Sexual Reproduction in Flowering Plants

NCERT Exemplar Solutions

Multiple Choice Questions (MCQs)

1. Among the terms listed below, those that of are not technically correct names for a floral whorl are
(i) androecium
(ii) carpel
(iii) corolla
(iv) sepal
(a) (i) and (iv)
(b) (iii) and (iv)
(c) (ii) and (iv)
(d) (i) and (ii)
Ans. ***(c)*** (ii) and (iv).

2. Embryo sac is to ovule as ..... is to an anther.
(a) stamen
(b) filament
(c) pollen grain
(d) androecium
Ans. ***(c)*** Pollen grains.

3. In a typical complete, bisexual and hypogynous flower the arrangement of floral whorls on the thalamus from the outermost to the innermost is
(a) calyx, corolla, androecium, and gynoecium
(b) calyx, corolla, gynoecium, and androecium
(c) gynoecium, androecium, corolla, and calyx
(d) androecium, gynoecium, corolla, and calyx
Ans. (a) calyx, corolla, androecium, and gynoecium

4. A dicotyledonous plant bears flowers, but never produces fruits and seeds. The most probable cause for the above situation is
(a) plant is dioecious and bears only pistillate flowers
(b) plant is dioecious and bears both pistillate and staminate flowers
(c) plant is monoecious

(d) plant is dioecious and bears only staminate flowers
Ans. (d) plant is dioecious and bears only staminate flowers

5. The outermost and innermost wall layers of the microsporangium in an anther are respectively.
(a) Endothecium and tapetum
(b) Epidermis and endodermis
(c) Epidermis and middle layer
(d) Epidermis and tapetum
Ans. ***(d)*** Epidermis and tapetum

6. During microsporogenesis, meiosis occurs in
(a) endothecium
(b) microspore mother cells
(c) microspore tetrads
(d) pollen grains
Ans. ***(b)*** microspore mother cells

7. From among the sets of terms given below, identify those that are associated with the gynoecium.
(a) Stigma, ovule, embryo sac, placenta
(b) Thalamus, pistil, style, ovule
(c) Ovule, ovary, embryo sac, tapetum
(d) Ovule, stamen, ovary, embryo sac
Ans. (a) Stigma, ovule, embryo sac, placenta

8. Starting from the innermost part, the correct sequence of parts in an ovule are
(a) egg, nucellus, embryo sac, integument
(b) egg, embryo sac, nucellus, integument
(c) embryo sac, nucellus, integument, egg
(d) egg, integument, embryo sac, nucellus
Ans. (b) egg, embryo sac, nucellus, integument

9. From the statements given below, choose the options that are true for a typical female gametophyte of.
(i) It is eight-nucleate and seven-celled at maturity.

(ii) It is free-nuclear during development.
(iii) It is situated inside the integument, but outside the nucleus.
(iv) It has an egg apparatus situated at the chalazal end.
(a) (i) and (iv)
(b) (ii) and (iii)
(c) (i) and (ii)
(d) (ii) and (iv)
Ans. (c) (i) and (ii)

10. Autogamy can occur in a chasmogamous flower if
(a) pollen matures before maturity of ovule
(b) ovules mature before maturity of pollen
(c) both pollen and ovules mature simultaneously
(d) both anther and stigma are of equal length
Ans. (c) both pollen and ovules mature simultaneously

11. Choose the correct statement from the following.
(a) Cleistogamous flowers always exhibit autogamy.
(b) Chasmogamous flowers always exhibit geitonogamy.
(c) Cleistogamous flowers exhibit both autogamy and geitonogamy.
(d) Chasmogamous flowers never exhibit autogamy.
Ans. (a) Cleistogamous flowers always exhibit autogamy.

12. A particular species of plant produces light, non-sticky pollen in large numbers, and its stigmas are long and feathery. These modifications facilitate pollination by
(a) insects
(b) water
(c) wind
(d) animals
Ans. (c) wind

13. From among the situations given below, choose the one that prevents both autogamy and geitonogamy.
(a) Monoecious plant bearing unisexual flowers.
(b) Dioecious plant bearing only male or female flowers.

(c) Monoecious plant with bisexual flowers.
(d) Dioecious plant with bisexual flowers.
Ans. (b) Dioecious plant bearing only male or female flowers.

14. In a fertilised embryo sac, the haploid, diploid and triploid structure are
(a) synergid, zygote, and primary endosperm nucleus
(b) synergid, antipodal, and polar nuclei
(c) antipodal, synergid, and primary endosperm nucleus
(d) synergid, polar nuclei, and zygote
Ans. (b) synergid, antipodal, and polar nuclei

15. In an embryo sac, the cells that degenerate after fertilisation are
(a) synergids and primary endosperm cell
(b) synergids and antipodals
(c) antipodals and primary endosperm cell
(d) egg and antipodals
Ans. ***(b)*** synergids and antipodals

16. While planning for an artificial hybridisation programme involving dioecious plants, which of the following steps would not be relevant?
(a) Bagging of female flower
(b) Dusting of pollen on stigma
(c) Emasculation
(d) Collection of pollen
Ans. (c) Emasculation

17. In the embryos of a typical dicot and a grass, true homologous structures are
(a) coleorhiza and coleoptile
(b) coleoptile and scutellum
(c) cotyledons and scutellum
(d) hypocotyl and radicle
Ans. (c) cotyledons and scutellum

18. The phenomenon observed in some plants where in parts of the sexual apparatus is used for forming embryos without fertilisation is called
(a) parthenocarpy

(b) apomixis
(c) vegetative propagation
(d) sexual reproduction
Ans. (b) Apomixis

19. In a flower, if the megaspore mother cell forms megaspores without undergoing meiosis and if one of the megaspores develops into an embryo sac, its nuclei would be
(a) haploid
(b) diploid
(c) a few haploid and a few diploid
(d) with varying ploidy
Ans. (b) diploid

20. The phenomenon wherein the ovary develops into a fruit without fertilisation is called
(a) parthenocarpy
(b) apomixis
(c) asexual reproduction
(d) sexual reproduction
Ans. ***(a)*** Parthenocarpy

Very Short Answer Type Questions

1. Name the component cells of the 'egg-apparatus' in an embryo sac.
Ans. The component cells of the 'egg-apparatus' in an embryo sac include two synergids, one egg cell, and the filiform apparatus.

2. Name the part of gynoecium that determines the compatible nature of pollen grain.
Ans. The pistil can recognise pollen, whether it is of the right type (compatible) or of the wrong type (incompatible). If it is of the right type, the pistil accepts the pollen and promotes post-pollination events that lead to fertilisation. If the pollen is of the wrong type, the pistil rejects the pollen.
The ability of the pistil to recognise the pollen is followed by its acceptance or rejection. It is the result of a continuous dialogue between the pollen grain and the pistil mediated by chemical components of the pollen interacting with those of the

pistil.

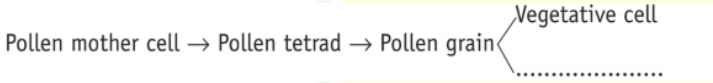
3. Name the common function that cotyledons and nucellus perform.

Ans. The common functions that cotyledons and nucellus perform are as follows

(i) Storage of reserve food material.

(ii) **Nourishment** Cotyledons nourish embryos, and the nucellus nourishes the embryo sac.

4. Complete the following flow chart

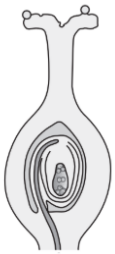


Ans.

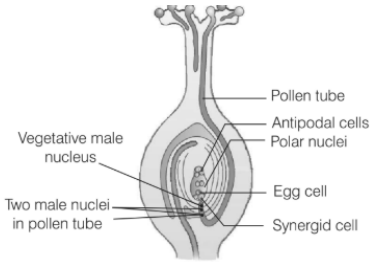
5. Indicate the stages where meiosis and mitosis occur (1, 2 or 3) in the flow chart.

Ans.

6. In the diagram given below, show the path of a pollen tube from the pollen on the stigma into the embryo sac. Name the components of egg apparatus.



Ans.



- Following compatible pollination, the pollen grain germinates on the stigma to produce a pollen tube through one of the germ pores.
- The contents of the pollen grain (2 male nuclei) move into the pollen tube.
- The pollen tube grows through the tissues of the stigma and reaches the ovary.
- After reaching the ovary, the pollen tube enters the ovule through the micropyle and then enters the embryo sac by passing into one of the synergids through the filiform apparatus. It leads to the degeneration of that synergid.
- The pollen tube breaks to release its contents (2 male nuclei).
- Out of the two male gametes, one fuses with the egg and the other fuses with the central cell and fertilizes.
- The component cells of the egg apparatus in an embryo sac include two synergids, one egg cell, and the filiform apparatus.

7. Name the parts of pistil which develop into fruit and seeds.
Ans. The ovary develops into the fruit, and the ovule develops into a seed.

8. In case of polyembryony, if an embryo develops from the synergid and another from the nucellus which is haploid and which is diploid?
Ans. The embryo developed from the synergid is haploid, as the ploidy of the synergid is haploid. An embryo developed from the nucellus is diploid as the ploidy of the nucellus is diploid.

9. Can an unfertilised, apomictic embryo sac give rise to a diploid embryo? If yes, then how?
Ans. Yes, if a megaspore develops into an embryo sac without meiotic division, the egg will be diploid. A diploid egg develops into an embryo by mitotic divisions.

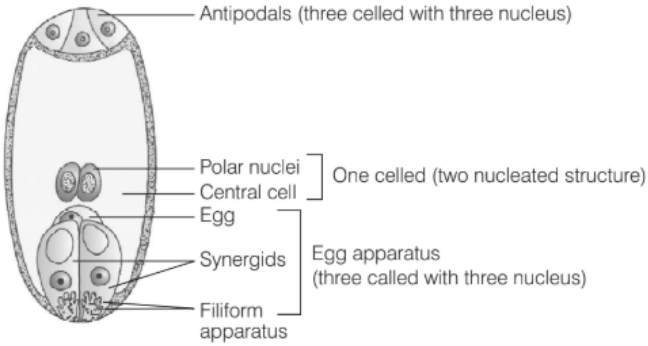
10. Which are the three cells found in a pollen grain when it is shed at the three-celled stage?
Ans. In over 60% of angiosperms, pollen grains are shed at the two cells further stage (vegetative cell and generative cell). In the remaining species, the generative cell divides mitotically to give rise to the two male gametes before pollen grains are shed at the three-celled stage (are vegetative cell and two male gametes).

11. What is self-incompatibility?
Ans. It is a genetic mechanism that prevents self-pollen from fertilising the ovules by

inhibiting pollen germination of pollen tube growth in the pistil.

12. Name the type of pollination in self-incompatible plants.
Ans. Cross-pollination occurs.

13. Draw the diagram of a mature embryo sac and show its eight-nucleate, seven-celled nature. Show the following parts-antipodals, synergids, egg, central cell, polar nuclei.
Ans.



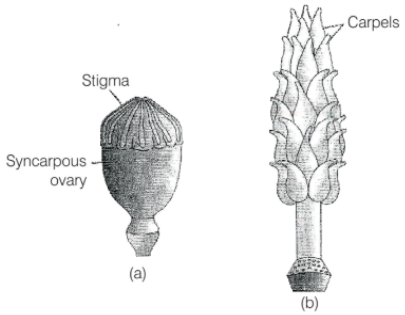
A mature embryo sac (seven celled with eight nucleated structure)

14. Which is the triploid tissue in a fertilised ovule? How is the triploid condition achieved?
Ans. Endosperm is the triploid tissue. It results from triple fusion involving the union of one male gamete and two haploid polar nuclei.

15. Are pollination and fertilisation necessary in apomixis? Give reasons.
Ans. Pollination and fertilisation are not necessary for apomixis. The reasons in support of this are given below

- An embryo sac can develop from a megaspore without meiosis; the egg is diploid and develops into an embryo.
- Embryo sacs can also develop from diploid nucellus cells, in which case the egg is diploid and develops into an embryo parthenogenetically.

16. Identify the type of carpel with the help of diagrams given below Carpels



Ans. (a) If a gynoecium has multiple carpels fused into a single structure, it is syncarpous.
(b) If a gynoecium has multiple carpels in free form, it is apocarpous.

17. How is pollination carried out in water plants?
Ans.

(a) In many aquatic plants with emergent flowers, pollination occurs by wind and insects.
(b) In water plants, if pollination occurs below the surface of water is called hypohydrophily, *e.g., Ceratophyllum*.
(c) In water plants, if pollination takes place over the surface of water, it is called epihydrophily, *e.g., Vallisneria spiralis*.

18 What is the function of the two male gametes produced by each pollen grain in angiosperms?
Ans. One male gamete unites with an egg, forming an embryo. This process is called fertilisation or syngamy.
Another male gamete unites with two polar nuclei, resulting in the formation of endosperm triple fusion.

Short Answer Type Questions

1. List three strategies that a bisexual chasmogamous flower can evolve to prevent self-pollination (autogamy).
Ans. A bisexual chasmogamous flower can evolve the following (three) strategies to prevent self-pollination (autogamy).

(a) **Dichogamy.** In this mechanism, pollen release and stigma receptivity are not synchronised. In sunflowers, the pollen is released before the stigma becomes receptive (protandry). In *Datura*, *Solanum*, the stigma becomes receptive much

before the release of pollen (protogyny) leads to cross-pollination.

(b) **Herkogamy:** The male and female sex organs are placed at different positions or in different directions is called Herkogamy. In these plants, the pollen cannot come in contact with the stigma of the same flower. It has undergone cross-pollination, *e.g., Hibiscus, Gloriosa*.

(c) **Self-sterility.** It is a genetic mechanism that prevents the self-pollen from fertilising the ovules by inhibiting pollen germination of pollen tube growth in the pistil, *e.g.,* Abutilon.

2. Given below are the events that are observed in an artificial hybridisation programme. Arrange them in the correct sequential order in which they are followed in the hybridisation programme: (a) Re-bagging, (b) Selection of parents (c) Bagging, (d) Dusting the pollen on stigma, (e) Emasculation, (f) Collection of pollen from male parent.

Ans. The correct sequential order of artificial hybridisation is as follows:

(a) Selection of parents.

(b) Emasculation (removal of anthers from the flower bud before the anther dehisces). (c) Bagging (the process of covering the emasculated flower with a bag made up of butter paper).

(c) Collection of pollen from other male plants.

(d) Dusting of pollen on the stigma.

(e) Re-bagging

3. Vivipary automatically limits the number of offspring in a litter. How?

Ans. Vivipary is defined as the seed germination, while the fruit is still attached to the mother plant.

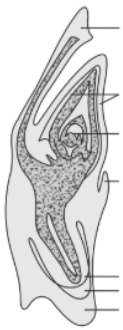
- Plants that grow in marshy places are called **Mangroves.**
- In these plants, when seeds fall on marshy places, they cannot germinate because of high salinity and more water conditions.
- So, in those plants, seeds germinate when they are still attached to the mother plant.
- Litter is the offspring at one birth of an animal, usually 3-8 in number.
- Vivipary automatically limits the number of offspring in litter due to the reason that a limited number of eggs or ova are produced and fertilised during the reproductive cycle of females.

4. Does self-incompatibility impose any restrictions on autogamy? Give reasons and suggest the method of pollination in such plants.

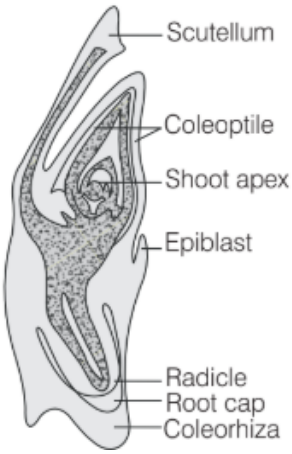
Ans. Self-incompatibility imposes restrictions on autogamy. The reason so far may be:

- The majority of flowering plants produce hermaphrodite flowers, and when pollen grains come in contact with the stigma of the same flower, to continue self-pollination. Such a type of continued self-pollination results in inbreeding depression. That's why flowering plants have developed many devices to discourage self-pollination and to encourage cross-pollination. One of the major ways to prevent self-pollination is self-sterility.
- Self-sterility in some bisexual flowers, if the pollen grains fall on the stigma of the same flower, germination does not occur. But the same pollen grains germinate when they fall on the stigma of other flowers of the same species. It is a genetic mechanism to prevent self-pollination.

5. In the given diagram, write the names of parts shown with lines.



Ans.



6. What is polyembryony, and how can it be commercially exploited?

Ans. Polyembryony is the occurrence of more than one embryo in a seed. In many citrus and mango varieties, some of the nucellar cells surrounding the embryo sac start dividing, protrude into the embryo sac, and develop into embryos. In such species, each ovule contains many embryos.

- Polyembryony plays a major role in plant breeding and horticulture.
- The plantlets obtained from these embryos are virus-free and have more vigour.
- Hybrid varieties of several food and vegetable crops are being extensively cultivated, and these hybrid cultivars possess high productivity.

7. Are parthenocarpy and apomixis different phenomena? Discuss their benefits.

Ans. Yes, parthenocarpy and apomixis are different phenomena.

Importance of Parthenocarpy

- The fruit production without fertilisation of the ovary is called **parthenocarpy.** This phenomenon is applied to the commercial production of seedless fruits. *e.g.,* banana, grapes.
- This is more useful in the juice industry.

Importance of Apomixis

- During apomixis, chromosomal segregation and recombination do not occur. So, characters are stable for several generations.
- It simplifies commercial hybridised production because isolation is not necessary to produce F_1or maintain parental generation.
- Adventive embryony is being used in the production of uniform rootstock and virus-free varieties.

8. Why does the zygote begin to divide only after the division of Primary Endosperm Cell (PEC)?

Ans. The primary endosperm cell divides repeatedly and forms a triploid endosperm tissue. The cells of this tissue are filled with reserve food materials and are used for the nutrition of the developing embryo.

The embryo develops at the micropylar end of the embryo sac, where the zygote is situated. Most zygotes divide only after a certain amount of endosperm is formed. This is an adaptation to provide assured nutrition to the developing embryo.

9. The generative cell of a two-celled pollen divides in the pollen tube, but not in a

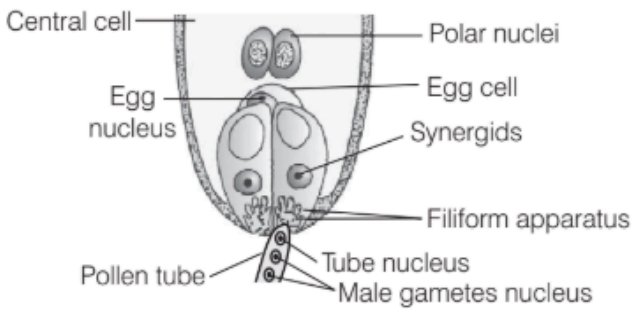
three-celled pollen. Give reasons.

Ans.

- In over 60 % of angiosperms, pollen grains are shed at this 2-celled stage tube cell or vegetative cell, generative cell. In the remaining species, the generative cell divides mitotically to give rise to the two male gametes before pollen grains are shed tube cell or vegetative cell contains two male gametes, 3-celled stage.
- In 3-celled stages, the pollen grains further germinate on the stigma to produce pollen tubes through one of the germ pores. The contents of the pollen grains move into the tube. The pollen tube grows through the tissues of the stigma and style and reaches the ovary.
- In plants, when pollen grains are shed at the 2-celled stage, the generative cell divides and forms two male gametes during the growth of the pollen tube in the stigma.

10. In the figure given below label the following parts-male gametes, egg cell, polar nuclei, synergid, and pollen tube

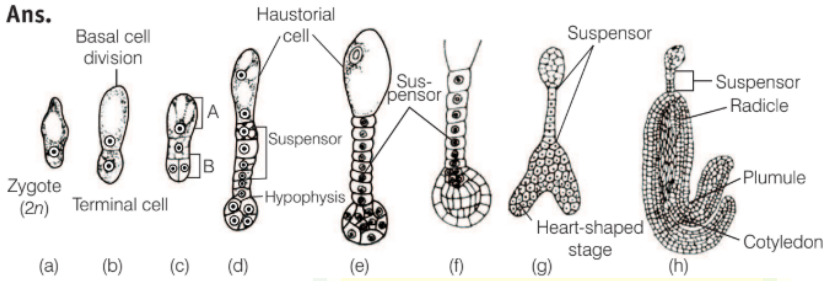
Ans. *The following are the parts of this figure*



Long Answer Type Questions

1. Starting with the zygote, draw the diagrams of the different stages of embryo development in a dicot.

Ans.



2. What are the possible types of pollinations in chasmogamous flowers? Give reasons.

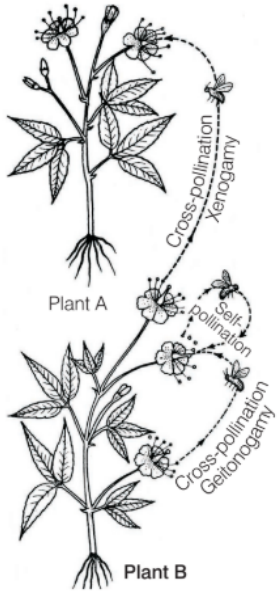
Ans. There are two types of pollination (chasmogamy) in chasmogamous flowers, *i e*., self-pollination and cross-pollination.

(a) **Self-pollination**(Autogamy) The transfer of pollen grains from anther to stigma of the same flower is called **self-pollination.** It is found in both cleistogamous and chasmogamous flowers.

(b) **Cross-pollination** (Allogamy) The transfer of pollen grains from anther to stigma of another flower is called **cross-pollination.** It is of two types.

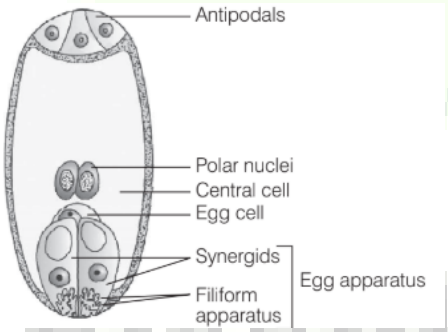
(i) **Geitonogamy** is the transfer of pollen grains from anther to the stigma of another flower of the same plant. It is functionally a type of cross-pollination involving a pollinating agent, genetically. It is similar to autogamy.

(ii) **Xenogamy:** The transfer of pollen grains from the flower of one plant to the stigma of another plant. This is the only type of pollination that brings genetically different types of pollen grains to the stigma.



3. With a neat, labelled diagram, describe the parts of a mature angiosperm embryo sac. Mention the role of synergids.

Ans. After the 8-nucleate stage, cell walls are laid down, leading to the organisation of the typical female gametophyte or embryo sac.



A mature embryo sac of angiosperm

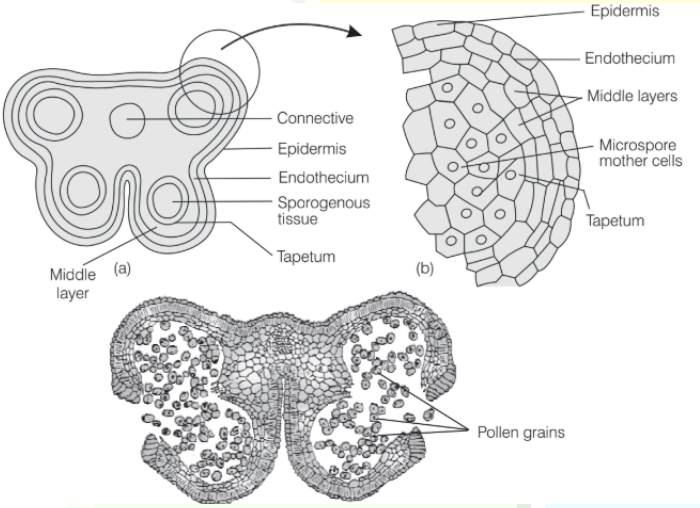
- Six of the eight nuclei are surrounded by cell walls and organised into cells. Three cells present towards the micropylar end, grouped together, constitute the egg apparatus. The egg apparatus, in turn, consists of two synergids and one egg cell.
- Three cells of the chalazal end are called the antipodals. The large central cell is formed by the fusion of 2-polar nuclei. Thus, a typical angiosperm embryo sac, at maturity, consists of eight nuclei and seven cells. This embryo sac is

formed from a single megaspore, so it is called a ‘monosporic embryo sac.

Role of Synergids: The synergids have special cellular thickenings at the micropylar tip called filiform apparatus, which play an important role in guiding the pollen tubes into the synergid.

4. Draw the diagram of a microsporangium and label its wall layers. Write briefly about the wall layers.

Ans. The diagram representation of a microsporangium is shown below



(a) Transverse section of a young anther (b) Enlarged view of one microsporangium showing wall layers (c) Mature dehisced anther showing pollen grain

In a transverse section, a typical microsporangium is circular in outline and is surrounded by four wall layers.

- **Epidermis:** The epidermis is the outermost protective layer. It is composed of tangentially flattened cells. The cells are closely fitted and have thick walls, which is helpful in the dehiscence of the anther.
- **Endothecium.** It is present below the epidermis and expands radially with fibrous thickenings. At maturity, these cells lose water, contract, and help in the dehiscence of the pollen sac.
- **Wall Layers** It is present between well marked endothecium and tapetum. These are thin-walled layers, arranged in one to five layers, which also help in the dehiscence of the anther.
- **Tapetum.** It is the innermost wall layer with large cells, thin cell walls, abundant cytoplasm, and has more than one nucleus. Tapetum is a nutritive

tissue that nourishes the developing pollen grains.

- The centre of the microsporangium consists of sporogenous tissue, which undergoes meiotic divisions to form microspore tetrads. This process is known as microsporogenesis.

5. Embryo sacs of some apomictic species appear normal, but contain diploid cells. Suggest a suitable explanation for the condition.

Ans. Replacement of the normal sexual reproduction by asexual reproduction without fertilisation is called apomixis. *e.g.,* replacement of the flower by bulbils and replacement of the seed by a plant.

Apomictically produced offspring are genetically identical to the parent plant. In flowering plants, apomixis is used in a restricted sense to mean angiosperm, *i.e.*, asexual reproduction through seeds.

In some plant species, it is common, *e.g.,* Asteraceae, Poaceae. In some species, the diploid egg cell is formed without reduction division and develops into an embryo without fertilisation. It is an asexual reproduction in the absence of pollinators, such as in extreme environments.

In some species, like citrus, some of the nucellar cells surrounding the embryo sac start dividing and develop into embryos. It occurs when the megaspore mother cell does not undergo meiosis, thus producing diploid embryo sacs through mitotic divisions.

Thus, it explains that embryo sacs of some apomictic species appear normal but produce diploid cells.