitat loss and fragmentation ii)Over-Exploitation

iii) Alien Species Invasion (iv) Co-extinction

Refer to NCERT textbook 13.1.4 page no. 222, 223

2.Since the origin of life on earth, there were five episodes of mass extinction of species.
(i) How is the 'Sixth extinction', presently in progress, different from the previous episodes?
(ii) Who is mainly responsible for 'Sixth Extinction'?
(iii) List any four points that can help to overcome this disaster.

Answer: (i) The current species extinction rate is estimated to be 100-1000 time faster than in the pre-human era.

(ii) All activities performed by human beings for survival and maintenance of their lifestyle.

(iii) Point that can help to overcome this disaster are as follows

- Preventing habitat loss and fragmentation.
- Checking overexploiting.
- Preventing alien species invasion.
- Preventing co extinction.
- Conservation/protection of species.

3.(i) India has greater ecosystem diversity than Norway. Do you agree with the statement? Give reasons in support of your answer.

(ii) Write the difference between genetic biodiversity and species biodiversity that exists at all the levels of biological organisation.

Answer:

(i) Refer to NCERT textbook 13.1.2 (page no. 219)

(ii) Answer: Differences between genetic and species biodiversity Refer to NCERT textbook 13.1 (page no. 217)

BIOLOGY