MODEL QUESTIONS PAPER

(Academic Session : 2020 - 2021)

BIOLOGY

TIME : 3:00 Hrs. **M.M. : 70**

General Instructions:-

1. All questions are compulsory.
2. The question paper has four sections: A, B, C and D. There are 33 questions in the question paper.
3. Section–A has total 16 questions, 10 are very short, 4 A&R based MCQs and 02 case-based question which further have 5 MCQ type of questions, attempt only 4 out of 5 and each question have 1 marks.
4. Section–B has 9 questions of 2 marks each. Section–C has 5 questions of 3 marks each and Section–D has 3 questions of 5 marks each.
5. There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.
6. Wherever necessary, neat and properly labeled diagrams should be drawn.

Section	Question Type	Que. Numbering	Marks	No. of Que. × Marks	Total. Marks
A	Very Short Ans. Que. **(VSA)**	**01 to10**	**1**	**10×1**	**10**
	Assertion/ Reason type- **MCQ.**	**11 to 14**	**1**	**4×1**	**4**
	Case-based questions. (Passage - Attempt any 4 out of 5)	**15 -(i) to(v)**	**1**	**4×1**	**4**
	Case-based questions. (Passage - Attempt any 4 out of 5)	**16-(i) to(v)**	**1**	**4×1**	**4**
B	Short Ans. Que. Type -I **(SA-I)**	**17 to 25**	**2**	**9×2**	**18**
C	Short Ans. Que. Type -II **(SA-II)**	**26 to 30**	**3**	**5×3**	**15**
D	Long Ans. Que. **(LA)**	**31 to 33**	**5**	**3×5**	**15**
Total No. of Questions		**33**	**Total Marks**		**70**

SECTION A

1. What was the speciality of the milk produced by the transgenic cow Rosie? **[1]**

OR

How do neutrophils act as a cellular barrier to pathogens in humans?

2. Name an IUD that you would recommend to promote the cervix hostility to the sperm. **[1]**

3. When do the oogenesis and the spermatogenesis initiate in human females and males, respectively. **[1]**

4. State the chromosomal defects in individuals with Turner's syndrome. **[1]**

5. Who developed a graphical representation of a genetic cross called "Punnett Square". **[1]**

6. Name the condition in vertebrates where the body attacks self-cells. **[1]**

7. State the role of C- peptide in human insulin. **[1]**

8. Name two enzymes that are essential for constructing a recombinant DNA. **[1]**

9. How does the moderate and high dosage of cocaine affect the human body? **[1]**

10. Why is tropical environment able to support greater species diversity? **[1]**

Directions: In the following questions 11-14, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as :-

(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

(b) Both assertion (A) and reason (R) are true but reason (B) is not the correct explanation of assertion (A).

(c) Assertion (A) is true but reason (R) is false

(d) Assertion (A) is false but reason (R) is true.

11. **Assertion (A):** Thermus aquaticus is used in PCR technique.

Reason (R): It is a heat-stable DNA polymerase. **[1]**

12. **Assertion (A):** Bt-toxins are released as inactive crystals in the bacterial body.

Reason (R): It is converted into an active protein (due to alkaline pH of the gut of the bollworm). **[1]**

OR

Assertion : In a DNA molecule, A–T rich parts melt before G–C rich parts.
Reason : In between A and T there are three H–bond, whereas in between G and C there are two H-bonds.

13. **Assertion (A):** 'Saheli' is considered as an improved form of contraceptive for human females.

Reason: It is a non-steroidal preparation and is once a week pill. **[1]**

14. **Assertion :** Haemophilia is an autosomal disorder.

Reason: A haemophilic father can never pass the gene for haemophilia to his son. **[1]**

15. Read the following and answer any four questions : **[4]**

Humans are sexually reproducing and viviparous it involves male and female reproductive systems. The male reproductive system is located in the pelvis region. It includes a pair of testis along with accessory ducts, glands and the external genitalia. The testes are situated outside the abdominal cavity within a pouch called the scrotum. The testis is covered by a dense covering. Each testis has about 250 compartments. Each lobule contains one to three highly coiled seminiferous tubules in which sperms are produced. Each seminiferous tubule is lined on its inside by two types of cells. The regions outside the seminiferous tubules called interstitial spaces contain small blood vessels. Seminiferous tubules of the testis open into the vasa efferentia through rete testis. The vasa efferentia leave the testis and open into epididymis located along the posterior surface of each testis.

(i) The vas deferens receives duct from the seminal vesicle and opens into the urethra as

(a) epididymis

(b) ejaculatory duct

(c) efferent ductule

(d) ureter

(ii) Which one of the following is not a male accessory gland?

(a) Seminal vesicle

(b) Ampulla

(c) Prostate

(d) Bulbourethral gland

(iii) The temperature of the scrotum which is necessary for the functioning of the testis is always around below body temperature.

(a) 2-2.5°C

(b) 4-5°C

(c) 6-6.5°C

(d) 7-8°C

(iv) The nutritive cells found in seminiferous tubules are

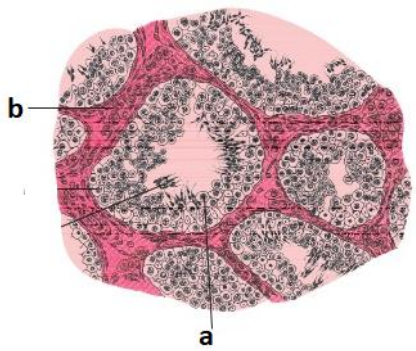
(a) Leydig's cells

(b) Male germ cells

(c) Sertoli cells

(d) Chromaffin cells.

(v) Identify (a) and (b) in the given image.



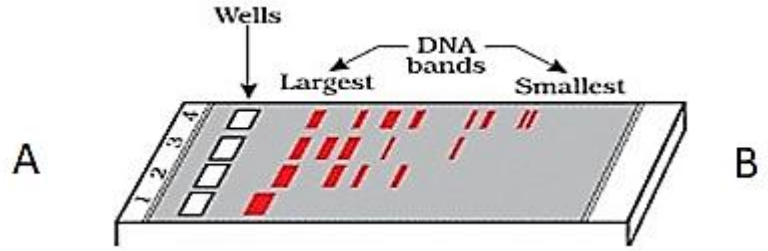
(a) a - Sertoli cell, b - interstitial cell

(b) a - interstitial cell, b - spermatogonia

(c) a - spermatozoa, b - Sertoli cell

(d) a - spermatozoa, b – spermatogonia

16. Rajesh was doing gel electrophoresis to purify DNA fragments. Given below is the sketch of the observations of the experiment performed by him. Study the observations and answer any of the four questions asked below. **[4]**



(a) Mark the positive and negative terminals.
(b) At which end he would have loaded the samples and where?
(c) What is the criterion for DNA fragments movement on agarose gel during gel electrophoresis ?
(i) The larger the fragment size, farther it moves.
(ii) The smaller the fragment size, farther it moves.
(iii) Positively charged fragment move to farther end.
(iv) Negatively charged fragment do not move.
(d) Elaborate the step he would have followed to visualize DNA bands.
(e) How are the separated DNA fragments finally isolated?

SECTION 'B'

17. A mature embryo-sac in a flowering plant may possess 7-cells, but 8-nuclei. Explain with the help of a diagram only. **[2]**

18. Describe the structure of a nucleosome. **[2]**

19. Name the gas released and the process responsible for puffing up of the bread dough when *Saccharomyces cerevisiae* is added to it. **[2]**

20. Explain with the help of a suitable example the naming of a restriction endonuclease. **[2]**

OR

Name the source organism of Taq polymerase. Explain the specific role of this enzyme in PCR.

21. Name the interaction in each of the following : **[2]**
(a) *Cuscuta* growing on a shoe flower plant.
(b) Mycorrhizae living on the roots of higher plants.
(c) Clown fish living among the tentacles of sea anemone.
(d) *Koel* laying her eggs in crow's nest.

22. A plant of *Antirrhinum majus* with red flowers was crossed with another plant of the same species with white flowers. The plants of the F_1 generation bore pink flowers. Explain the pattern of inheritance with the help of a cross? **[2]**

OR

Write the full form of VNTR. How is VNTR different from 'probe'?

23. Why do sports persons often fall victim to cocaine addiction? **[2]**

24. If the advise is not followed by the patient, there is an apprehension that the patient might contract a disease that would destroy the immune system of his/her body. Diagrammatically explain how the immune system would get affected and destroyed. **[2]**

25. Discuss the role the enzyme DNA ligase plays during DNA replication **[2]**

SECTION 'C'

26. (a) Differentiate between spermatogenesis and spermiogenesis. **[3]**
(b) Mention the function of mitochondria in sperm.

27. DNA separated from one cell, when introduced into another cell is able to bestow some of the properties of former to the latter. What is this change called in technical terms? Describe the experimental evidences which led to the discovery of the above phenomenon. **[3]**

OR

Name a blood related autosomal Mendelian disorder. Why is it called Mendelian disorder? How is this disorder transmitted from parents to offspring?

28. (a) Draw a labelled schematic diagram of a replication fork showing continuous and discontinuous replication of DNA strands. **[3]**
(b) State a reason why is the replication continuous and discontinuous in the diagram drawn.

29. Name and describe any three causes of biodiversity losses. **[3]**

30. Highlight the differences and a similarity between the following population interactions : competition, predation and commensalism. **[3]**

SECTION 'D'

31. (a) Draw a schematic labelled diagram of a fertilised embryo sac of an Angiosperm.
(b) Describe the stages in embryo development in a dicot plant. **[5]**

OR

(a) Draw a labelled diagram of a sectional view of human seminiferous tubule.
(b) Differentiate between gametogenesis in human males and females on the basis of:
(i) time of initiation of the process.
(ii) products formed at the end of the process. **[5]**

32. Explain the steps involved in the production of genetically engineered insulin. **[5]**

OR

(a) Name the nematode that infests and damages tobacco roots.
(b) How are transgenic tobacco plants produced to solve this problem?

33. What is 'semi-conservative' DNA replication? How was it experimentally proved and by whom? **[5]**

OR

A homozygous tall pea plant with green seeds is crossed with a dwarf pea plant with yellow seeds:
(i) What would be the phenotype and genotype of F_1?
(ii) Work out the phenotypic ratio of F_2 generation with the help of a Punnett Square.

MODEL QUESTIONS PAPER

(Academic Session : 2020 - 2021)

BIOLOGY SOLUTION

SECTION – A

1. Rosie produced milk with human alpha-lact albumin and was nutritionally a more balanced product for human babies than natural cow-milk.

OR

Neutrophils in blood can phagocytose and destroy the microbes.

2. Cu-T (Copper releasing IUD), suppress sperm motility and fertilizing capacity of sperms.

3. Oogenesis starts in female in their foetal stage while spermatogenesis in males starts at puberty.

4. Monosomy of sex chromosome/XO condition/Absence of one X chromosome (in female).

5. R.C. Punnett.

6. Auto immune disorder or auto-immune disease.

7. C-peptide is an extra stretch of polypeptide. It makes the insulin inactive.

8. Restriction enzymes / polymerase enzymes/ ligase.

9. Its moderate dose produces a sense of euphoria and increased energy while high dose causes hallucination.

10. Tropical latitudes have remained undisturbed for millions of years and had a long evolutionary time for species diversification.

11. (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

12. (b) Both assertion (A) and reason (R) are true but reason (B) is not the correct explanation of assertion (A).

OR

(c) Assertion (A) is true but reason (R) is false

13. (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

14. (d) Assertion (A) is false but reason (R) is true.

15. **(i)** (b) ejaculatory duct

(ii) (b) Ampulla

(iii) (a) 2-2.5°C

(iv) (c) Sertoli cell

(v) (a) a - Sertoli cell, b - interstitial cell

16. (a) Positive terminal-'B' and negative terminal-'A'

(b) He would have loaded the samples near end A, in the wells.

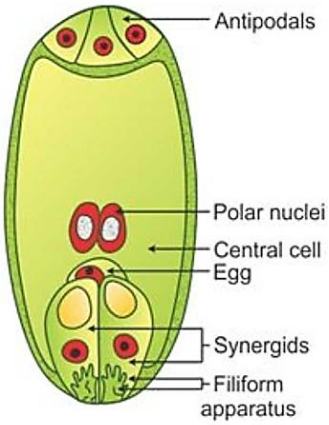
(c) (ii) The smaller the fragment size, farther it moves.

(d) After staining the DNA with ethidium bromide followed by exposure to UV radiations the DNA bands appear coloured.

(e) By elution separated bands of DNA are cut out from the agarose gel and extracted from the gel piece.

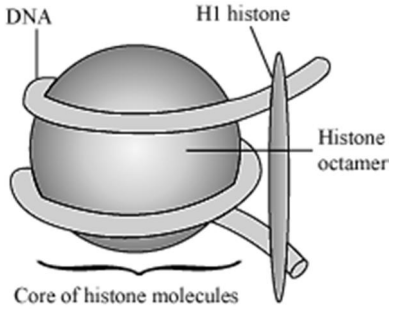
SECTION – B

17.



Mature Embryo Sac

18. A unit of eight molecules of positively charged histones, negatively charged DNA, wrapped around the Histone octamer, contains 200 bp of DNA helix.



DNA is negatively charged, histone is positively charged, 200 bp of DNA helix.

19. Gas - Carbon dioxide

Process - Fermentation

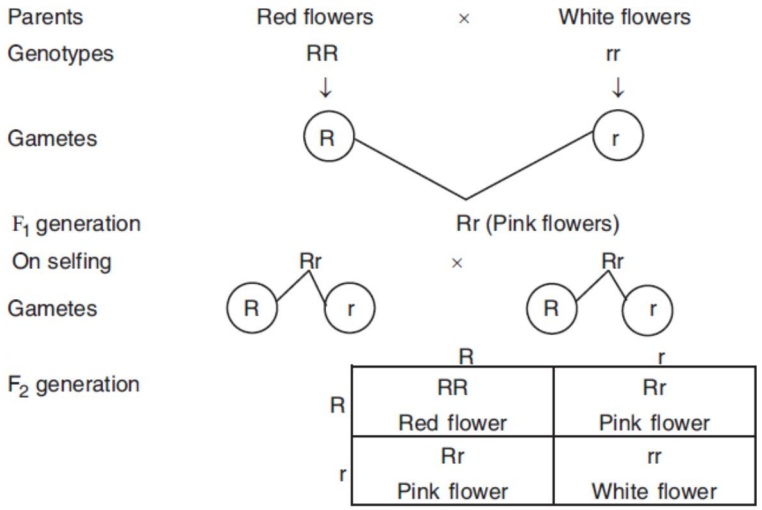
20. **EcoRI -** The first letter of the name comes from the genus and the next two from the name of the species of the bacterium i.e. prokaryotic cell. Thus, Eco stands for the genus and species of the prokaryotic cell from which the enzyme was isolated i.e. E. coli, R stands for strain. I follows order in which enzyme was isolated.

OR

Ther*mus aquaticus*, it remains active during the high temperature, (induced to denature double stranded DNA) and catalyses polymerisation of DNA.

21. (a) Parasitism (b) Mutualism (c) Commensalism (d) Brood parasitism.

22. Inheritance of flower colour in *Antirrhinum majus*.



The above pattern shows law of independent assortment which states that when two pairs of traits are combined in a hybrid, segregation of one pair of characters is independent of the other pair of characters.

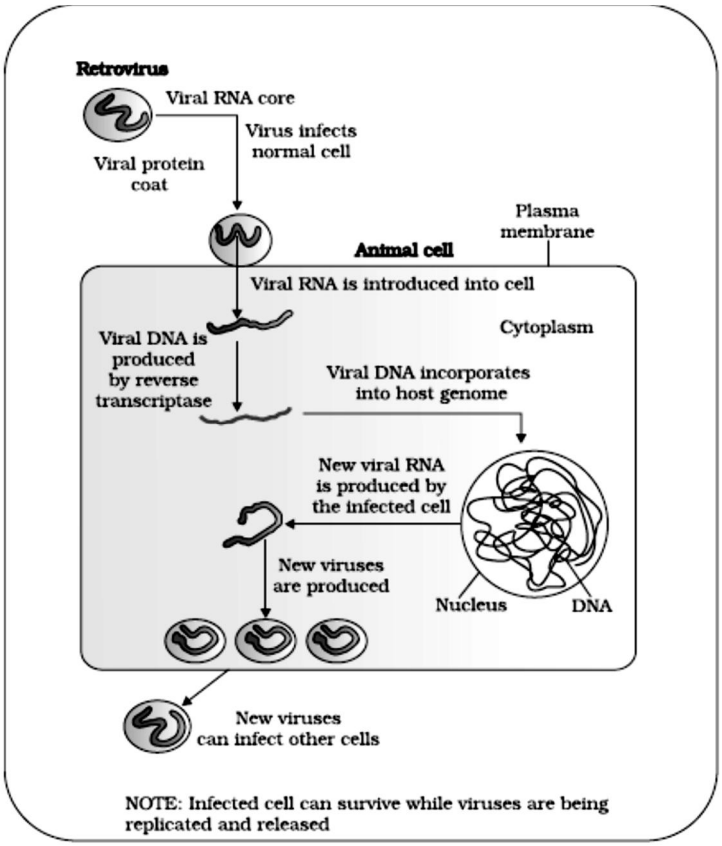
OR

VNTR stands for Variable Number of Tandem Repeats.

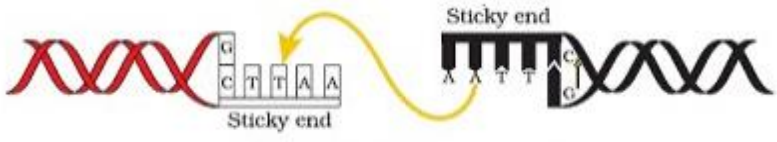
Probe is labelled or radioactive (single stranded polynucleotide that hybridises DNA fragments

23. Cocaine has a potent stimulating action on central nervous system, producing a sense of euphoria and increased energy. Certain sports persons misuse it to enhance their performance.

24.



25. DNA fragments are joined /sealed by them /sticky ends of vector and foreign DNA, joined by them.



26. (a) Difference between spermatogenesis and spermiogenesis :

Spermatogenesis is a process of formation of haploid spermatozoa from germinal cells while spermiogenesis is a process of differentiation of spermatozoa into a spermatid. Here, a spermatid forms a single spermatozoa.

(b) Mitochondria provide energy for the movement of sperm.

27. Transformation

Griffith experiment, Avery, MacLeod and McCarty identified the biochemical nature of transforming principle i.e. DNA (brief explanation).

Transformation is the technique. Avery, MacLeod and McCarty identified the biochemical nature of transforming principle i.e. DNA.

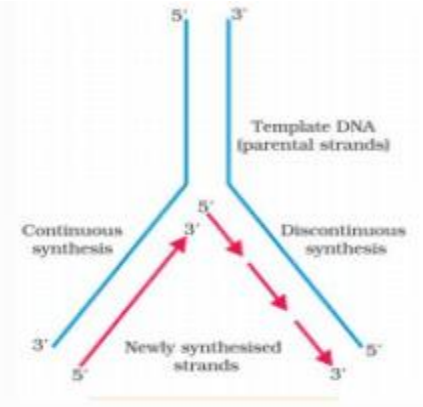
They worked to determine the biochemical nature of transforming principle' in Griffith's experiment. They purified biochemicals (proteins, DNA, RNA etc.) from the heat killed 'S' cells to see which ones could transform live 'R' cells into 'S' cells. They discovered that DNA alone is transformed. Proteases and RNases did not affect transformation. Digestion with DNase inhibited transformation, suggesting that the DNA caused the transformation. Thus, they concluded that DNA is the hereditary material.

OR

Blood related autosomal Mendelian disorder is sickle cell anaemia. It is called Mendelian disorder due to alteration or mutation in a single gene.

The defective haemoglobin undergoes polymerization under low oxygen tension and changes the shape of RBC from biconcave cells to sickle-shaped elongated cells. The disease is controlled by a single pair of alleles, Hb^A and Hb^S. Of the three possible genotypes, only individual homozygous for Hb^S show the disease. Heterozygous individuals (Hb^A Hb^S) are carriers.

28. (a)



(b) 2 strands are anti parallel. DNA polymerase acts only in one direction i.e. 5'→ 3'

29. **Habitat loss and fragmentation** - Habitat loss from tropical rainforest / The Amazon rain forest is being cut and cleared / for raising cattle / for conversion to grasslands / for cultivating soyabeans / large habitats are broken up into small fragments due to human activities / mammals and birds requiring large territories are badly affected leading to decline in population.

Over exploitation - when 'need' turns 'greed' lead to over exploitation of natural resources / Steller's sea cow /passenger pigeon were over exploited /marine fish populations around the world are over exploited/endangering existence of commercially important species.

Alien species invasions - when introduced unintentionally or deliberately for any purpose some of them turn invasive and decline indigenous species/carrot grass/ Parthenium / African cat fish/*Clarias gariepinus* poses threat to indigenous cat fishes of our river.

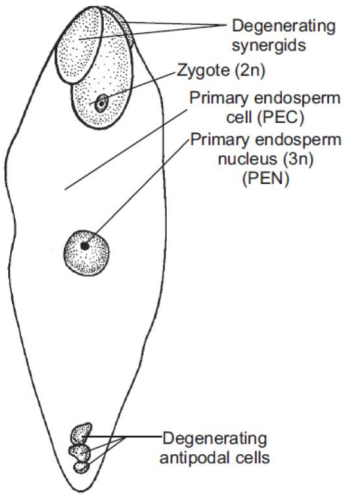
Co-extinctions - when a species becomes extinct the plant or animal species associated with it (an obligate way) become extinct / when a host species becomes extinct (its unique assemblage of) parasites meets the same fate / extinction of any member in plant pollinator mutualism leads to extinction of other.

30.

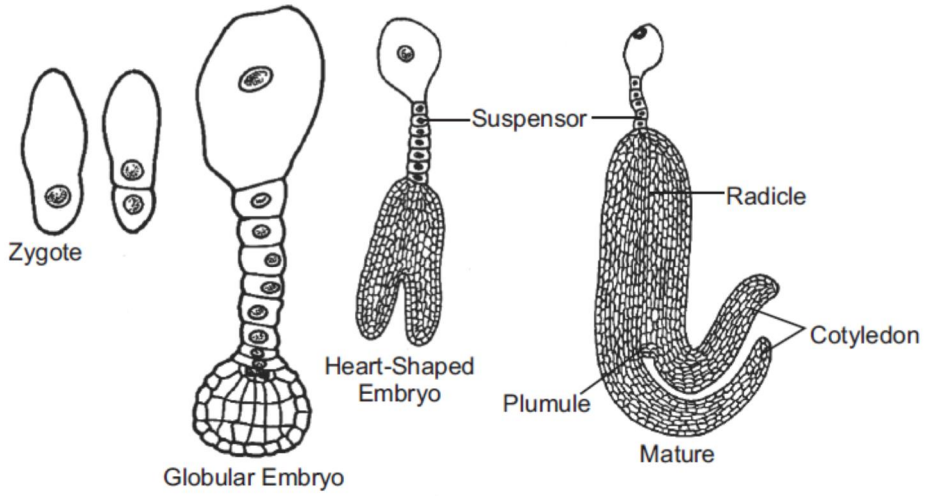
	Competition	**Predation**	**Commensalism**
Differences	Both species lose in their interaction.	Only one species benefits in their interaction.	One species is benefitted and the other is neither benefitted nor harmed in their interaction.
Similarity	Both the interacting species live together.	Both the interacting species live together.	Both the interacting species live together.

SECTION–D

31. (a) Fertilised embryo sac showing zygote and Primary Endosperm Nucleus (PEN)



(b)



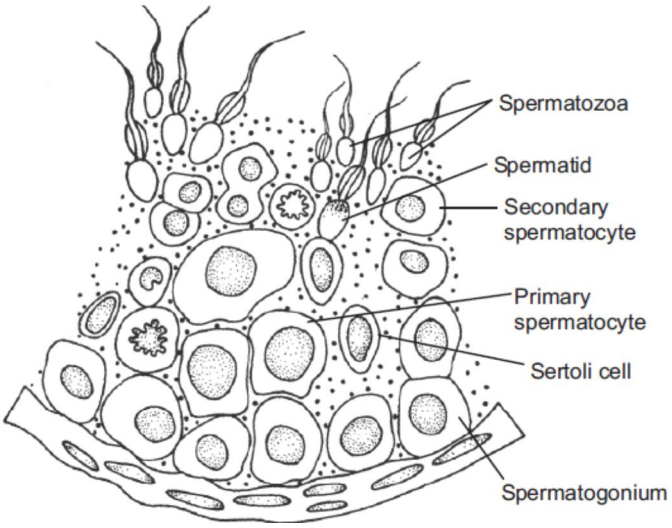
Development of dicot embryo

Stages in dicot embryo development:

- The zygote undergoes transverse division forming a large basal cell and a small apical or terminal cell.
- The large basal cell enlarges and undergoes transverse division to from a group of 6–10 cells called **suspensor**.
- The first cell of the suspensor towards the micropylar end is called **haustorium**, whereas the last cell of the suspensor toward the chalazal end is called **hypophysis** that later develops into radicle.
- The smaller terminal or apical cell undergoes one vertical division. The two cells formed from terminal cell divide by a transverse division thus forming four embryonal cell (**quadrant stage**).
- Finally these four cells divide vertically forming 8-celled proembryo (**octate stage**). Four cells at the apex give rise to plumule and another four give rise to hypocotyl except its tip.

OR

(a) Diagrammatic sectional view of a seminiferous tubule (enlarged)



(b)

S. No.	Process of gametogenesis	Males	Females
(i)	Time of initiation of the process	At puberty	At puberty
(ii)	Products formed at the end of the process	Four spermatozoa are produced from one primary spermatocyte.	One ovum and two polar bodies are produced from one primary oocyte.

32. **Genetically engineered insulin:** Production of insulin by *r*DNA techniques was achieved by an American company, Eli Lilly, in 1983. It prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of *E.coli* for production. The A and B chains produced were separated, extracted and combined by creating disulfide bonds to form human insulin.

OR

(a) Nematode *Meloidegyne incognitia* infects the roots of tobacco plant.

(b) Transgenic tobacco plants are produced in following way:

(i) To prevent the roots of tobacco plants from infections a strategy was adopted based on the process of RNA interference (RNAi).

(ii) Nematode-specific genes were introduced into the host plants using *Agrobacterium* vectors.

(iii) The introduction of DNA was such that it produced both sense and anti-sense RNA in the host cells.

(iv) These two RNAs being complementary to each other formed a double stranded RNA (*ds*RNA) that initiated RNAi and thus, silenced the specific *m*RNA of the nematode.

(v) The parasite could not survive in a transgenic host expressing specific interfering RNA, thus plant got itself protected from the parasite.

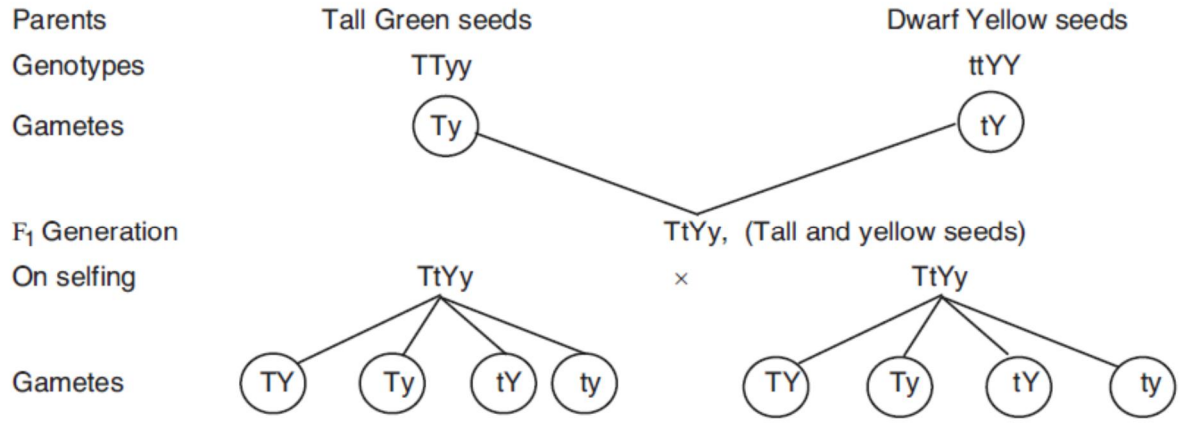
33. **Watson** and **Crick** in 1953 proposed a scheme that DNA replication was **semi-conservative**. According to the scheme, the two parental strands separate and each strand acts as a template for synthesising a complementary strand over it. After completion of replication, each DNA had one parental strand and one newly synthesised strand.

Experimental Proof for semi-conservative mode of DNA replication:

- **Matthew Meselson** and **Franklin Stahl** in 1958 performed experiments on *E. coli* to prove that DNA replication is semi-conservative.
- They grew *E. coli* in a medium containing $^{15}NH_4Cl$ (in which ^{15}N is the heavy isotope of nitrogen) for many generations.
- As a result, ^{15}N got incorporated into newly synthesised DNA.

- This heavy DNA can be differentiated from normal DNA by centrifugation in Caesium chloride (CsCl) density gradient.
- Then they transferred the cells into a medium with normal $14NH_4Cl$ and took the samples at various definite time intervals as the cells multiplied.
- The extracted DNAs were centrifuged and measured to get their densities.
- The DNA extracted from the culture after one generation of transfer from the 15N medium to 14N medium (i.e., after 20 minutes) showed an intermediate hybrid density.
- The DNA extracted from culture after two generations (i.e., after 40 minutes) showed equal amount of light DNA and hybrid DNA.

OR



F_2 generation

	TY	Ty	tY	ty
TY	TTYY Tall, Yellow seeds	TTYy Tall, Yellow seeds	TtYY Tall, Yellow seeds	TtYy Tall, Yellow seeds
Ty	TTYy Tall, Yellow seeds	TTyy Tall, Green seeds	TtYy Tall, Yellow seeds	Ttyy Tall, Green seeds
tY	TtYY Tall, Yellow seeds	TtYy Tall, Yellow seeds	ttYY Dwarf, Yellow seeds	ttYy Dwarf, Yellow seeds
ty	TtYy Tall, Yellow seeds	Ttyy Tall, Green seeds	ttYy Dwarf, Yellow seeds	ttyy Dwarf, Green seeds

(i) Phenotype of F_1—Tall plants with yellow seeds.
Genotype of F_1—TtYy.

(ii) Phenotypic ratio of F_2 generation:

Tall plants, yellow seeds	:	Tall plants, green seeds	:	Dwarf plants, yellow seeds	:	Dwarf plants, green seeds
9	:	3	:	3	:	1