

## Class-XII

### Biology (Theory)

#### Design of the Question Paper

Maximum Marks : 70

Time : 3 hours

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

#### 1. Weightage of Contents / Subject Units

Units	Content	Mark
VI	Reproduction	14
VII	Genetics and Evolution	18
VIII	Biology and Human Welfare	14
IX	Biotechnology and its application	10
X	Ecology and Environment	14
<b>Total</b>		<b>70</b>

#### 2. Weightage of Different Form of Questions

S.No.	Form of Questions	Marks for each	No. of Questions	Total Marks
1.	Very Short Answer (VSA)	1	08	08
2.	Short Answer (SA II)	2	10	20
3.	Short Answer (SA I)	3	09	27
4.	Long Answer (LA)	5	03	15
Total .		-	30	70

#### 3. Scheme of Option

1. Three will be no overall option.
2. Internal choice (either/or type) on a very selective basis has been provided. The choice has been given in one question of 2 marks, one question of 3 marks and all the three questions of 5 marks weightage.

#### 4. Weightage to difficulty level of questions

S. No.	Estimated Difficulty Level	Percentage
1.	Easy	15
2.	Average	70
3.	Difficult	15

About 20% weightage has been assigned to questions testing higher order thinking skills of learners.

- The question paper will include value Based Question (s) to the extent of 3-5 marks

# CONTENTS

## S. No. Chapter

1. Reproduction in Organisms
2. Sexual Reproduction in Flowering Plants
3. Human Reproduction
4. Reproductive Health
5. Principles of Inheritance and Variation
6. Molecular Basis of Inheritance
7. Evolution
8. Human Health and Disease
9. Strategies for Enhancement in Food Production
10. Microbes in Human Welfare
11. Biotechnology : Principles and Processes
12. Biotechnology and Its Applications
13. Organisms and Populations
14. Ecosystem
15. Biodiversity and Conservation
16. Environmental Issues

Model Papers

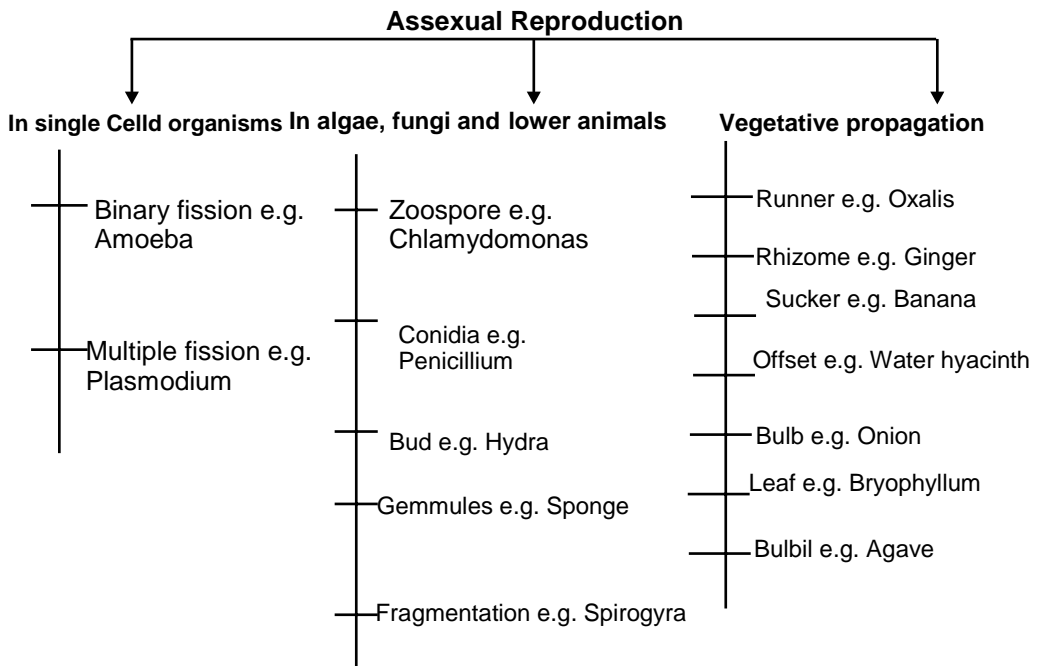
CBSE Paper

# CHAPTER 1

## REPRODUCTION IN ORGANISMS

### POINTS TO REMEMBER

- Clone :** A group of organism derived from a single individual and hence morphologically and genetically similar.
- Embryogenesis :** The process of development of embryo from zygote.
- Juvenile Phase :** It is the period of growth before maturity when sex organs are not functional.
- Meiocytes :** These are specialized cells of diploid organisms which undergo meiosis.
- Pericarp :** It is the protective covering of fruit, may be divided into epicarp, mesocarp and endocarp.
- Parthenogenesis :** Development of an egg into an embryo without fertilisation.



## Gamete Transfer

1. **In Algae, Bryophytes and Pteridophytes** : The male and female gametes are flagellated and motile, need a medium (water) to reach the egg.
2. **In seed Plants** : Pollen grains are transferred to stigma of flower of same species by various agents.
3. **In animals:**
  - (a) By Copulation . e.g., Reptiles, Birds and Mammals.
  - (b) By External medium . e.g., Fishes and Amphibians.

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

**Fragmentation** : It is a type of asexual reproduction where an organism splits into fragments. These fragments develop into fully grown individuals. eg. Spirogyra, fungi and some annelids.

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

~~In~~ human, liver has power of regeneration, if it is partially damaged.

~~During~~ danger a lizard discards a part of tail which can regenerate later.

## QUESTIONS

### VSA (1 MARK)

1. Offspring produced by asexual reproduction are referred to as clones. Why?
2. Name the most invasive aquatic plant weed which is called as 'Terror of Bengal'.
3. How does a zygote usually differ from a zoospore in terms of ploidy?
4. Mention the main difference between the offspring produced by asexual reproduction and progeny produced by sexual reproduction.

5. Which characteristic property of Bryophyllum is exploited by gardeners and farmers?

**SA II (2Marks)**

6. Higher organisms have resorted to sexual reproduction in spite of its complexity. Why?
7. Tapeworms possess both male and female reproductive organs. What is the name given to such organisms? Give two more examples of such organisms.
8. Study the relationship between first two words and suggest a suitable word for fourth place.
- (a) Male flower : Stamens :: Female Flower : .....
- (b) Birds : oviparous :: Primates : .....
- (c) *Chlamydomonas* : Zoospores :: *Penicilium* : .....
- (d) Ginger : Rhizome :: Agave : .....
9. Bryophytes and Pteridophytes produce a large number of male gametes but relatively very few female gametes. Why?

**SA I (3 Marks)**

10. Mention the site of zygote formation in the ovule of a flowering plant. What happens to sepals, petals and stamens after fertilisation? State the fate of zygote, ovule and ovary in these plants.
11. Distinguish between gametogenesis and embryogenesis.
12. Fill the blank spaces a, b, c, and d given in the following table.

Organism	Organ	Gamete
a	Testes	Spermatozoa
Human female	b	Ovum
Plant (Angiosperm)	c	Pollen grains
Plant (Pteridophyte)	antheridium	d

### LA (5 MARKS)

13. (a) Distinguish between asexual and sexual reproduction. Why is vegetative reproduction also considered as a type of asexual reproduction?
- (b) Which is better mode of reproduction : Sexual or Asexual? Why?

### VSA (1Mark) Answer

1. Because offsprings produced by Asexual reproduction is morphologically and genetically identical to parent.
2. Water hyacinth (*Eicchornia*)
3. Zygote . diploid, zoospore . haploid.
4. Offspring produced by asexual reproduction are genetically similar while progeny produced by sexual reproduction exhibit genetic variation.
5. Adventitious bud arising from margin of the leaf.

### SA (II 2 MARKS)

6. Because of variations, gene pool, vigour and vitality and parental care.
7. Hermaphrodite; Examples : Earthworm, Leech.
8. (a) Carpel (b) Viviparous  
(c) Conidia (d) Bulbil
9. Because, male gamete need medium (water) to reach egg/female gamete. A large number of the male gametes fail to reach the female gamete.

### SA . I (3 MARKS)

10. Embryo sac  
Sepals, Petals and Stamens dry and fall off. Zygote develops into embryo. Ovule develops into seed and ovary into fruit.

- |     |                             |                              |
|-----|-----------------------------|------------------------------|
| 11. | Gametogenesis               | Embryogenesis                |
|     | 1. Formation of gametes     | 1. Formation of embryo       |
|     | 2. Produces haploid gametes | 2. Embryo is diploid         |
|     | 3. Cell division is meiotic | 3. Cell division is mitotic. |
| 12. | a = Human male              | b = ovary                    |
|     | c = Anther                  | d = Antherozoid              |

**LA (5 Marks)**

- |     |  |   |
|-----|--|---|
| 13. | (a)  |   |
|     | Asexual Reproduction                         | Sexual Reproduction   |
|     | (i) Uniparental                              | (i) Biparental  |
|     | (ii) Gametes are not involved                | (ii) Gametes are involved   |
|     | (iii) Only mitotic division takes            | (iii) Meiosis at the time of gamete place formation and mitosis after fertilisation |
|     | (iv) Offspring genetically similar to parent | (iv) Offspring different from parent.   |

Vegegate propagation takes place when new individuals arise from vegetative part of parent and have characters similar to that of parent plant.

- (b) Sexual reproduction introduces variations in offsprings and has evolutionary significance. It helps offsprings to adjust according to the changes in environment. It produces better offsprings due to character combination.

## CHAPTER 2

### SEXUAL REPRODUCTION IN FLOWERING PLANTS

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#### POINTS TO REMEMBER

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

**Coleorhiza** : A protective sheath of radicle in monocot seed.

**Coleoptile** : A protective sheath of plumule in monocot seed.

**Endothecium** : A fibrous layer in the anther next to epidermis.

**Geitonogamy** : Self pollination between flowers of the same plant.

**Micropyle** : A small pore in the ovule through which the pollen tube enters.

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

**Tapetum** : Inner most layer of cells in pollen sac which provide nutrition to developing pollengrains

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

**1. Microsporangium (Pollen sac) :**

Outermost layer = Epidermis

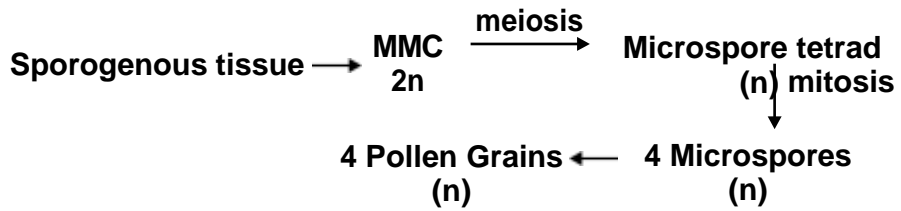
Second layer = Endothecium

Middle layer = 2 - 4 layers of cells

Innermost layer = Tapetum [Nourishes the developing pollen grains (Microspores)]

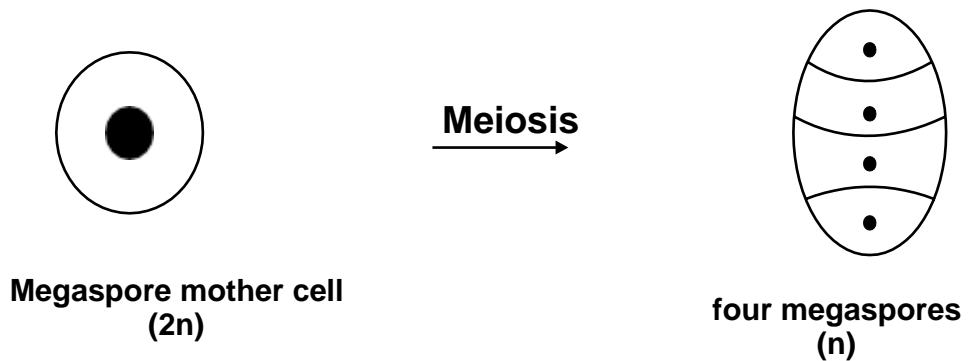
**2. Microsporogenesis** : Process of formation of microspores from a pollen mothercell.





3. Pollen grain
- $\rightarrow$  outer wall (Exine) - Thick, hard and made of sporopollenin
  - $\rightarrow$  Innerwall (intine) - Thin, made of cellulose and pectin
  - $\rightarrow$  cells - a vegetative cell (large in size) and a generative cell (small in size)

4. **Megasporogenesis** . Process of formation of megaspore from the mega spore mother cell.

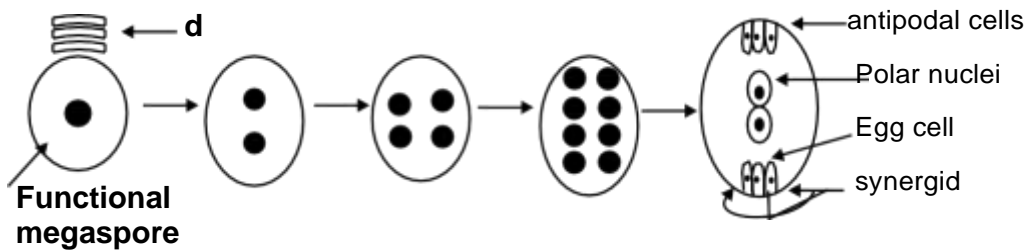


## 5. Megasporangium (Ovule) :

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

## 6. Female gametophyte (Embryo sac) : In a majority of flowering plant one of the megaspore is functional while other three degenerate.

- The functional megaspore develops in embryo sac.
- The nucleus of the functional megaspore (n) undergoes three successive mitotic cell division which results the formation of eight nucleate stage of embryo sac (free nuclear division)
- The cell wall formation starts at eight nuclear stages. Three cells are grouped together at micropylar end to form the egg apparatus (2 synergids + 1 egg cell).



Three cells are grouped at chalazal end, called antipodal cells.

The remaining 2 nuclei are called polar nuclei move to the centre of embryo sac, called central cell.

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

## 7. Pollen - pistil interaction

- The pistil has the ability to recognize the pollen, whether it is right type (Compatible) or of the wrong type (incompatible).
- If it is compatible, the pistil accepts the pollen.

→The pollen grains germinate on stigma to produce tubes. The contents of the generative cell (or the two male gametes in those species whose pollen is liberated in the three celled stage). move into the pollen tube.

→Pollen tube grows through the tissue of stigma and style by secreting enzyme and enters the ovule.

8. **Double Fertilisation** : The pollen tube releases two male gamete into the cytoplasm of synergid

Syngamy : One male gamete + Egg cell → Zygote (2n)

Triple Fusion : Second male gamete + 2 polar nuclei →PEN (3n)

9. **Post Fertilisation events** : (i) Endosperm and embryo development (ii) Maturation of ovule and ovary

Ovary	Fruit	(2n)
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Ovary wall	Pericarp	(2n)
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Ovule	Seed	(2n)
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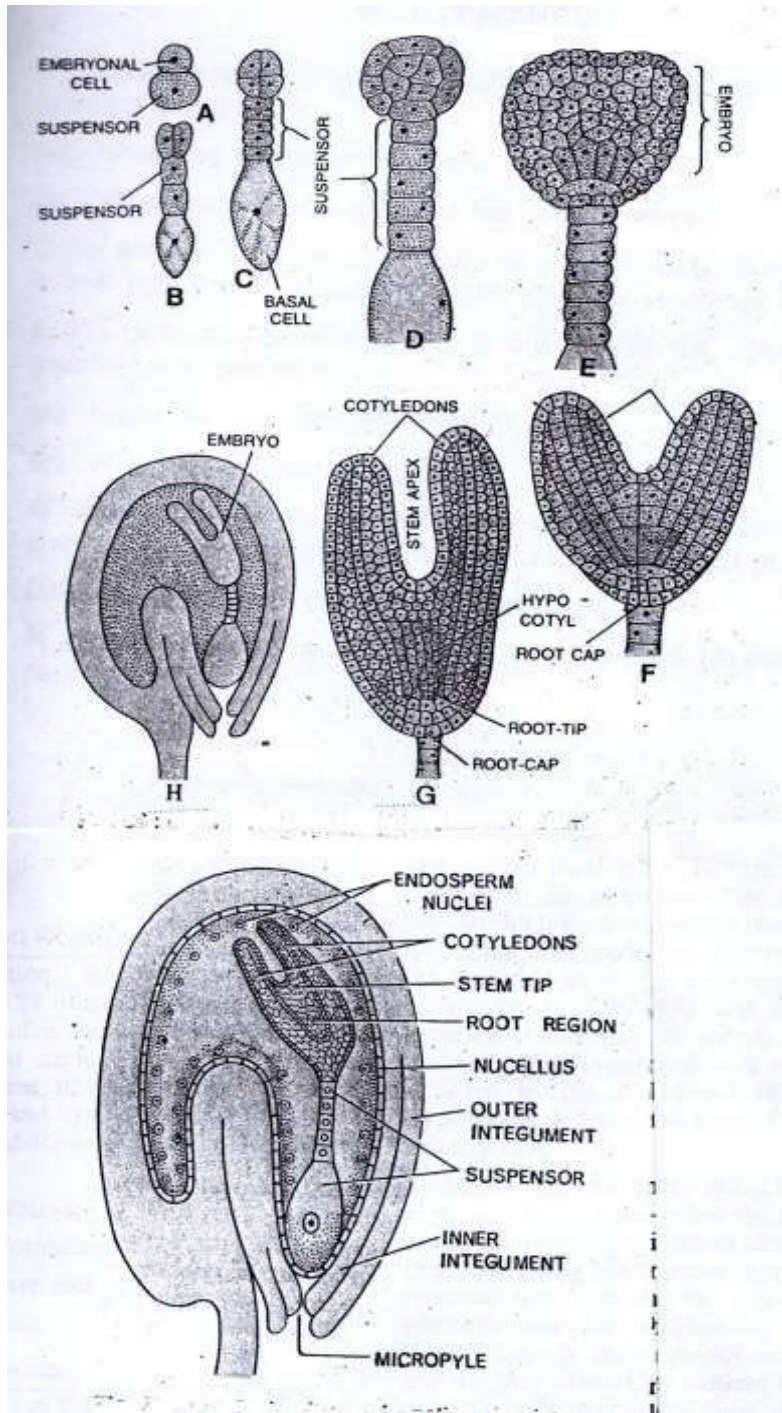
Outer Integument	Testa	(2n)
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Inner Integument	Tegmen	(2n)
------------------	--------	------

Zygote	Embryo	(2n)
--------	--------	------

Primary Endospermcell	Endosperm	(3n)
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Embryo formation starts after certain amount of endosperm is formed  
Zygote → Pro-embryo → Globular embryo → Heart shaped embryo →  
Mature embryo



Stages of development of Embryo

10. **Dicot Embryo** : A typical dicot embryo consist of an embryonal axis and two cotyledons. The portion of embryonal axis above the level of cotyledons is the epicotyle which terminates with the plumule or stem tip.

The portion below the level of cotyledons is hypocotyl that terminates at its lower end in the radicle or root tip.

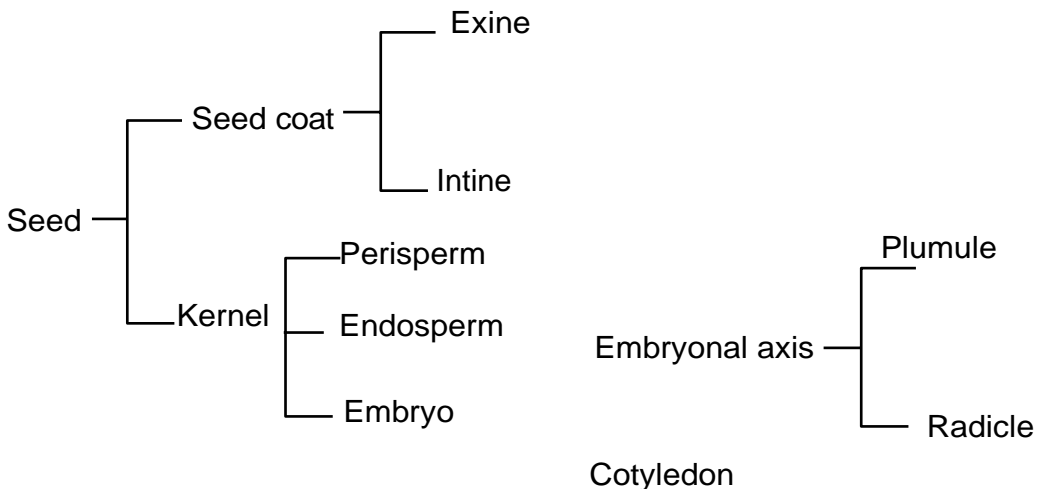
**Monocot Embryo** : Monocot (Rice, Maize etc.) has one cotyledon called Scutellum. The embryonal axis has the radicle and root cap enclosed by a sheath called Coleorrhiza.

The upper end (epicotyle) has plumule which is covered by hollow folder sturcture, thecoleoptile.

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

**Polyembryony** : Occurance of more than one embryo in a seed. e.g. Orange, lemon, onion, mango, ground nut.

**Reasons of polyembryony** : More than one egg may be formed in the embryo sac. More than one embryo sac may be formed in an ovule.



**QUESTIONS**  
**VSA (1 MARK)**

1. In a young anther, a group of compactly arranged homogenous cells were observed in the centre of each microsporangium. What is the name given to these cells?
2. Give the scientific name of a plant which came to India as a contaminant with imported wheat and causes pollen allergy.
3. Pollen grains of water pollinated species have a special characteristics for protection from water. What is that?
4. Why are pollen grains produced in enormous quantity in Maize?
5. In some species of Asteraceae and grasses, seeds are formed without fusion of gametes. Mention the scientific term for such form of reproduction.
6. Arrange the following in correct developmental sequence : Male gamete, Potential pollen mother cell, sporogenous tissue, Pollen grains, Microsporetetrad.
7. If the diploid number of chromosomes in an angiospermic plant is 16. Mention number of chromosomes in the endosperm and antipodal cell.

**SA-II (2 MARKS)**

8. In angiospermic plant before formation of microspore sporogenous tissue undergo cell division
  - (a) Name the type of cell division.
  - (b) What would be the ploidy of the cells of tetrad?
9. Outer envelop of pollen grain made of a highly resistant substance. What is that substance? At which particular point the substance is not present?
10. Fruits generally develops from ovary, but in few species thalamus contributes to fruit formation.
  - (a) Name the two categories of fruits.
  - (b) Give one example of each.

11. Among the animals, insects particularly bees are the dominant pollinating agents. List any four characteristic features of the insect pollinated flower.
12. Differentiate between geitonogamy and xenogamy.
13. In the given figure of a dicot embryo, label the parts (A) and (B) and give their function.

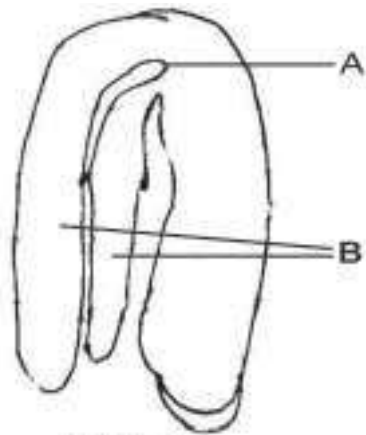


Figure 1

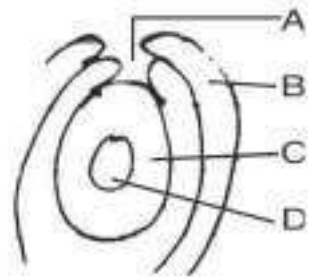
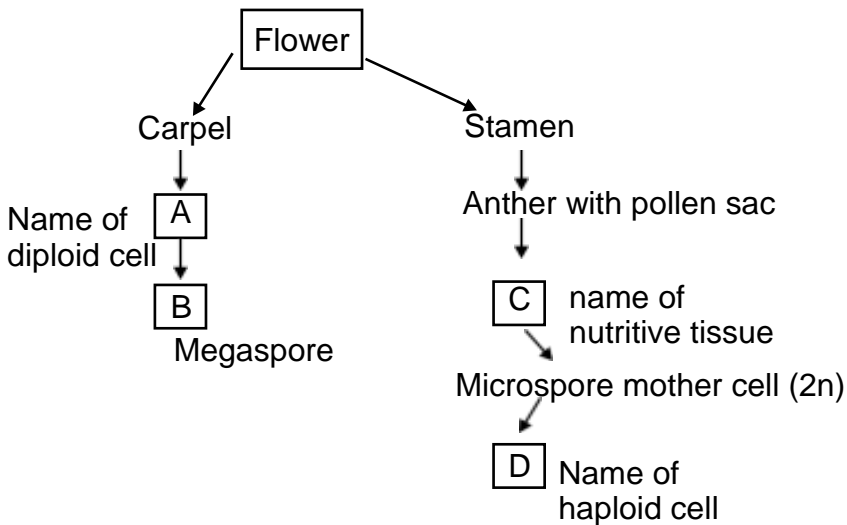


Figure 2

14. Name the parts A, B, C and D of the anatropous ovule (Figure 2) given above.
15. Given below is an incomplete flow chart showing formation of gamete in angiospermic plant. Observe the flow chart carefully and fill in the blank A, B, C and D.



16. Name the blank spaces a, b, c and d in the table given below :

Item	What it represents in the plant
(i) Pericarp	a
(ii) b	Cotyledon in seeds of grass family
(iii) Embryonal axis	c
(iv) d	Remains of nucellus in a seed.

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

### SA-I (3 MARKS)

18. Continued self pollination lead to inbreeding depression. List three devices, which flowering plant have developed to discourage self pollination?
19. What will be the fate of following structures in the angiospermic plant? Ovary wall, Ovule, zygote, outer integument Inner integument and primary endosperm nucleus.
20. Differentiate between microsporogenesis and megasporogenesis. What type of cell division occurs during these events. Name the structure formed at the end of these two events.



### LA (5 MARKS)

21. Draw the embryo sac of a flowering plants and label :
- (a) (i) Central Cell (ii) Chalazal end
  - (iii) Synergids
  - (b) Name the cell that develops into embryo sac and explain how this cell leads to formation of embryo sac.
  - (c) Mention the role played by various cells of embryo sac.
  - (d) Give the role of filiform apparatus.

### ANSWERS

#### VSA (1 Mark)

1. Sporogenous tissue
2. Parthenium
3. Presence of mucilagenous covering
4. To ensure pollination because Maize is pollinated by wind.
5. Apomixis
6. Sporogenous tissue → Potential pollen mother cell → microspore tetrad → Pollen grain → male gamete.
7. 24 Chromosomes in endosperm and 16 chromosomes in antipodal cell.

#### SA - II (2 MARKS)

8. (a) meiosis division (b) haploid
9. Sporopollenin; at germ pore sporopollenin is absent.
10. Two categories of fruits are :
  - (i) True fruits e.g., Mango
  - (ii) False fruit e.g., Apple
11.
  1. Flowers are large.
  2. Colorful petals of flowers.
  3. Presence of fragrance.
  4. Rich in nectar.

12.

	<b><i>Geitonogamy</i></b>	<b><i>Xenogamy</i></b>
1.	Transfer of pollen grains from the anther to stigma of another flower of the same plant	Transfer of Pollen grains from anther to stigma of different plant.
2.	Does not provide opportunity for gametic recombination.	

13. A = Plumule - To form shoot system

B = Cotyledons - Storage of food

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

15. A = Ovule/megasporangium, C = Tapetum

B = Megaspore mother cell, D = Pollen grains

16. a = wall of fruit, b = scutellum, c = shoot and root tip, d = perisperm

17. Because only one male gamete is involved in syngamy. i.e. fusion of male gamete with egg cell.

### **SA - I (3 MARKS)**

18. (a) Release of pollen and stigma receptivity is not synchronised in some species.

(b) Anther and stigma are at different positions/heights in some plants

(c) Self-incompatibility (a genetic mechanism).

19. Ovary wall = Pericarp ; Ovule = Seed,

Zygote - Embryo; Outer integument = Testa;

Inner integument = Tegmen; Primary endosperm nucleus = Endosperm.

20. Microsporogenesis : Process of formation of microspore from a Pollen mother cell.

Megsporogenesis : Process of formation of megaspore from megaspore mothercell.

Meiotic division in both

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

**LA (5 MARKS)**

21. A. Refer to figure 2.8(c) page 26 NCERT book.
- B. Functional Megaspore, Refer text on page 27 NCERT book.
- C. Egg : Fuses with male gamete to form zygote or future embryo  
Synergid : Absorption of nutrient, attract and guides pollen tube.

Antipodal Cells : Take part in absorbing nourishment from the surrounding nucleolar cells (or may degenerate)

Central Cell : After fusion with second male gamete forms Primary endosperm cell which gives rise to Endosperm

- D. Guides the entry of pollen tube.

## CHAPTER 3

### HUMAN REPRODUCTION

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#### POINTS TO REMEMBER

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

**Endometrium** : Innermost glandular layer lining the uterine cavity.

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

**Hymen** : A thin membrane partially covering the vaginal aperture.

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

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

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

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

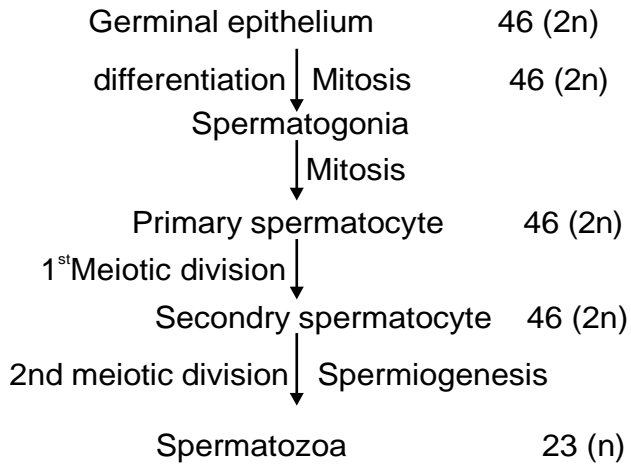
**Parturition** : Process of delivery of the foetus (Child birth).

**Puberty** : A stage at which immature reproductive system of boy or girl becomes mature.

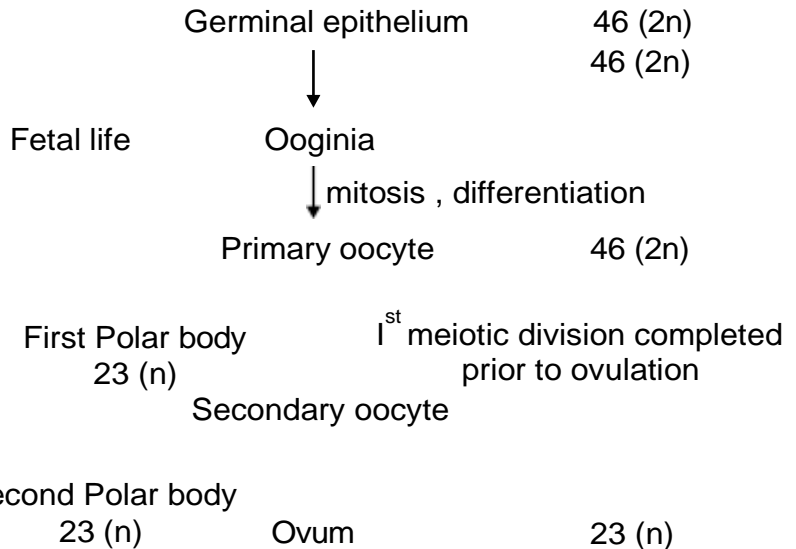
**Spermeigenesis**: Transformation of spermatids into sperms.

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

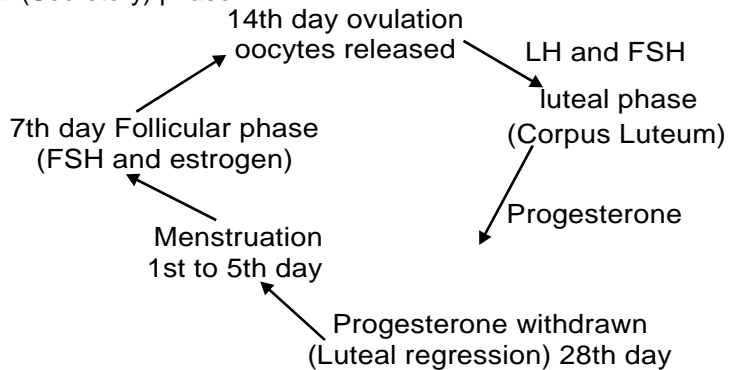
**Spermatogenesis** : Process of formation of sperm from male germ. cells in the testes.

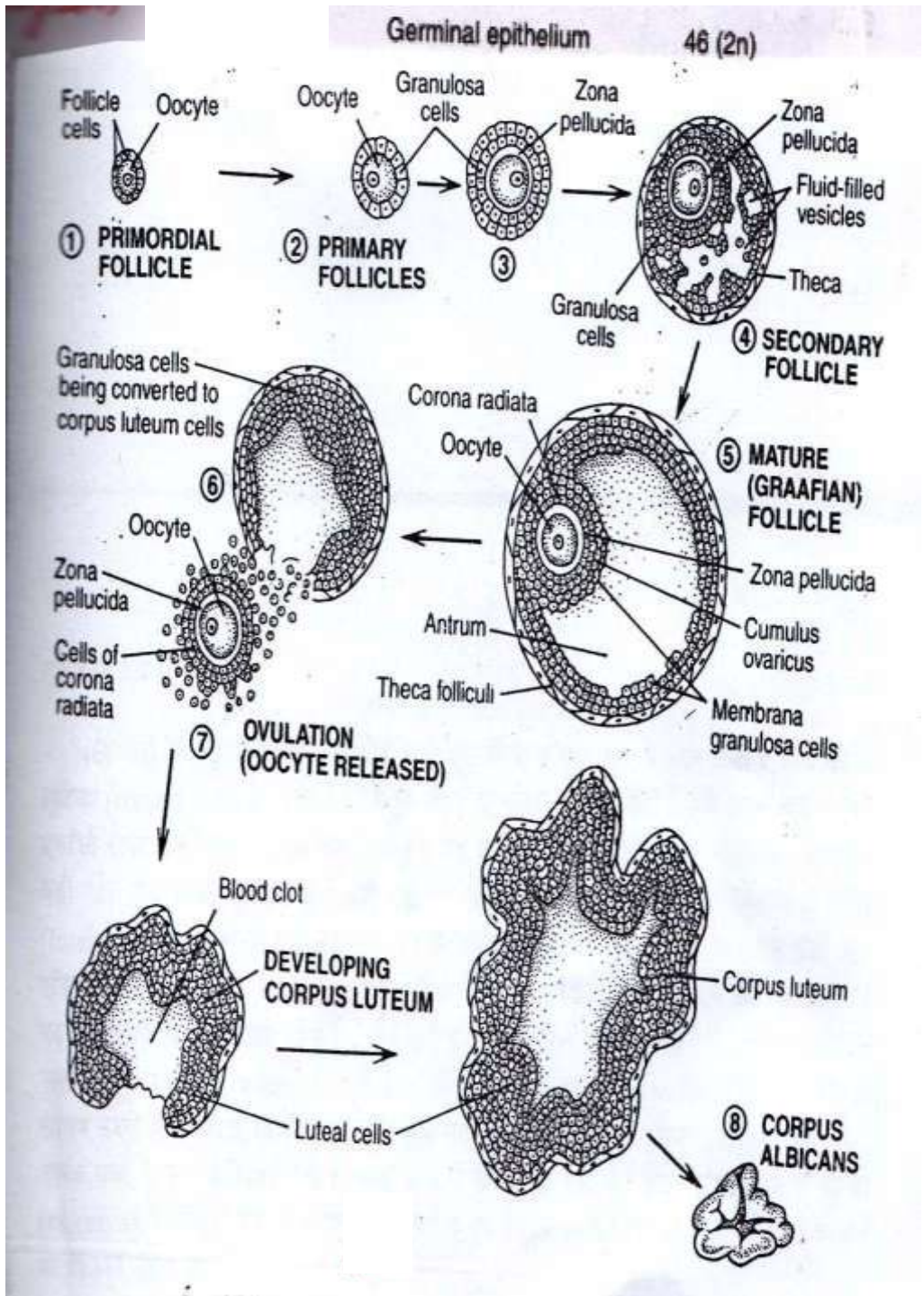


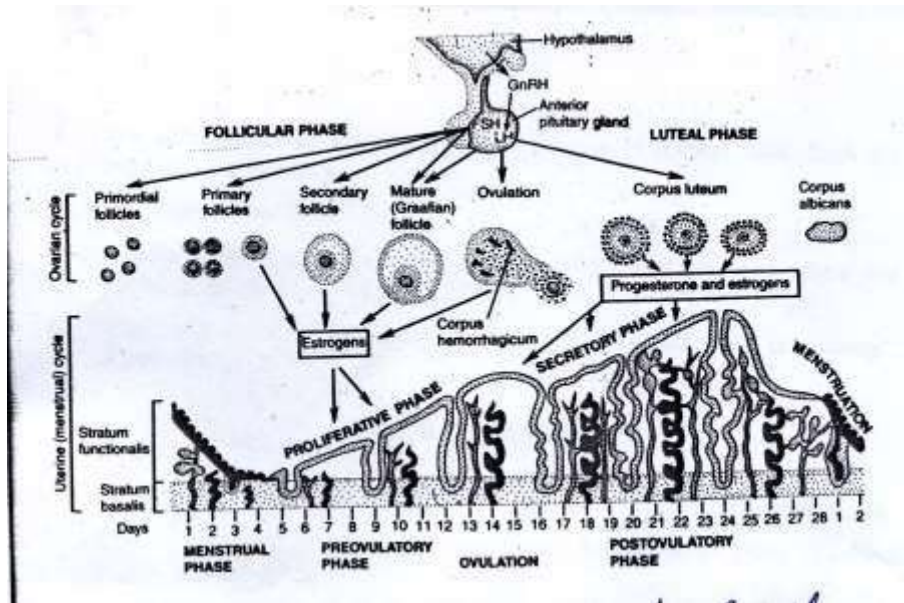
**Oogenesis** : Process of formation of ova in ovary



**Phases of Menstrual Cycle** : Menstrual Phase, Follicular (Proliferative) Phase, Ovulatory phase and Luteal (Secretory) phase







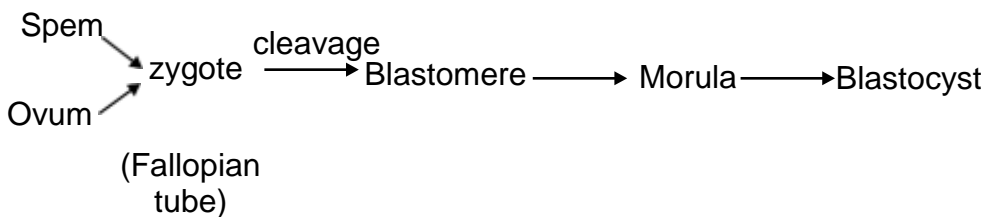
**Fertilisation** : Process of fusion of sperm with ovum

→ **Site of fertilisation in human female** : Ampullary - isthmic junction  
 Secretion of acrosome helps the sperm entry into cytoplasm of ovum through zona pellucida and plasma membrane. Sperm entry induce the completion of the 2nd meiotic division of secondary oocyte.

Ovum 23 (n)

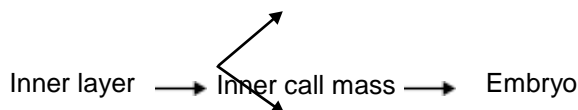
Secondary Oocyte

Second Polar body 23 (n)



Outer layer → Trophoblast → get attached to endometrium

Blastocyst



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

**Function of Placenta** : Nutrition, Respiration, Excretion, as barrier, Endocrine function.

**Placenta as Endocrine tissue** : Placenta Produces several hormones such as . Estrogen, hCG, hPL, Progesterone and relaxin (in late phase of pregnancy).

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

**QUESTION  
VSA (1 MARK)**

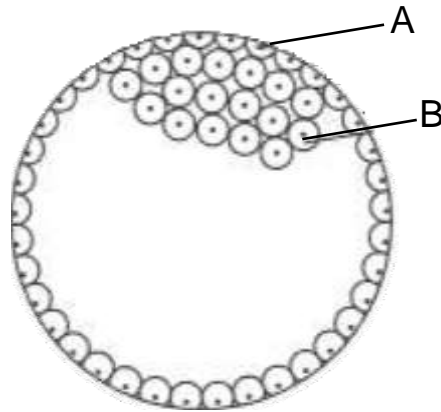
1. Failure of testes to descend into scrotal sacs leads to sterility. Why?
2. Both vaccine and colostrum produce immunity. Name type of immunity produced by these.
3. How many sperms will be produced from 10 primary spermatocytes and how many eggs will be produced from 10 primary oocytes?
4. The spermatogonial cell has 46 chromosomes in human male. Give the number of chromosomes in .  
(a) Primary spermatocyte                      (b) Spermatid
5. In ovary which structure transforms as corpus luteum and name the hormone secreted by corpus luteum?
6. Each and every coitus does not results in fertilisation and pregnancy..Justify the statement.

**SA-II (2 MARKS)**

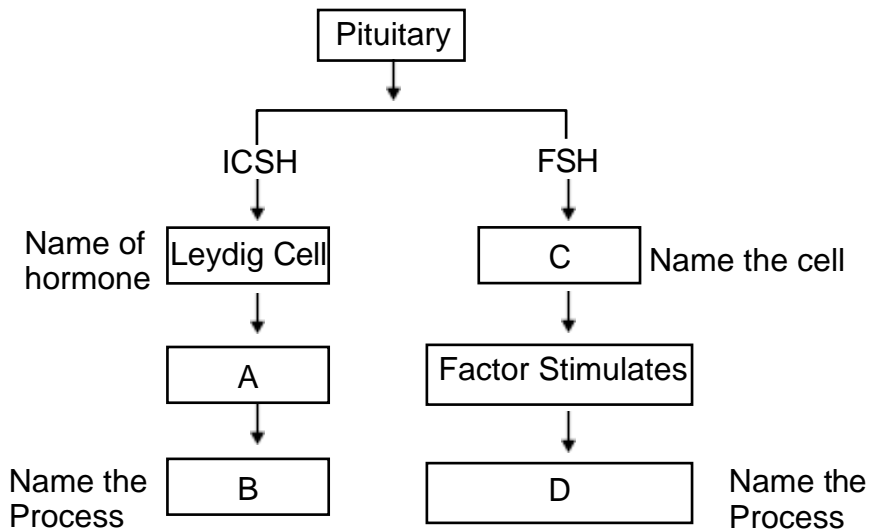
7. Give the function of  
(a) Corpus luteum                                      (b) Endometrium



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



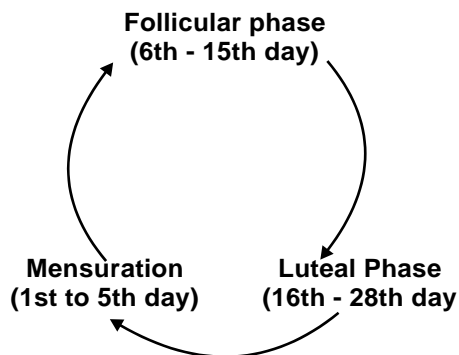
9. Given below is an incomplete flow chart showing influence of hormone on gametogenesis in male, observe the flow chart carefully and fill in the blank A, B, C and D.



10. Give reason for the following :
- The first half of the menstrual cycle is called follicular phase as well as proliferative phase.
  - The second half of the menstrual cycle is called luteal phase as well as secretory phase.
11. What is meant by L.H. Surge? Write the role of L.H.
12. Explain significance of the condition in which the testes remain suspended in scrotum outside the abdomen.

**SA-I (3 MARKS)**

13. Mention the name and role of hormones which are involved in regulation of gamete formation in human male.
14. Three of the steps of neuro endocrine mechanism in respect of parturition are mentioned below.  
Write the missing steps in proper sequence.
- Signals originate from fully developed foetus and placenta.
  - \_\_\_\_\_.
  - \_\_\_\_\_.
  - Oxytocin causes strong uterine contraction
  - Uterine contraction stimulates further secretion of oxytocin.
  - \_\_\_\_\_.

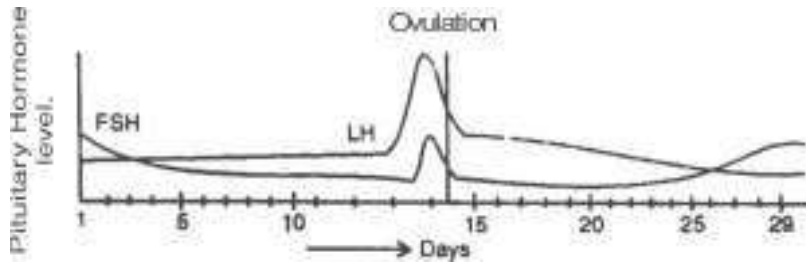


15. The events of the menstrual cycle are represented below.  
Answer the following questions.
- State the levels of FSH, LH and Progesterone simply by mentioning high or low around 13th and 14th day and 21st to 23rd day.

(ii) In which of the above mentioned phases does egg travel to fallopian tube?

(iii) Why there is no mensuration after fertilisation?

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



(i) 10th .14th days

(ii) 14th .15th days

(iii) 16th .23th days

(iv) 25th .29th days

(If the ovum is not fertilised)

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

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

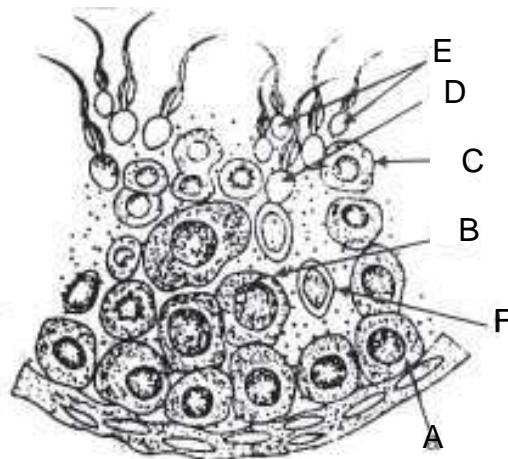
(i) Name the two types of cells of germinal epithelium.

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

Differentiate between them on the basis of their functions.

**LA (5 MARKS)**

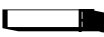
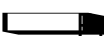
18.



Study the figure given :

- (i) Pick out and name the cells that undergo spermiogenesis.
- (ii) Name .A. and .C. cells.
- (iii) Give ploidy of .B. and .E.
- (iv) What are the cells marked as .F.? Mention their function.
- (v) Mention the type of cell division in A and B.

**ANSWERS**  
**VSA (1 MARKS)**

1. High temperature of abdomen kills the spermatogenic tissue of the testes, so no sperm are formed.
2. Vaccine . Active immunity Colostrum . Passive immunity.
3. 40 sperms, 10 eggs.
4. (i) 46 in Primary spermatocyte  
(ii) 23 in spermatid.
5.  llicular cells of empty Graafian follicle.  
 ogesterone.
6. Ovum and sperm should reach simultaneously to the ampullary - isthmic junction.

**SA-II (2 MARKS)**

7. **Corpus luteum** : It secretes progesterone which prepares endometrium of uterus for implantation and normal development of foetus.  
**Endometrium** : It undergoes cyclic changes during menstrual cycle and prepares itself for implantation of blastocyst.
8. A = Trophoblast . Gets attached to endometrium and draws nutritive material secreted by uterine endometrium gland.  
B = Inner cell mass - Differentiates as Embryo.
9. A = Testosterone; B = Spermatogenesis  
C = Sertoli cells; D Spermiogenesis

10. (a) During this phase, primary follicles transform into Graafian follicle under FSH stimulation. Graafian follicles secrete estrogens with stimulate enlargement of Endometrium of uterus.
- (b) During this phase, Corpus luteum is fully formed and secretes large quantity of Progesterone.
11. Refer page 51 NCERT book
12. Refer page 43 NCERT book.

**SA-1 (3 MARKS)**

13. **GnRH** : Stimulates adenophysis to secrete gonadotrophins.  
**GSH** : Stimulates Sertoli cells to secrete factors while help in spermatogenesis.  
**ICSH** : Stimulates interstitial cells to secrete testosterone.
14. (b) Foetal ejection reflex  
(c) The reflex triggers release of oxytocin  
(f) Expulsion of the baby out through birth canal.
15. (i)
- |              | <b>13 - 14th day</b> |      | <b>21st - 23rd day</b> |
|--------------|----------------------|------|------------------------|
| FSH          | →                    | High | Low                    |
| LH           | →                    | High | Low                    |
| Progesterone | →                    | Low  | High                   |
- (ii) End of follicular or proliferative phase.  
(iii) Menstruation does not occur during pregnancy upon fertilisation due to high level of progesterone secreted by persisting corpus luteum and Placenta.
16. (a) (i) Gonadotropins and FSH increases  
(ii) LH attains peak level but FSH decreases  
(iii) LH and FSH level decreases  
(iv) LH remains low and FSH increases.
- (b) After 29th day, there is a menstrual flow involving discharge of blood and cast off endometrium lining.

17. (i) Germinal epithelium have two types of cell.
1. Spermatogonium.
  2. Sertoli cells
- (ii) Leydig cells or Interstitial cells.

**Functions:**

Spermatogonium undergoes meiotic division leading to sperm formation.

Sertoli cell : Nourishes germ cells

Leydig cell : Synthesise and Secrete hormone androgen.

**LA 5(MARKS)**

18. (i) 'D' Spermatids = undergo spermiogenesis
- (ii) 'A' = Spermatogonium; B = Primary spermatocyte
- (iii) 'B' = Diploid E = Haploid
- (iv) 'F' = Sertoli cells - Nutrition to germ cells
- (v) Mitosis in Cell 'A', Meiosis in cell 'B'

## CHAPTER 4

# REPRODUCTIVE HEALTH

---

### POINTS TO REMEMBER

**Amniocentesis** : Diagnostic technique to detect genetic disorder in the foetus.

**Infertility** : Inability to produce children inspite of unprotected sexual co-habitation of a couple.

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

**IUCD** : Intra Uterine Contraceptive Device

**RCH** : Reproductive and Child Health care

**STD** : Sexually Transmitted Disease

**CDRI** : Central Drug Research Institute

**MMR** : Maternal Mortality Rate

**MTP** : Medical Termination of Pregnancy

**VD** : Venereal Disease

**RTI** : Reproductive Tract Infection

**PID** : Pelvic Inflammatory Disease

**ART** : Assisted Reproductive Technologies

**IVF** : In Vitro Fertilisation

**ZIFT** : Zygote Intra Fallopian Transfer

#### **Reasons for Infertility :**

- (i) Physical
- (ii) Congenital diseases
- (iii) Drugs
- (iv) Immunological reaction 'S'

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

- (i) **In vitro fertilisation (IVF)** : Fertilisation outside the body in almost similar conditions as that in the body, followed by embryo transfer (E.T.).  
**Test Tube baby Programme** : Ova from the wife/donor female and sperm from husband/donor male are allowed to fuse under simulated condition in the laboratory.  
**ZIFT** : Zygote intra fallopian transfer . Zygote or early embryo upto Eight blastomeres is transferred into the fallopian tube.  
**IUT** : Intra Uterine Transfer . Embryo with more than eight blasomeres are transferred.
- (ii) **Gamete intra fallopian transfer (GIFT)** : Transfer of an ovum collected from a donor to fallopian tube of another female who can not produce ova, but can provide suitable conditions for fertilization and further development of the foetus upto parturition,
- (iii) **Intra Cytoplasmic sperm injection (ICSI)** : The sperm is directly injected into the ovum to form an embryo in the laboratory and then embryo transfer is carried out.
- (iv) **Artificial Insemination** : This method is used in cases where infertility is due to the inability of the male partner to inseminate the female or due to very low sperm counts in the ejaculates. In this method, the semen collected from the husband or a healthy donor is artificially introduced into the vagina or into the uterus (IUI-Intra uterine insemination).

### Method of Birth Control

- (i) Natural Methods : Periodic abstinence  
Coitus interruptus  
Lactational amenorrhea.
- (ii) Barrier methods : Condom, Diaphragms, Cervical cap.
- (iii) Intra uterine devices : Non . medicated e.g. Lippes loop  
Copper releasing e.g.,Cu-T,multiload  
375 Hormone releasing e.g. LNG.20,  
progestasert
- (iv) Oral contraceptives : Pills / Saheli  
Small doses of either progestogens or  
Progestogen . estrogen combination
- (v) Surgical (Sterilisation) : (1) Tubectomy; (2) Vasectomy



## **QUESTIONS**

### **VSA (1 MARK)**

1. Give the term for prenatal diagnostic technique aimed to know the sex of developing foetus and to detect congenital disorders.
2. After a successful in vitro fertilisation, the fertilised egg begins to divide. Where is this egg transferred before it reaches the 8-celled stage and what is this technique called?
3. Give the term for rapid population growth.
4. Name the fluid from which foetal cells are extracted for chromosomal analysis.
5. Give technical name of female used to bring up in vitro fertilized egg to maturity.
6. Name the oral contraceptive developed by CDRI, Lucknow.

### **SA-II (2 MARKS)**

7. Lactational Amenorrhea is a method of contraception. Justify. What is the maximum effectiveness of this method in terms of period/duration?
8. How are non medicated IUDs different from hormone releasing IUDs? Give examples.
9. What are implants? How do they help in preventing fertilisation?
10. Briefly explain two natural barriers for birth control.
11. Enlist any four possible reasons for infertility in human beings.

### **SA-1 (3 MARKS)**

12. Give another name for sexually transmitted diseases. Name two sexually transmitted diseases which are curable and two diseases which are not curable.
13. Differentiate between Vasectomy and Tubectomy.
14. Name the techniques which are employed in following cases :
  - (a) Transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce ova but can provide suitable environment for fertilisation and development.

- (b) Embryo is formed in laboratory in which sperm is directly injected into ovum.
- (c) Semen collected either from husband or a healthy donor is artificially introduced either into vagina or uterus.
- 15. Mention the various precautions one has to take in order to protect himself/herself from STDs.
- 16. What are the disturbing trends observed regarding MTP?

**LA (5 MARKS)**

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

**ANSWERS**

**VSA (1 MARKS)**

- 1. Amniocentesis.
- 2. Fallopian tube; Zygote intra fallopian transfer (ZIFT)
- 3. Population explosion.
- 4. Amniotic fluid.
- 5. Surrogate mother.
- 6. Saheli

**SA-II (2 MARKS)**

- 7. (a) Ovulation and menstrual cycle do not occur during the period of intense lactation following parturition. Therefore, as the mother breast feeds, chances of conception are nil.  
(b) It is effective only upto a maximum period of six months following parturition.
- 8. (a) Non medicated IUDs = Lippes loop, Copper releasing IUDs ( CuT, Multiload 375)→These increase phagocytosis of sperms within uterus and release copper ions which suppress sperm motility and fertilising capacity of sperms.  
(b) Hormone releasing IUDs . Progestasert, LNG.20 . These makes uterus unsuitable for implantation and the cervix hostile to sperms.
- 9. The structures which contain hormones like progesterone and estrogen and are placed under the skin.

10. Periodic abstinence . couple should avoid coitus from 10th to 17th day of menstrual cycle.

Coitus interruptus . Male partner withdraws his penis from the vagina just before ejaculation of semen.

11. Physical, congenital disease, Drugs, Immunological and even psychological (anyfour).

**SA-I (3 MARKS)**

12. Venereal disease (VD)/Reproductive tract infection (RTI)

Curable : Syphilis, Gonorrhoea

Non Curable : Hepatitis B, AIDS, Genital herpes

13.

<b>Vasectomy</b>	<b>Tubectomy</b>
1. Method of sterilisation in males	1. Method of sterilisation in females.
2. Vasa defferentia of both are sides are cut and tied	2. Fallopian tube of both sides cut and tied.
3. Prevents movement of sperms at cut end.	3. Prevent movement of egg at cut end.

14. (a) Gamete intra fallopian transfer.

(b) Intra cytoplasmic sperm injection

(c) Intra uterine insemination.

15. (i) Avoid blood transfusion from an infected person.

(ii) Avoid sex with an unknown partner or multiple partners.

(iii) Always use condom.

(iv) Avoid sharing of injections needles and syringes and surgical instruments.

16. Majority MTP.s performed illegally by unqualified quacks, missuse for femalefoeticide.

**LA (5 MARKS)**

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

## CHAPTER 5

# PRINCIPLES OF INHERITANCE AND VARIATION

---

### POINTS TO REMEMBER

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

**Phenotype** : The observable or external characteristics of an organism

**Genotype** : The genetic constitution of an organism.

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

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

**Co-dominance** : When two alleles of a gene are equally dominant and express themselves even when they are together.

**Multiple allelism** : When a gene exists in more than two allelic forms e.g., gene for blood group exist in three allelic forms, IA, IB and i.

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

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

**Male heterogamety** : When male produces two different types of gametes/ sperms e.g., In human beings X and Y.

**Mutation** : The sudden heritable change in the base sequence of DNA, or structure of chromosome or a change in the number of chromosomes.

**Pedigree Analysis** : The analysis of the distribution and movement of trait in a series of generations of a family.

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

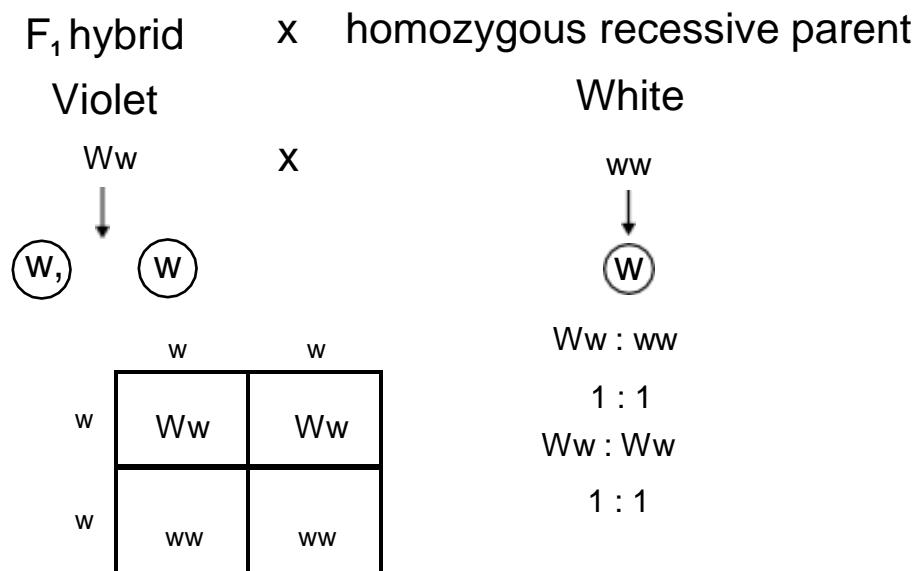
**Law of Dominance** : When two individuals of a species differing in a pair of contrasting characters/traits are crossed, the trait that appears in the F1 hybrid is dominant and the alternate from that remain hidden, is called recessive.

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

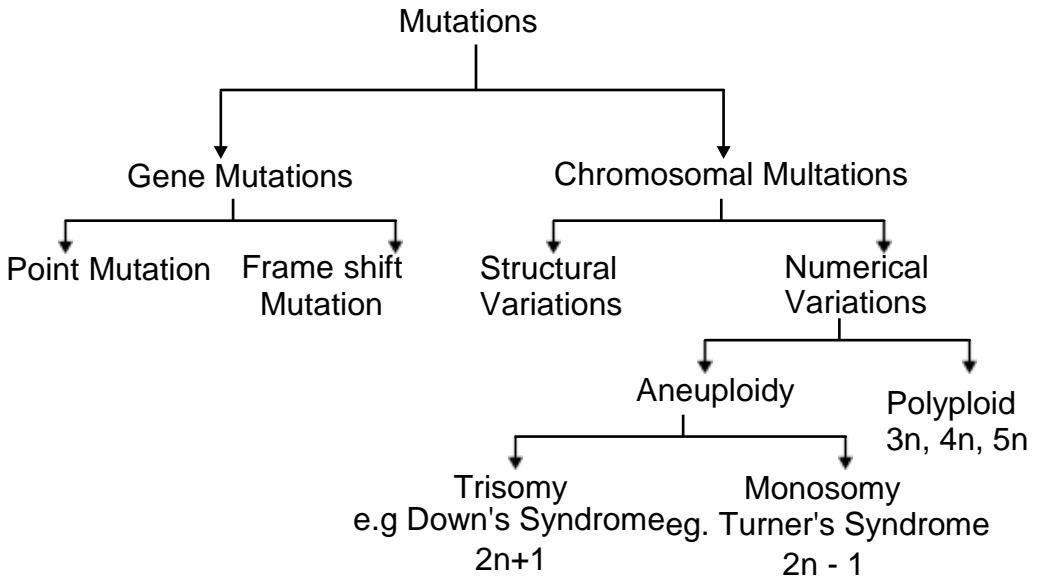
**Law of Independent Assortment** : In the inheritance of two pairs of contrasting characters, the factors of each pair of characters segregate independently of the factors of the other pair of characters.

**Test Cross** : When offspring or individual with dominant phenotype, whose genotype is not known, is crossed with an individual who is homozygous recessive for the trait.

The progeny of monohybrid test cross ratio is 1 : 1 while the dihybrid test cross ratio is 1 : 1 : 1 : 1.



**Use of Test Cross :** The test cross is used to find the genotype of an organism.



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

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

Example : Human blood groups.

Blood Group	Genotype
A	$I^A I^A, I^A i$
B	$I^B I^B, I^B i$
AB	$I^A I^B$
O	$ii$

In human blood, there are six genotype and four phenotypes.

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

**Linkage-** is the tendency of genes on a chromosome to remain together.

- Linked genes occur in the same chromosome.

- They lie in linear sequence in the chromosome-There is a tendency to maintain the parental combination of genes except for occasional choosers.
- Strength of linkage between genes is inversely proportional to the distance between the two.

**Recombination** - is the generation of non-parental gene combinations to the offsprings.

Tightly linked genes show very low recombination frequency. Loosely linked genes show higher recombination frequency.

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

### **Chromosomal basis of sex determination**

- XX - XY type - female homogametic ie XX and male heterogametic ie. XY is *Drosophila*, humans.
- XX - XO type All eggs bear additional X chromosome, Males have only one X chromosome besides autosomes whereas females have a pair of X chromosomes eg grasshoppers.
- ZW - ZZ type - The females are heterogametic and have one Z and one W chromosome. The males are homogametic with a pair of Z chromosomes besides autosomes eg - birds.

### **Pedigree Analysis**

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

### **Usefulness of Pedigree Analysis**

1. It is useful for genetic counsellors to advise intending couples about the possibility of having children with genetic defects like haemophilia, thalassaemia etc.
2. It is helpful to study certain genetic trait and find out the possibility or absence or presence of that trait in homozygous or heterozygous condition in a particular individual.

### **Mendelian disorders:**

These are mainly determined by alteration or mutation in single genes. or mutation in single genes.

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

$X^h Y$  . Sufferer male

$X^h X$  . carrier female

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

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

$Hb^A Hb^A$  . Normal

$Hb^S Hb^S$

$Hb^A Hb^S$  . Apparently unaffected/carriers sufferer

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

**Thalassemia** - Thalassemia is autosome linked recessive disease. This disorder caused by defects in the synthesis of globin chain. Thalassemia is of two types - Alpha ( $\alpha$ ) Thalassemia , Beta ( $\beta$ ) Thalassemia.

In alpha Thalassemia production of alpha globin chain is affected. This Thalassemia is controlled by genes HBA1 and HBA 2 located on chromosome 16<sup>th</sup> of each parent. Thalassemia occurs due to mutation or deletion of one or more of the four genes.

- In Beta thalassemia production of  $\beta$ -globin chain is affected this thalassemia is controlled by gene HBB located on 11<sup>th</sup> chromosome of each parent. It occurs due to one or both HBB genes.
- In Thalassemia too few globin is synthesized whereas in sickle cell anaemia there is a synthesis of incorrectly functioning globin.

### Chromosomal disorders



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

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

$X^cX^c$  ——— Colour blind female

$X X^c$  ——— Carrierfemale

$X^c y$  ——— Colour blind male

y-chromosome of male do not carry any gene for certain vision.

**Down.s syndrome** . Trisomy of chromosome number 21.

Affected individual is short statured with small round head, furrowed tongue, partially open month, broad palm. Physical, psychomotor and mental development is retarded.

**Klinefelter.s syndrome** - extra copy of X chromosome; karyotype XXY. Affected individual has overall masculine development with feminine characters like gynaecomastia (development of breast) and is sterile.

**Turner.s syndrome** - has absence of one X chromosome ie. 45 with XO. Affected females are sterile with rudimentary ovaries and lack secondary sexual characters.

## PLEIOTROPY

The ability of a gene to have multiple phenotypic effects because it influences a number of characters simultaneously is known as pleiotropy. The gene having a multiple phenotypic effect because of its ability to control expression of a number of characters is called pleiotropic gene.

Eg. in Garden Pea, the gene which controls the flower colour also controls the colour of seed coat and presence of red spot in the leaf axil.

## POLYGENIC INHERITANCE

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

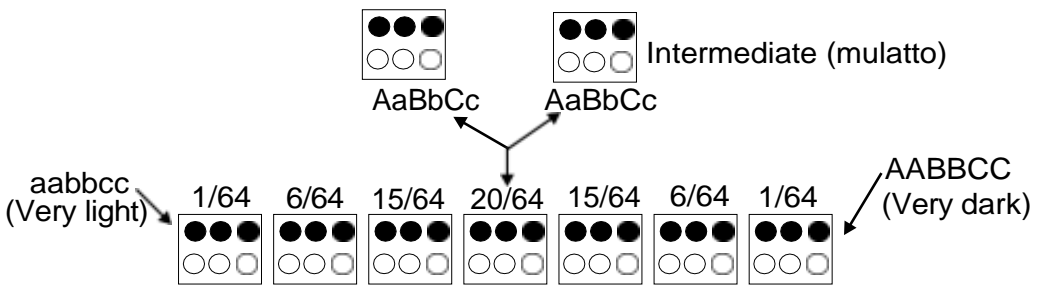
Eg. Kernel colour in wheat, skin colour in human beings, height in humans, cob length in maize etc.

In polygenic inheritance, a cross between two pure breeding parents produces an intermediate trait in  $F_1$ . In  $F_2$  generation, apart from the two

parental types, there are several intermediates (gradiations, show a bell shaped curve). F<sub>1</sub> hybrid form 8 kinds of gamete in each sex giving 64 combination in F<sub>2</sub> having 7 genotype and phenotype.

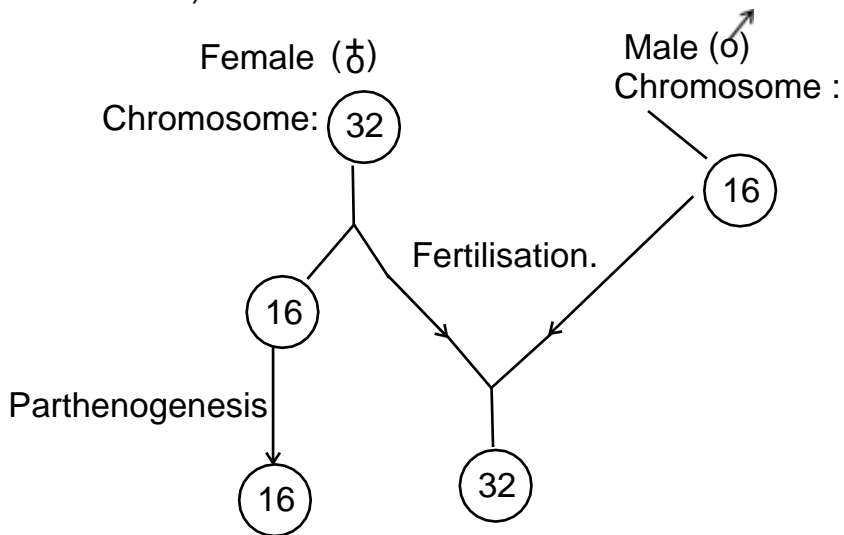
**Polygenic inheritance of skin tone**

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



Offspring can have tone darker or lighter than either parent

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



**QUESTIONS**  
**VSA (1 MARK)**

1. Give any two reasons for the selection of pea plants by Mendel for his experiments.
2. Name any one plant that shows the phenomenon of incomplete dominance during the inheritance of its flower colour.
3. Name the base change and the amino acid change, responsible for sickle cell anaemia.
4. Name the disorder with the following chromosome complement.
  - (i) 22 pairs of autosomes + X X Y
  - (ii) 22 pairs of autosomes + 21st chromosome + XY.
5. A haemophilic man marries a normal homozygous woman. What is the probability that their daughter will be haemophilic?
6. A test is performed to know whether the given plant is homozygous dominant or heterozygous. Name the test and phenotypic ratio of this test for a monohybrid cross.

**SA-II (2 MARKS)**

7. Identify the sex of organism as male or female in which the sex chromosome are found as
  - (i) ZW in bird
  - (ii) XY in Drosophila
  - (iii) ZZ in birds.
  - (iv) XO in grasshopper.
8. Mention two differences between Turner's syndrome and Klinefelter's syndrome.
9. The human male never passes on the gene for haemophilia to his son. Why is it so?
10. Mention four reasons why Drosophila was chosen by Morgan for his experiments in genetics.
11. Differentiate between point mutation and frameshift mutations.

**SA-I (3 MARKS)**

12. A woman with O blood group marries a man with AB blood group.
  - (i) work out all the possible phenotypes and genotypes of the progeny.
  - (ii) Discuss the kind of dominance in the parents and the progeny in this case.

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

**SA-I (3 MARKS)**

12. (i) Blood group AB has alleles as  $I^A$ ,  $I^B$  and O group has  $i$  which on cross gives the both blood groups A and B while the genotype of progeny will be  $I^A i$  and  $I^B i$ .
- (ii)  $I^A$  and  $I^B$  are equally dominant (co-dominant). In multiple allelism, the gene I exists in 3 allelic forms,  $I^A$ ,  $I^B$  and  $i$ .
13. **Cause** : Presence of an extra chromosome in male i.e., XXY.  
**Symptoms** : Development of breast, Female type pubic hair pattern, poor beard growth, under developed testes and tall stature with feminised physique.

14. (i) Green pod colour is dominant  
 (ii) Green podcolour  
 (iii) Parents GG(green) X gg (yellow)
- |                  |                   |                   |                                       |
|------------------|-------------------|-------------------|---------------------------------------|
| Gametes          | $\textcircled{G}$ |                   | $\textcircled{g}$                     |
| F1 generation    |                   | Gg (Hybridgreen)  |                                       |
| Gametes          | $\textcircled{G}$ | $\textcircled{g}$ | X $\textcircled{G}$ $\textcircled{g}$ |
| F2 generation    | GG                | Gg                | Gg gg                                 |
| Phenotypic ratio | 3 : 1             |                   |                                       |
| Genotypic ratio  | 1 : 2 : 1         |                   |                                       |

**LA (5 MARKS)**

15. (i) It is a dihybrid test cross

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(ii) Parent RrYy (Round Yellow) × rryy (Wrinkled green)  
Gametes (RY), (Ry), (rY), (ry) × ry

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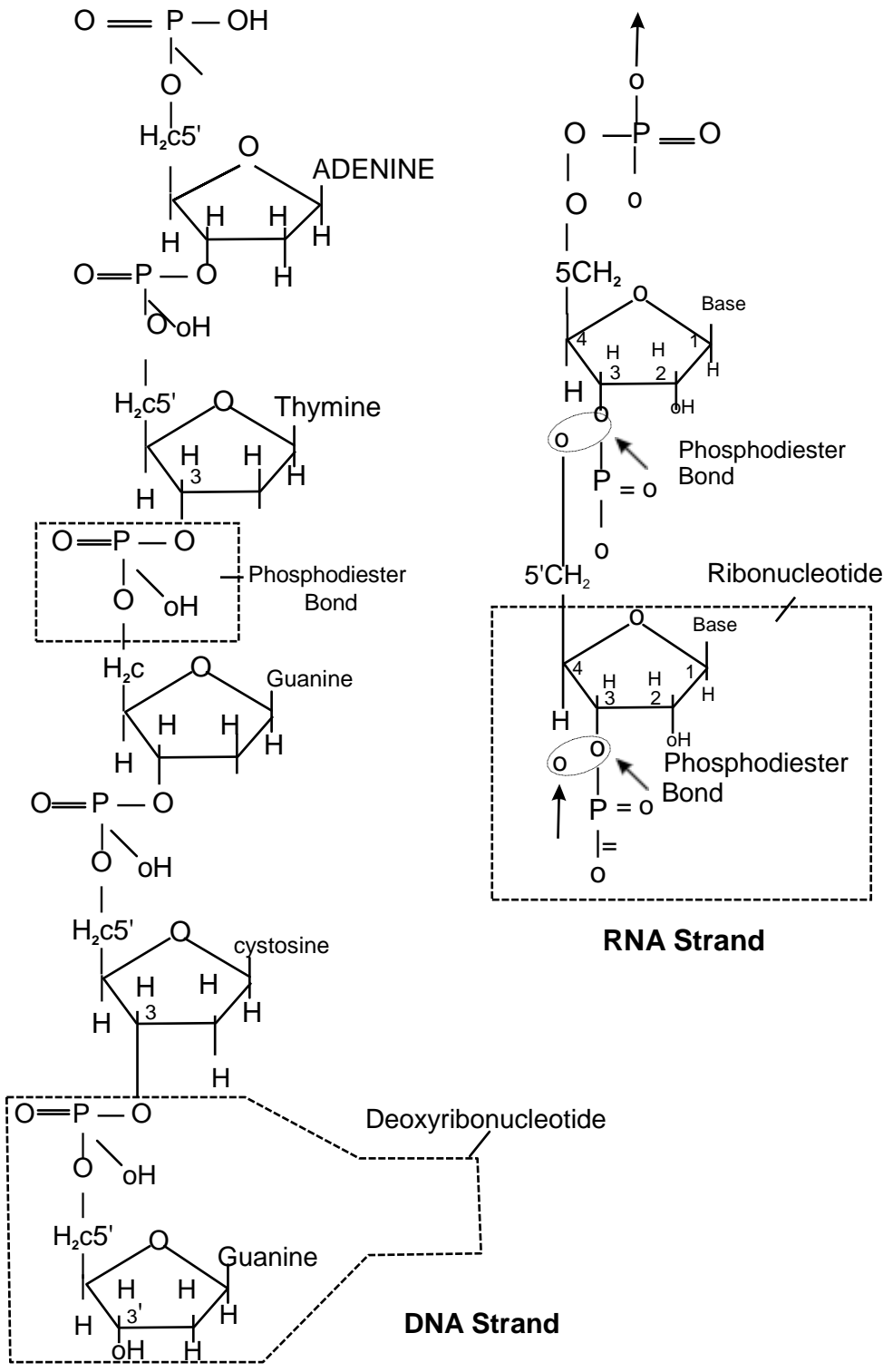
	Gametes	RY	Ry	rY	ry
F1 progeny	ry	RrYy	Rryy	rrYy	rryy
		Round, Yellow	Round and Green	Wrinkled Yellow	Wrinkled, Green

---

Phenotypic ratio : 1 : 1 : 1 : 1

Genotypic ratio : 1 : 1 : 1 : 1

(iii) It illustrates the Principle of independent assortment.



## CHAPTER 6

### MOLECULAR BASIS OF INHERITANCE

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#### POINTS TO REMEMBER

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

**Transformation** : The phenomenon by which the DNA isolated from one type of a cell, when introduced into another type, is able to express some of the properties of the former into the latter.

**Nucleosome** : The structure formed when negatively charged DNA is wrapped around positively charged histone octamer.

**DNA Polymorphism** : The variations at genetic level, where an inheritable mutation is observed.

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

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

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

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

**Euchromatin** : The region of chromatin which is loosely packed and transcriptionally active.

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

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

13. Explain the cause of Klinefelter's syndrome. Give any four symptoms shown by sufferer of this syndrome.
14. In Mendel's breeding experiment on garden pea, the offspring of F<sub>2</sub> generation are obtained in the ratio of 25% pure yellow pod, 50% hybrid green pods and 25% green pods State (i) which pod colour is dominant
  - (ii) The Phenotypes of the individuals of F<sub>1</sub> generation.
  - (iii) Workout the cross.

### LA (5 MARKS)

15. A dihybrid heterozygous round, yellow seeded garden pea (*Pisum sativum*) was crossed with a double recessive plant.
  - (i) What type of cross is this?
  - (ii) Work out the genotype and phenotype of the progeny.
  - (iii) What principle of Mendel is illustrated through the result of this cross?

### ANSWERS

#### VSA (1 MARK)

1. (i) Many varieties with contrasting forms of characters  
(ii) Can easily be cross pollinated as well as self pollinated.
2. Dog flower (Snapdragon or *Antirrhinum* sp.)
3. GAG changes as GUG, Glutamic acid is substituted by valine.
4. (i) Klinefelter's Syndrome                      (ii) Down's syndrome
5. Their daughter can never be haemophilic. (0%).
6. Test cross 1 : 1.

#### SA-II (2 MARKS)

7. (i) Female;    (ii) Male;    (iii) Female    (iv) Male
8. **Turner's Syndrome** : The individual is female and it has 45 chromosomes i.e., one X chromosome is less.  
**Klinefelter's Syndrome** : The individual is male and has 47 chromosomes i.e., one extra X chromosome.



## Central Dogma :

Replication



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

**VNTR** : Variable Number Tandem Repeats

**YAC** : Yeast Artificial Chromosome

**BAC** : Bacterial Artificial Chromosome

**SNPs** : Single Nucleotide polymorphism

**HGP** : Human Genome Project

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

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

### 1. Nitrogen base

(i) Purines : Adenine and Guanine

(ii) Pyrimidines : Cytosine, Thymine and Uracil

Thymine in DNA and Uracil in RNA.

2. **Pentose Sugar** : Ribose (in RNA) or Deoxyribose (in DNA).

### 3. Phosphate Group

☐ Nitrogen base is linked to pentose sugar through N-glycosidic linkage.

☐ Nitrogen base + Sugar = Nucleoside

☐ Phosphate group is linked to 5'.OH of a nucleoside through phosphoester linkage.

☐ Nucleoside + Phosphate group = Nucleotide.

☐ Two nucleotides are linked through 3'.5' phosphodiester linkage to form a dinucleotide

☐ Polynucleotide chain has free phosphate group at 5'.end of ribose sugar and 3'.OH group at other end.

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

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

- (i) DNA is made up of two polynucleotide chains.
- (ii) The backbone is made up of sugar and phosphate and the bases project inside.
- (iii) Both polynucleotide chains are antiparallel i.e. one chain has polarity 5'-3' and other chain has 3'-5'.
- (iv) These two strands of chains are held together by hydrogen bonds i.e. A=T, C=G.
- (v) Both chains are coiled in right handed fashion. The pitch of helix is 3.4 nm with 10 bp in each turn.

**Hershey and Chase Experiment :** In 1952, Hershey and Chase performed an experiment on bacteriophages (Viruses that infect bacteria) and proved that

DNA is the genetic material.

Bacteriophage Radioactive ( $^{35}\text{S}$ ) labelled protein coat	Bacteriophage Radioactive ( $^{32}\text{P}$ ) labelled DNA
---	--



**Infection :** E.coli



E.coli



**Blending :** Viral coats removed from the bacteria.



**Centrifugation :** Viral particles separated from the bacterial cell.



No radioactive ( $^{35}\text{S}$ )  
detected in bacterial cells  
but detected in  
supernatant



Radioactive ( $^{35}\text{P}$ )  
detected in bacterial  
cells but not in  
supernatant

**Conclusion :** DNA is the genetic material.

**Meselson and Stahl's Experiment :**

- Meselson and Stahl performed the experiment in 1958 on *E.coli* to prove that DNA replication is semiconservative.
- *E.coli* was grown in  $^{15}\text{NH}_4\text{Cl}$  for many generations.
- $^{15}\text{N}$  was incorporated into newly synthesised DNA.
- This heavy DNA could be differentiated from normal DNA by centrifugation in cesium chloride (CsCl) density gradient.

Then they transferred these E.coli into a medium with normal  $^{14}\text{NH}_4\text{Cl}$ .

- After 20 minutes, it was found that all the DNA molecules of daughter cells were hybrid. First generation.
- After 40 minutes, it was found that 50% DNA molecules were hybrid and 50% were normal-second generation.

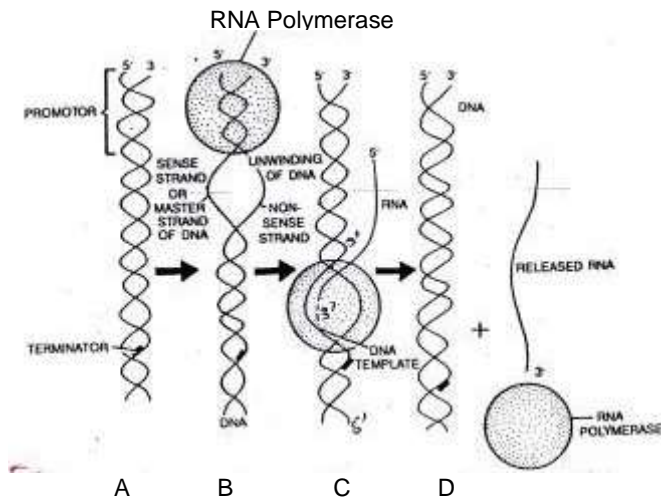
### DNA Replication :

- (i) **Origin of replication** - it is the starting point when replication of DNA begins.
- (ii) **Replication fork** - for long DNA molecules, since the two strands of DNA cannot be separated in its entire length, the replication occurs within a small opening of DNA helix, referred to as replication fork.
- (iii) **Continuous synthesis** - DNA dependent DNA polymerase catalyses polymerisation only in 5'→3' direction, one strand (the template with polarity 3'→5'), the replication is continuous.
- (iv) **Discontinuous synthesis** - In the template with 5'→3' the replication is discontinuous and the fragments are joined by enzyme ligase.

**Transcription** : The process of copying genetic information from one strand of DNA into RNA.

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

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



### Transcription in Eukaryotes :

█ In eukaryotes three types of RNA polymerases found in the nucleus (apart from RNA polymerases are found in the organelles) are involved in transcription.

**RNA Polymerase I :** Transcribes rRNAs.

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

**RNA Polymerase III :** Transcribes tRNA, 5 srRNA and snRNA.

█ The primary transcript has both exon and intron regions.

█ Introns which are non-coding regions removed by a process called splicing.

█ hnRNA undergoes two additional processes :

- (a) **Capping :** An unusual nucleotide (methylguanosine triphosphate) is added to 5'-end of hnRNA.
- (b) **Tailing :** Adenylate residues (200-300) are added at 3'-end. It is fully processed hnRNA, now called mRNA is transported out of the nucleus

### Lac Operon

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

→ The lac operon consists of one regulatory gene (the i-gene) and three structural genes (z, y and a).

→ The i-gene codes for repressor of lac operon.

→ Lactose is an inducer.

- Gene z - Codes for b-galactosidase
- Gene y - Codes for permease
- Gene a - Codes for transacetylase.

**In the absence of Inducer (lactose)**

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

Operator turns off

RNA polymerase stops the transcription

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

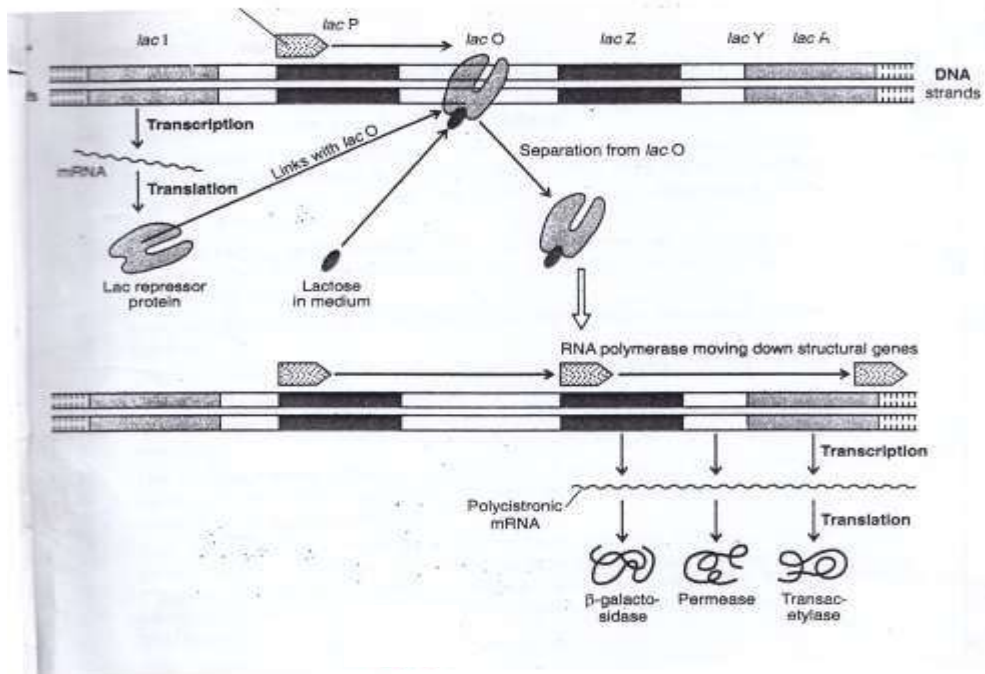
**In the presence of Inducer (lactose)**

Repressor binds to inducer (lactose)

Operator (o) turns ON

RNA polymerase starts the transcription

Structural genes (z, y and a) produce mRNA and enzymes (β-galactosidase, permease and transacetylase respectively)



## Packaging of DNA Helix

- The average distance between the two adjacent base pairs is 0.34 nm ( $0.34 \times 10^{-9} \text{m}$  or  $3.4^\circ \text{A}$ )
- The number of base pairs in *E. coli* is  $4.6 \times 10^6$ .
- **DNA Packaging in Prokaryotes** - DNA is not scattered throughout the cell. DNA (negatively charged) is held by some proteins (has positive charges) in a region termed as 'nucleoid'. The DNA in nucleoid is organised in large loops held by proteins.
- **DNA packaging in Eukaryotes** - There is a set of positively charged basic proteins called histones. Histones are rich in the basic amines and residues lysines and arginines.
- Histones are organised to form a unit of eight molecules called histone octamer.
- The negatively charged DNA is wrapped around positively charged histone octamer to form a structure called nucleosome
- Nucleosomes constitute the repeating unit of a structure in nucleus called chromatin
- The beads-on-string structure in chromatin is packaged to form chromatin fibres that are further coiled and condensed at metaphase stage of cell division to form chromosomes
- The packaging of chromatin at higher level requires additional set of protein that collectively are referred to as Non-histone chromosomal (NHC) proteins. At places chromatin is densely packed to form darkly staining heterochromatin. At other places chromatin is loosely packed to form euchromatin

## Genetic Code

- (i) The codon is triplet 61 codons code for amino acids and 3 codons function as stop codons (UAG, UGA, UAA)
- (ii) One codon codes for only one amino acid, hence the codon is unambiguous and specific.
- (iii) Some amino acids are coded by more than one codon . degenerate

- (iv) The codon is read in mRNA in a contiguous fashion. There are no punctuations
- (v) The code is nearly universal
- (vi) AUG has dual functions. It codes for Methionine (met) and it also acts as initiator codon.

### **tRNA.the Adapter Molecule :**

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

### **Translation :**

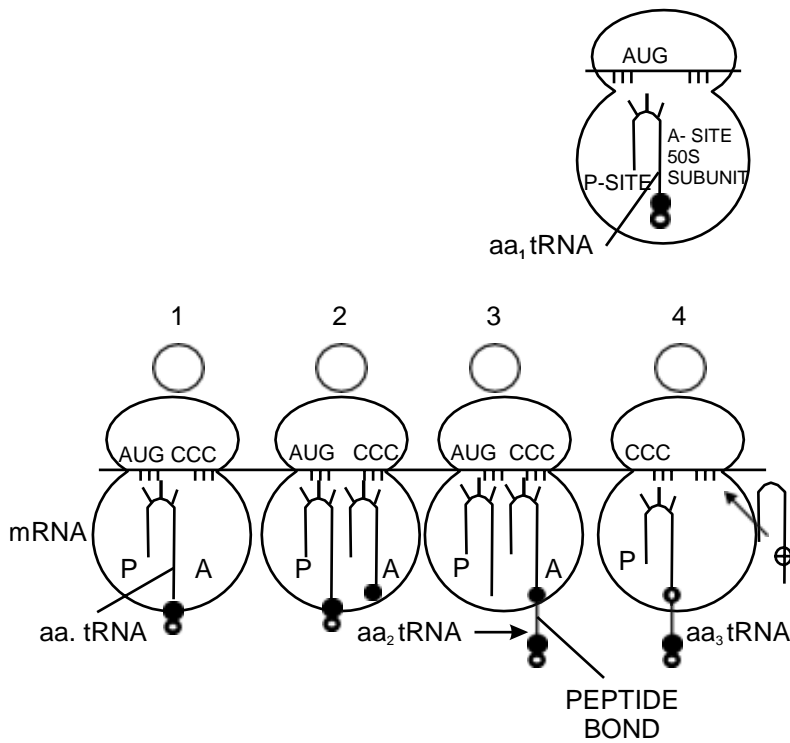
← Translation refers to the process of polymerisation of amino acids to form a polypeptide. The order and sequence of amino acids are defined by the sequence of bases in the mRNA.

← First step is - charging of tRNA or aminoacylation of tRNA-here amino acids are activated in the presence of ATP and linked to specific tRNA.

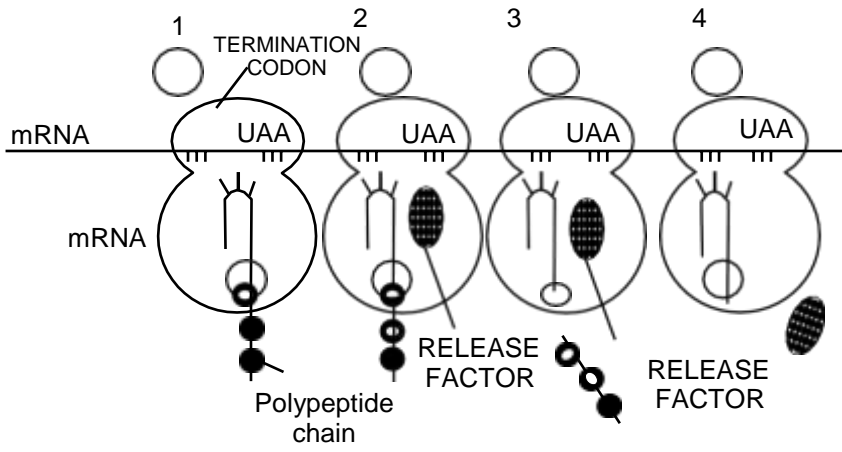
← Initiation - Ribosome binds to mRNA at the start codon (AUG) that is recognised by the initiator tRNA.

← **Elongation phase** - Here complexes composed of an amino acid linked to tRNA, sequentially bind to the appropriate codon in mRNA by forming complementary base pairs with tRNA codon. The ribosomes move from codon to codon along with the mRNA. Amino acids are added one by one, translated into polypeptide sequences.

← **Termination** - Release factors binds to the stop codon, terminating translation and releasing the complete polypeptide from the ribosome.

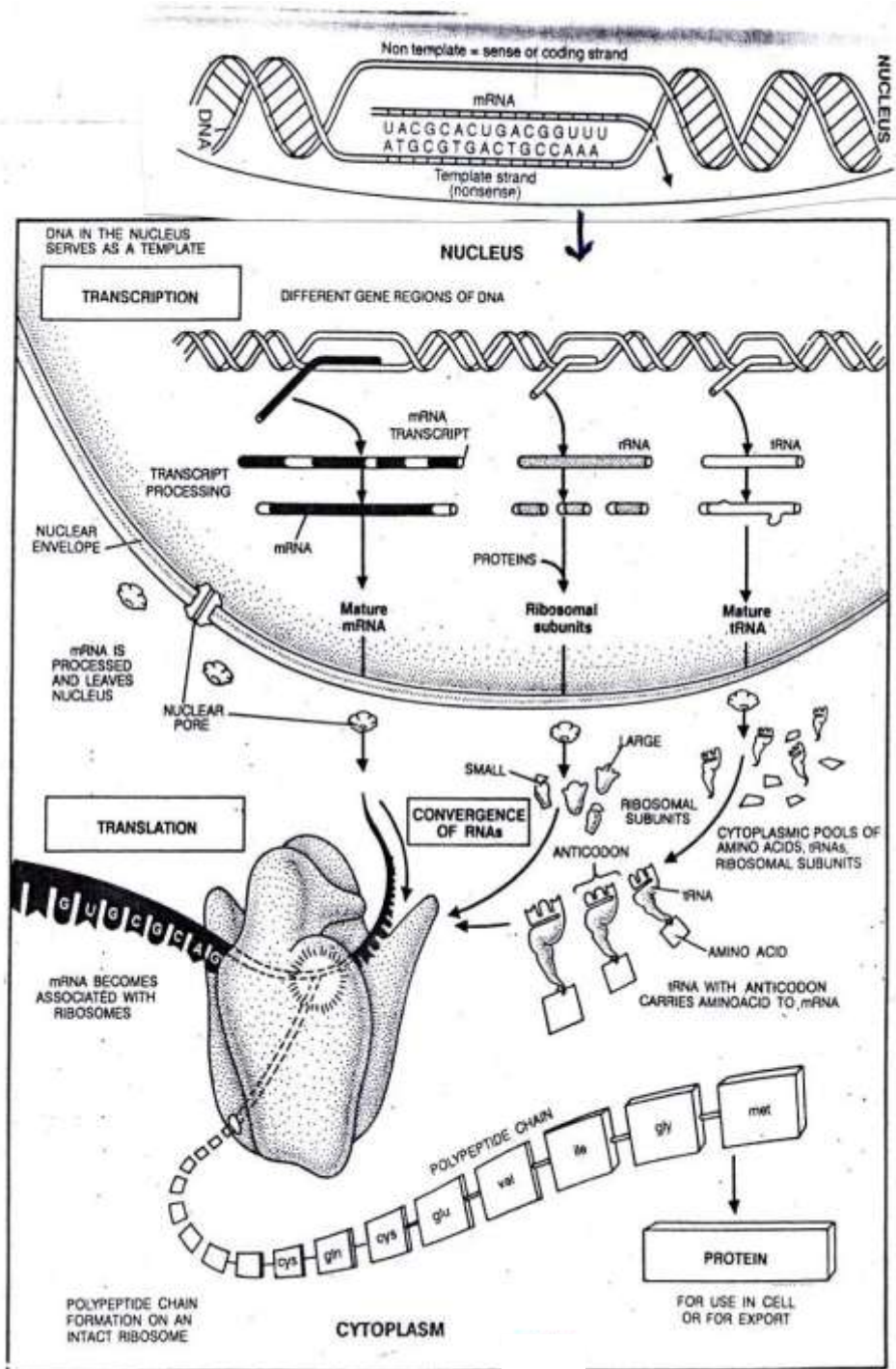


ELONGATION



TERMIINATION

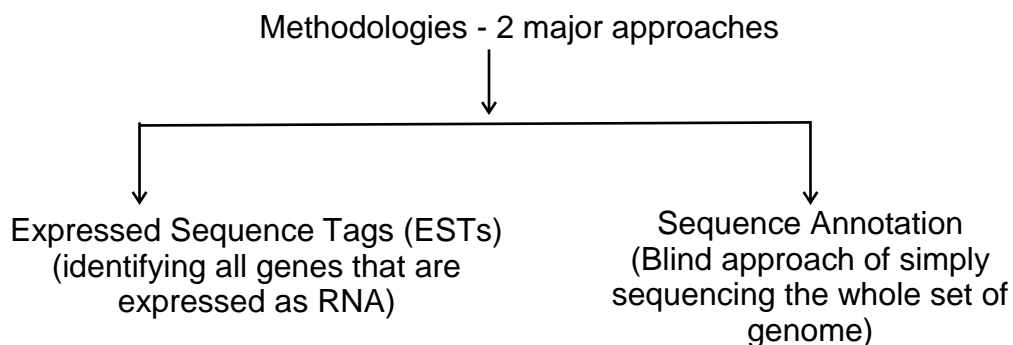




**Human Genome Project** was a 13 year project coordinated by the U.S. Department of energy and National Institute of Health, It was completed in 2003.

### Important goals of HGP

- (i) Identify all the approximately 20,000-25,000 genes in human DNA.
- (ii) Determine the sequences of the 3 billion chemical base pairs that make up human DNA.
- (iii) Store this information in database.
- (iv) Transfer related technologies to other sectors, such as industries.
- (v) Address the ethical, legal and social issues (ELSI) that may arise from the project.



Salient features of Human Genome - Refer Pg - 120, NCERT Class XII)

**DNA Fingerprinting** - It is a technique of determining nucleotide sequences of certain areas of DNA which are unique to each individual

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

**Steps/procedure in DNA fingerprinting .**

- Extraction of DNA - using high speed refrigerated centrifuge.
- Amplification - many copies are made using PCR
- Restriction Digestion - using restriction enzymes DNA is cut into fragments.
- Separation of DNA fragments - using electrophoresis-agarose polymer gel.
- Southern Blotting : Separated DNA sequences are transferred on to nitrocellulose or nylon membrane.
- Hybridisation : The nylon memberane exposed to radio active probes.
- Autoradiography : The dark bands develop at the probe site.

**Applications of DNA Fingerprinting**

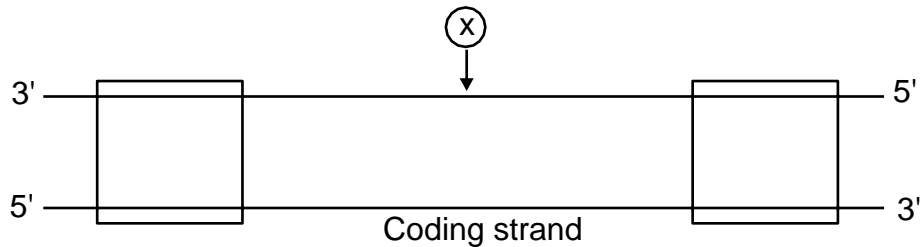
- (i) identify criminals in forensic labs.
- (ii) determine paternity
- (iii) verify whether a hopeful immigrant is really close relative of an already established resident.
- (iv) identify racial groups to rewrite biological evolution.

**QUESTIONS**

**VSA (1 MARK)**

1. Name the factors for RNA polymerase enzyme which recognises the start and termination signals on DNA for transcription process in Bacteria.
2. Mention the function of non-histone protein.
3. During translation what role is performed by tRNA
4. RNA viruses mutate and evolve faster than other viruses. Why?

5. Name the parts 'X' and 'Y' of the transcription unit given below.

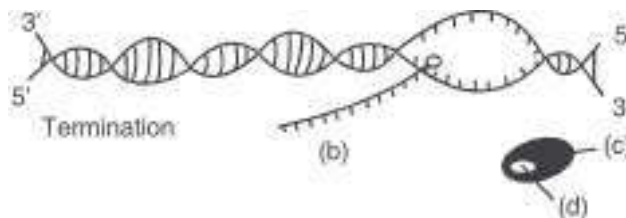


6. Mention the dual functions of AUG.  
 7. Write the segment of RNA transcribed from the given DNA .  
 3' → ATGCAGTACGTCGTA . 5' - Template Strand  
 5' ← TACGTCATGCAGCAT . 3' . Coding Strand.

**SA-II (2 MARKS)**

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

(a)



9. Complete the blanks a, b, c and d on the basis of Frederick Griffith Experiment.

S Strain → inject into mice → (a)

R strain → inject into mice → (b)

S strain (heat killed) → inject into mice → (c)

S strain (heat killed) + R strain (live) → inject into mice → (d)

10. Give two reasons why both the strands of DNA are not copied during transcription.

11. Mention any two applications of DNA fingerprinting.

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

### SA-I (3 MARKS)

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

OR

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

15. Name the three major types of RNAs, specifying the function of each in the synthesis of polypeptide.
16. Enlist the goals of Human genome project.
17. A tRNA is charged with the amino acid methionine.
  - (i) Give the anti-codon of this tRNA.
  - (ii) Write the Codon for methionine.
  - (iii) Name the enzyme responsible for binding of amino acid to tRNA.
18. Illustrate schematically the process of initiation, elongation and termination during transcription of a gene in a bacterium.

### LA (5 MARKS)

19. What is meant by semi conservative replication? How did Meselson and Stahl prove it experimentally?
20. What does the lac operon consist of? How is the operator switch turned on and off in the expression of genes in this operon? Explain.
21. State salient features of genetic code.
22. Describe the process of transcription of mRNA in a eukaryotic cell.
23. Describe the various steps involved in the technique of DNA fingerprinting.

### ANSWERS

#### VSA (1 MARK)

1. Sigma (s) factor and Rho(p) factor)
2. Packaging of chromatin
3. (i) Structural role  
(ii) Transfer of amino acid.

4. —OH group is present on RNA, which is a reactive group so it is unstable and mutate faster.
5. X . Template strand, Y . Terminator.
6. (i) Acts as initiation codon for protein synthesis  
(ii) It codes for methionine.
7. 5' . U A C G U C A U G C A G C A U 3' (In RNA .T. is replaced by .U.)

**SA-II (2 MARKS)**

8. (a) DNA molecule (b) mRNA transcript  
(c) RNA polymers (d) Rho factor
9. (a) Mice die (b) mice live  
(c) mice live (d) mice die
10. (a) If both the strands of DNA are copied, two different RNAs (complementary to each other) and hence two different polypeptides will produce; If a segment of DNA produces two polypeptides, the genetic information machinery becomes complicated.  
(b) The two complementary RNA molecules (produced simultaneously) would form a double stranded RNA rather than getting translated into polypeptides.  
(c) RNA polymerase carries out polymerisation in 5'—3' direction and hence the DNA strand with 3'—5' polarity acts as the template strand. (Any two)
11. (i) To identify criminals in the forensic laboratory.  
(ii) To determine the real or biological parents in case of disputes.  
(iii) To identify racial groups to rewrite the biological evolution. (Any two)
12. (i) It should be able to generate its replica.  
(ii) Should be chemically and structurally stable.  
(iii) Should be able to express itself in the form of Mendelian characters.  
(iv) Should provide the scope for slow changes (mutations) that are necessary for evolution.

### SA-I (3 MARKS)

- 13.
- | DNA   |  | RNA   |   |
|-------|--|-------|---|
| (i)   | Double stranded molecules              | (i)   | Single stranded molecules                     |
| (ii)  | Thymine as pyrimidine base             | (ii)  | Uracil as pyrimidine base                     |
| (iii) | Pentose sugar is Deoxyribose           | (iii) | Sugar is Ribose                               |
| (iv)  | Quite stable and not very reactive     | (iv)  | 2'-OH makes it reactive                       |
| (v)   | Dictates the synthesis of Polypeptides | (v)   | Perform their functions in protein synthesis. |
| (vi)  | Found in the nucleus.                  | (vi)  | They are transported into the cytoplasm.      |
14. hnRNA is precursor of mRNA. It undergoes
- Splicing** : Introns are removed and exons are joined together.
  - Capping** : an unusual nucleotide (methyl guanosine triphosphate) is added to the 5' end of hnRNA.
  - Adenylate residues (200-300) are added at 3' end of hnRNA.

OR

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

- 15.
- mRNA-(Messenger RNA) : decides the sequence of amino acids.
  - tRNA-(Transfer RNA) : (a) Recognises the codon on mRNA (b) transport the aminoacid to the site of protein synthesis.
  - rRNA (Ribosomal RNA) : Plays the structural and catalytic role during translation.
16. Refer points given on page 118, NCERT, Biology XII.
17. (a) UAC (b) AUG  
(c) Amino-acyl tRNA synthetase.
18. Refer figure 6.10, page 109, NCERT Biology XII.

### LA (5 MARKS)

19. Meselson and Stahl, performed an experiment using *E. coli* to prove that DNA replication is semi conservative.
- They grew *E. coli* in a medium containing  $^{15}\text{NH}_4\text{Cl}$ .
  - Then separated heavy DNA from normal ( $^{14}\text{N}$ ) by centrifugation in CsCl density gradient.

- The DNA extracted, after one generation of transfer from  $^{15}\text{N}$  medium to  $^{14}\text{N}$  medium, had an intermediate density.
  - The DNA extracted after two generations consisted of equal amounts of light and hybrid DNA.
  - They proved that DNA replicates in a semiconservative manner. (Refer figure 6.7, page 105, NCERT Biology XII).
20. Lac Operon consists of the following :
- **Structural genes** : z, y, a which transcribe a polycistronic mRNA. . gene 'z' codes for b-galactosidase
  - gene 'y' codes for permease.
  - gene 'a' codes for transacetylase.
  - **Promotor** : The site where RNA polymerase binds for transcription.
  - Operator : acts as a switch for the operon
  - **Repressor** : It binds to the operator and prevents the RNA Polymerase from transcribing.
  - **Inducer** : Lactose is the inducer that inactivates the repressor by binding to it.
  - Allows an access for the RNA polymerase to the structural gene and transcription.
  - Refer figure 6.14, page 117, NCERT, Biology XII.
21. Refer notes
22. Refer notes 35 and figure 6.11, page 110, NCERT Biology XII.
23. Refer points to remember . Steps involved in DNA fingerprinting



## CHAPTER 7

### EVOLUTION

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#### POINTS TO REMEMBER

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

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

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

**Genetic Drift** : Chance elimination of genes of certain traits from a population due to migration or death.

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

**Saltation** : Single step large mutations.

**Speciation** : It is the formation of new species from the pre-existing ones.  
Organic (Biological) Evolution : Changes in the characteristics/features of organisms or groups of such populations over a number of generations.

**Homologous organs** : These have same basic structure and embryonic origin but perform different functions in different species.

**Analogous organs** : These organs are different in their basic structure and embryonic origin but perform similar functions.

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

#### The Theories of Origin of Life

1. Theory of Special Creation : According to this theory God has created life within 6 days.
2. Theory of Spontaneous Generation : According to this theory life originated from decaying and rotting matter like straw and mud.
3. Panspermic Theory : According to this theory life come from space in the form of spores called .Panspermia.

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

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

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

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

Ernest Haeckel biogenetic law. This law states that "ontogeny (development of the embryo) recapitulates phylogeny (development of race)." This proposal disapproved by Karl Ernst von Baer on careful study von Baer noted that the embryos do not pass through the adult stages of another animals.

**Divergent evolution** : It shows relationship of structures having same origin but perform different functions. It is called homology. Examples : (i) Wings of a bird, forelimbs of horse, flippers of whale. (ii) Thorns of Bougainvillea and tendrils of cucurbita.

**Convergent evolution** : This shows the relationship of structures having functional similarities but different origin. It is called analogy. Examples : (i) Wings of insects and wings of bird. (ii) Sweet potato and potato.

**Industrial melanism** : It is an adaptation where moths living in the industrial area developed melanin pigments to match their body colour to the tree-trunk. Before Industrialisation in England, it was observed that there were more white-winged moths on trees than dark-winged moths (melanised moths). After industrialisation (in 1920), there were more dark

winged moths in some areas. After industrialisation, trees got covered by smoke. So white-winged moth were picked up by the birds but dark-winged moths escaped and survived. Thus, industrial melanism supports the evolution by natural selection.

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

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

**Hardy-Weinberg Principle** : The allele frequencies in a population are stable and is constant from generation to generation. Sum total of all the allele frequencies is 1.

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

- ← The Universe is about twenty billions years old.
- ← Earth was formed about 4.5 billion years ago.
- ← Life started appearing about 4 billion years earlier

## QUESTIONS

### VSA (1 MARK)

1. Name one fish like reptile that evolved from land reptile about 200 million years ago?
2. For a long time, it was believed that life originated from decaying matter. What is this theory known as ? Name the scientist who experimentally disproved this theory.
3. If abiotic origin of life is in progress on a planet other than earth, what should be the conditions there?
4. Name the person who proposed that population tends to increase geometrically while food production increases arithmetically.
5. Name the scientist who had also come to similar conclusion as that of Darwin about natural selection as a mechanism of evolution. Which place did he visit to come to conclusions?

### SA-II (2 MARKS)

6. Explain Oparin-Haldane theory of chemical evolution of life.
7. Distinguish between convergent and divergent evolution giving one example of each.
8. What is adaptive radiation? Explain with an example.
9. How did Louis Pasteur disprove spontaneous generation theory?

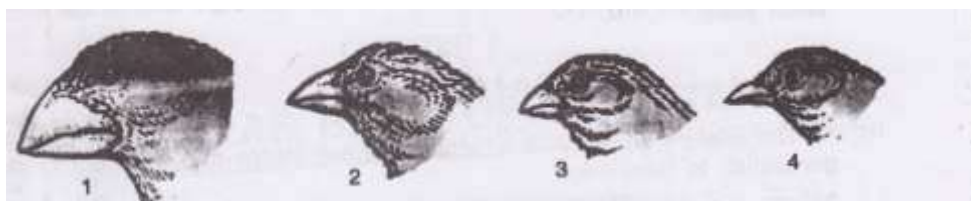
### SA-1 (3 MARKS)

10.
  - (i) State the Hardy-Weinberg principle.
  - (ii) When there is a disturbance in the Hardy-Weinberg equilibrium, what would it result in?
  - (iii) According to this principle, what is the sum total of all allelic frequencies?
11. Classify the following as examples of homology and analogy.
  - (i) Hearts of fish and crocodile
  - (ii) Wings of butterfly and birds
  - (iii) Eyes of Octopus and Mammals
  - (iv) Tubers of potato and Sweet potato
  - (v) Thorns of Bougainvillea and spines of Opuntia
  - (vi) Thorn of Bougainvillea and tendrils of cucurbits.
12. Stanley Miller and Harold Urey performed an experiment by recreating in the laboratory the probable conditions of the atmosphere of the primitive earth.
  - (i) What was the aim of the experiment?
  - (ii) In what forms was the energy supplied for chemical reactions to occur?
  - (iii) For how long was the experiment run continuously? Name two products formed.
13. 'Industrial Melanism' in peppered moth is an excellent example of .Natural selection.. Justify the statement.

14. Fill up the blanks left in the table showing Era, period and organism.

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

15. (i) In which part of the world, Neanderthal man lived?  
 (ii) What was his brain is capacity?  
 (iii) Mention the advancement which Neanderthal man showed over *Homoerectus*.
16. Figures given below are of Darwin.s finches?



Variety of beaks of Darwin's finches.

- (a) Mention the specific geographical area where these were found.  
 (b) Name and explain the phenomenon that has resulted in the evolution of such diverse species in the region.  
 (c) How did Darwin visit the particular geographical area?
17. Give examples to show evolution by anthropogenic action.

**LA (5 MARKS)**

18. Is evolution a .process. or the end result of a .process.? Discuss. Describe various factors that effect Hardy-Weinberg equilibrium.

19. How do Darwin and Hugo de Vries after regarding Mechanism of Evolution?
20. With the help of suitable diagram, represent the operation of natural selection on different traits.

### **ANSWERS**

#### **VSA (1 MARK)**

1. *Ichthyosaurs.*
2. Theory of Spontaneous generation; Louis Pasteur.
3. Very high temperature, volcanic storms, Reducing atmosphere containing CH<sub>4</sub>, NH<sub>3</sub>, H<sub>2</sub> and water vapours.
4. Thomas Malthus.
5. Alfred Wallace, Malay Archipelago

#### **SA-II (2Marks)**

6. The first life form could have come from the pre-existing, non living organic molecules (like RNA, Proteins, etc.) and the formation of life was preceded by chemical evolution.
7. Refer page 130, 131, NCERT Text book, Biology - XII
8. Refer page 133, NCERT book, Biology - XII
9. Louis Pasteur showed that in pre-sterilized flasks, life did not come from killed yeast while in another flask open to air, new organisms arose from .killed yeast.

#### **SA-I (3 MARKS)**

10. (i) The allele frequency in a population are stable and constant from generation to generation.  
(ii) Evolution.  
(iii) One.
11. (i) Homology      (ii) Analogy      (iii) Analogy  
(iv) Analogy      (v) Analogy      (vi) Homology
12. (i) To prove Oparin's theory of origin of life.  
(ii) Electric discharge using electrodes.  
(iii) One week; Amino acids and Sugar.
13. Refer Page 131, NCERT Text book of class XII.

14. (a) Quaternary (b) Coenozoic  
(c) Cretaceous (d) Mesozoic  
(e) Carboniferous (f) Paleozoic
15. (i) Near Eastern and Central Asia  
(ii) 1400 c.c.  
(iii) More brain capacity, use of hides to cover body and burial of dead.
16. (a) Galapagos Island.  
(b) Adaptive radiation . Refer page 133, NCERT book.  
(c) Through sea voyage in a sail ship called H.M.S. Beagle.
17. Excess use of herbicides pesticides etc. has resulted in selection of resistant varieties in a much lesser time scale. Same is true for antibiotic or drug resistant microbes.

**LA (5 MARKS)**

18. Refer page 135, NCERT Text book, Biology - XII
19. **Darwin** : Darwinian variations are gradual, small and directional  
**Hugo deVries** : put forth idea of mutations, mutations are sudden random and directional
20. Refer page No. 136, NCERT Text book of class XII.

## CHAPTER 8

### HUMAN HEALTH AND DISEASE

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#### POINTS TO REMEMBER

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

**Immuno Suppressant** : The chemical which suppress the immunity response to antigen partially or completely.

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

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

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

**Oncogenes** : Viral genome which causes cancer.

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

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

**Syndrome** : Collection of disease symptoms responsible for a disorder or a disease.

**Vaccination** : Inoculation of a vaccine to stimulate production of antibodies and provide immunity for one or more disease.

#### ABBREVIATIONS

**PMNL** : Polymorpho-Nuclear Leukocytes

**CMI** : Cell Mediated Immunity



**ELISA** : Enzyme Linked Immunosorbent Assay

**HLA** : Human Leukocyte Antigen

**MALT** : Mucosal Associated Lymphoid Tissue

**SCID** : Severe Combined Immuno Deficiency

**NACO** : National AIDS Control Organisation

**MRI** : Magnetic Resonance Imaging

- **Health** - The state of complete physical, mental and social well beings

- Good health can be achieved by

- (i) awareness about disease and their effects on different body functions.
- (ii) vaccination
- (iii) control of vectors
- (iv) proper disposal of wastes
- (v) Maintenance of hygienic food and water resources.

- **Infectious Diseases**

- (i) Viral Diseases eg. polio, common cold, measles, rabies
- (ii) Bacterial diseases. eg. Typhoid, pneumonia, Diptheria, Tetanus,
- (iii) Fungal diseases - eg. Ring worm & Scabies (v) Helminthic diseases-eg Ascariasis, Filariasis, Taeniasis

<b>Disease</b>	<b>Causative Agents</b>	<b>Symptoms</b>
1. Common cold	Rhinoviruses	Nasal congestion and discharge, sore throat cough, headache, tiredness and hoarseness.
2. Typhoid	<i>Salmonella typhi</i>	sustained high fever, stomach pain, loss of appetite, constipation, headache.
3. Pneumonia	<i>Streptococcus pneumoniae</i> and <i>Haemophilus influenzae</i>	fever, headache, cough, chills. in severe cases finger nails may turn grey to bluish in colour.
4. Malaria	<i>Plasmodium P. malaria,</i>	yaming, tiredness, acute headache, muscular pain,

	<i>P.vivax,</i> <i>P. falciparum</i>	feeling of chillness and shivering, nausea and high temperatures
5. Amoebic dysentery	<i>Entamoeba histolytica</i>	Abdominal pain, cramps, stool with excess mucus and blood clots, constipation
6. Ringworm	<i>Microsporium Epidermophyton and Trichophyton</i>	Dry scaly lesions on skin, nails and scalp, itching
7. Ascariasis	<i>Ascaris lumbricoides</i>	Anaemia, muscular pain, internal bleeding, insomnia, blockage of intestinal passage
8. Filariasis or Elephantiasis	<i>Wuchereria bancrofti and W. malayi</i>	fever, blockage of lymphatic vessels, enormous swelling of affected part viz. arm, foot, leg, mamma or scrotum

**Immunity** : Resistance to infections or antigens.

Two types of immunities .

- (i) Innate immunity : inherited by the organism from the parents and protects from birth through out life.

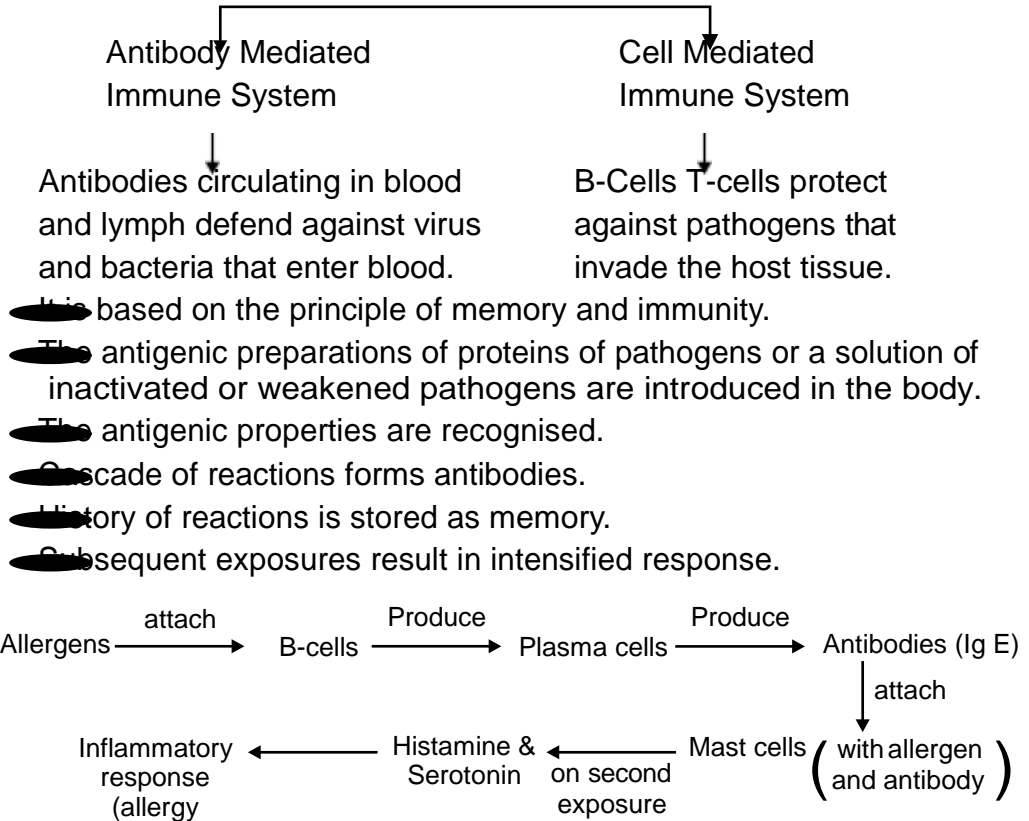
Four types of barriers

- (a) Physical - eg skin, mucus coating epithelium of respiratory, gastrointestinal and urinogenital tracts.
- (b) Physiological - eg. acid of stomach, lysozymes of saliva and tears
- (c) Cellular eg. PMNL, monocytes, Neutrophils and macrophages
- (d) Cytokine - eg virus infected cells secrete proteins called interferons which protect non-infected cells from further infection
- (ii) Acquired Immunity . Acquired by a person after birth by vaccination or contacting the disease.

### **FACTORS AFFECTING HEALTH**

- (a) Genetic : Child may inherit certain disorders from parents.
- (b) Life Style : Water/food intake, rest, exercise, personal hygiene.
- (c) Infection and Corresponding immunity.

## Acquired Specific Immunity (Defense Mechanism)



### Drugs

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

## – Acquired Immunity

- (i) May be Humoral (containing antibodies which circulate in body fluids). mediated by B.lymphocytes.
- (ii) Cell-Mediated (CMI) - mediated by T-lymphocytes
- Acquired immunity may be active or passive.
- Vaccination and immunisation are based on the property called 'memory' of the immune systems.
- **Symptoms of Allergy**– Sneezing, watery eyes, rashes, running nose and difficulty in breathing.
- **Auto Immunity** - When the immune system of body starts destroying 'self' cells and molecules, called auto immune diseases eg Rheumatoid arthritis, multiple sclerosis and insulin-dependent diabetes.
- Immune system in the body play an important role in organ transplantation, allergic reactions and auto immune diseases
- Immune system consists of lymphoid organs, bone marrow, thymus, spleen, lymph nodes and MALT (Mucosal Associated Lymphoid Tissue)
- AIDS - (Acquired Immuno Deficiency Syndrome)**
- caused by HIV (Human Immunodeficiency Virus) which belongs to retrovirus category of viruses.

## **Modes of transmission**

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

## **Persons who are at high risk of getting infection include-**

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

## **Prevention of AIDS**

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

## Cancer

- Carcinogens induce the transformation of normal cells into cancerous cells eg. UV rays, X-rays, g-rays, aniline dyes and tumour viruses, cadmium oxide, mustard gas, Ni & Cr compounds etc

Two types of tumors . (a) Benign - confined to the area of formation and do not spread to other parts. (b) Malignant - show metastasis ie. cells of these tumors can be carried by blood stream or lymph to other parts of body and form secondaries in neighbouring organs.

Treatment - through surgery, radiotherapy, chemotherapy, immunotherapy.

### QUESTIONS

#### VSA (1 MARK)

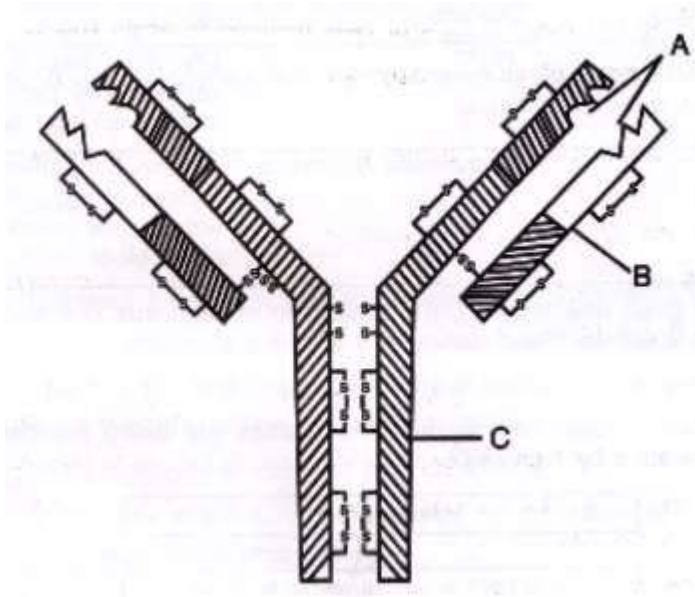
1. Name the diagnostic test which confirms typhoid.
2. Name the two major groups of cells required to attain specific immunity.
3. You have heard of many incidences of Chickengunya in our country. Name the vector of the disease.
4. Breast fed babies are more immune to diseases than the bottle fed babies. Why?
5. Name the pathogen which causes malignant malaria.
6. Which microorganism is used to produce hepatitis B Vaccine?
7. What is the reason of shivering in malarial patient?

#### SA-II (2 MARKS)

8. Where are B-cells and T-cells formed? How do they differ from each other?
9. 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* - Filariasis
  - (b) *Microsporium* - Ringworm
  - (c) *Salmonella* - Common Cold
  - (d) *Plasmodium* - Malaria
10. What would happen to the immune system, if thymus gland is removed from the body of a person?
11. Lymph nodes are secondary lymphoid organs. Describe the role of lymph nodes in our immune response.
12. What is the role of histamine in inflammatory response? Name few drugs which reduce the symptoms of allergy.

### SA-I (3 MARKS)

13. What are Cannabinoids? From which plant Cannabinoids are obtained? Which part of the body is affected by consuming these substances?
14. In the figure, structure of an antibody molecule is shown. Observe it and Give the answer of the following questions.
- Label the parts A, B and C.
  - Which cells produce these chemicals?
  - State the function of these molecules.



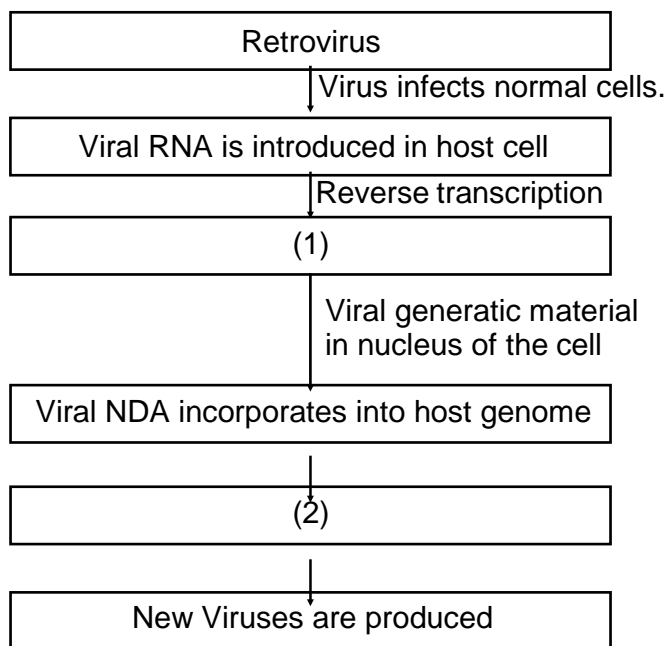
15. Mention any three causes of drug abuse. Suggest some measures for the prevention and control of drug abuse.
16. A person shows unwelcome immunogenic reactions while exposed to certain substances.
- Name this condition.
  - What common term is given to the substances responsible for this condition?
  - Name the cells and the chemical substances released which cause such reactions.

17. Fill in the blanks in the different columns of the table given below to identify the nos 1 to 6.

	<b>Name of disease</b>	<b>Causative organism</b>	<b>Symptoms</b>
1.	Pneumonia	<i>Streptococcus</i>	(1)
2.	Typhoid	(2)	High fever, weakness, headache, stomach pain
3.	(3)	Rhinoviruses	Nasal Congestion, and discharge sorethroat cough, headache
4.	Ascariasis	<i>Ascaris</i>	(4)
5.	Ringworm	(5)	Dry, Scaly lesions on various body parts, Intense itching, redness.
6.	(6)	<i>Entamoeba histolytica</i>	Constipation, cramps, abdominal pain, Stools with excess mucous and blood clots.

18. In the given flow diagram, the replication of retrovirus in a host cell is shown. Examine it and answer the following questions

- (a) Why is virus called reterovirus? (b) Fill in (1) and (2)  
 (c) Can infected cell survie while viruses are being replicated and released by host cell?



19. What is innate immunity? List the four types of barriers which protect the body from the entry of the foreign agents.

**LA (5 MARKS)**

20. Answer the following with respect to Cancer.

- (a) How does a cancerous cell differ from a normal cell?
- (b) Benign tumor is less dangerous than malignant tumor. Why
- (c) Describe causes of cancer.
- (d) mention two methods of treatment of the disease.

21. The pathogen of a disease depends on RBCs of human for growth and reproduction. The person with this pathogen suffers with chill and high fever.

- (a) Identify the disease.
- (b) Name the pathogen.
- (c) What is the cause of fever?
- (d) Represent the life cycle of the pathogen diagrammatically.

22. The immune system of a person is suppressed. He was found positive for a pathogen in the diagnostic test ELISA.

- (a) Name the disease, the patient is suffering from.
- (b) Which pathogen is identified by ELISA test?
- (c) Which cells of the body are attacked by the pathogen?
- (d) Suggest preventive measure of the infection.

**ANSWERS**

**VSA (1 MARK)**

- 1. Widal test
- 2. B-lymphocytes and T-lymphocytes.
- 3. *Aedes* mosquitoes.
- 4. The mother's milk consists of antibodies (Ig A) such antibodies are not available to bottle fed babies.
- 5. *Plasmodium falciparum*.
- 6. Yeast.
- 7. After sporozoite infection, when RBC ruptures, a toxic substance haemozoin is released which cause chilling and high fever.



### SA-II (2 MARKS)

8. B-cells and T-cells are formed in bone marrow. B-cells produce antibodies but E-cells do not produce antibodies but help B-cells to produce them.
9. *Salmonella* : Common cold is not a matching pair.
10. T-lymphocytes are developed and matured in thymus gland, Immune system will become weak on removal of thymus gland.
11. Lymph nodes provide the sites for interaction of lymphocytes with the antigen. When the microorganisms enter the lymph nodes, lymphocytes present there are activated and cause the immune response.
12. Histamine acts as allergy-mediator which cause blood vessels to dilate. It is released by mast cells. Antihistamine steroids and adrenaline quickly reduce the symptoms of allergy.

### SA-I (3 MARKS)

13. – Cannabinoids are a group of chemicals which interact with Cannabinoid receptors present
  - Principally in the brain Cannabinoids are obtained from the inflorescences of the plant *Cannabis sativa*.
  - The substances affect the cardiovascular system adversely
14. (a) A-Antigen binding site B-Light chain
  - (b) B-lymphocytes.
  - (c) Heavy Chain
  - (d) Antibodies provide acquired immune response.
15. **Reasons to attract towards drug abuse** : Curiosity, peer pressure, escape from frustration and failure, family problems, false belief of enhanced performance.  
**Preventive measures:**
  - Avoid undue peer pressure
  - Education and Counselling
  - Seeking help from parents and peers.
  - Looking for danger signs
  - Seeking professional and medical help

16. (a) Allergy (b) Allergens  
(c) Mast Cells . Histamine, Serotonin
17. (i) Alveoli filled with fluid, reduced breathing, fever, chills, cough and headache.  
(ii) *Salmonella typhi*  
(iii) Common Cold  
(iv) Internal bleeding, muscular pain, anaemia, fever and blockage of the intestinal passage.  
(v) *Microsporum* species/*Trichophyton* species/*Epidermophyton* Species.  
(vi) Amoebiasis/amoebic dysentery
18. (a) HIV has RNA genome. It produces DNA by reverse transcription.  
(b) 1 : Viral DNA is produced by reverse transcriptase.  
2 : New Viral RNA is produced by the infected cell.  
(c) Infected cell can survive.
19. Innate Immunity is non-specific type of defense that is present at the time of birth.  
(i) **Physical Barriers** : Skin, mucous-coated epithelium or respiratory, digestive and urinogenital tract.  
(ii) **Physiological Barriers** : Acidity of Stomach, lysozyme in saliva, tears, sweat.  
(iii) **Cellular Barrier** : Macrophages, neutrophils, monocytes and natural killer lymphocytes..  
(iv) **Cytokine Barriers** : Interferons produced by Viral infected cells, protect the non-infected cells from further Viral infection.
20. (a) In normal cells, growth and differentiation is highly controlled and regulated (contact inhibition). The cancerous cells have lost the property of contact inhibition, hence continue to divide giving rise to masses of cells (tumors).  
(b) The benign tumor remains confined in the organ affected as it is enclosed in a connective tissue sheath and does not enter the metastatic stage.  
(c) Cancer may be caused due to carcinogens which are physical (radiations), chemicals (Nicotine, Aflatoxin, Cadmium oxide, Asbestos) and biological (viral oncogens).  
(d) Surgery, radiotherapy, Chemotherapy

21. (a) Malaria
- (b) Different species of Plasmodium viz P. vivax, P. Malariae and P. falciparum.
  - (c) Malaria is caused by the toxins (haemozoin) produced in the human body by the malarial parasite. This toxin is released by the rupturing of RBCs.
  - (d) Life cycle of *Plasmodium* : Fig. 8.1 Page 148, NCERT book, Biology -XII
22. (i) AIDS (Acquired Immuno Deficiency Syndrome)
- (ii) HIV (Human Immunodeficiency Virus)
  - (iii) Helper T-cells, macrophages, B-lymphocytes.
  - (iv) Preventive measures:**
    - (a) People should be educated about AIDS transmission.
    - (b) Disposable needles and syringes should be used
    - (c) Sexual habits should be changed immediately
    - (d) High-risk groups should be discouraged from donating blood.
    - (e) Routine screening may be done.

**CHAPTER 9**  
**STRATEGIES FOR ENHANCEMENT IN**  
**FOOD PRODUCTION**

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**POINTS TO REMEMBER**

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

**Artificial insemination** : Introduction of semen of good quality of male into the vagina of female.

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

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

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

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

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

**Super Ovulation** : Stimulation of good female animal by administering hormones to produce more eggs.

**Mutation breeding** : Mutation in plants is induced artificially through use of mutagens to obtain desirable characters. These plants (as a source) are used inbreeding.

**Totipotency** : The ability to generate a whole plant from any cell/explant.

**ABBREVIATIONS**

**ET** : Embryo Transfer

**IARI** : Indian Agricultural Research Institute

**IRRI** : International Rice Research Institute

**ICAR** : Indian Council of Agriculture Research

**MOET** : Multiple Ovulation Embryo Transfer

**NDRI** : National Dairy Research Institute

- **Animal Husbandry** . care and breeding of livestock, useful to human beings.
- **Poultry Farm Management** : Chicken and ducks and some times turkey and geese are included in poultry.
- **Bee-keeping (Apiculture)** *Apis indica* is the most common species of honey bee.) Maintenance of honey bee for production of honey and wax. Honey is a food of high nutritive value.
- **Management of fisheries** :
  - (i) Fresh water fishes : *Catla*, *Rohu*, common carp etc.
  - (ii) Marine fishes : *Hilsa*, Sardines. Mackerel and Pomfrets etc.
- **Aquaculture and Pisciculture** - The production of useful aquatic plants and animals (both freshwater and marine) like fishes, prawns lobsters and edible oysters is called .aquaculture. while the production of fishes only is called .pisciculture.
- Blue-revolution is associated with fish production.
- **Out crossing** : The practice of mating of animals of same breed but have no common ancestor on either side of pedigree upto 4-6 generations. A single outcross helps to overcome the inbreeding depression.
- **Cross breeding** : The method of outbreeding in which superior males of one breed are mated with the superior females of another breed of same species.

**Main steps in breeding a new genetic variety of crop:**

- (i) Germ-plam collection or collection of variability
- (ii) Evaluation and selection of parents

- (iii) Cross breeding or hybridisation of selected parents.
- (iv) Selection and testing of superior recombinants
- (v) Testing, release and commercialisation of new cultivars.

**High yielding varieties of:**

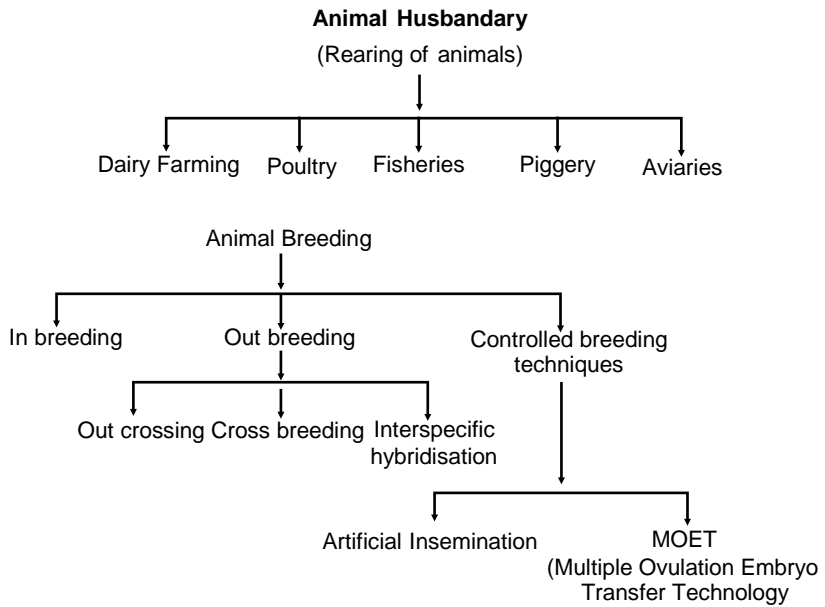
- (i) Wheat - Sonalika, kalyan sona
- (ii) Rice - IR-8, Taichung Native-1, Jaya, Ratna, Padma etc.
- (iii) Sugar Cane - A hybrid of *Saccharum barberi* and *S. officinarum*.

**Diseases of plants -**

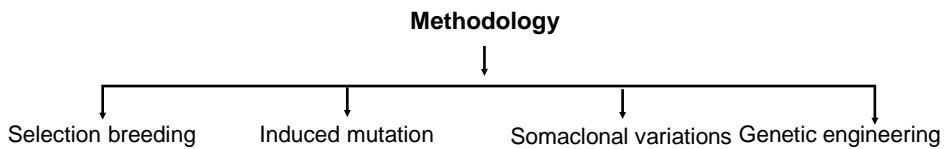
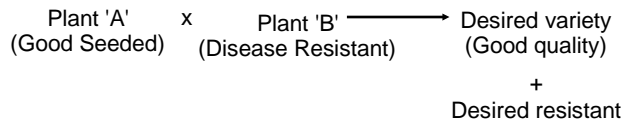
- (i) Viral - Tobacco mosaic, turnip mosaic
- (ii) Bacterial - Black rot of crucifers, Blight of rice
- (iii) Fungal - Rust of wheat, red rot of sugarcane, late blight of potato.

**Germplasm** - The sum total of all the alleles of the genes present in an individual organism and its related species

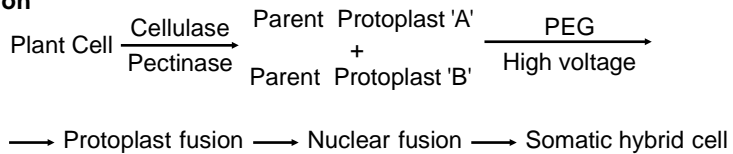
**Explant** - A plant part excised from a specific location in a plant to be used for initiating a culture.



**Plant Breeding for Developing Disease Resistant Varieties**



**Somatic Hybridisation**



**QUESTIONS**  
**VSA (1 MARK)**

1. Why is inbreeding necessary in animal husbandary?
2. Name two fungal diseases of Crop plants.
3. Which product of Apiculture is used in cosmetics and polishes?
4. Semi-dwarf varieties of a crop plant were derived from IR-8. Name that crop.
5. Write two qualities of *Saccharum officinarum* (Sugarcane) grown in South India.

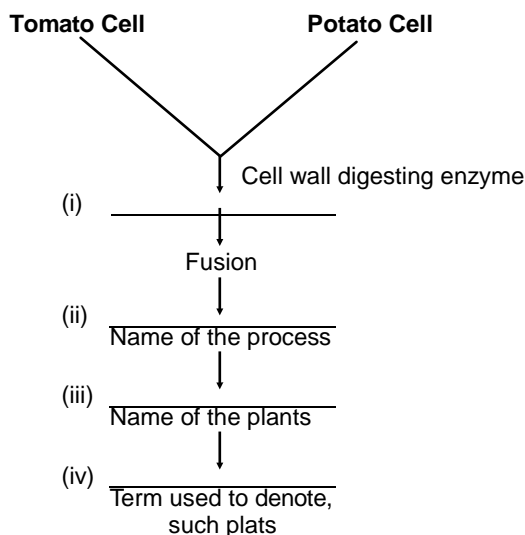
**SA-II (2 MARKS)**

6. A new breed of sheep was developed in Punjab by crossing two different breeds of Sheep. Name the two breeds which were crossed and the new breed developed.
7. Study the table given below and fill in the blanks marked A, B, C and D

<b>S.No.</b>	<b>Crop Variety</b>	<b>Resistant to Disease</b>
1. Wheat	Himgiri	(A)
2. Brassica	(B)	White rust
3. (C)	Pusa Komal	Bacterial blight
4. Chilli Tobacco mosaic		(D) Chilly mosaic Virus, Virus and leaf curl

8. Why are proteins synthesized from *Spirulina* called Single celled Proteins? What is the significance of such a protein?
9. Differentiate between inbreeding and outbreeding in animals.
10. Observe the process of Somatic hybridisation given below and fill in the blanks. (i), (ii), (iii) and (iv)





### SA I (3 MARKS)

11. What is micropropagation? Why are plants produced by this technique called somaclones? Name any two food plants which are produced on commercial scale using this method.
12. What is mutation? Explain the significance of mutation in plant breeding. Give an example of a disease resistant variety of cultivated plant induced by mutation.
13. How can we improve the success rate of fertilisation during artificial insemination in animal husbandary programmes?
14. Biofortification is the most practical means to improve public health. Justify the statement with examples.
15. What is meant by germplasm Collection? Describe its significance in plant breeding programmes.
16. To which product, following are related (a) Blue revolution (b) white revolution (c) Green revolution

### LA-I (5 MARKS)

17. Does apiculture offer multiple advantages to farmers? List its advantages, if it is located near a place of commercial flower cultivation. Name the most common species of bee which is reared in India.
18. What is somatic hybridisation? Describe the various steps in producing somatic hybrids from protoplasts. Mention any two uses of somatic hybridisation.

**ANSWERS**  
**VSA (1 MARK)**

1. Inbreeding increases homozygosity.
2. Brown rust of wheat, Smut of wheat, red rot of Sugar cane, Late blight of potato.
3. Beewax.
4. Paddy crop (rice)
5. Thicker stem and higher sugar content.

**SA-II (2 MARKS)**

6. By crossing Bikaneri ewes and Marino rams, the new breed Hisardale was developed.
7. A – Leaf and Stripe rust, hill bunt.  
B – Pusa swarnim (Karan rai).  
C – Cowpea  
D – Pusa Sadabahar
8. The protein rich food produced by microbes is called as single called protein (SCP) Spirulina is a microorganism which has more protein. It is a quick method of protein production because the growth rate of microbes is enormous. Hence, it provides a protein rich diet for human beings.
9. When breeding is between animals of the same breed, it is called inbreeding, while cross between different breeds is called outbreeding.
10. (i) Isolation of protoplast of Tomato cell and Potato cell.  
(ii) Somatic hybridisation.  
(iii) Pomato  
(iv) Somatic hybrid

**SA-I (3 MARKS)**

11.  The method of producing many plants through tissue culture is called micropropagation.  
 The plants produced through micropropagation will be genetically identical to the original plant from which they were grown, hence are called somaclones.

Tomato, banana, apple are produced on commercial scale using this method.

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

Mutation results in a new character or trait which, not found in the parental type

It can also be induced by using mutagens like gamma radiations.

Such plant materials are used as such or used for breeding new varieties.

Mung bean resistance to yellow mosaic virus and powdery mildew.

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

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

- (i) New hybrid of maize : has twice the amount of amino acid lysine and tryptophan.
- (ii) Wheat : Atlas 66, having a high protein content.
- (iii) Rice : 5 times iron than the normal amount. IARI Delhi has released several crops which are rich in vitamins and minerals. Consumption of such biofortified food will vastly improve the public health.

15. The collection of all the diverse alleles of all the genes of crop plant is called germ plasm collection.

In plant breeding programmes, the germplasm provides the entire of genes and alleles, and the characteristics which they express. The plant breeders select the most favourable characters of a particular gene and manipulate its transfer to a desirable parent.

16. (a) Fish production (b) Milk production (c) Crop production

**LA (5 MARKS)**

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

- (i) Bees are pollinators of many crop species including flowering crops such as sunflower.
- (ii) It improves the honey yield, because honeybees collect the nectar from flowers for making honey. *Apis indica* is the most common species which is reared in India.

18. **Somatic Hybridisation** : The process of fusing protoplasts of Somatic cells derived from different varieties or species of plants to produce a hybrid.

**Steps :**

- (i) Removal of cell wall of fusing cells by digestion with a combination of pectinase and cellulase to form protoplasts.
- (ii) Fusion between protoplasts of selected parents is induced by the use of poly ethylene glycol (PEG).
- (iii) The resulted product is cultured on a suitable medium to regenerate cellwalls.
- (iv) The cells obtained begin to divide to produce plantlets called somatic hybrids.

**Uses/Applications :**

- (i) Somaclonal variations can be created
- (ii) Lines or varieties/species of plants which can not be sexually hybridised, they can be hybridised.
- (iii) Allopolyploids can be raised by the method.

## CHAPTER 10

### MICROBES IN HUMAN WELFARE

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#### POINTS TO REMEMBER

**Activated Sludge Process** : Aerobic sewage treatment process using aerobic micro-organisms present in sewage sludge to break down organic matter in sewage.

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

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

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

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

**Biocontrol Agents** : Use of biological methods for controlling plant diseases and pests

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

**Immunosuppressive Agent** : Chemical substances which suppress the immunity against organ transplant.

**Lactic Acid Bacteria (LAB)** : Bacteria growing in milk and convert it into curd e.g., *Lactobacillus*.

**Organic Farming** : Technique of farming, in which biofertilisers are used to enrich the soil.

**Prion** - The proteinaceous infectious plants.

**Thermal vents** - The sites deep inside the geysers/ hot springs, where the average temp. is as high as 100°C.

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

GAP : Ganga Action Plan

KVIC : Khadi and Village Industries Commission

TMV : Tobacco Mosaic Virus

YAP : Yamuna Action Plan

IPM : Integrated Pest Management.

Microbes includes protozoa, bacteria, fungi, microscopic plants, viruses, viroids and prions.

### Microbes in household products :

Milk  $\xrightarrow{\text{Lactobacillus}}$  Curd

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

Dough  $\xrightarrow{\text{Microbes}}$  Toddy (fermented drink)

### Microbes in production of Biogas :

Some bacteria which grow anaerobically on cellulosic material produce large amount of Methane ( $\text{CH}_4$ ), along with Carbondioxide and hydrogen. These bacteria are called methanogens e.g., *Methanobacterium*.

Methanogens are naturally found in rumen of cattle and sewage

Cattle + Cellulosic food  $\xrightarrow{\text{Methnaogens}}$  Partially digested cellulose  
+ methane ( $\text{CH}_4$ )  
↓  
Manure + Biogas  $\xleftarrow{\text{Methnaogens}}$  Cattle dung (Gobar)

## Microbes as Biocontrol Agents

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

## Microbes as Biofertilisers

*Rhizobium*, *Azospirillum*, *Azotobacter* . (Bacteria) *Anabaena*, *Nostoc*, *Oscillatoria* (Cyanobacteria) Genus *Glomus* (Mycorrhiza).

## Microbes in Industries :

- (a) Fermented Beverages : *Saccharomyces cerevisiae* a yeast is used to make bread, fermented fruit juice and alcohol.
- (b) Antibiotics : *Penicillium notatum*
- (c) Other chemicals /enzymes/Bioactive molecules Many organic acids, enzymes are also produced by microorganisms

S.No.	Microbe	Category Product
1.	<i>Aspergillus niger</i>	Fungus (Yeast) Citric Acid
2.	<i>Acetobacter</i>	Aceti bacterium Acetic acid (Vinegar)
3.	<i>Saccharomyces cerevisiae</i>	Fungus Ethanol
4.	<i>Lactobacillus</i>	Bacteria Lactic acid
5.	<i>Streptococcus</i>	Bacteria Streptokinase
6.	<i>Clostridium butylicum</i>	Bacteria Butyric acid
7.	<i>Monascus purpureus</i>	Fungus (Yeast) Statin (Blood cholesterol lowering agent)
8.	<i>Trichoderma polysporum</i>	Fungus Cyclosporin A (Immunosuppressive agent)

## Microbes in sewage Treatment :

Heterotrophic microbes present in the sewage are involved in the treatment of water. Some methanogenic bacteria are commonly found in the anaerobic sludge during sewage treatment.

## QUESTIONS

### VSA (1 MARK)

1. How does a small amount of curd added to fresh milk convert it into curd? Mention a nutritional quality that get added to the curd.
2. Why is secondary treatment of water in sewage treatment plant called biological treatment?
3. An antibiotic called .Wonder Drug. was used to treat the wounded soldiers of America during World War-II. Name the drug and the scientist who discovered it.
4. You have observed that fruit juice in bottles bought from the market are clearer as compared to those made at home. Give reason.
5. Alexander Fleming discovered .Penicillin, but its full potential as an effective antibiotic was established by other scientists. Name the two scientists.
6. Name the plant whose sap is used in making .Toddy.. Mention the process involved in it.

### SA II (2 MARKS)

7. Name two alcoholic drinks produced in each of the following ways.  
(i) by distillation and (ii) without distillation.
8. Lactic Acid Bacteria (LAB) is commonly used in the conversion of milk into curd. Mention any two other functions of LAB that are useful to humans.
9. How do mycorrhizae function as biofertilisers? Explain with example.
10. Cyanobacteria (*Nostoc*, *Anabaena*) are used as biofertilisers in certain crop fields. Name such one crop. Also, mention the names of two other microorganisms which perform the same function.
11. Which Ministry of Govt. of India had initiated Ganga Action Plan and Yamuna Action Plan? What are the objectives of these plans?



### SA - I (3 MARKS)

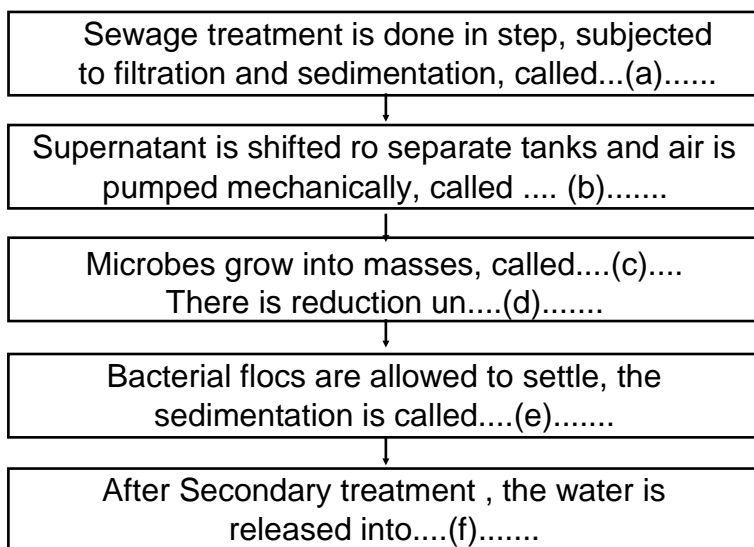
12. Fill in the blanks spaces a, b, c, d, e, and f, given in the following table:

S. No.	Name of Organism	Commercial Product	Application
1.	<i>Penicillium notatum</i>	Penicillin	(a)
2.	(b)	Lactic acid	Making Curd.
3.	<i>Streptococcus</i>	Clot buster enzyme	(c)
4.	<i>Trichoderma polysporum</i>	(d)	Immuno suppressive agent
5.	<i>Saccharomyces cerevisiae</i>	Ethanol	(e)
6.	(f)	Swiss cheese	Food Product

13. What is biochemical oxygen demand (BOD) test? At what stage of Sewage treatment this test is performed?

BOD level of three samples of water labelled as A, B and C are 30 mg/L, 10mg/L and 500 mg/L respectively. Which sample of water is most polluted?

14. Given below is the Flow chart of Sewage treatment. Fill in the blank spaces marked .a. to .f..



15. What are biofertilisers? A farmer is advised to add a culture of bacterium in the soil before sowing the crop. Name the bacterium in the culture. How is this bacterium useful to the crop?
16. What are statins? Name the microorganism that produces this substance. How is it medically important?

**LA (5 MARKS)**

17. How does primary sludge differ from activated sludge? What type of changes in the sludge are carried out in anaerobic sludge digester? Give the composition of biogas produced in the sewage treatment plant.

**ANSWERS**

**VSA (1 MARK)**

1. A large number of lactic acid bacteria are found in small amount of curd which multiply and convert the milk into curd by producing the lactic acid. The nutritional quality improves by increasing Vitamin B12.
2. In this treatment Organic wastes of sewage water are decomposed by certain microorganisms in presence of water.
3. Penicillin, Alexander Fleming.
4. Bottle juices are clarified by the use of pectinase and proteases.
5. Ernest chain and Howard Florey.
6. Palm tree, by fermentation.

**SA - II (2 MARKS)**

7. (i) Whisky, brandy, rum . by distillation  
(ii) Wine, beer . without distillation
8. (i) LAB in human intestine synthesizes Vitamin B12.  
(ii) LAB in human stomach checks the growth of harmful microbes.
9. Mycorrhiza are fungi associated with the roots of plants. Many members of genus *Glomus* form mycorrhiza. These fungal symbiont absorbs water and minerals like phosphorus from the soil and provide them to the plant.

10. Peddy (Rice Crop), *Rhizobium* and *Azotobacter*.

11. • The Ministry of Environment and Forests.

- The objective of Ganga Action Plan and Yamuna Action Plan is to save these rivers from pollution. It was proposed to build a large number of sewage treatment plants. So that only treated sewage may be discharged into these rivers.

**SA-I (3 MARKS)**

12 (i) to kill disease causing bacteria

(b) *Lactobacillus*

(c) remove clots from blood vessels

(d) Cyclosporin A

(e) Beverage/medicines

(d) *Propionibacterium sharmanii*.

13. ● The BOD test measures the rate of uptake of oxygen by microorganisms in a sample of water.

● Biological treatment or Secondary treatment

● Sample C. is most polluted because it has highest BOD level among the three samples of water.

14. (a) Primary treatment (b) Aeration

(c) Flocs (d) Biochemical Oxygen Demand (BOD)

(e) Activated sludge (f) Water bodies like riverstream.

15. ● Biofertilisers are organisms that enrich the nutrient quality of the soil.

● *Azotobacter/Azospirillum* (free living)

● This bacterium fixes atmospheric nitrogen into organic forms, which is used by the plants as nutrient.

16. ● Statins are cholesterol reducing agents.

● They are produced by *Monascus purpureus* (Yeast)

● They act by competitively inhibiting the enzymes responsible for synthesis of cholesterol and are used as blood cholesterol lowering agents.